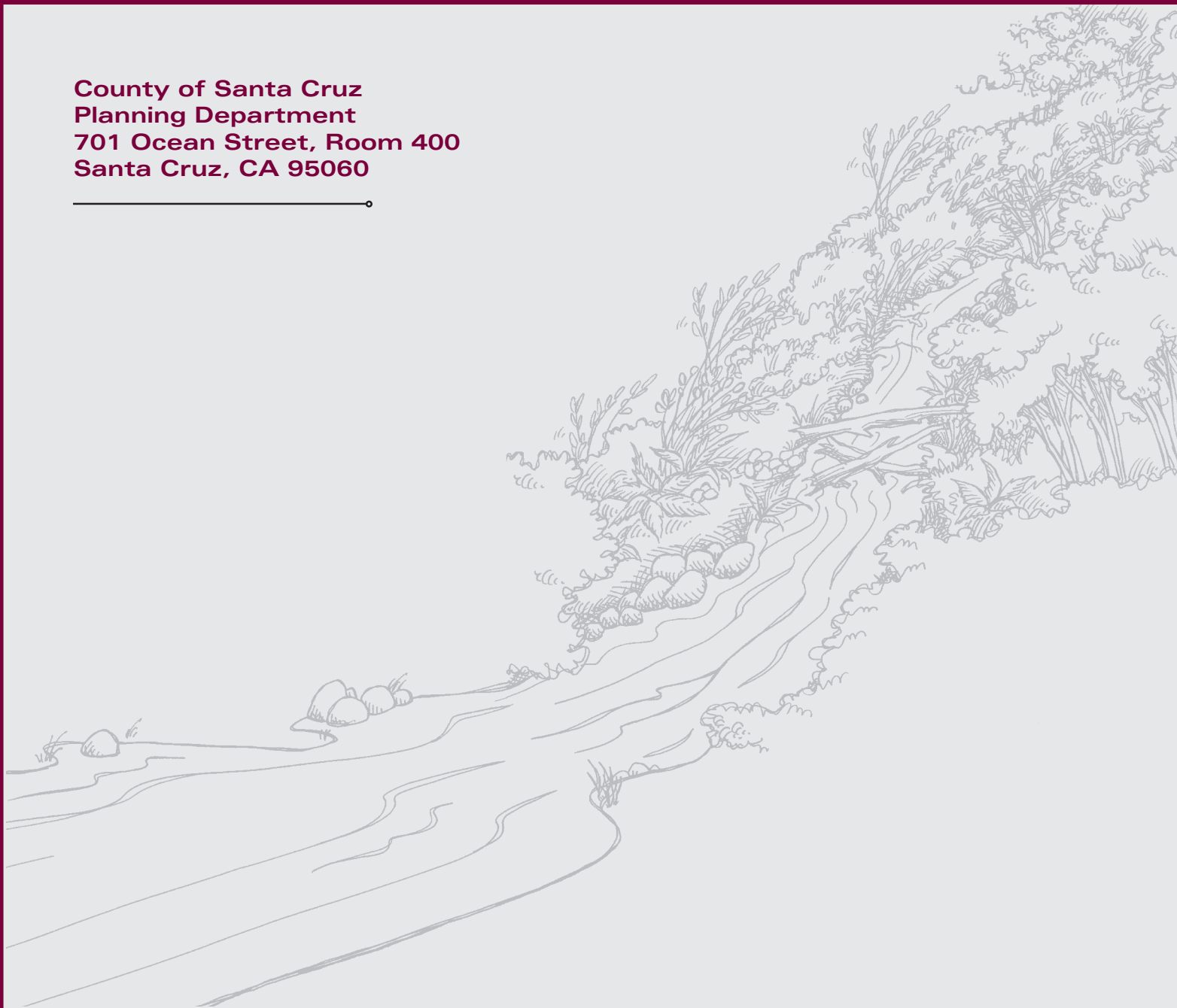
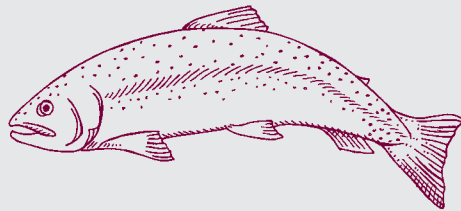


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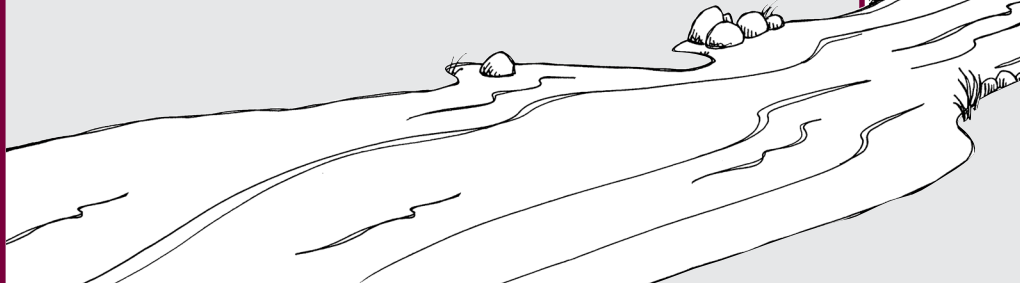
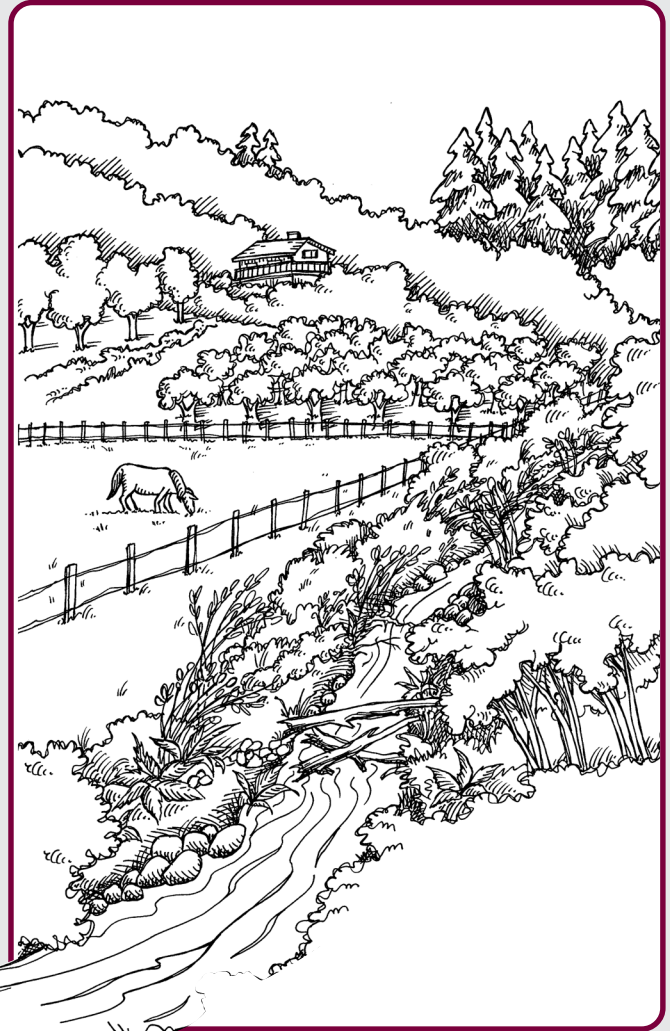
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**Santa Cruz County**



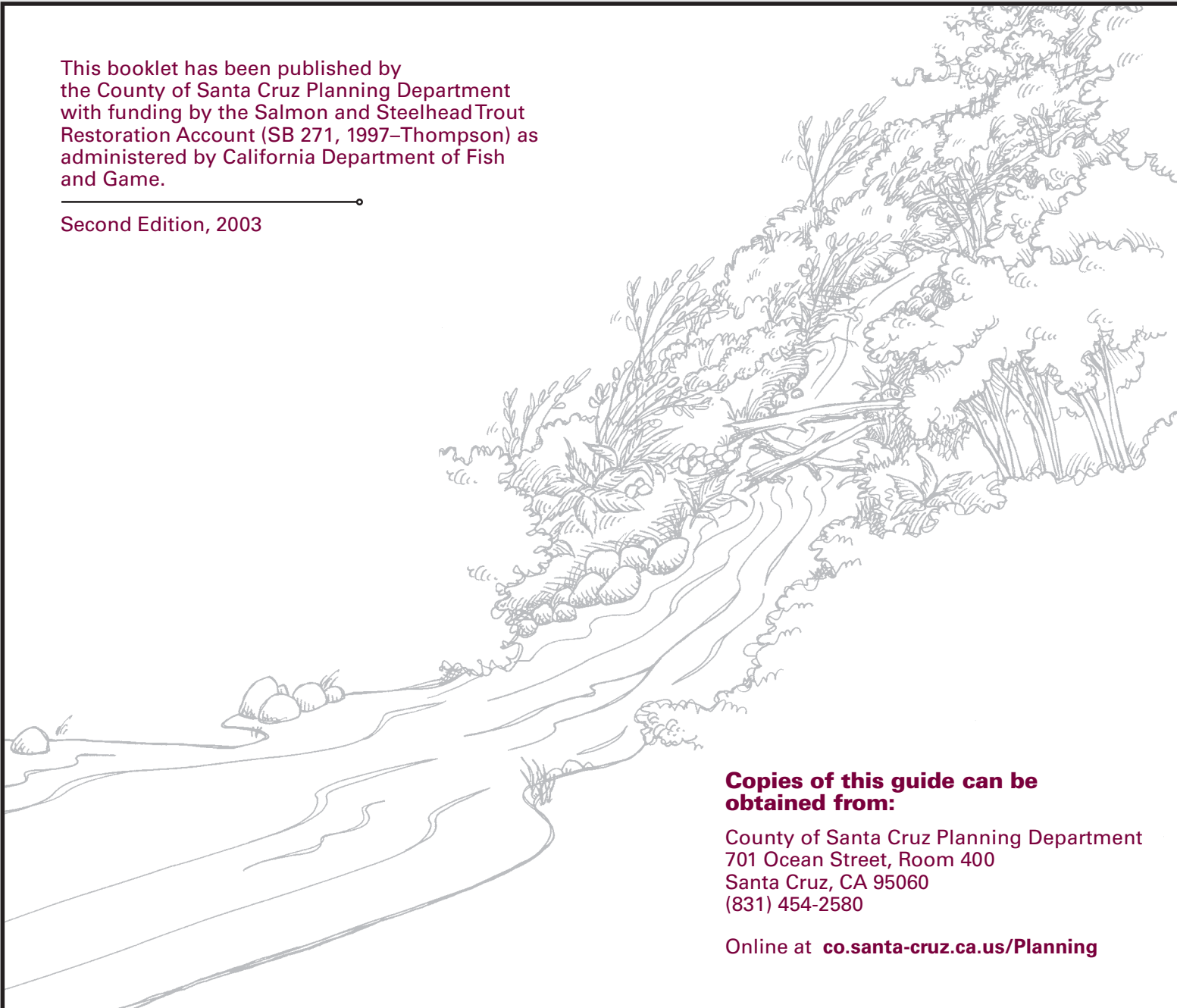
**Stream Care  
Guide**



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County of Santa Cruz Planning Department  
701 Ocean Street, Room 400  
Santa Cruz, CA 95060  
(831) 454-2580

Online at [co.santa-cruz.ca.us/Planning](http://co.santa-cruz.ca.us/Planning)

**Compiled and Written by:**

Jennifer Michaud and Liza Prunuske,  
Prunuske Chatham, Inc. and  
Kristen Schroeder, County of Santa Cruz  
Planning Department

**With contributions by:**

Kathy Lyons, Biotic Resources Group,  
Bryan Mori, Wildlife Biologist, and  
Kelli Camara, Natural Resources  
Conservation Service.

**Graphic Design and Illustration:**

Lisa Krieshok

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## Introduction

Streams, from large rivers to small creeks, touch the lives of every Santa Cruz County resident. More than 770 miles of waterways flow through the County, so no one lives very far from a creek, stream, or river. By providing water supply, wildlife habitat, flood capacity, and aesthetic and recreation values, our waterways comprise an invaluable resource—but one that can be easily damaged by careless actions or improper land use.

Since most streamside acreage is in private ownership, much of the responsibility for the life and health of our streams lies with you, the streamside resident or property owner. Proper management of your stream bank and its vegetation can prevent or minimize erosion, preserve water quality, contribute to the survival of the area's fish and wildlife, help avoid flood losses, and protect property values.

The principles of proper stream care are simple, but they require your active participation. This booklet seeks to stimulate that participation and to guide you in your stream stewardship. With a little care, you can preserve and enhance your streamside environment and protect Santa Cruz County's heritage of productive streams, flowing free and clear.

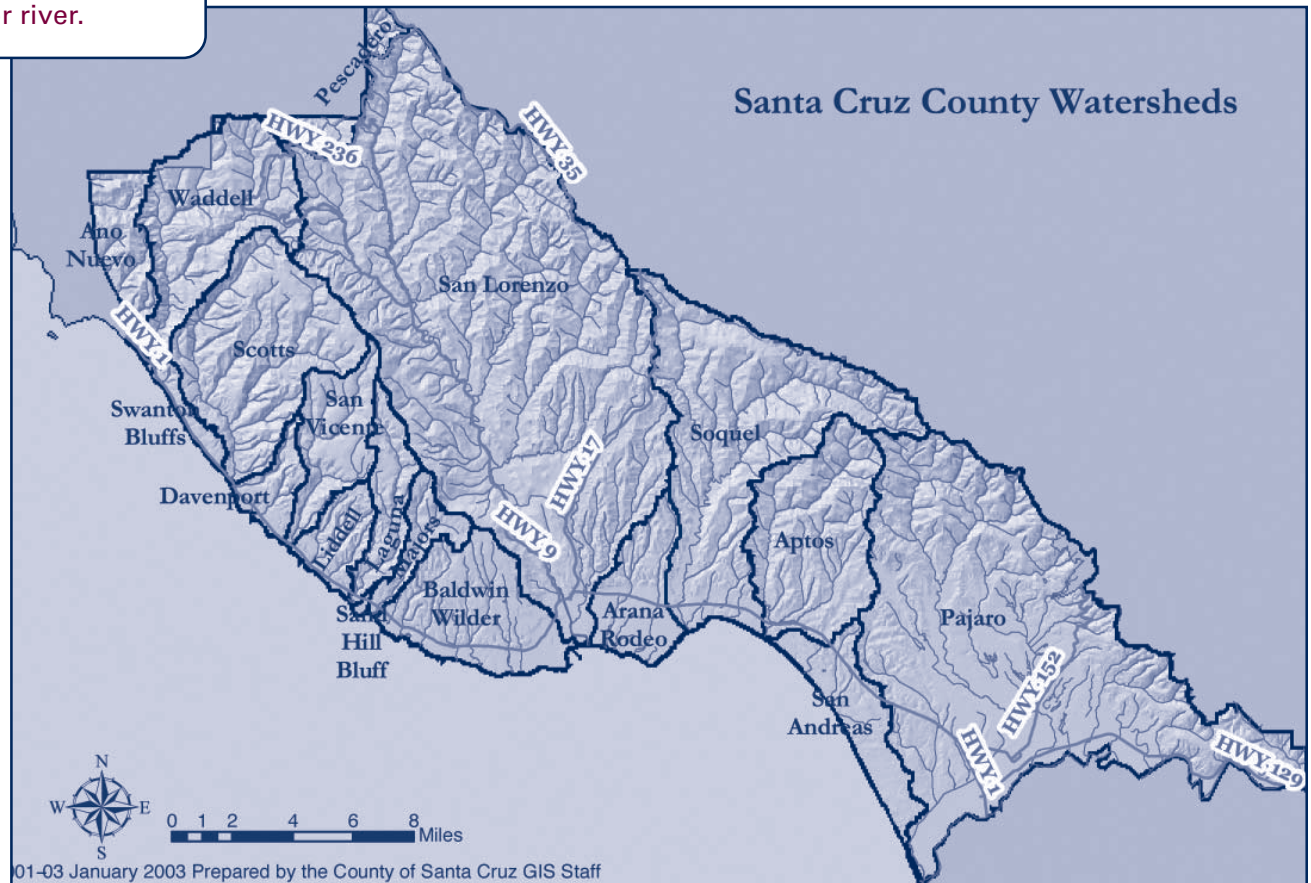


## Santa Cruz County Watersheds

Everyone lives within a watershed. A watershed comprises all of the land that drains into a distinct stream, creek, or river system. All Santa Cruz County watersheds drain to Monterey Bay and the Pacific Ocean.

**Watershed** – all of the land and subsurface groundwater that drains to a particular point along a stream or river.

Major watersheds in Santa Cruz County include the San Lorenzo River, Waddell, Scotts, Soquel and Aptos creeks, and the Corralitos and Salspuedes subbasins of the Pajaro River. Smaller watersheds in the County include Arana Gulch, Rodeo Gulch and the North Coast streams—San Vicente, Liddell, Laguna, Baldwin and Wilder creeks.



## Table of Contents

Introduction .....	1
Santa Cruz County Watersheds .....	2
The Living Stream .....	4
Our Local Streams .....	5
Fish Facts .....	6
The Riparian Corridor .....	7
Use Native Riparian Plants .....	8
Avoid Non-Native Plants in the Riparian Corridor .....	9
Riparian Wildlife .....	10
Managing Woody Material .....	11
Erosion Control .....	12
Common Practices to Control Erosion .....	13-14
Streambank Erosion Prevention and Solutions .....	14
Planting Willows for Bank Protection .....	15
Fish Passage Barriers .....	16
Temporary or “Flashboard” Dams .....	16
Water Diversions .....	17
Horse Keeping for Healthy Streams .....	18
The Storm Drain Connection .....	19
Home Maintenance Tips .....	20-21
Regulations .....	22
Resources .....	23
Regulatory Agencies .....	23
Native Plant Nurseries .....	24



## The Living Stream

**Riparian habitat** – the area adjacent to a stream together with the plant and animal community it supports.

A stream is more than just a channel for rainwater in its passage to the ocean. It is a complex, living system where the characteristics of the stream bed—its composition, shape, and elevation drop—interact with the dissolved nutrients and organic matter in flowing water to create a dynamic environment rich with plant and animal life.

Streams reflect what is happening on the surrounding land. A healthy stream will have:

- cool, clear oxygen-rich water free of pollutants and excess algae
- gravel and cobble without too much sand and silt for aquatic insect production and fish spawning
- a balance of fast water riffles for aquatic insects, fish spawning and feeding, and pool habitats as cover and refuge from high flows
- abundant woody material to provide habitat and cover for aquatic and riparian species, and to scour pools
- adequate summer streamflow
- lush streamside vegetation to stabilize banks and provide shade and food for wildlife

The health of the stream environment depends on several physical factors: water quality; water temperature; the amount of sunlight reaching the stream; the character of the stream bottom (whether bedrock, boulder, gravel, sand, or fine silt); and the volume and timing of water flowing through the stream. Human activities can influence all of these.

Riparian habitats cover only about 1 percent of the County's watersheds, but provide food and shelter for a great variety of wildlife. This zone is also critical as a migration corridor for many animals, especially where nearby upland development can be a barrier to overland travel.

Coastal streams are also important for the tidally-influenced lagoons in the lower portions of the watershed. These highly productive ecosystems depend on high quality freshwater and adequate stream flows. In turn, healthy streams and lagoons benefit the health of our coastal marine waters including the Monterey Bay National Marine Sanctuary, one of the most biologically diverse marine ecosystems in the world.



## Our Local Streams

Santa Cruz County streams are home to a wide variety of native fish, plants and wildlife. Our local streams support native fishes that include steelhead, coho salmon, Pacific lamprey, Sacramento sucker, prickly sculpin, three-spine stickleback, and California roach. Santa Cruz County streams also support other sensitive wildlife species such as the California red-legged frog, foothill yellow-legged frog, and western pond turtle.

Steelhead trout are found in the San Lorenzo, Arana, Soquel, Aptos and Pajaro River watersheds, and several north coast streams including Waddell, Scotts, and San Vicente creeks. Small remnant runs of coho salmon exist in Waddell, Scotts, and San Vicente creeks.

Steelhead populations have declined from historic levels for many reasons including past and current water diversions, road building, urbanization, forestry practices, channelization, hatchery practices, removal of large wood, and degradation of riparian areas. Steelhead and coho salmon are protected currently under the Federal and State Endangered Species Act.

Reduced streamflows and fine sediments, especially sand, are the greatest threats to Santa Cruz County streams. Reduced streamflows from both surface diversions and groundwater extraction reduce the quantity and quality of instream habitat. Fine sediments from accelerated erosion clog spawning gravels and fill rearing habitats for steelhead and coho salmon.

## Common Stream Concerns

- **Excessive soil erosion** reduces drinking water quality, diminishes fish habitat by filling in pools, reduces insect abundance, smothers fish eggs in the gravel, and reduces a stream's ability to carry flood waters.
- **Stream diversions** reduce flows thereby lowering the quality and quantity of summer rearing habitat for steelhead and other native fishes.
- **Removal of woody material** decreases cover habitat for fish and other wildlife and can alter pool development.
- **Loss of habitat** can occur from the removal of native plants or the construction of wooden or concrete walls along stream banks.
- **Impervious (or hard) surfaces** such as roofs and roads lessen the amount of water that soaks into the soil for groundwater recharge. This can increase flooding and lead to erosion problems.
- **Bare, unstable stream banks** with little or no plants contribute to bank erosion and do not provide shade or wildlife cover.
- **Excess nutrients** from manure, fertilizer, or septic systems can cause algae to grow at a high rate. Too much algae can use up oxygen in the water—stressing or killing fish.
- **Pollutants** such as metals, pesticides, sewage, oil, yard waste, trash, and construction debris harm fish, wildlife and their habitats. Excess landscape irrigation, household greywater, swimming pool or spa water are also considered to be pollutants.
- **Warm water** (>60° F) without adequate food sources can stress fish. Water over 75° F can kill both steelhead and coho salmon.

Although most local streams have been degraded by human impacts to some degree, many residents, community groups, and agencies have come together to reverse this trend. Your stewardship of creek habitats on your property will aid in these efforts.



## Fish Facts

### Steelhead and Coho Salmon Life Cycles

#### Steelhead and Salmon Habitat Requirements

- Access to spawning areas.
- Clean spawning cobble and gravels without fine sediments.
- A year-round supply of cool, well-oxygenated water.
- Diverse habitat with deep, quiet pools and shallow rocky areas (riffles).
- Relatively stable creek banks.
- Dense shade canopy from streamside vegetation to cool water, provide insect habitat, and contribute nutrients.
- Lots of woody material from fallen trees, rootwads and large branches.
- Adequate food supply—mostly insects.
- Lots of cover—undercut banks, rocks, tree roots, surface turbulence, overhanging creekside vegetation, deep quiet pools, and woody material—for refuge from predators and fast storm flows.

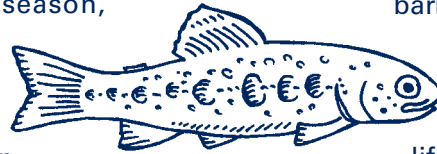
Steelhead and coho salmon are anadromous fish—they spawn in freshwater and mature in the ocean. Steelhead that never enter the ocean and remain in freshwater streams are called rainbow trout.

Adult steelhead migrate upstream from the ocean during the rainy season, and spawn anytime from November to June. Steelhead and coho salmon enter local streams only when sufficient streamflow has opened coastal lagoons through which the stream drains to the ocean. Steelhead spawn (mate and lay eggs) typically at the downstream edge of pools where cover habitat exists nearby for predator protection. Eggs are laid in a depression called a redd

dug into cobble or gravel substrate. Unlike salmon, steelhead can migrate out to the ocean after spawning and return in subsequent years to spawn again. Eggs hatch in 30-60 days, depending on stream temperatures. The newly hatched fish—called alevins—stay in the gravel for a few additional weeks, until their yolk sac is absorbed. When they emerge,

they seek slow-water areas, often at stream edges. As they grow bigger, the young fish—called juveniles—move into faster water to feed on drifting insects.

Juvenile steelhead remain in freshwater streams from 1 to 3 years, depending on their rate of growth. Rearing juveniles have many habitat requirements. Most importantly they need sufficient, cool streamflow to transport drifting insects for feeding, and cover habitat such as undercut banks, woody material, boulders, and deep pools to hide from predators and have refuge during high flows. When juveniles are large enough, they migrate out to the ocean as “smolts.” During this out-migration, steelhead and salmon need adequate streamflow to swim past barriers, and cover for predator protection.



Coho salmon have a similar, but more rigid lifecycle, than steelhead. Coho salmon spend their first year in freshwater streams, migrate out to sea where they mature for two years, and return to their native freshwater streams to spawn and die. Because all non-hatchery females are three years old, coho salmon develop three consecutive “year classes” in each stream. Since coho salmon are at the southern distribution of their range in Santa Cruz County, they are vulnerable to extreme environmental conditions such as droughts, floods, and the timing of winter storms, which affects when the sandbar opens for upstream migration and affects the survival of redds and juveniles.

Large climatic cycles affect not only the timing and intensity of winter storms, but also influence the survival and return of adult steelhead and coho salmon. While humans cannot control the weather or natural ocean conditions, we can protect and enhance the freshwater environment where these fish spawn and rear.



## The Riparian Corridor

The riparian corridor is the area adjacent to the stream that supports a plant and animal community adapted to flooding or wet conditions. Willows, alders, and cottonwoods are common riparian tree species. Redwood and Douglas fir often inhabit the riparian corridor, particularly in the upper reaches of the watersheds. All of these tree species contribute to bank stability, shade, undercut banks, and woody material within the stream. Understory plants, such as ferns and native blackberry, are also important components of the riparian ecosystem.

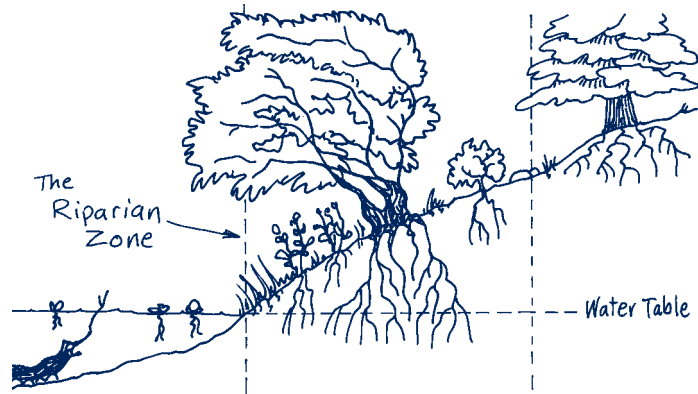
In the County of Santa Cruz, the riparian corridor is a protected habitat as defined by the Riparian Corridor and Wetlands Protection Ordinance (see page 22). For most properties, the protected riparian corridor is 50' from the bankfull flowline or the extent of riparian woodland.

Healthy streams need banks with undisturbed native vegetation. Riparian plants not only provide critical wildlife habitat, they also directly affect living conditions in the stream itself. Leaves and insects dropping from nearby trees and shrubs supply food for many aquatic animals, while plant roots stabilize the bank, preventing erosion.

Some streambank erosion is natural. Small areas of erosion can provide open areas for new tree seedlings to colonize. However, large areas of erosion can significantly degrade the habitat quality within the stream. Whenever possible, you should avoid "improving" your creekside area by mowing, clearing, or stripping vegetation. If you are considering altering your streambank vegetation, you

should first consult with the County, as a permit may be required (see page 22, the Riparian Corridor and Wetlands Protection Ordinance, for details).

In times of flooding, a well-vegetated streambank is your property's best protection from bank erosion. The plants growing there are uniquely adapted to surviving flood conditions, providing erosion protection at high flows, and recovering quickly when flood waters subside. The roots of riparian trees, especially willows, stabilize streambanks by holding the soil together with their strong roots.

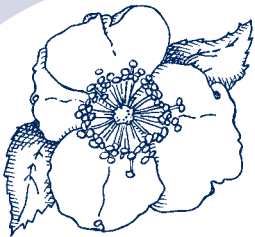


Riparian vegetation can also act as a sediment and nutrient filter, trapping silt from adjacent properties and absorbing most of the nutrients released by animals, fertilizers, and septic systems (60–95%). To be an effective filter, this zone of vegetation must be sufficiently wide, and the shrubs, vines, and grasses of the understory, not just the trees, must be present.



## Use Native Riparian Plants

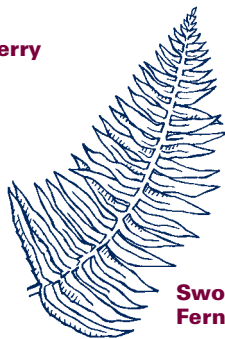
Only native species should be planted in a riparian corridor. These plants provide low maintenance, attractive landscaping as well as habitat for native wildlife. Local plants form the base of the food chain and are part of the complex web between insects, birds, fish, and other wildlife species. Native plants often require less water and are more resilient to insects and disease than many non-native ornamentals. When planted properly, native plants can also help prevent soil erosion.



California Rose



Coffeeberry



Sword Fern

Plants that occur naturally along a specific creek are adapted to local conditions and will be the easiest to grow. Contact your local native plant nursery to assist you in determining which plants are best suited for your area (see page 24). Your plants will have an increased chance of survival if you water them regularly during the dry season for the first 3 to 5 years, and weed regularly. Native trees and shrubs do not require fertilizers and pesticides.

When selecting plants for your riparian corridor, choose a variety of species including ground covers, shrubs, and trees. By planting a diversity of riparian plants you will create a more natural setting, which will benefit both aquatic and terrestrial species.



## Common Riparian Plants in Santa Cruz County

### Ground Covers:

- Sword Fern (*Polystichum munitum*)
- Chain Fern (*Woodwardia fimbriata*)
- California Blackberry (*Rubus ursinus*)
- Mugwort (*Artemisia douglasiana*)
- Alum Root (*Heuchera micrantha*)

### Shrubs:

- Blue Elderberry (*Sambucus mexicana*)
- California Rose (*Rosa californica*)
- California Huckleberry (*Vaccinium ovatum*)
- Thimbleberry (*Rubus parviflorus*)
- Coffeeberry (*Rhamnus californica*)
- Oregon Grape (*Mahonia aquifolium*)
- Pink Flowering Currant (*Ribes sanguineum* and *R. californicum*)
- Snow Berry (*Symphoricarpos albus*)
- Hazelnut (*Corylus cornuta*)

### Trees:

- Big Leaf Maple (*Acer macrophyllum*)
- California Bay Laurel (*Umbellularia californica*)
- Coast Redwood (*Sequoia sempervirens*)
- Douglas Fir (*Pseudotsuga menziesii*)
- Red Willow (*Salix laevigata*)
- Red Alder (*Alnus rubra*)
- Arroyo Willow (*Salix lasiolepis*)
- Box Elder (*Acer negundo*)
- Black Cottonwood (*Populus balsamifera* ssp. *trichocarpa*)
- Red Dogwood (*Cornus sericea*)
- Coast Live Oak (*Quercus agrifolia*)

## Avoid Non-Native Plants in the Riparian Corridor

Homeowners should avoid planting non-native plants within the riparian corridor. Non-native plants do not provide the same wildlife habitat or food value as native plants.

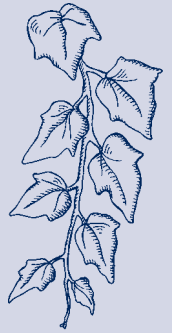
While many non-native plant species occur in the riparian areas of the County, only some of these species have invasive growth habits that degrade the value of the riparian ecosystem. Due to their vigorous growth, these plants often form dense monocultures, crowding out native species, and reducing the overall plant diversity of the habitat. The following list of species are those considered to be the most detrimental to riparian habitats and should be avoided.

If these species occur within the riparian habitat on your property, you are encouraged to remove and/or control their spread. Most species can be removed or controlled by hand or mechanical methods. If possible, the entire plant should be removed, including the roots (shrubs, groundcovers, and vines). Tree trunks and roots should be retained to prevent bank disturbances. Tree trunks and roots can be spot-treated with an

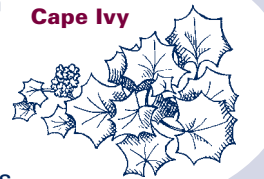
herbicide to reduce re-sprouting and suckering. Contact the UC Cooperative Extension for advice (see page 23) and follow herbicide labels exactly.

### Control of Ivies (English, Algerian, and Cape)

These three ivy species grow rapidly by underground runners and are found along most streams in the County. For small infestations among native plants, the vines can be removed by hand, although repeated efforts will be necessary. Where the vines grow into the tree canopy, they can be pulled down or cut away from the tree trunk, leaving the cut vines to die and decompose. If you have a large infestation with few native plants, you can hand-grub the ground to remove the above-ground plant and underground runners. Seed the grubbed areas with native perennial grasses to control erosion, and then re-plant with native riparian shrubs and trees. Due to their persistence, repeated efforts, including herbicides, may be required to successfully remove these species. **Since cape ivy and periwinkle can root from pieces, all plant parts should be put in plastic garbage bags and taken to the sanitary landfill. Other removed plants can be sent to the yard waste recycling program.**



English Ivy



Cape Ivy



Algerian Ivy

### Plant Species to Avoid:

#### Trees:

- Black Locust (*Robinia pseudoacacia*)
- Acacia, all species (*Acacia* sp.)
- Monterey Pine (*Pinus radiata*)
- Blue Gum Eucalyptus (*Eucalyptus globulus*)
- Tree-of-heaven (*Ailanthus altissima*)

#### Shrubs:

- French Broom (*Genista monspessulana*)
- Scotch Broom (*Cytisus scoparius*)
- Portuguese Broom (*Cytisus striatus*)

- Spanish Broom (*Spartium junceum*)
- Giant Reed (*Arundo donax*)
- Pampas Grass (*Cortaderia jubata* and *C. selloana*)

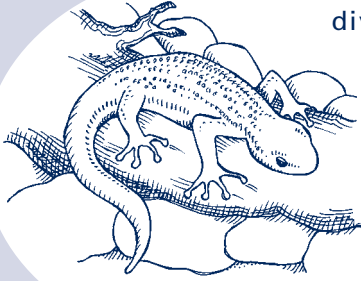
#### Groundcovers and Vines:

- Periwinkle (*Vinca major*)
- Poison Hemlock (*Conium maculatum*)
- Cape Ivy (*Delaireia odorata*) (previously known as German Ivy, *Senecio mikanoides*)
- English Ivy (*Hedera helix*)
- Algerian Ivy (*Hedera* sp.)

- Iceplant (*Carpobrotus edulis*)
- Italian Thistle (*Carduus pycnocephalus*)
- Harding Grass (*Phalaris* spp.)
- Mexican Eupatorium (*Ageratina adenophora*)
- Bull Thistle (*Cirsium vulgare*)
- Himalaya Berry (*Rubus procerus*)
- Wandering Jew (*Tradescantia* sp.)
- Garden Nasturtium (*Tropaeolum majus*)
- Forget-me-not (*Myosotis latifolia*)
- Hedge Bindweed (*Calystegia sepium*)



## Riparian Wildlife



California Newt

In California, riparian forests support the greatest diversity and abundance of wildlife species. Because of the available water and the complex vegetation structure, insects, birds, reptiles, mammals, and amphibians use the riparian forest for nesting, food, shelter, and as corridors for movement. Protecting and restoring riparian habitat is one of the most effective ways you can help wildlife.

### Riparian Habitat Protection Measures:

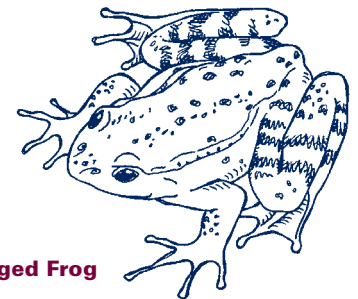
1. Protect and enhance the riparian vegetation on your property.
2. Unless there is a safety issue, keep your standing dead trees (snags) and dead limbs. Snags and dead limbs are important resources for cavity-nesting and roosting species, such as common mergansers, wood ducks, woodpeckers, chestnut-backed chickadees, bats, and other small mammals.
3. If you must remove a tree or a snag, do this work during the non-breeding season for birds (i.e., generally outside of the period from March 1<sup>st</sup>–August 1<sup>st</sup>).
4. Leave downed woody material on the streambank to provide cover and feeding areas for wildlife. If necessary for safety reasons, you can remove material during the non-breeding season.
5. Avoid clearing dense native understory vegetation to create open park-like areas. Understory vegetation provides foraging sites and concealment of ground nests.
6. Direct security lighting away from the riparian corridor to minimize disturbances to roosting and nocturnal wildlife, such as bats and owls.



### Local riparian wildlife species

California newt	Pacific-slope flycatcher
Pacific giant salamander	Warbling vireo
California red-legged frog	Swainson's thrush
Foothill yellow-legged frog	Yellow warbler
Green heron	Wilson's warbler
Common merganser	Song sparrow
Wood duck	Spotted towhee
Red-shouldered hawk	Black-headed grosbeak
Belted kingfisher	San Francisco dusky-footed woodrat
Downy woodpecker	Bobcat
Allen's hummingbird	Raccoon
American dipper	

7. Avoid planting invasive, non-native plant species, such as acacia, ivies, and periwinkle in your riparian area.
8. Do not release non-native wildlife, such as bullfrogs and exotic fish, into creeks. Avoid establishing non-native fish or wildlife populations in ponds.
9. To protect native birds and other wildlife, and to help reduce the County's feral cat population, participate in the County's spay and neuter program. Do not leave food outdoors that can attract feral animals.



California Red-legged Frog

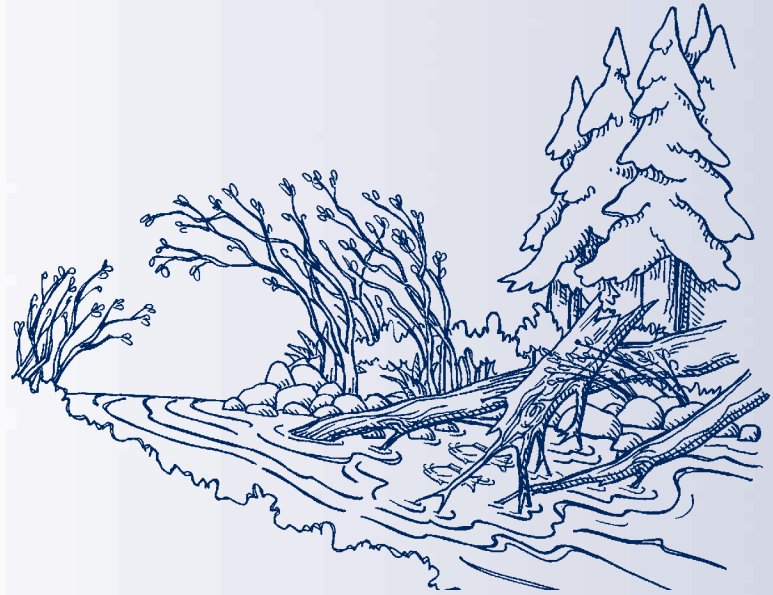
## Managing Woody Material

Large woody material in the creek—fallen logs, stumps, root wads, and large branches—provide an important source of cover, food, and shelter for fish and other stream dwellers. Areas of accumulated woody material have been found to support the highest number of juvenile steelhead and coho salmon in local streams. A moderate amount of such material can also provide natural protection for streambanks.

In cases where large woody material is causing rapid bank erosion by redirecting stream flow, or creating a flood hazard on your property, modification or removal of this material may be warranted. This work requires a consultation with the California Department of Fish and Game to ensure it is done properly without harming the stream. The County of Santa Cruz Public Works Department provides assistance with the assessment and modification of large woody material accumulations for flood control purposes.

Here are some important tips to keep in mind while managing woody material in and surrounding your stream:

- Woody material should be left in the creek. Lack of woody material can significantly limit habitat for steelhead and coho salmon in local streams.
- Woody material may need to be modified or removed if it causes flooding or erosion that threatens life or property, or speeds up natural erosion processes. In an emergency, you have the right to protect life and property, but must notify the California Department of Fish and Game within 2 weeks of starting a project. In a non-emergency, contact Fish and Game for advice and information about obtaining a permit.



- In an emergency, trim smaller branches that catch other material first. Otherwise, modify woody material so that trunks or root wads remain intact. Keep log lengths at least 1½ times the stream width.
- Most fish can swim through, under, or around log clusters or debris jams, especially during high flows. If you know that fish can't swim through a barrier, contact the California Department of Fish and Game.
- Brush, weeds, grass clippings, or other small material should not be thrown into a creek or dumped on creek banks where it can be washed away by the stream. This small material could create a debris jam or block a culvert which can cause flooding, erosion, or block fish passage.



## Erosion Control

Erosion and the movement of sediment through watercourses are natural processes that shape a stream and deliver nutrients and beneficial substrates to aquatic ecosystems. However, accelerated erosion, directly or indirectly caused by human disturbance, can overload a stream with sediment. Excessive sediment in the channel bed impairs water quality, reduces the stream's ability to carry flood waters, and causes or aggravates bank stability problems.

In local streams, excessive fine sediment, especially sand, is a primary factor limiting habitat for steelhead, coho salmon, and other aquatic species. Excess fine sediment degrades fish spawning and rearing habitat, and reduces aquatic insect habitat which diminishes food supplies for steelhead and coho salmon.

Erosion control efforts can prevent and minimize erosion and sedimentation in riparian corridors, upland areas and along streambanks. Your erosion control efforts should also focus on minimizing erosion from nearby roads, especially dirt roads.



### Basic Strategies for Preventing Soil Erosion:

- **Protect bare soil surfaces.** Native trees, shrubs and grasses, cover crops, or mulch (gravel, sterile straw, wood chips) hold the soil in place and allow water to soak into the soil. During construction, use sterile straw or erosion control fabrics to help protect exposed soils.
- **Minimize disturbing existing plants.** If plants are disturbed, such as for the removal of invasive, non-native species, replant the area with native plants as quickly as possible.
- **Identify natural drainages and steep slopes.** Do not obstruct natural flows; allow water to flow in natural drainages or sheet flow over the surface.
- **Maintain undisturbed buffers around natural drainages.**
- **Avoid concentrating water flows, unless absolutely necessary.** Protect water or pipe outlets by using carefully placed rock or an energy dissipater.
- **Know areas of concern, such as landslides and fill slopes.** Do not concentrate flow into these areas.
- **Check and fix drainage concerns such as gutters, roads, driveways.** Make sure drainage is released onto non-erosive surfaces .

## Common Practices to Control Erosion

The following practices can be used in riparian or upslope areas to prevent erosion or solve small erosion problems. Addressing large-scale erosion can be complicated, and mistakes can further aggravate the problems. For large erosion problems, you are encouraged to contact the local Natural Resources Conservation Service office, the County Planning Office, or a Certified Erosion and Sediment Control Specialist (see pages 23-24). The Natural Resources Conservation Service office can also answer questions and provide more information about the following erosion control practices.

### Seeding and Mulching

Seeding and mulching is a simple, inexpensive way to help protect the soil surface from the erosive force of storm water runoff. Native seeds can be easily applied to eroding surfaces by following the few steps outlined in "Seeding Tips."

Mulching, alone or after seeding, is also a common way to protect bare soil, unprotected slopes, unpaved roads, cutbanks, and other disturbed areas that have a high potential for erosion. Mulch is any material spread on the soil surface to 1) reduce runoff and erosion, 2) conserve moisture, 3) buffer temperature, 4) control weed growth, 5) protect seed, and 6) prevent compaction or crusting. Common mulches include: sterile barley straw, weed free rice straw (1 bale per 1,000 square feet), wood chips or shavings (2<sup>1</sup>/<sub>2</sub>–4<sup>1</sup>/<sub>2</sub>

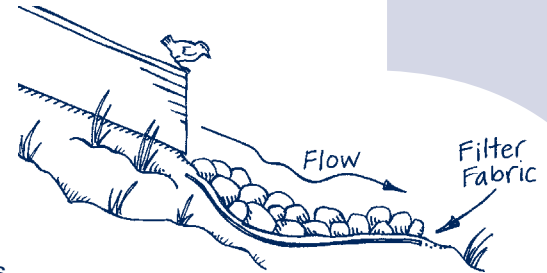
#### Seeding Tips

- 1) Lightly aerate compacted soils.
- 2) Apply a fertilizer approved for use near streams.
- 3) Broadcast seed by hand or with a seed broadcaster.
- 4) Lightly bury seed about 1/2" deep by passing over it with a rake.
- 5) Plant between September 15<sup>th</sup> and October 15<sup>th</sup> (supplemental irrigation will be needed if you plant before September 15<sup>th</sup>).

tons per square 10,000 feet), and pine needles (1/2 ton per 10,000 square feet). It is important to use weed-free or sterile straw to prevent the introduction of non-native plants. Remember if your layer of mulch is too thick, the seeds will not be able to germinate. If possible, avoid using erosion control blankets with plastic mesh which can entangle wildlife.

### Energy Dissipaters

Energy dissipaters are simple structures consisting of rock riprap, rock-filled containers, gabion mattresses, or other non-erosive materials, which prevent scouring at the outlet of a channel, drain, or other conduits by reducing the water velocity. The rock should be large and heavy enough that water cannot dislodge it and be underlain by filter fabric to prevent erosion beneath it.



**Energy Dissipater**

### Waterbars

A waterbar, also known as a waterbreak, is an easily built structure on paved or dirt roads. A series of waterbars decreases the velocity and erosive force of water by directing small amounts of road runoff to stable areas. On unpaved roads a waterbar consists of a shallow trench with a parallel berm or ridge on the down slope side. The waterbar is placed diagonally across a sloping road at pre-designed intervals to divert runoff to non-erosive locations.

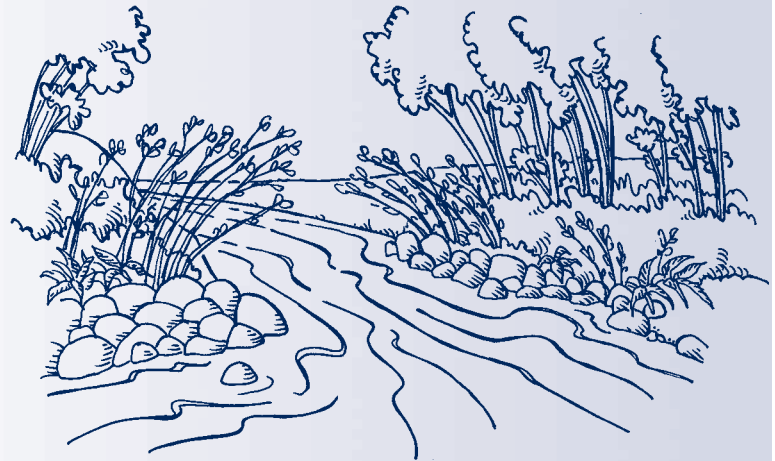


## Roadside Ditches

When roadside ditches are steep, undersized, not maintained properly, or filled with debris and rock, erosion and gullyng can occur. To minimize erosion problems, line the ditch with low growing vegetation or rock, install more frequent cross drains and culverts, and perform regular maintenance. Regular maintenance would include clearing cross drains, mowing and cutting vegetation, and addressing initial erosion.

## Native Plantings

Please see the Use Native Riparian Plants and Planting Willows sections of this guide for tips on how to use native plants to control for erosion.



**Vegetated Rock Slope Protection**

## Streambank Erosion Prevention and Solutions

- Remove debris and yard clippings dumped on the streambank. Loose brush and debris can kill existing bank-stabilizing vegetation, inhibit growth of vegetation and contribute to bank instability.
- Protect and enhance existing native vegetation.
- Plant native riparian vegetation, including hardwoods.
- Control over-bank flow, especially concentrated water runoff.
- Work with your neighbors. Bank protection can cause bank erosion downstream and upstream.
- Consider biotechnical solutions first that use plant material to stabilize banks.
- As a last resort, protect banks with structural devices such as rock slope protection interplanted with willow trees and other riparian species.
- Request your engineer to incorporate habitat enhancement features.

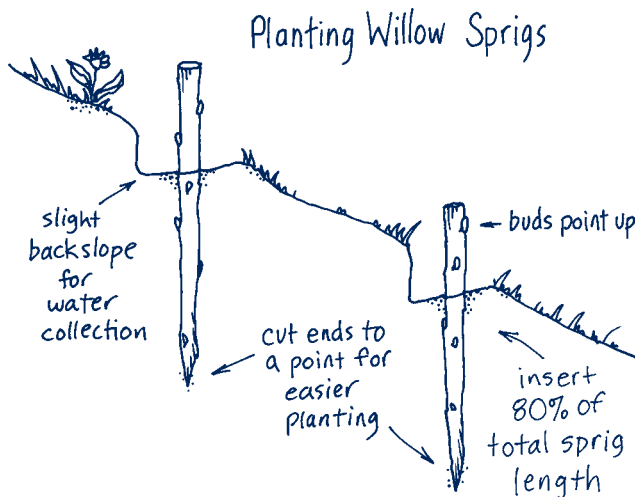


## Planting Willows for Bank Protection

Willows are an important component of a healthy riparian community. Historically, willows grew along most streams in California, and they still do. When planted properly, willows are an effective and inexpensive way to repair eroding streambanks and to provide important wildlife habitat.

Revegetating with willows is the easiest way to establish woody vegetation on a denuded creek bank. Willows need only sunshine and a year-round water supply; even if surface flows evaporate, groundwater may be close enough to the surface to support willows. Willows spread easily and respond well to heavy pruning.

Willow sprigs can be harvested and planted from dormant cuttings following these steps:

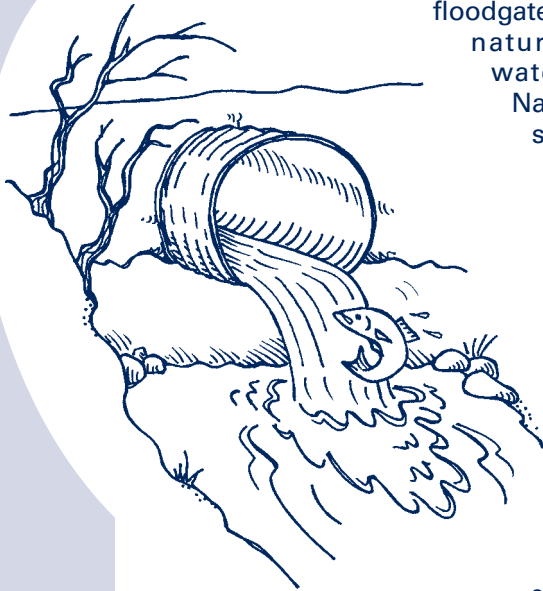


1. Willow sprigs should be collected and planted during the winter when the ground is soft and wet, and the willow plants are dormant (i.e., leaves are gone). In Santa Cruz County, willows are typically dormant in December and January. Planting in the winter ensures the willows will have plenty of time for the roots to become established before they sprout leaves in the spring.
2. Willow sprigs should be at least  $\frac{3}{4}$  inch in diameter, a minimum of 2-3 feet long, and stripped of all branches and leaves.
3. Willows should be planted right-side up. One almost-foolproof method is to point the planting end of the sprig right after it is cut from the tree. To give plenty of area for root growth, sprigs should be planted into the soil 75 to 80% of the length of the cutting. The top of sprigs should be angled slightly downstream to lessen the resistance to the flow of water.
4. Plant willows low enough on the bank to ensure adequate soil moisture during summer months. If planted too high on the bank, willows will dry out and die, even if stream or gullies have year-round water. If the willow sprigs can be irrigated for the first summer, plantings can be placed higher on the bank.
5. Try to plant more than one species of native willow. Some willows grow tall; others have a short, shrub-like form. Structural diversity greatly increases bird use. A dense growth of willow can also reduce infestations of invasive, non-native plant species.



## Fish Passage Barriers

A fish barrier is an obstacle that prevents or inhibits the natural migration of salmon, steelhead, and other native fish. These barriers typically include culverts, dams, weirs, and floodgates. Barriers also include natural features such as waterfalls and logjams. Natural and human-made



structures can create barriers when there is no pool at the downstream side for fish to jump from, the height is too high for fish to jump over, water velocities are too high, or the water depth is too shallow to swim through.

These barriers can also cause behavior changes in fish. Barriers can have a significant impact on native fish by restricting migration during spawning. As fish congregate at barriers, overcrowding increases the likelihood of stress, injury, and predation. Barriers also lead to the under-use of the habitat isolated by the barriers. Removal of human-made barriers will allow fish and other aquatic creatures to fully use the stream and swim freely throughout the watershed.

The removal of passage barriers is a priority for fishery restoration. Contact the California Department of Fish and Game or Santa Cruz County Resource Conservation District for technical assistance.



### Keep Lagoons Closed!

Breaching and draining a closed lagoon is illegal and can kill juvenile steelhead and coho salmon by flushing them out to the ocean before they are ready. If you see someone attempting to breach a lagoon, call the California Department of Fish and Game (888) 334-2258.

### Temporary or “Flashboard” Dams

Each year, many streamside residents erect small, seasonal dams to create temporary ponds or lakes for recreation, water diversion, or aesthetic purposes during the summer months. Most of these structures are “flashboard” dams, consisting of separate wooden boards set in a supporting frame.

The construction and use of a flashboard dam requires a permit from the California Department of Fish and Game and may require consultation with the National Marine Fisheries Service.

These dams can interfere with the downstream migration of steelhead and coho salmon smolts, fall-winter migration of adults, and summer movement of juveniles.

Flashboards should not be set in place before June 15<sup>th</sup> and should be removed by October 15<sup>th</sup> or after 1 inch of rain has fallen. In addition, flashboard dams should be assembled and removed slowly—one board at a time—to lessen their impact on the stream below the dam.

## Water Diversions

Pumping water from streams and wells reduces streamflow and affects the life of your stream in the most fundamental of ways. In fact, without adequate water flows, especially in the summer, your stream can't support much life at all. Low stream flows are one of the greatest causes of fish habitat loss and consequent fish declines.

Small streams may be heavily impacted by even a small water diversion during the summer when streamflow is at its lowest. During these months, the amount of life that a stream can support is directly related to the amount of water in it. Diversions and wells located near creeks decrease the underground streamflows, which are critical for summer pools.

### Ways to Minimize Diversion Impacts:

- Practice water conservation
- Use low volume pumps and pump to storage tanks

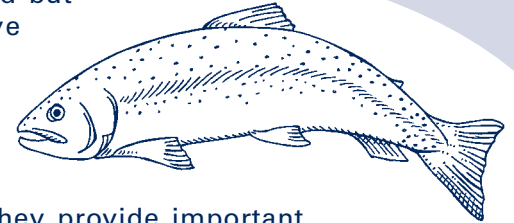
### Use Water Legally

Water diversions from streams are only legal if you have a Riparian Right, an Appropriative Water Right permit, or a Small Domestic Registration. A Riparian Right is limited to parcels adjacent to creeks and stays with the property, unless deleted from the title. Diverted water can be used only on riparian land. You are required to file a Statement of Water Diversion and Use with the Division of Water Rights. Storage of water beyond 30 days requires a water right permit. With an Appropriative Water Right, use of diverted water is not restricted to land next to a stream. A permit is required and water can be stored over 30 days. A Small Domestic Registration is for

- When flows are low, your diversion should have no visible impact on the stream. If it does, install a flow constrictor on your pump.
- Pump at night when natural stream flows are higher
- Use wells instead of direct pumping from streams

### Perennial and Intermittent Streams

Both perennial and intermittent streams contribute to healthy stream habitats. Perennial streams flow year-round, but may run dry during drought years or in areas impacted by landslides and excessive sedimentation. Intermittent streams flow only during the rainy season. While intermittent streams provide less fish habitat than perennial streams, they provide important wildlife habitat and migratory corridors and can be a source of excessive sediments.



landowners who use less than 4,500 gallons per day and store less than 10 acre-feet of water.

For more information, contact the State Water Resources Control Board, Division of Water Rights at (916) 341-5300 or [www.waterrights.ca.gov](http://www.waterrights.ca.gov). Any stream modification (e.g. rock-dam) requires a permit from California Department of Fish and Game. Pump intakes must also be screened according to National Marine Fisheries Service guidelines to keep from drawing up aquatic life. Legally, you must leave enough water to fulfill the needs of legitimate downstream water users. In any case, it is illegal to pump a stream dry.



## Horse Keeping for Healthy Streams

Many Santa Cruz County residents enjoy keeping horses. By following these guidelines, horse owners can make sure their creeks are as healthy as their horses.

### Protect Sensitive Areas

- Maintain a vegetated buffer between all horse-keeping activities—including pastures, barnyards, paddocks, manure storage areas—and the stream. Riparian corridors and wetland areas naturally filter contaminants, absorb nutrients, and reduce erosion.
- Locate paddock areas as far as possible from streams and sloping areas to reduce erosion and protect water quality.
- Maintain animals in paddock areas to reduce trampling impacts on pastures and prevent compaction of wet soils.
- Install fences to keep animals out of the Riparian Corridor protected by County ordinance.
- When crossing a stream, ride straight across and avoid trampling streambanks. Avoid crossing at shallow riffles in spring and early summer to avoid trampling steelhead or coho salmon redds (nests).

### Prevent Animal Waste From Polluting Rainwater Runoff and Streams

- Collect manure from uncovered paddocks daily, particularly during winter, and store in sheltered stockpile areas.
- Locate manure stockpiles on an impervious surface (concrete pad or plastic tarp) and cover them to prevent leaching of contaminants into surface and ground water.
- Prevent chemicals from horse grooming and health products from draining directly into streams.

### Maintain Proper Site Drainage

- Install roof gutters and downspouts to divert clean runoff away from paddocks, pastures, and manure storage areas.
- Use grassed ditches, berms, or subsurface drains to divert contaminated runoff away from waterways to low-gradient buffer areas.
- Construct/repair trails, arenas, roads, parking areas, drainage ditches, and culverts to drain water in a non-erosive manner.
- Grade and baserock paddock areas to minimize water logging.

### Manage Manure Piles

- Remove stockpiled manure on a regular basis.
- Manure can be composted for use in the garden.
- During the dry season, moisten paddock areas after manure clean-up to facilitate decomposition of residual waste.

### Manage Grazing

- Maintain pasture productivity by controlling the number of horses and amount of time they spend on a pasture.
- Prevent bare areas by allowing time for re-growth and use cross-fencing for pasture rotation.
- Use fencing to exclude grazing in riparian corridors.

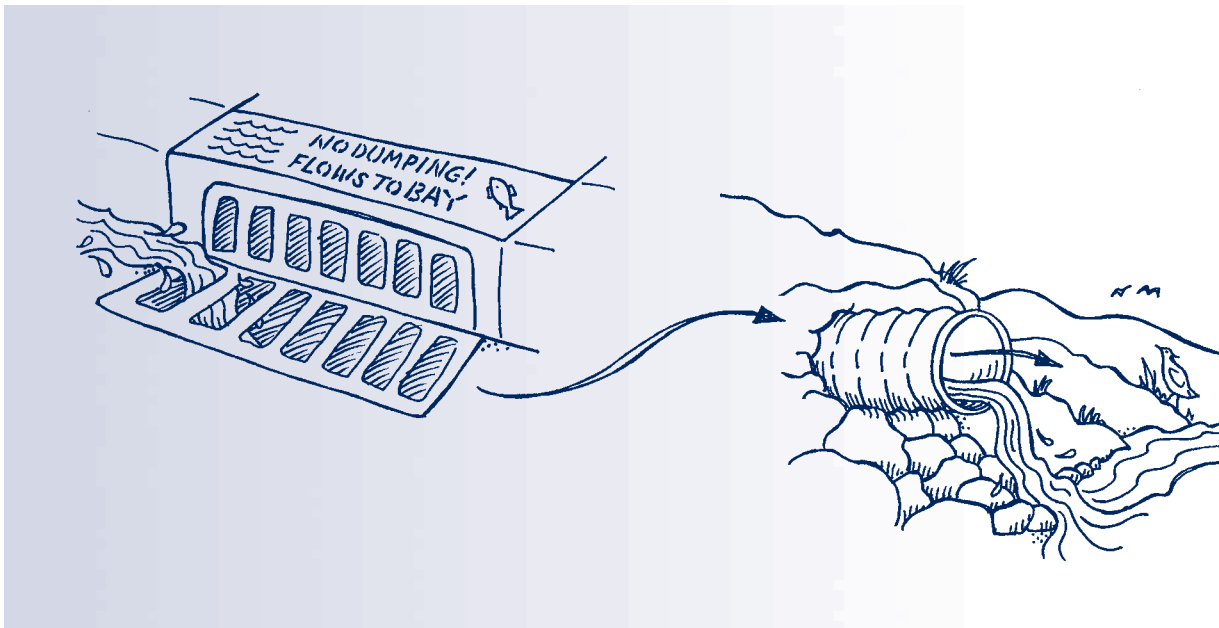
Contact the Santa Cruz County Resource Conservation District for more information on Horse Keeping Practices (see Resources, page 23).



## The Storm Drain Connection

Within urbanized areas of the County, water running off lawns, gardens, roofs, and paved areas such as streets, sidewalks, driveways, and parking lots empties into a storm drain system. The storm drain system is separate from the sanitary sewer system which collects wastewater from households and commercial sources through indoor plumbing. Water in the sanitary sewer is treated at a wastewater treatment plant before being discharged into the Bay. Water passing through the storm drain system receives no treatment before entering local creeks and the Monterey Bay. Many storm drains are marked with a “No dumping! Flows to Bay” stencil.

Storm water runoff is a major source of water pollution in California. Water entering the storm drain system—whether rainwater or water from a hose—can pick up soil, bacteria, viruses, pet waste, chemicals, garbage, and other pollutants. Some pollutants—such as oil, grease, car washing soaps, and heavy metals on parking lots and roads—enter streams primarily through storm drain inlets. Do not put pollutants into storm drains or in areas where they can wash into them.





## Home Maintenance Tips

### Check your septic system frequently and pump it regularly

If you live by a stream and use a septic system, you have a special responsibility to make sure it is functioning efficiently. Rural areas in the county contain a high density of septic systems. Human waste leaking from faulty septic systems can be a source of water pollution. Replacement of failing septic systems and regular pumping of all systems (every 3 to 7 years) can help keep this substantial source of stream contamination in check.

### Dispose of wastes properly, not in or near a stream

Keep trash out of the creek, off the street and out of storm drains. Remove trash that may have piled up alongside or in the creek.

Do not dump motor oil, gasoline, antifreeze, battery acid, transmission fluid, brake fluid, paint, solvents, pesticides, insecticides and herbicides, or household cleaners into a storm drain, stream, or riparian area. Even in small amounts, these hazardous materials will degrade the drinking water supply and harm fish and wildlife. These materials can also be transported and affect stream health downstream.

Take all hazardous items (used automotive fluids, batteries, paint, solvent, and pesticides) to a free household hazardous waste facility. For all County residents, including city residents, call (831) 454-2606 for drop-off information. For city residents, contact your sanitation department or garbage service.

Heavy metals are used in many household and automotive products. Excessive levels of metals can

harm aquatic life by causing mortality, changes in behavior, growth and development, or an inability to reproduce. Metals also accumulate in the food chain. For this reason, avoid hosing down paved surfaces like driveways. Use a broom instead and put debris in a trash can.

Don't let greywater from your washing machine run into a storm drain or stream. Greywater contains detergents, bacteria, and pathogens and must be discharged into a sewer, septic, or underground system. Properly dispose of pet waste in your garbage receptacle, sewer system, or by burying it. Do not leave it where it will wash into a stream or storm drain.

### Exercise care when using any pesticides, herbicides or fertilizers

Many yard and garden chemicals are extremely toxic to aquatic organisms and other inhabitants of the riparian corridor, such as birds. Even small amounts of these compounds entering streams directly or from airborne droplets can affect stream life. Avoid using herbicides or pesticides within the riparian corridor and exercise caution when applying them on adjacent areas as well, taking care to minimize any possible wind drift. If garden chemicals must be used, check your local nursery for products that have been registered for use near water.

### Use less-toxic or non-toxic products in your home and garden

Use mechanical methods to clean drains that are blocked by roots. Avoid copper-based root control products. Use water-based paint and paint removers when possible. If using oil-based paint, clean brushes at a sink that drains to the sewer or septic system and properly dispose of cleaning products, such as thinner or turpentine. Do not dump into a sewer or



septic system. Use of native vegetation adjacent to the stream corridor will eliminate the need for fertilizers and pesticides.

### **Keep yard clippings and debris off the streambank and out of the creek**

Yard clippings dumped on streambanks will kill vegetation underneath and can lead to bank erosion. Yard clippings can wash downstream and plug culverts, leading to flooding and property damage.

### **If you own a pool or spa, drain water into the sanitary sewer system not to a creek, street, or storm drain.**

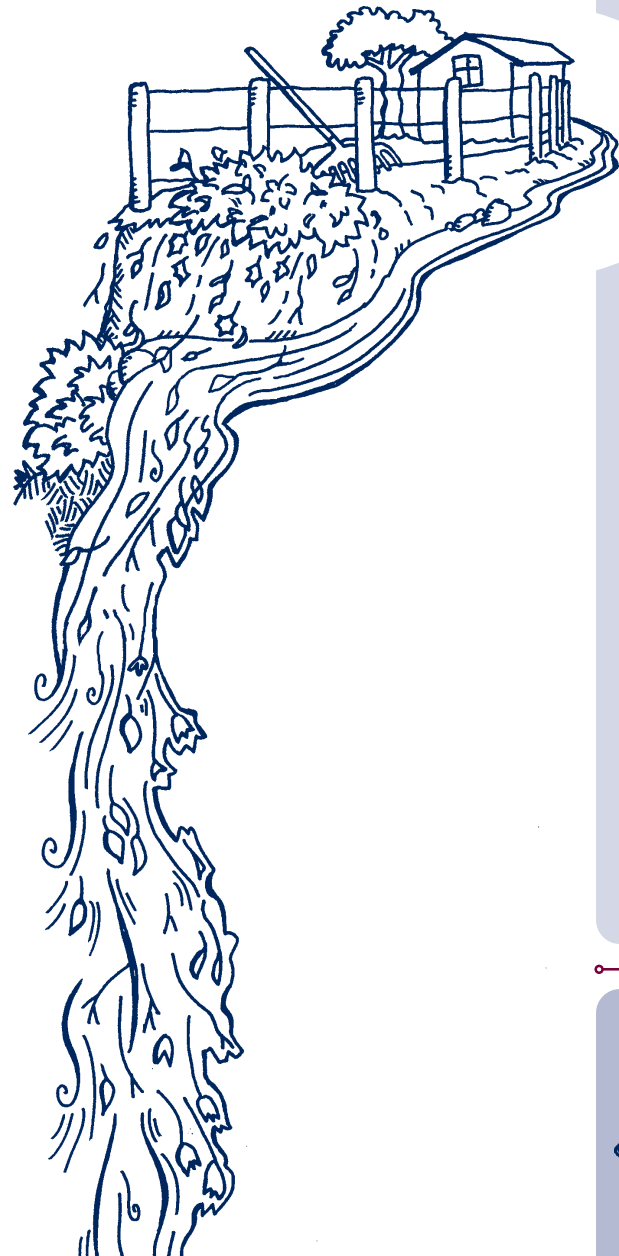
Chlorine and algaecides used in pools and spas are toxic to plants and aquatic life. Try non-chlorine alternatives for pool maintenance. Use diatomaceous earth (DE) cautiously.

### **Wash cars and boats away from the stream or at a commercial carwash.**

Don't use soap if it will drain into a storm drain or creek. Detergents cause foaming and prevent oxygen from dissolving in the water.

### **Minimize impervious surfaces on your property.**

Impervious surfaces such as your home, paved driveways and patios, reduce the amount of rain that soaks into the soil. In turn, impervious surfaces increase stream runoff, often resulting in increased gully and bank erosion and flooding problems downstream. In some areas of the County, impervious surfaces also reduce the amount of groundwater recharge, impacting our local water supply. Hard packed or compacted soils and denuded areas can increase surface runoff similar to impervious surfaces.



## Regulations

### County of Santa Cruz

Several County ordinances govern activities to protect riparian and stream habitats. One of the most important is the Riparian Corridor and Wetlands Protection Ordinance which was adopted to protect wildlife and aquatic habitat, reduce flooding, and safeguard water quality and cultural and aesthetic values.

Under the Riparian Corridor and Wetlands Protection Ordinance, the protected riparian corridor is defined as:

- Lands extending 50 feet (measured horizontally) out from each side of a perennial stream. Distance is measured from the mean rainy season (bankfull) flowline.
- Lands extending 30 feet (measured horizontally) out from each side of an intermittent stream. Distance is measured from the mean rainy season (bankfull) flowline.
- Lands extending 100 feet (measured horizontally) out from each side of a lake, wetland, estuary, lagoon or natural body of standing water.
- Lands within an arroyo located within the Urban Services Line or the Rural Services Line.
- Lands containing riparian woodland (cottonwood, sycamore, alder, box elder, etc.)

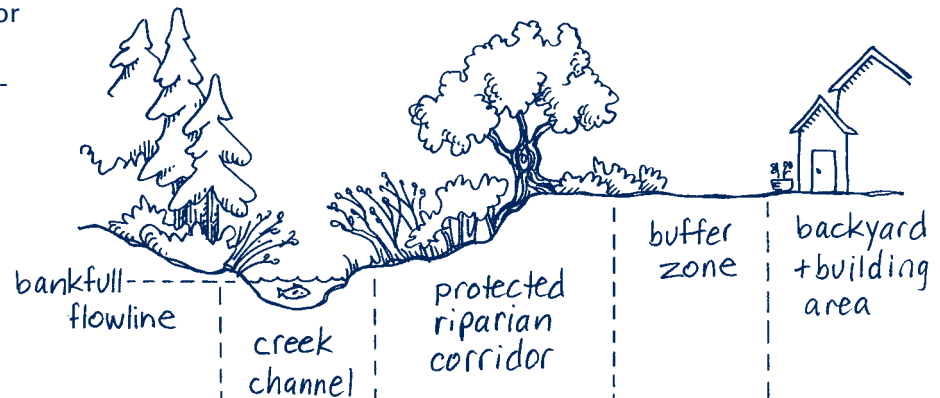
Within these defined areas, the ordinance prohibits any development, including tree cutting, vegetation removal, grading or construction, without a Riparian Exception

permit from the Planning Department. Deposition of debris and use of pesticides are prohibited.

Grading, including grading outside of the riparian corridor, can create erosion and degrade stream habitats. Most grading requires a permit and should be careful not to alter natural drainage patterns. Under the Erosion Control Ordinance, it is an owner's responsibility to control erosion on their property. For more information, contact the Planning Department or visit the County of Santa Cruz website: [www.co.santa-cruz.ca.us](http://www.co.santa-cruz.ca.us).

### State and Federal Agencies

Several state and federal agencies have jurisdiction over certain activities in the riparian corridor or stream. Most activities within the riparian zone require a Streambed Alteration Agreement from the California Department of Fish and Game. Many projects within the riparian zone require a permit from the Regional Water Quality Control Board, and an application for a permit from U.S. Army Corps of Engineers, which includes review by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service.



## Resources

**Santa Cruz County Resource Conservation District (SCCRCD)** – is a local non-regulating, not-for-profit public entity. The mission of the SCCRCD is to help people protect, conserve and restore natural resources through information, education and technical assistance programs. The RCD has hand-outs on erosion control, home and road maintenance, water conservation and revegetation as well as funding information for restoration projects.  
**820 Bay Ave., Suite 107, Capitola, CA 95010, (831)464-2950**

**USDA Natural Resources Conservation Service** – a non-regulatory federal agency. Soils and vegetation information, conservation planning, erosion control, technical and financial assistance programs. All services free of charge.  
**820 Bay Avenue, Suite 107, Capitola, CA 95010 (831) 475-1967 www.nrcs.usda.gov**

**Coastal Watershed Council** – community-based watershed stewardship programs, community storm drain and monitoring programs, education, and community outreach.  
**P.O. Box 1459, Santa Cruz, CA 95061, (831) 464-9200 www.coastal-watershed.org**

**County of Santa Cruz Environmental Health** – permits for septic systems and repairs, new wells, hazardous materials and water quality.  
**701 Ocean Street, Santa Cruz, CA 95060, (831) 454-2022**

**County of Santa Cruz Public Works** – woody material removal, water conservation.  
**701 Ocean Street, Santa Cruz, CA 95060, (831) 454-2160**

**California Native Plant Society** – Santa Cruz Chapter  
**(831) 429-7681 www.cruzcnps.org**

**Recycling and Hazardous Waste Disposal**  
**(831) 454-2333 (24 hour Recording)**

**California Environmental Hotline (Earth 911)**  
**1-800-CLEANUP www.earth911.org**

**UC Cooperative Extension** – master gardeners and information on herbicides, non-native plant removal and sudden oak death.  
**1432 Freedom Boulevard, Watsonville, CA 95076 (831) 763-8040**

Check your telephone directory yellow pages under the following headings, *Environmental and Ecological Services*, *Erosion Control* and *Nurseries* for listings of ecological consultants, erosion control supplies, seeds and plant sources.

## Regulatory Agencies

**County of Santa Cruz Planning Department**  
**(831) 454-2580**  
**701 Ocean Street, Santa Cruz, CA 95060**  
**www.co.santa-cruz.ca.us**

Activities in riparian corridors and in streams must comply with local ordinances (see Regulations, page 22). Contact the Planning Department for current regulations and permit requirements.

**California Department of Fish and Game (CDFG)**  
**(831) 649-2870**  
**20 Lower Ragsdale Drive, Suite 100, Monterey, CA 93940 www.dfg.ca.gov**

Any activity affecting the bed or bank of a stream requires a permit from CDFG.

**Central Coast Region (3) – Regional Water Quality Control Board**  
**(805) 549-3147**  
**895 Aerovista Place, Suite 101, San Luis Obispo, CA 93401-9706**

The regional board is responsible for issuing water quality certificates for any project requiring a permit from the U.S. Army Corps of Engineers.

**State Water Resources Control Board (SWRCB)**  
**(916) 341-5250**  
**P.O. Box 100, Sacramento, CA 95812-0100**  
**www.swrcb.ca.gov**

The SWRCB provides information pertaining to water rights and water diversions.

**U.S. Army Corps of Engineers (ACOE)**  
**(415) 977-8462**  
**333 Market Street, 8th Floor, San Francisco, CA 94105**  
 The ACOE regulates the discharge of dredged or fill material in most creeks, rivers, and wetlands. A Nationwide Permit, from the ACOE, must be obtained prior to starting such projects.

**National Marine Fisheries Service (NOAA Fisheries)**  
**(707) 575-6050**  
**777 Sonoma Ave., Santa Rosa, CA 95404**

NOAA Fisheries must be consulted when anadromous steelhead and salmon are potentially affected by an activity.



## Native Plant Nurseries

Many nurseries carry native plants which are suitable for planting within your riparian area. The following nurseries specialize in native plants of local origin; these, and other nurseries, can provide you with assistance on what plants are best for your area:

### Central Coast Wilds

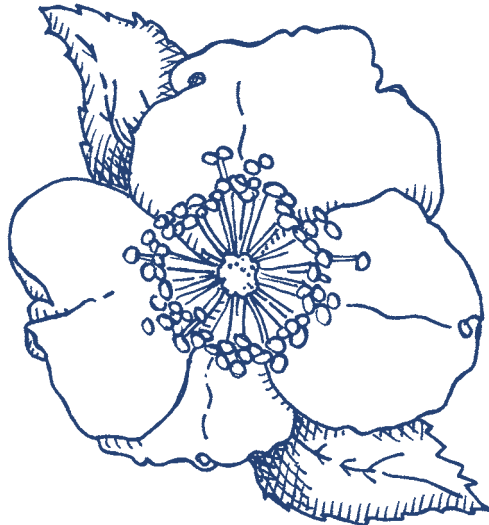
336 Golf Club Drive, Santa Cruz  
(831) 459-0655

### Elkhorn Native Plant Nursery

1957 Highway 1, Moss Landing  
(831) 763-1207

### Native Revival Nursery

2600 Mar Vista Drive, Aptos  
(831) 684-1811



## Erosion Control Supplies

Erosion Control Supplies are available at the Native Plant Nurseries and at:

### Augies Feed

2571 E Lake Avenue, Watsonville  
(831) 728-1711

### Central Home Supply

808 River Street, Santa Cruz  
(831) 423-0763

### General Feed and Seed

1900 Commercial, Santa Cruz  
(831) 476-5344

### John Snow Seed Company

21855 Roseheart Way, Salinas  
(831) 758-9869

### L.A. Hearne

8525 Prunedale N. Road, Prunedale  
(831) 663-1572

### San Lorenzo Lumber Garden Center

235 River Street, Santa Cruz  
(831) 423-0223

### Scotts Valley Sprinkler Supply

Scotts Valley (831) 438-6450  
Watsonville (831) 728-0446

*For a list of Certified Professionals in Erosion and Sediment Control, contact the Natural Resources Conservation Service or the County of Santa Cruz Planning Department.*

## Local Watershed Efforts

If you are interested in getting involved with a local watershed effort, contact the Santa Cruz County Resource Conservation District for contact information about active watershed efforts.

