Rain Garden Installation Clinic

CNMI Museum of Culture and History, Saipan

April 25-26, 2012

COASTAL RESOURCES MANAGEMENT

Division of Environmental Quality DEQ CNMI

NOAA CORAL REEF CONSERVATION PROGRAM

Horsley Witten Group

CENTER FOR WATERSHED PROTECTION

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hui o ko'olaupoko

Agenda

Day 1

Wednesday, April 25, 2012
CNMI Museum of Culture and History (across from Sugar King Park)

8:00 **Registration**

8:30 – 9:00 **Rain Gardens & Stormwater Introduction/Icebreaker**
Group discussion about the role that rain gardens play in stormwater management and why they are important

9:00 – 12:00 **Rain Garden Installation**
Hands on installation of rain garden; walk around museum site to discuss other potential rain garden locations

12:00 – 1:00 **Lunch**

1:00 – 2:00 **Rain Garden Design**
How do you determine how big the rain garden should be? What is so important about soils on site? How does water get in and out of the rain garden? What plants do you use?

2:00 – 3:00 **Rain Garden Construction**
What are the procedures for constructing a rain garden? What can go wrong and how big of a deal is it? Where can we get these materials on island?

3:00 – 3:30 **Rain Garden Maintenance**
What kind of maintenance is required (1) immediately after installation, (2) within the first year or two, (3) long-term, and (4) do rain gardens ever need to be completely redone?

3:30 – 4:00 **Quiz**

Day 2

Thursday, April 26, 2012
Location TBA

8:00-11:30 **Rain Garden Site Selection and Design**
In small groups, use the rain garden field form to look for other potential sites around Garapan. Sketch a rain garden design, include sizing estimates.

Rain Garden Basics

Rain gardens are vegetated depressions designed and built to accept stormwater runoff from rooftops, roads, parking lots, and compacted soils. Rain gardens use native soils and plants, and are increasingly being constructed by homeowners to reduce the impact of stormwater on nearshore waters.

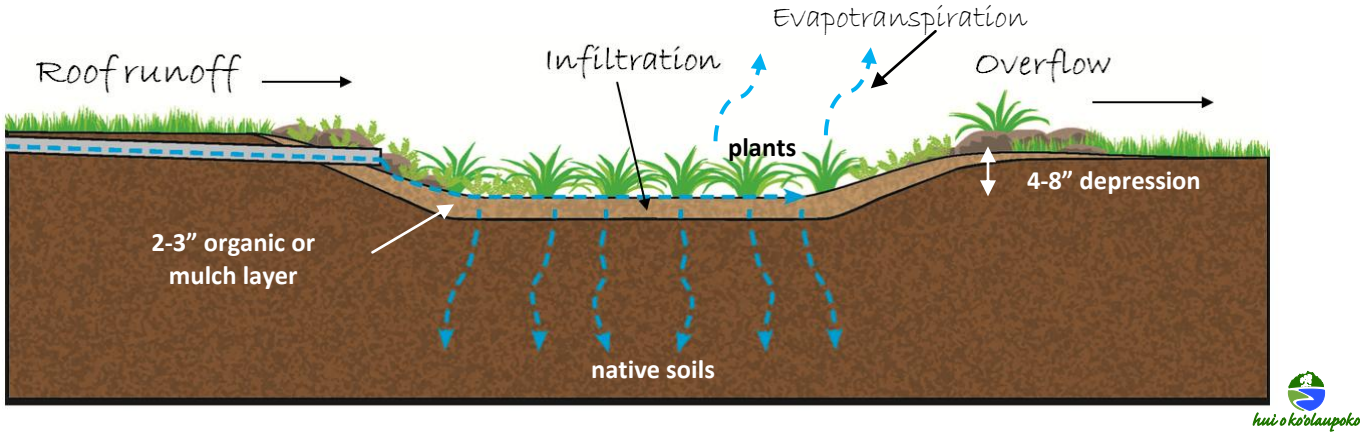


Figure 1. Cross-section of a typical rain garden and the fate of stormwater runoff (adapted from Hui o ko'olaupoko).

Stormwater runoff is the fraction of rainfall that collects on impervious surfaces such as rooftops, roads, parking lots, and compacted soils rather than soaking into the ground, evaporating, or being taken up by plants. This runoff can: 1) carry pollutants; 2) cause flooding; 3) erode streams, ditches, and exposed soils; 4) damage infrastructure; and 5) negatively impact freshwater and marine ecosystems.

Rain garden soils can filter some of the pollutants from stormwater runoff, promote recharge to groundwater, and encourage evapotranspiration from the plants. Rain gardens can also serve aesthetic purposes, replace other landscaped features, and provide habitat. They should drain in well under 24 hours after a small rain event.

The 2006 CNMI/Guam Stormwater Design Manual provides standards and information on structural best management practices (BMPs) that can be used in CNMI to help reduce the impacts of stormwater runoff. Rain gardens are "lighter" versions of the bioretention facilities included in the manual. Rain gardens are simpler in design, may include minor soil modifications, and are intended for homeowners to construct. Bioretention practices are more engineered (e.g., underdrain system, outlet structure, and an engineered soil media) and require professional assistance in design and installation.

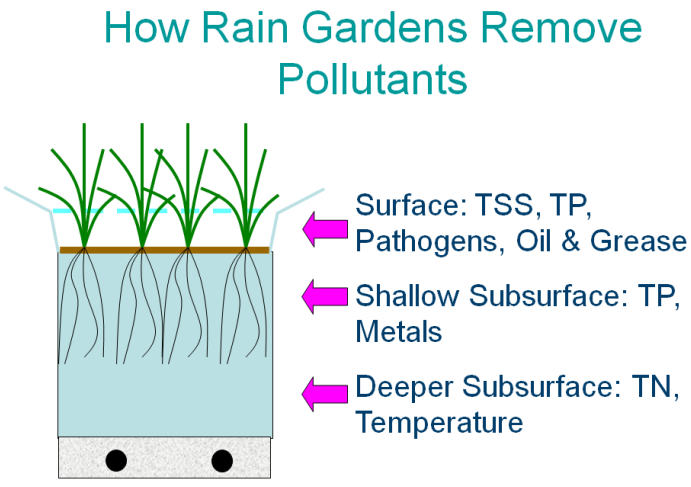


Figure 2. Pollutant removal in different parts of the rain garden.

Building a Rain Garden

Rain gardens can collect runoff from rooftops, driveways, roads, parking lots, and areas of compacted soils.

Site Selection

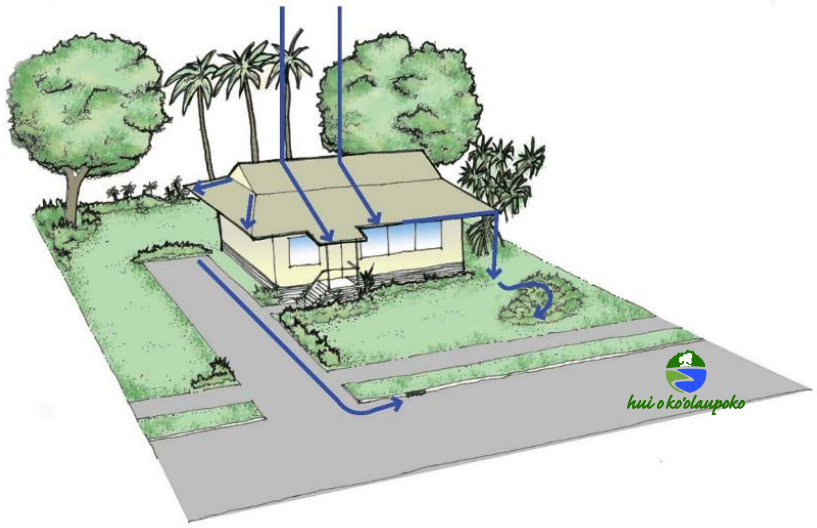


Figure 3. Follow the flow path to identify a good spot for a rain garden.

- **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, soils.

- **Determine the best location for your rain garden**

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

- **Estimating drainage area, slope, soils, and infiltration rates**
  - ✓ 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.
  - ✓ Slope can be estimated using two stakes, a string, a level, and a measuring tape.
  - ✓ For soils, consider testing nutrients, pH, texture, and percolation rate (**see attached sheet for procedures)**. Use the following charts as a guidance based on your 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.

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

Rain Garden Design

- **Sizing your rain garden**

  Rain garden dimensions include surface area and ponding depth. Residential rain gardens are typically 100-300 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 CNMI's Water Quality rainfall target, or 90% of most storm events, which is equal to **1.5 inches** (or 0.125 ft).

Table 2. Approximate Rain Garden Size (ft^2) to meet CNMI rainfall target of 1.5"

Impervious Drainage Area	Ponding Depth		
	3" (.25 ft)	6" (.50 ft)	8" (.67 ft)
500 ft^2	250	125	95
750 ft^2	375	190	140
1000 ft^2	500	250	190
1500 ft^2	750	375	280
2000 ft^2	1000	500	375

- ✓ Depth can depend upon the soil
  - Sandy loam: great! 4-8"depth
  - 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 following equation:

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

See attached Sizing Exercise

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

- **Soil amendments**
  - ✓ For 100 sq ft rain garden with 6” ponding depth
    - Coarse Sand (Bank Run Sand)—1 cubic yard
    - Compost—1 cubic yard

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

- **Plant selection and placement**

  Plants will be specific to each island and rainfall regime. Check with University Extension, NRCS or other resources to determine best match for local climate.
  - ✓ Use plants tolerant to both wet/dry conditions, as well as site shade, salt, & wind factors;
  - ✓ Prefer native species over non-native (some exceptions) 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 materials);
  - ✓ Avoid placing woody vegetation at inflow/outflow locations; and
  - ✓ Consider how the plants fit within the property’s visual appeal and maintenance routine.

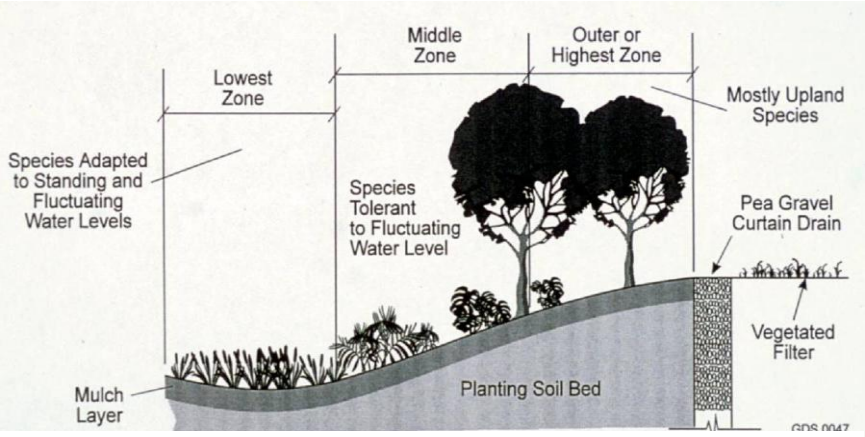


Figure 4. Example locations within a rain garden for placement of various types of plants.

Approximate # of Plants Based on Size at Maturity

Size of Rain Garden	Approximate Amount of Plants
100 square feet	1 Small Tree (Optional) 7 Shrubs 24 Herbaceous Species
200 square feet	1 Small Tree (Optional) 14 Shrubs 48 Herbaceous Species

Plant Spacing Cheat Sheet

18” O.C. = divide sq ft by .44
24” O.C. = divide sq ft by .25
30” O.C. = divide sq ft by .16
36” O.C. = divide sq ft by .11

Rain Garden Installation

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

- **Excavate to desired depth**
  - ✓ With a ponding depth of 4-8 inches, plus 2-3 inches of organic layer, may need to excavate ½-1 foot. May need to dig a little deeper to aerate compacted soils.
  - ✓ Create berms with excavated material.
  - ✓ Work amendments into the native soil.
  - ✓ Be sure to level the bottom of ponding area.

- **Amend soils with sand and organics, where necessary**
  - ✓ Clayey soils will need more amending
  - ✓ Be sure not to compact area when refilling
  - ✓ Be sure to level the bottom of ponding area

- **Install inlet and overflow systems**

- **Install plants**
  - ✓ 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

- **Add mulch/organic surface layer (~3 inches)**
  - ✓ Protect small plants

- **Turn on water to inspect flow path and to soak plants**
  - ✓ May need to water for the first few weeks

- **Clean up site**

- **Remove ESC practices once site is stabilized**

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)

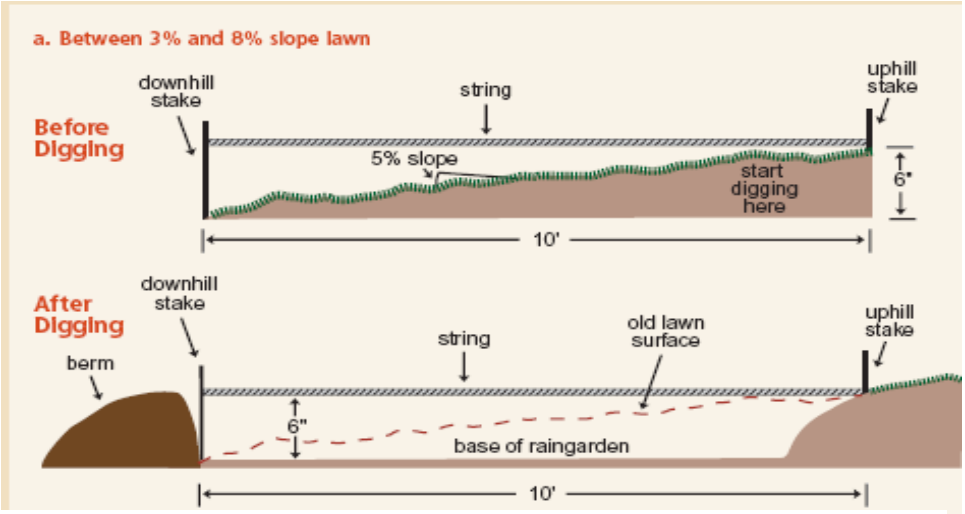


Figure 5. Cut and fill during rain garden excavation (University of Wisconsin Extension).

Inspection and Maintenance

Regular maintenance is critical to ensuring proper rain garden function.

- ✓ Establish a maintenance plan for the rain garden (**see attached handout).**

- ✓ 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.

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

- ✓ 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

Bannerman, Roger, and Ellen Considine. 2003. *Rain Gardens: A How-to Manual for Homeowners.* UWEX Publication GWQ0371-06-5M-100-S. University of Wisconsin Extension. http://dnr.wi.gov/runoff/pdf/rg/rgmanual.pdf

Center for Watershed Protection and Horsley Witten. 2009. Island Stormwater Practice Design Supplement. http://www.deq.gov.mp/artdoc/Sec6art55ID672.pdf

Dietz, M., Filchak, K., ands. Schadt. 2011. Rain Gardens: a Design Guideline for homeowners in Connecticutt. University of Connecticut. http://nemo.uconn.edu/publications/rain_garden_broch.pdf.

Horsley Witten. 2006. CNMI and Guam Stormwater Management Manual. Prepared for CNMI Division of Environmental Quality and Guam Enivronmental Protection Agency. www.deq.gov.mp/article.aspx?secID=6&artID=199.

Hui o ko'olaupoko (HOK). 2011. He'eia Rain Garden. http://huihawaii.org/raingardens.html

HOK. 2012. State of Hawaii Rain Garden Manual with plant selection guide (coming soon).

Oregon State University. 2010. *The Oregon Rain Garden Guide: Landscaping for Clean Water and Healthy Streams*. http://seagrant.oregonstate.edu/sgpubs/onlinepubs.html

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

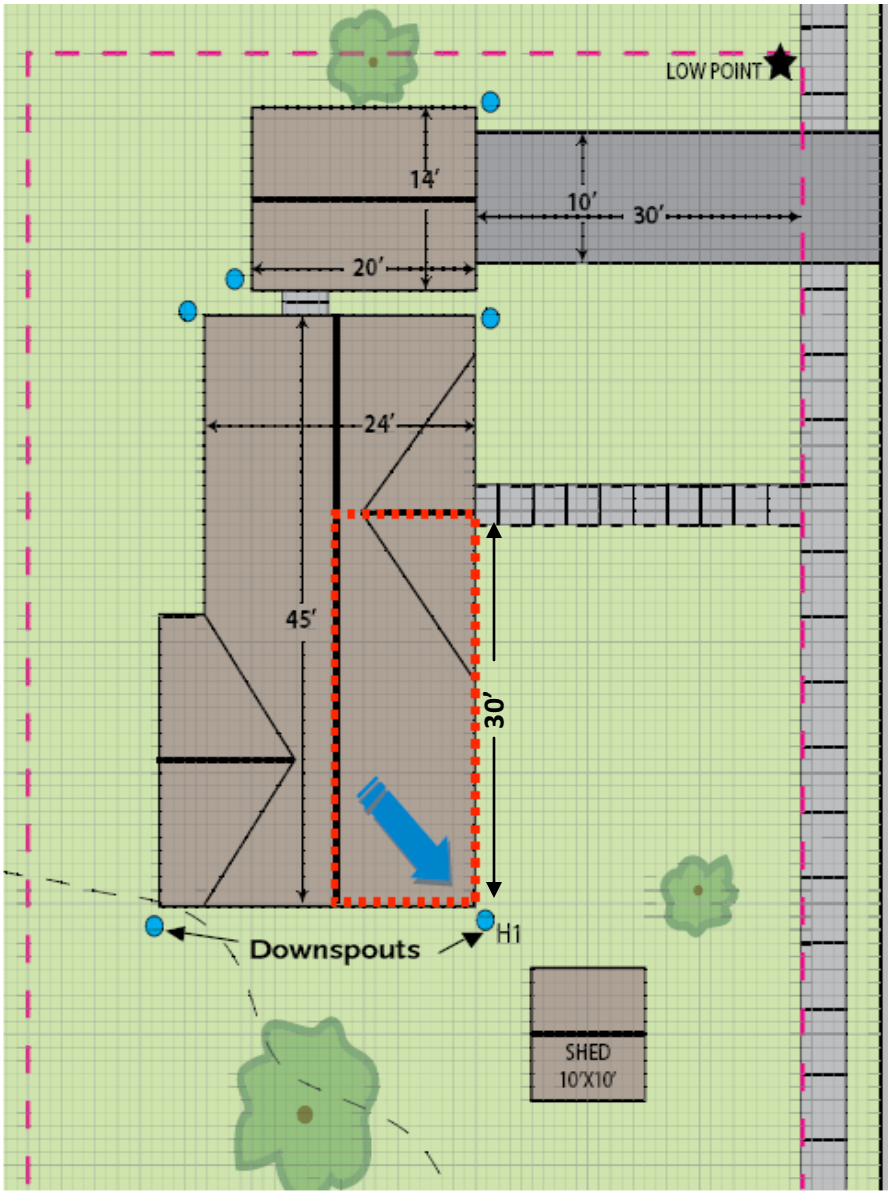
Soils that have a high sand content will drain quickly and might need to have some amendments added to increase moisture holding ability during the dry periods. Alternatively, you may want to plant more drought tolerant plants in rain gardens with sandy soils.

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.

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 CNMI rainfall target of 1.5 inches. Use the following equation. Don't forget to convert inches to feet!

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



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

CNMI Museum of Culture and History Site
Rain Garden Sizing

1. Delineate the drainage area to rain garden installation.

2. Calculate the target rain garden surface area.

3. Does this rain garden manage the 1.5 inch rainfall depth target?

4. Can you identify other rain garden options for this site?

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 (24 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.
- ***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.
- ***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.
- ***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 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	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 CNMI Museum Rain Garden
Group Exercise

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

1. Responsible Party (ies):

General Site Maintenance
Inlet and Outlet Locations
Plant Maintenance
Filter Bed and Mulch Maintenance
Other?

DATE:	WATERSHED:	NAME:

SITE IDENTIFICATION:

Name/Address:

Ownership: ☐ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:_____

WHAT AREA IS BEING TREATED BY YOUR PROPOSED RAIN GARDEN?

☐ Roof ☐ Parking Lot ☐ Walkway/Patio ☐ Other:_____

HOW BIG IS THE DRAINAGE AREA TO BE TREATED? (MEASURE OR PACE OFF)

Length = _____feet

Width = _____feet

Area = _____square feet

DESCRIBE THE SOIL IN THE AREA PROPOSED FOR THE RAIN GARDEN

☐ Clay ☐ Sand ☐ Loam ☐ Other:_____
☐ Compacted ☐ High groundwater (<2 ft)

DESCRIBE THE LOCATION OF YOUR PROPOSED RAIN GARDEN?

Slope: ☐ Area is flat ☐ Area has moderate slope ☐ Area has steep slope

Veg.: ☐ Grassy ☐ Existing trees & shrubs ☐ Existing forest

Visibility: ☐ High visibility area/lots of people will see it ☐ Some visibility ☐ Low visibility/hidden

Cover: ☐ Sunny ☐ Mixed sun & shade ☐ Shady

Utilities: ☐ Likely ☐ Maybe or nearby ☐ unlikely

Inlet: ☐ Already goes there ☐ Some effort ☐ Will require work ☐ not sure

Outlet: ☐ Easy ☐ Hard ☐ Not sure

Setbacks: ☐ Met ☐ May be too close ☐ Probably not enough room

Describe features of your proposed rain garden location:

Unique Site ID:_____

SKETCH YOUR PROPOSED RAIN GARDEN *(INCLUDE DIMENSIONS OF AVAILABLE SPACE)*

TARGET SURFACE AREA ESTIMATES

Drainage area (impervious) _____ sf **X** CNMI target rainfall **0.125** ft **/** ponding depth _____ft (e.g.,0.25, 0.50 , 0.67 ft) **=** Target rain garden surface area _____ sf

Is space available? ☐ Yes, full ☐ Partial (≥50%) ☐ Partial (<50%)

Unique Site ID:_____

CNMI Rain Garden Installation Clinic
April 25-26, 2012
EVALUATION FORM

1. Please rate your agreement with the following statements. Circle your response.

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree, NA = does not apply.

I know how to choose a proper site for a rain garden.	1	2	3	4	5	NA
I know how to prepare a rain garden.	1	2	3	4	5	NA
I know how to maintain a rain garden.	1	2	3	4	5	NA
I know how to create a landscape design for a rain garden	1	2	3	4	5	NA
I know the costs involved with installing a rain garden	1	2	3	4	5	NA
I know how to correct standing-water problems in a rain garden.	1	2	3	4	5	NA

2. Please provide your evaluation of the workshop by completing this form. For each category below, please CIRCLE the number that best reflects your evaluation.

	Poor		**Good**		**Excellent**	**N/A**
Rain Garden Field Installation						
1. Relevance and usefulness	1	2	3	4	5	○
2. Quality of presentation	1	2	3	4	5	
Rain Garden Site Selection and Design						
1. Relevance and usefulness	1	2	3	4	5	○
2. Quality of presentation	1	2	3	4	5	
Rain Garden Installation & Maintenance						
1. Relevance and usefulness	1	2	3	4	5	○
2. Quality of presentation	1	2	3	4	5	
Walking Field Trip to Identify Sites						
1. Relevance and usefulness	1	2	3	4	5	○
2. Quality of presentation	1	2	3	4	5	

3. Strengths and Weaknesses:

Which aspects of the workshop did you consider most beneficial?

_____

Which aspects of the workshop did you consider least beneficial?

_____

4. Did this workshop meet your expectations? ○ Yes ○ No

5. Overall rating of the entire workshop:

Poor		Good		Excellent
1	2	3	4	5

Other comments:

_____

_____

_____

_____

_____

Name (optional): _____

THANK YOU FOR COMPLETING THIS FORM!

CNMI Rain Garden Installation Clinic
April 25-26, 2012
Quiz

Your Name: _____

Thank you for joining us for this workshop. Place the letter of your response on the blank line next to the question.

_____ 1. All plants chosen for a rain garden design should be wetland species.

A. true
B. false

_____ 2. Which of the following tactics could be used to improve drainage in a rain garden that holds standing water for more than 2 days?

A. increase the surface area of the garden
B. amend the soil
C. provide an underdrain
D. all of the above

_____ 3 . The proper depth of a rain garden is:

A. 4 to 8 inches
B. 1 to 2 feet
C. deep enough to swim
D. less than 1.5 inch/hr

_____ 4. A clay soil with poor drainage can be amended by adding:

A. compost
B. a fine textured sand (mason sand)
C. coarse sand
D. A & C

_____ 5. Rain gardens should be located at least _____ feet away from the foundation of a building with a basement.

A. five
B. ten
C. fifteen
D. we don't have basements

_____ 6. Which of the following parts of a rain garden should be level?

A. the drainage area
B. the overflow
C. the ponding area
D. A & B

_____ 7. A rain garden on a residential property should drain within ____ hours of a rainstorm.

A. twenty-four
B. forty-eight
C. seventy-two
D. one

____ 8. Native plants in a rain garden should be fertilized:

A. only at planting and only if necessary
B. annually
C. every two years
D. whenever you remember

____9. Rain garden sizing is based on:

A. drainage area
B. ponding depth
C. rainfall amount
D. all of the above

____10. When constructing a rain garden, the first thing you do is:

A. water the plants
B. mark the area for excavation
C. make sure no utility lines are in the way
D. call your friends with shovels

____11. A good location for a rain garden is:

A. in a place where standing water already exists
B. below a small roof area
C. in a place with high bedrock
D. where the drainage area is large

____12. Rain garden maintenance is:

A. required to ensure function
B. limited to mowing
C. not required after installation
D. always more effort than regular landscaping

____13. Which of the following should be inspected regularly:

A. plant growth and health
B. sediment accumulation
C. erosion of slopes and bed
D. all of the above

____14. Soil infiltration rates of 1.5 in/hr:

A. are ideal for rain gardens
B. must be amended to function
C. influence rain garden design
D. A & C

____15. The surface area of a rain garden:

A. is equal to (drainage area x target rainfall depth)/ponding depth
B. can be adjusted based on site conditions
C. depends on the amount of space available
D. A & B