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SUMMARY MEMO

TO:	Susie Holst (NOAA) and Meagan Curtis (CRAG)
FROM:	Anne Kitchell, Horsley Witten Group (HW)
DATE:	September 30, 2015
RE:	Summary of Faga'alu Rain Garden Installation Clinic

This memorandum provides a brief summary of the August 26-27, 2015 rain garden installation clinic at the Faga'alu Beach Park and the Office of Samoan Affairs conference room. This project fits within a broader context of watershed implementation activities within the Faga'alu watershed. The purpose of the clinic was to: 1) construct a demonstration rain garden; 2) increase local capacity to install additional rain gardens; and 3) provide instructional materials that can be adapted by CRAG for future use. CRAG will be installing more rain gardens around the island under NFWF funding.

While on island, we also visited the quarry site, attended an island-wide meeting of village mayors, and toured three villages to look at watershed issues and identify potential sites for future rain gardens. In addition, this project was conducted concurrently with site visits and meetings related to shoreline and stream stabilization planning in Faga'alu. This report provides a brief summary of each of these activities. Press on the event can be found at: https://www.facebook.com/AS.CRAG; http://samoanews.com/content/en/rain-garden-installation-begins-fagaalu; and http://www.talanei.com/NOAA-promises-you-a-rain-garden/21906151.

Rain Garden Installation Training

A number of planning meetings were required in advance of the workshop to choose an ideal site, meet with site managers, review the design plan, secure materials, and navigate the permitting process. Meagan Curtis (CRAG) was responsible for coordination efforts. Three sites were evaluated for the installation: an interior courtyard at LBJ hospital, the Matafao School, and Faga'alu Beach Park. Ultimately, the Beach Park was selected; however designs were developed and permits obtained for the hospital as well (see Meagan Curtis for approved permit copies). HW described the rain garden sites, preliminary planting plans, and sizing calculations in a permitting narrative report dated June 30, 2015.

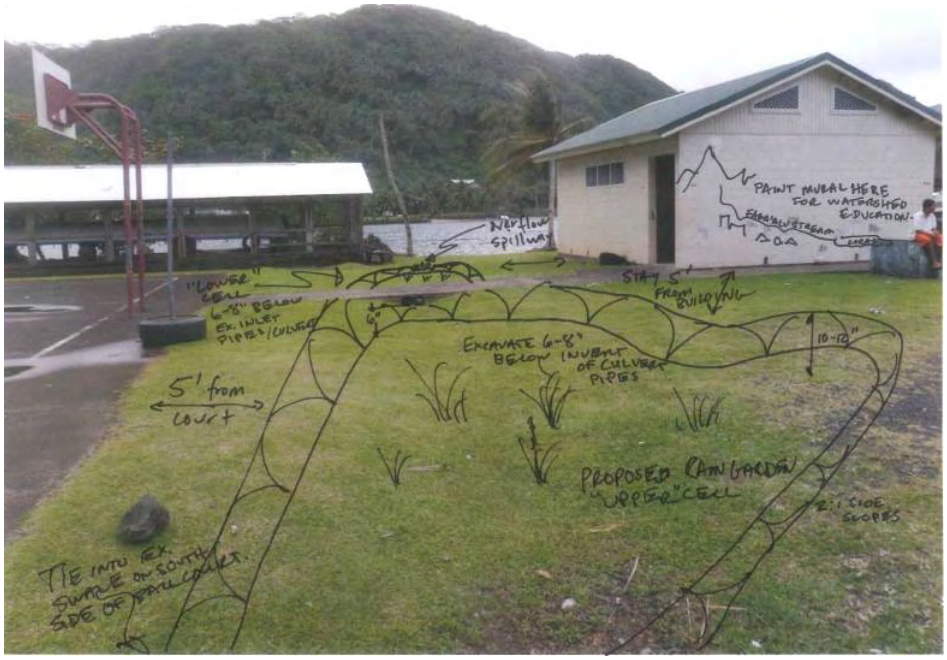
This workshop would not have been possible without the support of the Faga'alu Village mayor, Land Grant (donated plant materials), and Samoa Maritime (donated equipment/operator time, stone, and filter fabric).

There were over 40 participants at the two-day clinic including a mixture of agencies and village representatives (see CRAG for a complete participants list). Anne Kitchell (HW) and Todd Cullison (Hui o Ko'olaupoko) were the instructors for the Day 1 classroom portion of the workshop, which was a 3-4 hour session in the morning covering the basics of rain garden features, site selection, design, and maintenance. Participants were taken outside to look for rain garden opportunities around the Office of Samoan Affairs facility. Potential project locations that were identified are summarized later in this summary report. Day 2 of the workshop was the hands-on installation in the park. Rich Claytor (HW) and Todd Cullison (HOK) led the construction part of the training. Land Grant provided oversight of the planting.

Each participant was given a rain garden installation training guide, as well as copies of a general maintenance plan (see Attachments A and B). Electronic copies of all instructional materials, training slideshows, and other materials will be made available to CRAG for distribution to interested participants. CRAG created a time-lapse video of the installation.


The rain garden clinic was a two-day event, with half a day classroom lecture at the office of Samoan affairs and the second day installation at Faga'alu Beach Park.

The location of the 500-600 SF rain garden (shown in green) at the Fag'alu Beach Park. The contributing drainage area (shown in red) and impervious area (red hatched) draining to the rain garden was used to estimate the size of the facility needed to managed water quality volume target. The area shown in yellow includes the existing drainage swale and potential location for an additional raingarden cell (not used).



Initial sketch shows that plans change based on site conditions. It was determined that only one cell at the downstream end of the bathrooms would be installed due to active use of the upper location for cricket play and parking. We were able to create a ~500-SF rain garden. Based on high infiltration rates of existing soils and the fact that this is already where the water goes, we were comfortable with being close to the 1" rainfall target.

A summary of materials and supplies purchased/used for this installation is provided in Table 1. This list does not include design and permitting time, nor does it include tent rental, water, lunch, etc for installation training clinic.

Table 1. Materials List

Item	Quantity	Cost
mulch	3 pickup truck loads	$ 400.00
compost	20 bags	$ 560.00
plants (Ti variety, taro variety, lemon grass, spider lily, crotus)	100	donated
stone (3-4")	1/2 bucket load	donated
boulders (>12 in)	5	donated
filter fabric	25 sq ft	donated
silt sock/safety cone for filling	25 ft	$ 25.00
Coconut husk shavings (for silt sock)	4 bags	donated
rebar 1/2" 3 ft length/caps	4	$ 10.00
line level (plus string)	1	$ 10.00
bucket (5 gallon)	1	$ 5.00
shovels	6	$ 75.00
rakes	4	$ 70.00
gloves (pair)	8 pairs	$ 25.00
trowels	5	$ 15.00
utility knife	1	$ 10.00
tape measure	1	$ 10.00
hammer	1	$ 15.00
tarp	2	$ 100.00
wheel barrows	3	Borrowed
TOTAL		**$1,330**

Sequence of construction included the following steps:

1. Prep work (prior to installation day)—survey and siting, marking of footprint, installing erosion control practices, rough excavation, and staging of materials on site
2. Fine grading—using line level to make sure bottom elevation is flat and side slopes at 3:1 angle, including berm at downstream end and proper elevation of overflow spillway
3. Inlet stabilization- dropping inlet to below invert of sidewalk culvert and adding stone pad for stabilization
4. Amending native soil with compost
5. Installing outlet—creation of overflow spillway, using filter fabric below layer of stone
6. Planting—generally, have a written planting plan in advance, but in this case, it was verbal instruction from Land Grant
7. Add mulch around plants (can do mulch first then planting, depends), replace sod on side slopes and berms
8. Add boulders and large stones
9. Water, soak plants to help them establish





Materials used for the installation (top left to bottom right) include: mulch to protect the plants, trap water and add organics to the rain garden soil; compost to add organic mix to soil and help slow infiltration rate; plants donated by Land grant; stone for inlet and outlet stabilization; and boulders to provide additional interest to block vehicles from entering rain garden.

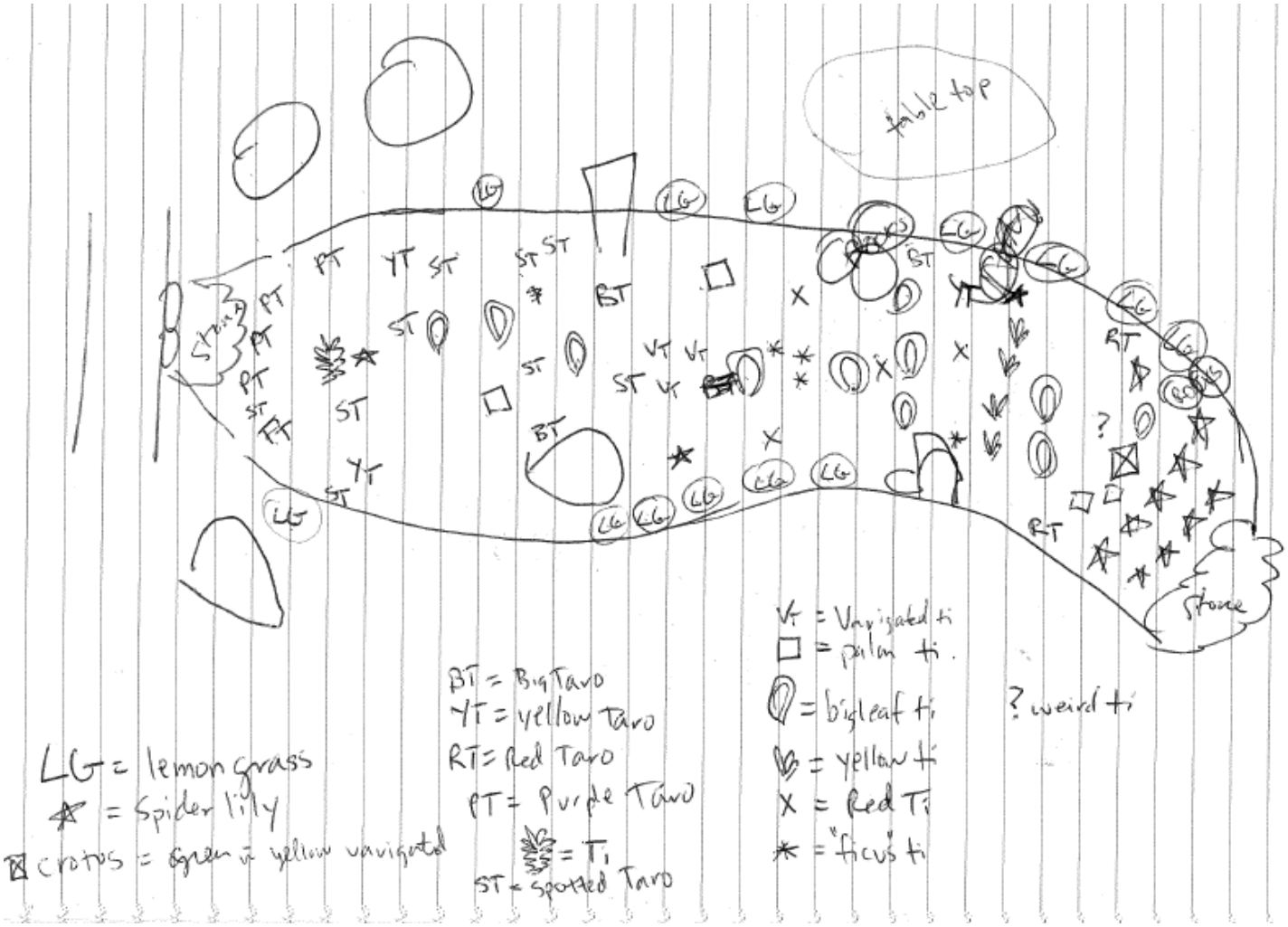
Prep work prior to the installation clinic included (top left to bottom right): survey to establish relative elevations and properly site the rain garden; marking the perimeter of rain garden bottom for excavation; sod removal and rough excavation; installation of erosion and sediment control practices; and staging of materials on site.

Rain garden installation steps.

Post-installation, it will be critical to water the plants and sod to ensure that they get established until the rainy season begins and to keep basketballs and foot traffic out of the rain garden. This involves soaking the plants at least every other day for the first few weeks, making sure the net and boulders are in place, and keeping an eye on plants and stones being removed by kids or others. Depending on how well the sod takes, the lemon grass planted on the side slopes may need to be relocated if ultimately, that area is going to be mowed. The following table outlines the inspection and maintenance plan for this rain garden.

Rain Garden: Faga'alu Beach Park	
Responsible Party (ies): CRAG in the short-term, then workout an agreement to turn it over to Parks or the Village mayor's office.	
Task	**Frequency***
General Site Maintenance	
Keep foot and vehicular traffic out of rain garden; install signage	Immediately after installation; make sure the net keeping basketballs out of facility stays up until plants are established. The boulders should do a good job of keeping out cars.
Site Area Cleanup	Immediately after installation, ensure that all trash is picked up and disturbed areas are stabilized with seed or erosion control matting. Remove silt socks once the sod is established and there is no more exposed soil behind the bathroom building.
Trash Removal	Inspect minimum monthly & after major storms; remove trash as needed
Inlet Locations	
Sediment removal	Inspect minimum once per year and after major storm events; Ensure sediment does not block inlet and cause flow to bypass the rain garden
Stabilize erosion	Inspect minimum once per year and after major storm events; stabilize as needed;
Repair/replace inlet materials (e.g., downspout, curb cuts, stone)	Make sure kids haven't removed all the stone at the inlet; Inspect minimum once per year; repair/replace as needed
Plant Maintenance	
Watering	Immediately after installation; during dry periods the first 1 - 2 years
Weeding	Monthly at first, then at least twice a year (more may be necessary if invasive species are present)
Plant Cutting/Thinning	Annually—this will be hard to do since you worked so hard to get plants established, maybe start thinning on year 2
Plant Replacement	Add reinforcement plantings during the first 6 months to a year to maintain desired vegetation density and aesthetics; then, as needed
Mulch Maintenance	
Replace or supplement existing mulch	Once every 1-2 years as required to maintain desired depth
Re-mulch bare areas	After major storm events as needed
Filter Bed Maintenance	
Sediment removal	Inspect minimum once per year and after major storm events; remove sediment if buildup of >1 inch is observed. If you frequently observe a lot of sediment in your rain garden, check that the contributing area is stabilized.
Stabilize erosion gullies on side slopes and in the bed itself	Inspect minimum once per year and after major storm events; stabilize as needed
Tilling/soil amendments to improve drainage	If standing water does not drain after 48 hours
Outlet Locations	
Stabilize erosion	Inspect minimum annually & after major storm events; stabilize as needed
Adjust height	If standing water is a problem in your rain garden, adjust height of outlet to let more water out.

After one year, it would be good to inventory the plants to evaluate survival. Part of this installation was to experiment with available plants from Land Grant to determine which species would work best in a rain garden. Below is a rough sketch of the plants installed at Faga'alu Beach Park, but a more detailed inventory may be possible once the vegetation becomes more established/distinguishable.



Rough planting plan sketch.

Some follow-up items for CRAG include:

1. Clean up remaining stockpiles.
2. Prepare educational signage to inform visitors about the rain garden and its role in helping to protect water resources.
3. Work on a watershed mural to paint on the bathroom wall facing the rain garden.
4. Establish a long-term maintenance plan for the rain garden (see suggested maintenance plan attached to this memo).

5. Prepare a schedule for tracking this rain garden's success, particularly with the various plants used. Send photos to HW and HOK of the rain garden over the next few months. Try to get out there when it is raining.
6. Prepare an American Samoa Rain Garden Guide as part of CRAG's future rain garden builds.
7. Apply any lessons learned from this installation into your future installations.

Stream and Shoreline Restoration Planning

During the rain garden installation, Rich Claytor (HW) was able to meet with knowledgeable agency staff to brainstorm appropriate plants for vegetated shoreline stabilization projects in Faga'alu. Rich walked the Faga'alu stream and evaluated a few shoreline locations at the Park and at the Matafao school for potential opportunities for shoreline stabilization. A report on specific locations and conceptual design plans is currently underway.

Team of experts looking at the Faga'alu shoreline map and drafting a list of appropriate tree, shrub and other species that are locally available.

Mayors Meeting

Gataivai Talamoa, the NOAA liason with the American Samoa Government, Office of Samoan Affairs (OSA), at the invitation of Secretary Paramount Chief Mauga Tasi Asuega, and OSA Deputy Secretary High Talking Chief (HTC) Tuiagamoa T. Tavita requested a special presentation of the "Rain Garden" project to the Village Mayors' (VM) of American Samoa.

There are more than 60 mayors and village representatives that attend a Monday meeting every two weeks. This was an opportunity to invite them to the rain garden workshop and to discuss opportunities to bring future rain garden installations to other villages. Susie Holst (NOAA), CRAG, HW, and HOK attended the meeting on August 24, 2015 and gave a 20 minute presentation on the rain garden project. We offered to tour any villages while on island to discuss drainage issues and look for potential rain garden opportunities. A key discussion item that came from the work shop included the need to have training materials available in the Samoan language. Meagan Curtis distributed applications for rain gardens.

Watershed Walkabout

The villages of Malaeloa, Utulei, and Lauli'i requested that we investigate opportunities for drainage improvements and/or potential rain garden locations. The table below summarizes some of the opportunities discussed during those visits, which were organized by Gataivai Talamoa and led by Mr. Edwin Toilolo, Mr. Mike Taufagamanu, and Mr. Laloniu, respectively. Site sketches and photos from the walkabout can be found in a separate summary memo dated September 30, 2015.

Village	**Potential Projects/Discussion**
Malaeloa	M1. Excavate dry forebay/basin at stream bend above culvert near Satauro Ole Ola M2. Install a berm on either side of inlet at road culvert where stream is currently jumping out onto road; excavate low flow channel through the taro ponding area to direct flow into culvert M3.Road near Mr. Toilolo's house-- further up road, extend wall and install a speed bump to divert flows M4. Church—rain garden installation out front between parking area and the stream
Utulei	U1. Three options for rain gardens at Office of Samoan Affairs and one option between the Bank and Office of Samoan Affairs; possibly an opportunity adjacent to the basketball court U2. Consider installing a box/pipe to convey groundwater flows into existing outlet structure to prevent ponding along road behind school yard U3. Open up manhole and evaluate pipe size and or if the pipe is clogged. This is the pinch point and it maybe that the pipe size needs to be increased. U4. Clean stream channel/remove debris jams through housing development and identify key locations for stream bank stabilization. Investigate illicit discharge and complete pipe inventory/mapping while in channel.
Lauli'i	L1. A number of rain garden options exist at the school yard L2. Opportunity for rain garden in parking area adjacent to school yard L3. Cleanup garbage/debris (white goods) dumped in stream channel

Other general findings include:

- Many of the villages have instituted a weekly trash cleanup regime, which has resulted in fewer blockages of streams and drainage inlets in addition to other benefits.
- Most villages seem to prefer concrete channelization and clearing within the stream corridor to prevent flooding and reduce mosquitoes. This approach eliminates in-stream habitats and alters the natural watershed hydrology. Additional work is needed to identify alternatives that can accommodate conveyance without sacrificing the benefits of a naturalized channel.
- In general, there seems to be a need for more equipment for drainage and vegetative maintenance.

HW, NOAA, and Village leaders touring some of the drainage issues in three villages.

Attachment A

Agenda

Draft Flyer

Sizing Exercise (not used)

Maintenance Planning

Soil Testing

Rain Garden Workshop

August 25-26, 2015
Office of Samoan Affairs Conference Room
Tutuila, American Samoa
AGENDA

Tuesday, Classroom Training

8:30 – 9:00	**Registration**
9:00 – 9:30	**Rain Garden Introduction** *What is a rain garden and why do you want one? Discuss stormwater runoff and how this relates to the Faga'alu watershed management plan.*
9:30 – 10:30	**Rain Garden Design and Materials** *How do you determine where a rain garden should go and how big it should be? What is so important about soils and how does water get in and out of the rain garden? What plants do you use?*
10:30 – 11:30	**Rain Garden Construction Sequence and Maintenance** *How do I build a rain garden? What should I expect for maintenance?*
11:30 – 12:00	**Q/A and Rain Garden Wrap-up**

Wednesday, Rain Garden Installation

8:30 –2:30	**Meet at Faga'alu Beach Park basketball court** Bring gloves and a shovel and wear appropriate clothes for digging and planting. Lunch will be provided.

NOAA CORAL REEF CONSERVATION PROGRAM

CORAL REEF ADVISORY GROUP CRAG

Horsley Witten Group

hui o ko'olaupoko

RAIN GARDEN TRAINING WORKSHOP

August 26-27, 2015

WHAT?

A two-day short course for agencies, landscapers, designers, maintenance care providers, and volunteers to learn about how rain gardens can help clean our waters!

WHEN AND WHERE?

Wednesday, Aug 26, 2015
9:00 am—11:30 am
Classroom session on how to design, build, and maintain a rain garden. Held at the Office of Samoan Affairs Conference Room

Thursday, Aug. 27, 2015
9:00 am- 2 pm
Come build a rain garden!
Meet in the cantina court yard at the LBJ Hospital.

COST?

Nada, nothing, zero, ziltch!!
This FREE training is sponsored by the NOAA Coral Reef Conservation Program. Lunch will be provided on installation day.

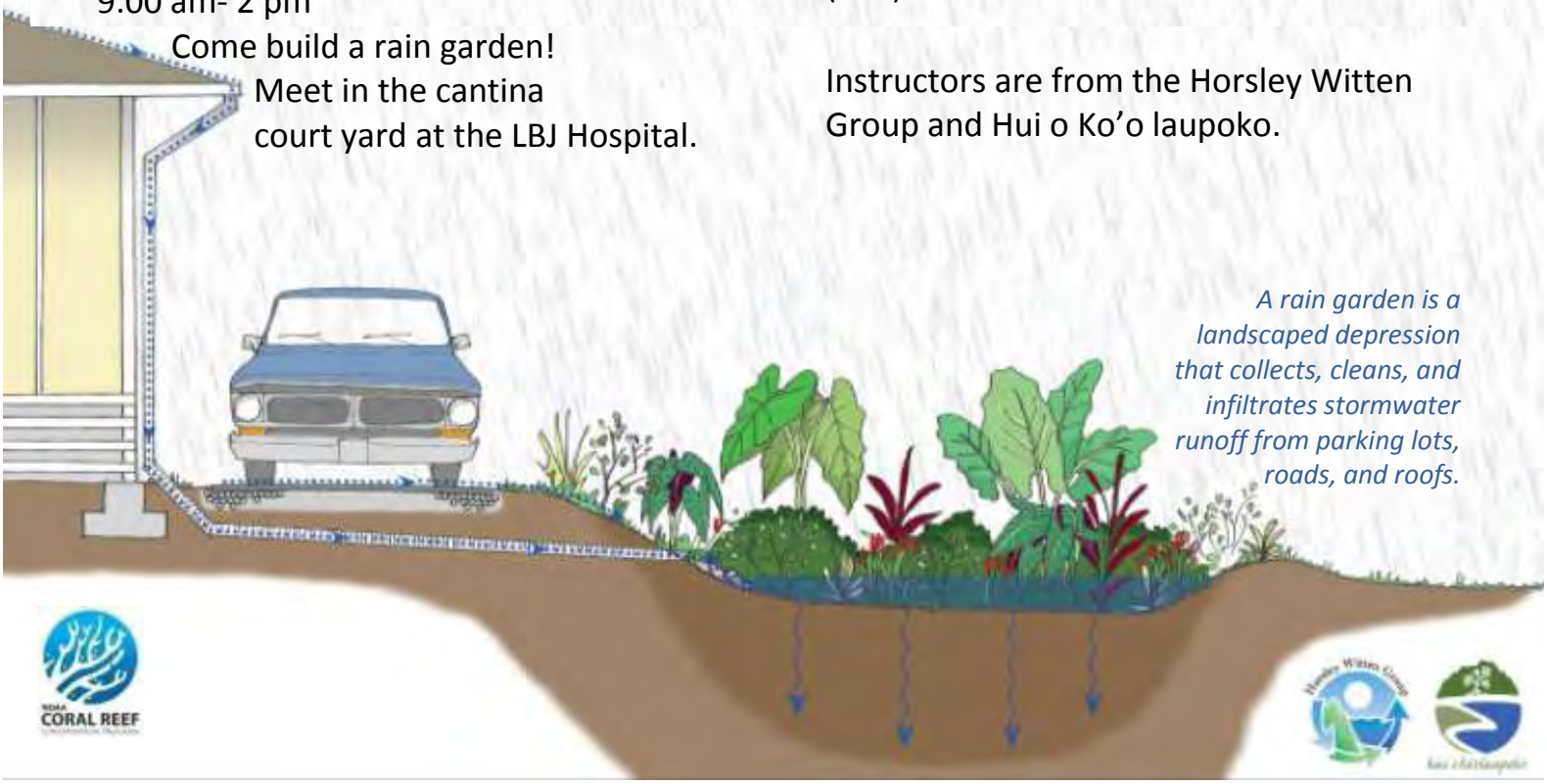
DON'T WAIT!

Seating for this workshop is limited. Register by Monday, August 10, 2015.

FOR DETAILS AND TO REGISTER, CONTACT

Meagan Curtis at meagan.curtis@crag.as or (684) 633-0382.

Instructors are from the Horsley Witten Group and Hui o Ko'o laupoko.

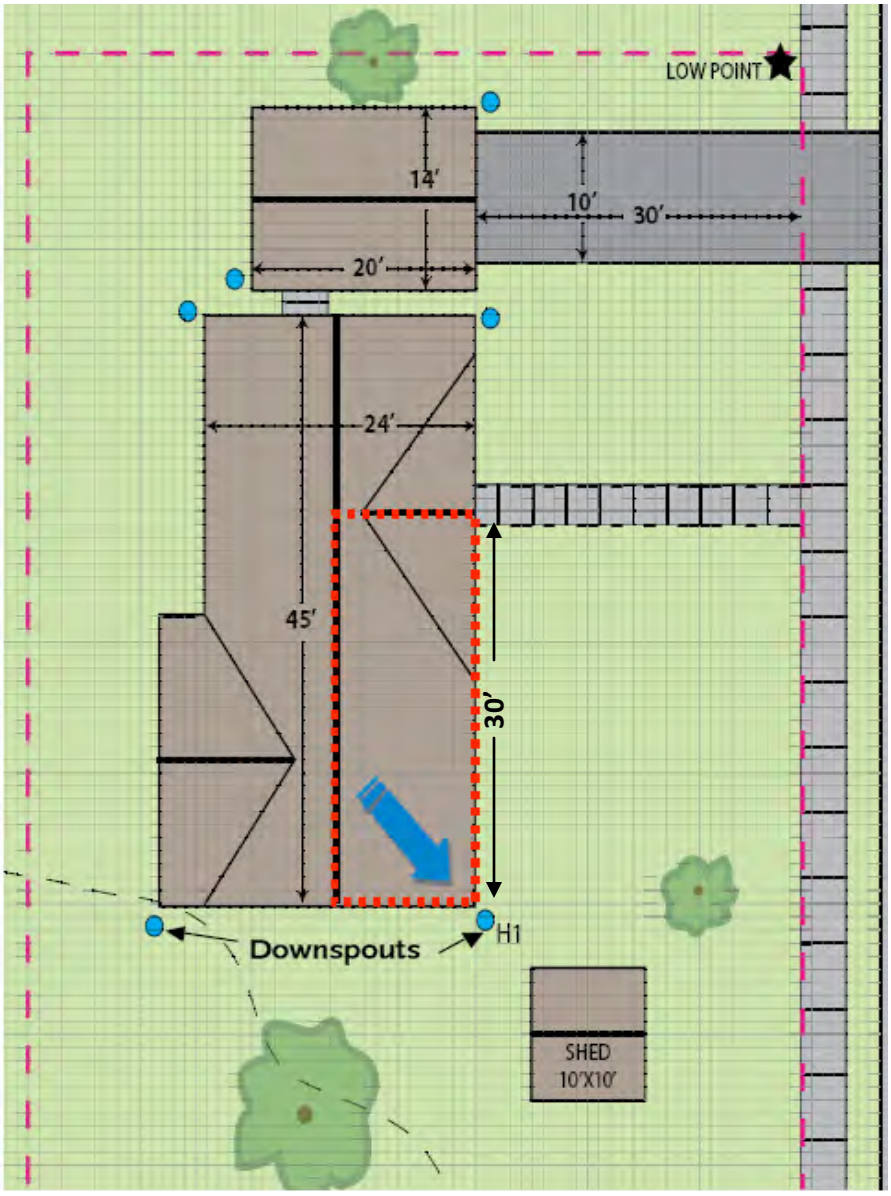


A rain garden is a landscaped depression that collects, cleans, and infiltrates stormwater runoff from parking lots, roads, and roofs.

Rain Garden Sizing Exercise

What is the recommended surface area of a rain garden installed to manage drainage from the downspout labeled H1 in the figure below? Assume soils are good and your ponding depth is going to be 6 inches. Also assume that you want to try to meet the American Samoa rainfall target of 1.6 inches (0.13 ft). Use the following equation. Don't forget to convert inches to feet!

$$\text{Rain garden surface area (ft}^2\text{)} = \frac{\text{Drainage area (ft}^2\text{ impervious) X AS target rainfall depth (ft)}}{\text{Ponding Depth (ft)}}$$



Steps:

1. Calculate the roof area draining to downspout labeled H1 (in red).
   _____ft^2
2. Convert ponding depth from inches to feet.
   _____ft
3. Convert rainfall depth from inches to feet
   _____ft
4. Multiply drainage area times rainfall depth and then divide by ponding depth to get target rain garden surface area of:
   _____ft^2
5. Sketch the raingarden footprint on the graphic.
6. What would the size be if soils were clayey?

   Ponding depth_____ft

   Surface area_____ft^2

Graphic from Oregon State University Rain Garden Manual

Faga'alu Beach Park
Rain Garden Sizing

1. Calculate the rain garden surface area needed for the 1.6 inch rainfall depth target.
2. Is the proposed rain garden footprint large enough to meet the target?
3. If it does not meet the target size, how would you justify making it smaller?

Rain Garden Maintenance and Care

1. Immediately after Installation

Now that you've installed your rain garden, it is time to sit back and enjoy the beautiful addition to your landscape. But first, check a few things:

- ***Site Area Cleanup.*** In particular, make sure that exposed soil is not likely to cause sedimentation in your rain garden. If areas of exposed soil are present in the drainage area, seed and mulch immediately, or, better yet, seed and cover with erosion control matting.
- ***Make Sure Your Plants Are Happy.*** Often plants need a good initial watering and need to be mulched. Depending on the plants and soil, one-time, spot fertilization may be needed after initial plantings (e.g., very sandy soils).
- ***Advertise.*** Believe it or not, many people may not know what they are looking at when they see the rain garden. Your rain garden may need signage or temporary fencing so people know to keep out during the tender establishment period. This is particularly true if you are using small plugs that will take a little time to get established.

2. First Year or Two of Maintenance

In the first year, your rain garden will mature from a newborn to a rowdy adolescent. As a result, you need to exercise some parental control:

- ***Check on your rain garden's behavior.*** For the first 6 months following installation, the site should be inspected at least twice after storm events that exceed 1/2 inch of rainfall. Check for areas of erosion, water short-circuiting through or around the rain garden, and areas of standing water (30 hours after the storm). After heavy downpours, it is important to check your rain garden for areas of damage, erosion, or water bypassing the rain garden.
- ***Watering.*** If the weather is dry, watering is needed once a week during the first 2 months after installation, and then as needed, depending on rainfall.
- ***Weeds, weeds, weeds.*** *Plants can grow like mad here in the tropics. You may have imported additional seeds with your mulch or compost. Weeding will likely be a monthly activity.*
- ***Spot reseeding in drainage area.*** Look for bare or eroding areas in the contributing drainage area or around the rain garden, and make sure they are immediately stabilized with turf, mulch, or other vegetative cover.
- ***Remove and replace dead plants.*** Since up to 10% of the plant stock may die off in the first year, it is important to note whether plants do not take root in the first growing season. If plant mortality creates bare areas in your rain garden, you may want to do supplemental planting 6 months to a year after installation.

- ***Don't let water loiter in your rain garden.*** If there is still standing water in the rain garden 48 hours after a storm event, then your rain garden is probably not draining properly. If this is the case, try: (1) supplementing the soil with coarse sand and compost, (2) adjusting the overflow structure to let more water out, or (3) installing a perforated drain pipe (e.g., corrugated landscape pipe) in the shallow soil zone that discharges to a downhill location.
- ***Add more mulch.*** The tropics are a tough climate for mulch! You will probably need to remulch after one year, or until the plants cover the surface of your rain garden.
- ***Remove sediment from the filter bed surface.*** If more than a little sediment accumulates on the surface of the rain garden, it is a good idea to remove it with a flat shovel, and add more soil or sand if necessary.

3. Long-Term Maintenance

After a couple of years, your rain garden should be fairly self-sufficient, but plants still need to be cared for.

- ***Maintain good surface cover with plants & mulch.*** Check to see if 75% to 90% cover (mulch plus vegetative cover) has been achieved in the bed, and measure the depth of the remaining mulch. Thinning, pruning, and removing some plants will help keep plant diversity in your rain garden, as certain species are likely to want to take over. Inevitably, invasives will creep in, and you will need to remove these on a regular basis.
- ***Keep flow paths clear in the drainage area.*** Check for sediment buildup at curb cuts, pavement edges, downspouts, and any other inflow points that prevents flow from getting into the rain garden, and check for other signs of water bypassing the rain garden (e.g., flowing around it instead of through it).
- ***Check for sediment and trash on the filter bed.*** Note presence of accumulated sand, sediment and trash in the rain garden, and remove it.
- ***Check and repair erosion.*** Look at side slopes and areas around the rain garden for evidence of any rill or gully erosion, and repair it. In some cases after heavy storms, water may create channels or gullies through the bed of the rain garden itself. It is important to stop water from channelizing by trying to spread the flow more evenly over the rain garden surface by plugging the gullies with new soil, coarse sand, and/or compost and mulch.
- ***Trade your rain garden in for a newer model?*** In some cases, rain gardens may simply not work in the location chosen. Causes could be too much drainage area, improper soil, high water table, or improper construction techniques. The main symptom will be standing water. In these cases, it may be better to try installing a rain garden in a different location than trying to continuously nurse a sick patient.

The table below is a quick checklist of typical rain garden maintenance tasks and frequencies. You should always make a more specific plan and/or checklist for your installation.

Typical Maintenance Activities for a Rain Garden

Task	Frequency*
General Site Maintenance	
Keep foot and vehicular traffic out of rain garden; install signage	Immediately after installation
Site Area Cleanup	Immediately after installation, ensure that all trash is picked up and disturbed areas are stabilized with seed or erosion control matting
Trash Removal	Inspect minimum monthly and after major storm events; remove trash as needed
Inlet Locations	
Sediment removal	Inspect minimum once per year and after major storm events; Ensure sediment does not block inlet and cause flow to bypass the rain garden
Stabilize erosion	Inspect minimum once per year and after major storm events; stabilize as needed
Repair/replace inlet materials (e.g., downspout, curb cuts, stone)	Inspect minimum once per year; repair/replace as needed
Plant Maintenance	
Plant Cutting/Thinning	Annually
Weeding	Monthly at first, then at least twice a year (more may be necessary if invasive species are present)
Watering	Immediately after installation; during dry periods the first 1 - 2 years
Plant Replacement	Add reinforcement plantings during the first 6 months to a year to maintain desired vegetation density and aesthetics; then, as needed
Fertilizing	Should not be required
Mulch Maintenance	
Replace or supplement existing mulch	Once every 1-2 years as required to maintain desired depth
Re-mulch bare areas	After major storm events as needed
Filter Bed Maintenance	
Sediment removal	Inspect minimum once per year and after major storm events; remove sediment if buildup of >1 inch is observed. If you frequently observe a lot of sediment in your rain garden, check that the contributing drainage area is stabilized.
Stabilize erosion gullies on side slopes and in the bed itself	Inspect minimum once per year and after major storm events; stabilize as needed
Tilling/soil amendments to improve drainage	If standing water does not drain after 48 hours
Add underdrain	If standing water does not drain after 48 hours after tilling and/or soil amendments have been added
Outlet Locations	
Stabilize erosion	Inspect minimum once per year and after major storm events; stabilize as needed
Adjust height	If standing water is a problem in your rain garden, adjust height of outlet to let more water out.
*Adjust frequency as needed, particularly if there are chronic issues or unique features requiring special attention.	

Maintenance Plan for the Faga'alu Beach Park Rain Garden

Each rain garden should have a specialized maintenance plan. As a group, discuss the key elements unique to this rain garden and propose a plan for inspection and maintenance.

1. Responsible Party (ies):

General Site Maintenance
Inlet Location(s)
Plant Maintenance
Filter Bed and Mulch Maintenance
Outlet Location(s)
Other?

Testing Soil for Rain Gardens

The quality of your soil—its ability to hold and drain water is one of the most important considerations for understanding your site and sizing a rain garden. How fast your soil drains depends on its ability to absorb water at the surface and then allow it to percolate down into the lower layers. The constituent parts of the soil, organic matter, sand, silt, and clay all play into this ability. Testing soil also helps you find out if high water tables and underlying bedrock may make a rain garden impractical on a site.

There are two steps for assessing your site's soil. First, you will dig a hole and test the soil's infiltration ability. Then you will use your senses to learn about the consistency of the soil and its constituent parts.

Testing Infiltration: the Simple Approach

1. Dig a test hole in the area where you expect to build your rain garden. Try to site the hole so that it is in what you think will be the middle of your garden. If your garden will be 6 inches in depth, then excavate to 6 inches (or 9 or 12 inches respectively). Set the spoils from your hole aside for a "feel" test later.
2. If you run into a hard layer that cannot be penetrated with a shovel or, you come across water in the hole, then stop and note this. Rain gardens should not be sited over high water tables, so your site is inappropriate. If your hard surface is rock, you may also want to move the rain garden to another location where you don't have that layer.
3. Fill the hole with water to just below the rim. Record the exact time you stop filling the hole and the time it drains completely.
4. Refill the hole again and repeat step 3 twice more. The third test will give you the best measure of how quickly your soil absorbs water when it is fully saturated as it would be during a rainy period of the year or during a series of storms that deliver a lot of rainfall in a short period of time. Building a rain garden to handle these conditions is a way to be safe that you will not cause damage to your own or a neighbor's property.
5. Divide the amount the water dropped by the amount of time it took for it to drop. For example, if the water dropped 1 inch in 2 hours, then 1 divided by 2 equals 0.5 inch per hour of infiltration.

Testing Infiltration: the Modeling Approach

1. Dig a hole to the proposed rain garden depth (6, 9 or 12 inches).
2. Fill with water, measure depth, record time and depth.
3. Measure depth and record time at regular intervals until water drains completely. If the water drains quickly, then check it at least every minute. If it drains slowly, check it every 10 minutes for at least an hour or until all of the water is gone. Record the distance the water had dropped from the edge of the hole.
4. Calculate infiltration rate for **each time period** = depth (inches) / time (hours)
5. Repeat process at least two more times or until the slowest measured rate does not vary.
6. The slowest rate measured is the "design" infiltration rate and can be used with a sizing table and precipitation map, provided separately.

Note that some jurisdictions require the slowest rate to be divided by 2 as a safety factor, thus increasing the size of the rain garden.

Interpreting the Infiltration Test(s)

If your soils drained water between 0.5 and 2 inches per hour, then you have adequate infiltration for a rain garden. If you drained faster than 2 inches/hour, then you will need to plan for more drought-tolerant plants in your rain garden, since it will likely absorb most of the water at the inflow points.

If you have less than 0.5 inches per hour of infiltration, then you should not build a rain garden at that site. Most local governments will not allow a rain garden to be installed in a site where soils are poorly drained (below 0.5 inch/hour), over high water tables, or over close to the surface bedrock.

Using the "Feel" Test for Soil Consistency

1. Take a handful of the soil you have excavated from your infiltration test. Pulverize it in your hand and remove any bits of organic matter or obvious rocks.
2. Wet it with a small amount of water and rub it between your thumb and index finger. Don't saturate it until it is runny mud. You might feel stickiness, grittiness or smoothness. The grittier the feel, the more sand is present in your soil. The slicker the soil, the more clay in it. Smooth soils are sometimes an indicator of a fine silt or loam. Discard the soil.
3. Next, take another sample in your hand. Wet it until it has the consistency of dough. You should be able to form a ball with the soil in your palm that holds together. If you cannot get the ball to form, then your soil is very sandy. In most soils, however, you should be able to create a rough ball.
4. Knead the soil together between your thumb and fingers. Again, remove any obvious organic matter or rocks. You should be able to form a ribbon with the soil. As you build the ribbon, it will either hold together or break off. If the soil breaks quickly in the process, then it has a high sand content. If the ribbon forms quickly and stays strong, it has more clay.

Interpreting the Soil Consistency Test and Using it with the Infiltration Test

Soils that have a high sand content will drain quickly and might need to have some amendments added to increase moisture holding ability during the dry periods. Alternatively, you may want to plant more drought tolerant plants in rain gardens with sandy soils.

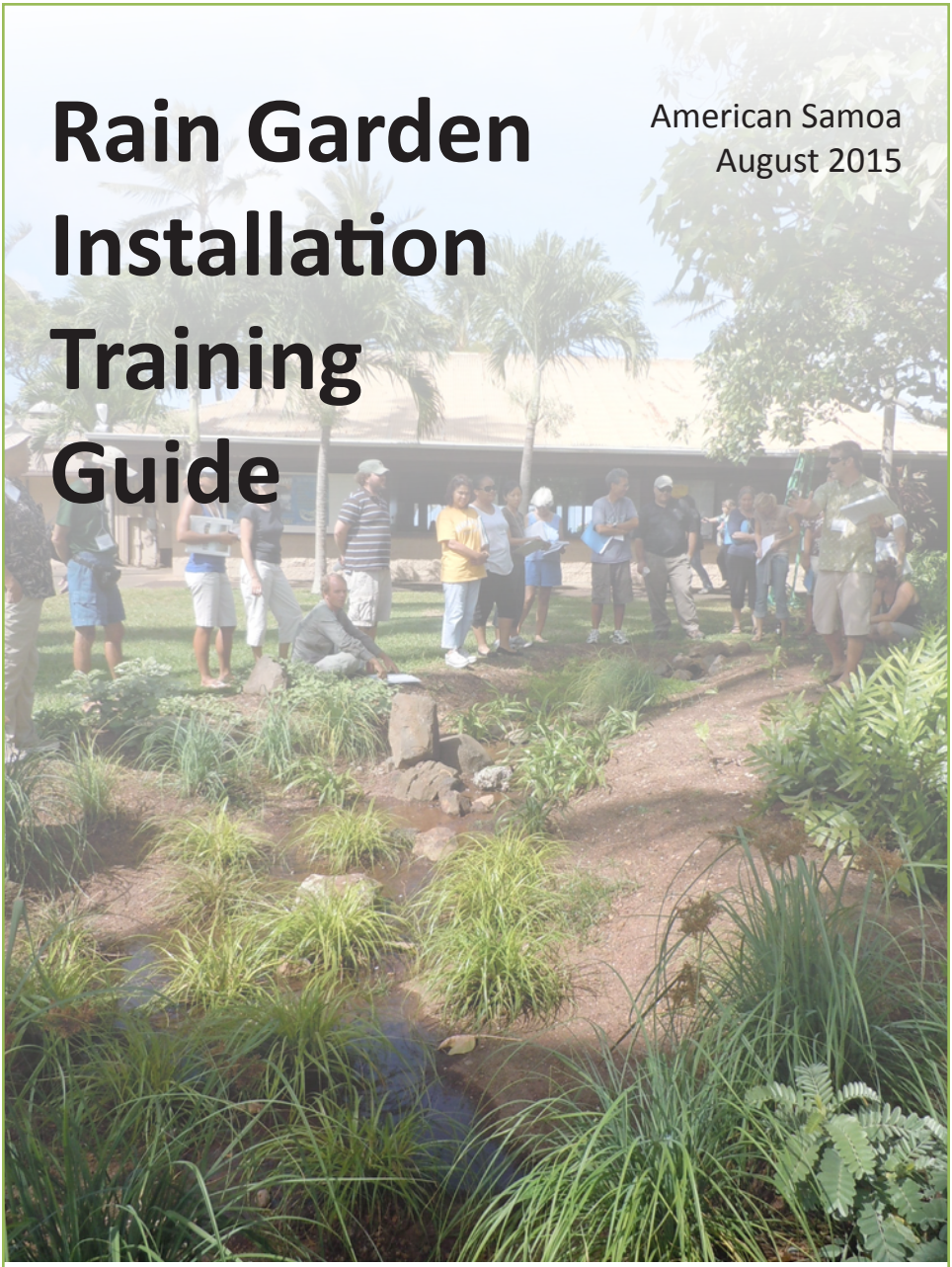
Soils with high clay content will drain slowly or sometimes, not at all. High clay soils will need some organic matter added to increase infiltration. Conversely, you may need to plan for a larger rain garden (doubling the size for example) or a constructing a deeper basin (12" instead of 6" for example) that will hold more water. With high clay soils, plan for plants in that type of soil that will be flooded more often and for longer periods. Even on the coast, however, these plants may need to be irrigated in the summertime or should be tolerant of drought during a 2-3 month period.

Attachment B

Rain Garden Installation Guide

Rain Garden Installation Training Guide

American Samoa
August 2015



CORAL REEF ADVISORY GROUP
CRAG

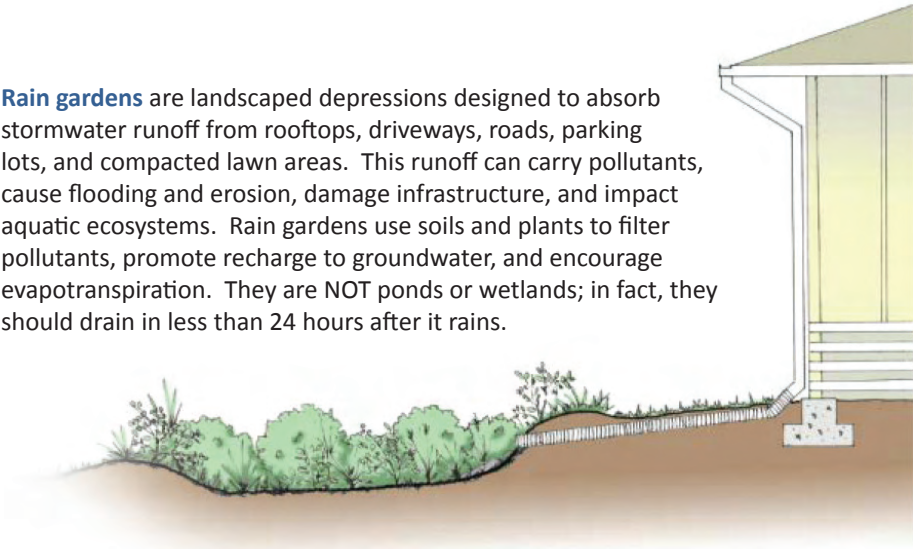
NOAA CORAL REEF

Horsley Witten Group

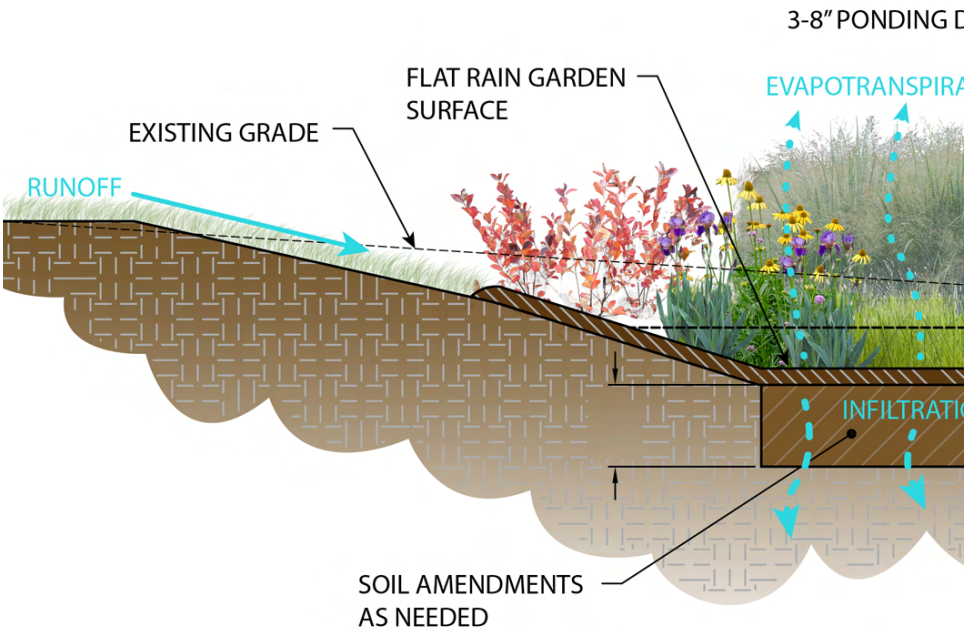
hui o ko'olaupoko

Rain Garden Basics

Rain gardens are landscaped depressions designed to absorb stormwater runoff from rooftops, driveways, roads, parking lots, and compacted lawn areas. This runoff can carry pollutants, cause flooding and erosion, damage infrastructure, and impact aquatic ecosystems. Rain gardens use soils and plants to filter pollutants, promote recharge to groundwater, and encourage evapotranspiration. They are NOT ponds or wetlands; in fact, they should drain in less than 24 hours after it rains.



Rain gardens are frequently used at homes, schools, and public buildings to manage fooftop runoff.

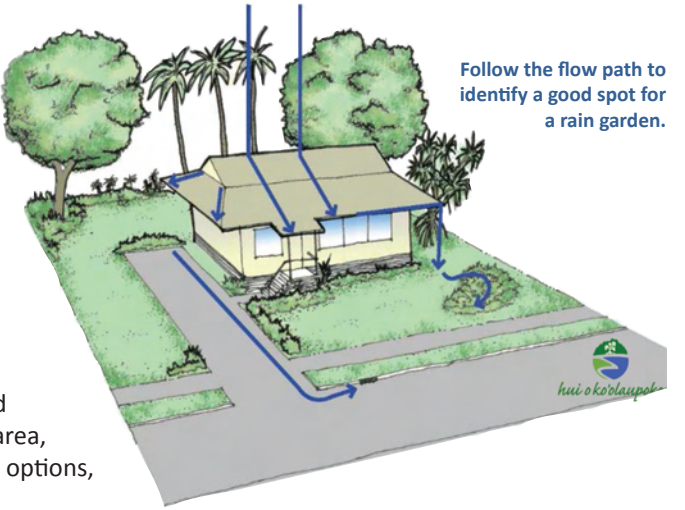


Site Selection

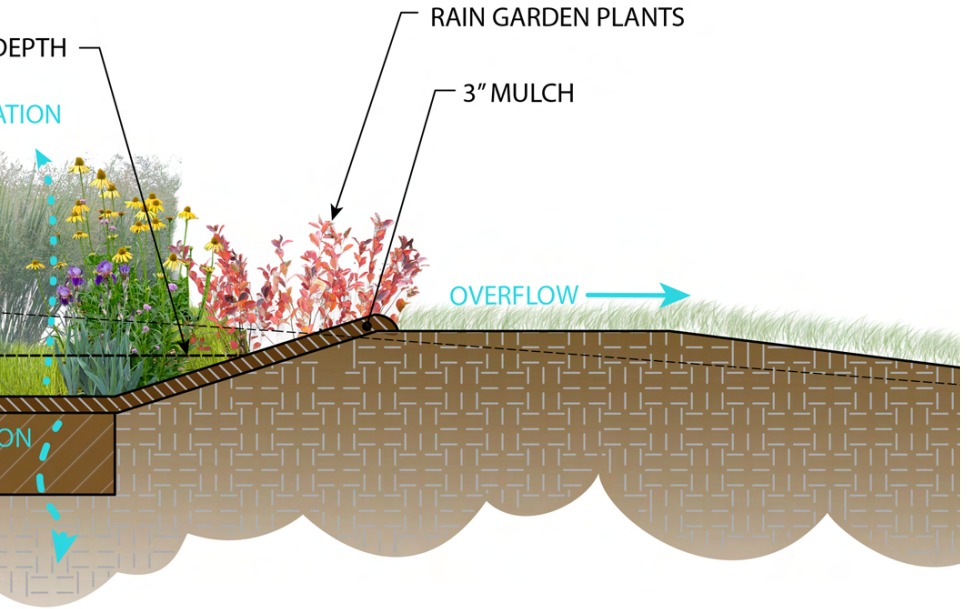
Picking the right spot for your rain garden is essential.

1. Walk the site.

- ✓ Trace the stormwater flow path;
- ✓ Note location of drainage infrastructure as well as trees, retaining walls, adjacent property, cesspools, etc; and
- ✓ Identify drainage area, slope, conveyance options, and soils.



Follow the flow path to identify a good spot for a rain garden.



Cross-section of a typical rain garden and how plants and soils managae stormwater runoff.

Site Selection

2. **Determine the best location for your rain garden.** Several issues need to be considered before determining the exact location of your rain garden:
   - ✓ Setbacks
     - o 2 ft from a crawl space or slab;
     - o 10 ft from a wall and basements;
     - o 3-4 ft from a sidewalk/driveway; and
     - o 25-50 ft from septic/cesspools.
   - ✓ Avoid areas:
     - o That stay consistently wet, as this indicates poor drainage;
     - o In soils that have high groundwater or bedrock;
     - o Where infiltration is < ½ in/hr, unless you plan to amend soils.
     - o Under trees or within close proximity such that roots will be damaged during digging;
     - o On steep slopes, unless you are prepared for more digging and/or engineering;
     - o Where there is a large contributing drainage area; and
     - o That you can't get water into and out of easily.

Dig a hole and test the soil infiltration rate.

3. **Estimate drainage area, slope, soils, and infiltration rates.**
   a. For simplicity, the drainage area is defined as the total impervious area draining to the rain garden measured in sq ft. Roofs are easy; parking lots and roads can be a little more difficult.
   b. Slope can be estimated using two stakes, a string, a level, and a measuring tape.
   c. For soils, consider testing nutrients, pH, texture, and percolation rate. Use Table 1. for guidance based on results.

Table 1. Results from Infiltration Tests

Drainage Rate	Recommendation
< ½inch/hour	May want to seek professional assistance; rain garden likely needs perforated drain pipe in or under the soil layer.
½ - 1 inch/hour	Low infiltration for a rain garden. Homeowners may want to build a larger or deeper garden, or likewise plan for additional overflow during high-rainfall storms.
1 - 1 ½ inches/hour	Adequate infiltration for a rain garden. Plan for sufficient overflow during high-rainfall storms.
1 ½ - 2 inches/hour	
> 2 inches/hour	High infiltration for a rain garden. Design should feature fewer moisture-loving and more drought-tolerant plants. The rain garden may also be sized to hold smaller amounts of water, have a deeper mulch layer, or have denser plantings.

Source: OSU, Sea Grant: The Oregon Rain Garden Guide

Design

You don't need to be an engineer to design a rain garden.

1. Size your rain garden.

Rain garden dimensions include surface area and ponding depth. Residential rain gardens are typically 200-400 sq ft in surface area. The size of the rain garden can be estimated as a function of volume of runoff to be treated and infiltrated. A good target to shoot for is sizing the rain garden to handle 90% of most storm events, which is equal to 1.6 inches (or 0.13 ft).

- ✓ Depth can depend upon the soil
  - o Sandy loam: great! 4-8"depth
  - o Clay: not so great! Increase the surface area, decrease the depth, or amend soils (coarse sand and/or compost). 3" depth recommended.
- ✓ Approximate surface area can be derived using the equation below.

Table 2. Approximate Rain Garden Size (ft^2) to meet AS rainfall target of 1.6" (0.13 ft)

Impervious Drainage Area	Ponding Depth		
	3" (.25 ft)	6" (.50 ft)	8" (.67 ft)
500 ft^2	260	130	100
750 ft^2	390	195	150
1000 ft^2	520	260	195
1500 ft^2	780	390	290
2000 ft^2	1040	520	390

- ✓ Adjust size based on length of flow path over pervious area; depth selected; amended soils; drainage area reductions; or managing less than the target rainfall depth.

2. Amend soils (if necessary).

- ✓ For 100 sq ft rain garden with 6" ponding depth:
  - o Coarse Sand —1 cubic yard
  - o Compost—1 cubic yard

$$\text{Rain garden surface area } (ft^2) = \frac{\text{Drainage area } (ft^2 \text{ impervious}) \times \text{AS rainfall target (ft)}}{\text{Rain garden ponding depth (ft)}}$$

Rain gardens can be designed as aesthetic landscapes.

Design

3. Direct water in and out.

- ✓ For inlet, consider the following:
  - o Extended downspout/gutter;
  - o Across lawn via a gradual slope;
  - o Vegetated or stone-lined swales;
  - o Diversion berm along bottom of slope; and
  - o Paved surface.
- ✓ For overflows, consider the following:
  - o Do not direct overflow to other properties or structures (i.e., away from buildings);
  - o Making berm higher near buildings;
  - o Directing sheet flow over lawn, driveway or walkway;
  - o Directing flows into existing yard drain inlets; and
  - o Directing flows into existing storm drain inlets on streets.

4. Develop a planting plan.

Check with Land Grant or CRAG to determine best plants.

- ✓ Use plants tolerant to both wet/dry conditions, as well as site shade & salt;
- ✓ Prefer native species and DO NOT plant invasive vegetation;
- ✓ Avoid using edible plants, particularly if treating parking lots or roads;
- ✓ Provide for variable heights, color, leaf shape (trees, shrubs, herbaceous);
- ✓ Avoid placing woody vegetation at inflow/outflow locations; and
- ✓ Consider visual appeal and maintenance.

Example plants include:

Taro, ti, ginger, lily, lemongrass, vetiver, aloe, hibiscus, beach pea, and banana (possibly).

Ti plants offer interesting color variations.

Installation

Building a rain garden is easy, but does take some planning.

1. Prepare.
- ✓ Delineate footprint with string/ spray paint.
- ✓ Install erosion & sediment controls (ESC).
- ✓ Material and equipment staging.
- ✓ Remove grass (reuse, if possible).
- ✓ Call for utility locations before you dig!!

2. Excavate.
- ✓ With a ponding depth of 4-8", plus 2-3" of organic layer, may need to excavate ½-1 ft. May need to over-excavate to aerate compacted soils.
- ✓ Create berms with excavated material.
- ✓ Be sure to level the bottom of ponding area.

3. Install inlets and overflows.
This will vary depending on design. Use pipes, stone or channels as needed.

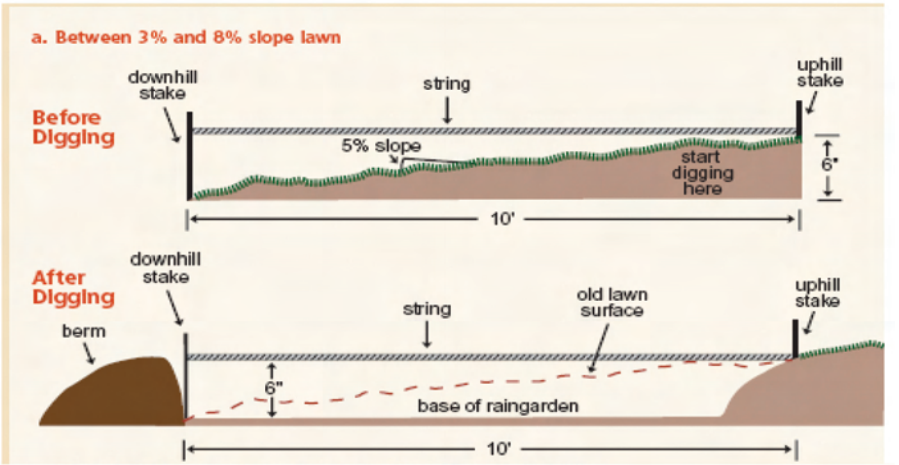
4. Amend soils.
- ✓ Amend soils with sand and organics, where necessary. Clayey soils may need more sand.
- ✓ Be sure not to compact area when refilling.

5. Add mulch/organic surface layer (1-3"). Protect small plants.

6. Plant.
- ✓ Arrange plants first, then remove from containers.
- ✓ Score root-bound plants.
- ✓ Dig holes (width 2 x root ball width); leave room for mulch layer.
- ✓ Plugs can go in after mulch.

7. Turn on water to inspect flow path and to soak plants. May need to water for the first few weeks.

8. Clean up site. Remove ESC once area is stabilized.



Cut and fill during rain garden excavation (University of Wisconsin Extension).

Installation

Steps 1 & 2
Mark perimeter and excavate.

Step 3
Install inlet and outlet structures.

Installation

Step 4
Amend soil with sand or organics, if necessary.

Step 5
Add mulch to keep soil moist and reduce weeds.

Step 6
Add rain garden plants.

Installation

List of tools
- ✓ Shovel(s)
- ✓ Trowel(s)
- ✓ Rake(s)
- ✓ Hammer
- ✓ Gloves
- ✓ 3' level and 2"x4" (optional)
- ✓ Wheel barrow
- ✓ Tarp
- ✓ 2 wooden stakes
- ✓ String
- ✓ Rope or spray paint (to mark footprint)
- ✓ Measuring Tape
- ✓ Calculator
- ✓ Hose for watering
- ✓ Rototiller (optional)
- ✓ Backhoe (optional)
- ✓ Saw (optional)

List of supplies
- ✓ Soil amendments (if needed)
- ✓ Mulch or compost
- ✓ Plants
- ✓ Stone (optional)
- ✓ Pipe (optional)
- ✓ Timber (optional)

Step 7
Water plants to help them establish.

Santos Memorial Park rain garden, Guam after 1 year.

Inspection & Maintenance

Regular inspection and maintenance is critical to ensuring proper rain garden function.

1. **Establish a maintenance plan for the rain garden**.

2. **Maintenance inspections** should be performed once a month for the first few months after installation. Afterwards, inspections should generally occur on an annual-basis, after rain storms, and during regular on-site landscaping activities. Maintenance plans should be tailored to specific installations to address unique features and/or chronic maintenance concerns.

3. **Be sure to look for:**
   - ✓ Debris and trash accumulation
   - ✓ Weeds and invasive plants
   - ✓ Sediment build up
   - ✓ Plant and grass health
   - ✓ Erosion/gullying
   - ✓ Inlet/outlet structure clogging
   - ✓ Standing water/drainage issues

4. **Outline specific procedures** for each individual rain garden that give instructions for:
   - ✓ Debris and sediment removal
   - ✓ Vegetation pruning and trimming
   - ✓ Mowing
   - ✓ Chemical maintenance for disease and pest control (not suggested). No fertilization is recommended
   - ✓ Plant and mulch replacement
   - ✓ Measures for dealing with drainage failures (e.g., structural repair, soil replacement)

Resources

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