SAFEGUARDING CORAL REEFS

Rain Gardens to Filter Stormwater Runoff and Reduce Water Pollution

Demonstration Project: Creating a rain garden with Hawaiian tea garden plants at the Maui Economic Opportunity (MEO) Demonstration Farm

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CORAL REEF ALLIANCE

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State of Hawaii

The Coral Reef Alliance (CORAL) is an international nonprofit that unites communities to save coral reefs. In Hawai'i, CORAL is working with local partners to improve water quality for reefs and people through its Clean Water for Reefs Initiative.

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coral.org
maui@coral.org
@CoralReefAlliance
@coral_org
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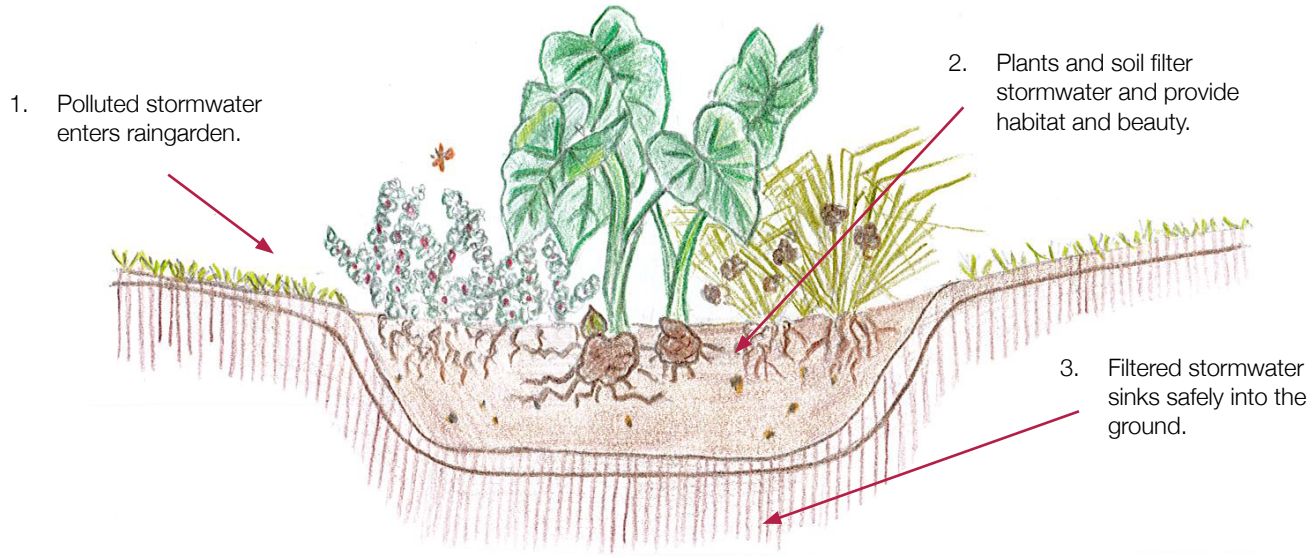
Solution

A **rain garden** is an effective and affordable low impact design (LID) practice to reduce stormwater pollution reaching our streams and the ocean. LID practices seek to mimic natural processes that allow stormwater to be slowed down, stored, filtered or sunk into the ground on its way to the ocean. A rain garden is a landscaped depression in the ground designed to collect a predetermined volume of stormwater runoff from rooftops and other impervious surfaces. When it rains, rain gardens fill up with a few inches of stormwater. Afterwards, this water filters through vegetation and sinks safely into the ground instead of running off into a storm drain or water body. Not only is a rain garden a beautiful landscape feature, but it also protects streams and the ocean from polluted stormwater runoff.

How a Rain Garden Works



Demonstration Project

Demonstration Site

The Maui Economic Opportunity (MEO) Demonstration Farm is located in Waihee, in Central Maui at the corner of Kahekili Highway and Waiehu Beach Road. The 13 acre farm provides training programs and workshops in sustainable agriculture techniques and methods. The goal of the farm is to empower the next generation of farmers to sustainably feed the people of Maui. The rain catchment system and rain garden will teach participants about LID and empower them to create similar systems throughout Maui.

Objectives

1. Create a rain garden showcasing native plants used traditionally in Hawai'i for herbal teas.
2. Collect rain water that runs off the rooftop to provide supplemental irrigation for the garden during drier times.
3. Filter stormwater into the ground instead of allowing it to flow into the nearby Waiehu Stream that drains directly to the ocean.
4. Provide a demonstration project which farm apprentices and others can visit.
5. Inspire construction of more rain gardens island-wide.

Constructing the Rain Garden

To construct our rain garden, we used the Hui o Ko'olaupoko's Hawai'i Residential Rain Garden Manual and the Coral Reef Alliance (CORAL) guide to building a rain garden (See Additional Resources).

Step 1: Choose the location

Successful rain gardens should be near the runoff sources, well-drained, not too steep and at least four feet away from structures.

We used a 275 gallon 'tote tank' to collect rainwater from the roof. Used tote tanks are often available for 50 to 100 dollars from food and beverage wholesale venders, aquaculture suppliers or through website resellers such as Craigslist; ours was donated to this project by Hawai'i Commercial and Sugar Company. When selecting your used tote tank, be certain that the tanks did not previously contain caustic or harmful chemicals; ours contained a 'food grade polymer' that is used in the sugar making process and doesn't leave an unsafe residue inside the tanks.

Tank donation

Constructing the Rain Garden (cont'd)

The tank was positioned such that the rain gutter downspouts could be directed into the tank's top opening. The tank was elevated on top of nine cinder blocks, raising it approximately eight inches off of the ground. This allows for a downward (gravity) flow of water out of the tank and to the garden's irrigation system. Make certain that the tank is adequately supported on the blocks as the full tank can weigh up to 2,300 pounds.

We set up a drip irrigation system and connected it to the outflow of the rain harvest tank using fittings available at any local hardware store. We included a fitting for a standard garden hose for hand watering. We added a small piece of screen over the top where the water comes in from the gutter to filter out leaves and prevent mosquitoes from breeding inside the tank. We piped water approximately four feet from the rain harvest tank to the rain garden.


Tank location


Water spout

Step 2: Determine the right size for the rain garden

The depth and size of a rain garden are determined by how much water it can effectively filter and sink into the ground over a 24 hour period. Thus, the right size for a rain garden depends upon three factors:

1. The area of impervious surface that will contribute stormwater to your garden
2. Soil drainage characteristics
3. The amount rainfall in the area

Constructing the Rain Garden (cont'd)

Step 2: Determine the right size for the rain garden (cont'd)

We used the following steps to determine the appropriate size for our rain garden:

a. Find the contributing area: Rain gardens are designed to capture a predetermined volume of stormwater generally coming from a rooftop or paved area, called the 'contributing area' (CA). With our rain garden, we wanted to capture and filter the stormwater coming off of an office building. We measured the building and found it to be 12 feet by 20 feet. This is a CA of 240 square feet. As there are future plans to add approximately 800 square feet of additional office space to the site, we decided to accommodate the stormwater from this future expansion with our rain garden as well, creating a total CA of 1,000 square feet.

Step 2, a

b. Determine the soil drainage characteristics: The soil drainage characteristics of a site will determine the overall size a rain garden needs to be to effectively filter stormwater. We conducted an infiltration test on the site to see how quickly stormwater would drain into the soil. We found that the soil at our site drained at a rate of 0.5 inches per hour.

c. Calculate the right size for your rain garden: We used a table from the Hui o Koʻolaupoko's Hawaiʻi Residential Rain Garden Manual to identify the right sizing factor for our rain garden. This chart is based on the infiltration rate and historic rainfall data for Hawaiʻi. We calculated that a rain garden size of 200 feet was necessary to adequately treat the stormwater from our current and future rooftops.

Step 2, b and c

Constructing the Rain Garden (cont'd)

Step 3: Start digging


Step 3

Digging the rain garden can be easily done by hand, ideally with some willing volunteers. In this project, we used excavating equipment because the soil was severely compacted — possibly due to the land's former use as a macadamia nut farm. The site was prepared by tilling the ground with an excavator to a depth of approximately three feet. By tilling the ground, we 'fluffed up' the soil and improved its ability to absorb and filter stormwater.

We then dug the rain garden to a depth of one foot to create the depression necessary to capture the stormwater.

Step 4: Plant locally-appropriate plants

Plants should be chosen for a rain garden based on the site's light, moisture and soil characteristics. Beyond that, the plants for a rain garden are a personal choice, and can be chosen to match the existing landscape aesthetic. We created a border around the garden with rocks found at the site and planted several herbs and shrubs used to make herbal teas in Hawai'i ("Hawaiian tea garden plants"). We included some native Hawaiian plants which are adapted to local conditions and can handle the periodic wet and dry conditions found in rain gardens. We also included some non-invasive, introduced plants because of their traditional and medicinal properties. After planting, we watered the garden thoroughly and covered the bare soil with a six-inch layer of mulch to help retain moisture in the soil.


Rock wall


Plants laid out


Planting

Hawaiian tea garden plants included:

1. Mamaki (*Piptirus albidus*) – native to Hawai'i
2. Kokio keo keo; Native white hibiscus (*Hibiscus arnottianus* subsp. *punaluuensis*) – native to Hawai'i
3. 'Olena'; Tumeric (*Curcuma domestica*) – Polynesian canoe plant
4. Blood Orange (*Citrus sinensis*) – non-invasive, introduced
5. Lemongrass (*Cymbopogon flexuosus*) – non-invasive, introduced

Demonstration Project (cont'd)

Project Costs

Item	Cost (approx.)
'Tea' plants	$240
Mulch	$100
Drip irrigation	$50
9 cinder blocks	$15
Gutter fittings	$50
Excavator rental	$150
Total Cost	**$605**

Results

- The rain garden safely absorbs and filters a total of approximately 5,000 gallons of polluted stormwater per year, thereby preventing it from running unfiltered into the ocean.
- The site will be used for farm apprentice training, technical courses and agriculture extension activities and serve as an example for the site's approximately 500 visitors per year.

Completed rain garden with irrigation system

THANK YOU!

Mahalo to those that helped make this project a success, including:

- Maui Economic Opportunity (MEO)
- Hawai‘i Commercial and Sugar Company
- Starwood Hotels

Additional Resources

Learn more about ways to reduce water pollution in Hawai‘i’s marine environment at coral.org/our-publications.

Learn more about low impact design (LID) at coral.org/LID.

To visit the demonstration site or to learn more about this solution, contact maui@coral.org.

Learn more about how to build a rain garden:

Building a Rain Garden to Filter Stormwater, published by CORAL:

coral.org/blog/wp-content/uploads/2017/07/CORAL_SafeguardCoralReefs_RainGardens.pdf

Hawai’i Residential Rain Garden Manual, published by the Hui o Ko‘olaupoko:

www.huihawaii.org/rain-gardens.html

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