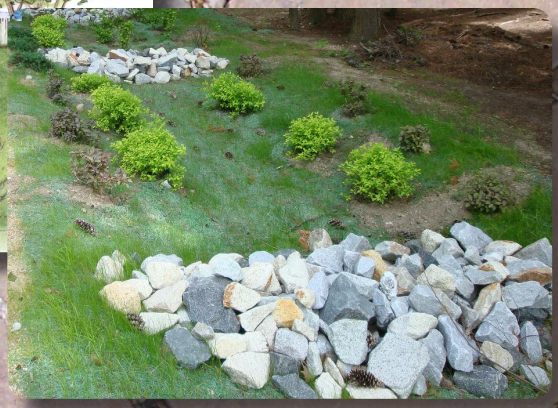
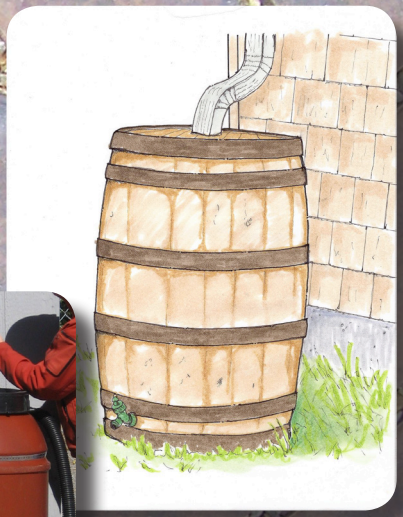
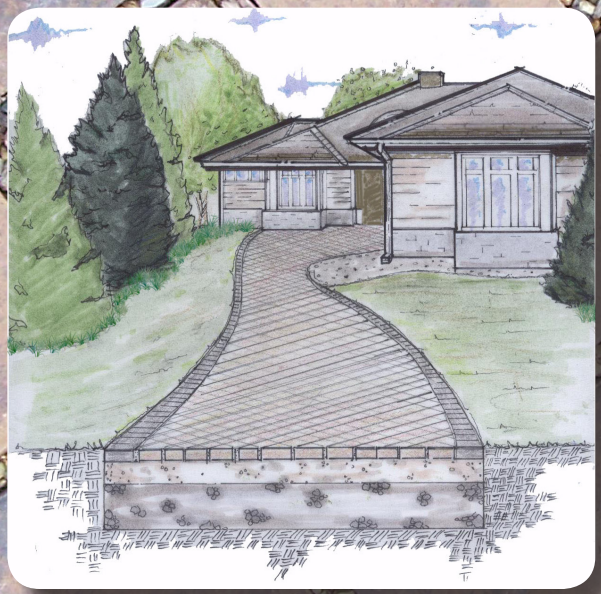
New Hampshire Homeowner's Guide to Stormwater Management

Do-It-Yourself Stormwater Solutions For Your Home







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New Hampshire Homeowner's Guide to Stormwater Management

Do-It-Yourself Stormwater Solutions For Your Home

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Introduction

What is Stormwater?

Stormwater is water from rain or melting snow that does not soak into the ground. In a forest, meadow, or other natural landscape, stormwater soaks into the ground and naturally filters through the soil. When forests and meadows are developed, they are replaced with neighborhoods, shopping centers, and other areas that introduce **impervious surfaces** such as rooftops, roads, parking lots, and driveways. Impervious surfaces prevent rain or melting snow from soaking into the ground. This creates excess stormwater runoff and stormwater pollution.

In New Hampshire, stormwater contributes to over 80 percent of the **surface water quality impairments** in the state. All across New Hampshire, communities, businesses, and property owners experience the challenge of managing stormwater to maintain roads and drainage infrastructure, to protect water quality, and to simply keep our neighborhood roads from flooding and our driveways from washing out each year.

Stormwater in Your Own Back Yard

That's right, you have stormwater in your own yard. Your roof, driveway, and other hard surfaces create stormwater. The way you manage and care for your property and the stormwater it creates can impact the entire **watershed**.

Impervious surfaces - hard surfaces that cover the ground and prevent rain and melting snow from soaking into the soil, such as roofs, roads, and parking lots and driveways.

Hydrology - how water moves over the land and through the ground.

Surface water quality impairment - when a waterbody does not meet one of its designated uses, such as fishing, swimming, or it does not support aquatic life because of one or more pollutants. Waters that do not meet one of their designated uses is often called an impaired water.

Actions that seem harmless, such as hosing down your driveway instead of sweeping it or using an entire bag of fertilizer on your lawn instead of only the amount it needs can cause excess stormwater runoff and can result in pollutants being washed into nearby streams and ponds.

Small, simple changes in the way we manage our properties can have a big impact and help protect the waterbodies that we play in and depend on.

Purpose of this Guide

This guide is designed to help you, the residential homeowner, better manage stormwater on your property.

This guide provides:

a. INTRODUCTION: Describes the sources of **stormwater pollution**, how stormwater pollution impacts the quality of our lakes and streams, and how good stormwater management including stormwater treatment practices can be used to reduce the stormwater problem.

b. DIY PROJECT PLAN: Provides instructions for completing a project plan for your property, including how to the amount of impervious surfaces and other land covers on your property, as well as choosing the best location to install stormwater treatment practices.

c. DIY STORMWATER TREATMENT PRACTICES: Provides DIY fact sheets to install **low impact development** (LID) stormwater treatment practices, such as dry wells and rain gardens, on your property with your own two hands. Each fact sheet includes a list of materials, illustrations, and step-by-step instructions for construction.

Low impact development (LID) - a way of developing the landscape that reduces the impact on the environment. LID uses conservation and treatment practices to reduce the amount of stormwater and stormwater pollution created by traditional development.

Stormwater pollution - stormwater that has become a problem because there is too much of it and it is causing flooding or erosion, or because it contains contaminants such as sediment, nutrients, metals, or other substances that lower water quality.

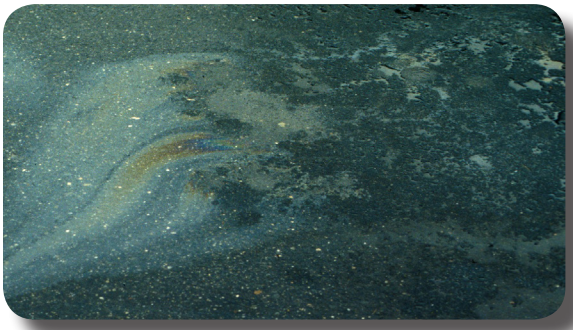
Watershed - a geographic area to which all water drains to a given stream, lake, wetland, estuary, or ocean, similar to a funnel. Our landscape is made up of many interconnected watersheds. The boundary between each is defined by the line that connects the highest elevations around the waterbodies.

This guide can be used along with the NH Residential Loading model available at www.des.nh.gov/organization/divisions/water/stormwater to estimate the amount of stormwater pollutants that come from your property (your "stormwater footprint"), and to determine how adding stormwater treatment practices on your property can reduce your stormwater footprint.

Common Sources of Stormwater Problems

Stock piled yard waste can add nutrients.

Poor erosion control can add sediment.



Leaking vehicle fluid can add toxic pollutants.

Washing driveways creates excess stormwater.

Common Stormwater Problems and Their Effects

Stormwater can cause many different problems including flooding, erosion, and water pollution. The pollutants in stormwater are essentially the same as the pollutants that we treat in our wastewater. They just come from different sources. Common stormwater problems and pollutants include the following.

CHANGES IN HYDROLOGY **Hydrology** is the term used to describe how water flows over and through the land. There is more stormwater runoff from developed land (i.e. a subdivision or shopping mall) than undeveloped land (i.e., a forest or meadow). Too much stormwater runoff becomes a problem when streams have to accommodate more flow than nature designed them to. When this happens flooding is more frequent, stream banks erode, and the groundwater table is lowered.

SEDIMENT can be washed or eroded into lakes and ponds from streams with unstable banks, dirt driveways, or other activities that disturb the land, such as construction. Fine sediments stay suspended in the water. This makes the water appear cloudy and reduces how far you can see into the water. Fine sediments can clog the gills of fish, and sediment that settles to the bottom can smother fish habitat and bottom-dwellers. Sediment can literally fill in the lake, making it easier for plants, including invasive plants like purple loosestrife and exotic milfoil, to take root. Sediment tends to carry other pollutants such as nutrients and metals with it.

NUTRIENTS come from organic waste (including pet waste), septic systems, fertilizers, and eroding soils. Excess nutrients speed up plant and algae growth, including cyanobacteria, which can be

harmful to humans and animals. Plants and algae can be a nuisance for swimming and boating, and can decrease the amount of oxygen in the water as they die and decompose. This means that less oxygen is available for fish and other organisms.

BACTERIA come from pet waste that is left on the ground, failing septic systems, and wildlife. Bacteria can make swimmers sick and can lead to beach closures. Bacteria not only pose a public health risk, but can cause an economic hardship for communities who rely on bathing beaches for tourism revenue.

CHLORIDES are found in road salts and other deicing materials that are applied to roads, highways, parking lots, and driveways in the winter months. Chlorides increase the salinity of our surface waters. This stresses aquatic organisms that depend on freshwater habitats and makes waterbodies more susceptible to invasive species. Freshwater plants die off and salt-tolerant plants take over. Chloride can also contaminate drinking water supplies including private wells. Unlike other stormwater pollutants, there is no reasonable treatment for chloride pollution except for source control to use only the amount we need where it is needed.

TOXIC CONTAMINANTS come from a variety of sources including petroleum products such as motor oil and gasoline, pesticides, and herbicides. Often, the products used to kill unwanted weeds and pests are also harmful to aquatic organisms, other animals, and humans.

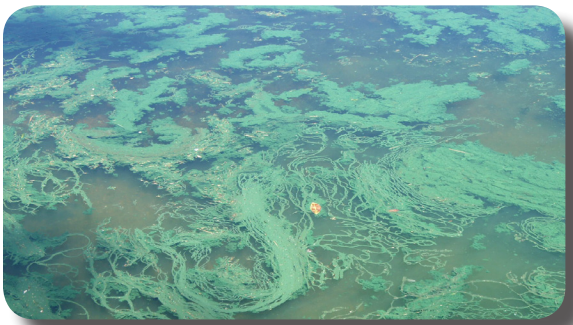
THERMAL POLLUTION can occur when stormwater runs over hot pavement or other surfaces with very little shade. This heats the stormwater and can increase the temperature of streams and ponds. Many fish and aquatic species depend on the higher oxygen concentrations that cool water temperatures provide. Warmer water has less oxygen and makes it more difficult for fish to breath.

Common Effects of Stormwater Problems

Turbid streams from erosion and sediment.

Fish kills and harm to aquatic life.

Cloudy, discolored water, surface sheens and build-up from toxic contaminants.



Algae blooms from excess nutrients.

Infiltrate - when rain and snowmelt soak into the soil

Managing Stormwater With Low Impact Development

What is Low Impact Development?

Low Impact Development (LID) is a way of developing (and redeveloping) the landscape that focuses on working with nature to manage and treat stormwater as close to its source as possible. The overall goal of LID is to reduce the impact of built areas by mimicking the way water naturally flows over and through the ground.

LID approaches often include reducing and disconnecting impervious surfaces to minimize the amount of stormwater created as well as to preserving natural landscape features like forested buffers and good soils. Stormwater treatment practices, like dry wells and rain gardens, are used to treat the stormwater that cannot be avoided to **infiltrate** it on site.

Where Can LID Work?

LID can be applied anywhere. It can be used for new homes and buildings, and it can also be incorporated into existing development. Whether you're in the middle of the city, the middle of the country, or somewhere in between, there are LID strategies for your property.

How do LID Stormwater Treatment Practices Work?

Stormwater treatment practices capture runoff from roofs, driveways, patios, and even lawns and **infiltrate** it into stone reservoirs, natural soils, or filter media. The plants and soils filter and remove stormwater pollutants. Infiltration reduces the volume of stormwater running off of a property and also reduces the potential for stormwater pollution.

How Can You Benefit from LID and Stormwater Treatment Practices?

- LID reduces the volume of stormwater created, this means it can help reduce flooding and flooding-related damages and costs.
- Most LID strategies focus on maintaining the natural landscape or creating vegetated practices, such as rain gardens. These are created with function and aesthetics in mind, which increases curb appeal, improves landscaping and wildlife habitat, and reduces erosion potential.
- LID practices such as rain barrels and larger cisterns capture rain from your roof and prevent it from running off of your property. This helps to conserve water by being able to use the captured water during dry periods to water your plants or provide for other non-drinking water needs around your home.
- Most LID practices work by slowing down stormwater runoff and creating places for it to soak into the ground. Eventually, water that soaks into the ground replenishes the groundwater. This groundwater fills your well or public water supply, helps prevent droughts, and keeps streams flowing during periods of dry weather.
- LID practices focus on infiltrating and treating water close to the source. This can help reduce the burden on and increase the lifespan of municipal storm drainage systems by reducing the volume of stormwater being directed to those systems.
- Using LID on your property can reduce the impact of your house, driveway, lawn, and other built areas of your property on the natural environment, including nearby lakes and streams. This will help keep the lakes and rivers near your home healthy and clean so you and future generations can enjoy swimming, fishing, and playing in them.
- Using LID on your property gives you the satisfaction of being a **watershed** steward. By using LID and carefully managing your property, you are taking care of the environment and reducing your stormwater footprint.

Do-It-Yourself Stormwater Management

This section gives you everything you need to start better managing stormwater on your property. There are several different approaches you can use to get started.

1. Dig Right In!

You can simply choose any of the stormwater treatment practices and use the DIY fact sheets contained in this section to install them. While you might not select the absolute best-suited stormwater treatment practice or location on your property, every positive action helps and any stormwater treatment is better than none.

2. Create a Project Plan

If you want to get a bit more technical, this section outlines steps to document the existing and planned conditions of your property (if you are proposing to build a garage or patio or other improvement to your property) and select the best suited type and location of stormwater treatment practice for your property.

3. Estimate Your Stormwater Footprint

If you want to understand the impact of your property on the water quality of your watershed as well as the benefit of installing stormwater treatment practices, you can use all of the information gathered in your project plan, and use the NH Residential Loading Model available at www.des.nh.gov/organization/divisions/water/stormwater to estimate your "stormwater footprint". Your stormwater footprint is the amount of phosphorus, nitrogen, and sediment that run off of your property. You can also use the model to see what type of stormwater treatment will be most effective at reducing your stormwater footprint.

Create A Project Plan

Any change that you make on your property to reduce impervious surfaces, prevent erosion, and infiltrate stormwater makes a positive difference in your **watershed** and reduces your stormwater footprint.

To best manage stormwater on your property it helps to create a plan to map out your property and estimate how much stormwater your property creates, where the stormwater is coming from, and how it travels across your property. Once you identify these details, you can decide how to best manage your stormwater and you can use the NH Residential Loading Model to estimate your stormwater footprint.

1. MAP YOUR PROPERTY

The first step to creating a project plan is to map your property. There are several resources that you can use to do this. The **Site Sketch Grid** in Appendix C can be used to create a drawing of your property. The squares on the grid can be used as a scale to help you draw the house, driveway, and other property features in proportion to one another. Other resources available to map your property include:

- Google Maps - satellite or Google Earth imagery
- Municipal offices/web site - tax map, online GIS (if available)
- Approved septic system plan, if you have a septic system

If you are proposing changes from the existing condition, for example if you are putting on an addition or installing stormwater treatment practices, you may want to make separate maps.

When using the Site Sketch Grid, do your best to scale your drawings so your house, driveway, and other property features are in proportion to one another.

1/2 acre lot: 1 sq = 25 ft²
1 acre lot: 1 sq = 50 ft²
2 acre lot: 1 sq = 100 ft²

HELPFUL TOOLS

Gather the following materials to help create your project plan.

- Measuring tape
- Ruler
- Calculator
- Shovel
- Bucket or waterproof container
- Paper and Pen
- Site Sketch Grid from Appendix C
- Tax map or aerial photo of your property with lot lines (this is available on many town websites)

EXISTING CONDITION

Map or sketch your property the way it currently exists including the features identified in Property Details in Step 2.

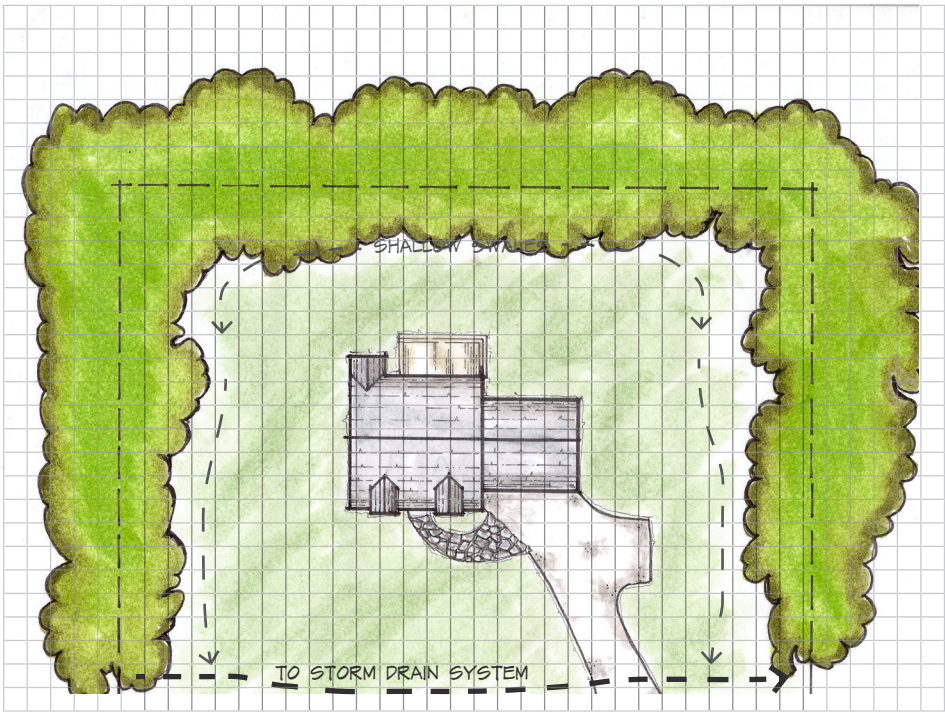


Figure 1. Example existing conditions map

PLANNED CONDITION

Make a sketch of your property to show proposed changes and improvements such as building an addition, deck or storage shed, clearing trees to expand your lawn, or installing stormwater treatment practices.

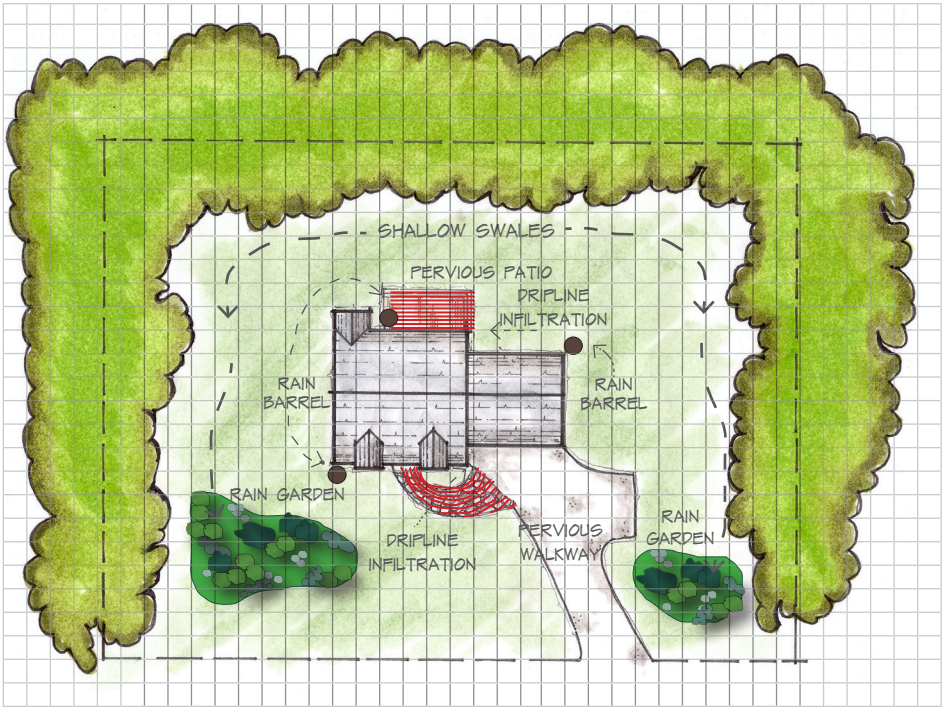


Figure 2. Example planned conditions map.

2. IDENTIFY PROPERTY DETAILS

Complete the **Project Planning Worksheet** in Appendix D by identify the following features of your property including:

Lot Size

You can look up the size of your lot on your property tax assessment, the deed to your house, the purchase and sales agreement for your home, on your town's web site, or you can contact your town offices.

Note: If you are proposing changes or improvements to your property such as building an addition, deck, or storage shed, clearing trees to expand your lawn, or installing stormwater treatment practices, you will want to identify these features for both the existing and planned conditions.

Break Down of Land Cover Types

Knowing the general size of each type of land cover on your property can help you create a property plan to manage stormwater. For example, impervious areas can be reduced, disconnected, or eliminated. Lawns areas can be made smaller and buffers can be created. You can estimate the area of each land use type by doing the following.

Impervious Roof

Measure the length and width of your house, garage, and any other structure that has a roof with a tape measure (Figure 3).

~ ROOF AREA (ft²) = LENGTH x WIDTH

ROOF AREA 1 = 32' x 38' = 1216 ft²

ROOF AREA 2 = 24' x 26' = 624 ft²

Add the roof areas together to get the total impervious roof area for the property.

ROOF AREA$_1$ + ROOF AREA$_2$ + ... = TOTAL IMPERVIOUS ROOF (ft²)

1216 ft² + 624 ft² = 1840 ft²

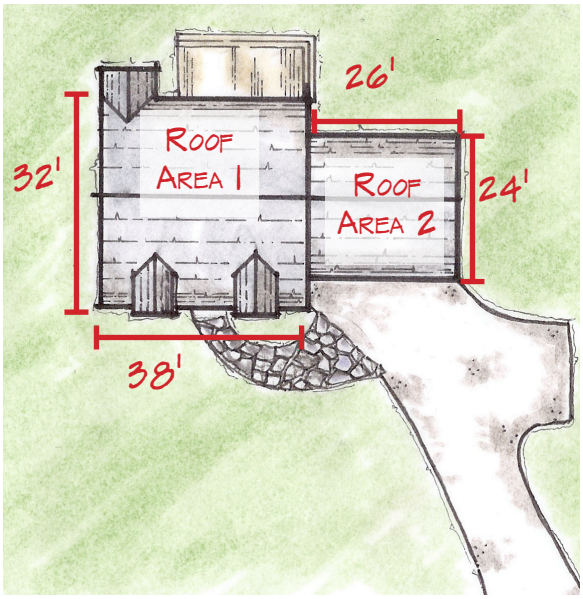


Figure 3. Measuring impervious roof areas.

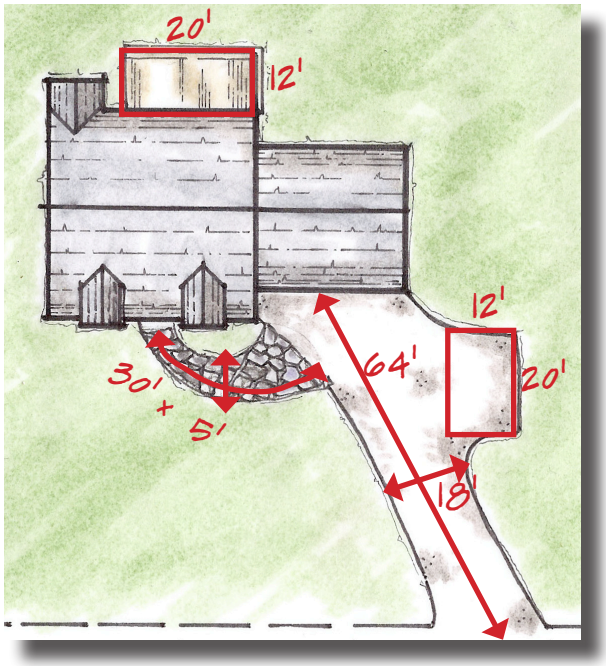


Figure 4. Measuring other hard surface areas.

Other Hard Surfaces

Other hard surfaces include any driveways, walkways, decks, patios, or other surfaces that prevent water from soaking into the ground. Measure the average length and average width of these areas with a tape measure (Figure 4). Add the areas together to get the total other hard surfaces area for the property.

~ OTHER HARD SURFACE AREA (ft²) = LENGTH x WIDTH

DRIVEWAY 1 = 64' x 18' = 1152 ft²
DRIVEWAY 2 = 20' x 12' = 240 ft²
WALKWAY = 30' x 5' = 150 ft²
PATIO = 20' x 12' = 240 ft²

TOTAL OTHER HARD SURFACES AREA (ft²):

1152 ft² + 240 ft² + 150 ft² + 240 ft² = 1782 ft²

Lawn and Landscaped Areas

Lawn and landscaped areas include any areas with grass or gardens that you regularly maintain. Measure the average length and average width of each of these areas with a tape measure (Figure 5). Add the areas together to get the total lawn/landscape area. If your property has no natural or forested areas on it, you can simply subtract the impervious roof and other hard surface areas from your total lot size to get the lawn/landscaped area.

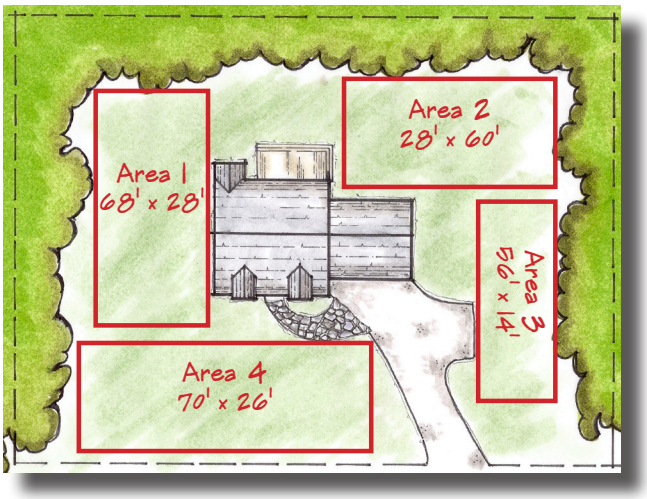


Figure 5. Measuring lawn areas.

~ LAWN/LANDSCAPE AREA (ft²) = LENGTH x WIDTH

AREA 1 = 68' x 28' = 1904 ft²
AREA 2 = 28' x 60' = 1680 ft²
AREA 3 = 56' x 14' = 784 ft²
AREA 4 = 70' x 26' = 1820 ft²

TOTAL LAWN/LANDSCAPE AREAS (ft²):

1904 ft² + 1680 ft² + 784 ft² + 1820 ft² = 6188 ft²

Forested or Natural Areas

Forested and natural areas include any areas that are naturally vegetated and are not actively maintained. You can estimate the size of these areas by measuring the average length and average width of each area and adding them together. Or, you can subtract the impervious roof, other hard surfaces, and lawn/landscaped areas from the total lot size to get the forested/natural area of your property.

~ TOTAL FORESTED/NATURAL AREA = TOTAL LOT SIZE - (IMPERVIOUS ROOF + OTHER HARD SURFACES + LAWN/ LANDSCAPED AREAS)

EXAMPLE: 43,560 ft^2 - (1840 ft^2 + 1782 ft^2 + 6188 ft^2) = 33,750 ft^2

Roof Downspouts

If you have gutters on your house, follow them along the roof line to where they travel down the side of the house and discharge out the downspout. There may be more than one downspout on your house. Identify their locations or other areas where rain collects and runs off of your roof such as a valley where two roofs join together. This will help you plan the best placement for stormwater treatment practices to capture roof runoff.

Vegetated Buffer Areas

Identify **vegetated buffer** areas such as trees or other vegetated areas at the edge of your property boundary or around features on your property such as streams, wetlands, or steep slopes.

Vegetated Buffer - areas of natural or established vegetation allowed to grow with minimal to no maintenance.

Buffers reduce the velocity of runoff, promote groundwater recharge, filter out sediments and provide shade to reduce the thermal impacts of runoff to receiving waters. Buffers also provide habitat for wildlife.

Steep Slopes & Other Vulnerable Areas

Identify any areas on your property with steep slopes. Take note if there are any areas on the slope that regularly erode. Existing rills or gullies in the soil or exposed roots and rocks identify areas that may have erosion problems. Planting or allowing natural vegetation to grow along the top of the slope to create a buffer can protect against slope erosion.

Stormwater Treatment Practices

Identify any existing or planned stormwater treatment practices and their approximate location on your property.

Streams or Ponds

Identify any streams or ponds on your property or near your property that your property drains to. You can go one step farther and look up the watershed that your property resides in and the waterbodies that your property has the potential to impact. You can also look up the water quality of those waterbodies to see if they are high quality or if they have any impairments to consider in the New Hampshire Surface Water Quality Assessment at www.des.nh.gov/organization/divisions/water/wmb/swqa/index.

3. IDENTIFY HOW AND WHERE STORMWATER FLOWS

When rain hits the ground, it often flows over the ground surface, down hills or through channels before it exits your property, soaks into the ground, or finds a low spot to puddle. Using the property maps that you created, you can estimate how and where stormwater flows on your property by following the steps below.

1. Pretend you're a raindrop (use a ball to mimic a raindrop, or better yet, watch a real storm event). Identify high points in your lawn or driveway. Observe the directions that water flows and the places where the water ends up (the stormwater endpoints). These could be places where water puddles, where it enters a catch basin, or where it enters or will enter a stormwater treatment practice.

2. Draw a boundary line on your project map around the area that drains to each stormwater endpoint. The boundary line represents the "drainage area" for each stormwater endpoint. Within that boundary line, all of the water that falls on the property drains to a common endpoint. For example, Figure 6 below shows that all of the stormwater from the back of this garage drains to a rain barrel. So a line was drawn around the perimeter of the back half of the garage roof. This rain barrel drainage area is labeled with a "1".

   Also, most of the yard to the right of the house flows into a swale and then drains into a rain garden at the bottom right of the property. So a line was drawn around the perimeter of the yard area that drains to the rain garden. This rain garden drainage area is labeled with a "7" in Figure 6.

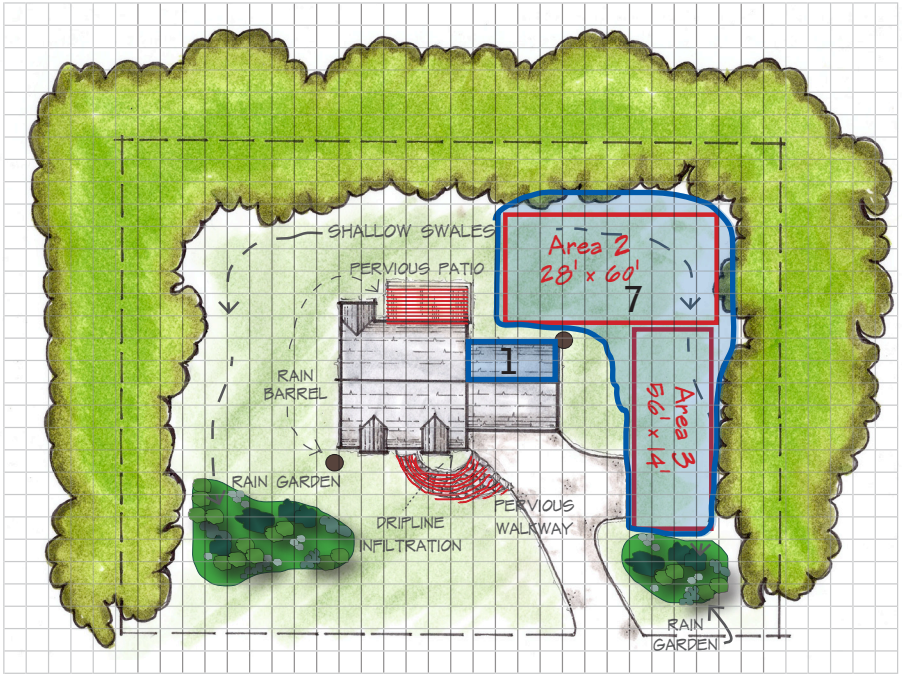


Figure 6. Draw the boundary lines (drainage areas) for stormwater endpoints.

3. To estimate the size of the drainage area to each stormwater endpoint, you can use the measurements that you recorded on your Project Planning Worksheet to estimate the average area within each boundary line, or if you used the **Site Sketch Grid** in Appendix C, you can count the squares within each boundary line. The example property in figure 7 is a 1-acre lot. This makes each grid box approximately 50 ft^2. The estimated drainage areas to each stormwater treatment practice are summarized in Table 1 below.

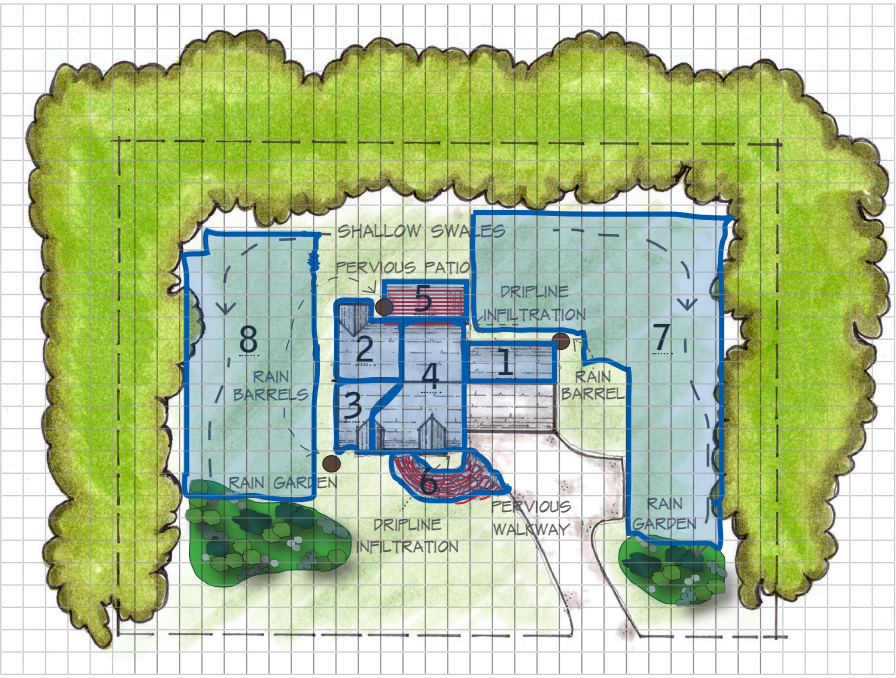


Figure 7. Estimate the drainage area within each boundary line.

Table 1. Summary of example drainage areas to each stormwater treatment practice.

Drainage Area	Stormwater Treatment Practice	Land Use Type	Approx. area (ft^2)
1	rain barrel	impervious roof	312
2	rain barrel	impervious roof	304
3	rain barrel	impervious roof	203
4	dripline infiltration trench	impervious roof	709
5	pervious pavers	other hard surface	240
6	pervious pavers	other hard surface	150
7	rain garden	lawn/landscape	2464
8	rain garden	lawn/landscape	2814

4. You can group drainage areas with the same stormwater treatment practices and the same land use type together if desired (Figure 8). This is recommended if you are going to estimate your stormwater footprint using the NH Residential Loading Model.

Table 2. Drainage areas grouped by land use type and stormwater treatment practice.

Drainage Area	Stormwater Treatment Practice	Land Use Type	Approx. area (ft^2)
1	rain barrel	impervious roof	312
2	rain barrel	impervious roof	304
3	rain barrel	impervious roof	203
4	dripline infiltration trench	impervious roof	709
5	pervious pavers	other hard surface	240
6	pervious pavers	other hard surface	150
7	rain garden	lawn/landscape	2464
8	rain garden	lawn/landscape	2814

4. ESTIMATE HOW MUCH STORMWATER YOUR PROPERTY CREATES

The roof and other hard surfaces (e.g., impervious areas) on your property, such as driveways, walkways, decks, and patios, create the most stormwater. While lawns and landscaped areas contribute to the stormwater problem, managing the stormwater that comes from the impervious surfaces on your property is the best way to reduce the amount of stormwater created and reduce your overall stormwater footprint.

Note: In NH, capturing and treating the first 1-inch of runoff from a rain event is roughly equivalent to capturing the "water quality volume" or 90 percent of the annual stormwater runoff volume. By capturing and treating the water quality volume, you remove the majority of stormwater pollutants.

Identify the impervious areas that create the most stormwater runoff helps to select the best locations to install stormwater treatment practices to address the problem areas.

To estimate the amount of stormwater your property creates, complete the following steps:

1. Add up all the areas of impervious roof and other hard surfaces (in ft^2) that you identified in your Property Details.

$IMPERVIOUS\ AREA_1 + IMPERVIOUS\ AREA_2 + \ldots = IMPERVIOUS\ AREA_{total}$

2. To determine the volume of stormwater created during a storm that produces 1-inch of rain, multiply the total area of impervious (from above) by 1-inch. Keep in mind that some storms produce greater than an inch of runoff. Stormwater treatment practices could be oversized to accommodate overflow or the practice could be designed to direct overflow to another treatment practice or a designated pervious area.

$(IMPERVIOUS\ AREA_{total}\ ft^2) \times (1\ inch / 12) = STORMWATER\ VOLUME\ (ft^3)$

Example: During a rain storm that produces 1-inch of rain, a typical 2400 ft^2* house with a two car garage would create...

$(3{,}730\ ft^2) \times (1\ inch/12) = 311\ ft^3$

That is equal to 2,326 gallons or about 55 bath tubs filled to the brim!

* House is assumed to be 2-story with ~1200 ft^2 of roof area, 800 ft^2 of garage roof, and 1730 ft^2 of other hard surfaces including driveway, walkways and patios.

5. IDENTIFY STORMWATER TREATMENT PRACTICES

Use the table below to help select one or more stormwater treatment practices that are right for your property. Refer to the **DIY Fact Sheets** section on page 25 for a description of each treatment practice.

Table 3. Summary of requirements and limitations of stormwater treatment practices.

	Infiltration Trenches	Dry Well	Rain Garden	Pervious Walkway	Vegetated Swale	Infiltration Steps	Rain Barrel	Water Bar
Space Required min surface area: min width: min length: min depth:	 8 to 32 ft² 1 to 4 ft 4 to 8 ft 8 inches	 8 to 32 ft² 2 to 4 ft 4 to 8 ft 3 ft	 50 to 200 ft² 5 to 10 ft 10 to 20 ft 3 to 8 inches	as needed to accommo-date walkway or patio area	bottom width: 2 ft. minimum 6 ft maximum	as needed to accomodate slope	not a factor - near downspouts	as needed
% Nutrient Removal Total Phosphorus: Total Nitrogen:	 60 55	 60 55	 34 65	 65 60	 20 20	 60 55	 0 0	 0 0
% Runoff Volume Reduction	90	90	80	75	60	90	40	0
Slopes	usually not a limitation, but a design consideration. Should locate down-slope of buildings and foundations			5% or less	swale side slopes: 3:1 or flatter longitudinal slope: 1.0% min	usually not a limitation, but a design consideration		
Water Table/ Bedrock	1 to 4 ft clearance				usually not a factor			
Proximity to foundations	minimum distance of 10 ft down-slope from buildings and foundations - unless dripline infiltration trench						not a factor	
Maintenance All LID practices should be inspected seasonally and after major storm events.	moderate - Inspect for signs of erosion or clogging. Remove any vegetation growing in the trench.	low - Inspect for signs of clogging such as ponding. Remove any vegetation growing over the dry well.	low - Inspect for signs of erosion where water enters the garden. Remove accumulated sediment. Replace mulch and vegetation as needed.	moderate to high - Inspect for signs of clogging such as ponding. Pressure wash and replace pea stone as needed to maintain infiltration.	low - Inspect for erosion. Remove accumulated sediment and replace vegetation as needed.	moderate - Inspect for signs of erosion or clogging. Remove any vegetation growing in the steps.	low - Empty barrel after each rain event or, at a minimum, when barrel is full.	

Adapted from Low-Impact Development: An Integrated Design Approach. Price George's County, Maryland. June 1999 and the NH Stormwater Manual. December 2008.

6. SELECT AND VERIFY THE LOCATION OF YOUR STORMWATER TREATMENT PRACTICES

Using the map of your property that you created, select the best locations to install your stormwater treatment practices. Keep the following tips in mind:

- ✓ A stormwater treatment practice should be placed along the natural path where stormwater flows.
- ✓ Place LID practices at least 10 feet away from the building to prevent seepage into the basement.
- ✓ Do not place over a septic tank or leach field.
- ✓ Do not place near a drinking water well.
- ✓ Avoid disturbing tree roots as the tree may be injured by digging and may not tolerate additional soil moisture.
- ✓ Make sure LID practices meet all property setbacks. You can verify setbacks with your town.

Call Before You Dig:
Before you start any excavation project, it is your responsibility to locate any underground utilities on your property. Check for private wiring or underground utilities such as driveway lights and sheds with electricity. Call Dig Safe® at 1-888-dig-safe at least three days before digging to avoid underground pipes and utilities.

Before installing your stormwater treatment practice it is important to make sure that the water table and soils in the area you choose will allow the practice to function properly.

Water Table

The water table is the level underground where water has fully saturated the soil and is the source of groundwater. If there are any low points on your property that tend to be wet or have very moist soil even when it has not rained, this typically means there is a high water table or slowly draining soils. It is important that the bottom of your stormwater treatment practice is above the seasonal high water table. This will make sure that it functions correctly and there is enough soil to treat the stormwater before coming into contact with the groundwater.

Basic Soil Types

In simple terms, soils can be classified as sandy, loam, or clay. Knowing the type of soil on your property can help you choose what stormwater practice to use. Sandy soils have the fastest infiltration and clay soils have the slowest. Since clay soils take longer to drain, they may require you to construct a larger stormwater treatment practice than if there were sandy soils.

You can do the following tests to help determine if the location you have selected to install your stormwater treatment practice is a good location.

Quick Tests

Simple Perc Test

To conduct a simple perc test, use the following steps.

a. Using a shovel or a post hole digger, dig a 1-foot deep hole and use a watering can or bucket to fill it with water.

b. Fill the hole with water to moisten the soil and allow it to drain completely (NOTE: if the hole fills with water on its own or if water is still in the hole after 24 hours, choose a new location).

c. Fill the hole with water a second time and place a ruler or yard stick in the hole. Note the water level and time. After 15 minutes, check the water level again and note the new water level. Multiply the change in water level by 4 to get the number of inches of infiltration in an hour.

Soil Ribbon Test

Estimate your soil type by performing a ribbon test using the following steps:

a. Grab a handful of moist soil and roll it into a ball in your hand.

b. Place the ball of soils 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 1/4 inch thick.

c. Try to keep the ribbon uniform in thickness and width. Repeat the motion to lengthen the ribbon until it breaks under its own weight. Measure the ribbon with a ruler or measuring tape and compare it to the following table.

Example soil ribbon test.
photo: North Dakota State University

Soil Type	Ribbon Length (inches)	Min. absorption rate (inches/hour)
sand	soil does not form a ribbon at all	8 in/hr
silt	a weak ribbon <1.5 inches is formed before breaking	1 in/hr
clay	a ribbon >1.5 inches is formed	0.04 in/hr

Estimate Your Stormwater Footprint

By completing the steps to create your project plan and filling out the Project Planning Worksheet, you can take your project one step further to use the NH Residential Loading Model to estimate your stormwater footprint.

The NH Residential Loading Model was developed by the NH Department of Environmental Services specifically for property owners to use to estimate the loading of sediment and nutrients, specifically phosphorus and nitrogen, running off of your property. This model can be used to:

- Calculate a property's "stormwater footprint", which is how much sediment, phosphorus or nitrogen runs off of a property
- Calculate the water quality benefit of installing stormwater treatment practices on your property.
- Compare the existing and planned future conditions of your property with different stormwater treatment scenarios. For example, to estimate the impact that building a garage or the impact that constructing a rain garden on your property would have on nutrient loading.
- Determine if your property meets a targeted nutrient goal or nutrient reduction for your watershed, if a target goal or reduction has been set.

The NH Residential Loading Model is available at www.des.nh.gov/organization/divisions/water/stormwater.

Follow the instructions for using the NH Residential Loading Model and you'll be on your way to better understanding and managing stormwater on your property to protect water quality.

Do-It-Yourself Fact Sheets

The fact sheets contained in this section give you everything you need to build these stormwater management practices at home.

Dripline Infiltration Trench - Page 29

Dripline infiltration trenches collect stormwater from your roof and store it until it soaks into the ground. They help control stormwater from running off your property.

Driveway Infiltration Trench - Page 31

Driveway infiltration trenches collect stormwater from your driveway and store it until it soaks into the ground. They help control stormwater from running off your property.

Dry Well - Page 33

Dry wells collect and infiltrate roof runoff at gutter downspouts, roof valleys, and other places where large amounts of water flow off of a roof. They help to reduce erosion and can reduce ponding and sitting water.

Infiltration Steps - Page 35

Infiltration steps slow down and infiltrate runoff on moderate slopes of 45° or less to help reduce erosion and define walking paths.

Pervious Walkways & Patios - Page 39

Pervious pavers have stone reservoirs under them that collect and infiltrate the rain and snow that accumulate on them. They help to reduce the stormwater runoff from your property.

Rain Barrel - Page 43

Rain barrels capture rainwater from your roof and store it for later use to water lawns, gardens, and indoor plants. They help to reduce the stormwater runoff from your property and also conserve water.

Rain Garden - Page 45

Rain gardens are bowl-shaped gardens that use soil, mulch, and plants to capture, absorb, and treat stormwater. They help to reduce stormwater runoff from your property and recharge groundwater.

Vegetated Swale - Page 49

A vegetated swale is a shallow channel that slows stormwater runoff and directs it to an area where it can infiltrate. Swales are typically used next to roads, sidewalks, and driveways. The plants in the swale help remove pollutants from stormwater and trap sediment, and the root system helps prevent erosion.

Water Bar - Page 51

A water bar intercepts water traveling down walkways, paths, gravel driveways, and other areas to divert water into stable vegetated areas. They helps prevent erosion.

Maintenance of LID Practices

As with any stormwater system, regular maintenance is essential to maximize performance and water quality benefits of LID practices. The general maintenance steps described below should be followed to properly maintain the treatment practices described in this guide.

INSPECT: Periodically and after rain events, inspect the practice for any obvious signs of stress or potential failure. Remove accumulated debris and sediment as needed. Check for ponding or poorly draining water - this can be a sign of clogging.

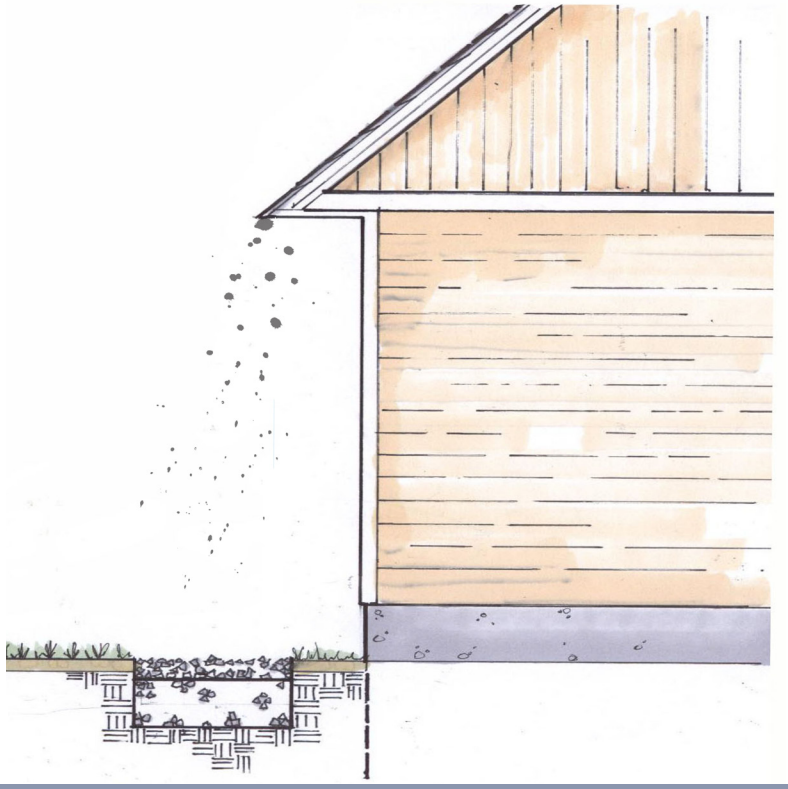
PLANTS: For practices with vegetation, new plants need to be watered frequently until their roots are established. Frequent weeding may be necessary in the first few years before plants become established. Check vegetation for signs of stress, disease and die-off and replace plants as necessary.

MULCH: For practices with vegetation, initially, 2" - 3" of mulch should be used to maintain soil moisture. Check periodically and after rain events and replenish mulch if needed. Once the vegetation in the treatment practices is established (2-3 years), mulch is not necessary, unless it is preferred for appearance.

OTHER MATERIALS: For practices with stone and other materials, periodically remove accumulated sediment, debris, and weeds from the surface. Practices lined with geo-textile fabric can clog over time. Check for ponding or slowly draining water. This can be a sign of clogging. If clogged, remove and wash the stone to clean out the accumulated sediment and debris.

Dripline Infiltration Trench

A dripline infiltration trench collects and infiltrates stormwater from your roof until it soaks into the ground. It helps control stormwater from running off your property.



Sizing and Design

STEP 1. Measure the distance from the side of your house to the edge of your roof line. If you cannot reach the roof line, align your body under the edge of your roof line and measure the distance from your body to the house. This is your reference line.

STEP 2. Mark the reference line on the ground along the perimeter of your house where you will be installing the dripline trench.

STEP 3. Measure 12" from the reference line away from your house and mark this along the perimeter. This the outside boundary line for excavation

STEP 4. Measure 6" from the reference in toward your house and mark this along the perimeter. This is the inside boundary line for excavation.

EQUIPMENT & MATERIALS

- Measuring tape
- Shovel
- Crushed stone ($^1/_2$" to $1^1/_2$" diameter)
- Non-woven geotextile fabric (or landscape weed fabric for smaller projects)

OPTIONAL

- Perforated PVC or other plastic piping
- String or spray paint

Dripline Infiltration Trench

Installation

STEP 1. Dig a trench at least 8" deep between the outside and inside boundary lines marked along the perimeter of your house. Slope the bottom of the trench away from the house so that water will drain away from the foundation.

STEP 2. To extend the life of the trench, line the sides with non-woven geotextile fabric.

STEP 3.

For Well Drained Soils: Fill the bottom 5 inches of trench with $^1/_2$" to $1^1/_2$" crushed stone. Fold a piece of non-woven geotextile fabric over the stone layer and fill the remaining three inches with additional stone (Figure 1).

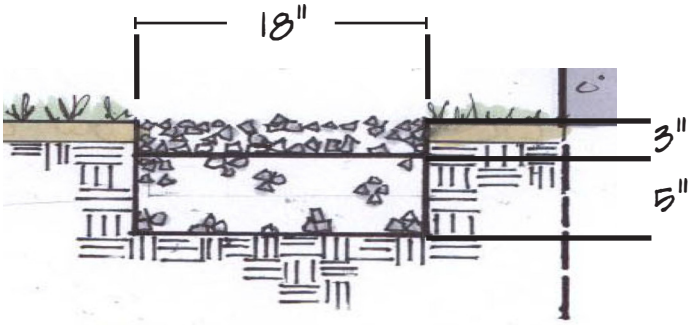


Figure 1. Profile for well drained soils.

For Slowly Draining Soils: Fill the bottom 1" - 2" of the trench with crushed stone. Lay a 4" perforated pipe with the holes facing up along the trench. The end of the pipe should either outlet to a vegetated area with a **splash guard** to prevent erosion or to another treatment practice such as a dry well or a rain garden. The pipe should be sloped toward the outlet so the water easily flows out of the pipe. Cover the pipe with non-woven geotextile fabric and fill the remainder of the trench with stone (Figure 2).

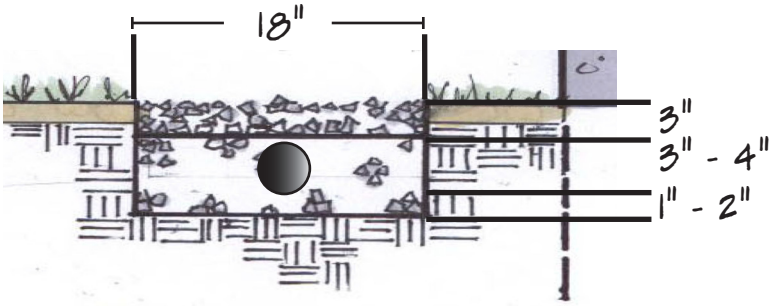


Figure 2. Profile for slowly draining soils.

Splash guard - prevents erosion at the end of pipes and gutter downspouts. You can purchase plastic or concrete splash guards at hardware stores or you can simply use a flat stone.

NOTE. *Dripline trenches work best in sand and gravel soils that quickly infiltrate large volumes of water. If your property sits on poorly draining soils, you can install a perforated PVC (or other plastic) pipe in the trench as described here.*

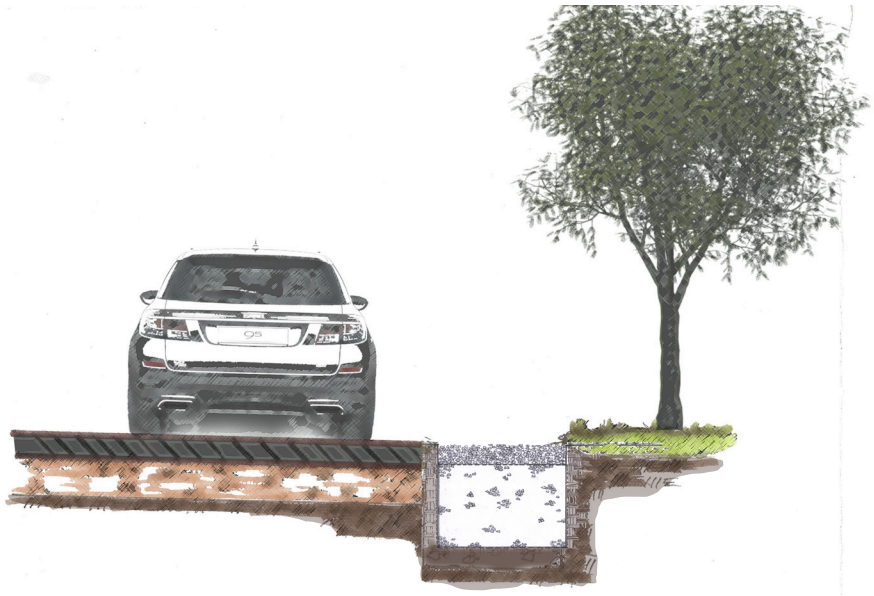
STEP 4. OPTIONAL: As material allows, spread a layer of stone all the way to the edge of your foundation. This creates a cleaner appearance and reduces the need for vegetation between the trench and your foundation.

Design Reference

Maine Department of Environmental Protection. *Conservation Practices for Homeowners*. Fact Sheet Series. May 2006.

Driveway Infiltration Trench

A driveway infiltration trench collects and infiltrates stormwater from your driveway until it soaks into the ground. It helps control stormwater from running off your property.



Sizing and Design

STEP 1. Look at your driveway during a rain storm to determine how stormwater runoff flows across it. Depending on the volume of runoff and where it flows, you may only need an infiltration trench along one side or only a portion of your driveway.

STEP 2. Decide the width of the trench you want to install. They should be between 12" and 18", as space allows.

STEP 3. Mark your desired trench width (12" - 18") along the edge of your driveway where you will be installing the trench. This is the boundary line for excavation.

EQUIPMENT & MATERIALS

- Measuring tape
- Shovel
- Crushed stone ($^1/_2$" to $1^1/_2$")
- Non-woven geotextile fabric (or landscape weed fabric for smaller projects)

OPTIONAL

- Perforated PVC or other plastic piping
- String or spray paint

Installation

STEP 1. Dig a trench at least 8" deep between the edge of your driveway and the excavation boundary line marked along the perimeter of your driveway. Slope the bottom of the trench away from the driveway, if possible so that water will drain away from the driveway.

Driveway Infiltration Trench

STEP 2. To extend the life of the trench, line the sides with non-woven geotextile fabric.

STEP 3.

For Well Drained Soils: Fill the bottom 5" of trench with $^{1}/_{2}$" to $1^{1}/_{2}$" crushed stone. Fold a piece of non-woven geotextile fabric over the stone layer and fill the remaining 3" with additional stone (Figure 1).

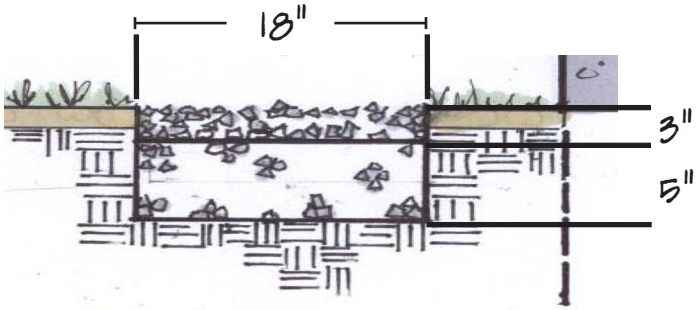


Figure 1. Profile for well drained soils.

For Slowly Draining Soils: Fill the bottom 1" - 2" of the trench with crushed stone. Lay a 4" perforated pipe with the holes facing up along the trench. The end of the pipe should either outlet to a vegetated area with a **splash guard** to prevent erosion or to another treatment practice such as a dry well or a rain garden. The pipe should be sloped toward the outlet so the water easily flows out of the pipe. Cover the pipe with non-woven geotextile fabric and fill the remainder of the trench with stone (Figure 2).

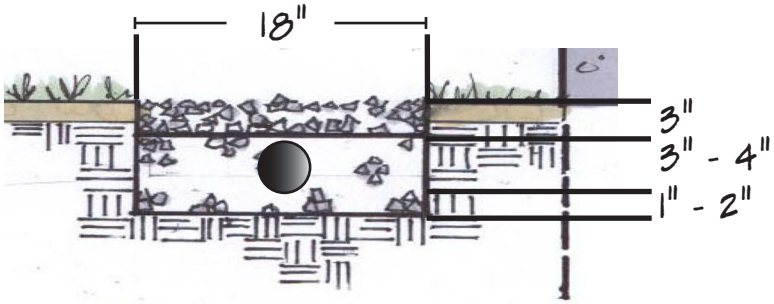


Figure 2. Profile for slowly draining soils.

NOTE. *Driveway trenches work best in sand and gravel soils that can quickly infiltrate large volumes of water. If your property sits on poorly draining soils, you can install a perforated PVC (or other plastic) pipe in the trench as described here.*

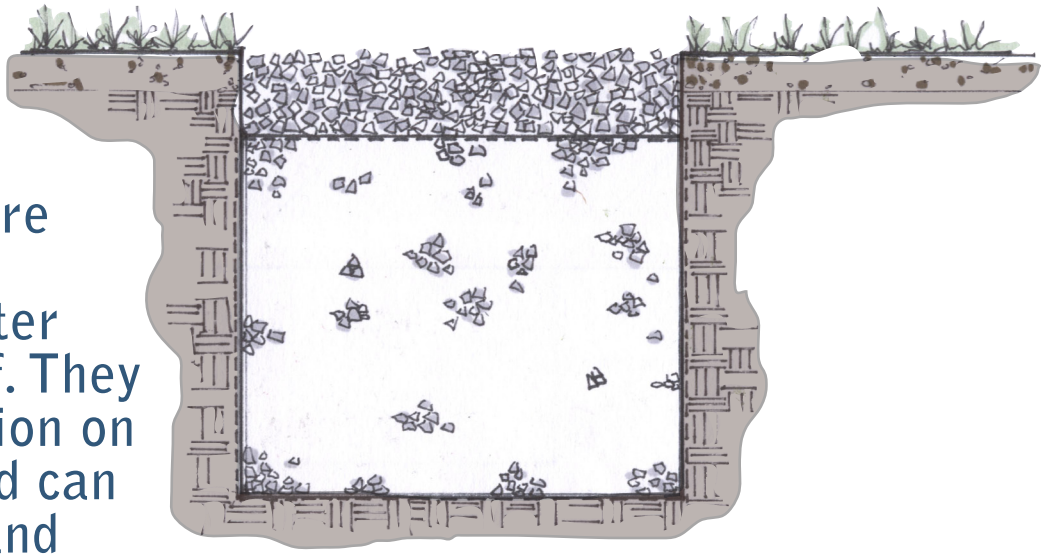
Design References

Maine Department of Environmental Protection. *Conservation Practices for Homeowners*. Fact Sheet Series. May 2006.

Riversides. *Toronto Homeowners' Guide to Rainfall*. http://www.riversides.org/rainguide.

Dry Well

Dry wells collect and infiltrate roof runoff at gutter downspouts, roof valleys, and other places where large amounts of concentrated water flow off of a roof. They help reduce erosion on your property and can reduce ponding and sitting water.



Sizing and Design

STEP 1. Determine the best placement for your dry well. This is usually where large amounts of concentrated runoff flow, such as off of a roof valley or at the end of your roof gutter downspout. It is best to observe runoff during a rain storm.

STEP 2. Follow the steps to **Estimate How Much Stormwater Your Property Creates** (page 14) to determine how large to make your dry well. A typical dry well measures about 3′ x 3′ x 3′.

STEP 3. Clearly mark the boundary of your dry well to identify where you will dig.

Installation

STEP 1. Dig down 3′ within the dry well boundary you marked in step 3 above.

EQUIPMENT & MATERIALS

- Measuring tape
- Shovel
- Crushed stone ($^1/_2$″ to $1^1/_2$″ diameter)
- Non-woven geotextile fabric (or landscape weed fabric for smaller projects)

OPTIONAL

- Perforated PVC or other plastic piping
- Splash guard
- Gutter downspout extension

Dry Well

STEP 2. Slope the bottom of the dry well away from your house so that water drains away from the foundation.

STEP 3. Extend the life of the dry well by lining the sides with non-woven geotextile fabric.

STEP 4. Fill the dry well hole with 1/2" to 1-1/2" diameter crushed stone to within 3" of the ground surface.

STEP 5. Fold a flap of filter fabric over the top of the dry well.

STEP 6. Cover the filter fabric with additional crushed stone until it is even with the ground surface.

STEP 7. Connect your runoff to the dry well. There are a number of ways to direct runoff to the dry well.

a. If the dry well is designed to absorb water from a roof valley, no special piping is needed. The drywell should be placed under the roof valley so that runoff can simply run down the valley and land on the surface of the dry well.

b. If the dry well is designed to absorb water from a roof downspout, you can either extend the downspout to direct runoff to surface of the dry well, or you can extend the downspout, wrap the end of the downspout in filter fabric, and bury the end of the downspout in the drywell. Burying the downspout allow you to cover and seed over the surface of the dry well to make it less noticeable; however, this makes it more difficult to determine if your drywell is working properly. Be sure to inspect your dry well for signs that it is clogged or failing such as ponding at the surface of the drywell or water backing up in your gutters (if your downspout is buried). Parts for extending your dry well can be purchased at your local home improvement store.

Design Reference

Maine Department of Environmental Protection. *Conservation Practices for Homeowners*. Fact Sheet Series. May 2006.

Infiltration Steps

Infiltration steps slow down and infiltrate runoff on moderate slopes of 45° or less to help reduce erosion and define walking paths.

They are typically built with timbers and crushed stone or pea stone, but can be modified by using granite edging and pervious pavers.

Sizing and Design

STEP 1. Measure the overall rise and run of your steps in inches (figure 1).

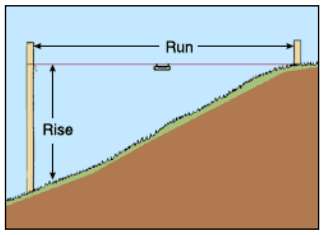


Figure 1

STEP 2. Determine the number of steps that you will need.

Divide the rise in your slope (measured in step 1) by the height of the timber (6" unless you are using different sized timbers) and round to the nearest whole number. This is the number of steps you will need.

RISE / TIMBER HEIGHT = NUMBER OF STEPS

EQUIPMENT & MATERIALS

- Measuring tape or ruler
- Hammer
- 4 wooden stakes
- String or spray paint
- shovel
- $^{3}/_{4}$" crushed stone or pea stone
- Non-woven geotextile fabric
- 6" x 6" pressure treated timbers
- 18" long pieces of $^{1}/_{2}$" diameter steel rebar
- Level
- Power drill with $^{1}/_{2}$" drill bit
- 12" galvanized spikes

Infiltration Steps

STEP 3. Determine the depth (tread) of the steps by dividing the run of the slope by the number of steps (figured in step 2). A comfortable step tread is at least 15".

RUN / NUMBER OF STEPS = DEPTH OF STEP TREAD

STEP 4. Determine the width of the steps. A comfortable width is usually 4', but depending on the topography, trees, or other site conditions, a wider or narrower step may be desired.

STEP 5. Determine your material needs. Once you know the number of steps that you need, their width and tread depth, you can determine the length of timber and the amount of steel rebar that you will need. If you are using side timbers, be sure to add the length of each side timber (the tread depth) to the step width to get the total length of timber you'll need per step. If you are using side timbers, you will need 6 pieces of 18" long $^1/_2$" diameter steel rebar for each step. If you are not using side timbers, you will need two pieces for each step.

> ***NOTE.*** *Infiltration steps may not require side timbers, especially if the steps are in an eroded pathway where the surrounding land is higher. In this case, extend the timbers into the adjacent banks so water will not go around the steps.*

Use the following equations to determine the length (in feet) of timber material you will need:

(STEP WIDTH + TREAD DEPTH + TREAD DEPTH) = TIMBER LENGTH PER STEP

(TIMBER LENGTH PER STEP x # OF STEPS) = TOTAL TIMBER LENGTH

Installation

STEP 1. Stake out the perimeter of the stairway by driving a stake into the ground at each corner of the stairway and stretching string between them (figure 2).

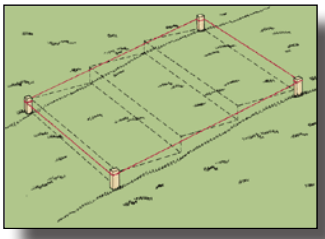


Figure 2

STEP 2. Determine the areas that need to be excavated for each step. Using a measuring tape and starting from the string at the bottom of the slope, measure and mark the depth of the each step until you reach the string at the top of the slope. Use spray paint, sand, or flour to mark the depth of each step (figure 2).

STEP 3. Excavate the first step. Starting at the bottom, dig a trench for the first riser timber (this will be more like a shallow groove in the ground). Next, if using

Infiltration Steps

side timbers, dig trenches for the side timbers, which should be long enough to extend 6" passed the next step's riser. Check the make sure the trenches are level (figure 3).

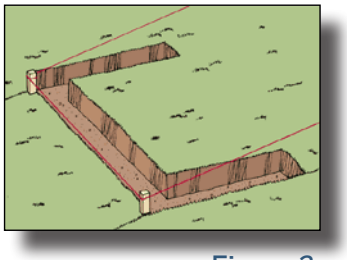


Figure 3

STEP 4. Prepare materials by cutting the timbers to the appropriate length. For each step, cut one riser timber as long as the step width and 2 timbers as long as the step depth for the side timbers (remember that each step should extend 6" past the next step's riser.) Drill $^{1}/_{2}$" diameter holes approximately 6" from the ends of each timber (figure 4).

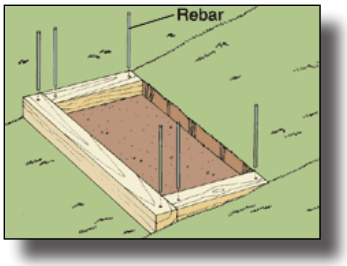


Figure 4

NOTE. *If you do not have your own saw, most home improvement stores have a cutting station that you can use yourself, or they will cut it for you if you give them the lengths you need.*

STEP 5. Position the timbers in the step and remove or add soil as needed to level them (figure 4).

STEP 6. Anchor the timbers by driving the steel rebar through the drilled holes on the end of each timber and into the ground. Make sure the rebar is level with the timber surface or slightly recessed since the edges may be sharp (figure 4).

STEP 7. Shovel out the soil inside the step to create a surface roughly level with the bottom of the timbers. Additional soil can be removed to provide more area for infiltration if desired. Make sure to dispose of excavated soil in a place where it will not wash away (figure 4).

STEP 8. To build the next step, measure from the front of the first riser timber and mark the step depth on the side timbers with a pencil. Align the front of the second step riser timber with the pencil lines on the side timbers of the step below. Secure the riser timber to the side timbers using 12" galvanized spikes (figure 5).

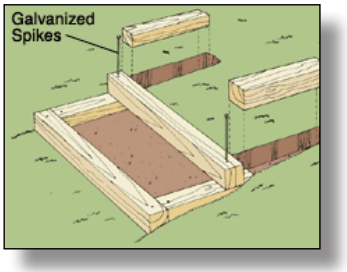


Figure 5

NOTE. *To make it easier to drive the galvanized spikes into the timber, you can pre-drill holes to about 5" deep into the timber.*

STEP 9. Excavate for the side timbers and set the side timbers. Anchor the side timbers by driving the steel rebar through the drilled holes on the end of each timber into the ground (figure 5).

STEP 10. Shovel out the soil inside the step to create a surface roughly level with the bottom of the timbers the same as in step 7.

Infiltration Steps

STEP 11. Repeat steps 8 through 10 for each remaining step. When installing the top step, cut the side timbers 6" shorter than the ones on the lower steps - these timbers do not need the extra length since no stairs will rest on them.

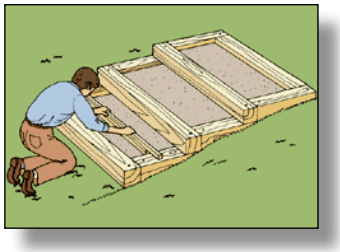


Figure 6

STEP 12. Lay down geotextile fabric and backfill with stone.

a. Line the area inside each set of timbers with non-woven geotextile fabric. Make sure the fabric is long enough to extend a few inches up the sides of the timbers (figure 6).
b. Fill each step with $^{3}/_{4}$" crushed stone or pea stone until it is about 1" below the top of the timber.
c. Seed and/or mulch bare soil adjacent to the steps.

To Retrofit Existing Steps

Existing steps can be retrofit to improve infiltration by removing several inches of soil from behind each step and following step 12.

NOTE. *If the timbers are not firmly secured, drill $^{1}/_{2}$" diameter holes, 6" from the ends of each timber. Drive $^{1}/_{2}$" diameter, 18" long steel rebar through the holes with a sledge hammer. For gentle slopes, wooden stakes or large rocks can also secure the timbers.*

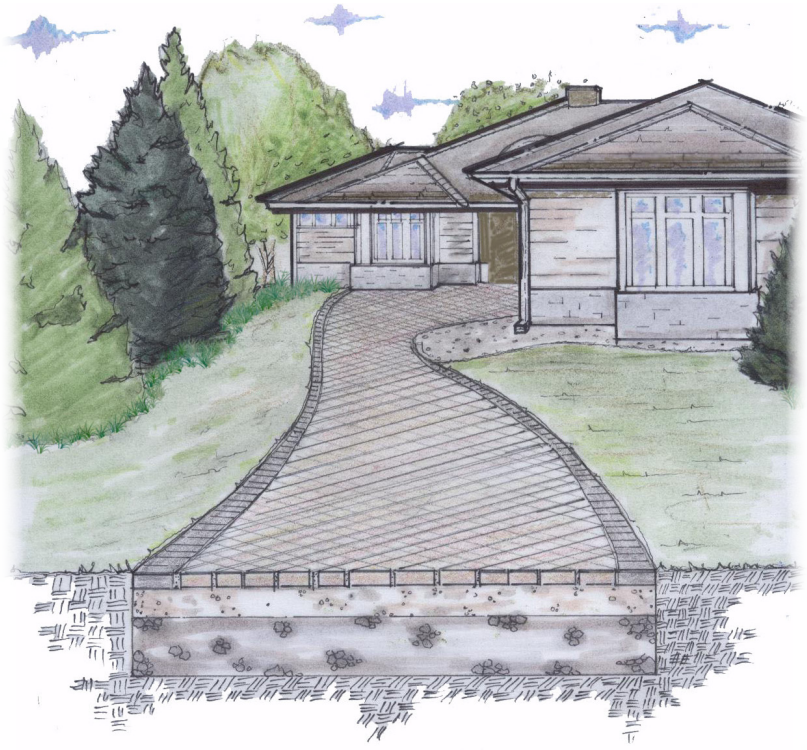
Design Reference

Maine Department of Environmental Protection. *Conservation Practices for Homeowners*. Fact Sheet Series. May 2006.

Figures used with permission from the Maine Department of Environmental Protection.

Pervious Walkways & Patios

Pervious pavers look like traditional brick, stone, or concrete pavers, but have spaces between them and a stone reservoir under them to absorb and store rain and snowmelt. This helps reduce the amount of runoff from your property and makes an impervious surface pervious.



NOTE. *Manufactured pervious pavers come with instructions for the type and depth of sub-base material. If the information in this fact sheet differs from the manufacturer's instructions, follow the manufacturer's instructions.*

Sizing and Design

STEP 1. Determine the areas that you will be installing pervious pavers.

Pervious pavers are best for areas with slopes of less than 2%. They should have a minimum of 2′ between the bottom of the gravel base and bedrock or the water table. Do a **Simple Perc Test** (page 19) to determine if pervious pavers will work on your property.

EQUIPMENT & MATERIALS

- Measuring tape or ruler
- Shovel
- $1^1/_2$″ crushed stone
- $^3/_8$″ pea stone
- Non-woven geotextile fabric (or landscape weed fabric for smaller projects)
- Pervious pavers

OPTIONAL

- Perforated PVC or other plastic piping

Pervious Walkways & Patios

STEP 2. Material needs.

a. Calculate the area of the new or existing walkway, patio, or driveway that you will be installing with pervious pavers.

b. Determine the square footage of pavers you will need by multiplying the length (in feet) and width (in feet) of the area to be paved.

   If the area you are paving is not a simple square or rectangle, sketch the area where the pavers will be installed on a piece of paper, write down the corresponding measurements, and bring it to your local landscape supply yard or store where you will be purchasing the pavers. They will be able to help you determine how many pavers you need.

c. Sub-base material (figure 1) is the gravel and pea stone layers that go under the pavers. This material provides a reservoir for stormwater before it soaks into the ground underneath. You should have a minimum depth of 12" of $1^1/_2$" diameter crushed stone and 6" of 3/8" pea stone for your sub-base. Use the following equations to determine the amount of sub-base materials you will need:

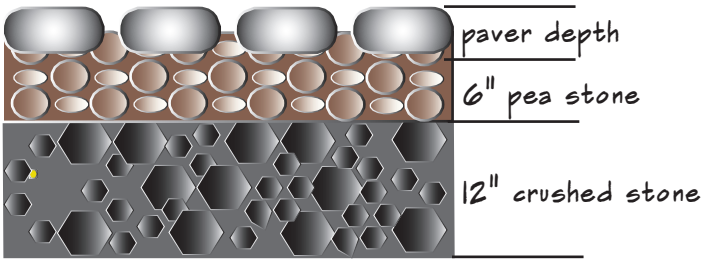


Figure 1. Pervious walkway profile.

(PAVEMENT AREA (SQ. FT.) x 1 FT.) x 0.037 = YARDS OF 1-1/2" CRUSHED STONE

(PAVEMENT AREA (SQ. FT.) x 0.5 FT.) x 0.037 = YARDS OF 3/8" PEA STONE

Installation

STEP 1. Prepare the installation site. Remove any existing walkway or patio material. This may require renting a jackhammer or other equipment such as a backhoe. Mark the location of the walkway or patio with either landscaping paint or place a string line on either side.

STEP 2. Excavate the site approximately 20-inches deep, depending on the type of paver you're using. Smooth the area you've excavated with a rake.

STEP 3. Lay the sub base material and pavers.

a. Spread the crushed gravel over the excavated dirt. The depth of the gravel should be 12" or per manufacturer's instructions.

b. Place a layer of non-woven geotextile fabric over the crushed gravel.

c. Spread the pea stone over the fabric. The depth of the pea stone should be 6" or per manufacturer's instructions.

d. Install the pavers on top of the pea stone and use a level to make sure they are installed uniformly. Most pervious pavers have tabs on the edges to create proper spacing between them.

e. Once the pavers are installed, spread more pea stone over the top and use a push broom to work the pea stone into the space between the pavers.

Design Reference

Low Impact Development Center. Permeable Paver Specification. 1995.

NH Department of Environmental Services. Permeable Pavement Demonstration Brochure. 2010.

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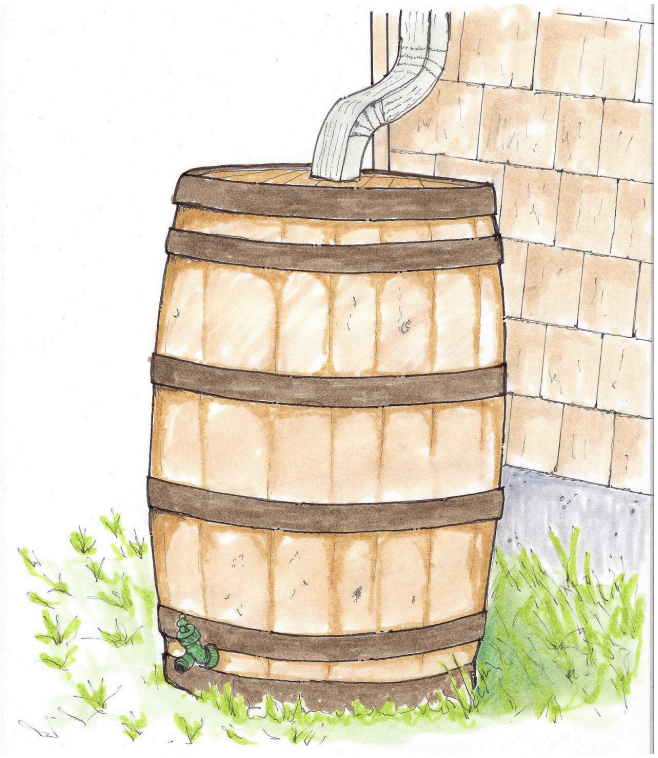
Rain Barrel

Rain barrels capture rainwater from your roof and store it for later use. This reduces stormwater runoff from your property and allows you to use captured water for lawns, gardens, and indoor plants.

Rain barrels must be emptied between rain events so they don't overflow and are able to capture runoff from the next storm.



Sizing and Design

STEP 1. Observe your roof runoff. Note where you have existing roof gutter downspouts or valleys that drain large amounts of water.

STEP 2. Use the steps in **Estimate How Much Stormwater Your Property Creates** (page 14) to determine how many rain barrels you need. This will help you decide whether you need to establish an area to direct your rain barrel overflow.

Installation

STEP 1. Once you have determined where you want your rain barrels to go, level the ground surface. You

EQUIPMENT & MATERIALS

- Pre-made or home-made rain barrel (food grade container)
- Shovel
- Cinder blocks

OPTIONAL

- Soaker hose for overflow
- Crushed stone
- Mulch
- Splash guard

Rain Barrel

can use crushed stone or mulch to stabilize the ground surface.

NOTE. *You may need to cut your gutter downspout so the water flows onto the screen on top of the barrel.*

STEP 2. Elevate your rain barrel by placing it on cinder blocks or other sturdy base.

> ***NOTE.*** *Your rain barrel must be secured on a firm, level surface. A full, 55-gallon rain barrel weighs over 400 pounds.*

STEP 3. Attach additional rain barrels in a series, if you have more than one, or direct the overflow hose to an area that can receive overflow water such as a garden or dry well. Using a **splash guard** under the overflow hose will help prevent soil erosion during larger storm events.

Build Your Own Rain Barrel

Pre-made rain barrels are available in many sizes and styles and range in price from $50 to over $200. To save money, you can use the instructions at: http://www.portlandonline.com/shared/cfm/image.cfm?id=182095 to make your own rain barrel (City of Portland Environmental Services How to Manage Stormwater Rain Barrels fact sheet).

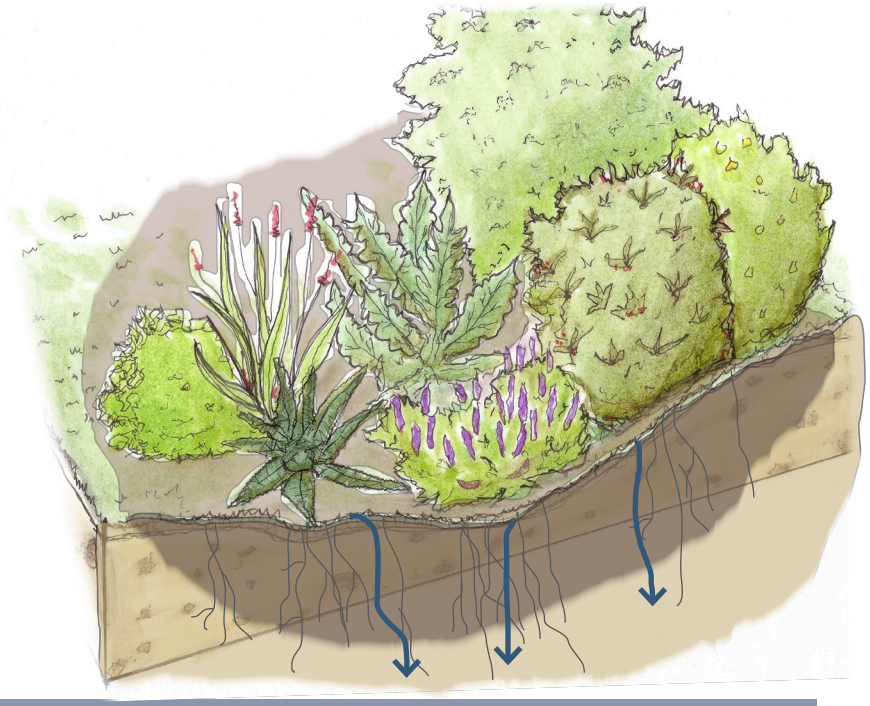
Design References

RiverSides Stewardship Alliance. *Toronto Homeowner's Guide to Rainfall*. 2005

Vermont Department of Environmental Conservation. *Low Impact Development Guide for Residential and Small Sites*. December 2010.

Rain Garden

A rain garden is a bowl-shaped garden that uses soil, mulch, and plants to capture, absorb, and treat stormwater. This helps to reduce the amount of stormwater coming from your property and to recharge groundwater.



Sizing and Design

STEP 1. Calculate the drainage area using the information in the **Estimate How Much Stormwater Your Property Creates** (page 14) section of this Guide.

STEP 2. Determine the soil type and suitability for a rain garden using the information in the **Water Table and Soil Testing** (page 19) section of this Guide.

STEP 3. Calculate the slope to determine the rain garden's depth.

a. Place one stake at the uphill end of the rain garden and another at the downhill end as illustrated in Figure 1.
b. Level the string between the two stakes.
c. Measure the total length of the string and the height of the string at the downhill stake in inches.
d. Divide the height by the length and then multiply the result by 100. This is the slope.

EQUIPMENT & MATERIALS

- Calculator
- Measuring tape or ruler
- Stakes (2)
- String or yarn
- Shovel
- Level
- Compost
- Mulch
- Plants

OPTIONAL

- PVC or other plastic piping
- Landscaping stones or edging

Rain Garden

e. 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

Table 2			
Soil Type	Rain Garden Depth (from Table 1)		
	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

STEP 4. Determine the rain garden's size.

a. Use Table 2 to determine the rain garden size factor.

b. Multiply the size factor by the drainage area. This is the recommended rain garden size.

SIZE FACTOR x DRAINAGE AREA (square feet) = RAIN GARDEN SIZE (square feet)

STEP 5. Design your Rain Garden.

a. Your rain garden can be any shape, but MUST have a level bottom.

b. Stabilize the area where water will enter your rain garden with stone or gravel to slow the flow and prevent erosion. Place hardy flood tolerant plants where the stormwater enters the garden.

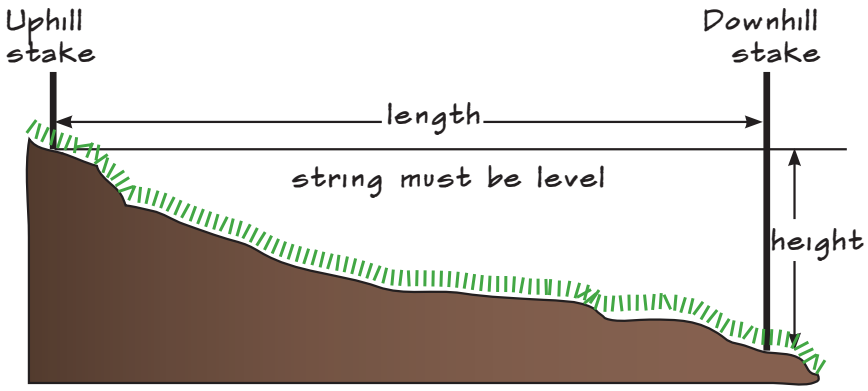


Figure 1. Determine the slope of the landscape before digging.

c. Select plants that are able to tolerate extreme moisture fluctuations typical of a rain garden. Plants must be able to tolerate both wet and dry conditions and survive the freezing winter conditions. See the **Native Plant List** in Appendix A of this guide for a list of recommended plants.

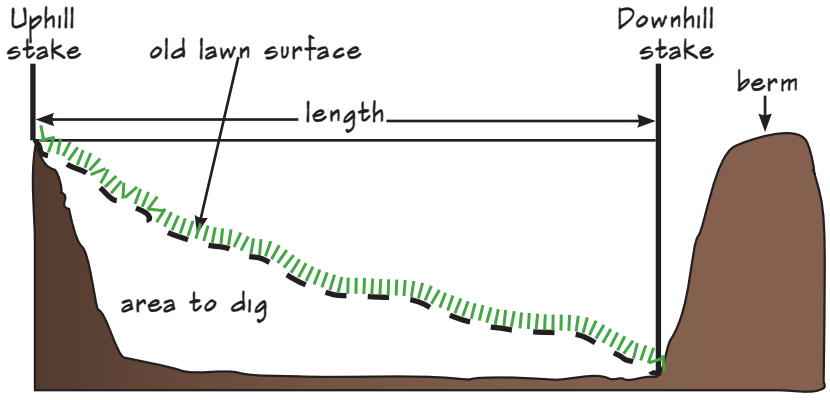


Figure 2. Where to dig and put the soil.

Rain Garden

Installation

STEP 1. Define the borders by using string or spray paint to outline the shape of the rain garden.

STEP 2. Remove the grass within the rain garden area. You can either dig through the lawn or lay a tarp or sheet of black plastic within the rain garden area for several weeks to kill the grass. Herbicides are not recommended because they could kill newly planted rain garden plants.

STEP 3. Dig the rain garden.

a. Prepare the perimeter of the garden:

   On a Slope: If the rain garden is on a slope, a berm or low wall is needed on the downside of the rain garden to hold the water in the garden (Figure 2). Create a berm while digging the rain garden by piling the soil around the downside garden edges. The berm should be the same height as the uphill side of the garden to make the entire perimeter of the garden level. After shaping the berm, compact the soil and cover with sod, mulch, or other stabilizing ground cover.

   On Level Ground: If the rain garden is on level ground, no berm is necessary and the excavated soil can be removed or used somewhere else on your property. Landscaping stone or edging can be used to help hold water in the garden.

b. Dig the rain garden bed (bottom) 4" - 6" deeper than determined earlier to make room for compost and mulch. Avoid compacting the soils on the bottom of the garden. When the entire rain garden area has been dug out, lay a 2 x 4 board in the garden and place a carpenter's level on it. Dig or add soil to level out the bottom. Once level, rake the soil.

c. Apply at least 2" of compost to the rain garden and mix into the native soils to help retain moisture and improve plant growth.

NOTE. *There is no need to add fertilizer to your rain garden soil. Adding fertilizer will add unnecessary nutrients and will reduce the ability for the rain garden to effectively treat stormwater.*

STEP 4. Place plants in the garden according to your planting plan. When removing the plants from their pots, loosen the root ball with your fingers to encourage root growth. Water generously after planting.

STEP 5. Apply a 2"-3" layer of mulch over the entire rain garden to help retain moisture in the soil and to prevent weeds. A cubic yard of mulch will cover approximately a 100 square-foot-area with about 3 inches of mulch.

Design References

Winooski Natural Resources Conservation District. *The Vermont Rain Garden Manual "Gardening to Absorb the Storm"*. 2009

Wisconsin Department of Natural Resources. *Rain Gardens: A How-to Manual for Homeowners.* 2003.

Figures adapted from Wisconsin Department of Natural Resources. *Rain Gardens: A How-to Manual for Homeowners.* 2003.

Vegetated Swale

A vegetated swale is a shallow channel that slows stormwater runoff and directs it to an area where it can infiltrate. Swales receive drainage from roads, sidewalks, and driveways. They use plants to help trap sediment, remove pollutants from stormwater, and prevent erosion.

Sizing and Design

STEP 1: Determine the best location, shape, and size for your swale. Swales are often located close to roads or driveways. The swale should be located in a place where it will receive runoff at one end and have enough slope to it that the runoff will naturally flow through the swale to the other end to outlet. A slope of 1" for every foot in length is enough to move the runoff.

STEP 2: Select plants for the swale using the **Native Plant List** in Appendix A of this guide. Hardy ground covers and grasses that produce uniform, dense cover, and can withstand flood and drought conditions are best. If the swale is to be located close to a road or in an area where you will store snow, choose salt-tolerant plants.

EQUIPMENT & MATERIALS

- Measuring tape
- Shovel
- Grass sod or other vegetation - native grasses, sedges, and seedlings. Drought & flood tolerant plants are best suited.
- Soil mix (depending on existing soil type)

OPTIONAL

- Downspout extension
- Splash guard
- Crushed stone (for check dams)

Vegetated Swale

Installation

STEP 1: Dig out the shape of the swale to match your design. The deepest part of the swale in the center should be approximately 3' deep. The width of the swale will depend on how much space you have on your site. A swale can be any size or length, but most are shaped like a trapezoid with the sides being three times wider than the width of the base. The slope of the sides should be between 1% and 4% (figure 1).

NOTE: Be careful not to compact the soil when digging, because it will reduce the ability of the swale to infiltrate runoff. For clay soils or other poorly infiltrating soils, you may want to dig down an additional 1 1/2' below the bottom of the swale and create a sandy loam by mixing sand in with the existing soil, then refill the hole. This will improve infiltration.

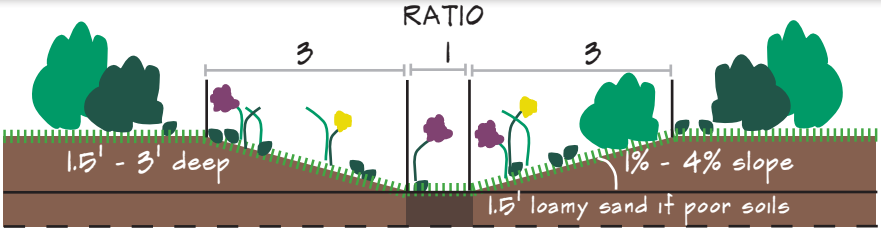


Figure 1. Profile of vegetated swale.

STEP 2: Dig the swale at a slight slope downhill to move water through the swale. Dispose of any excess soil in a place where it will not runoff the property. For steeper slopes, check dams should be used to slow down the flow of runoff and reduce the potential for erosion. Check dams are small dams, usually made of crushed stone, that are built across a swale. They are used to slow down the speed of the stormwater as it flows through the swale.

STEP 3: At the inflow end of the swale, where runoff enters, you may want to use a splash guard or pile stones or gravel to reduce erosion from fast moving runoff.

STEP 4: Plant the swale with seedlings, seeds, or sod. You can use the **Native Plant List** on page 51 of this guide or your local nursery can help you select native plants that are drought and flood tolerant, and tolerant of sun or shade conditions on your property. Runoff should not be directed to a swale until the vegetation is well established. Temporary mulch check dams can be used to slow the flow of runoff in the swale until the ground cover has matured and will not be damaged by runoff.

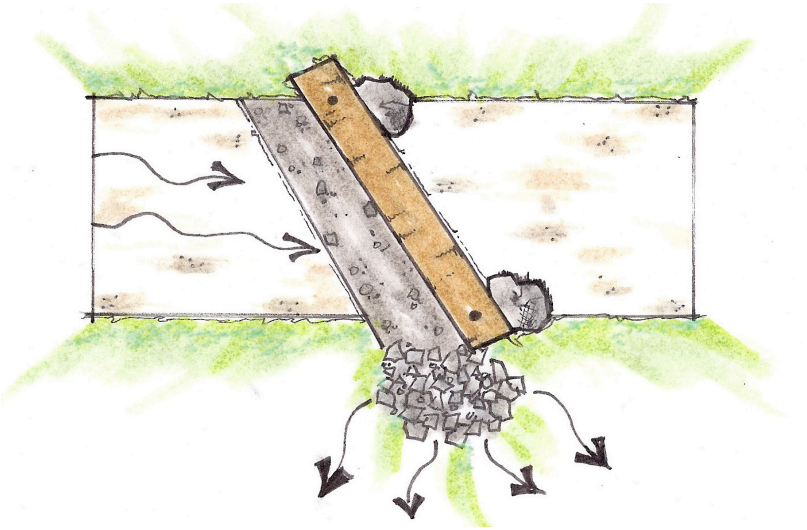
Design References

RiverSides Stewardship Alliance. *Toronto Homeowner's Guide to Rainfall*. 2005

Vermont Department of Environmental Conservation. *Low Impact Development Guide for Residential and Small Sites*. December 2010.

Water Bar

A water bar intercepts water traveling down moderately steep walkways, paths, gravel driveways, and other areas to divert water into stable vegetated areas. This helps to prevent erosion.



Sizing and Design

STEP 1. Determine how many water bars.

a. You will need to calculate the slope of your path (figure 1) using the following equation:

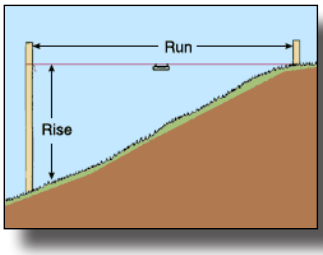


Figure 1.

(RISE / RUN) x 100 = % SLOPE

b. Compare your % slope to the waterbar spacing in table 1 to determine how far apart the water bars should be.

c. Divide the length of your path (along the ground surface) by the spacing between water bars from table 1 to get the number of water bars that you will need.

LENGTH OF PATH / WATER BAR SPACING = # WATER BARS

NOTE: If your path has known problem areas (e.g., areas erode or wash out frequently), place the water bars to specifically target these problem areas instead of using the spacing in table 1.

EQUIPMENT & MATERIALS

- Measuring tape
- Shovel
- Saw
- 6″ x 6″ or 8″ x 8″ pressure treated or cedar timbers or other rot-resistant logs
- 18″ long pieces of $^{1}/_{2}$″ rebar (2 for each water bar)
- $^{3}/_{4}$″ crushed stone
- Mulch

Water Bar

STEP 2. Determine material needs. Measure the width of your path. The timbers should extend 6" off both sides of the path. To determine the length of timbers you will need, use the following equation:

NUMBER OF WATER BARS + (PATH WIDTH + 1) = TIMBER LENGTH IN FEET

Table 1	
% Slope	Spacing between water bars (in feet)
2	250
5	130
10	80
15	50
25+	40

Installation

STEP 1. Dig a trench for the wood timber or log that is at approximately a 30° angle across the path. The trench should be deep enough so the top of the timber or log will be almost flush with the trail on it's downhill side once in place. Store soil and rocks excavated from the trench on the trail below the water bar to be used later to backfill the trench.

STEP 2. Prepare materials by cutting the timbers or logs to the appropriate length. For each water bar, cut one timber as long as the path width plus 1' (remember that each timber should extend 6" on each side). Drill $^1/_2$" diameter holes approximately 6" from the ends of each timber.

NOTE. *If you do not have your own saw, most home improvement stores have a cutting station that you can use yourself, or they will cut it for you at the lengths you need.*

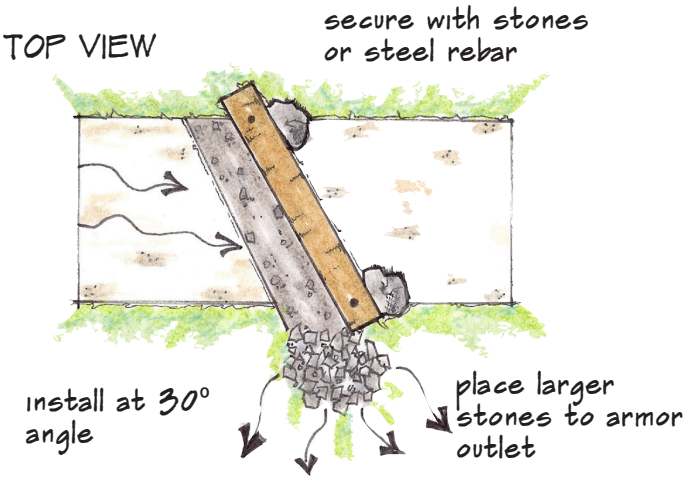


Figure 1. Top view of waterbar.

STEP 3. Install the timber or log by placing it snug against the downhill side of the trench. The timber should be level and have no high points or voids under it.

STEP 4. Secure the timber with rebar stakes making sure that the rebar is pounded down to be flush or slightly recessed with the top of the timber to avoid any sharp edges.

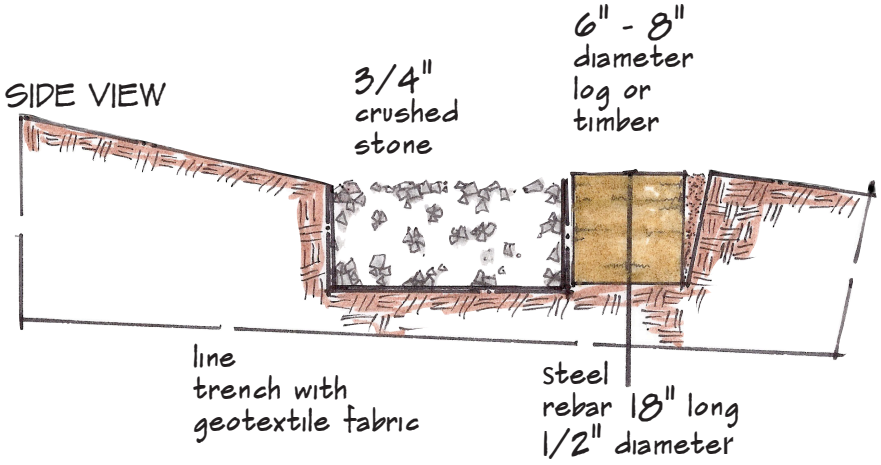


Figure 2. Side view of waterbar.

STEP 5. Back Fill around the water bar.

a. Dig a 12" wide and 6" deep trench along the uphill side of the timber.
b. Fill the trench with crushed stone, leaving a few inches of the timber exposed.
c. At the outlet of the waterbar, place an apron of crushed stone to prevent erosion.
d. Pack soil and gravel up against the downhill side of the timber so that the top of it is flush with the path.
e. Cover all disturbed soil with seed and mulch or leaf litter.

Design Reference

Maine Department of Environmental Protection. *Conservation Practices for Homeowners*. Fact Sheet Series. May 2006.

Figure used with permission from the Maine Department of Environmental Protection.

Good Housekeeping

The following good housekeeping practices help reduce the volume of stormwater created and help prevent pollutants from coming in contact with stormwater.

AUTOMOBILE MAINTENANCE

- Keep your vehicles (and any other motors) serviced regularly by a qualified mechanic.
- Clean up fluid leaks with cat litter and put an absorbent rag or carpet remnant under the leak to absorb the fluid until it is fixed.

CAR WASH

- Take your vehicle to a local car wash that recycles and reuses the wash water and uses non-toxic cleaners.
- If you have to wash your vehicle at home, park your car on a grassy or pervious area, use a non-toxic soap, and minimize the amount of water that you use by running the hose only when you need it.

"GREEN" YARD CARE & LANDSCAPING

- Reduce the square footage of your lawn area by planting low-maintenance ground-covers, trees, flowers, and shrubs to help water infiltrate into the ground and prevent soil erosion.
- For new lawns, use 6" - 12" of topsoils to encourage deeper root growth.
- Choose native grasses and ground coverings as alternatives to conventional turf lawns on some or all of your property. Native plants have evolved and originated in your area and generally require less water, herbicides, pesticides, fertilizers, and trimming.
- Test your soil to see what it really needs before you apply fertilizer or lime (contact your county UNH Cooperative Extension office for information on soil testing).
- When fertilizer is necessary, use a slow-release fertilizer to avoid excess nutrients running into the water.
- If you have an automated irrigation system, make sure that it has a rain gauge or soil moisture sensor to prevent watering when it isn't necessary - like when it is raining or immediately following a rain shower.
- Aerate your lawn to help the soil breathe and promote stronger root systems.
- Raise and keep your lawn mower at a height of 7.5 cm (3 inches).

- Leave mulched grass clippings on your lawn to naturally fertilize and prevent evaporation to reduce the amount you need to water.
- Maintain natural vegetation and buffers around your property.
- Sweep up the yard waste and other materials from your driveway using a regular broom or, if that is too difficult, use a shop vacuum to collect the material.

REDUCE IMPERVIOUS COVER

- Limit the amount of impervious surface created on your property.
- Replace impervious surfaces with natural, native ground cover or materials that allow rain water to seep into the ground such as gravel, brick, stepping stones, wood chips, or other porous surfaces.
- Direct runoff from impervious areas to pervious ones. For example, direct the downspout from your roof gutter away from your driveway and instead into a vegetated area such as a swale or garden area.

SEPTIC SYSTEM MAINTENANCE

- Know the location of your septic tank and leach field area.
- Have your tank inspected yearly. If the sludge and surface scum combined are as thick as $^1/_3$ the liquid depth of your tank, have it pumped out by a licensed septage hauler.
- Keep bulky items like diapers, sanitary pads, cigarettes, and paper towels out of the system as they will cause clogging.
- Keep toxic materials like paint thinners, pesticides, and bleach out of your system. The chemicals could kill the good bacteria that live in your septic tank that keep it functioning.
- Do not use septic tank additives. They could be harmful to the bacteria.
- Repair leaking faucets and fixtures promptly to reduce the amount of water the system has to treat.
- Avoid putting food waste and grease into the system or using a garbage disposal. Food waste in your system would require more frequent pumping and can leach nutrients into the soils surrounding your leach field.
- Keep deep-rooted trees and bushes away from the leach field.
- Keep vehicles, equipment, and heavy foot traffic away from the leach field to avoid compacting the soils.
- Use alternative cleaning products, such as baking soda and borax, to avoid chlorine and strong acids that could kill the good bacteria in the septic system.

WINTER WALKWAY AND DRIVEWAY MAINTENANCE

- Reduce the amount of salt that you apply to your driveway and walkways.
- Use only sand to provide traction.
- If you have multiple entries to your home, designate one of them as the "winter entrance" and only maintain the walkway that serves that door.

PET WASTE

- Take the time to "scoop the poop" and dispose of it properly.
- Pick up pet waste. Flush it down the toilet, put it in the trash, or bury it in the yard at least 5" deep and away from vegetable gardens and waterways.
- Do not put pet waste into storm drains.
- For more information, see DES Scoop the Poop Campaign.

Glossary

Hydrology (hydrologic function) — the way water moves over the land and through the ground.

Infiltrate — when rain and snow melt soak into the soil.

Impervious cover (impervious surface) — hard surfaces that cover the ground and prevent rain and melting snow from soaking into the soil, such as the roofs of houses and buildings, roads, and parking lots.

Low impact development — a stormwater management and land development strategy used at the lot and subdivision scale that uses thoughtful land use planning and on-site natural features with small-scale stormwater controls to try to match the way the stormwater traveled over and through the landscaping before development.

Phosphorus — an essential nutrient for life and the limiting nutrient in fresh water lakes and ponds that causes plants and algae to grow. Too much phosphorus can cause plants and algae to overgrow and become a nuisance for boating and swimming. It can also increase the likelihood of toxic algae blooms that can harm humans and animals. When plants and algae die, they decompose and use up the oxygen in the water, leaving less oxygen for fish and other aquatic organisms who depend on it.

Splash guard — prevents erosion at the end of pipes and gutter downspouts. You can purchase plastic or concrete splash guards at hardware stores or you can simply use a flat stone.

Stormwater — Water from rain or melting snow that does not soak into the ground.

Stormwater pollution — stormwater that has become a problem because there is too much of it and it is causing flooding or erosion, or because it contains pollutants such as sediment, nutrients, metals, or other substances that lower water quality.

Surface water quality impairments — when a waterbody does not meet one of its designated uses, such as fishing, swimming, or it does not support aquatic life, it gets reported in the New Hampshire 305(b) Surface Water Quality Report and the 303(d) List of Impaired Waters. This report is updated by DES every two years and is submitted to the United States Environmental Protection Agency. Waterbodies that are listed as impaired need to be restored.

Vegetated Buffers — areas of natural or established vegetation allowed to grow with minimal to no maintenance. Buffers are particularly desirable along shorelines of waterbodies and wetlands. Buffers reduce the velocity of runoff, promote groundwater recharge, filter out sediments and provide shade to reduce the thermal impacts of runoff to receiving waters. Buffers also provide habitat for wildlife.

Watershed — a geographic area to which all water drains to a given stream, lake, wetland, estuary, or ocean; similar to a funnel. Our landscape is made up of many interconnected watersheds. The boundary between each is defined by the line that connects the highest elevations around the waterbodies.

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APPENDIX A
Native Plant List

Plants, shrubs, and trees used in vegetated stormwater management practices should be able to tolerate both flood and drought conditions and should be hardy enough to tolerate stormwater pollutants. Plants that are native to New Hampshire are best suited for these conditions and will prevent the introduction of exotic, invasive plants to the state. The plant species listed here are from the University of New Hampshire Cooperative Extension's 2007 publication titled, *Integrated Landscaping: Following Nature's Lead* and are suitable for stormwater treatment landscaping.

TREES

Black Gum - *Nyssa sylvatica*

Red Maple - *Acer rubrum*

Black Spruce - *Picea mariana*

River Birch - *Betula nigra*

Shadblow Serviceberry - *Amelanchier canadensis*

Pagoda Dogwood - *Cornus alternifolia*

SHRUBS/VINES

Sweet Gale - *Myrica gale*

Speckled Alder - *Alnus incaba subsp. rugosa*

Meadowsweet - *Spirea alba var. latifolia*

Steeplebush - *Spirea tomentosa*

Spicebush - *Lindera benzoin*

Silky Dogwood - *Cornus amomum*

Winterberry Holly (male) - *Ilex verticillata*

Black Chokeberry - *Aronia melanocarpa*

Red Chokeberry - *Aronia arbutifolia*

Red Sprite Winterberry Holly - *Ilex verticillata 'Red Sprite'*

Diablo Common Ninebark - *Physocarpus opulifolius 'Diable'*

Pinkshell Azalea - *Rhododendron vaseyi*

Swamp Rose - *Rosa palustris*

Inkberry - Ilex glabra

GROUNDCOVER/GRASSES

Creeping Phlox - *Phlox stolonifera*

Bunchberry - *Cornus canadensis*

Sheep Laurel - *Kalmia angustifolia*

False Hellebore - *Veratrum viride*

PERENNIALS

Blue Flag Iris - *Iris versicolor*

Cardinal Flower - *Lobelia cardinalis*

Joe Pye Weed - *Eupatorium macalatum*

Swamp Milkweed - *Ascelpias incarnate*

Bluebead lily - *Clintonia borealis*

Jack-in-the-Pulpit - *Arisaema triphyluum*

Whorled Aster - *Aster acumiatus*

Marsh Marigold - *Caltha palustris*

Turtlehead - *Cheloni lyonii*

Bottle gentian - *Gentiana clausa*

Blasing Star Gayfeather - *Liatris spicata*

New York Ironweed - *Veronia noveboracensis*

Appendix B

State and Federal Regulations to Protect Water Quality

The state of New Hampshire uses the following programs and permits to protect water quality:

ALTERATION OF TERRAIN LAWS protect surface waters, drinking water supplies and groundwater by controlling soil erosion and managing stormwater runoff from developed areas that propose to disturb 100,000 square feet of terrain (50,000 square feet if any portion of the project is within the protected shoreland) or, for smaller projects, the General Permit by Rule applies.

MORE INFORMATION:
(603)-271-3434 or http://des.nh.gov/organization/divisions/water/aot/index/htm

SHORELAND PROTECTION LAWS protects surface waters through the Shoreland Permit by managing the disturbance of shoreland areas to maintain naturally vegetated shoreland buffers that protect against the potentially harmful effects of stormwater runoff. It applies to all fourth order and greater streams, designated rivers, tidal waters, and lakes, ponds and impoundments over 10 acres in size.

MORE INFORMATION:
(603)-271-2147 or http://des.nh.gov/organizations/water/wetlands/cspa/index.htm

WETLANDS LAWS protect surface waters by requiring avoidance and minimization of potential impacts to state surface waters, banks of lakes, ponds, or rivers, and tidal or non-tidal wetlands.

MORE INFORMATION:
(603)-271-2147 or http://des.nh.gov/organizations/water/wetlands/index.htm

SECTION 401 WATER QUALITY CERTIFICATION protects water quality by making sure that the state water quality standards are met in nearby lakes, ponds, streams, rivers, and other surface waters, during and after construction of large projects, such as the development of a large subdivision, shopping center, or for wastewater discharges.

MORE INFORMATION:
(603)-271-8872 or http://des.nh.gov/organization/divisions/water/wmb/section401/index.htm

The United States Environmental Protection Agency (EPA) regulates stormwater under the Federal Clean Water Act. Specifically, the National Pollutant Discharge Elimination System Program uses the following "Phase II" permits to regulate stormwater.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) GENERAL PERMIT protects water quality by making sure that discharges from municipal stormwater drainage systems meet minimum requirements.

MORE INFORMATION:
(603)-271-2984 or http://des.nh.gov/organization/divisions/water/stormwater/ms4.htm

MULTI-SECTOR GENERAL PERMIT protects water quality by making sure that discharges from industrial activities, such as material handling and storage, meet minimum requirements.

MORE INFORMATION:
(603)-271-2984 or http://des.nh.gov/organization/divisions/water/stormwater/industrial.htm

CONSTRUCTION GENERAL PERMIT protects water quality by making sure that discharges from construction activity that disturbs over 1 acre of land, meets minimum requirements.

MORE INFORMATION:
(603)-271-2984 or http://des.nh.gov/organization/divisions/water/stormwater/construction.htm

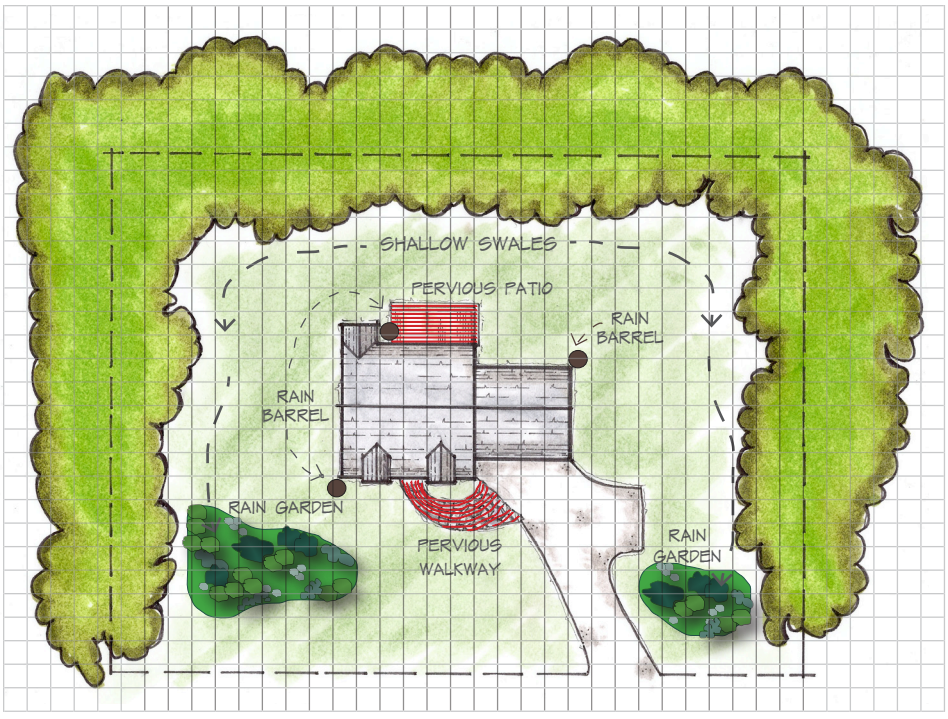
APPENDIX C

Site Sketch Grid

Use the grid on the following page to sketch your property and identify the property features listed below for the existing and the planned conditions.

- Impervious Roof
- Other Hard Surfaces (including driveways, walkways, decks, and patios)
- Lawn and Landscaped Areas
- Forest or other Undisturbed Areas
- Drainage Patterns (the way the water flows on your property)
- Best Management Practices (BMPs)

Approximations: For a 1/2 acre lot: 1 square = 5 ft. x 5 ft. (25 sq. ft.)
For a 1 acre lot: 1 square = 7 ft. x 7 ft. (50 sq. ft)
For a 2 acre lot: 1 square = 10 ft. x 10 ft. (100 sq. ft)



Example future conditions site sketch.

APPENDIX D

Project Planning Worksheet

Print and complete this worksheet to help plan your project. This information can be entered into the NH Residential Loading Model available at www.des.nh.gov/organization/divisions/water/stormwater to estimate your "stormwater footprint" and quantify the water quality benefit of installing stormwater treatment practices on your property.

EXISTING CONDITION

1. Lot size: _____ ft²

2. Impervious Roof

House: L:_____ ft X W:_____ ft = _____ ft²
Garage: L:_____ ft X W:_____ ft = _____ ft²
Other: L:_____ ft X W:_____ ft = _____ ft²

TOTAL: _____ ft²

3. Other Hard Surfaces

Driveway: _____ ft (length) X _____ ft (avg. width) = _____ ft²
Walkways: _____ ft (length) X _____ ft (avg. width) = _____ ft²
Decks: _____ ft (length) X _____ ft (avg. width) = _____ ft²
Patios: _____ ft (length) X _____ ft (avg. width) = _____ ft²

TOTAL: _____ ft²

4. Lawn/landscaped areas

Area 1: _____ ft (length) X _____ ft (avg. width) = _____ ft²
Area 2: _____ ft (length) X _____ ft (avg. width) = _____ ft²
Area 3: _____ ft (length) X _____ ft (avg. width) = _____ ft²

TOTAL: _____ ft²

5. Forested/natural areas:

lot size - (totals from 2, 3 & 4 above) = _____ ft²

PLANNED CONDITION

1. Lot size: _____ ft²

2. Impervious Roof

House: L:_____ ft X W:_____ ft = _____ ft²
Garage: L:_____ ft X W:_____ ft = _____ ft²
Other: L:_____ ft X W:_____ ft = _____ ft²

TOTAL: _____ ft²

3. Other Hard Surfaces

Driveway: _____ ft (length) X _____ ft (avg. width) = _____ ft²
Walkways: _____ ft (length) X _____ ft (avg. width) = _____ ft²
Decks: _____ ft (length) X _____ ft (avg. width) = _____ ft²
Patios: _____ ft (length) X _____ ft (avg. width) = _____ ft²

TOTAL: _____ ft²

4. Lawn/landscaped areas

Area 1: _____ ft (length) X _____ ft (avg. width) = _____ ft²
Area 2: _____ ft (length) X _____ ft (avg. width) = _____ ft²
Area 3: _____ ft (length) X _____ ft (avg. width) = _____ ft²

TOTAL: _____ ft²

5. Forested/natural areas:

lot size - (totals from 2, 3 & 4 above) = _____ ft²

EXISTING CONDITION

Stormwater Volume Created:

(total impervious roof + total other hard surfaces)
X (1 inch / 12) = _____ ft^3

PLANNED CONDITION

Stormwater Volume Created:

(total impervious roof + total other hard surfaces)
X (1 inch / 12) = _____ ft^3

EXISTING CONDITION

Stormwater Treatment Practices:

Example:
Type: Rain Garden
area draining to it: 600 ft^2
from (land use type): impervious roof

Type: _____
area draining to it: _____
from (land use type): _____

Type: _____
area draining to it: _____
from (land use type): _____

Type: _____
area draining to it: _____
from (land use type): _____

Type: _____
area draining to it: _____
from (land use type): _____

PLANNED CONDITION

Stormwater Treatment Practices:

Type: _____
area draining to it: _____
from (land use type): _____

Type: _____
area draining to it: _____
from (land use type): _____

Type: _____
area draining to it: _____
from (land use type): _____

Type: _____
area draining to it: _____
from (land use type): _____

Type: _____
area draining to it: _____
from (land use type): _____

Simple Perc Test - test up to 5 different sites on your property to select the best location

	1	2	3	4	5
starting water level (inches)					
ending water level - after 15 minutes (inches)					

Soil Ribbon Test - test up to 5 different sites on your property to select the best location

	1	2	3	4	5
ribbon length (inches)					

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