

# Slow it. Spread it. Sink it. Store it!

Guide to Beneficial Stormwater Management and Water Conservation Strategies





# Slow it. Spread it. Sink it. Store it!

## Guide to Beneficial Stormwater Management and Water Conservation Strategies

Practical Ways to Protect Your Property and the Environment from the Effects of Stormwater Runoff

Second Edition June 2015

**Compiled and Written by:** The Sonoma Resource Conservation District and  
the Resource Conservation District of Santa Cruz County  
**Guide Design & Layout:** Blue Heron Design Group  
**Illustrations By:** Ritch Waldron, Wildways Illustrated  
Page Gruys



**Sonoma Resource Conservation District**

(707) 569-1448

Download copies at: <http://sonomarcd.org/htm/rainwater.htm>

## STATEMENT OF PURPOSE

This manual has been developed for educational purposes by the Sonoma RCD and the Resource Conservation District of Santa Cruz County. The storm water runoff improvement practices included in this guide are meant to be used as general 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 for these practices. Site-specific designs that address each individual site's needs and constraints are essential.

## WHO WE ARE

The Sonoma RCD is a special district organized under state law and a public resource agency with no enforcement or regulatory function. Since the 1940's, the RCD has worked closely with local rural and agricultural landowners and partners in responding to natural resource and watershed management needs in Sonoma County. Our primary focus is to provide soil and water conservation technical assistance to landowners owning over 24,250 rural and agricultural parcels, including over 5,100 farms and ranches in our district.

## ACKNOWLEDGEMENTS

Many organizations contributed to the development of this guide including:

- **Sonoma Valley Groundwater Management Program Basin Advisory Panel and Technical Advisory Committee**
- **Resource Conservation District of Santa Cruz County**
- **Sonoma County Water Agency**
- **Sonoma Resource Conservation District**
- **Sonoma County Permit & Resource Management Department**
- **Sonoma County Department of Environmental Health**
- **Sonoma-Marin Vector Control District**
- **County of Sonoma**
- **City of Sonoma**
- **City of Santa Rosa**
- **Sonoma County Agricultural Preservation and Open Space District**
- **Sonoma Valley County Sanitation District**
- **Valley of the Moon Water District**
- **The Occidental Arts and Ecology Center/The WATER Institute**
- **City of Petaluma**
- **North Bay Watershed Association**
- **Gold Ridge Resource Conservation District**
- **BlueBarrel Rainwater Catchment Systems**
- **Elder Creek Landscapes**

The Sonoma Resource Conservation District thanks Brock Dolman of the Occidental Arts and Ecology Center's WATER Institute for the use of the original phrase, "Slow It! Spread It! Sink It!"

*IMPORTANT NOTE: Federal, state, and local regulations in California pertain to many of the subjects presented in this guide. Regulations can 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 on page 61 for a list of contacts. To learn permit requirements for your project, refer to Sonoma RCD's "Navigating the Permitting Process" document at: <http://sonomarcd.org/htm/publications.htm>*

# TABLE OF CONTENTS

INTRODUCTION .....	8
CHAPTER 1: UNDERSTANDING AND EVALUATING STORMWATER RUNOFF .....	12
Roof Runoff.....	13
Elevated Structures .....	15
Walkways and Patios .....	16
Driveways and Parking Areas.....	17
Bare Soils and Landscapes.....	18
Do-It-Yourself Stormwater Runoff Evaluation .....	19
Stormwater Management and Mosquito Control .....	21
CHAPTER 2: BEST MANAGEMENT PRACTICES FOR STORMWATER RUNOFF .....	23
CHAPTER 3: DIFFICULT SITES AND SITE CONSTRAINTS .....	50
CHAPTER 4: LOCAL PROJECTS.....	52
RESOURCES GUIDE .....	61

## DID YOU KNOW?

Something as simple as water from a downspout contributes to a number of unwanted consequences. Roofs and other impervious surfaces alter natural hydrology, increasing the volume and velocity of stormwater runoff. This has a variety of impacts including streambank erosion and degraded wildlife habitat. Other unintended outcomes associated with accelerated stormwater runoff are potholes, damage to structures, beach closures, and in severe cases, land and mud slides. Fortunately there are simple low-cost things that we all can do to help decrease the volume of, and minimize the pollutants in the runoff leaving our properties. And many have the added benefit of beautifying our landscapes!

## DID YOU KNOW THAT THIS:



## CAN CONTRIBUTE TO THIS:



## SO WHY NOT TRY ONE OF THESE?

Here are just a few of the ideas you'll find in this guide to address stormwater runoff around your home.

Collect your roof water in a **RAIN BARREL**.



**Cost:** LOW  
**Installation difficulty:** EASY  
See page 29

Plant a **RAIN GARDEN** in your landscape.



**Cost:** LOW to MODERATE  
**Installation difficulty:** EASY to INTERMEDIATE  
See page 33

Install a **WATERBAR** on your driveway.



**Cost:** MODERATE  
**Installation difficulty:** INTERMEDIATE  
See page 43

Use **PERVIOUS PAVERS** when renovating your patio or driveway



**Cost:** MODERATE - HIGH  
**Installation difficulty:** INTERMEDIATE  
See page 38

# Introduction

Before Sonoma County and its incorporated cities became the developed, unique communities they are today, the diverse collection of habitats including redwood forests, oak woodlands, native grasslands, riparian areas, coastal dunes, and wetlands were virtually undisturbed. Rivers and streams, capturing and conveying rainwater, flowed from upland areas through rivers and creeks to the Pacific Ocean and San Pablo Bay along sinuous unchanneled corridors. Intact wetlands functioned as natural filters and buffers 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 stream flows, and sustaining ecosystem function. Another 40% was released into the atmosphere through evapotranspiration (evaporation of surface and ground water plus water loss from plants). Only about 10% contributed to stormwater runoff (rainwater that flows over the land surface). Our modern day urban centers and rural neighborhoods are made up of impervious surfaces (hardened surfaces that do not allow water to pass through) such as roofs, streets, and parking areas. When rain falls on these surfaces, it

flows faster and in greater amounts than it would have under pre-development conditions significantly increasing runoff and decreasing infiltration and evapotranspiration. Runoff is typically conveyed by pipes, driveways, streets, and storm drains to creeks and rivers, where it contributes to flooding, road damage, stream erosion, and landslides. Runoff also carries sediment and other pollutants to beaches and rivers, making them unsafe for recreation and wildlife. Though it starts as relatively clean rainwater, runoff collects pollutants as it flows over the landscape. For example, excess lawn fertilizers, pet waste, soap from car washing, oil and grease from leaking engines, zinc from tires, and copper from brakes are just some contaminants that have been found in runoff in the county. It is important to note that nearly ALL storm drains in Sonoma County empty into local waterways UNTREATED.

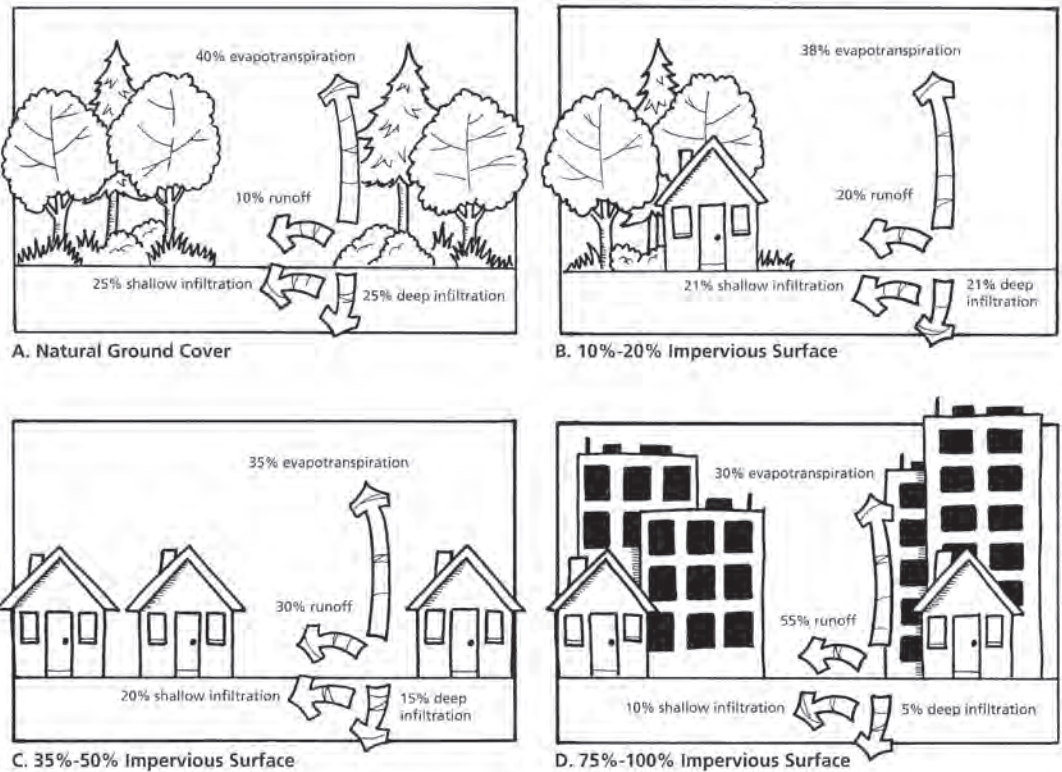


FIGURE 1: PERCENTAGE RUNOFF GENERATED FROM IMPERVIOUS SURFACES, ADAPTED FROM FISRWG 1998

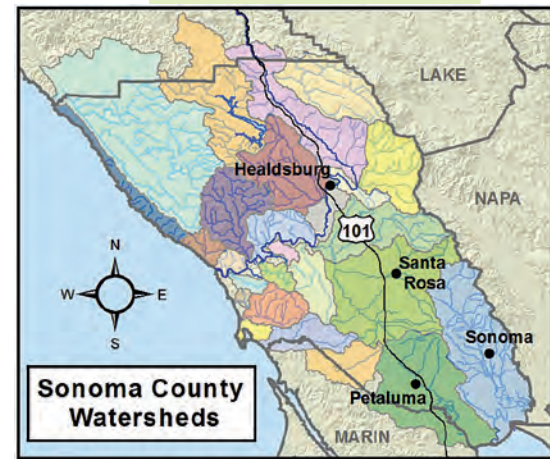




RUNOFF FROM THE SURROUNDING HOMES AND STREETS FLOWS THROUGH THIS STORM DRAIN...



...AND CONTINUES DIRECTLY INTO LOCAL CREEKS AND RIVERS.



### DID YOU KNOW?

Just as a city, county, state, or even our personal property has boundaries, so does a watershed. We define a watershed as the land that contributes water to a given area. Watersheds are normally named after the river, creek, or stream that they drain to. For instance, much of the the City of Sonoma is in the Sonoma Creek Watershed. If you live in Santa Rosa or Rohnert Park, you are in the Laguna de Santa Rosa Watershed. In Sonoma County, all of the rainfall and runoff from a home drains into the watershed where it is located, eventually replenishing critical groundwater resources or flowing to the Pacific Ocean or San Pablo Bay.

One way to help reduce the negative impacts of runoff and promoting sustainable groundwater use is by changing the way we approach new construction. However, since much of our county is already developed, a great benefit can be derived by addressing runoff from our existing homes. Just as with new construction, through good planning and design we can accomplish the following:

- **Conserve and protect groundwater resources**
- **Clean up our creeks, streams, and the bay**
- **Create healthier homes**
- **Protect infrastructure and reduce flooding**

In addition to the information provided in this guide, your local Resource Conservation District (RCD), in partnership with the USDA Natural Resources Conservation Service (NRCS) and other local organizations, offers free technical publications, educational workshops, and in some cases cost-share assistance for implementing stormwater Best Management Practices (BMPs). For more information on water management and other conservation topics, contact your local RCD (see resources section on page 61).

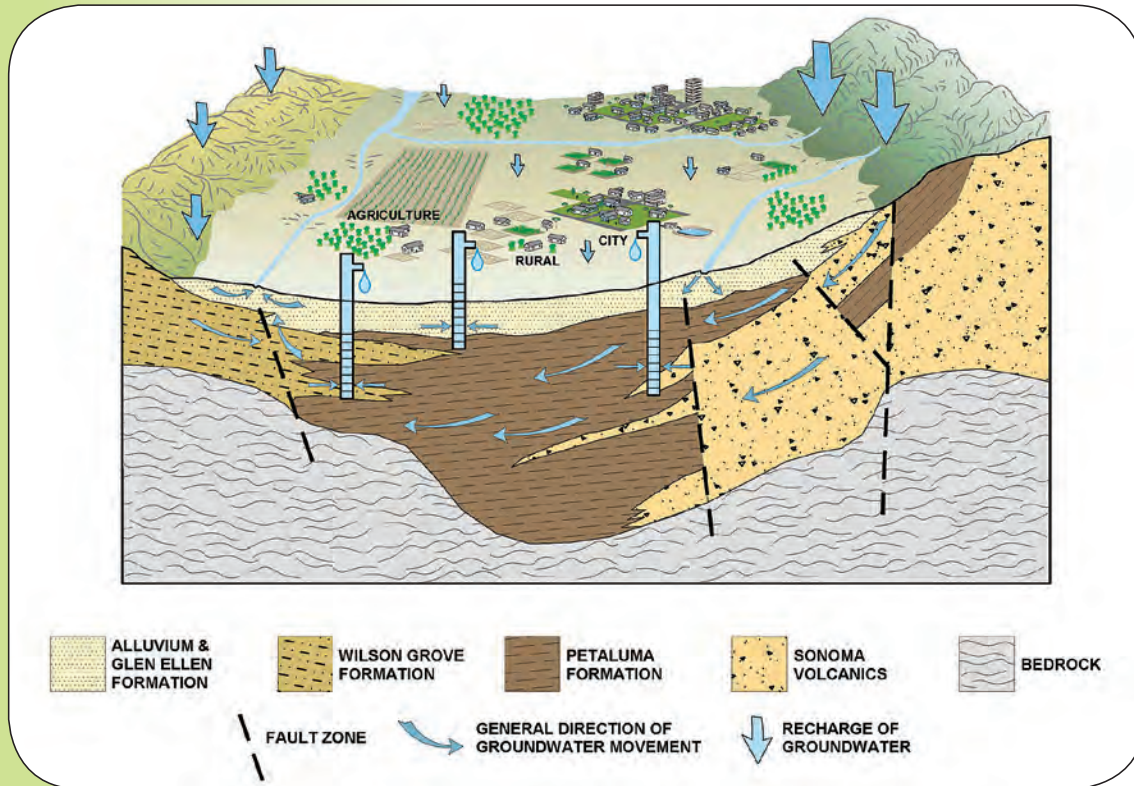


## Groundwater Management in Sonoma County; Laying the Groundwork for Sustaining Groundwater Resources

Groundwater resources have long played a significant role in the development, growth, and sustainability of Sonoma County and provide numerous benefits to the region, including rural residential and municipal water supplies, irrigation water for agriculture, and base-flow to streams, surface water bodies and associated ecosystems. Groundwater accounts for over half of the total water supply in many

areas of Sonoma County and, in some areas, may represent the only reliable source of water. Trends in water use, land use, population growth, and climate change indicate that the region's water resources will come under increasing stresses in the future, requiring careful and thoughtful monitoring and management. In recognizing the importance of understanding and managing the region's groundwater resources, the Sonoma County Water Agency partnered with research scientists from the U.S. Geological Survey to conduct scientific basin-wide technical studies of the larger and more developed groundwater basins in Sonoma County: studies of Alexander Valley and Sonoma Valley were completed in 2006; the study for the Santa Rosa Plain was completed in 2014; and a three-year study of Petaluma Valley was initiated in 2014.

Following the completion of these studies, diverse stakeholder groups representing local agriculture, dairies, government, business, water purveyors, well owners and environmental interests collaboratively developed voluntary, non-regulatory groundwater management plans in Sonoma Valley and the Santa Rosa Plain. The primary goal of the plans is to locally manage, protect and enhance groundwater resources for all beneficial uses, in a sustainable, environmentally sound, economical, and equitable manner for generations to come.



Groundwater flow in the Santa Rosa Area



### **Future Groundwater Management Planning in Sonoma County**

In September 2014, Governor Brown signed historic legislation requiring that California’s groundwater resources be sustainably managed by local agencies. The Sustainable Groundwater Management Act (Act) gives local agencies additional powers and authorities to sustainably manage groundwater. The Act requires the formation of new Groundwater Sustainability Agencies tasked with assessing the conditions in their local basins and adopting Groundwater Sustainability Plans. The Act also mandates that basins subject to the Act achieve sustainability within 20 years of adopting the Groundwater Sustainability Plans and provides mechanisms for the State to intervene if this is not accomplished.

The groundwater studies, monitoring and stakeholder planning conducted through the Sonoma Valley and Santa Rosa Plain groundwater management plans form a strong foundation for meeting these statewide requirements. The practices described in this guidebook represent one of the strategies recommended by local stakeholders for sustaining groundwater resources. This guidebook empowers home and landowners to get directly involved in these critical efforts to protect and enhance our quality of life in Sonoma County today and for future generations. It provides straightforward best management practices that can help to protect and replenish groundwater resources, offset groundwater use, reduce erosion and pollution, while providing many other environmental benefits. Almost anyone can make a real and lasting difference that will help to improve and secure our quality of life. We encourage you to explore this resource guide and to “Slow It. Spread It. Sink It. Store It!”

## CHAPTER 1

# UNDERSTANDING AND EVALUATING STORMWATER RUNOFF

Most counties and cities in California are required by law to develop and submit a Stormwater Management Plan (SWMP) to the state. A SWMP must detail specific actions or practices, called Best Management Practices (BMPs) that will be implemented to minimize the effects of stormwater runoff. An example of a BMP is slowing runoff by temporarily storing it in a rain barrel or other containment system where it can be used to water plants or get distributed to the landscape once rains have passed. Another example is allowing runoff to sink into the ground by directing it to landscape vegetation where sediment can be filtered out and contaminants reduced through bioremediation (use of plants and microorganisms to biologically break down and thereby remove pollutants). Low Impact Development (LID) is another common term normally referred to in larger scale developments that incorporate “green” stormwater management practices. Although new construction will soon be required to utilize BMPs and LID, many buildable areas of the county are already developed. It is essential that we each do our part to implement stormwater BMPs.

This guide will focus on BMPs that you can do at your home, farm or ranch. The BMPs are not complicated. The concepts presented follow a simple mantra: Slow It. Spread It. Sink It. Store It.

- **Slow the runoff**
- **Spread it out in planters, gardens, or over other pervious surfaces - do not confine runoff to pipes**
- **Sink it back into the ground**
- **Store it for the future!**

This chapter divides your property into five major areas or “zones” that can contribute to runoff: 1) roofs, 2) elevated structure, 3) walkways and patios, 4) driveways and parking areas, and 5) bare soils and landscapes. It examines each zone for common problems related to runoff and suggests potential solutions. The end of the chapter provides instructions for a simple do-it-yourself evaluation of your property to assist you in choosing BMPs that suit your specific needs.



## ROOFS

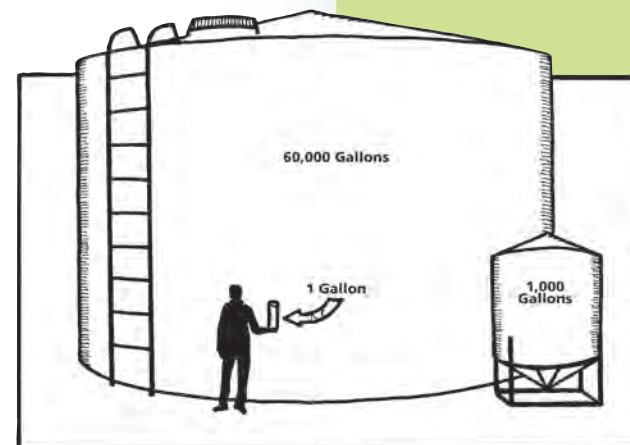
Your roof likely generates the most runoff from your home. While the majority of roofs are outfitted with gutters and downspouts, some are not, so protection measures for either possibility are discussed. Regardless of which system you use, all eaves and downspouts should be routed away from sensitive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

### 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 is an inexpensive option that can help direct water away from your foundation to an area where you can slow, spread, sink, and store it.

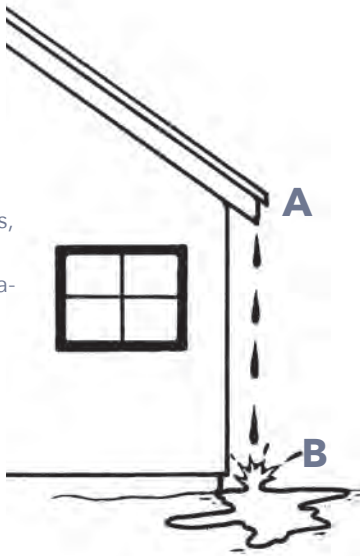


### WHAT IS YOUR ROOF MADE OF?

Metal and tile roofs are preferred catchment surfaces. Composite roofs require the installation of a downspout diverter to filter the asphalt and contaminants out so that the water can be clean enough for irrigating edible garden crops.



### DID YOU KNOW?

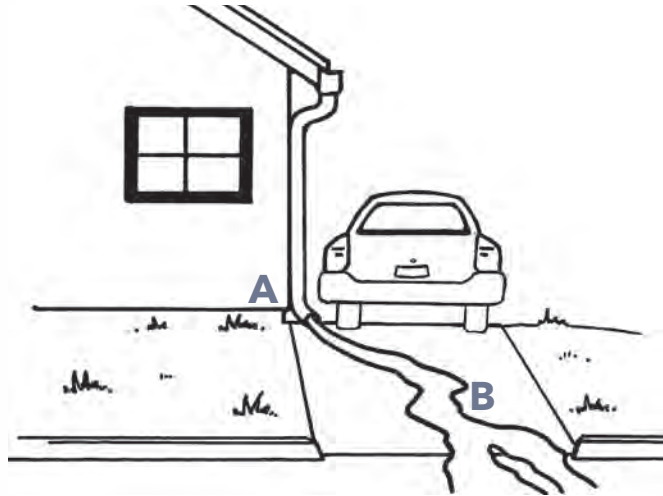
It takes only one inch of rain falling on a typical 1500-square-foot roof to generate approximately 1,000 gallons of runoff. Annual rainfall in Sonoma County typically ranges from 20 to 60 inches depending on where you live (residents at higher elevations generally receive higher amounts of rainfall). This means that in one winter, your roof alone could shed between 20,000 and 60,000 gallons of water as runoff!

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><i>Repairing mold and water damage</i></p>	 <p><b>A</b> Adding gutters and downspouts works to direct water to a safe location away from bare soil and buildings (see page 25).</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 27)</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 driveways is common but can contribute to downstream flooding, surface water pollution, potholes and other issues. ALWAYS avoid sending runoff toward hillsides, septic system leachfields, and buildings where they could cause significant damage to your property.

### POTENTIAL PROBLEMS



**A** 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.

**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.



*Runoff from residential homes can carry pollutants to local streams that can be harmful to wildlife.*

### 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 29, 32, 33).



**B** See Driveways and Parking Areas (page 17).

## ELEVATED STRUCTURES

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 protection measures. Locations with over a 50% slope are particularly vulnerable and may require treatments designed and installed by a qualified licensed professional.

### 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 nearby storm drains and streams.



*Visible erosion under a deck is common.*

**C** Runoff on steep slopes with bare soils 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.

### BMP SOLUTIONS



**A** Adding drain rock or vegetation to the perimeter SLOWS and SPREADS water limiting the transport of sediment (pages 27-28)



**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 27-28).



**C** Terracing or retaining walls may be added to sloped areas to keep rock or other mulch in place and protect hillsides (pages 44-45)

**DID YOU KNOW?**

It's important to scoop your poop! Roundworms, E. coli, and Giardia are just a few of the many harmful microorganisms that can be transmitted from pet waste to humans. Some can last in your yard for as long as four years if not cleaned up. Children who play outside and adults who garden are at greatest risk of infection. Pet waste is also one of the causes of bacterial contamination of creeks in Sonoma County. The American Pet Products Manufacturers Association claims four in 10 U.S. households have at least one dog. That equates to over 186,000 dogs within Sonoma county and incorporated cities! That's a lot of poop. Let's work to keep our families healthy and waterways clean. The solution is safe and easy: 1. Scoop the poop;



2. Put it in a bag (recycled or biodegradable bags are the best option);
3. Place it in the trash; and
4. Wash your hands.

**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** Mulch, gravel, or wood chips work well in low-traffic areas and allow for more runoff to SINK into the ground (page 40).



**B** Turf block works well for allowing water to SINK into the soil in medium-traffic areas or driveways with separate parking areas (pages 39).



**C** Use paver stones for high-traffic areas and patios. For areas with excess runoff, use plant borders to allow more water to SINK into the ground (pages 38).

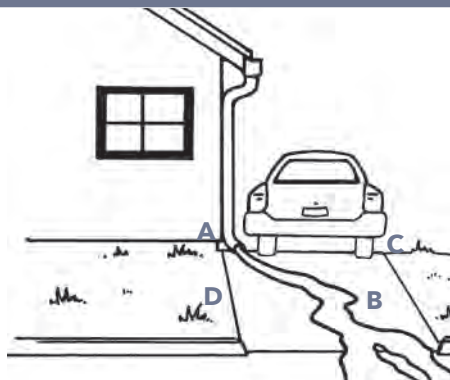


## DRIVEWAYS AND PARKING AREAS

Traditionally driveways have been constructed to divert runoff directly to the street. That runoff can carry with it a variety of pollutants, such as oil and grease, soaps from car washing, leaked antifreeze and more. Your driveway also acts as a conduit for large volumes of roof runoff. Concentrating large volumes of water that outlet 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 BMPs for addressing runoff on your driveway or parking areas. Mendocino and Santa Cruz RCD's publish useful guides on the design and maintenance of private residential and ranch roads. These publications can be found and or ordered online at: [www.mcrcd.org/publications](http://www.mcrcd.org/publications) and [www.rcdsantacruz.org/publications](http://www.rcdsantacruz.org/publications).

### POTENTIAL PROBLEMS

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



**B** This driveway slopes toward the street and creates runoff potentially contributing to flooding, erosion, and pollutants in nearby storm drains and streams.

**C** 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.

**D** 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.



*Driveways can act as conduits for excess amounts of runoff that can damage roads.*

### BMP SOLUTIONS

**A** See Guttered Roofs on page 25.



**B** A small speed bump known as a waterbar can be added to existing driveways to SLOW and SPREAD runoff to vegetated or rocked infiltration areas (page 43).



**C** Pervious concrete (pictured) or other materials such as paver stones or turf block, allow water to SINK into the soil decreasing runoff (pages 38-39).



**D** A rocked 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 34-35).

### DID YOU KNOW?

**We have all heard that cars contribute to air pollution. But, did you know they can also play a part in water contamination? Soap from car washing, oil and grease from leaking engines, zinc from tires, and copper from brakes can all end up in the water where we play, fish, live, and even drink! Keeping cars properly maintained, using only commercial car washes, that contain and recycle wastewater, recycling oil and antifreeze, recycling used batteries, keeping tires properly inflated, and simply driving less will all contribute to cleaner water for everyone!**



## 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 leads to catastrophic events such as landslides. Erosion on bare soils can be identified by uneven soil surfaces, depressions in the soils that create small gullies, and any sign that indicates soil loss. 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 such as certain kinds of ivy or ice plant can actually hinder the stability of sloped areas due to poor root structure or added weight, and 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.*

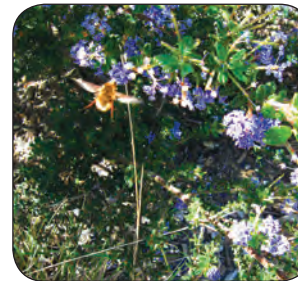
### BMP SOLUTIONS



**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 (page 27).

## DO-IT-YOURSELF STORMWATER RUNOFF EVALUATION

To discover where you can implement BMPs that draw on the fundamentals of “slow it, spread it, sink it, store it” we recommend that you conduct a simple do-it-yourself evaluation of your property. The evaluation consists of a walk around your property on a rainy day to record observations of the 5 zones (see page 12) and how runoff is currently handled, where runoff is going, and where there might be potential for installing BMPs.

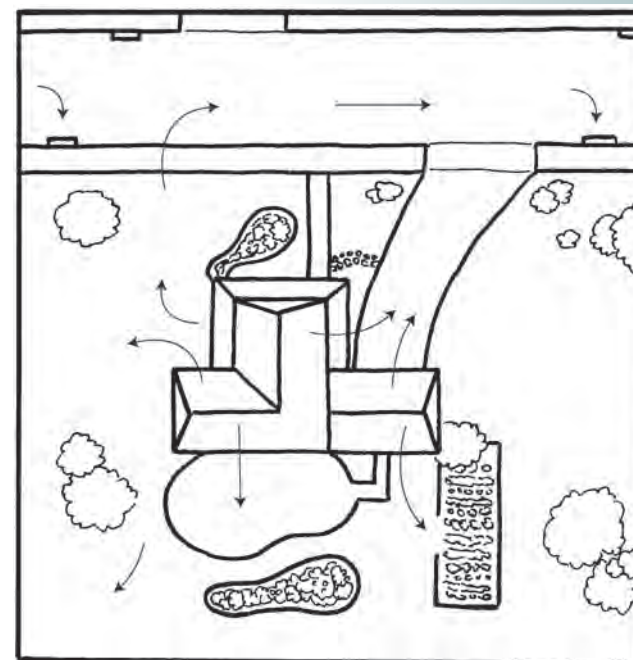
**1) TOOLS.** Below is a list of items you will need:

- rain gear
- a clipboard with scratch paper
- a simple sketch of your property
- a pencil (ink may run if it gets wet)
- an 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 stream, 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! If you need professional assistance, it is always good to take photographs when water is flowing. Share your recorded observations and photos with professionals helping you to evaluate your runoff and on-site needs.

**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. 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 rain events (more than a ½ inch). Go out during a subsequent storm once you see water flowing on your property. 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 the BMPs 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.

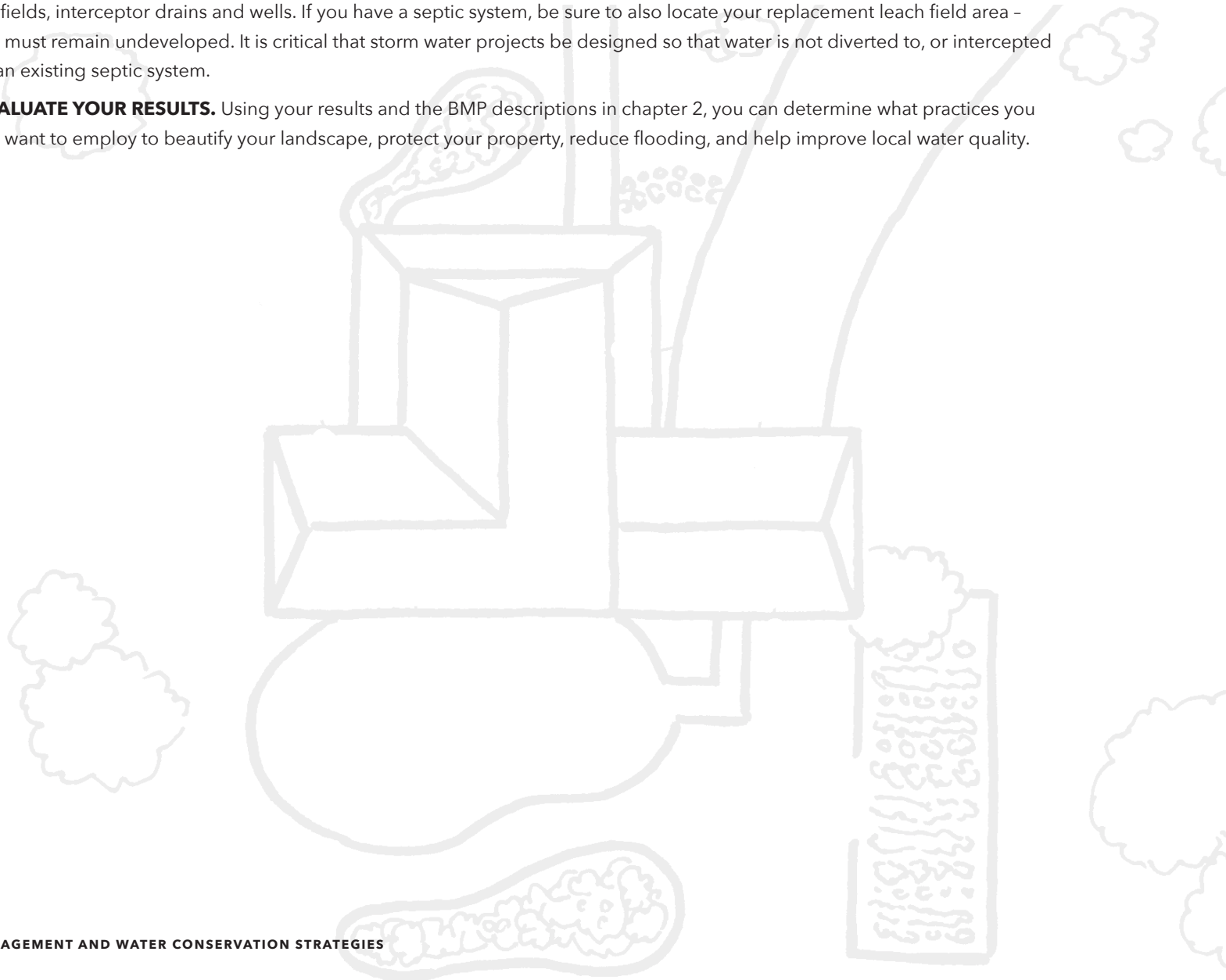
**4) KNOW YOUR SOILS AND RAINFALL RATES!** This is one of the most critical pieces of information you need. Soil maps are available online at <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>. However, it is highly recommended that you consult a professional for an evaluation of the soils at your location. Soils with poor infiltration rates are NOT RECOMMENDED for many of the BMPs described in this guide. A rainfall map is also available through your local NRCS office.



**5) ASSESS POTENTIAL POLLUTANTS.** Determine what your roof is made of: Asphalt shingles, metal, etc. Do you live in an area with significant air quality concerns such as industry or high traffic volume? Do your automobiles leak oil and or antifreeze in your driveway? Both are highly toxic to pets and the environment. Identify these potential sources of pollution, mitigate wherever possible and then determine areas that need to be protected from pollutants and erosion.

**6) LOCATE SEPTIC SYSTEMS AND WELL, 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.

**7) EVALUATE YOUR RESULTS.** Using your results and the BMP descriptions 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 ON STORMWATER MANAGEMENT AND MOSQUITO CONTROL

Mosquitoes need standing water to reproduce. When open water is left to stagnate, mosquito populations can soar. In addition to the nuisance of an itchy bite, mosquitoes also have the capability to transmit disease. While we strive to conserve, protect and diversify our water supplies it is also our responsibility to maintain a healthy environment that does not harm or affect the health of those around us. To prevent unwanted mosquito breeding, please remember to follow these mosquito-proofing tips for standard stormwater management and water conservation practices:

### FOR RAINWATER COLLECTION SYSTEMS:

- 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 the top of the barrel at least 1 to 2 times a week or use a barrel with a self-draining lid
- 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

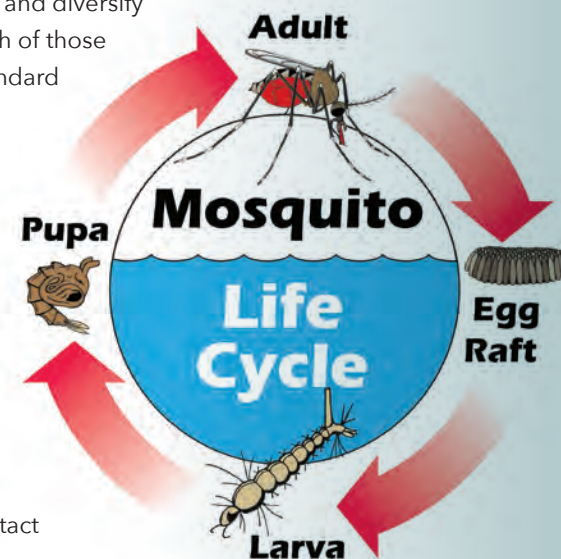
### FOR LARGE WATER TANKS/CISTERNS:

- 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

### BEST MANAGEMENT PRACTICES (BMPs) FOR MOSQUITO CONTROL IN SWALES, RAIN GARDENS, AND 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.

Stormwater treatment features such as rock-lined swales, rain gardens, and retention basins should not contain standing water in excess of 48-72 hours.



The following list provides examples of how to minimize mosquito production when implementing Stormwater BMPs

### PLANNING

- Select and maintain proper grade for water conveyance (e.g. swales, retention features, 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 type catchment system that holds 18 or more inches of water as this poses a potential drowning hazard

### VEGETATION

- 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)
- 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 the Marin/Sonoma Mosquito and Vector Control District.

Marin/Sonoma Mosquito & Vector Control District  
 595 Helman Lane  
 Cotati, Ca 94931  
 1-800-231-3236 or 707-285-2200  
[www.msmosquito.com](http://www.msmosquito.com)



## CHAPTER 2

# BEST MANAGEMENT PRACTICES FOR STORMWATER RUNOFF

*Disclaimer: The Best Management Practices (BMPs) described in this guide are provided exclusively for general educational and information purposes. The guide is intended to help landowners consider their current management practices and to identify concerns and potential solutions. Any BMP should be installed with the consultation of an experienced professional who can address specific site conditions. This chapter outlines a number of well-established practices along with recently introduced options for managing stormwater runoff.*

Managing 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 over 50 years, the approach has been to direct runoff away from the property as quickly as possible using pipes and pavement. While largely effective, we now recognize that this approach only shifted problems downstream. We are now experiencing the 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. The **Best Management Practices or BMPs** (practices thought to be the most practical and cost-effective) recommended in this guide move away from the old “pipe it and pave it” model and toward the slow it, spread it, sink it, and store it approach: slow the water down, spread the water out, and sink and store the water in the soil. This notion is at the heart of these practices and is a simple mantra you can use to address the runoff on your own property. The following chapter includes information on a variety of BMPs. Find the one 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.

Before embarking on any new project please remember:

1. In many cases a simple **change in management** of your current system may be all that is needed to minimize negative impacts of stormwater runoff. Each BMP includes details on maintenance. It is important to recognize that each BMP requires ongoing maintenance to remain effective, and to factor this maintenance into your plans. If you already use one of the listed BMPs, please review the maintenance section for tips on getting the most out of your existing features.
2. **Vegetation** plays several important roles in the function of BMPs, which may include:
  - Slowing down water and physically removing sediments
  - Helping to stabilize slopes through their root structure and reduction of rain impact on the soil
  - Biological removal of nutrients and other pollutants (bioremediation)
  - Improving soil infiltration
3. **Structural practices** are usually more expensive to install and maintain while placing a greater strain on resources and the environment. Structural practices should only be used when management changes or vegetation is not an option.
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 61.
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.

















### 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).**

**6. Important BMP Considerations for Properties with Septic Systems:** In Sonoma County there are an estimated 45,000 homes served by onsite sewage disposal systems (aka 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 storm water BMP be designed to not intercept subsurface sewage or interfere with the functioning of a septic system or interceptor drain. When you are in the stormwater BMP 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 design of the BMP's. Septic systems also have statutory setback requirements that you will need to consider when planning storm water BMPs.

**BENEFITS OF STORMWATER MANAGEMENT**

	<b>BENEFITS</b>
	Conserves water
	Promotes groundwater recharge
	Enhances & creates wildlife habitat
	Improves landscape aesthetics
	Reduces peak flows or runoff timing
	Reduces erosion
	Protects infrastructure
<b>COST</b>	
	Low cost
	Medium cost
	High cost
<b>INSTALLATION DIFFICULTY</b>	
	Easy
	Moderate
	Complex

The **Best Management Practices (BMPs)** 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 additionally noted where using a qualified licensed professional is highly recommended. Potential benefits 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 to protect our aquifers by enhancing recharge.

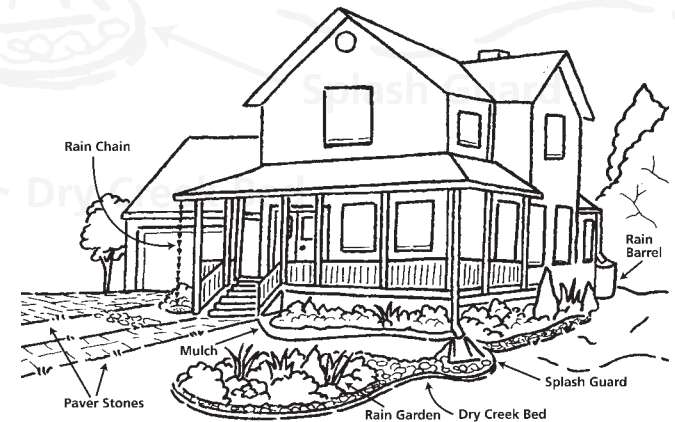
**Enhances and creates wildlife habitat:** When installing BMPs that use vegetation, choosing appropriate plants can create habitat for local wildlife and act as natural pest control.

**Improves landscape aesthetics:** Many of the BMPs in this guide can actually beautify your landscape

**Reduces peak flows or facilitates runoff timing:** Peak flows occur when runoff reaches its highest point. By changing the timing of our residential runoff, we can reduce peak flows and mitigate flooding and erosion potential.

**Reduces erosion:** Practices that reduce erosion limit the loss of top soil and reduce the volume of sediments entering local streams.

**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.





# Gutters and Downspouts



## USES: ROOF RUNOFF

Sonoma County and the incorporated cities may have specific requirements for installing gutters and downspouts. Since requirements often change, we have provided general guidelines, but you should contact your respective planning/building department for more detailed information. See the resources section on page 61 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. We recommended contacting a local qualified professional to 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 and 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 and reduces the potential for downstream flooding while promoting infiltration.

## 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.



### GUTTER PROFILES



Half Round



Ogee

Gutters not only come in different sizes, they come in different shapes too. 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. Ogee shaped gutters, for example, can handle more water than rounded gutters. However the ogee gutter's sharp edges and corners can collect sediment and debris.

**DID YOU KNOW?**

**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**

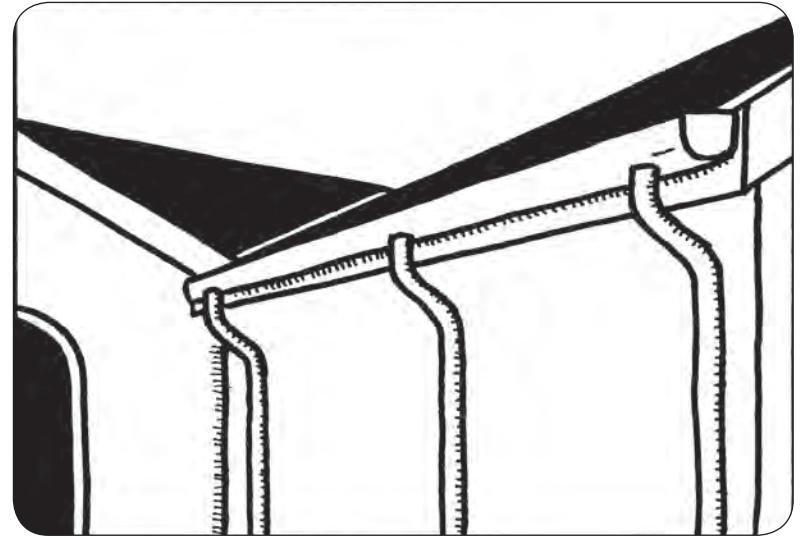
Space downspouts from 20 to 50 feet apart. Adding additional downspouts can increase capacity where necessary and help SLOW water down and SPREAD it out. Do not exceed 45-degree angle bends. Where needed use 4-inch-diameter extensions (flexible or rigid) to convey water to infiltration areas such as rain gardens and swales or to other safe outlets away from structures and steep slopes. All downspouts and pipes that outlet onto surfaces without substantial vegetation cover should use one of the outlet protection BMPs described on page 32. Do not direct downspout outlets to driveways or other impervious surfaces unless there are no safe alternatives. Instead, route them to vegetated areas. When harvesting water from your roof, loose asphalt, leaves and twigs can be prevented from entering storage tanks by installing a downspout diverter.

**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 27-28) below gutters that clog often. Check your system for leaks, damaged parts, rust, and evidence of past erosion. Make sure to check hidden outlets under decks or staircases that might be forgotten. Also see page 21 for information on how to prevent mosquito breeding.

Always check and clean gutters after severe storms.

**DO**

- Direct runoff to 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 an additional downspout helps reduce the volume and velocity of runoff at any given point reducing the potential for erosion.*

**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 is the ground below eaves that do not have gutters installed. For decks and other elevated surfaces it is the area underneath where water drips through (e.g., the area between and below the deck boards). Drip-line BMPs 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
- Plants, shrubs, or flower beds that are completely bordered by wood, rock, or turf with mulch between vegetation covering any bare soil

Contact the RCD, the local native plant society (NPS), native plant nursery, or a qualified professional for assistance with plants well-adapted to your specific location. See page 63 for contact information.

**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.



#### DO

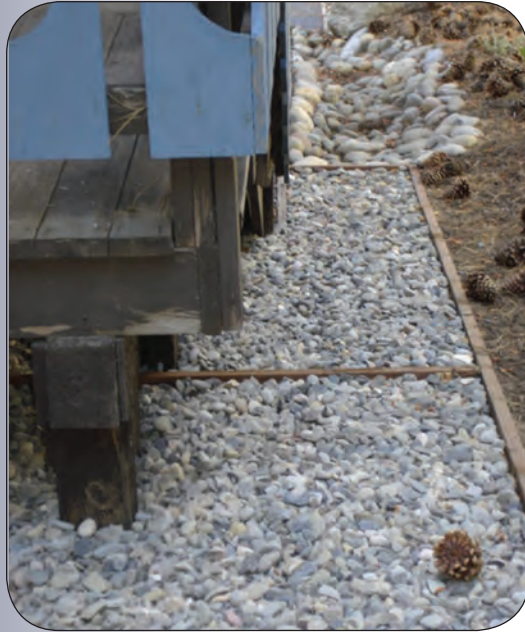
- Use California natives or drought tolerant plants.
- Keep plants well pruned to allow adequate ventilation.
- Keep soil a minimum of 6 inches below siding.
- Minimize fertilization to prevent water contamination.
- Try organic fertilizers and pest controls.

#### DON'T

- Plant invasive species such as periwinkle (Vinca Major) or ivy.
- 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:** Wood chips, mulch, or gravel can be used to protect soil from erosion and promote infiltration into soils with high permeability (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 rain-fall; however, you can use any kind of rock you would like to achieve desired aesthetic effects 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.

### DON'T

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

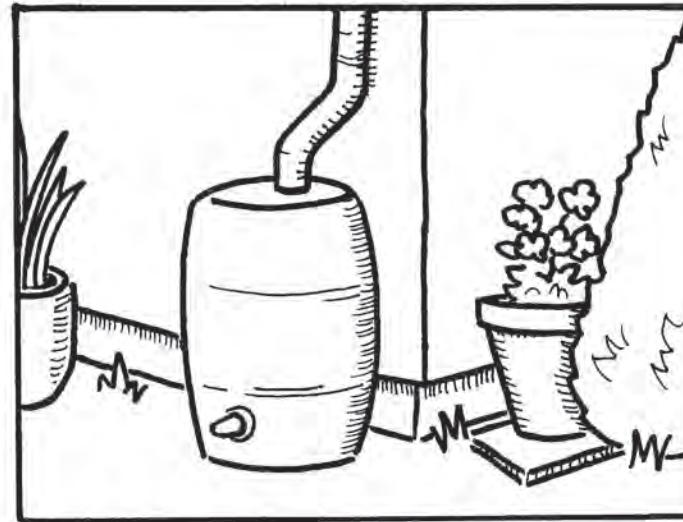
# Rainwater Collection Systems



## USES: COLLECT AND STORE WATER FROM ROOFS

Rain 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 or metered off slowly after storm events to allow for infiltration and reduced flooding.

**RAIN BARRELS** are small- to medium-sized containers placed outside buildings and connected to roof downspouts to collect runoff for later use in non-potable applications. Rain barrels have many advantages in urban settings. They take up very little space, are inexpensive, and easy to install. Rain barrels conserve water and reduce the volume of runoff moving off-site.



**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.

## DID YOU KNOW?

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.

### 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.

### 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.)

**WATER TANKS AND CISTERNS** are manufactured water storage containers for non-potable use in residential, commercial, or industrial applications. Some water 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 water tanks and rain barrels can be used without pumping devices if gravity provides adequate flow. Depending on the situation, a pump may be necessary.

Larger tanks can be designed to also function as privacy screens, fences, or small retaining walls. Tanks can also be hidden under decks or serve as the foundation for play structures or other landscape features. Get creative!

Underground tanks are excellent options for areas with limited space. However, do not install underground systems without appropriate engineering, or beneath the path of vehicles or heavy machinery traffic. 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.

Be aware that tanks over 5000 gallons in size require a permit from the county. Some projects of smaller size may require a grading permit before placing the tank.

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. This 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  
*This should be equal to or larger in diameter than the inflow pipe to avoid backup.*
- Overflow device
- Faucet and valve
- Filters and pumps (optional)



Underground 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 5000 gallons.
- Secure tanks with straps for protection from earth movement.
- Use gravity to your advantage wherever possible.
- 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

### RAINWATER HARVEST CALCULATION

To determine how much water you can harvest from your roof, use this formula:

**Harvested Water (gallons) = Catchment Area (foot squared, length x width) x rainfall depth (inches) x 0.623 (conversion factor)**

*This formula is provided by the American Rainwater Catchment Systems Association (ARCSA) website*

# Outlet Protection

\$-\$\$

E-M



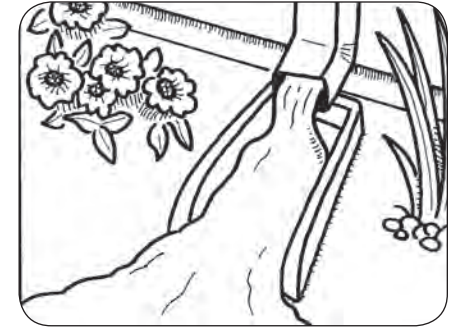
## USES: DOWNSPOUT, PIPE, OR CULVERT OUTLETS

One of the most overlooked parts of a drainage system is the outlet of downspouts and pipes. Outlets should not release water onto bare soil or to an area prone to erosion. On the other hand, discharging water onto hardened impervious surface eliminates infiltration and increases the velocity of water that is directed to streets and streams creating a new set of challenges. All outlets that drain onto soils or other erodible surfaces should have some type of outlet protection. The BMPs below work to SLOW water down and/or SPREAD it out so it can SINK and get STORED in the ground.



**SPLASH GUARDS** 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 an appropriate infiltration area and SINK back in to the soil.

**A HOSE ADAPTER** is a neat option (Drought Buster East Connect is pictured) that allows 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 surrounded by a wood border (similar to a rock drip-line). 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 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 waterway will need a permit. Contact your local RCD for permitting assistance or see page 61 for a list of agencies.

### 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

\$-\$\$

E-M



**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. It uses plants to remove pollutants and improve infiltration allowing water to soak back into the ground. In soils with low permeability this system may be used to temporarily store water (not completely infiltrate) and remove pollutants before they enter a waterway.

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.

Plant the center of the garden with species that tolerate wet conditions, such as native sedges and rushes. Around these, put plants suited to occasional standing water, like Yellow Monkeyflower (*Mimulus guttatus*) or California Aster (*Aster chilensis*). At the furthest edges there are a variety of native evergreen and deciduous shrubs that prefer drier soil. Contact your local RCD (page 61) or a local plant nursery knowledgeable in native and drought tolerant species for more suggestions. Rain gardens should be located at least 10 feet from your house and at least 40 feet from a septic system or steep slope. They should also be designed to drain within 72 hours to reduce the risk of standing water and mosquito breeding (see page 21 for more info). 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.

**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

\$-\$\$

E-M



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

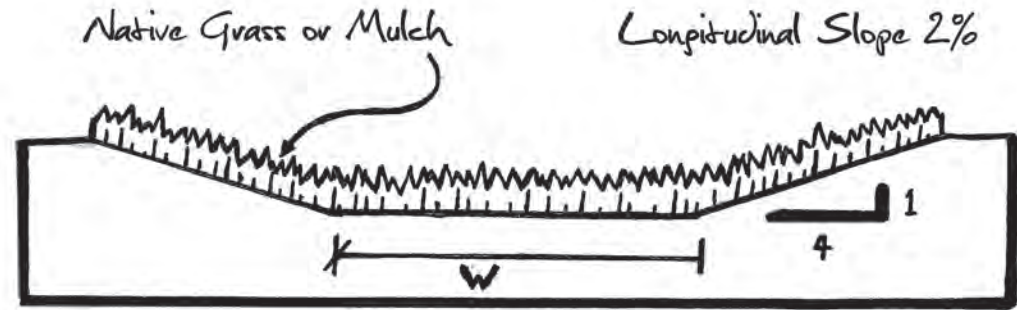
**Swales** are shallow channels designed to SLOW water down, SPREAD it out and allow it to SINK and get STORED in the soil during low flows. Once saturated, they convey water to a safe outlet such as a rain garden (page 33) or other infiltration areas. They can be formed to fit almost all site conditions 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 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 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 California native plants or drought tolerant plants.
- Use fertilizer and pesticides only when necessary.

### DON'T

- Walk or drive machinery directly in the swale as this will cause soil compaction.
- Place too close to your home's foundation.
- Allow water to stand or stagnate

## ROCK-LINED SWALES (DRY CREEK BEDS)

A rock-lined swale (or dry creek bed) 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



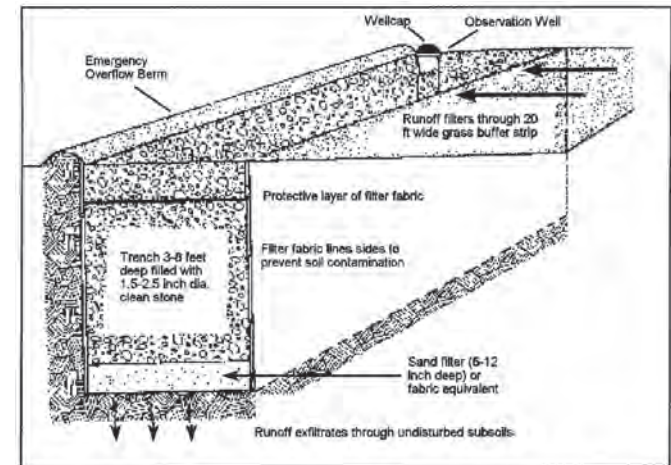
**USES: ROOF, WALKWAYS OR OTHER HARDSCAPES, VEGETATED AND/OR UNDEVELOPED AREA RUNOFF; LOW TO MODERATELY SLOPED AREAS**



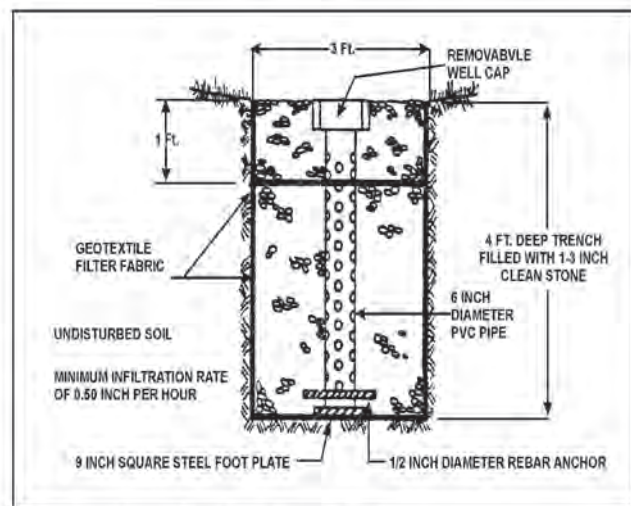
**INTRODUCTION:** Infiltration structures are typically underground storage chambers designed to collect stormwater and allow it to infiltrate into the surrounding soil for groundwater recharge. They go by many names including: infiltration gallery, seepage pit, drainage well, dry well etc. In addition to promoting groundwater recharge, they can also help to enhance base flows in nearby creeks, reduce runoff volume, and can improve water quality by removing 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 BMPs are advanced techniques and should only be undertaken with sufficient planning and professional assistance. Your local RCD can assist you in the early planning and permitting stages and provide referral assistance with public agencies and private consultants.

**GROUNDWATER PROTECTION:** A discussion of infiltration BMPs would be incomplete without a word on groundwater protection. In some areas, the water table may be shallow (“perched”) or have seasonal variation. Soil types and ground disturbance also varies by site location. The BMP relies on proper design, appropriate soil types and a minimum depth of underlying soil (above the water table) to filter pollutants before stormwater reaches the aquifer so groundwater contamination does not occur. Therefore, extreme care must be undertaken to ensure that the BMP is 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 the negative environmental impacts of peak storm flows 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 and possible failure of the BMP. In addition, infiltration trenches often need to be used in conjunction with other BMPs that pre-treat the stormwater. Pretreatment BMPs are important because they remove suspended solids before they enter the trench to prevent clogging and possible failure.



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.

**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 BMPs 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 BMP. However, maintenance requirements for properly designed and constructed infiltration BMPs are reasonable. Future planning should also take into account maintenance requirements for any associated BMPs that pre-treat the stormwater and include a specific inspection and maintenance schedule as well as acceptable performance guidelines. General guidelines recommend that in the first year, the BMP should be inspected during and after several major precipitation events 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 BMP is partially or completely clogged, consult a professional immediately to identify the problem and repair requirements. The probability of failure for an improperly sited, designed or maintained infiltration BMP is nearly 100%.

### DO

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

### DON'T

- Attempt to install without a site analysis
- Build an infiltration BMP in an area with high sediment input or excessive slopes
- Install a trench or pit that is greater than 3' deep

# Pervious Hardscapes

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

M-C



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

There are many new types of pervious 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.



## 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 planted. 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.

**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 where pollutants are removed. 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.

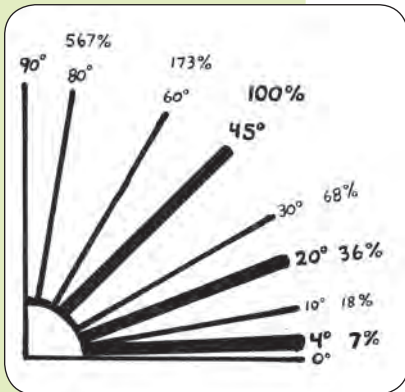
### DON'T

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



**DID YOU KNOW?**

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.

**SLOPE GRADIENT CONVERSION TABLE**

## Ground Covers



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



Using mulches 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. Ground cover varieties include vegetation, wood chip, gravel, or other mulches. 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 inorganic -- such as stones, brick chips, and recycled glass. Mulching has many benefits such as 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.

**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 materials.

#### DO

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

#### DON'T

- Use wood chips from diseased trees.
- Use straw mulch near stream 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 water infiltration. A drip irrigation system provides slow delivery of water to plants, so water infiltrates 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 solar, 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 Sonoma County Master Gardeners, UC Cooperative Extension (page 61) or a local plant nursery knowledgeable in native and drought tolerant species best suited for these functions.

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, and they are 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 Sonoma County Master Gardeners or UC Cooperative Extension (see page 61) for a complete list of plants that should be avoided.

**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 years 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 endure periods of saturation.
- 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) or certain ivys.
- Plant highly flammable vegetation near buildings.
- Allow irrigation water to drain to your driveway, the street, or bare soils.

## Erosion Control Blankets (ECBs)

\$-\$\$

E-M



### 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 or contact the RCD for assistance (see page 61) in choosing the correct blanket. We have included 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. Overlap the side edges of the contiguous blankets used by at least 4 inches and overlap the top and bottom edges of the blankets by at least 3 inches. The uphill roll should overlie the downhill roll. 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.

**MAINTENANCE:** Monitor for erosion until vegetation becomes established.

Check for proper placement that could be disturbed by animals or a large storm event. Ensure that overlaps remain in place and correct 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. Contact the Mendocino County RCD for a copy of a road maintenance guide and for more information on alternative techniques.

## WATERBARS

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 waterbreak, is a temporary structure consisting of a shallow trench with a parallel berm or ridge on the downslope side which is angled down across the road. 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 regularly and rebuild annually to ensure there is no erosion, and they are functioning.

## SLOTTED CHANNEL DRAIN

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 ½ 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.

**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. Slotted drains require frequent maintenance.



### DO

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

### DON'T

- Direct runoff to erodible surfaces.
- Outlet 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.
- Outlet water onto steep slopes.
- Direct water to a neighbor's property.
- Allow drain to clog and trap water.



# Retaining Walls and Terracing

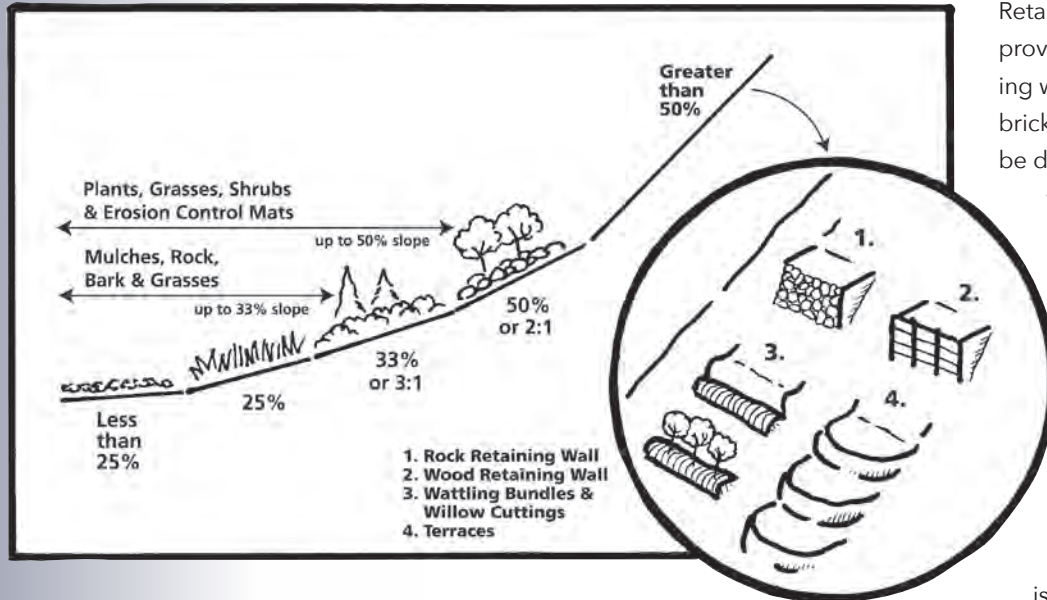
\$\$\$-\$\$\$

M-C



## USES: SLOPED AREAS

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



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 department to determine if a permit is necessary for your project. Contact information can be found on page 61.

## RETAINING WALLS

**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. Contact your local RCD for assistance (see page 61 for contact information).

## 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.

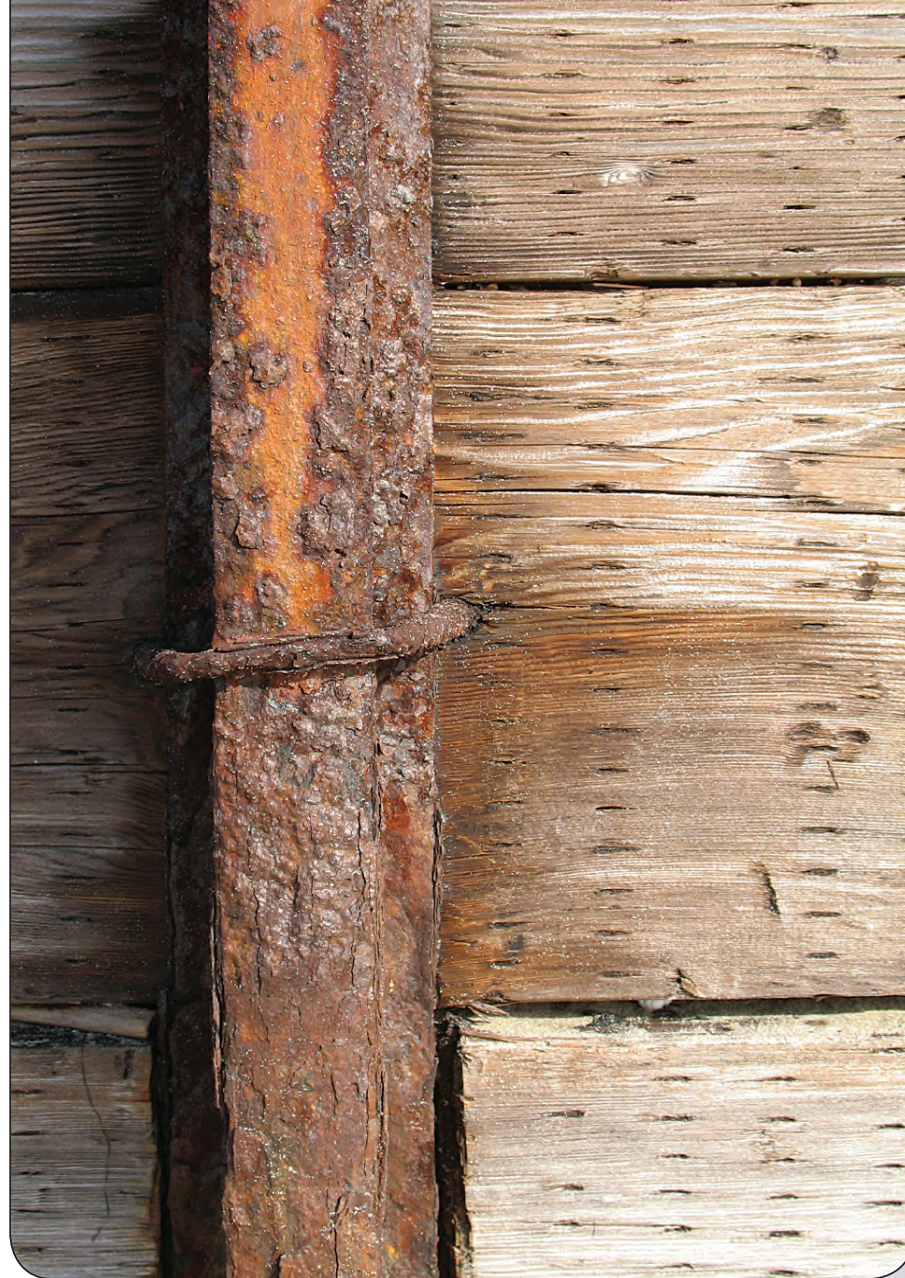
**MAINTENANCE:** Always check retaining walls to make sure they are not leaning or failing. Ensure there is adequate drainage behind walls and the drains remain functional.

### 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

\$-\$\$\$

M-C



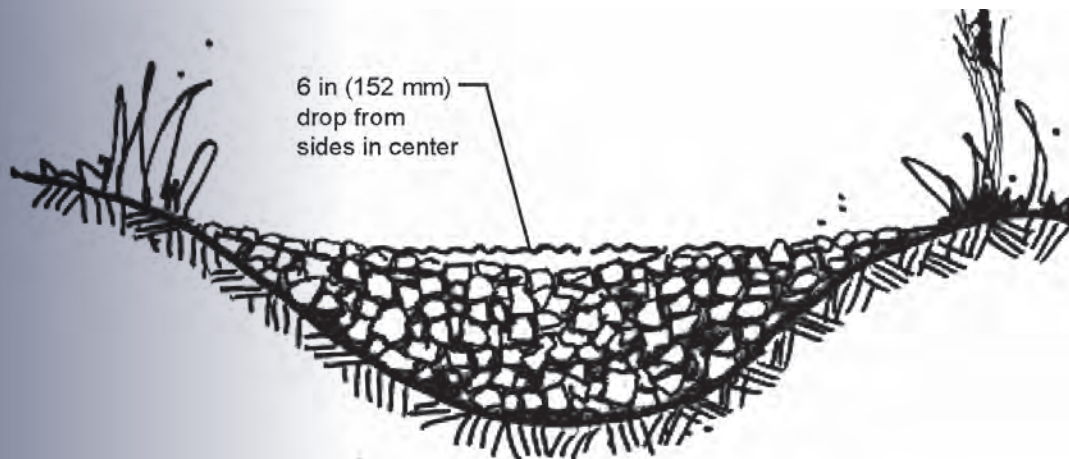
**USES: IN ROCK-LINED DRAINAGE CHANNELS; VEGETATED DITCHES AND SWALES; LOW TO MODERATELY SLOPED AREAS**



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 (see resources guide on page 61) 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.

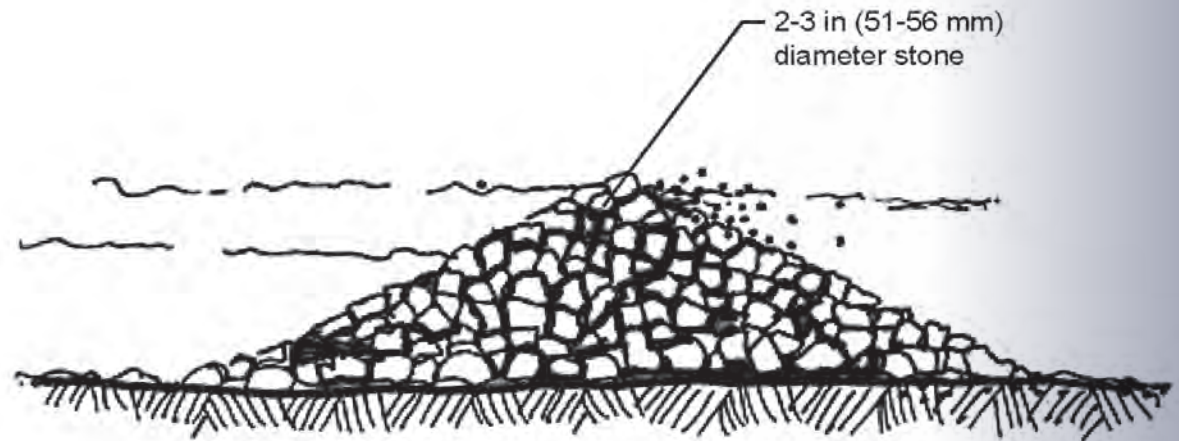


**Rock Check Dam  
Section View**

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 as 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



## Agricultural, Large Scale, and Multi Component Systems

**INTRODUCTION:** Several of the techniques in this guide can be enlarged or used in combination to address stormwater management goals for bigger parcels and in conjunction with a variety of land uses such as agricultural operations or livestock management. Large, integrated best management practice systems can yield substantial benefits. They also have the advantage of addressing multiple resource concerns including erosion control, environmental enhancement, and water quality/quantity attainment. However, project costs and maintenance requirements can be substantial, so careful consideration and planning is required when implementing large-scale systems. The landowner should first consider overall objectives and goals as well as ongoing maintenance obligations. Other important factors to consider are site conditions, design and engineering requirements, location, water quality, and neighboring landowners. Consult a professional or a local resource agency when considering a large-scale, advanced stormwater management system.



*Underground rainwater storage installed at west county dairy*

Listing every available 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. Agricultural producers and some non-agricultural landowners with special needs may be eligible for financial assistance to implement stormwater BMPs. Your local Resource Conservation District and the Natural Resources Conservation Service (NRCS) may be able to provide assistance and guidance for large or complex stormwater management systems (see resources section, page 61).

### **MULTIPLE, INTEGRATED BMPs AND SYSTEMS:**

A multiple treatment system uses two or more BMPs in a series or in an integrated fashion. Directly connected BMPs are also known as a “treatment train”. Many of the BMPs in this manual can be easily combined or integrated on a small or medium residential scale – so don’t hesitate to identify a set of BMPs that can help you to SLOW-SPREAD-SINK, and STORE stormwater.



For example, 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. Most parcels offer considerable opportunities to integrate several techniques regardless of their size.

Remember that many advanced techniques may not be sufficient or appropriate for addressing significant water quality requirements when deployed independently - especially in medium to large-scale scenarios. In these cases, the system is designed from the ground up with a set of integrated BMPs that attain a set of specific objectives. Large-scale integrated systems can benefit the landowner and environment in many ways. They do, however, require careful planning and professional consultation before implementation.

### LARGE SCALE PROJECTS

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. quality and volume). 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. Reconfiguring the stormwater flow regime on a large parcel with substantial earth movement may require engineered designs, and multiple agency permits. Consult a local resource agency or professional engineer when considering a large-scale, integrated BMP system.



*Pond designed to catch rainwater*



*Gully repair, native plant revegetation, and exclusionary fencing*

### MAINTENANCE CONSIDERATIONS

Each BMP will require maintenance as indicated. For advanced techniques, maintenance of one BMP may affect the functioning of all others in the system. Be sure to identify your maintenance needs in the design phase of your project and 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.

## CHAPTER 3

# DIFFICULT SITES AND SITE CONSTRAINTS

There are a wide variety of soil types found in Sonoma 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 your local RCD or a qualified professional. Also make sure to look for areas of shallow parent material or 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. Below is a list of primary site constraints that you should consider when evaluating drainage practices for your home. Although there are many opportunities to control runoff on site, it is important to consult a professional to ensure that all options are thoroughly considered and to avoid unforeseen consequences.

### 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. If your home is on or near steep slopes, please consult an expert before considering home drainage projects.



### PREEXISTING EROSION PROBLEMS

In some cases, preexisting 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 dynamic systems. If your home has existing erosion problems, please consult an expert before considering home drainage projects.

### GEOLOGICALLY HAZARDOUS SITES

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 four faults in Sonoma County where surface movement has taken place during the past 11,000 years. The Sonoma County Permit & Resource Management Department website provides maps of seismically active areas at <http://www.sonoma-county.org/prmd/>. These maps should be consulted to identify if your home is located within a hazard area. If **your** home is in one of these areas, please consult an expert before considering home drainage projects.



### 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 shoreline bulk heading or regrading of slopes, site drainage remains an essential component of the solution. Consult a drainage professional when designing drainage system for sites on coastal bluffs.



### AREAS PRONE 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 Sonoma PRMD or 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.



### LANDSLIDE ZONES

Areas of Sonoma County are susceptible to landslides due to the topography and geological soil characteristics. Installing complex drainage practices that promote infiltration may also promote landslide activity if hill slopes become saturated. Designing drainage practices on these sites requires special care. To determine if your home is in a landslide prone area, contact NRCS or Sonoma County PRMD (see page 61) to review potential landslide area maps. If your property is located in a landslide zone, consult an expert before considering home drainage projects.



## CHAPTER 4

### LOCAL PROJECTS

#### VEGETATED BIOSWALE AND DETENTION POND

**Location:** Frog Song Cohousing Community, Cotati, CA

**Project Description:** The bioswale is planted with low-water natives and other beneficial plants. It intercepts surface runoff from the cohousing community and helps to infiltrate water. Overflow is collected in a detention/percolation pond for controlled release. This system promotes groundwater recharge, and helps to reduce peak storm flows, non-point source pollution discharges, and erosion.

**Photo Credit:** Dave Ergo



#### LAWN REMOVAL, MULCH & LOW WATER LANDSCAPE INSTALLATION

**Location:** Sonoma Valley High School

**Project Description:** Taking advantage of the City of Sonoma's Cash for Grass program, Sonoma Valley High School took out over 13,900 square feet of turf, replacing it with mulch and other low-water use landscape features. The project offsets potable water use, prevents erosion, and increases infiltration.

2009 Sonoma Valley Groundwater Management Program Conservation Award Winner

**Photo Credit:** Glenn Moll

## PERVIOUS HARDSCAPE DRIVEWAY

**Location:** Sonoma, CA

Original concrete driveway was removed and replaced with pervious pavers and landscaped strips to further enhance infiltration. This improvement helps to reduce runoff volume, non-point source pollution and encourages infiltration and groundwater recharge.

**Photo Credit:** John Guardino



## RAINWATER CATCHMENT SYSTEM

**Location:** Bodega, CA

**Design & Installation:** Prunuske Chatham Inc.

**Project Description:** A 9,000-gallon rainwater catchment system installed to offset potable water use and minimize water diversion from a salmon stream. The system employs multiple 3,000-gallon tanks storing water collected from the roof of an out-building. The building's downspouts have diverters installed to convey the potentially contaminated "first flush" of roofwater away from the storage tanks. This system reduces the impact of summer water diversion on a salmon stream and reduces runoff and peak flows.

**Photo Credit:** John Green





## SOLAR POWERED WATER RECLAMATION AND RECYCLING SYSTEM

**Location:** Gundlach Bundschu Winery, Vineburg

**Project Description:** Gundlach Bundschu Winery installed a reclamation and reuse system to process over a million gallons of winery wastewater through a collection pond and integrated wetland system. BMPs include a deficit irrigation management program, water reclamation ponds, rainwater harvesting, sustainable winegrape production, and solar power generation. Wastewater collected from winery drains is filtered and mixed with rainwater. It moves by gravity to process ponds and a wetland system, before eventually being reused to irrigate grapes. Solar power provides 100% of the electricity needs for the reclamation system.

2009 Sonoma Valley Groundwater Management Program Conservation Award Winner.



## INTEGRATED WATER SUSTAINABILITY SYSTEM

**Location:** Salmon Creek Middle School, Occidental, CA

**Project Description:** The Salmon Creek Falls Environmental Center fosters eco-sustainability and provides environmental education to the community. Salmon Creek Falls Environmental Center stormwater management techniques include a living roof, water efficient fixtures, low-water native landscapes, and a rainwater collection system. These BMPs help to offset potable groundwater consumption, reduce peak flows, erosion, and non-point source pollution.

**Photo Credit:** David Ortiz

## INTEGRATED WATER CONSERVATION AND RE-USE PROJECT

**Location:** Sonoma County Administrative Complex - Santa Rosa, CA

**Design:** Sonoma County Permit & Resource Management Department

**Installation:** Broad collaborative effort of private and public entities

**Project Description:** This innovative demonstration project was a multi-agency collaborative effort to provide water quality treatment and storm water detention for 2-acres of parking lot via retrofit installation of storm water BMPs. The retrofit installation included eleven BMPs designed to treat storm water runoff as well as detain storm water to reduce peak runoff in nearby Paulin Creek. Some BMPs are public domain and some are proprietary but all act to either prevent rain water from coming in contact with pollutants, treating storm water runoff, detaining storm water, or a combination of treatment and detention. BMPs include:

1. Drop inlet filter inserts to catch trash
2. Unit pavers to allow infiltration
3. Pervious concrete to allow infiltration through a vehicle rated paving surface
4. Underground detention to reduce peak discharges
5. Bioretention pond to treat and detain water
6. Treepods biofilters to remove oil, grease, and other pollutants
7. Three vegetated swales to improve water quality and detain runoff
8. Erosion control fabric demonstration area with three types of fabric: jute, coconut, and wood product
9. Straw wattle demonstration area showing proper installation, embedding, and overlapping
10. Silt fence demonstration area showing proper installation, embedding, overlapping, and ending
11. Roof enclosure to prevent rain water from mixing with garbage and leaching onto the parking lot

This project is open to the public and can be viewed anytime during regular business hours.

**Photo Credit:** Sonoma County PRMD





## SIMPLE RAINWATER COLLECTION SYSTEM

**Location:** Occidental Arts and Ecology Center, Occidental, CA

**Design & Installation:** Brock Dolman

**Project Description:** This simple rainwater collection system was installed on a goat feeding shed roof. The attached flexible gutter and pipe feeds into a 1000 gallon storage tank. Stored water will be gravity fed to livestock areas for watering milking goats and chickens. The roof area is 160 square feet which roughly yields 100 gallons of water per inch of rainfall into the storage tank. Sliced flexible drain pipe was fastened over the end of a corrugated roof. The leading edge of the gutter acts as an effective prefilter for coarse leaves and twigs (see photo). This system is easily cleaned and maintained. An onion sack acts as a simple debris filter wired to the end of the flexible gutter pipe that is placed in the storage tank. This system is inexpensive and easy to build, install and maintain.

**Photo Credit:** Brock Dolman



## RURAL ROAD IMPROVEMENTS

**Location:** Occidental Arts and Ecology Center, Occidental, CA

**Design & Installation:** Pacific Watershed Associates, Gold Ridge Resource Conservation District, Brock Dolman

**Project Description:** This project integrates land and road management techniques to reduce erosion and sediment discharges into nearby streams. Sediment traps were installed above ditch relief culverts adjacent to a rural road to slow runoff and promote infiltration. The road surface was contoured with "rolling dips" to assist in reducing storm water flow velocity and removing fine sediment. Assistance for the design and installation of this project was made possible, in part, by a grant from the California Department of Fish and Game for sediment reduction in the Dutch Bill Creek Watershed.

**Photo Credit:** Brock Dolman



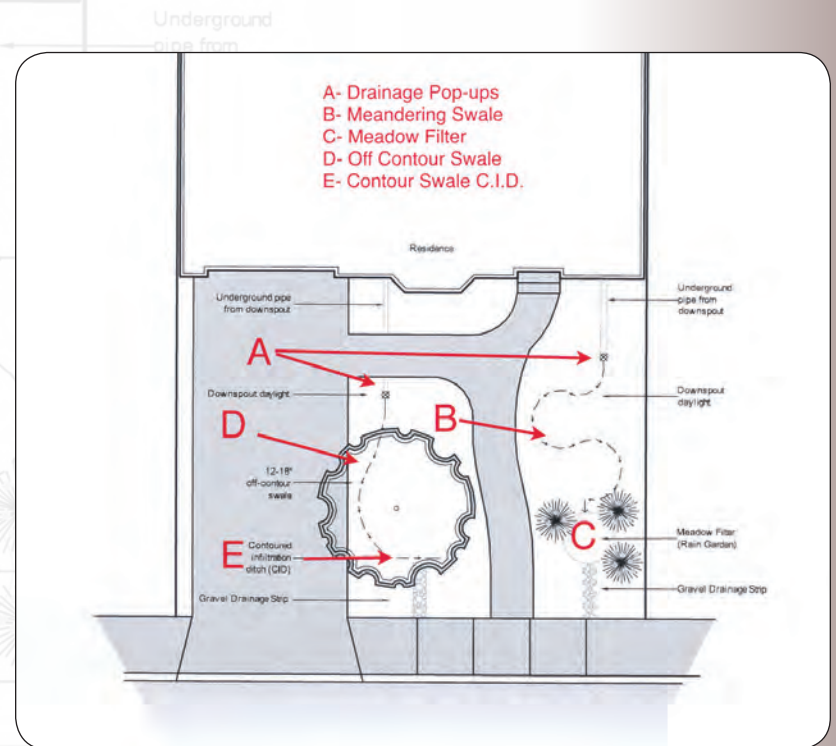
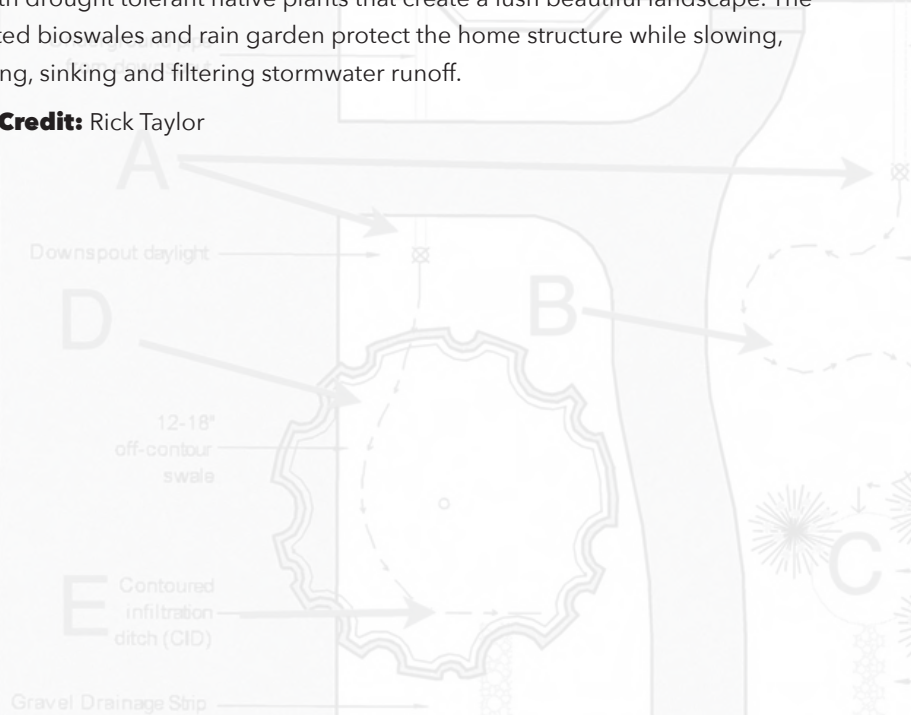
## SUBURBAN INTEGRATED STORMWATER MANAGEMENT SYSTEM

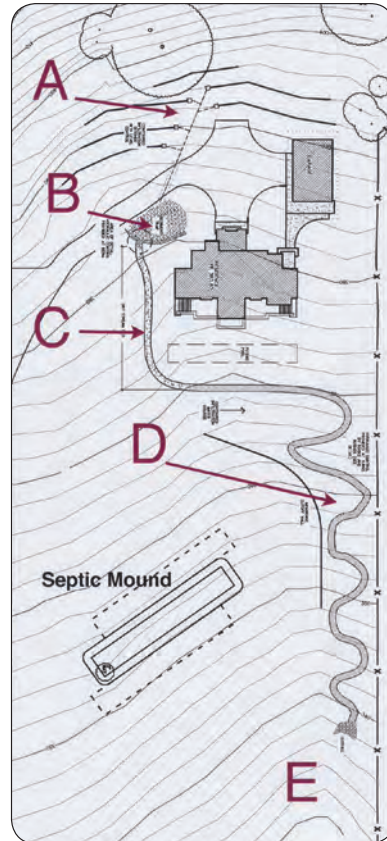
**Location:** Sebastopol, CA

**Design and Installation:** Rick Taylor, Elder Creek Landscapes

**Project Description:** This 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





## RURAL ORCHARD STORMWATER MANAGEMENT INTEGRATING MULTIPLE BMPS

**Location:** West Sonoma County, CA

**Design and Installation:** Rick Taylor, Elder Creek Landscapes

**Project Description:** This advanced case study project utilizes a Keyline approach while at the same time addressing 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

## THE MALONEY FAMILY MEMORIAL GARDEN

**Location:** The Sonoma Community Center- Sonoma, CA

**Design and Installation:** Community-wide effort with assistance from; City of Sonoma, Sonoma County Master Gardeners, Sonoma County Water Agency, Sonoma State University

**Project Description:** This water-wise demonstration garden replaces a grass lawn and showcases water conservation by integrating drought tolerant plants and rainwater collection systems. The site features a wide variety of demonstration gardens including a children's garden with scented plants, a Mediterranean garden to reflect our climate, a California native plant garden, a succulent garden and a rainwater garden. The rainwater collection system, developed by Sonoma State University, includes 3,000-gallon corrugated tanks with a filtration system that collects rain from the 16,000-square-foot roof of the center. The newly designed garden will use approximately 70 percent less water than the lawn it replaced. The rainwater collection system is expected to fulfill two-thirds of the garden's water needs greatly reducing dependence on drinking water for landscape irrigation.

**Photo Credits:**

John Guardino





## OFFSTREAM STORAGE POND

**Location:** Dry Creek Valley, CA

**Design and Installation:** Sonoma Resource Conservation District, Store-sund Consulting, Nelson Bulldozing, Trout Unlimited

**Project Description:** This offstream storage pond was installed to provide a reliable vineyard water source, while eliminating an existing flashboard dam and diversion from the stream. The pond is constructed of earthen embankments and lined with a polyethylene liner. It holds 1.4 acre-feet of water, and is filled with a combination of rainwater and water pumped from a well that is not hydrologically connected to the stream. Sensors in the pond send signals to turn on and off the well pump and keep the pond at a desired level without overflowing. The pond allows the landowner to overcome the limited flow capacity of the well pump, and provide sufficient quantities of water for frost protection when it is needed. The landowner also installed microsprinklers in place of traditional overhead sprinklers, to reduce water use. An aeration system was installed in the pond to control algal growth and maintain water quality. The pond is surrounded by a fence to limit wildlife access, and the landowner also installed a shade-cloth “escape ramp” around the perimeter of the pond so that any wildlife that does enter the pond can get traction to climb out. Funding for this project was provided by the National Fish and Wildlife Foundation, NOAA Restoration Center, US Fish and Wildlife Service, the USDA-Natural Resources Conservation Service, and cost share from the landowner and project partners.

**Photo Credits:** Landowner

# RESOURCES GUIDE

## TECHNICAL ASSISTANCE GROUPS

### Daily Acts

Offers resources and education on water conservation measures for people in urban locations

[www.dailyacts.org](http://www.dailyacts.org)  
707-789-9664

### Gold Ridge Resource Conservation District

Offers technical and educational assistance on water conservation projects in Lower Russian River, Salmon Creek, and the Estero Americano in west Sonoma County

[www.goldridgercd.org](http://www.goldridgercd.org)  
707-823-5244

### Low Impact Development Center

Provides a variety of information and resources for storm-water management in urban/developed watersheds

[www.lowimpactdevelopment.org/](http://www.lowimpactdevelopment.org/)  
301-982-5559

### Master Gardeners

Offers free at-home consultations on converting lawns to native landscaping, planting rain gardens and setting up drip irrigation (through their Garden Sense Program)

[www.ucanr.edu/sites/scmg/](http://www.ucanr.edu/sites/scmg/)  
707-565-2608

### OAEC WATER Institute

Provides resources and publications on water management and conservation

[www.oaec.org/water-institute](http://www.oaec.org/water-institute)  
707-874-1557 x106

### Sonoma Resource Conservation District

Offers technical and educational assistance on water conservation projects in Lower and Middle Russian River, Petaluma River, Sonoma Creek, and Gualala River Watersheds

[www.sonomarcd.org](http://www.sonomarcd.org)  
707-569-1448

### USDA-Natural Resources Conservation Service (NRCS)- Petaluma Field Office

Offers agriculturists cost share opportunities for several types of water efficiency and conservation activities thru their EQIP program

[www.ca.nrcs.usda.gov](http://www.ca.nrcs.usda.gov)  
707-794-1242

## CITIES/WATER PURVEYORS

Many cities sponsor water conservation and efficiency programs, provide technical support materials, and offer rebates for water saving techniques, lawn removal, water harvesting, low water landscaping and more. Contact your water provider to find out more.

### Cloverdale

[www.cloverdale.net/index.aspx?nid=263](http://www.cloverdale.net/index.aspx?nid=263)  
707-894-1792

### Cotati

[www.ci.cotati.ca.us/sections/services/water-conservation.cfm](http://www.ci.cotati.ca.us/sections/services/water-conservation.cfm)  
707-792-4600

### Healdsburg

[www.ci.healdsburg.ca.us/index.aspx?page=189](http://www.ci.healdsburg.ca.us/index.aspx?page=189)  
707-431-3317

### Petaluma

[www.cityofpetaluma.net/wrcd/waterconservation.html](http://www.cityofpetaluma.net/wrcd/waterconservation.html)  
707-778-4507

### Rohnert Park

[www.ci.rohnert-park.ca.us/index.aspx?page=538](http://www.ci.rohnert-park.ca.us/index.aspx?page=538)  
707-585-6750

### Santa Rosa

[www.srcity.org/departments/utilities/conserve/pages/default.aspx](http://www.srcity.org/departments/utilities/conserve/pages/default.aspx)  
707-543-3985

### Sebastopol

[ci.sebastopol.ca.us/page/water-conservation-incentives](http://ci.sebastopol.ca.us/page/water-conservation-incentives)  
707-823-8597

### Sonoma

[www.sonomaconserves.org/](http://www.sonomaconserves.org/)  
707-933-2247

### Sonoma County Water Agency

[www.scwa.ca.gov/conservation/](http://www.scwa.ca.gov/conservation/)  
707-526-5370

### Valley of the Moon Water District

[www.vomwd.com/conservation.php](http://www.vomwd.com/conservation.php)  
707-996-1037

### Windsor

[www.townofwindsor.com/index.aspx?nid=100](http://www.townofwindsor.com/index.aspx?nid=100)  
707-838-5357

## PROFESSIONAL ASSOCIATIONS

### American Rainwater Catchment Systems Association

Offers training, calendar listings, general information and resources

[www.arcsa.org](http://www.arcsa.org)  
512-617-6528

### California Stormwater Quality Association

Provides storm water BMP's and factsheets geared towards professionals

[www.casqa.org](http://www.casqa.org)  
650-366-1042

### Center for Watershed Protection

Provides a wide variety of information and educational resources

[www.cwp.org](http://www.cwp.org)  
410-461-8323

### Envirocert International Inc.

Provides a directory of certified professionals in erosion and sediment control

[www.cpsc.org](http://www.cpsc.org)

### International Erosion Control Association

Lists educational opportunities, calendar events, resources, and a directory of professionals

[www.ieca.org](http://www.ieca.org)

## WEBSITES

### ATTRA/NCAT

Offers several publications for agriculture on water, soil, and energy management/conservation

[www.attra.ncat.org/water\\_quality.html](http://www.attra.ncat.org/water_quality.html)

### California Agricultural Water Stewardship Initiative (CAWSI)

In depth information and case studies on agricultural water management and conservation

[www.agwaterstewards.org/index.php/practices](http://www.agwaterstewards.org/index.php/practices)

### Greywater Action

[www.greywateraction.org](http://www.greywateraction.org)

### Harvest Water

Articles, information and directories for rainwater harvesting

<http://www.harvesth2o.com/>

### Holy H2O

Providing information on local options to reuse & conserve water

[www.holyh2o.org](http://www.holyh2o.org)

### International Rainwater Catchment Systems Association

Factsheets on rainwater harvesting

[www.eng.warwick.ac.uk/ircsa/factsheets.htm](http://www.eng.warwick.ac.uk/ircsa/factsheets.htm)

### Oasis Design

Offering information, publications, and products for gray water, rainwater harvesting, and systems approaches

[www.oasisdesign.net](http://www.oasisdesign.net)

### Portland Downspout Disconnect Program

Information on urban based stormwater management

[www.portlandoregon.gov/bes/54651](http://www.portlandoregon.gov/bes/54651)

### Rainwater Harvesting for Drylands and Beyond

Factsheets and resources on a variety of water conservation techniques

[www.harvestingrainwater.com](http://www.harvestingrainwater.com)

### Rainwater Harvesting Guide

Providing information on various water catchment strategies and links to more resources

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

### Salmon Creek Watershed Council

Offering a variety of water management information for rural landowners

[www.salmoncreekwater.org/conservation-strategies.html](http://www.salmoncreekwater.org/conservation-strategies.html)

### San Francisco Public Utilities Commission

In depth resource guides and information

### Graywater Design Manual

[www.sfwater.org/modules/showdocument.aspx?documentid=55](http://www.sfwater.org/modules/showdocument.aspx?documentid=55)

### Rain Harvesting

[www.sfwater.org/index.aspx?page=178](http://www.sfwater.org/index.aspx?page=178)

### Stormwater Design Guidelines

[www.sfwater.org/index.aspx?page=446](http://www.sfwater.org/index.aspx?page=446)

# RESOURCES GUIDE

## **Sonoma County Water Agency**

[www.scwa.ca.gov/conservation](http://www.scwa.ca.gov/conservation)

## **Russian River Watershed Association**

Information and guides on stormwater management and landscaping in Sonoma County  
[www.rrwatershed.org](http://www.rrwatershed.org)  
707-666-4857

## **Sonoma County Energy Independence Program**

Can offer financing for water tanks in Sonoma County via your tax bill  
[www.sonomacountyenergy.org](http://www.sonomacountyenergy.org)  
707-565-6470

## **PUBLICATIONS/BOOKS**

### **ARCSA bookstore**

Books and manuals on rainwater harvesting  
<https://arcsa.site-ym.com/?page=254>

### **Creating Rain Gardens: Capturing the Rain for Your Own Water-Efficient Garden**

[www.timberpress.com/books/creating\\_rain\\_gardens/woelfle-erskine/9781604692402](http://www.timberpress.com/books/creating_rain_gardens/woelfle-erskine/9781604692402)

### **Groundwork: A Handbook for Small-Scale Erosion Control in Coastal California**

[www.consrv.ca.gov/dlrp/RCD/Documents/Erosion%20Control/Groundwork\\_4-18.pdf](http://www.consrv.ca.gov/dlrp/RCD/Documents/Erosion%20Control/Groundwork_4-18.pdf)

### **Handbook for Forest and Ranch Roads**

[www.mrcrd.org/wp-content/uploads/Handbook\\_for\\_Forest\\_Ranch&Rural\\_Roads.pdf](http://www.mrcrd.org/wp-content/uploads/Handbook_for_Forest_Ranch&Rural_Roads.pdf)

### **Santa Rosa and Sonoma County Stormwater Manual**

[http://www.ci.santa-rosa.ca.us/doclib/Documents/LID\\_ManualFinalUpdateOct12.pdf](http://www.ci.santa-rosa.ca.us/doclib/Documents/LID_ManualFinalUpdateOct12.pdf)

### **The Texas Manual on Rainwater Harvesting**

[www.twdb.state.tx.us/publications/brochures/conservation/doc/RainwaterHarvestingManual\\_3rdedition.pdf](http://www.twdb.state.tx.us/publications/brochures/conservation/doc/RainwaterHarvestingManual_3rdedition.pdf)

## **CONTRACTORS AND CONSULTANTS**

### **Allwest Construction**

Integrating storm water management features into construction projects  
<http://www.allwest.us/>  
707-732-6011

### **BlueBarrel Rainwater Catchment Systems**

Design and install small tank rain harvesting systems  
[www.bluebarrelsystems.com](http://www.bluebarrelsystems.com)

### **Carlile Macy**

Offers design, permitting and project implementation services for water and land management  
[www.carlilemacy.com](http://www.carlilemacy.com)  
707-542-6451

### **Ecological Concerns-Bobby Markowitz**

Design and consultation for rainwater harvesting  
[www.ecologicalconcerns.com/services/ecological-landscapes/rainwater-harvesting/](http://www.ecologicalconcerns.com/services/ecological-landscapes/rainwater-harvesting/)  
831-459-0656

### **Elder Creek Landscapes**

Landscape design with expertise in stormwater management  
[www.eldercreeklandscapes.com](http://www.eldercreeklandscapes.com)  
707-827-7913

### **Harmony Farm Supply**

Rainwater harvest system design  
[www.harmonyfarm.com/services](http://www.harmonyfarm.com/services)  
707-823-9125

### **Prunuske Chatham Inc.**

Offers design, permitting and project implementation services for water and land management  
[www.pcz.com](http://www.pcz.com)  
707-824-4600

### **RH and Sons**

Rainwater tank and irrigation system installation  
[www.rhsons.com](http://www.rhsons.com)  
800-675-3569

## **WaterSprout**

Can assist with developing systems for grey water, rainwater catchment, and monitoring  
[www.watersprout.org](http://www.watersprout.org)  
888-556-3669

## **Wonderland Inc.**

Design, consultation, and implementation for rainwater harvesting  
[www.wonderlandinc.net](http://www.wonderlandinc.net)  
530-926-9911

These landscaping based businesses specialize in design and installation for stormwater management, rain gardens, and water catchment

## **Christopher Reamer Permaculture Design/Build**

[www.gotothegarden.com](http://www.gotothegarden.com)  
415-298-2442

## **Community Soil**

[www.communitysoil.com](http://www.communitysoil.com)  
707-889-1744

## **Equinox**

[www.equinox-landscape.com](http://www.equinox-landscape.com)  
707-789-9786

## **Permaculture Artisans**

[www.permacultureartisans.com](http://www.permacultureartisans.com)  
707-824-0836

## **Sentient Landscape Inc.**

[www.sentientlandscape.com](http://www.sentientlandscape.com)  
707-829-3655

## **LANDSCAPER DIRECTORIES**

### **Bay Friendly Landscaping and Gardening Coalition**

[www.bayfriendlycoalition.org/QPdirectory.php](http://www.bayfriendlycoalition.org/QPdirectory.php)

### **California Landscape Contractors Association**

[www.member-clca.org/max/4DCGI/directory/contractor/index.html](http://www.member-clca.org/max/4DCGI/directory/contractor/index.html)

## **Qualified Water Efficient Landscaper Program**

Directory of landscapers who have completed and received certification for the Qualified Water Efficient Landscaper program  
[www.qwel.net](http://www.qwel.net)

## **LARGE STORAGE TANKS PURVEYORS**

### **American Tank Co. Inc.**

[www.watertanks.com](http://www.watertanks.com)  
1-877-655-1100

### **Harmony Farm Supply**

[http://www.harmonyfarm.com/search.php?search\\_query=tanks&x=0&y=0](http://www.harmonyfarm.com/search.php?search_query=tanks&x=0&y=0)  
707-823-9125

### **National Storage Tank**

[www.nationalstoragetank.com](http://www.nationalstoragetank.com)  
707-537-7433

### **Glazier and Glazier Builders Inc.**

Concrete tank construction and permitting  
[www.facebook.com/pages/Water-Tanks-by-Glazier-Glazier-Builders-Inc/366713200090559](https://www.facebook.com/pages/Water-Tanks-by-Glazier-Glazier-Builders-Inc/366713200090559)  
707-792-9292

### **Superior**

[www.superiortank.com](http://www.superiortank.com)  
661-392-0188

## **SMALL AND NON-TANK STORAGE ALTERNATIVES**

### **Cudo Water Storage System**

[www.kristar.com/index.php/stormwater-retention-detention/cudo-water-storage-system/45-products/stormwater-retention-detention](http://www.kristar.com/index.php/stormwater-retention-detention/cudo-water-storage-system/45-products/stormwater-retention-detention)  
800-579-8819

### **Invisible Structures Inc.**

[www.invisiblestructures.com/rainstore3.html](http://www.invisiblestructures.com/rainstore3.html)  
800-233-1510

### **Rainwater Hog**

[www.rainwaterhog.com](http://www.rainwaterhog.com)

# RESOURCES GUIDE

## RAINWATER CATCHMENT SUPPLIES AND ACCESSORIES

### Aquabarrel

[www.aquabarrel.com](http://www.aquabarrel.com)  
301-253-8855

### Bushman

*Sell tanks and related accessories*  
[www.bushmanusa.com](http://www.bushmanusa.com)  
866-920-8265

### Carson Manufacturing Co.

*Specialize in liners for tanks and ponds*  
[www.carsonliners.com](http://www.carsonliners.com)  
800-423-2380

### Friedman's

*Stores in Santa Rosa, Petaluma, Sonoma, and Ukiah*  
[www.friedmanshome.com](http://www.friedmanshome.com)

### Rain Harvest Systems

[www.rainharvest.com](http://www.rainharvest.com)

### Rain Harvesting

[www.rainharvesting.com](http://www.rainharvesting.com)

### Rutland Gutter Supply

[www.rutlandguttersupply.com/downspout.asp](http://www.rutlandguttersupply.com/downspout.asp)  
407-859-1119

### Urban Farmer Store

*Stores in Mill Valley, Richmond, and San Francisco*  
[www.urbanfarmerstore.com/pdflibrary/rainwater-harvesting](http://www.urbanfarmerstore.com/pdflibrary/rainwater-harvesting)

## REGIONAL RAIN GARDEN PLANT LISTS

### California Native Plant Society

<http://milobaker.cnps.org/index.php/native-plants/gardening-with-natives>

### Sonoma County Master Gardeners

[www.ucanr.edu/sites/scmg/files/122827.pdf](http://www.ucanr.edu/sites/scmg/files/122827.pdf)

### WATER Institute

[www.oaecwater.org/integrated-stormwater-retention-system](http://www.oaecwater.org/integrated-stormwater-retention-system) page 12

## NATIVE PLANT AND COVER CROP SOURCES

### Buckeye Nursery

[www.buckeye-nursery.com](http://www.buckeye-nursery.com)  
2425 Adobe Road  
Petaluma  
707-559-7081

### California Flora Nursery

[www.calfloranursery.com](http://www.calfloranursery.com)  
2990 Somers Street  
Fulton  
707-528-8813

### Delta Bluegrass

*California native grass sod, biofiltration grasses, etc.*  
[www.deltabluegrass.com/blendselectionguide](http://www.deltabluegrass.com/blendselectionguide)  
Stockton  
209-469-7979

### LeBallisters Seed

*Bulk cover crop seed*  
[www.leballistersseed.com](http://www.leballistersseed.com)  
1250 Sebastopol Road  
Santa Rosa  
707-526-6733

### Mostly Natives

*Closed in Winter*  
[www.mostlynatives.com](http://www.mostlynatives.com)  
27235 Highway One, Tomales  
707-878-2009

### North Coast Native Nurseries

[www.northcoastnativenursery.com](http://www.northcoastnativenursery.com)  
2700 Chileno Valley Road  
Petaluma  
707-769-1213

## LOCAL IRRIGATION SUPPLY STORES

*Purveyors of drip and water efficient supplies*

### Dripworks

*Catalog and online*  
[www.dripworks.com](http://www.dripworks.com)  
800-522-3747

### Harmony

[www.harmonyfarm.com](http://www.harmonyfarm.com)  
3244 Gravenstein Hwy North  
Sebastopol  
707-823-9125

### Horizon

<http://www.horizononline.com/>  
238 Todd Rd  
Santa Rosa  
707-584-7272

### Wyatt

*Stores in Santa Rosa, Petaluma, Napa, Ukiah*  
[www.wyattsupply.com](http://www.wyattsupply.com)  
747 Yolanda Ave.  
Santa Rosa  
707-578-3747

## GENERAL INFORMATION ON WATER CONSERVATION

### Alliance for Water Efficiency

[www.allianceforwaterefficiency.org](http://www.allianceforwaterefficiency.org)

### Cal Urban Water Conservation Council

[www.cuwcc.org](http://www.cuwcc.org)

### Save Our Water

*Hosted by DWR/Assoc. Cal. Water Agencies*  
[www.saveourh2o.org](http://www.saveourh2o.org)

### Sonoma-Marin Water Saving Partnership

[www.savingwaterpartnership.org](http://www.savingwaterpartnership.org)

### Water Education Foundation

[www.watereducation.org](http://www.watereducation.org)

### Water House

*Hosted by CUWCC/USEPA*  
[www.h2ouse.org](http://www.h2ouse.org)

### Water Sense

*Hosted by USEPA*  
[www.epa.gov/watersense](http://www.epa.gov/watersense)



**Sonoma Resource Conservation District**

(707) 569-1448

[www.sonomarcd.org](http://www.sonomarcd.org)



Printed on paper partially consisting of recycled post-consumer waste