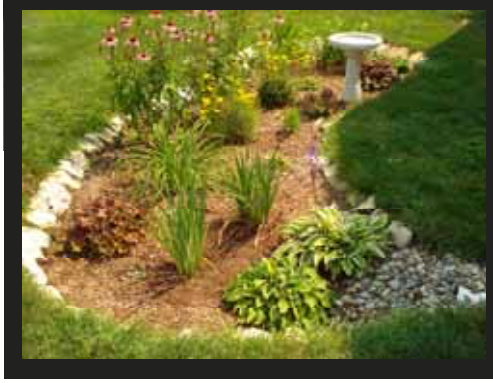
The Vermont Rain Garden Manual

"Gardening to Absorb the Storm"

Helping to protect and restore Vermont's rivers and lakes.



Winooski
Natural Resources
Conservation District

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

Lake Champlain Sea Grant

The Purpose of this Manual

This manual is a Vermont specific resource developed for homeowners, landscape architects, city planners, or anyone else interested in protecting local rivers and lakes through gardening. It's contents are designed to clarify the installation process, demonstrate how rain gardens are cost-effective stormwater management tools, and illustrate how they can be incorporated into a variety of landscapes.

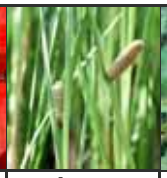
Contents

This manual is broken into sections to illustrate the step by step process in building a rain garden. The sections include:

This manual also includes:

Photographs of each rain garden plant are arranged alphabetically throughout the manual

Acer rubrum



Acorus americanus

Actaea rubra

Agalinis purpurea

Agastache foeniculum

Agrostis stolonifera

Alchemilla mollis

Allium cernuum

Alnus rugosa

Amelanchier arborea

What is a rain garden?

A rain garden is a bowl-shaped garden designed to capture and absorb rainfall and snowmelt (collectively referred to as "stormwater"). When stormwater runs off impervious surfaces such as parking lots, roofs, compacted soils, and roads, it accumulates pollutants and delivers them to a nearby lake or river either directly or via a storm drain. Stormwater pollutants typically include sediment; nutrients (nitrogen and phosphorus); bacteria from animal waste; and oil, grease, and heavy metals from cars. Stormwater also causes increased flooding, which erodes stream banks resulting in additional problems. However, if captured by a rain garden, stormwater soaks into the ground recharges the groundwater at a rate 30% greater than that of a typical lawn. Ultimately, if we all work together to create landscape features that absorb the stormwater, we can restore and help preserve the waterways that make Vermont so beautiful.

Choosing a Location

- If capturing roof runoff, place the garden about 10 feet away from the building to prevent potential water seepage into the basement.
- Do not place a rain garden over a septic tank or leach field.
- Do not place a rain garden near a drinking water well.
- Call Dig Safe® at 1-888-DIG-SAFE at least three days before digging to avoid underground pipes and utilities.
- Check for any private wiring or underground utilities such as driveway lights and sheds with electricity.
- Select a flat area if possible to make installation easier.
- Do not place the rain garden in a naturally wet area.
- Avoid disturbing tree roots. Trees may be injured by digging and may not tolerate the additional soil moisture.

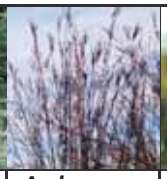
Build next to a house

Build next to a road

Build next to a parking lot

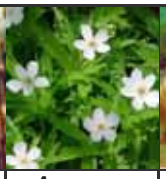
Photo courtesy Connecticut NEMO

Amorpha canescens

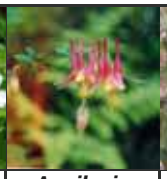


Andropogon gerardii

Andropogon virginicus



Anemone canadensis



Aquilegia canadensis

Aronia arbutifolia

Aronia melanocarpa

Arisaema triphyllum

Aruncus dioicus

Asarum canadensis

Asclepias incarnata

Asclepias tuberosa

Aster novae-angliae

Aster umbellatus

Astilbe spp.

Athyrium filix-femina

Baptisia australis

Betula nigra

Boltonia asteroides

Bouteloua curtipendula

Sizing the Rain Garden (4 Steps)

Step 1: Drainage Area

To calculate the drainage area (the area that will drain to the rain garden) from a roof, parking lot, sidewalk, or other impervious surface, multiply the length by the width.

(Length) x (Width) = _____ ft^2 (drainage area)

Add together the drainage area of multiple roofs.

Combine your roof runoff with a neighbors'.

Rain gardens can capture stormwater from a drip-line just as well as from a gutter system.

Estimating the stormwater that runs off streets, sidewalks, and parking lots can be tricky. It is best to visit the impervious area during a rain event to clearly see the extent of the drainage area.

Step 2: Soil

To determine if the soil type is suitable for a rain garden, first perform a simple pit test:

1. Dig a 6" deep hole and fill with water.
2. Choose a new location if the water is still standing after 24 hours.

After conducting the pit test, identify the soil type as sand, silt, or clay. Sandy soils have the fastest infiltration; clay soils have the slowest. Since clay soils take longer to drain water, they require a larger rain garden area. You can determine your soil type by performing the ribbon test:

1. Grab a handful of moist soil and roll it into a ball in your hand.
2. Place the ball of soil between your thumb and the side of your forefinger and gently push the soil forward with your thumb, squeezing it upwards to form a ribbon about ¼" thick.
3. Try to keep the ribbon uniform thickness and width. Repeat the motion to lengthen the ribbon until it breaks under its own weight. Measure the ribbon and evaluate below:

Courtesy of North Dakota State University

The ribbon formed here depicts a clay soil because it is greater than 1.5" in length.

SAND: Soil does not form a ribbon at all.
SILT: A weak ribbon < 1.5" is formed before breaking.
CLAY: A ribbon > 1.5" is formed.

Calamagrostis acutiflora

Caltha palustris

Camassia leichtlinii

Campanula americana

Carex flacca

Carex flaccosperma

Carex grayi

Carex muskingumensis

Carex vulpinoidea

Carpinus caroliniana

Cassia hebecarpa

Caulophyllum thalictroides

Celtis occidentalis

Cephalanthus occidentalis

Chelone glabra

Cimicifuga ramosa

Cinna latifolia

Clethra alnifolia

Clintonia borealis

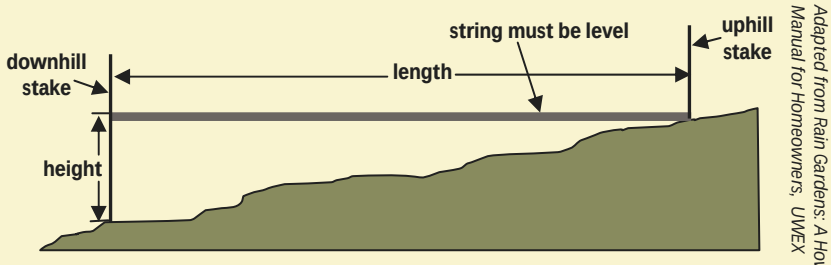
Comptonia peregrina

Step 3: Slope

Calculate the slope to determine the rain garden's depth:

1. Place one stake at the uphill end of the rain garden and another at the downhill end as illustrated in Figure 1.
2. Level the string between the two stakes.
3. Measure the total length of the string and the height of the string at the downhill stake in inches.
4. Divide the height by the length and multiply the result by 100. This is the slope.
5. Use Table 1 to determine the recommended rain garden depth.

Table 1	
Slope	**Depth**
< 4%	3-5 in
5-7%	6-7 in
8-12%	8 in+



Adapted from Rain Gardens: A How-to Manual for Homeowners, UWEX

Figure 1: Determine the slope of the landscape.

Step 4: Size

Finally, determine the rain garden's size:

1. Use Table 2 to determine the size factor.
2. Multiply the size factor by the drainage area. This is the recommended rain garden size.

Table 2	Depth		
Soil Type	**3-5 in**	**6-7 in**	**8 in +**
Sand	0.19	0.15	0.08
Silt	0.34	0.25	0.16
Clay	0.43	0.32	0.20

Size Factor X **Drainage Area** = **Rain Garden Area**

Note: If the rain garden is > 30 ft away from the drainage area then the area of the rain garden can be a half size smaller than calculated above. This is because a large amount of stormwater will be absorbed along the pathway that leads to the rain garden.

Benefits of a Rain Garden

Are easy and inexpensive to install and maintain

Reduce stormwater runoff

Recharge groundwater

Help control flash flooding

Provide wildlife habitat

Improve water quality

Help to sustain stream base flows

Are an attractive alternative to detention ponds

Remove Pollutants

Can be retrofit into existing urban landscapes

Convallaria majalis

Coreopsis lanceolata

Cornus amamum

Cornus sericea

Deparia acrostichoides

Desmodium canadense

Dicentra spectabilis

Diervilla lonicera

Dryoptera filix-mas x marginalis

Echinacea purpurea spp.

Epilobium angustifolium	*Erythronium americanum*	*Eupatorium coelestinum*	*Eupatorium maculatum*	*Eupatorium perfoliatum*	*Euthamia graminifolia*	*Filipendula rubra*	*Fraxinus americana*	*Fraxinus pennsylvanica*	*Gaylussacia baccata*

Designing the Rain Garden (4 Steps)

Step 1: Determine the Shape

Your rain garden can be any shape but it MUST have a level bed.

Step 2: Design the Entrance

Stabilize the area where the water enters your rain garden with stone or gravel to slow stormwater flow and prevent erosion within the garden. Place hardy plants that thrive in moist conditions where the stormwater enters the garden.

Some common methods for directing water from the drainage area to the rain garden include:

Gutter Extensions: Specifically shaped to attach to the end of your downspout.

PVC & Plastic Corrugated Piping: Can be attached to gutter extensions and buried to carry stormwater underground.

Grass-lined & Rock-lined Swales: Can be used to direct water to the rain garden. Swales should be sloped at a 2:1 ratio (1 ft rise for every 2 ft across). Ideal for heavy flows from roads or parking lots.

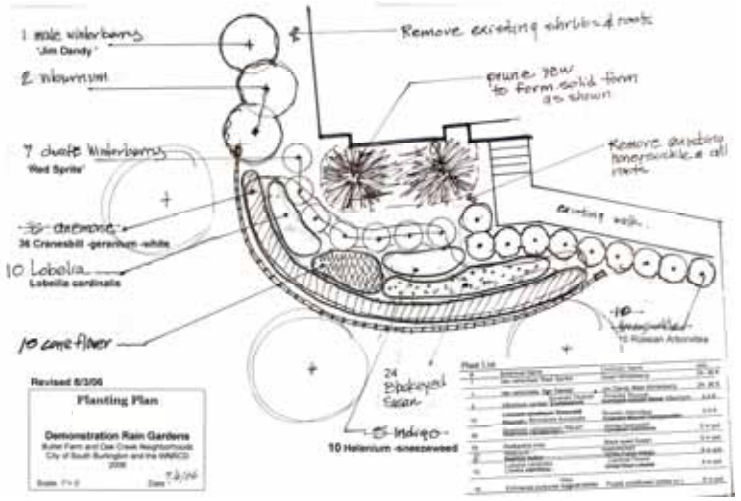
Step 3: Select Plants

Plants must be able to tolerate the extreme moisture conditions typical of a rain garden. When choosing plants it is important to remember that rain gardens are not wetlands. Rain gardens mimic upland forest systems. Plants that consistently require wet soils or standing water are not appropriate. Refer to The Vermont Rain Garden Plant List beginning on page 11 of this manual.

There are likely many more plants suitable for Vermont rain gardens than what is included in the plant list. To evaluate the suitability of each additional plant, use the following criteria: A suitable rain garden plant 1) is greater then 6" in height when mature and does not have low basal leaves—these plants may struggle when overcome by heavy flows; 2) can tolerate both wet and dry conditions; and 3) can survive in the local hardiness zone. Refer to the **Plant Hardiness Zones in Vermont** map included on the back cover.

Step 4: Final Rain Garden Design Sketch

Complete a to-scale drawing of the rain garden before breaking ground:



Gentiana andrewsii	*Geranium maculatum*	*Hamamelis virginiana*	*Helenium autumnale*	*Helianthus angustifolius*	*Heliopsis helianthoides*	*Hemerocallis ssp.*	*Heuchera 'Chocolate Ruffles'*	*Hibiscus moscheutos*	*Hosta ssp.*

Hydrophyllum virginianum

Ilex glabra

Ilex verticillata

Iris versicolor

Isopyrum biternatum

Juncus effusus

Juniperus virginiana

Kalmia latfolia

Liatris spicata

Lilium canadense

Installing the Rain Garden

Build the berm with sod

Borders defined by an earthen berm

Create a berm with landscaping stone

Borders defined by edging

Step 1: Define the Borders

Delineate the outline of the rain garden on the ground using string or spray paint. The berm or edging will go outside the string.

Step 2: Remove the Grass

To avoid digging through sod, kill the grass first by laying black plastic or a tarp on the lawn for several weeks. Using a herbicide is not recommended—It could harm the newly installed plants.

Step 3: Start Digging

Building on a slope: If the rain garden is built on a slope, a berm or low wall on the downhill side is required to increase the water holding capacity of the garden. Create the berm while digging the rain garden by heaping the soil around the edges where the berm will be (see figure 2). The berm height should be level with the uphill side of the garden, therefore making the entire perimeter of the garden the same height. After shaping the berm, compact the soil and cover with sod, mulch, or a groundcover. Use straw or other matting to protect the berm from erosion while the grass or groundcover takes root.

Building on level ground: If the rain garden is built on level ground, the profile of the garden can vary depending on available space and aesthetic preference. If space permits, the rain garden can have gently sloping sides (Figure 3). Note that soil conditions in the upper slope of this type of rain garden may be too dry for a true rain garden plant to survive, therefore a variety of upland plants might be appropriate here. If there is not a lot of space, then the profile in figure 4 might be appropriate. Only plants that can tolerate very moist soil conditions should be planted in this type of rain garden. This design is common in urban settings where a curb-cut is used to direct stormwater into the garden. A berm does not need to be constructed in a rain garden that is built on level ground because the stormwater is held in by the depression that is dug. Excavated soil therefore should be removed from the site. Landscaping stone, or other edging can be used to help hold water in the garden as well as to prevent grass from growing into the bed. *Tip:* Think about where stormwater will go when the rain garden overflows during a very large storm. Design a slight dip in the berm/perimeter to direct potential overflow away from the neighbors' yard or other priority area.

Lindera benzoin

Lobelia cardinalis

Lobelia spicata

Lysimachia ciliate ssp.

Matteuccia struthiopteris

Mentha arvensis

Mertensia virginica

Mimulus ringens

Mitella diphylla

Mondarda didyma

Nyssa sylcatica

Onoclea sensibilis

Osmunda cinnamomea

Osmunda claytoniana

Osmunda regalis

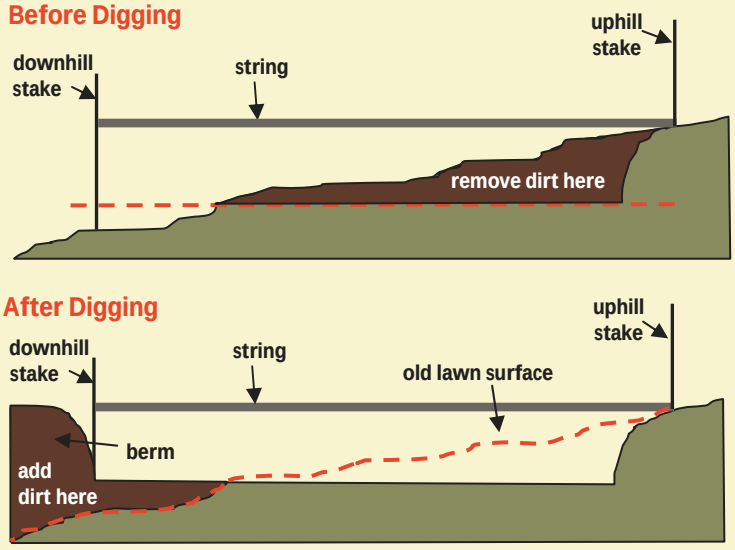
Ostraya virginiana

Panicum virgatum

Parthenium integrifolium

Penstemon digitalis

Phlox divaricata



Adapted from Rain Gardens: A How-to Manual for Homeowners, UWEX

Figure 2: When building a rain garden on a slope, a berm must be created to hold the water in the garden. When leveling the bed, use the dirt that you remove to build the berm.

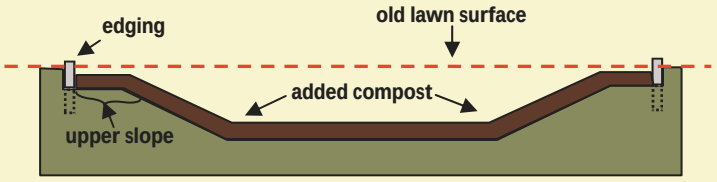


Figure 3: Level bed with sloping edges. This design requires more space. Only plants that can thrive in drier soil conditions can be planted on the upper slope of this type of raingarden; true rain garden plants will not thrive here.

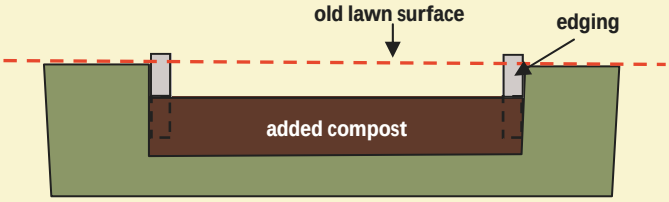


Figure 4: Level bed without sloping edges. Ideal design for tight spaces.

Physocarpus opulifolius

Polemonium reptans

Poylgonatum biflorum

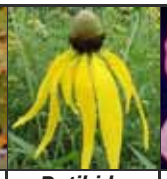
Polystichum acrostichoides

Pycnanthemum virginianum

Quercus bicolor

Quercus palustris

Quercus rubra



Ratibida pinnata

Rhexia virginica

Rhododrendron canadense

Rhododrendron maximum

Rhododrendron periclymenoides

Rosa palustris

Rodgersia henrici

Rudbeckia hirta

Salix discolor

Salix humuilis

Salix purpurea

Salvia verticillata

Level the bed

Improve the soil

Plant

Mulch

Water

Step 4: Level the Bed

Dig the rain garden bed 4-6" deeper than determined earlier to allow for the addition of compost and mulch. Maintain the rain garden's ability to absorb water by avoiding soil compaction. Work from one side to the other, or from the center to the outside. Loosen soil with a shovel if it becomes compacted. When the whole area has been dug out to the approximate depth, lay a 2x4 board in the rain garden with the carpenter's level sitting on it. Adjust to form a flat bottom. When the rain garden is completely level, rake the soil. *Tip:* Avoid digging and planting under wet conditions, especially when working in clay soils—Disturbing wet soils can result in compaction.

Step 5: Improve the Soil

At least two inches of compost should be added to the rain garden and mixed into the native soil. This helps the soil retain moisture and improve plant growth. Using a rotor-tiller to mix in the compost will make the job much easier.

Step 6: Plant

Set the plants out in the garden to match the planting plan. When removing the plants for the pots, gently loosen the root ball with your fingers before placing them in the ground. Water immediately after planting.

Step 7: Mulch

Apply a 2-3" layer of mulch to help retain soil moisture and discourage weeds. A cubic yard of mulch will cover a 100 square foot area with about three inches of mulch.

Care & Maintenance

- **Water:** New plants need to be watered regularly until their roots are established, even though the rain garden catches stormwater.
- **Weed:** Frequent weeding will be necessary in the first few years before plants become established.
- **Mulch:** To maintain the bowl-shaped profile and stormwater holding capacity of the rain garden, mulching is not suggested until a few years after the initial installation. Once the rain garden is established, mulch is not necessary, unless its more formal appearance is preferred. When applying mulch, maintain a 2-3" layer.

Sambucus canadensis

Sanguinaria canadensis

Sanguisorba tenuifolia

Schizachyrium scoparium

Soldago ssp.

Sorghastrum nutans

Spirea latifolia

Streptopus roseus

Thelypteris noveboracensis

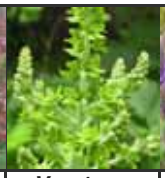
Thuja occidentalis

Tiarella cordifolia

Trillium undulatum

Tradescantia ohiensis

Vaccinium corymbosum



Veratrum viride

Verbenia hastata

Vernonia noveboracensis

Veronicastrum virginicum

Virburnum cassinoides

Viburnum lentago

Curb-Cut Rain Gardens

Rain gardens designed with a curb-cut can be effective in capturing stormwater from streets, parking lots, and other paved areas. In addition to reducing stormwater volume, curb-cut rain gardens increase urban aesthetics, reduce pollutant concentrations, and help counteract urban heat. A sample curb-cut rain garden planting plan is included on page 17 of this manual. Below are some things to consider when designing a curb-cut rain garden:

Plant Height: When planting in a streetscape, be sure to consider overhead conflicts (utility lines) and visibility issues, especially when planting in a median.

Salt Tolerance: Plants in a curb-cut rain garden must be able to tolerate road salt that accumulates in the soil and on exposed trunks and branches in the winter months. See the enclosed plant list for salt tolerant plants.

Right-of-Way: Anyone wishing to work within the right-of-way must obtain permission from the state or local municipality. A permit may be required. See page 18 for more information about permitting.

Pretreatment: To prevent clogging due to excess sediment it is best to pre-treat the stormwater before it enters the curb-cut rain garden if stormwater runoff is collected from a road or parking lot. Three recommended options for pretreatment are give on page 18 of this manual.

"With green infrastructure, stormwater management is accomplished by letting the environment manage water naturally; capturing and retaining rainfall, infiltrating runoff, and trapping and absorbing pollutants." Natural Resources Defense Council

Photos courtesy of © Bureau of Environmental Services, Portland Oregon

Common Questions

Does a rain garden form a pond?
No. After most storms a properly constructed rain garden will absorb water within a period of 24 hours and not more than 48 hours for larger storms depending on the soil type.

Do mosquitoes breed in rain gardens?
No. Mosquitoes require 7 to 12 days of standing water to lay and hatch eggs. Standing water will only last a few hours after most storms.

Do they require maintenance?
Like any garden, diligent weeding and watering will be needed in the first two years. As the garden matures, maintenance requirements will lessen. Plants may need to be thinned after a few years.

How much does a rain garden cost?
The cost varies depending on who does the work, the size of the garden, where the plants come from, and the planting density. If you purchase the plants and materials but you do all the labor, the cost will be roughly $4-$6 per sq ft. If you hire a professional to design and install the garden, it will cost roughly $10-$14 per sq ft.

Should a rain garden be placed where there is typically standing water?
Rain gardens are designed to infiltrate water. Standing water indicates poor infiltration, and we do not recommend directing additional water to these naturally wet areas.

What if there is a dry spell?
Plants suitable for a rain garden can handle both wet and dry conditions. However, during a dry spell, it is best to water the rain garden.

PLANT LIST
HOLDER PAGE

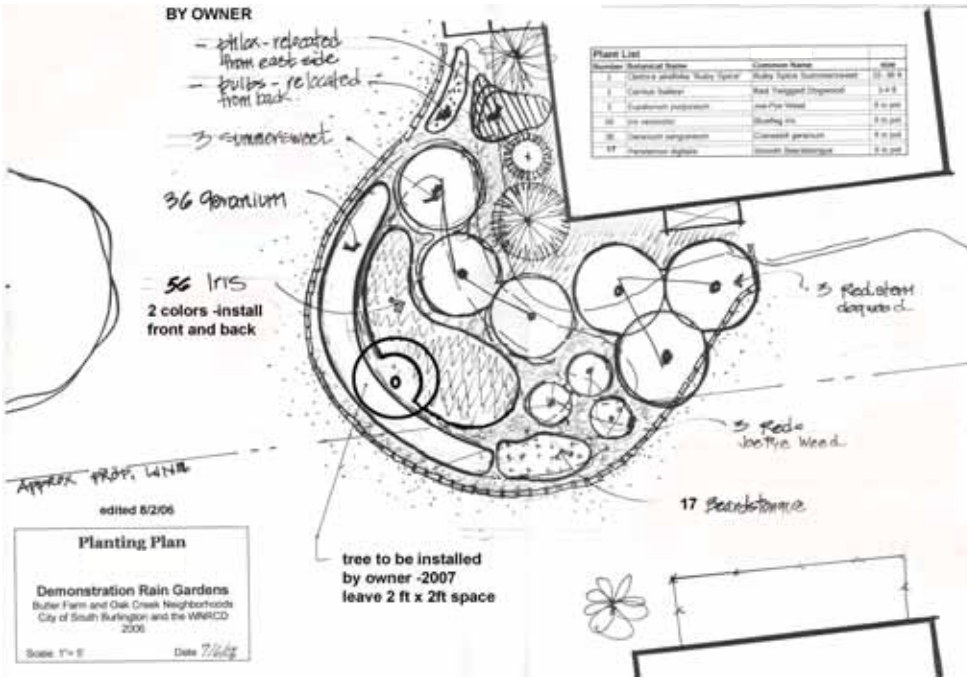
PLANT LIST
HOLDER PAGE

PLANT LIST
HOLDER PAGE

PLANT LIST
HOLDER PAGE

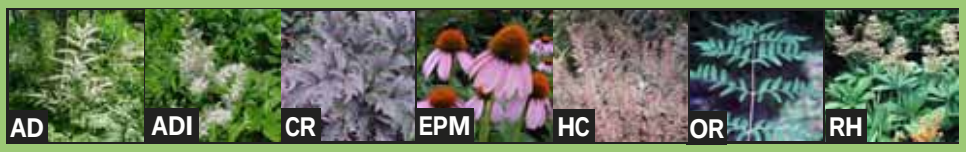
Sample Rain Garden Planting Plans

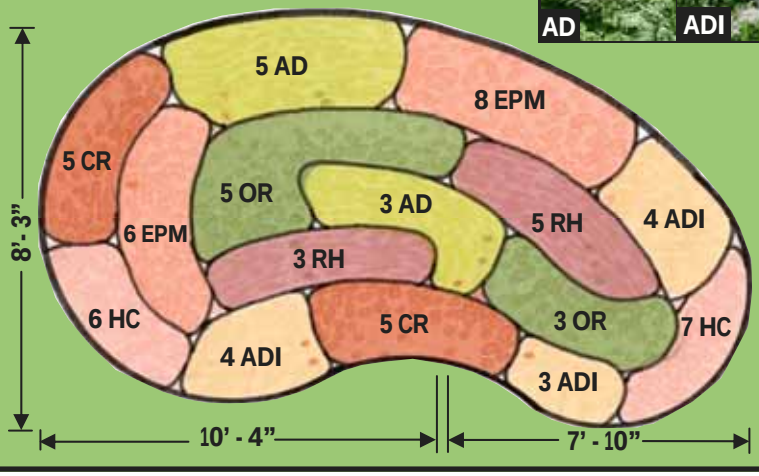
A well thought out planting plan will increase the success rate of each plant and will make installation easier. The placement of each plant should be based on a plant's moisture tolerance, height, and complimentary plant combinations. The following planting plans are designed for a 150 square foot rain garden. Each planting plan includes light exposure, a planting schedule, plant photos, a plant layout diagram, and a sizing chart. The sizing chart can be used to plan for gardens greater or less than the 150 square foot template provided. Recommended plant installation sizes indicated in the planting schedules include 1 gallon, 2 gallon, and 4" pots. Smaller plants can be installed if needed; however, increase the quantity of each plant and water and monitor the rain garden more frequently.



The Enchanted Garden - Part Shade

Abr	Qty	Botanical Name	Common Name	Height	Spread	S. Interest	Spacing	Install Size
AD	8	*Aruncis dioicus*	Goatsbeard	5'	2-4'	Spring	22-30"	1-2 Gallon
ADI	11	*Astilbe 'Diamant'*	Astilbe	30"	1.5-2'	Summer	22"	1 Gallon
CR	10	*Cimicifuga ramosa 'Brunette'*	Purple-leaf Bugbane	3-4'	2-3'	Sp, Su, Fall	22"	1 Gallon
EPM	14	*Echinacea purpurea 'Magnus'*	Coneflower	2.5-3'	1-1.5'	Summer	15-22"	1 Gallon
HC	13	*Heuchera 'Chocolate Ruffles'*	Coral Bells	1-2'	1-1.5'	Summer	15-22"	1 Gallon
OR	8	*Osmunda Regalis*	Royal Fern	3-4'	2-3'	Sp, Su, Fall	22-30"	1 Gallon
RH	8	*Rodgersia henrici Sub. Rodgersia aesculifolia*	Rodgersia	3-4'	3-4'	Summer	34-38"	1-2 Gallon



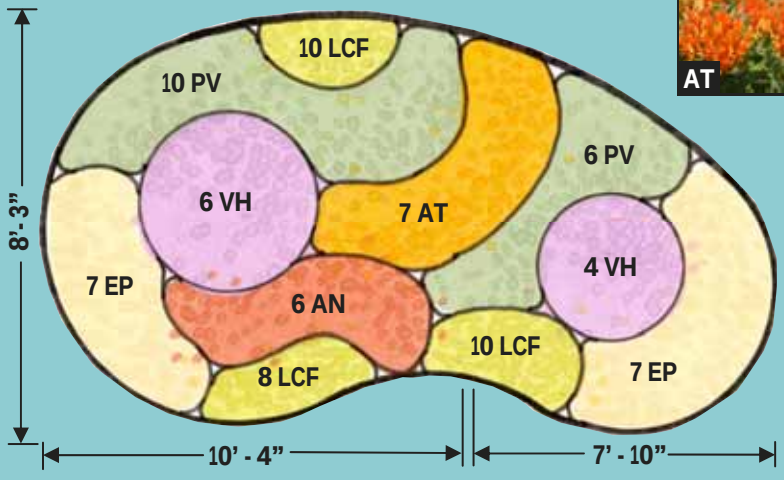


Sizing Chart

Sq Ft	Qty of Diff. Species	Total Plant Qty	Ex. Garden Dimensions
50	3	24	6' x 4'-6"
100	5	48	8'-6" x 6'-4"
150	7	72	18'-2" x 8'-3"
200	7	96	12' x 9'
250	7	120	13'-5" x 10'

The Bird & Butterfly Meadow - Sun

Abr	Qty	Botanical Name	Common Name	Height	Spread	S. Interest	Spacing	Install Size
AT	7	*Asclepias tuberosa*	Butterfly Plant	1-2.5’	1-1.5’	Summer	15-22”	1 Gallon
AN	6	*Aster novae-angliae*	New England Aster	18”	1.5-2’	Fall	22”	1 Gallon
EP	14	*Echinacea purpurea 'Alba'*	Coneflower	30”	1-2’	Summer	15-22”	1 Gallon
LCF	11	*Lysimachia ciliate ‘Firecracker’*	Fringed Loosestrife	1-3’	2-2.5’	Summer	22-30”	1 Gallon
PV	16	*Panicum virgatum*	Switch Grass	3-4’	2-3’	Sp, Su, Fall	22-30”	1-2 Gallon
VH	10	*Verbena hastate*	Blue Vervain	2-6’	1-1.5’	Su, Fall	15-22”	4” Pot

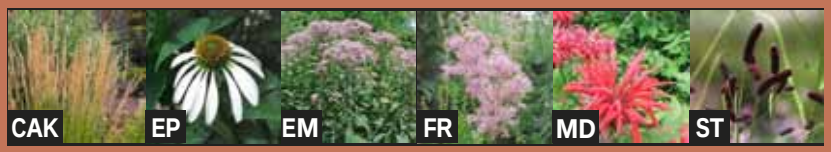


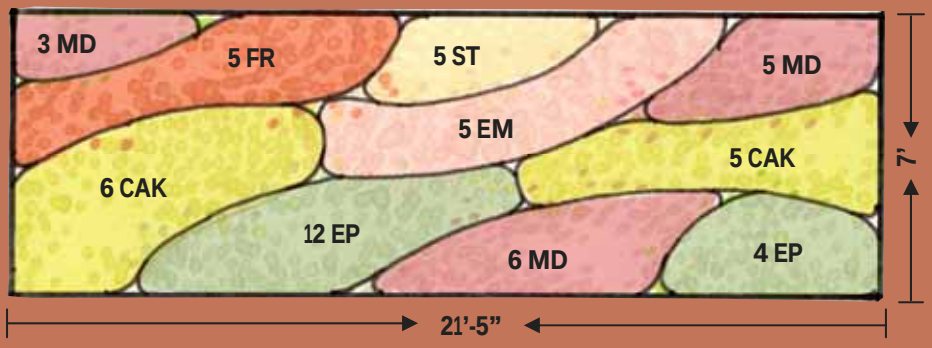
Sizing Chart

Sq Ft	Qty of Diff. Species	Total Plant Qty	Ex. Garden Dimensions
50	4	21	6’ x 4’-6”
100	4	42	8’-6” x 6’-4”
150	6	64	18’-2” x 8’-3”
200	6	85	12’ x 9’
250	6	106	13’-5” x 10’

The Bold Color Garden - Sun

Abr	Qty	Botanical Name	Common Name	Height	Spread	S. Interest	Spacing	Install Size
CAK	11	*Calamagrostis acutiflora 'Karl Foerster'*	Feather Reed Grass	3-5’	1.5-2’	Sp, Su, Fall	22-30”	1-2 Gallon
EP	16	*Echinacea purpurea 'Alba'*	Coneflower	30”	1-2’	Summer	15-22”	1 Gallon
EM	5	*Eupatorium maculatum*	Joe Pye Weed	4-6’	2-4’	Summer	30”	1-2 Gallon
FR	5	*Filipendula rubra 'Venusta'*	Queen of the Prairie	4-5’	3-4’	Sp & Su	30”	1 Gallon
MD	14	*Monarda didyma 'Jacob Cline'*	Bee Balm	3’	1-2’	Sp & Su	15-22”	1 Gallon
ST	5	*Sanguisorba tenuifolia*	Japanese Burnet	4-5’	1.5-2’	Su & Fall	22”	1 Gallon



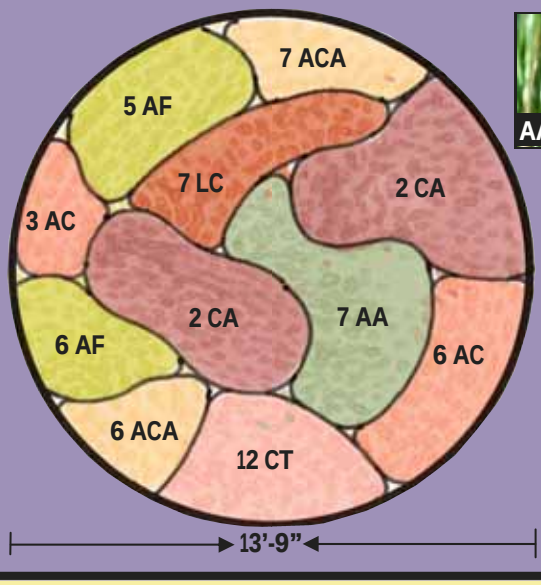


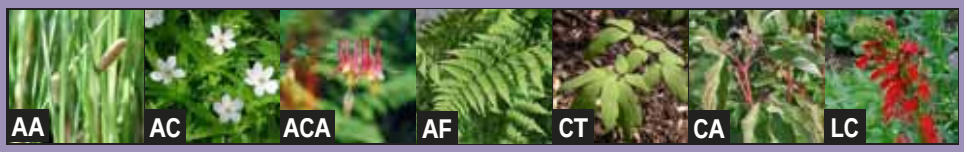
Sizing Chart

Sq Ft	Qty of Diff. Species	Total Plant Qty	Ex. Garden Dimensions
50	3	19	5’ x 10’
100	5	37	16’-8” x 6’
150	7	56	21’-5” x 7’
200	7	75	25’ x 8’
250	7	93	20’ x 12’-6”

The Native Woodland & Wildlife Garden - Part Shade

Abr	Qty	Botanical Name	Common Name	Height	Spread	S. Interest	Spacing	Install Size
AA	7	*Acorus americanus*	Sweet Flag	3'	1.5-2'	Sp, Su, Fall	22"	1 Gallon
AC	7	*Anemone canadensis*	Windflower	1-2'	2-2.5'	Spring	22-30"	1 Gallon
ACA	13	*Aquilegia canadensis*	Columbine	2-3'	1-1.5'	Spring	15-22"	1 Gallon
AF	11	*Athyrium filix-femina*	Lady Fern	2-3'	1-1.5'	Sp, Summer	22"	1 Gallon
CT	12	*Caulophyllum thalictroides*	Blue Cohosh	1-2'	0.5-1'	Summer	22"	1 Gallon
CA	4	*Cornus sericea 'Arctic Fire'*	Red Osier Dogwood	3-4'	3-4'	Sp, Su, Fall	4-5'	2-3 Gallon
LC	7	*Lobelia cardinalis*	Cardinal Flower	2-4'	1-2'	Summer	22"	1 Gallon



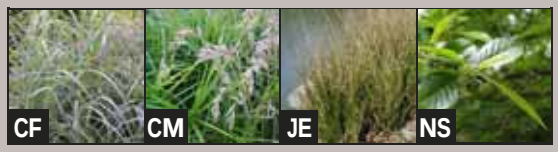


Sizing Chart

Sq Ft	Qty of Diff. Species	Total Plant Qty	Ex. Garden Dimensions
50	3	20	8' Diameter
100	5	41	11'-4" Diameter
150	7	61	13'-9" Diameter
200	7	82	16' Diameter
250	7	103	17'-10" Diameter

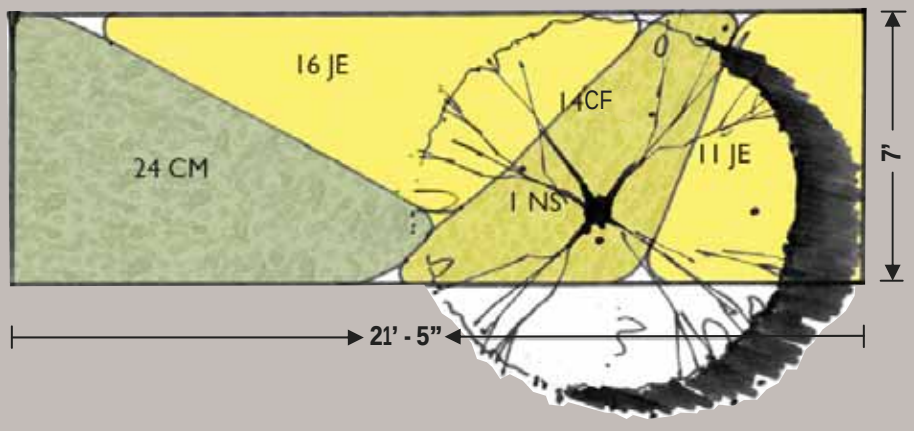
Urban Curb-Cut Rain Garden - Sun/Part Shade

Abr	Qty	Botanical Name	Common Name	Height	Spread	S. Interest	Spacing	Install Size
CG	14	*Carex flacca*	Blue Sedge	1-1.5'	1-1.5'	Sp, Su, Fall	18"	1 Gallon
CM	24	*Carex muskingumensis 'Oehme'*	Variegated Palm Sedge	2-3'	2-3'	Sp, Su, Fall	18"	1 Gallon
JE	27	*Juncus effusus*	Common Rush	2-3'	2-3'	Sp, Su, Fall	18"	1 Gallon
NS	1	*Nyssa sylvatica*	Tupelo, Black Gum	35'	25'	Fall	-	2-2.5 Caliper



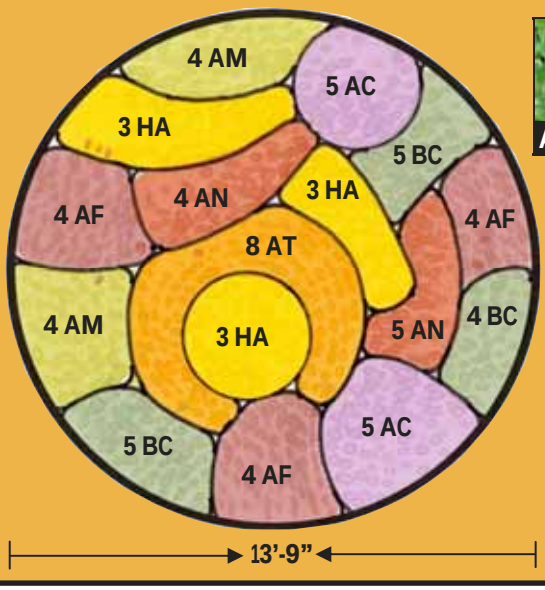
Sizing Chart

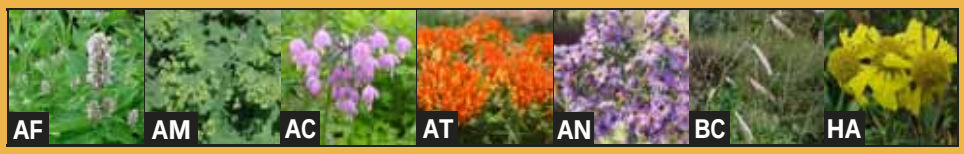
Sq Ft	Qty of Diff. Species	Total Plant Qty	Ex. Garden Dimensions
50	2	19	5' x 10'
100	2 to 3	37	16'-8" x 6'
150	4	56	21'-5" x 7'
200	4	75	25' x 8'
250	4	93	20' x 12'-6"



The Children's Discovery Garden - Sun

Abr	Qty	Botanical Name	Common Name	Height	Spread	S. Interest	Spacing	Install Size
AF	12	*Agastache foeniculum*	Lavender Hyssop	2-4'	1.5-2.5'	Summer	18-24"	1 Gallon
AM	8	*Alchemilla mollis*	Lady's Mantle	18-30"	1.5-2'	Spring	15-22"	1 Gallon
AC	20	*Allium cernuum*	Nodding Onion	1-3'	3-6"	Spring	1'	1 Gallon
AT	8	*Asclepias tuberosa*	Butterfly Plant	1-2.5'	1-1.5'	Summer	15-22"	1 Gallon
AN	7	*Aster novae-angliae*	New England Aster	18"	1.5-2'	Fall	22"	1 Gallon
BC	10	*Bouteloua curtipendula*	Side-oats Grama Grass	1.5-2.5'	1.5-2'	Su, Fall	22"	1-2 Gallon
HA	9	*Helenium autumnale 'Moerheim Beauty'*	Sneezeweed	3-4'	2-3'	Su. Fall	22-30"	1 Gallon





Sizing Chart

Sq Ft	Qty of Diff. Species	Total Plant Qty	Ex. Garden Dimensions
50	3	22	8' Diameter
100	5	45	11'-4" Diameter
150	7	68	13'-9" Diameter
200	7	90	16' Diameter
250	7	113	17'-10" Diameter

Rain Gardens and the Vermont Stormwater Management Manual

Property owners subject to a State Stormwater Permit can integrate rain gardens into their stormwater management plan by following the guidelines listed in the Vermont Stormwater Management Manual (VSMM). Property owners that would require permits include residential and commercial developers developing 1 acre or more of impervious surfaces and members of a home owners or condominium association in stormwater impaired watersheds that currently have no or failing stormwater treatment systems. In the VSMM, "rain garden" is a laymen's term for a bio-retention system that treats what is called the water quality volume (0.9 inches of rain) of a storm event or around 90% of the annual rain fall. Rain gardens are designed to capture and temporarily store the water quality volume and infiltrate the stormwater through a soil matrix bed designed to filter out pollutants. Rain gardens as described in this manual differ from the bio-retention systems in the VSMM because they are not designed to provide channel protection (Cpv) or extended detention (Qp) storage.

If stormwater runoff is collected from a road or parking lot, it will typically need to be pretreated prior to entering a rain garden. To prevent the rain garden from being clogged by excess sediment, the VSMM requires three forms of pretreatment including: 1) a grass filter strip below a level spreader or a grass channel before water enters the rain garden, 2) a gravel diaphragm (similar to a curtain/french drain for even flow of water across the rain garden), and 3) a mulch layer. Pretreatment is not required for rain gardens treating stormwater runoff from roofs.

Rain gardens are encouraged in Section 3, Voluntary Stormwater Credits (VSC), of the VSMM (Volume I). VSC's can be acquired when rain gardens are installed within a development. The use of VSC's can reduce the required water quality and recharge volumes, therefore reducing the size and cost of the structural stormwater treatment practices. Such a reduction will help to reduce the overall stormwater treatment costs and space requirement. Specifically, rain gardens are encouraged for rooftop disconnects (Section 3.2) and non-rooftop disconnects such as driveways and sidewalks (Section 3.3), and for Environmentally Sensitive Rural Development Credit (Section 3.6).

Rain Gardens & Permitting

The Vermont Agency of Natural Resources strongly supports the concept of rain gardens as an important means to both reduce overall stormwater runoff and to encourage infiltration. Currently, as the result of an overly expansive definition, the Agency's Underground Injection Control (UIC) rule would technically require a UIC permit for all rain garden projects. However the Agency has written and adopted a procedure that, in effect, exempts: 1) residential rain gardens that capture roof runoff from a home and 2) non-residential rain gardens that capture stormwater runoff from impervious surfaces (such as a parking lot, school rooftop, street, etc) that encompass less than 1 acre. It is important to note however, that any non-residential rain garden, regardless of size, must be registered with the Agency. Registration is free and the form can be downloaded at http://www.anr.state.vt.us/dec/ww/permits/UICStormwaterRegistrationForm.pdf. A sample of a completed registration form can be viewed at http://www.vacd.org/winooski/winooski_raingarden.shtml. Rain gardens designed to capture stormwater runoff from an impervious surface greater than 1 acre may be subject to a UIC permit. For more information about the UIC Program, visit http://www.anr.state.vt.us/dec/ww/uic.htm…Happy Gardening!

On the Web

This manual can be viewed and downloaded for free at:
www.vacd.org/winooski/winooski_raingarden.shtml

Additional Resources

Visit the Lake Champlain Sea Grant website to learn more about rain gardens. The website includes educational materials that are available to view and print as well as information about who, where, and when rain gardens were installed in Vermont: www.uvm.edu/~seagrant

Information on tree selection, site assessment, tree planting, and care of young trees is available on the Vermont Urban and Community Forestry Program's website: www.vtcommunityforestry.org

For gardening information contact the UVM Extension Master Gardener HELPLINE 1-800-639-2230
(656-5421 in Chittenden County)
master.gardener@uvm.edu
www.uvm.edu/mastergardener

References

Bannerman, R., E. Considine, and J. Horwatich, *Rain Gardens: A How To Manual for Homeowners,* UWEX Publications GWQ 037. University of Wisconsin-Extension, 2003

Kloss, C., and C. Calarusse, *Rooftops to Rivers: Green strategies for controlling stormwater and combined sewer overflows*, Natural Resources Defense Council, 2006

Pellett, N. E., and M. C. Starrett, *Landscape Plants for Vermont,* University of Vermont, 2002

Vermont Agency of Natural Resources, *Vermont Stormwater Management Manual*, Volume I and Volume II, 2002

Wilson, L., and M. Gilbertson, *Adding a Rain Garden to Your Landscape*, bulletin 2702 of the Landscapes for Maine series. Orono, ME: University Maine Cooperative Extension, 2006

Plant Photo Credits

With permission, the rain garden plant list photos were primarily provided by the following organizations:

Missouri Botanic Garden Plantfinder:
www.mobot.org/gardeninghelp/plantfinder/Alpha.asp

USDA, NRCS. The PLANTS Database, National Plant Data Center, Baton Rouge, LA 70874-4490 USA, 2007:
http://plants.usda.gov

Knoll Gardens: http://www.knollgardens.co.uk/

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Deina Luberts

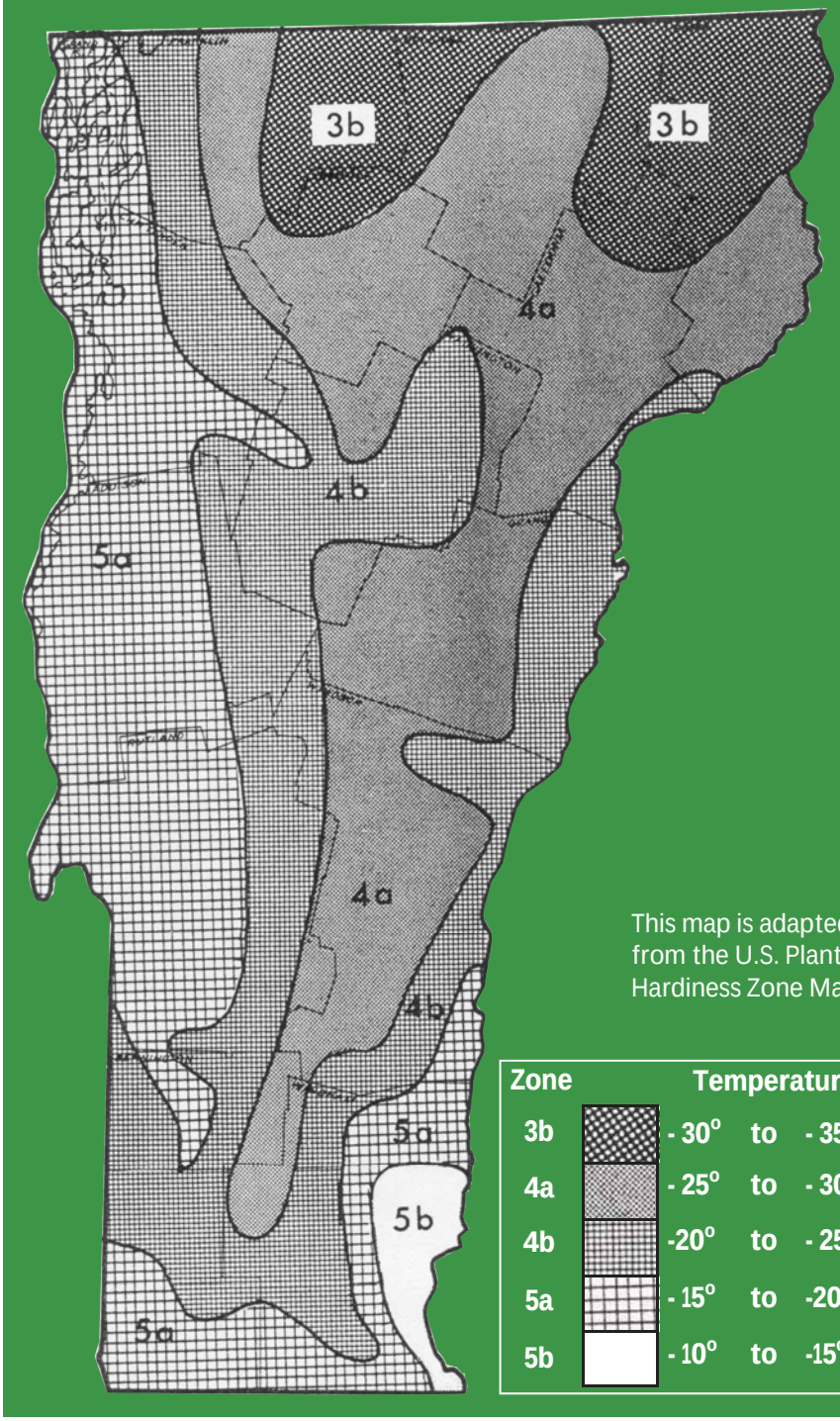
Kathleen Ryan, Landscape Architect

Fitzgerald Environmental:
Evan Fitzgerald

Eco Solutions:
Dave Whitney

Plant Hardiness Zones in Vermont

Average annual minimum temperatures



This map is adapted from the U.S. Plant Hardiness Zone Map

Zone		Temperature		
3b		- 30°	to	- 35°
4a		- 25°	to	- 30°
4b		-20°	to	- 25°
5a		- 15°	to	-20°
5b		- 10°	to	-15°

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Lake Champlain Sea Grant

South Burlington High School

New England Regional Water Program

Chittenden

University of Vermont Extension

EPA United States Environmental Protection Agency New England

The following businesses have demonstrated a commitment to protecting our local waterways by providing funding support and by committing to carry rain garden specific plants and supplies and/or provide technical assistance:

Round River Design, LLC.
Michael Blazewicz
michael@roundriverdesign.com
Burlington, VT 05401
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Web: www.roundriverdesign.com

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