The Small Sites Guide

For

Stormwater Management

VERMONT

Department of Environmental Conservation

December 2009

The Small Sites Guide for Stormwater Management

Small site structural Best Management Practices (BMPs) and Low Impact Development (LID) tools manage stormwater at its source. These practices infiltrate, filter, store, evaporate and detain runoff to minimize stormwater runoff and pollution.

Implementation of the practices within this guide may be used by "Category B and C Dischargers" in meeting the requirements of the Department's General Permit 3-9030 for Designated Discharges.

The practices in this guide are also intended to be universal in their application. Because LID/BMPs use a variety of useful techniques for controlling runoff, designs can be customized according to local regulatory and resource protection requirements, as well as site constraints.

Contact Information

VT DEC - Water Quality Division
Stormwater Section
103 South Main Street, Building 10 North
Waterbury, VT 05671-0408
Tel: 802-241-3770 or 4320

www.vtwaterquality.org/stormwater.htm

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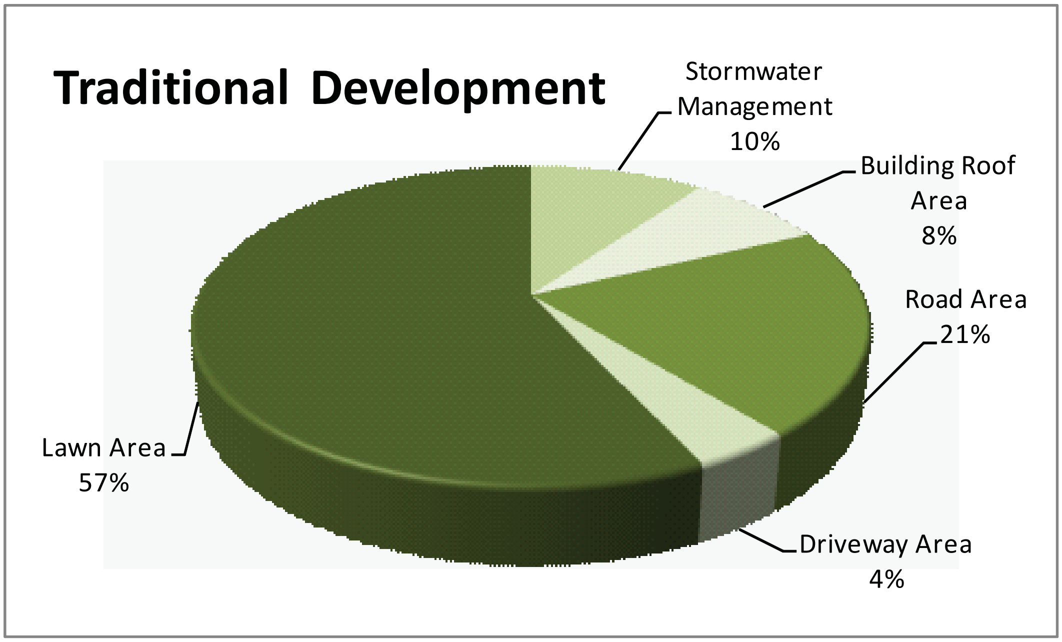
Introduction

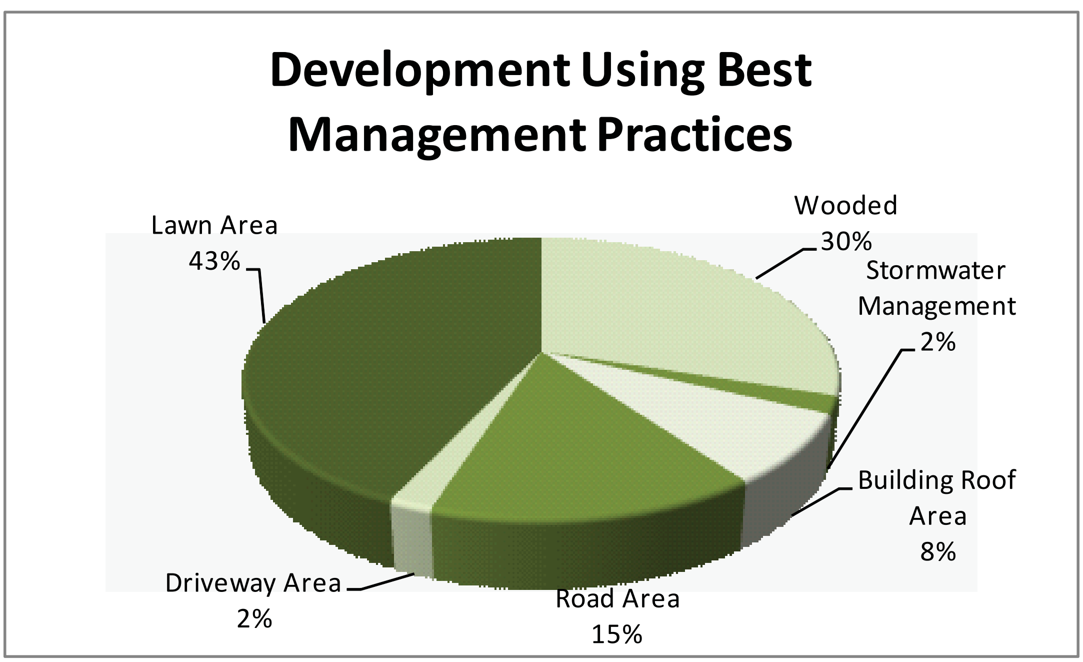
What are BMPs and why are they important?

During a rainstorm, water hits the ground and either infiltrates or flows across the ground. Flowing water can pick up and carry sediment and pollutants which can compromise water quality and habitat in surface waters. Excess stormwater can also cause damage such as erosion or debris jams. The effects of stormwater runoff are borne by municipalities, states, and federal organizations, which lands squarely on shoulders of the taxpayers. Permitting requirements can also place responsibility on individual businesses and property owners. BMPs help to increase infiltration, filtration, and storage, while reducing pollutants. Small sites, even those less than one acre, can use practices in this guide to reduce stress on water bodies and treatment systems.

Three main categories of stormwater treatment and control are used to separate BMP tools and are explained throughout this guide: maximizing sheet-flow and infiltration; preventing and eliminating soil erosion; and preventing and eliminating delivery of stormwater pollutants to conveyances. The tools in these categories lessen the amount and negative effects of stormwater runoff, thereby protecting downstream lakes, streams, and rivers.


Traditional Development
Stormwater Management 10%
Building Roof Area 8%
Road Area 21%
Driveway Area 4%
Lawn Area 57%

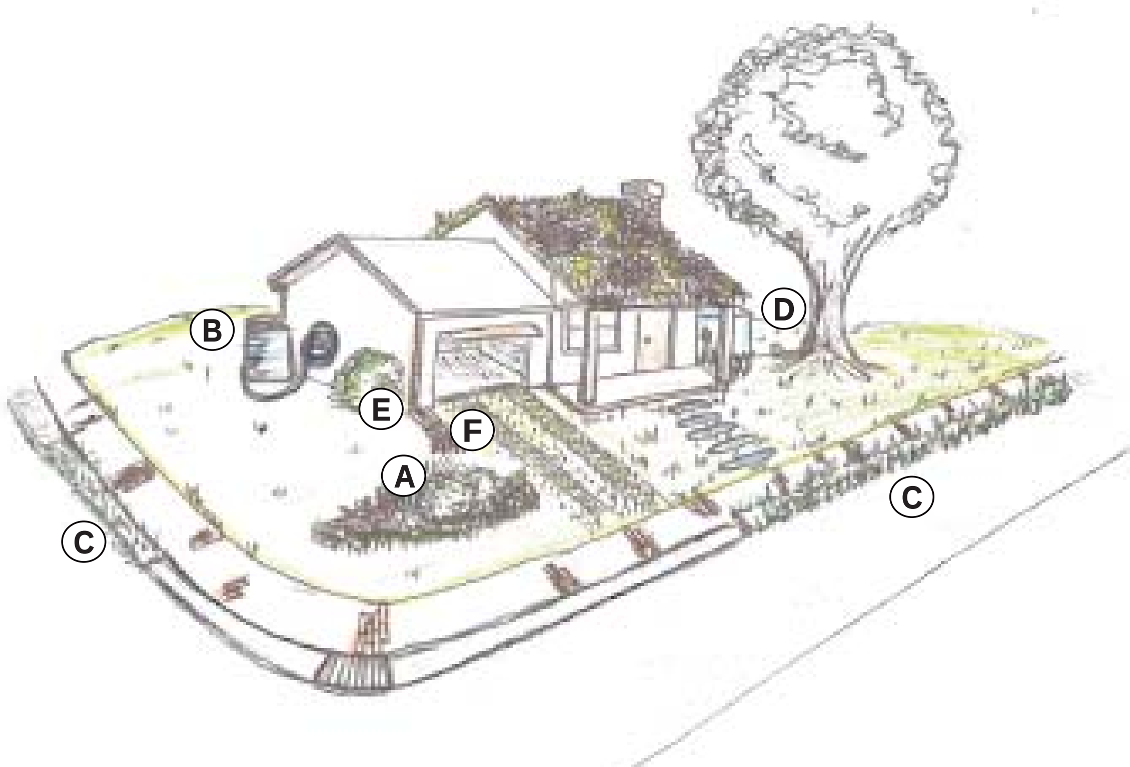
Versus


Development Using Best Management Practices
Lawn Area 43%
Wooded 30%
Stormwater Management 2%
Building Roof Area 8%
Road Area 15%
Driveway Area 2%

Traditional Small Lot Development Stormwater Practices

A conventional home or small site without best management practices. Conventional stormwater management focuses on quickly removing stormwater runoff from the site by collecting it via catch basins and pipes. These collection systems carry runoff to a treatment practice or a combined sewer system, or most often directly to a river or lake without any treatment at all.

LID/BMP Stormwater Practices



The above images show an example of a small site property transformed into one which utilizes many different best management practices that are explained in further detail on the following pages.

- A Rain Garden
- B Double Rain Barrel
- C Vegetated Swale
- D Cistern
- E Roof Top Disconnection
- F Infiltration Trench

It is not necessary to use every technique illustrated. Installing even just one of the noted techniques will help reduce stormwater runoff.

LID Tools
Maximize Sheet Flow and Infiltration

Designated discharges subject to General Permit 3-9030 shall maximize the ability of the site to achieve sheet-flow of stormwater runoff, as opposed to directing runoff into ditches, pipes or other means of conveyance. This may be accomplished through use of one or more of the following practices:

Roof Top Disconnection
Double Rain Barrels
Cisterns
Rain Gardens
Vegetated Swales
Infiltration Trenches

Rain Garden

Infiltration Trench

Vegetated Swale

Source: http://youngsierrans.files.wordpress.com

Above Ground Cistern

Source: http://martin.ifas.ufl.edu

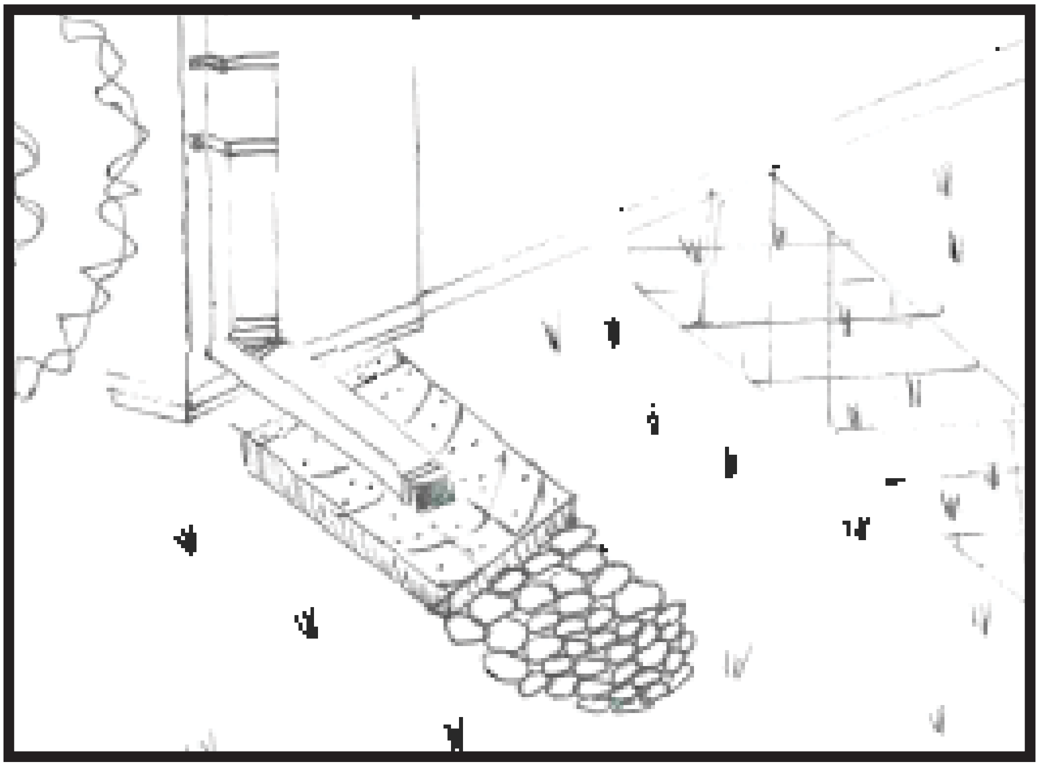
Double Rain Barrels

Photos supplied by and credited to: Linda Boudette Blasch of Better Backroads and Northern Vermont Research Conservation & Development

Roof Top Disconnection

Roof Top Disconnection

Disconnecting downspouts from the sewer system, driveways and roads allows roof water to drain to lawns and gardens. It's a more natural way to manage roof runoff because it allows water to soak into the ground and plants and soils filter pollutants.



Applications	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes
Road	N/A
Recreational	Yes

Stormwater Quantity Functions	
Volume	Medium
Groundwater Recharge	Medium
Peak Rate	Medium
Stormwater Quality Functions	
TSS	Varies
TP	Varies
TN	Varies

Additional Considerations	
Cost	Low
Maintenance	Low
Winter Performance	Low

Key Design Features

- Direct flows into stabilized vegetated areas
- Encourages sheet flow through vegetated areas
- Minimizes piped drainage systems
- Maximizes over-land flows

Benefits

- Reduces runoff volume and peak rate
- Increases water quality

Variations

- Rain Barrel or Cistern can be connected for reuse of rainwater
- Direct to a Bio-retention area

Limitations

- Requires area and proper soils for infiltration

Roof Top Downspout Disconnection

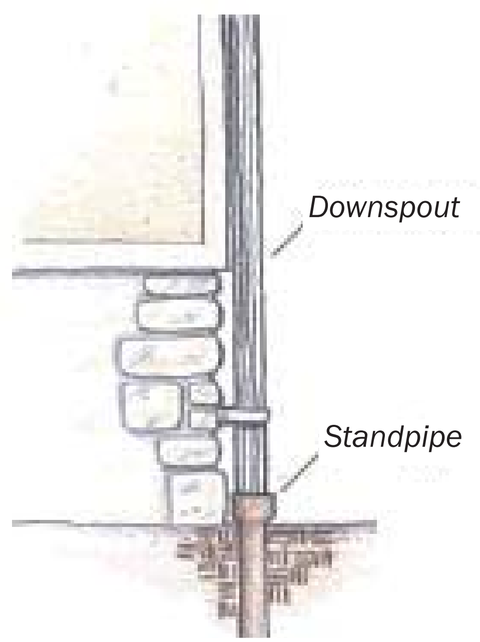
Disconnecting your downspout from a sewer intake pipe (standpipe), road or driveway; and then redirecting the flow of water to a grassy area or garden is a simple process that makes a big difference. It is an easy and effective way to reduce stormwater impacts to surface water resources.

Do it yourself directions for completing a roof top downspout disconnection

Supplies

Hacksaw	Sheet metal screws
Drill	Downspout elbow
Tape measure	Downspout extension
Pliers	Standpipe cap
Splash block	Pea gravel

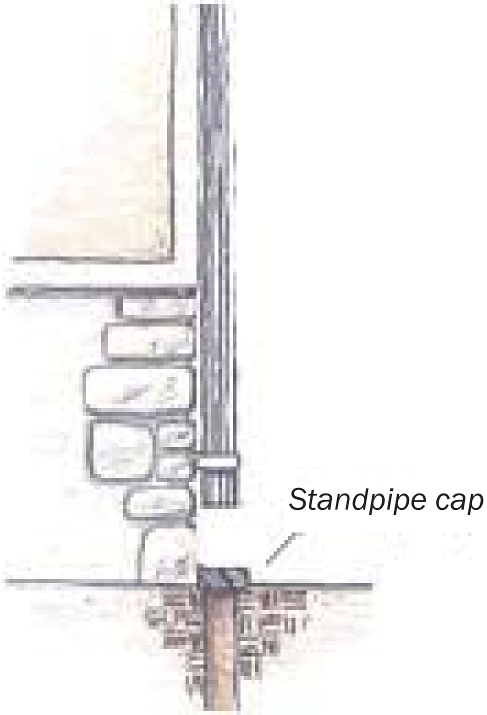
Note
There are different types, lengths and sizes, of standpipe caps, so be sure to take measurements before shopping. Capping the standpipe prevents water from going in while keeping pests (such as rodents) from entering/exiting the pipe.



Downspout connected to standpipe

Instructions:

- Cut the existing downspout approximately 9 inches above the sewer standpipe with a hacksaw.

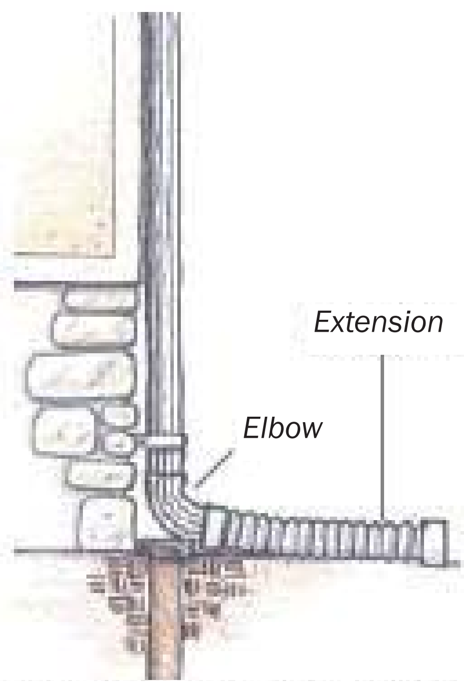


• Cap the sewer standpipe.

• Attach elbow by crimping the downspout with pliers to ensure a good fit.

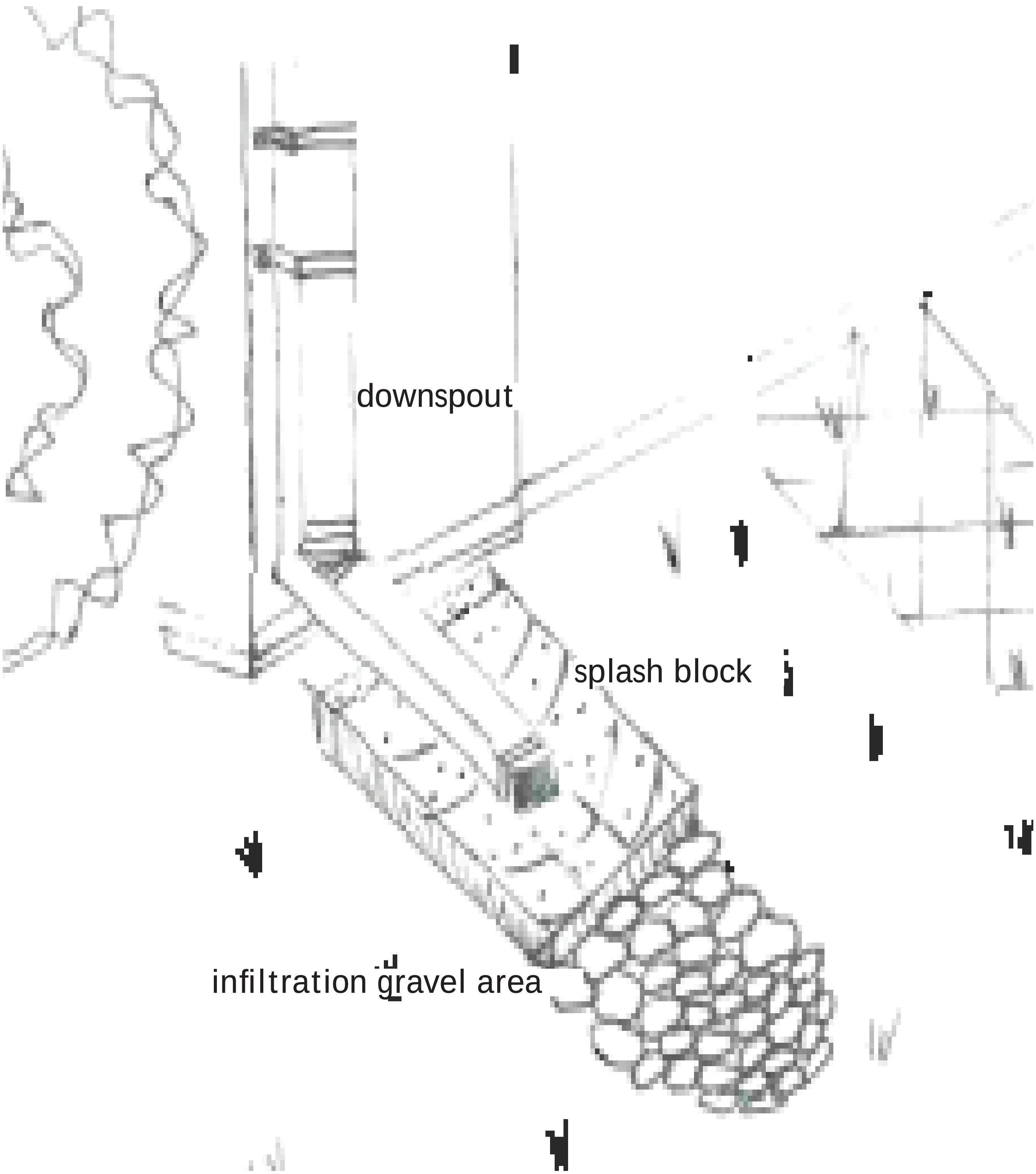
• Connect elbow to downspout using sheet metal screws. It may be necessary to pre-drill holes.

• Attach the elbow into the extension and secure with sheet metal screws. Water should drain at least five feet away from the house, so direct the extension accordingly. A splash block will help direct water further away from the house.



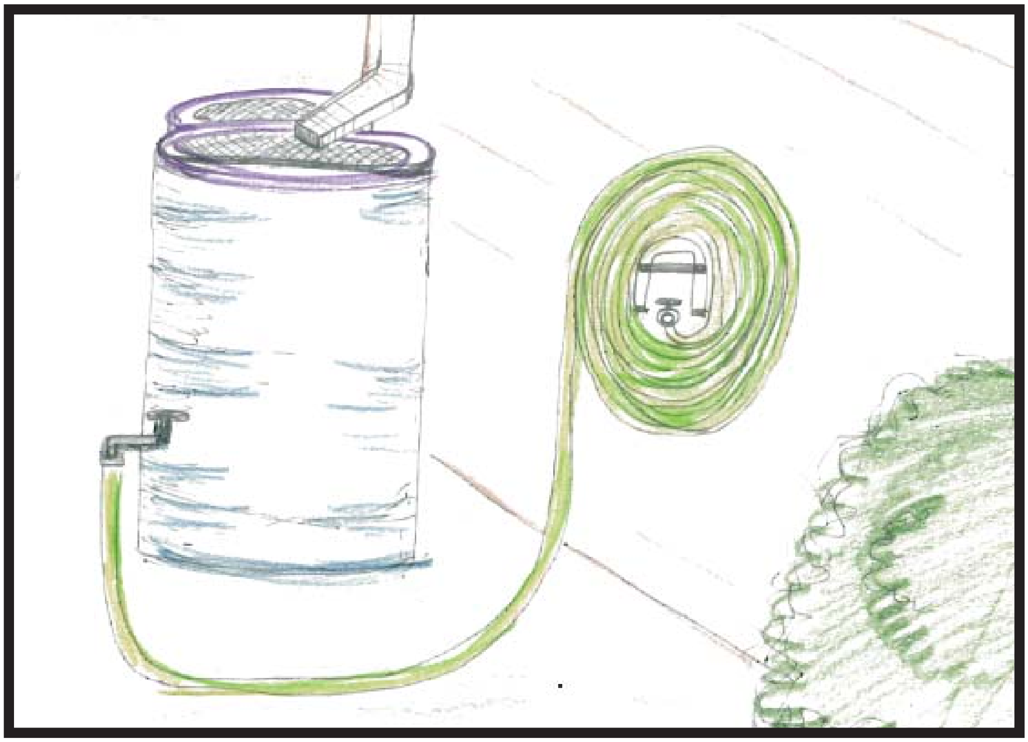
Elbow and extension attached to downspout

• Using gravel at the end of the splash block helps to disperse the water’s energy further allowing it time to infiltrate into the yard.



Double Rain Barrels

Double rain barrels are designed to intercept and store runoff from rooftops to allow for reuse, thus reducing volume and overall water quality impairment. The stormwater is contained and typically reused for watering lawns, plants, or flowers. The Department recommends double rain barrels or cistern use, as these are able to store a larger amount of water, thereby increasing their value at times when greater storage is necessary and water is less readily available.



Key Design Features
- Small Storm events are captured in most structures
- Design overflow for large events
- Drain between storm events
- Locate to provide gravity flow to eliminate pump needs

Benefits
- Reduced need for potable water for outside watering
- Provides supplemental water supply
- Wide applicability

Variations
- Cisterns
- Sub-surface storage

Limitations
- Can only manage small storm events

Applications	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes
Road	No
Recreational	Yes

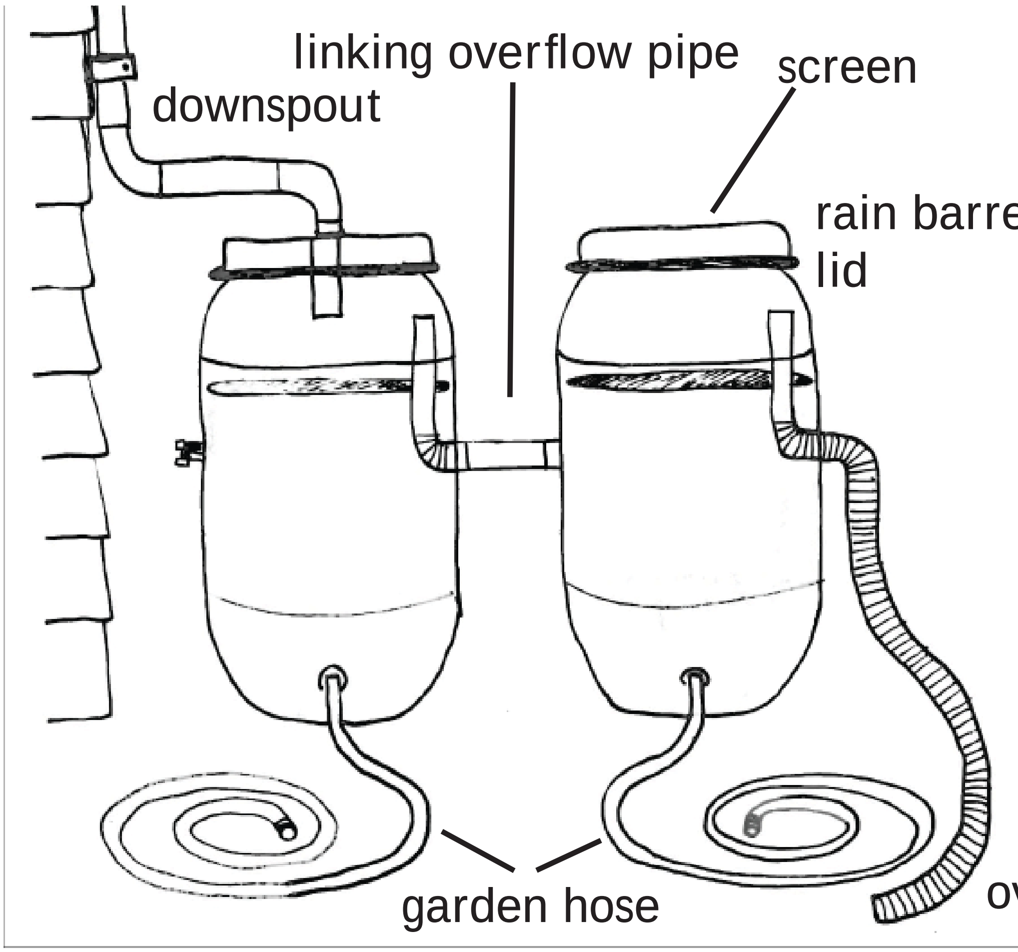
Stormwater Quantity Functions	
Volume	High
Groundwater Recharge	Low
Peak Rate	Low
Stormwater Quality Functions	
TSS	Medium
TP	Medium
TN	Medium

Additional Considerations	
Cost	Low
Maintenance	Medium
Winter Performance	Medium

Design Guidance for Double Rain Barrels

• Rain barrels should be installed near the building from which it collects rainfall.

• Water should be used or discharged between storm events.

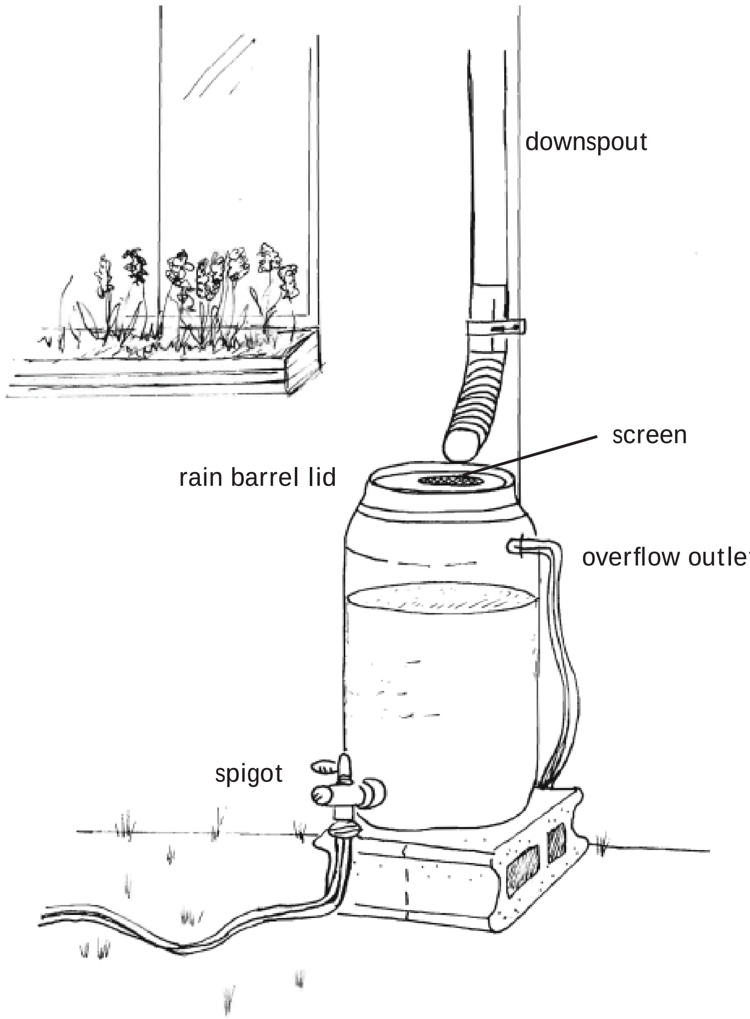


• Downspouts should be piped directly into the rain barrel. The top of the rain barrel should have a screen to filter debris and prevent insects from getting in.

• The overflow outlet should be 3 inches below the top of the rain barrel and should connect to the next barrel. The overflow from the second barrel should be directed to an area to infiltrate.

• Drain rock or a splash block should be positioned at the overflow outlet if a conveyance pipe is not implemented

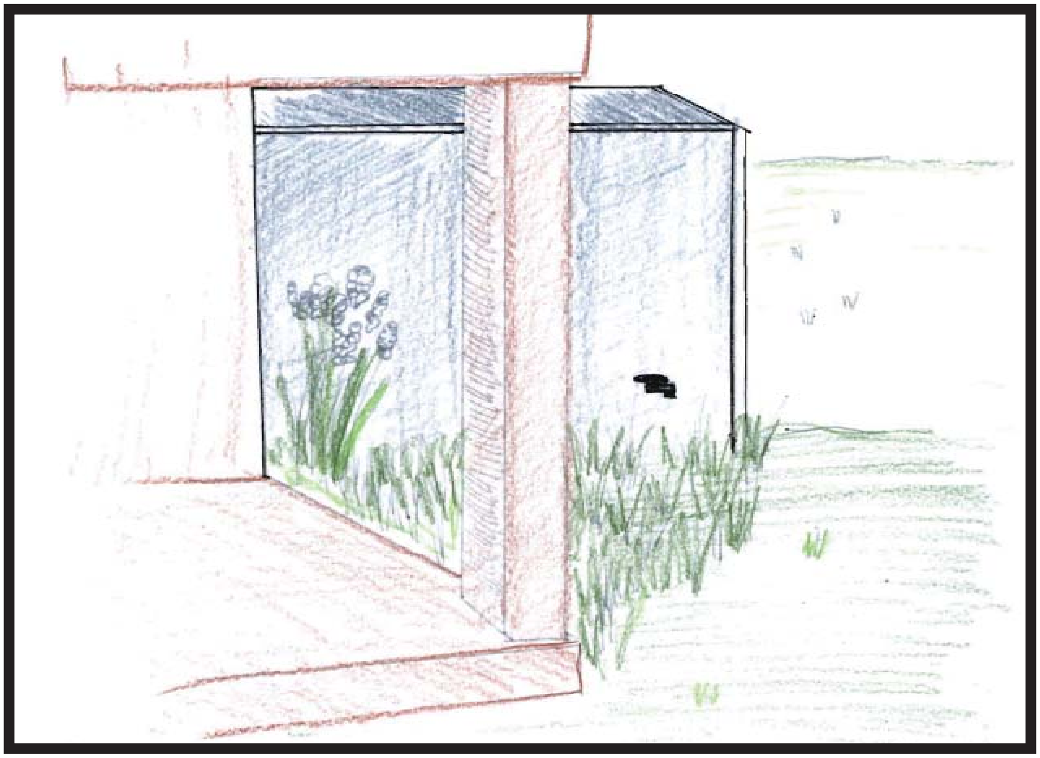
Standard barrel size = 24”wide X 36” tall
Each barrel is able to hold 50-150 gallons



Photos supplied by and credited to Ashley Lidman of Winooski Natural Resources Conservation District

Cisterns

A cistern is a container or tank that has greater storage capacity than a rain barrel. Cisterns may be comprised of fiberglass, brick, concrete plastic or wood and can be located above or below ground. A cistern can range in size from 200 gallons to upwards of 10,000 gallons. Typically cisterns are used to supplement gray water and irrigation needs. There are variations of these as well to allow slow release to recharge groundwater.



Applications	
Residential	Limited
Commercial	Yes
Industrial	Yes
Retrofit	Yes
Road	No
Recreational	Yes

Stormwater Quantity Functions	
Volume	High
Groundwater Recharge	Low
Peak Rate	Low
Stormwater Quality Functions	
TSS	Medium
TP	Medium
TN	Medium

Additional Considerations	
Cost	Medium
Maintenance	Medium
Winter Performance	Medium

Key Design Features
- Design overflow for large events
- Drain between storm events
- Locate to provide gravitational pressure to eliminate pump needs

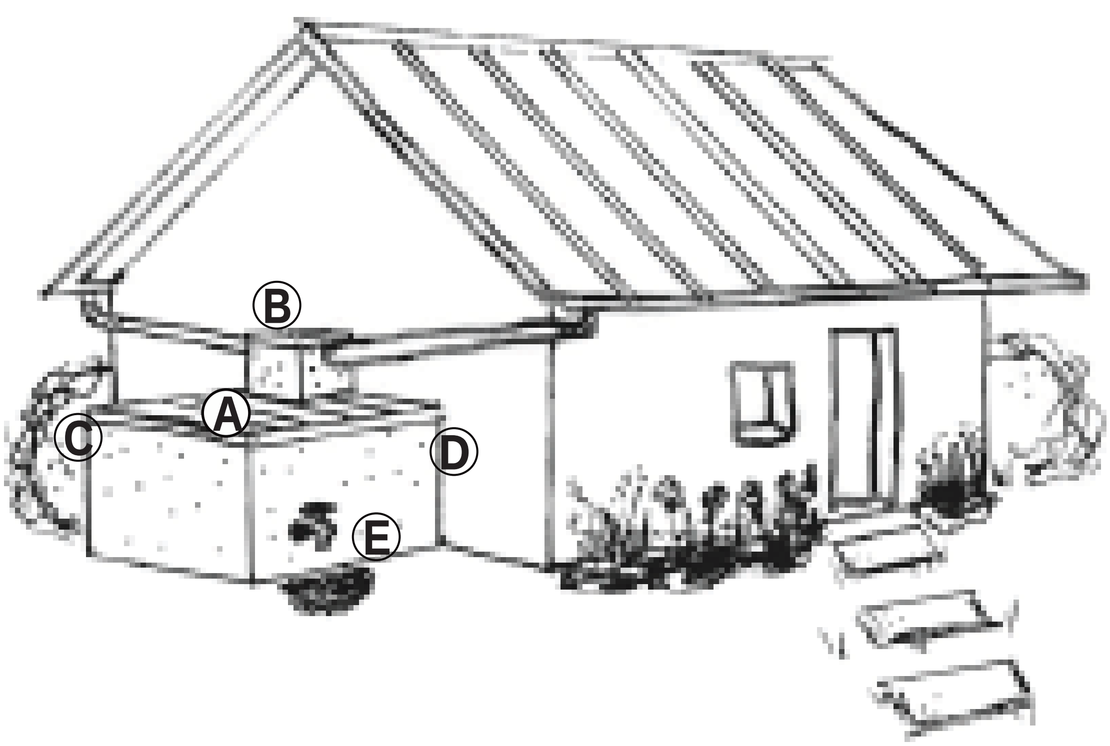
Benefits
- Reduced need for potable water for outside watering
- Provides supplemental water supply
- Wide Applicability

Variations
- Rain Barrels
- Sub-surface storage
- Groundwater infiltration system
- Gray water use

Limitations
- Has to be sized properly by an engineer or designer to handle larger storm events

There are three main types of cisterns: above ground, partially buried, and underground. Generally, all types include the following components:

- Ⓐ secure and solid cover
- Ⓑ screen at entrance to prevent insects from entering
- Ⓑ coarse inlet filter with clean out valve
- Ⓒ overflow pipe
- Ⓓ manhole, sump, and drain to facilitate cleaning
- Ⓔ water use spigot



Other features may include:

- Water level indicator
- Sediment trap, tipping bucket or other “foul flush” mechanisms
- Tank lock
- Pump if below ground
- A second sub surface tank (to provide water to livestock)

<u>Design Guidance</u>

Cistern volume is a function of roof area, precipitation required to fill the cistern, and water loss due to evaporation. In order to calculate the amount of stormwater to be stored in a cistern and provide overflow for exceptional amounts of rainfall, use the following equation:

V = (A2) (R) (0.90) (7.5 gallons/cubic feet)

V = volume of cistern (gallons)
A2 = surface area of roof (square feet)
R= rainfall (feet)
0.90 = losses to system (no units)
7.5 = conversion factor (gallons/cubic foot)

http://www.flickr.com/photos/rainwater-collection/

Similarly, the table below shows an estimate for water collected per 1,000 square feet of roof.

Estimated quantity of runoff per 1,000 square foot of roof	
Rainfall in inches	Water collected in gallons
0.10	56.0
0.25	140.0
0.50	281.0
0.75	422.0
1.0	563.0
2.0	1,125.0
3.0	1,688.0
4.0	2,250.0

Other design considerations

• Concrete in-ground, cast-in-place cisterns walls are recommended to be at least 6 inches thick in cold climates (Vermont).
• Place the above ground cistern in open spaces to aid in maintenance and cleaning. Specifically, access to each cistern compartment will be needed through a removable surface plate.
• Site cisterns close to buildings for roof runoff gathering or near the area where the gathered water will be used most.
• Size, material, holding capacity, and flow for above ground cisterns should be assessed by a site designer.

Above ground cisterns can be used with an irrigation system for outside use or connected to indoor plumbing to be used for non-potable functions. Any indoor use of cistern water should be reviewed by a design professional for compliance with applicable regulations. All water should be filtered prior to use to remove any solids.

Maintenance

• Clean roof surfaces and gutters of animal droppings and leaves.
• Check the cistern at least once a year for possible leaks.
• Remove deposits from the bottom of the tank as necessary.

Photos supplied by: Emma Melvin with credit to UVM Lake Champlain Sea Grant

Rain Gardens

A rain garden is a depressed area with native plantings used to capture, slow, infiltrate, and treat stormwater from impervious surfaces, including rooftops, streets, parking lots and driveways

Key Design Features
- Flexible in size & infiltration
- Native plants

Benefits
- Volume control and groundwater recharge & filtration
- Versatile with broad applicability
- Improved aesthetics and habitat

Variations
- Subsurface storage and infiltration bed
- Use of under drain

Limitations
- Higher maintenance until vegetation is established
- Initial plant selection and growth requires care
- May not work if soils drain poorly

Applications	
Residential	YES
Commercial	YES
Industrial	YES
Retrofit	YES
Road	YES
Recreational	YES

Stormwater Quantity Functions	
Volume	Med/High
Groundwater Recharge	Med/High
Peak Rate	Medium
Stormwater Quality Functions	
TSS	High
TP	Medium
TN	Medium

Additional Considerations	
Cost	Medium
Maintenance	Medium
Winter Performance	Medium

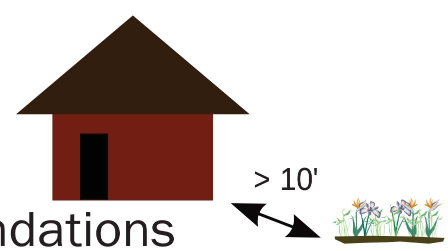
Steps to Install a Rain Garden

- Assess the soil drainage - conduct an infiltration test
- Calculate slope - assess other aspects of the rain garden location
- Construct a non-erodable outlet or spillway to discharge overflow
- Install amended soil for drainage and nutrients using a mixture of loose aggregate and compost
- Plant native species able to withstand drought and wet conditions
- Mulch plants and maintain garden by weeding, pruning, etc.

Design Guidance for Placement

To test the drainage of the possible rain garden location, dig a 6-8 inch deep and wide hole and fill with water. If the water does not drain within 12 hours, the location is not appropriate for a rain garden.

Rain gardens should be placed where they are needed and will intercept stormwater. For example, although placing a rain garden under a mature tree may capture stormwater, the tree is most likely taking up more water than the garden; therefore, a rain garden is unneeded in this location.



Placement of rain gardens should:
- be 100 feet from wells
- not be placed above septic systems
- be at least 10 feet from building foundations
- not be on soils where the water table is within 24 inches of the surface
- avoid utility crossings

Check with **Dig Safe System, Inc**. to ensure the placement of the rain garden does not interfere with buried utility lines.

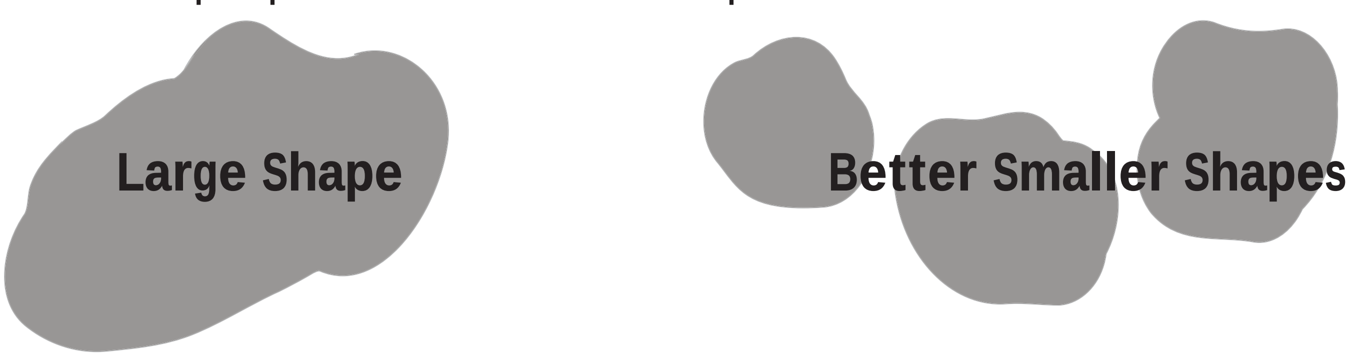
<u>Design Guidance for Size</u>

Soil type affects the size of the garden needed. The correct size garden will maximize groundwater recharge and ensure proper drainage. First, determine if the soil where your rain garden will go is clay, sandy, or loam (loamy soil drains better than clay, but holds water better than sand).Next, measure the impervious areas that will drain to it.

- For clay soils, the garden should be 60% of the impervious area
- For sandy soils the garden should be 10-20% of the impervious area
- For loamy soils the garden should be 20-60% of the impervious area

Shapes of the rain gardens may vary, but are most effective when:

- curvy
- situated with the longest length of the garden perpendicular to the slope of the land

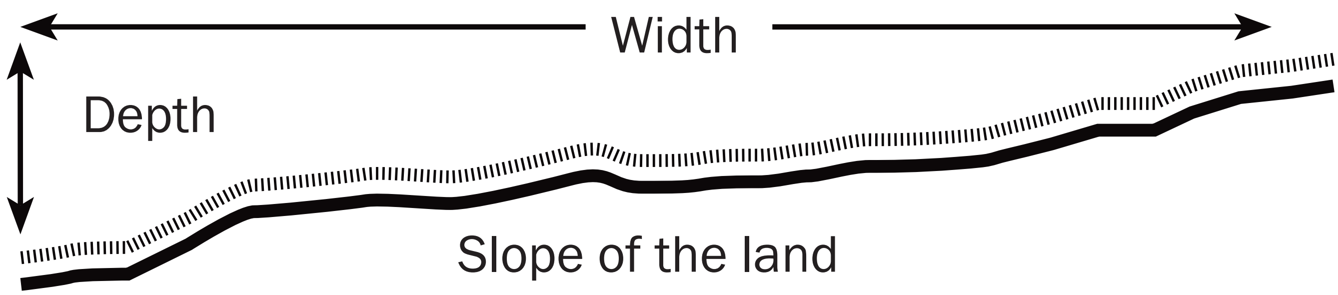


Smaller distributed rain gardens are more effective than a single large scale one.

Design Guidance for Depth

Rain gardens are typically between 4-8 inches in depth depending on slope. When slope is:

- < 4%, the depth should be 3-5 inches
- between 5-7%, the depth should be 6-7 inches
- between 8-12%, the depth should be 8 inches
- > 12% slope, should be individually assessed by a site designer



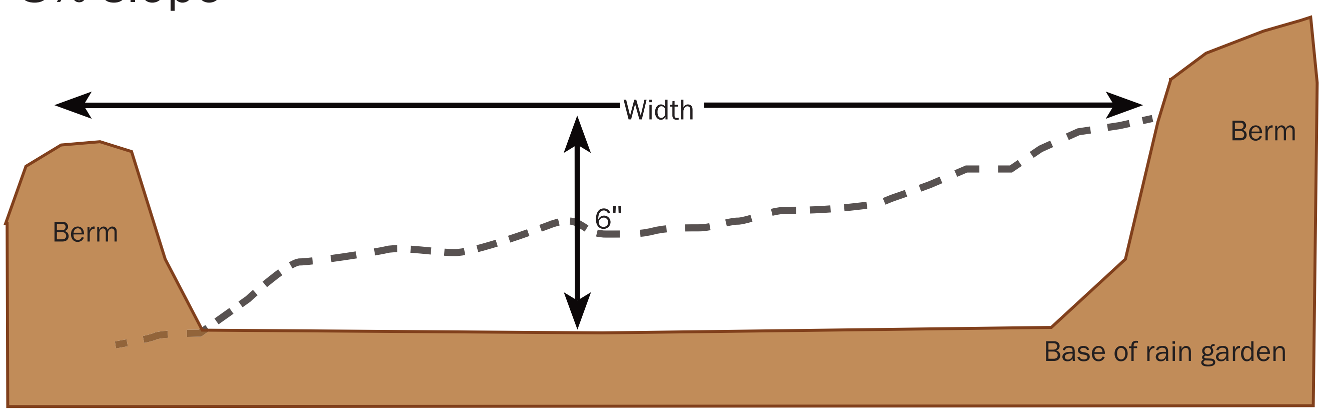
Rain Gardens placed near source of stormwater			
	Size factor		
	3-5 inches deep	6-7 inches deep	8 inches deep
Sandy Soil	.19	.15	.08
Loamy Soil	.34	.25	.16
Clayey Soil	.43	.32	.20

Rain Gardens placed further from source of stormwater	
	Size factor for all depths
Sandy Soil	.03
Loamy Soil	.06
Clayey Soil	.10

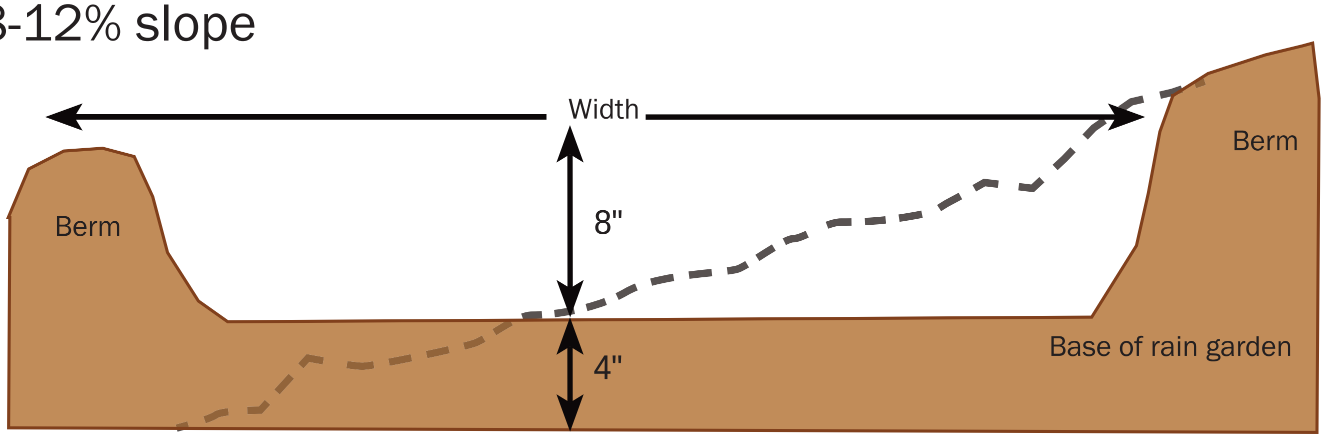
Steps for calculating surface area of a rain garden
1. From the previous tables, find the size factor for the depth and soil type of the rain garden 2. Multiply the upstream impervious area by the size factor 3. If the answer is > 300 sq. feet, create multiple smaller rain gardens

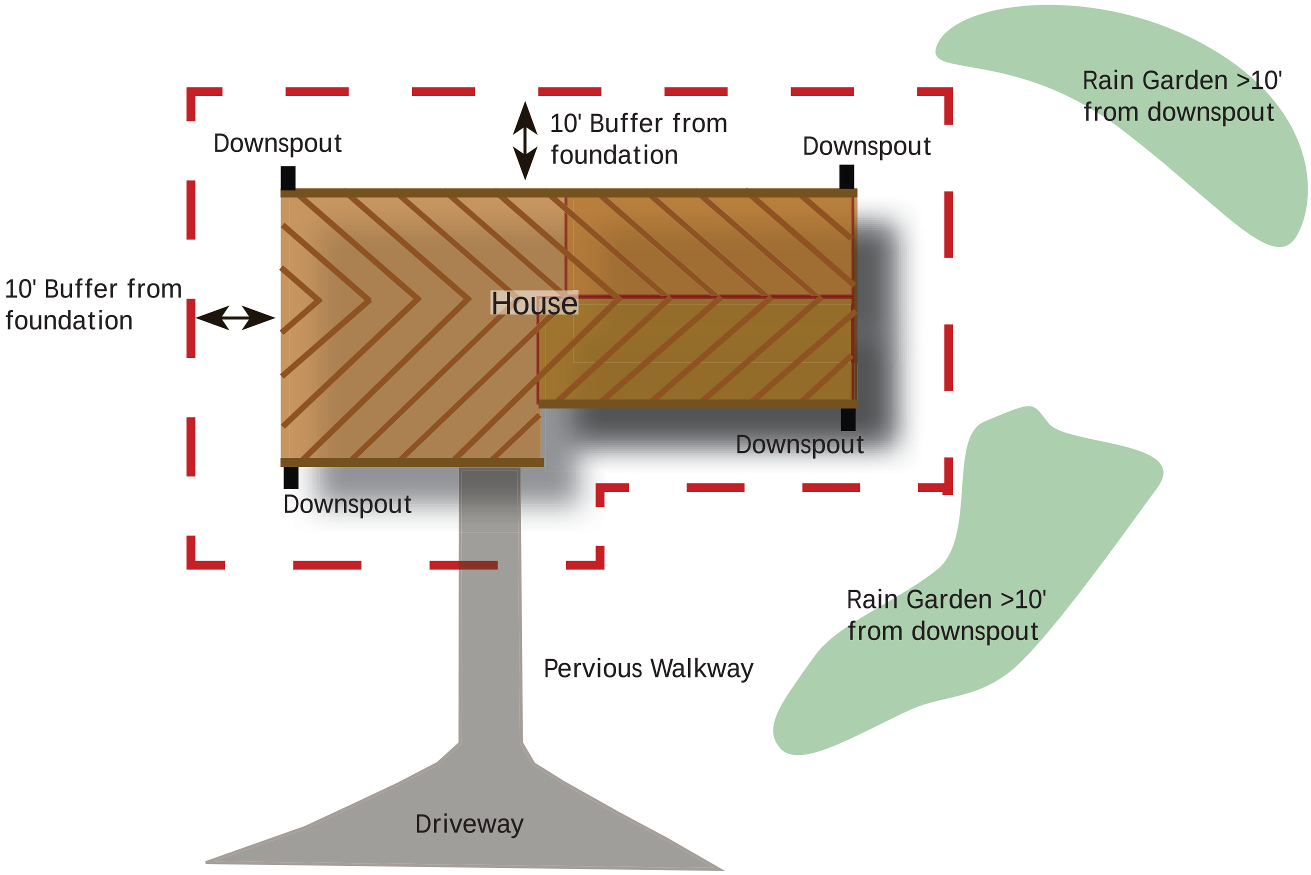
Design Guidance for Construction

3-8% slope

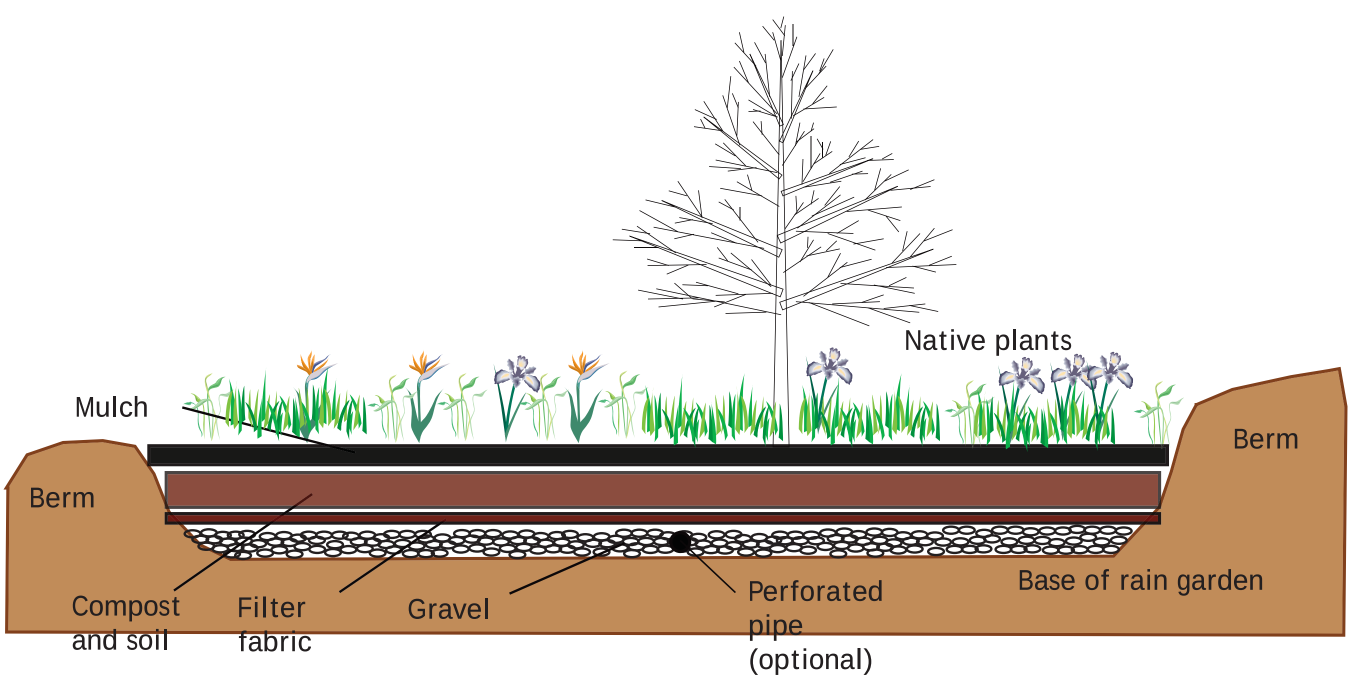


8-12% slope





PLAIN VIEW



PROFILE

Design Guidance for Construction Continued

After removing 8-10 inches of soil, creating berms, and forming the shape of the rain garden, the following layers should be applied to the level bottom of the of earth in order from bottom to top.

- stone or sand
- mix 2-4 inches of existing soil and organic compost (50/50 mix) and spread evenly (acidic soils may need lime application here - clay soils may need a more porous soil mixed in)
- plant native species suitable for the conditions
- 2-3 inches of mulch
- Perforated pipe should have a minimum 1 foot sump.
- Overflow from the pipe should be directed to a designated discharge area that complies with Vermont's permitting regulations.
- Overflow grate should be placed 1-2 inches below the top of the rain garden.
- It is important that all layers of the rain garden be level.
- A grass swale or gravel entrance to slow stormwater, should be installed to prevent channeling.

Engineered Rain Gardens with Underground Drainage System (should be designed by an individual with relevant expertise).

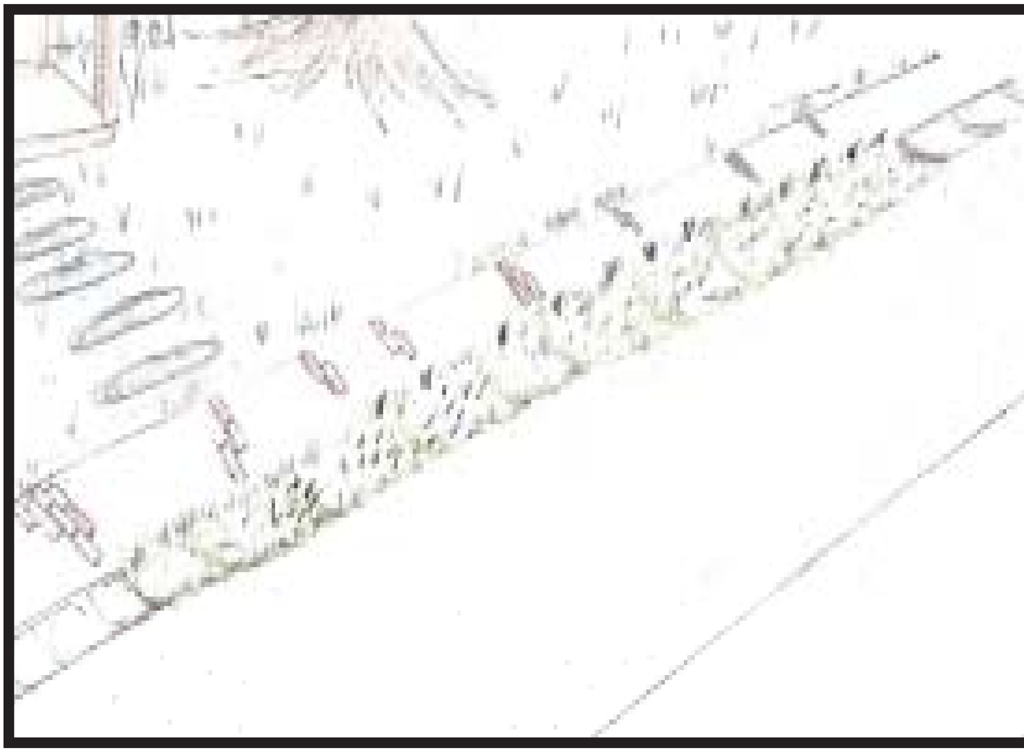
Beyond the typical rain garden, four types of engineered rain gardens are described in the following table.

Other Constructed Rain Gardens

Type of Engineered Rain Garden	Description	Elements
Full Infiltration	All inflow infiltrates into subsoil and overflow is taken via underground pipe	• Rain garden as described previously • Overflow standpipe or swale • Secondary overflow inlet at catch basin • Outflow pipe to storm drain
Full Infiltration with Reservoir	Has the addition of a drain rock reservoir for surface water to move into the substrates of soil	• Same elements as Full Infiltration Rain Garden • Drain rock reservoir • Geotextile lining drain rock reservoir
Partial Infiltration	Infiltrates most water into soil - overflow drains through perforated pipe placed near the top of the drain rock reservoir	• Same elements as Full Infiltration with Reservoir • Perforated pipe
Partial Infiltration with Reservoir	Acts as a small detention facility; treats water by decanting the top portion of the reservoir and rain garden - allows for infiltration as well.	• Same elements as Partial Infiltration • Flow restrictor assembly

Vegetative Swales

Vegetated swales are shallow open channels lined with dense vegetation designed to treat, attenuate, and convey excess stormwater runoff. Vegetated swales can replace curb or gutter systems and although they require more space, they better manage stormwater.



Key Design Features

- 2-year storms do not cause erosion
- Check dams can provide additional storage and infiltration

Benefits

- Can replace curb and gutter for site drainage and provide significant cost savings
- Peak and volume control with infiltration

Variations

- Subsurface storage and infiltration bed
- Use of underdrain

Limitations

- Limited application where space is minimal

Applications	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Limited
Road	Yes
Recreational	Yes

Stormwater Quantity Funtctions	
Volume	Low/Med
Groundwater Recharge	Low/Med
Peak Rate	Low/Med
Stormwater Quality Functions	
TSS	Med/High
TP	Low/High
TN	Medium

Additional Considerations	
Cost	Low/Med
Maintenance	Low/Med
Winter Performance	Medium

Vegetative swales are primarily designed to receive drainage from areas including roads, parking lots, rooftops, and other impervious surfaces.

Vegetated swales can be designed to provide infiltration, but are primarily used to convey water.

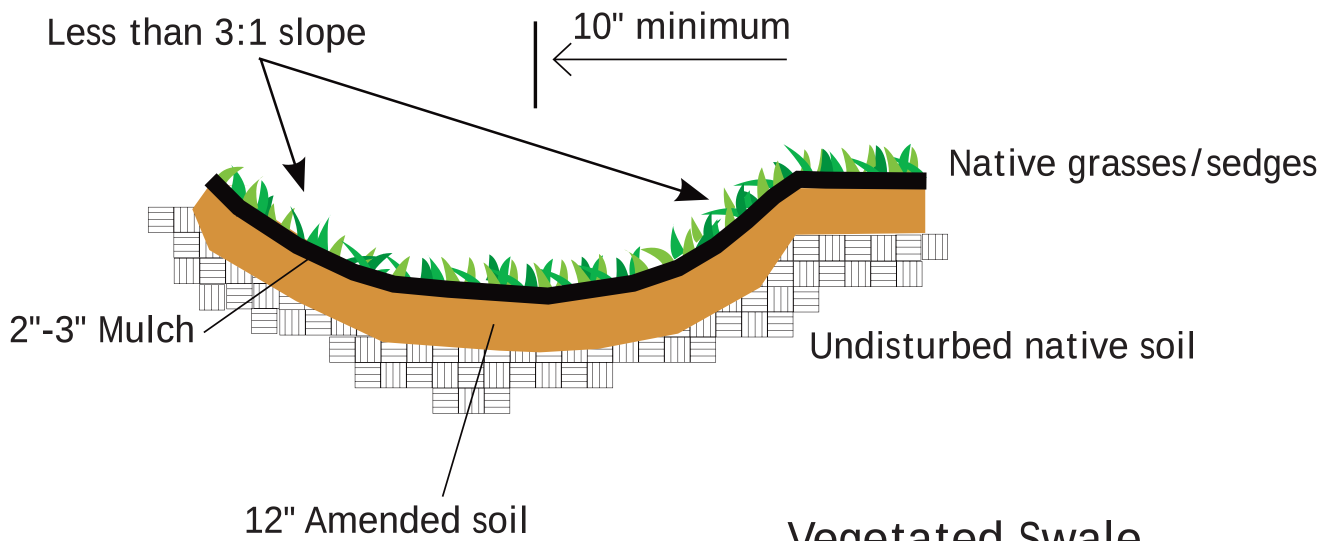
Photos supplied by: Emma Melvin with credit to UVM Lake Champlain Sea Grant

Design Considerations
The recommended slope for swales is 1-4%. For steeper slope (up to 5%) check dams are recommended to reduce flow velocity and erosion potential. In areas of steep slopes, swales should run parallel to contours of the landscape. Swales may not be appropriate for highly sloped areas.

Grasses or sedges are typically used in vegetated swales, but other native plants can be used as well. Please refer to the *The Vermont Stormwater Management Manual Volume II* for a list of recommended native species. The manual is available online at www.vtwaterquality.org/stormwater.htm

The bottom of a swale should be 2-4 feet above the seasonal high water table.

Outlet protection should be required at the discharge point from swales to prevent scour or erosion.

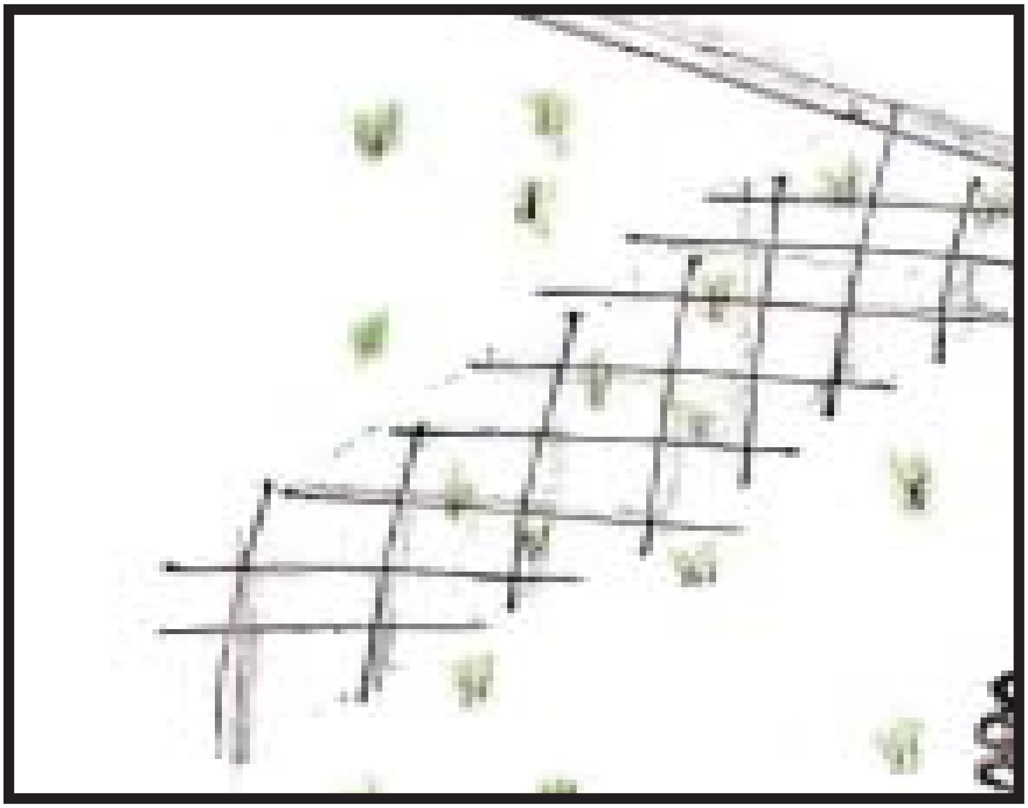


Vegetated Swale

Photos supplied by and credited to: Linda Boudette Blasch of Better Backroads and Northern Vermont Research Conservation & Development

Infiltration Trenches or Galleries

Infiltration trenches are shallow open channels lined with dense vegetation. Infiltration trenches can be used to treat stormwater. The first flush from a storm event can be diverted to infiltration trenches.



Key Design Features
- Requires level infiltration surface
- proximity to buildings, drinking water supplies, karst features and other sensitive areas needs to be taken into consideration

Benefits
- Reduces stormwater runoff
- Increases groundwater recharge
- Reduces peak rate runoff

Variations
- Subsurface storage and infiltration
- Use of geotextile
- Use of crushed stone

Limitations
- Pretreatment necessary
- Not recommended for steep slopes

Applications	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes
Road	Yes
Recreational	No

Stormwater Quantity Functions	
Volume	Medium
Groundwater Recharge	High
Peak Rate	Low/Med
Stormwater Quality Functions	
TSS	High
TP	High/Med
TN	Med/Low

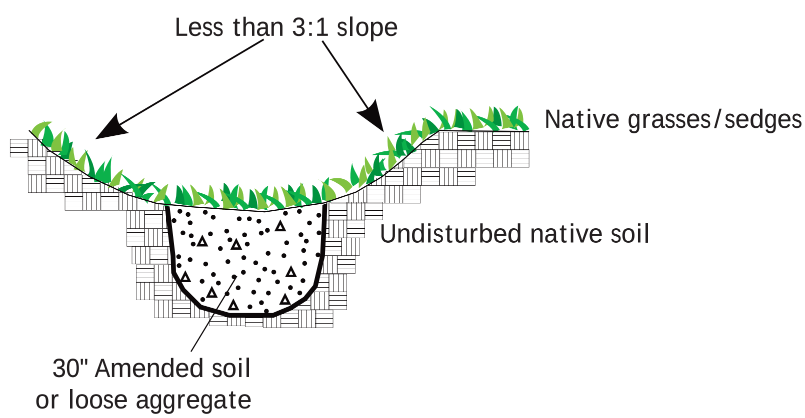
Additional Considerations	
Cost	Medium
Maintenance	Low/Med
Winter Performance	High

Design Considerations

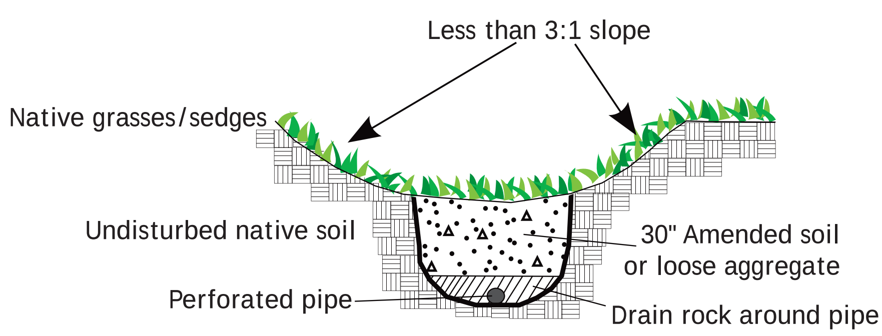
Infiltration Trenches or Galleries should be designed to hold water no longer than 24 hours. A 30 inch deep soil mix consisting of 50% topsoil and 50% sand should be used for water quality swales. Infiltration rates should be 0.5 inch/hour or greater. If native soils are not conducive to infiltration, an under-drain system should be installed beneath the soil layer to avoid long periods of standing water.

Infiltration trenches are generally 3-12 feet in depth and backfilled with amended soil or loose aggregate.

Infiltration trench without underground drain



Infiltration trench with underground drain



General Guidelines:

Lawn and Garden Watering

Soils, yard wastes, over watering, and garden chemicals become part of the urban runoff mix that winds its way through streets, gutters, and storm drains. For example, poorly functioning sprinklers and over watering wastes water and increases the number of pollutants flowing into storm drains. Do not over-water. Conserve water by using irrigation practices such as drip irrigation, soaker hoses, or micro-spray systems. Avoid watering onto paved surfaces or areas that drain into storm drains.

Mowing and Natural Buffers

Reducing the amount of lawn on a site and allowing native vegetation to grow, lessens the amount of fertilizer, fuel, and energy a site uses. Runoff is better infiltrated and pollutants better treated than having only turf. Equally important is creating or maintaining natural buffers around streams, wetlands, and other sensitive areas in order to intercept runoff, as well as infiltrate, filtrate and treat through vegetated uptake. It is recommended in Vermont to have at least 50 feet of natural buffer from receiving waterbodies, such as streams and lakes.

Prevent and Eliminate Soil Erosion

Designated discharges subject to General Permit 3-9030 shall eliminate areas of active erosion through re-vegetation, or stabilization with stone or other similar means. New construction that does not require a NPDES permit for disturbances of one or more acres of land shall implement proper erosion prevention and sediment control techniques to minimize the discharge of soil, or sediment from the site.

Construction projects that disturb one acre or more of earth surface require coverage under the Department's Construction General Permit #3-9020. Contact the Water Quality Division prior to construction at 241-3770 or www.vtwaterquality.org to determine application requirements.

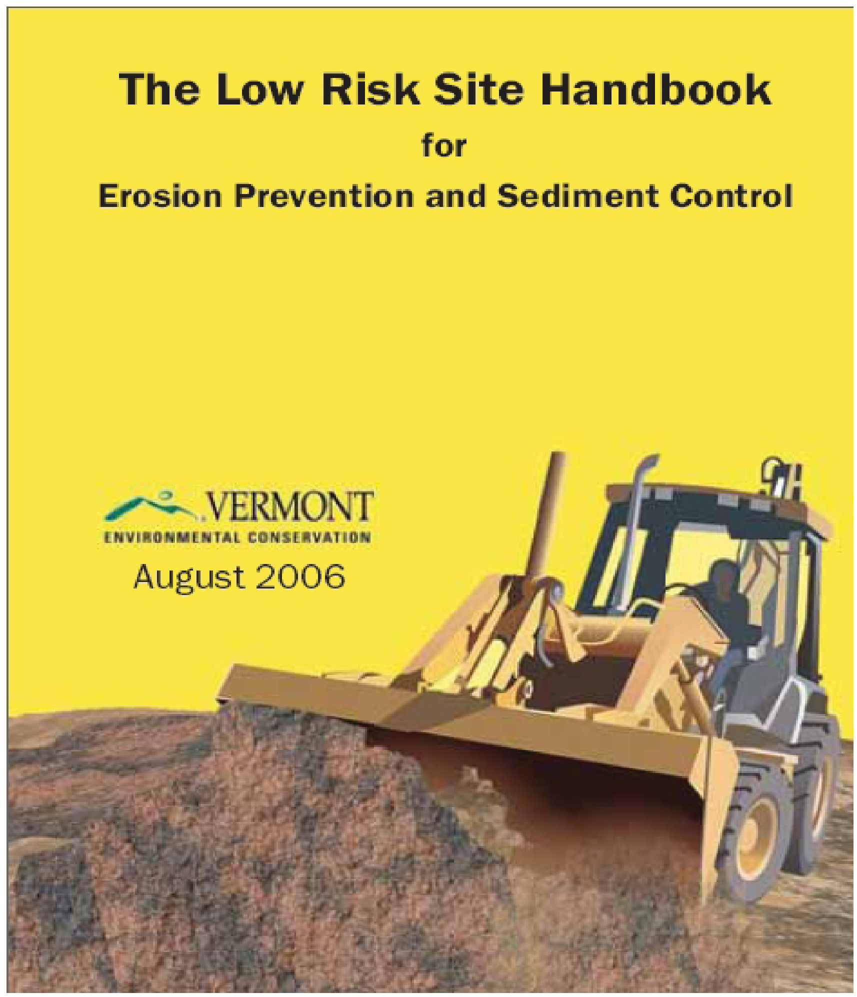
However, any earth disturbance regardless of size (including those smaller than one acre) should implement proper erosion prevention and sediment control techniques to minimize the discharge of soil, or sediment, from the site. These techniques include the measures described below.

- Areas of existing active erosion, including exposed soil that can be carried away by stormwater runoff, should be stabilized immediately, and either re-vegetated or protected by permanent cover such as stone.

- New construction projects should seek to limit the amount of exposed area at any one time. Limiting disturbance minimizes the potential for erosion.

• Disturbed areas should be stabilized as quickly as possible with either temporary or permanent cover. Once final grade has been reached on a project, stabilize the site with seed and mulch or erosion control matting.

• Prevent soil and mud from being tracked onto the street. A stabilized entrance on the driveway may be required to keep soil on site.



Specific installation instructions for all erosion control practices, and additional measures for larger sites, are available in the “Low Risk Site Handbook for Erosion Prevention and Sediment Control.”

This handbook is Available online at http://www.vtwaterquality.org/stormwater/docs/construction/sw_low_risk_site_handbook.pdf. A print copy may be requested by calling (802) 241-3770.

General Guidelines:

CONSTRUCTION

During construction or property work, protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting. Schedule grading and excavation projects for dry weather. Prevent erosion by planting fast-growing annual and perennial grasses to stabilize soils.

- Before beginning an outdoor project, locate the nearest storm drains and protect them from debris and other materials.
- Sweep up and properly dispose of construction debris such as concrete and mortar.

PLANT SELECTION

Reduce lawn area by planting gardens or use low growing native sedges to mimic lawn. Selecting native plants and grasses lessens the need for watering and pesticide use as they are typically more drought tolerant and pest resistant.

Prevent and Eliminate Delivery of Stormwater Pollutants to Conveyances

Designated discharges subject to General Permit 3-9030 shall not wash or rake anything directly into road gutters, storm drains, or catch basins. The following practices increase infiltration and lessen or eliminate stormwater runoff from to downstream water bodies.

General Guidelines:

FERTILIZER APPLICATION

Source: http://www.gardenipedia.com/wp-content/uploads/2009/08/Rotary-Spreader-769x1024.jpg

Fertilizers and herbicides wash off lawns and landscaped areas, harming not only the weeds, but also useful insects and vegetation. Ground and surface water is contaminated by the chemicals washing off the land. Fertilizers should be used sparingly. Many native species need no fertilizer at all. Do not fertilize before a rain storm. Similarly, use organic compost or create your own compost to use on your gardens. Store pesticides, fertilizers, and other chemicals in a covered area to prevent contaminated runoff.

PESTICIDES

Instead of pesticides, consider using pest management involving physical controls such as barriers or traps, biological controls (e.g. Green lacewings eat aphids), bacterial insecticides (e.g. Bacillus thuringiensis kills caterpillars), and finally as a last resort, chemical controls.

Source: http://thailand.ipm-info.org/images/pesticides/7a-Spraying_farmer_contaminates_environment.JPG

The following are the least harmful: Dehydrating dusts (e.g. silica gel), insecticidal soaps, boric acid powder horticultural oils, pyrethrin-based insecticides.

If you must use a pesticide, use one that is specifically designed to control your pest. The insect should be listed on the label. Approximately 90% of the insects on your lawn and garden are not harmful. Read labels! Use only as directed. In their zeal to control the problem, many gardeners use pesticides at over 20 times the rate that farmers do.

Dumping toxics into the street, gutter or storm drain is illegal! Household toxics–such as pesticides, cleansers and motor oil–can pollute and poison groundwater if disposed of in storm drains or gutters. Rinse empty pesticide containers and dispose of rinse water per the instructions on the product container. Dispose of empty rinsed containers in the trash.

AUTOMOBILES

When washing automobiles use green products or those that will break down more easily and are less toxic to plants. Soap should be used sparingly. Wash your car on a grassy area, if possible, to infiltrate and treat soapy water. Commercial car washes reuse wash water several times before sending it to the sewer system for treatment.

Check your car, boat, motorcycle, and other machinery and equipment for leaks and spills. Make repairs as soon as possible. Clean up spilled fluids with an absorbent material like kitty litter or sand and dispose of the absorbent material properly. Never dispose of oil or other engine fluids down storm drains, on the ground, or into a ditch.
Oil can be re-refined into re-usable lubricating oil. Reprocessing one gallon of used motor oil and burning it as fuel generates enough electricity to power everything in your home for a day. Auto supply stores and gas stations many times accept used oil.

PET WASTE
Pet waste left on the ground can be carried away by stormwater, contributing harmful bacteria, parasites and viruses to downstream water bodies. Pet waste does not fertilize the ground, but can be the cause of significant stormwater pollution and present health risks to adults, children and other pets.

Source http://www.zerowasteusa.com

To properly dispose of animal waste, use newspaper, bags, or pooper-scoopers to pick up wastes and place wrapped pet waste in the trash or unwrapped in a toilet. Never discard pet waste in a storm drain.

YARD SCRAPS

Source: http://www.freyinnovations.com/home_garden/bag_holder/problem.jpg

Leaves, grass clippings, and tree trimmings can clog catch basins and storm drains, increasing the risk of flooding. Yard scraps that enter rivers absorb oxygen as they decompose, straining or killing aquatic life. Do not blow or rake leaves into the street (unless there is an active designated municipal leaf pickup scheduled), gutter, or storm drains. Use approved containers for curb side pick-up of lawn scraps, do your own composting, or take scraps to a landfill that composts.

HOUSEHOLD CLEANERS AND OTHER CHEMICALS

It is important to dispose of cleaners and chemicals in the proper manner. Read the instructions on the container or

contact your local transfer station or waste water facility for more information.

Glossary

Best Management Practice (BMP)
A structural or non-structural technique for managing stormwater to prevent or reduce pollutant delivery and/or control stormwater runoff to surface water or ground water. Structural BMP may include, basins, discharge outlets, swales, rain gardens, or filters. Non-structural BMP may include source control or pollution prevention practices.

Check Dams
Dams constructed across a swale or channel to slow water flow. Dams are typically made of rock, gravel, sandbags, logs, or straw bales.

Conveyance
The process of water moving from one place to another.

Filter Strips
Bands of dense vegetation, typically ground cover or turf, planted between pollution sources and downstream receiving waters.

Gray Water
Gray water is wash water - all wastewater except toilet wastes and food wastes derived from garbage disposals. Gray water can be recycled for irrigation and wastewater uses

Impervious
Not allowing infiltration. Impervious surfaces include roads (paved and unpaved), parking areas, sidewalks, roofs, bike paths, and compact soils.

Infiltration
Is the process by which water on the ground surface enters the soil. Infiltration rate in soil science is a measure of the rate at which soil is able to absorb rainfall.

Low Impact Development (LID)
Low Impact Development seeks to manage rainfall at its source. LID's goal is to mimic a site's pre-development hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain stormwater runoff close to it's source.

National Pollutant Discharge Elimination (NPDES)
A permit program controlling water pollution by regulating point sources that discharge pollutants into US waters authorized by the Clean Water Act.

Permeable/Pervious
Allowing infiltration of gases, water, or other liquids to filter into or pass through.

Sedges
Sedges are close botanical cousins of grasses. Properly selected and planted sedges can function as a traditional lawn, yet require little or no maintenance and can tolerate a variety of environments.

Sheet Flow
The portion of precipitation that moves initially as overland flow in very shallow depths before eventually reaching a stream channel.

Stormwater (stormwater runoff)
Precipitation, snow melt, and the material dissolved or suspended in precipitation or snow melt that flows off impervious surfaces and discharges into surface waters or into groundwater via infiltration.

General Sources:
Vermont DEC Stormwater Management Program
http://www.anr.state.vt.us/dec/waterq/stormwater.htm

Lake Champlain Sea Grant - NEMO Program
http://www.uvm.edu/~seagrant/education/nemo.html

Winooski Natural Resources Conservation District
http://www.vacd.org/winooski/index.shtml

Urban Design Tools - LID
http://www.lid-stormwater.net

Pennsylvania Department of Environmental Protection
http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305

Southeast Michigan Council of Governments
http://www.semcog.org/Stormwater.aspx

West Coast Environmental Law
http://www.wcel.org/wcelpub/2007/14255.pdf

US Environmental Protection Agency
http://www.epa.gov/greeningepa/stormwater/hq_lid.htm
http://www.epa.gov/region1/topics/water/lid.html
http://cfpub.epa.gov/npdes/home.cfm?program_id=298

U.S. Department of Housing and Urban Development
http://www.huduser.org/publications/destech/lowimpactdevl.html

Urban Forest Values:
Economic Benefits of Trees in Cities
University of Washington, College of Forest Resources
http://slf-web.state.wy.us/forestry/econ.aspx

Rainfall interception by Sacramento's Urban Forest
http://www.fs.fed.us/psw/programs/cufr/products/cufr_28_XQ98_55.
PDF

Stormwater Quality Management Committee
Clark County, NV Regional Flood Control District
http://www.lvstormwater.com/bmps_homeowners.htm

Rain Gardens:
Metro Vancouver - British Columbia
http://www.metrovancouver.org/Pages/default.aspx

Infiltration of Stormwater in a Rain Garden: Richards Equation Numerical Model and Field Experiment
http://www.iemss.org/iemss2004/pdf/hydroresponses/dussinfi.pdf

SvR Design Company
www.svrdesign.com/docs/TSM%20-%20complete%20-%20reduced.pdf

Additional Rain Gardens information:
http://vacd.org/winooski/VtRainGardenManual.pdf
http://www.abbey-associates.com/splash-splash/blue_standards/rain_garden.html

Rain Barrels:
SustainIndy - City of Indianapolis
http://www.sustainindy.org/assets/uploads/4.3%20Cisterns%20and%20Rain%20Barrels.pdf

Cisterns:
Louisiana Department of Environmental Quality
http://www.abbey-associates.com/splash-splash/blue_standards/above_ground_cistern.html

The Low Impact Development Center, Inc.
www.lowimpactdevelopment.org/qapp/lid_design/raincist/raincist_specs.htm

Additional cistern information -
http://www.oas.org/usde/publications/Unit/oea59e/ch10.htm
http://www.wvu.edu/~exten/infores/pubs/ageng/sw12.pdf
http://www.clermontstorm.net/cistern.pdf

Roof Top Disconnection:
Mid-America Regional Council
http://www.marc.org/Environment/Water/

Vegetated Swales:
http://test.www.mapc.org/sites/default/files/LID_Fact_Sheet_-_Vegetated_Swales.pdf

*** Before installing any bio-retention areas, call Dig Safe Systems, Inc. 888-DIG-SAFE (344-7233)**

For more information on preventing soil erosion, Vermont's "Low Risk Handbook for Erosion Prevention and Sediment Control" can be accessed online by visiting:
http://www.vtwaterquality.org/stormwater/docs/construction/sw_low_risk_site_handbook.pdf

Illustrations of LID practices were provided by S. Mitchell

Roof top disconnection retrofit illustrations provided by the Mid-America Regional Council

The Vermont Department of Environmental Conservation is an equal opportunity agency and offers all persons the benefits of participating in each of its programs and competing in all areas of employment regardless of race, color, religion, sex, national origin, age, disability, sexual preference, or other non-merit factors.

VT Relay Service for the Hearing Impaired
1-800-253-0191 TDD>Voice - 1-800-253-0195 Voice>TDD

Vermont Department of Environmental Conservation
Water Quality Division - Stormwater Section
103 South Main Street, Building 10 North
Waterbury, VT 05671-0408
Tel: 802-241-3770 or 3777
Fax: 802-241-3287

www.vtwaterquality.org/stormwater.htm