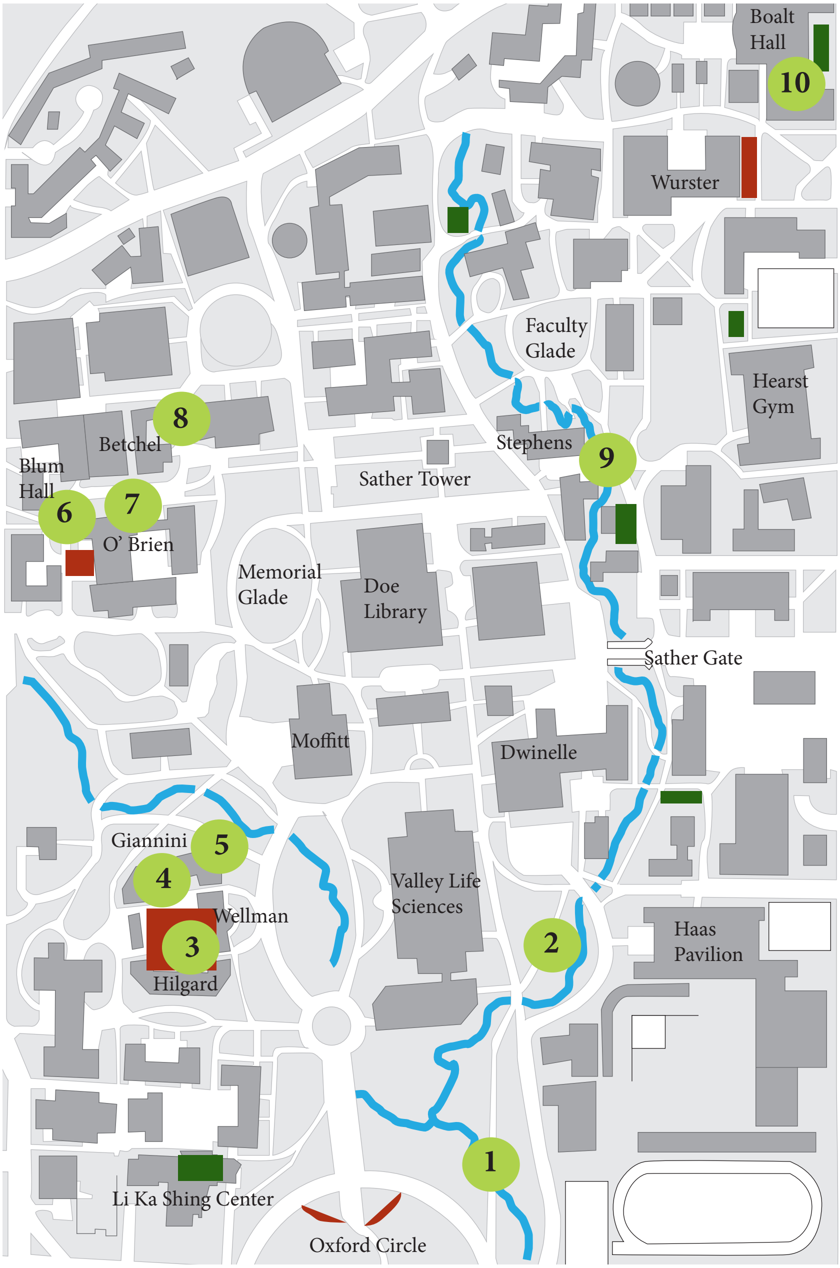
SUSTAINABLE WATER INFRASTRUCTURE TOUR

UNIVERSITY OF CALIFORNIA BERKELEY



Key:

Stops on this tour

Additional vegetated stormwater management

Additional pervious pavement

Strawberry Creek: A Walking Tour

This walking tour highlights various installations around campus that are examples of sustainable water management, and illustrates how each improvement affects Strawberry Creek. Each stop on the tour is labeled on the map on the facing page.

In the 1860s, UC Berkeley was built near Strawberry Creek both for its high quality drinking water springs in the upper canyons and so that the creek channel could carry the sewage generated on campus down to the San Francisco Bay. Fortunately, Strawberry Creek no longer serves as an open sewer (nor as a drinking water supply), but it still provides many benefits to the campus. Today, the creek and the soils and plants surrounding it absorb and moderate stormwater runoff, provide vital habitat for plants and animals, and serve as an outdoor classroom for students and community members.

Since the campus was built over a century ago, the natural state of Strawberry Creek has been drastically altered (and not only from the addition of raw sewage to its waters!). Buildings, paths, roads, and parking lots were built around the creek, covering much of the watershed with concrete and asphalt pavement. Unlike the soil and plants that used to surround the creek, concrete and asphalt do not absorb water and allow it to percolate into the ground. Instead, they cause water to flow rapidly over the surface when it rains, ultimately leading to higher and faster peak flows and more severe erosion of the creek banks.

In an attempt to control flooding and erosion, engineers funneled the creek into culverts, slowed its flow with small dams called "check dams", and armored its banks with concrete. These modifications have led to an altered water cycle in Strawberry Creek. Rainstorms now cause more energetic flows and higher water levels in the creek, increasing erosion downstream of the concrete reinforcements and washing away the small pebbles that are essential components of fish habitat. Urban pollutants accumulate on the surfaces of roads, roofs, and parking lots and wash into the stream after it rains. As the antiquated concrete systems for controlling the creek deteriorate, the risk of flooding increases.

Today, UC Berkeley is championing approaches to sustainable water management in the Strawberry Creek watershed in order to restore the natural ecology and function of the creek. This tour spotlights what we can do ensure our urban creeks optimally regulate stormwater flows, filter pollutants, and provide habitat for native species.

1.Grinnell Natural Ar

Top: Students replant native species from Strawberry Creek's banks. *Lower Left:* Tree roots hold the bank in place. *Lower Right*: Grinnell Natural Area.

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Our first stop is the Grinnell Natural Area, established by UC Berkeley in 1969 as a designated zone of protected native creekside vegetation. This protection ensures that rainfall in the Grinnell Natural Area will follow its natural path from the sky to trees to the soil, where it will gradually seep underground to the creek. This slow process is essential for reducing flooding and filtering pollutants out of the water.

Today, the Grinnell Natural Area is a model of an inexpensive alternative to concrete for controlling the flow path of an urban creek. Here, tree roots instead of concrete do an excellent job of curbing erosion by stabilizing the creek banks. Trees are more resilient to high flows than most man-made materials, because they can interlock their roots and twine them around boulders, keeping themselves firmly rooted even in a powerful storm. In addition, the trees shade the creek, keeping the water temperature cool enough for native fish to survive, and where their roots jut from the banks into the water, the tangled mass provides refuge for young fish to hide from predators.

Students Make a Difference

In 2005, over 500 students and community members removed the dense mat of invasive English Ivy that coated the banks of Strawberry Creek and replanted 49 different species of native plants to restore the habitat of the Grinnell Natural Area!

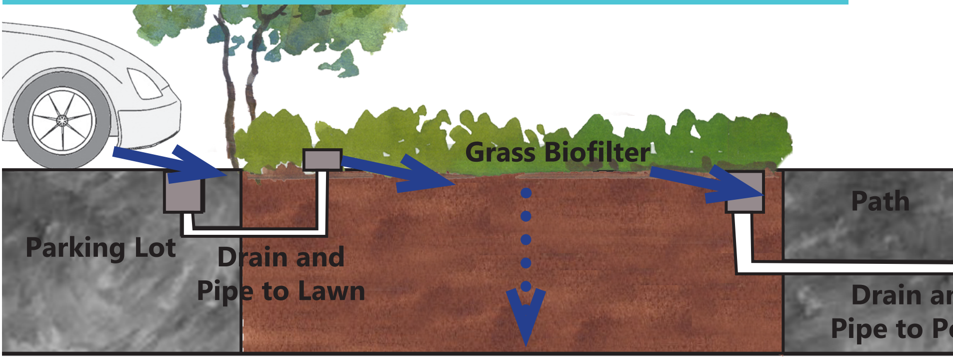
2.Stormwater Deten

As you follow the creek upstream, you will come across a bio-filtration system that prevents contaminated runoff from flowing into the creek. This system is the first on campus to address the way that parking lots affect water quality.

The Dwinelle parking lot accumulates a variety of pollutants throughout the year on its asphalt surface, including motor oil from leaky cars and heavy metals from brake dust. For decades, when the rainy season began after a long dry summer, these pollutants washed off the parking lot into a storm drain that ran straight to Strawberry Creek, which is only 20 meters away.

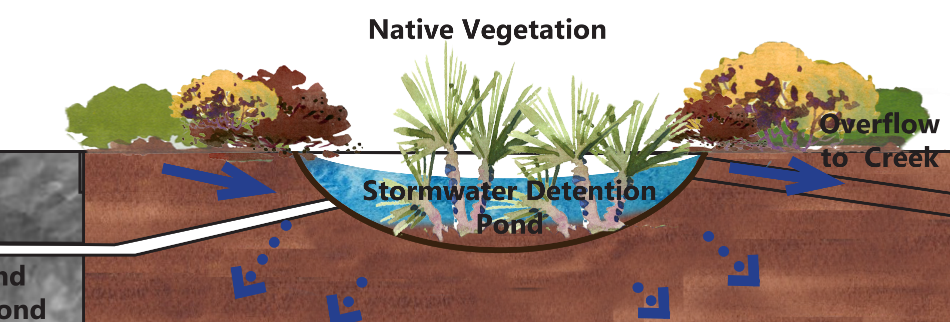
Now, the storm drain has been re-plumbed so that the stormwater will spread across the large lawn downhill of the parking lot. The grass and soil absorb much of the water, and microbes in the soil capture and decompose the pollutants that originated in the parking lot. Excess water flows into the stormwater detention pond, which holds the water and allows it to percolate slowly into the ground. The stormwater detention pond is planted with native shrubs that are adapted to having their roots wet in the rainy season and dry in the summer.

Though several parking lots on campus still drain directly into Strawberry Creek, this bio-filtration system is a model that we hope to replicate in many sites around campus to detain storm water and filter harmful pollutants before they enter the creek.



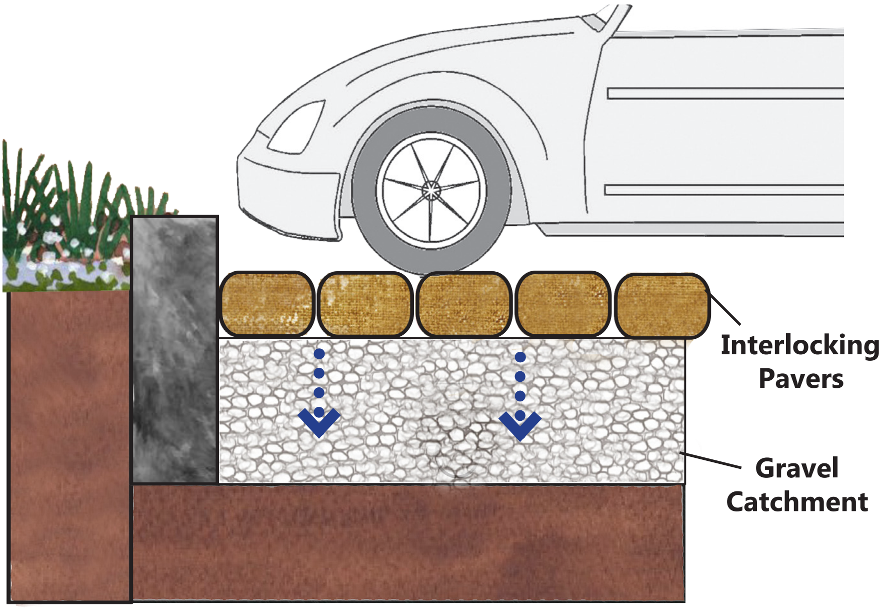
tion Pond

Above Left: An overflow drain from the grass biofilter carries runoff into the detention pond. *Above:* The detention pond filters and retains storm water before it flushes into the creek. *Left:* The detention pond is planted with native shrubs and grasses.



3. Wellman Parking L

While at first glance this may look like a regular parking lot, the Wellman parking lot is specially designed to catch and remove pollutants from stormwater. Unlike the Dwinelle parking lot, which is surfaced with a layer of impervious asphalt, the Wellman parking lot is made from interlocking pavers, which are laid so that a small gap exists between each one. Rainwater soaks into these gaps, draining into a "pool" of gravel under the lot that captures, retains, and filters the water. This parking lot lessens the possibility of flooding in and around Strawberry Creek, recharges the water table for surrounding vegetation, and filters out pollutants that would otherwise harm the creek ecosystem.



Lot

Above: Aerial view of Wellman parking lot. *Left*: Diagram showing flow of water into the gravel "pool" beneath the parking lot. *Below*: Interlocking pavers with gaps between them to allow for water percolation.

Economic Considerations

While the initial cost of interlocking pavers is two to three times higher than conventional asphalt for surfacing parking lots, they can provide substantial savings in reduced flood damages and water quality improvements over the life of the installation. And, unlike petroleum-based asphalt, these pavers are individually replaceable by hand if damaged, avoiding the costs of patching and crack-filling that are often required of asphalt surfaces.

4.Permeable Areas

Urban planners recognized the need for permeable pavements in the 1960s, and today there are over 200 different porous materials that can be used to surface parking lots, roads, sidewalks, and paths. Porous pavements are made with coarser material than conventional asphalt or concrete, creating air spaces that allow water to leak through instead of running off over the surface.

Above: A bed of decomposed granite creates a permeable area to park bikes.

Decomposed granite and mulch work as well as pavement for paths and bike parking areas. Next to the Wellman parking lot, you'll see that the space for bike parking is surfaced with decomposed granite instead of with asphalt—and this is just one of many bike parking areas around campus that have been resurfaced with permeable materials in order to allow stormwater to percolate into the ground.

Surface Materials

Porous Paving

Wood Chips

Decomposed Granite

Vegetation

5.Smart Irrigation

Above: The smart irrigation control box next to Wellman.

Until recently, UC Berkeley’s many sprinklers turned on for a set number of minutes each day, a system which resulted in a lot of over-watering and runoff. Runoff from excess lawn irrigation is harmful to the fish and insects in Strawberry Creek. Not only does the runoff transport fertilizers and herbicides from lawns to the creek, but it also contains 2 parts per million of chloramine, a disinfectant in our potable water that is toxic to aquatic organisms.

UC Berkeley reduces irrigation runoff to the creek by using “smart” irrigation technology that prevents over-watering. This metal box, mounted on the southeast corner of the Wellman Courtyard, houses a computer that wirelessly collects and transmits data about the weather. Using information about temperature, humidity, and precipitation, the computer determines how much irrigation is needed on the lawn near Strawberry Creek. After a rainstorm, for instance, this control system will know to not water the lawn. Though only some of the sprinklers on campus are currently controlled by “smart” irrigation systems, more installations are planned as resources become available.

6.Stormwater Catchm

Above: Catchment gardens planted with native vegetation in front of the Blum Center. *Left:* The catchment system allows these plants to thrive without additional irrigation. *Right*: Garden designed to filter runoff from surrounding pavement near the Hearst Gym.

ment Gardens

Runoff from the roof of the Blum Center is directed into a series of stormwater catchment gardens in front of the building. These gardens, which are landscaped with native plants, are fully irrigated by the water that runs off the roof in rainstorms. The plants absorb much of this runoff and the soil immobilizes pollutants that wash off the roof, thereby reducing the risk of flooding around Strawberry Creek and improving water quality in the creek as well. The stormwater catchment gardens also provide habitat for native pollinators, and the flowering plants look beautiful in the springtime. Maintenance costs for these stormwater catchment gardens are much less than for lawns because they don’t require fertilizer, irrigation or mowing.

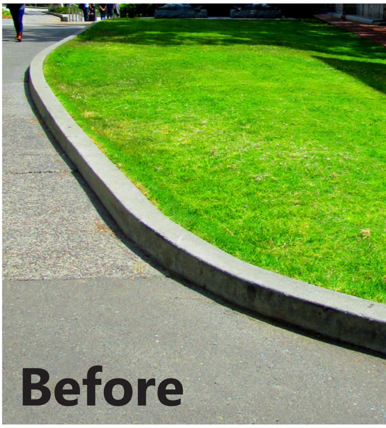
A similar garden exists near the Hearst Gym on the southeast side of campus; these are some of the first installations in a plan to include more stormwater catchment gardens around campus.

Water Collection

1000 square feet of roof space can collect 600 gallons of water per inch of rain. This means that in Berkeley, where we get about 20 inches of rain a year, the roof of the Blum Center can collect over 100,000 gallons of water per year that can be used for irrigation!

7.Vegetated Bio-Swa

Just behind the stormwater catchment gardens, you' ll see another type of landscaping that also helps manage stormwater runoff. This used to be a "lawn island," a little chunk of lawn that required large amounts of water and fertilizer but was rarely used because it was too small to be a pleasant place to sit. Now it has been transformed into a vegetated bio-swale, a landscaped feature designed to use plants and porous soil materials to catch and store runoff, and filter out pollutants.



The curb, shown with lighter colored concrete, is level with the road so that any water that runs off from the surrounding asphalt will drain towards the center of the swale, irrigating the planted vegetation.

In the case of a major rainstorm, the excess water will flow into an overflow drain. Vegetated bio-swales improve the quality of the water draining into the storm sewer system, which is important because everything in the storm sewers on campus drain directly into the creek or the Bay.

Point to Ponder

Do you see any other "lawn islands" on campus that could be converted to vegetated bio-swales to improve water quality? Look to the south at the small lawn with the bear statues. How does the curb affect the ability of this lawn vegetation to absorb and filter runoff from the road?

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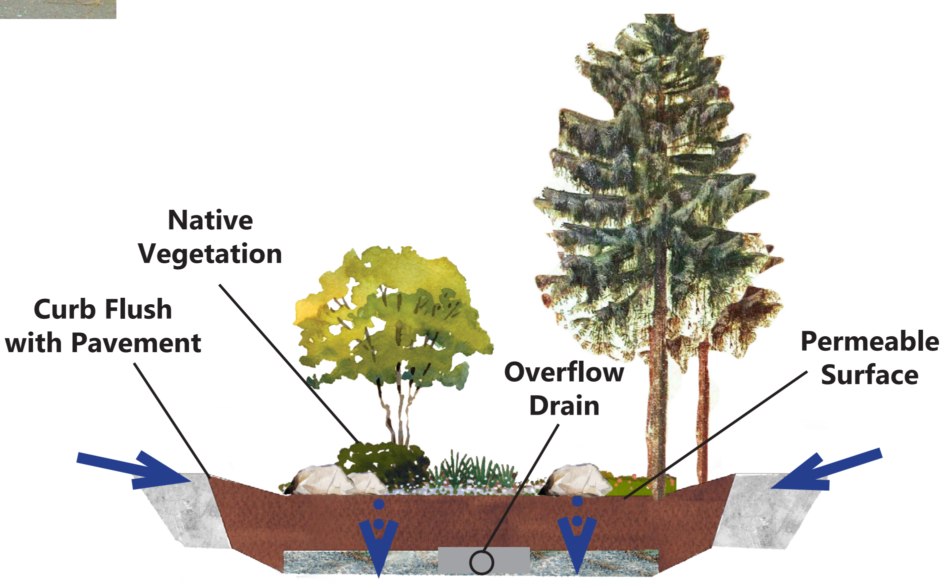
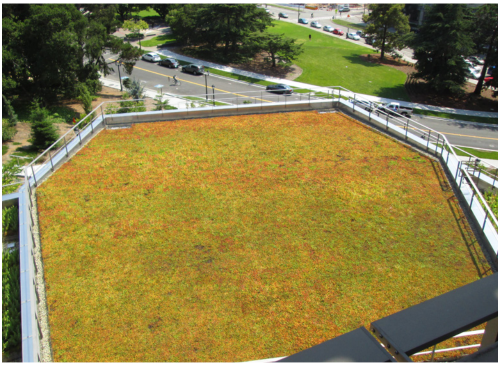
After


Native
Vegetation
Curb Flush
with Pavement
Overflow
Drain
Permeable
Surface

8.Green Roofs

In front of Bechtel Hall you will see a grassy area, which is actually the roof of the Engineering Library. Green roofs such as this one improve water quality by catching and absorbing airborne pollutants that would otherwise inevitably wash into the creek. They also deter flooding by absorbing rainwater instead of funneling it into gutters and storm drains. This particular green roof is a prototype for other roof gardens on campus, giving dual purpose—providing storm water management as well as a nice place to relax—to what would be an otherwise unused surface. Another example of a green roof at UC Berkeley is the garden on top of the Li Ka Shing building, located on the western edge of campus. Planted with native succulents, the garden creates a vibrant ecosystem for migrating butterflies and bees, while also detaining stormwater.

Left: Green roof at Betchel Hall. *Below Left*: Native grasses on top of Li Ka Shing. *Below*: Aerial view of Li Ka Shing's extensive green roof, covered in a layer of vegetation.

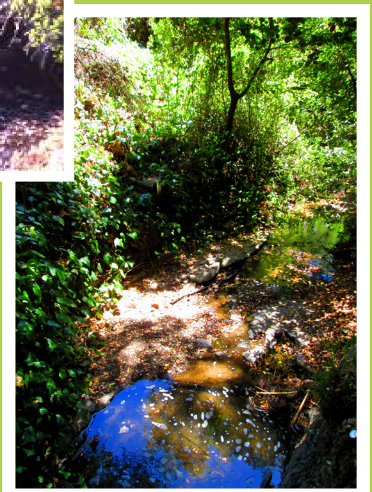


9.Redwood Cribwall

This redwood retaining wall, known as a cribwall, provides an effective solution to bank stabilization and protection while also providing habitat for native plant and animal species. The cribwall is designed for vegetation to grow over an interlocking structure of redwood logs. As the logs decompose over time, the roots from the vegetation will suffuse the logs themselves, locking the bank into place and creating a sustainable solution to erosion of the creek channel. The redwood cribwall is considered to be stronger and longer-lasting than traditional retaining walls built out of concrete.

Observe

Can you see any animals or birds using the cribwall as habitat?



Left: The redwood cribwall when it was first built in 1999. *Below:* Today the cribwall is covered with vegetation, creating habitat.

10.Memorial Stadium

The football stadium collects huge amounts of water when it rains. The water funnels down the steep bleachers and flows down to the field. Along the way, it picks up trash, spilled soda, and bits of food left behind by fans. This contaminated water used to flow directly to Strawberry Creek, but when the stadium was renovated in 2012, it was re-built to include a mechanical system to separate the trash from the stormwater before the water is released to the creek. The stormwater separation machinery is housed 10 feet under the parking lot north of the stadium, and can be accessed only by prying off the heavy manhole covers in the asphalt.

Mechanical stormwater treatment systems like this one are much more compact. Mechanical stormwater treatment systems like this one are extremely compact, and are useful for effectively removing trash and sediment from stormwater in a constrained space that can’ t accommodate a biological treatment system.

Memorial Stadium Stormwater Separation

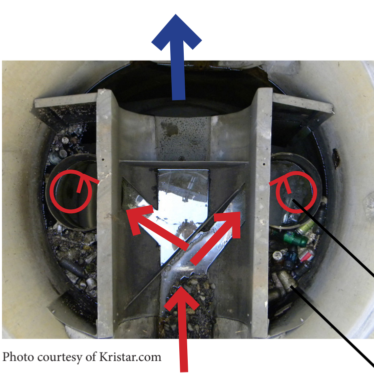


Photo courtesy of Kristar.com

Sediment settles out

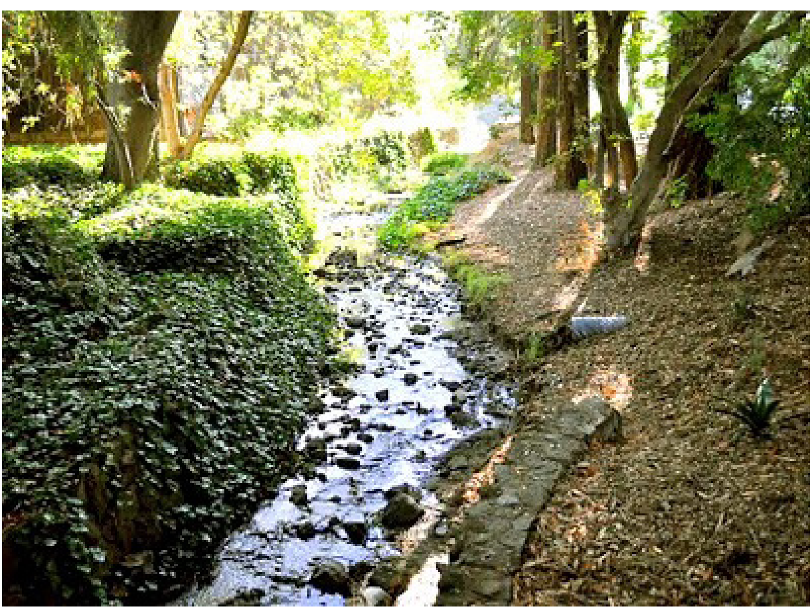
Contaminated stormwater flows in from stadium

Suspended solids and trash are trapped

What You Can Do

Its clear that the ways we choose to manage our stormwater, irrigate our gardens, pave and drain our parking lots, prevent flooding, and curb erosion on campus all have implications for the habitat and hydrology of Strawberry Creek. The stops on this tour highlight some of the ways we can build water infrastructure to support healthy creek ecosystems. Many of these techniques can be adapted to fit homes, schools, and office buildings, whether through using native vegetation for landscaping, harvesting rainwater, or using surfacing materials that allow stormwater to percolate into the ground below, and we hope you will build them and advocate for them in your school or community.

Many of the installations we looked at today have been promoted by and supported by the Cal student body. We' re lucky at UC Berkeley that we can see and enjoy the creek that flows through our campus, and its health provides a physical reminder and litmus test of how well we' re doing at creating sustainable systems for water management. Going forward, we hope to continue to see the resurgence of the Strawberry Creek watershed as a place that serves as a great habitat for humans and critters alike.



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By Nicole Kush, Sasha Harris-Lovett, Tim Pine, and Kara Nelson. 2013.