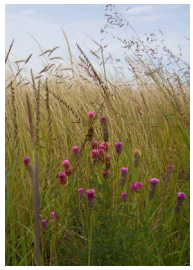
Water on the Land

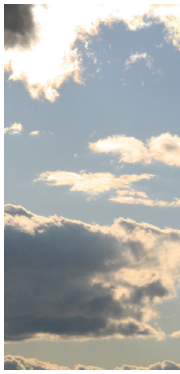
Sustainable stormwater management guide

Outdoor learning
Watershed health
Natural play opportunities





A guide for school grounds, public spaces, and mid-size commercial properties

Rivers West
Red River Corridor Inc.
Corridor Riviere Rouge Inc.

Manitoba

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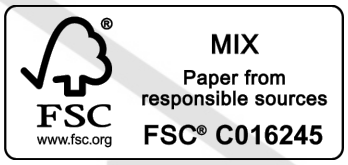

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RIVERS WEST
RED RIVER CORRIDOR INC.
CORRIDOR RIVIERE ROUGE INC.

This guide was prepared for Rivers West as a resource tool to assist communities, individuals, parent councils, and schools.

Rivers West Red River Corridor Association Inc./L'Association du Corridor Rivière Rouge (Rivers West) is a not-for-profit organization incorporated in 1999 that aims to pursue sustainable economic development along the Red River Corridor through tourism and conservation spanning from the US/Canada border to Lake Winnipeg.

Rivers West works directly with the Province of Manitoba, all regional levels of government, First Nations, and all key stakeholders and citizens, to facilitate and encourage a cooperative and integrated management approach that will recognize, promote, and sustain the cultural heritage values for which the Red River has been designated a Canadian Heritage River, as well as the river's natural heritage and recreational values.

Rivers West has a goal to "restore and protect the Corridor's natural environment through the application and encouragement of sustainable practices." Since its inception, the organization has executed studies and projects, and has created resource guides and other informational and educational pieces to attain this objective.

How to use this guide

Throughout this booklet you'll see several terms in **bold**. Definitions for these terms have been provided in the glossary on page 61.

For example:

Literary and online references are identified either by a superscript number that appears at the end of the source name or quotation, or by a web link underneath the respective graphic or caption. → *"...and South Dakota."*[1]

→ www.msid.ca/learn

Images that have a circled number on them are from an external source, while all others without a number or web link, are courtesy of Scatliff+Miller+Murray. → (1)

References and photo credits that are numbered are listed sequentially in the last section of this document. Images on the title page and the chapter title pages are also listed here.

BRAIN DRAIN

Record your questions, thoughts, and ideas.

1 What is Stormwater Management and Why is it Important?



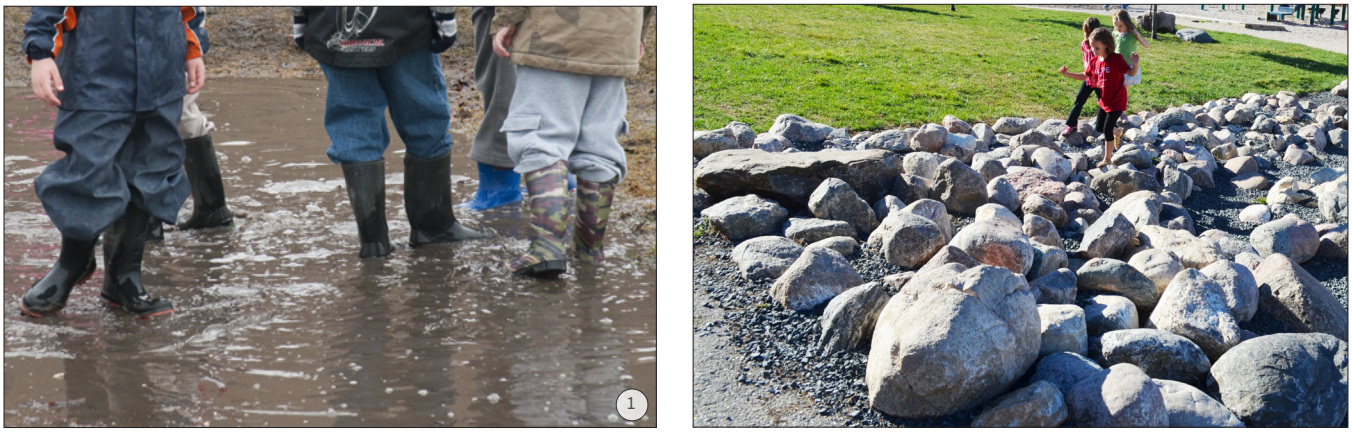

BRAIN DRAIN

Record your questions, thoughts, and ideas.

What is Stormwater Management and Why is it Important?

"Rain, rain, go away, and come again some other day."

Mother Nature doesn't always heed our pleas for sunshine! We need to manage the rain that falls on our properties and schoolyards so that we can experience and enjoy them regardless of the weather. By utilizing **sustainable stormwater management** practices, school communities can minimize or eliminate those days where recess is spent in a sea of mud and, at the same time, provide a real environmental benefit and a valuable teaching opportunity for students and the general public.



Before and after the playground redevelopment at École St. Avila, Winnipeg, Manitoba — Poor drainage (left) leads to lost play time, while good management of stormwater (right) creates opportunities for play and learning as well as environmental benefits.

Stormwater refers to water that comes from rainfall or melting snow. Stormwater that does not penetrate into the ground (such as on your lawn, schoolyard, or local park), becomes surface **runoff** that travels along the land surface in the direction of downward slope.

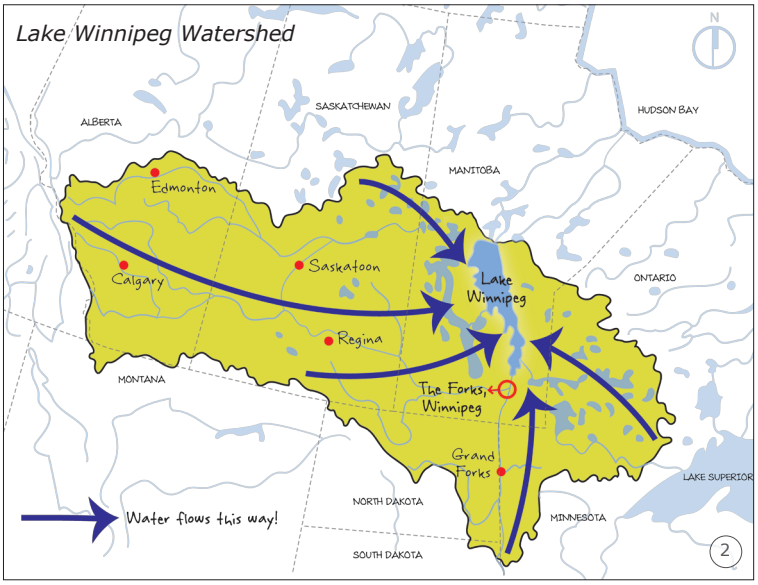
As surface runoff travels, it may cause erosion of the soil it passes over, picking up sediment in addition to any pollutants that are present. Some common pollutants of surface runoff include fertilizer from lawns, fuel and oil from vehicles, detergents from washing your car in the driveway, and salt from winter road de-icing.

Stormwater management consists of practices and **mitigation** strategies that reduce the volume of surface runoff or decrease the speed of its flow. Stormwater management practices may also include treatments that remove sediment and contaminants from runoff.

Watershed health

Water is the essence of life. However, over one third of the world's population lives in countries that are experiencing moderate to high water stress, where many people do not even have access to **potable** water. While it may seem like Manitoba's supply of fresh water is plentiful, it is not endless. That is why it is vital that we conserve water and maintain its quality and quantity now and for the future.

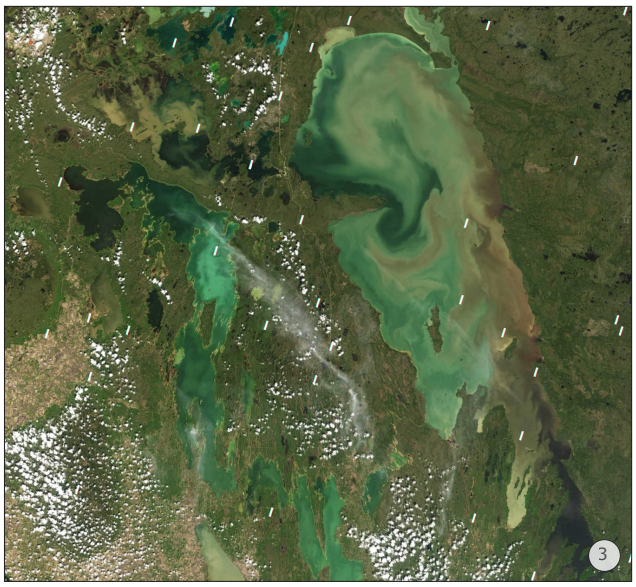
Stormwater management is a crucial component of water conservation, **watershed health**, and environmental **stewardship** because polluted surface runoff does not pass through a water treatment facility. Ultimately, the water, along with any sediment and/or contaminants it contains, will make its way either into the groundwater or to lakes, rivers, and streams within the Lake Winnipeg watershed.



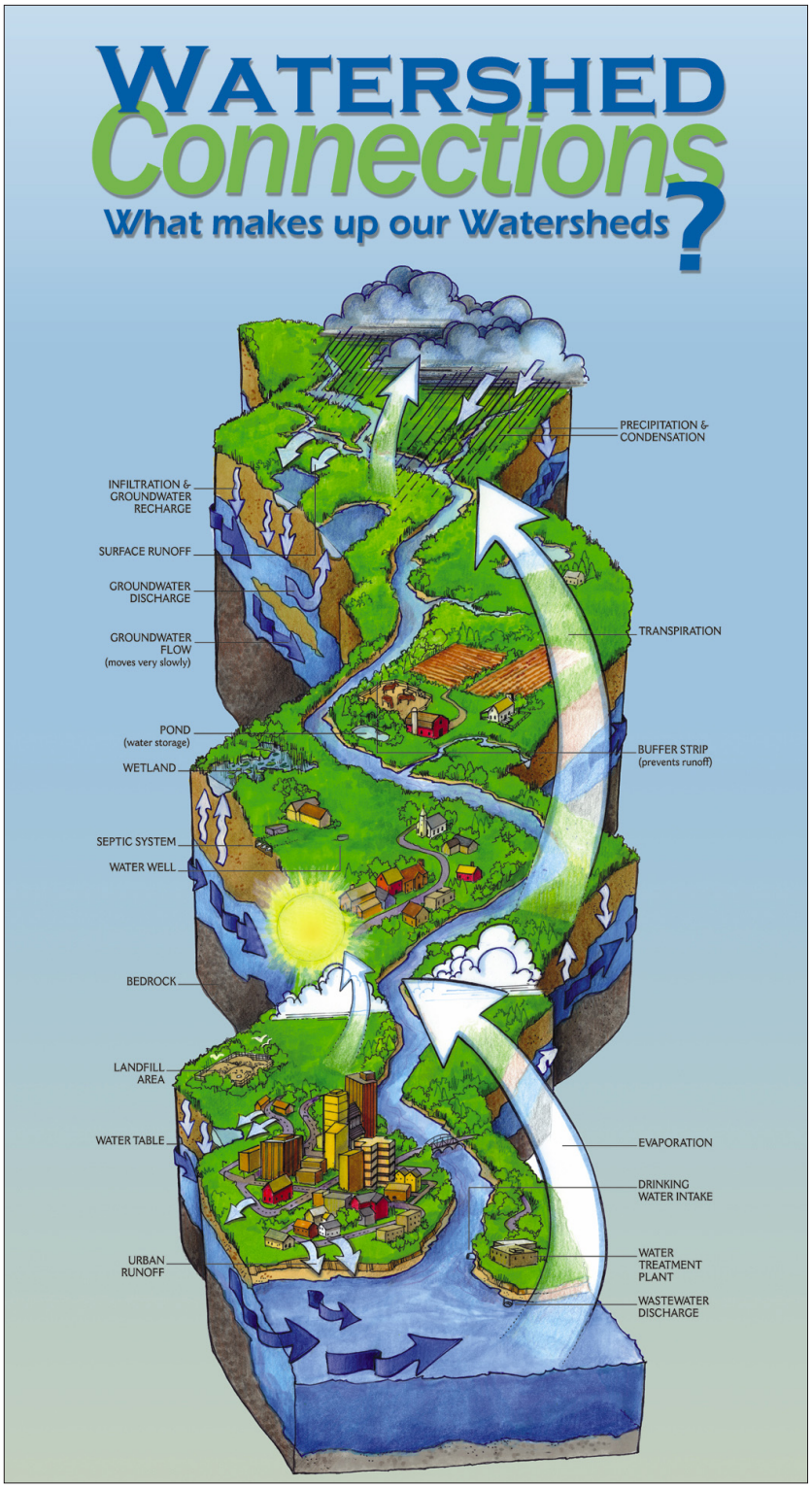
A watershed (also called a drainage basin or a catchment) is defined as an area of land that intercepts and drains precipitation through a particular river system or group of river systems. Lake Winnipeg's watershed is 1,000,000 square kilometres in area and stretches west to the Rockies, east to near the shores of Lake Superior, and south to Minnesota and South Dakota.[1]

An increase in algal blooms in Lake Winnipeg in recent years has been linked to excess nutrients (**eutrophication**) from both urban and rural sources that enter the lake as runoff. Our water resources are valuable for health reasons as a source of clean drinking water and recreation and for economic reasons including tourism and fisheries. As a society and as individuals, we have a responsibility to protect the health of our waterways for future generations.

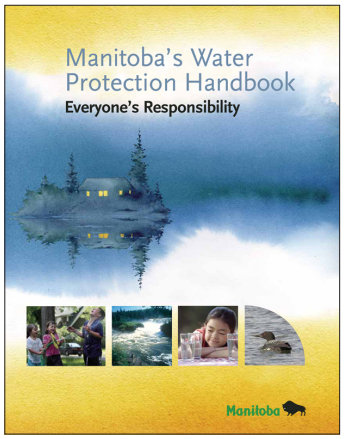
An understanding and awareness of stormwater management issues are consistent with Manitoba Education's Mission and First Overarching Goal: "To ensure education in Manitoba supports students experiencing and learning about what it means to live in a sustainable manner."[2]



Aerial image of algal blooms on Lake Winnipeg.

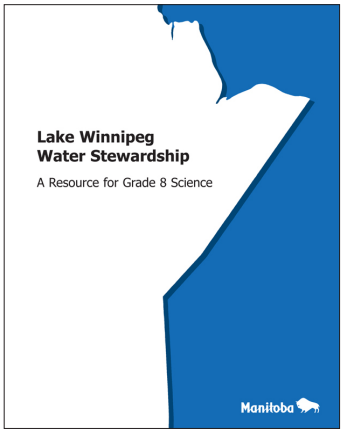


***Water Resource Graphics**, courtesy of Conservation Ontario*
www.conservation-ontario.on.ca/resources/graphics/index.html



***Manitoba's Water Protection Handbook** is for all Manitobans living and working in urban and rural areas with an interest in keeping our waters clean.*

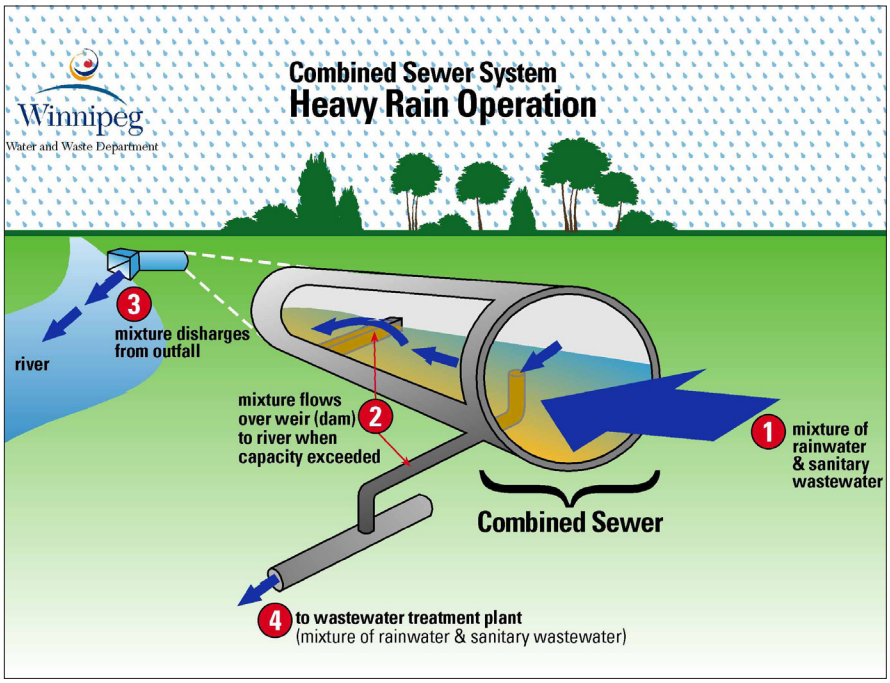
www.gov.mb.ca/waterstewardship/reports/water_protection_handbook.pdf



***Lake Winnipeg Water Stewardship: A Resource for Grade 8 Science** provides a context for students to deepen their understandings about water systems and concepts related to sustainable development.*

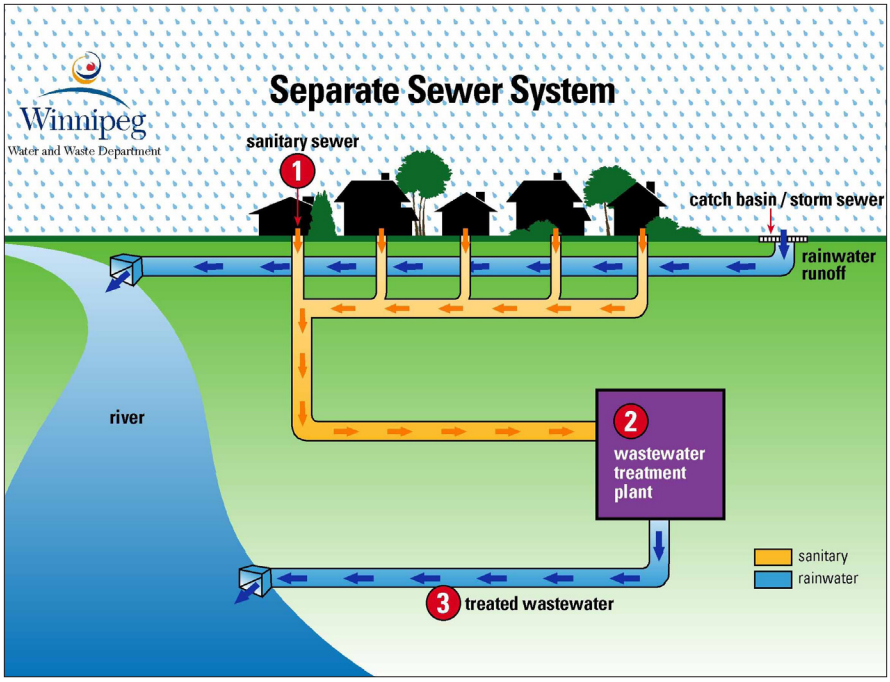
www.edu.gov.mb.ca/k12/esd/water/index.html

How does urban runoff get to Lake Winnipeg?



Combined Sewer System:

A system of single pipes that collects both waste water from homes, businesses, and industries as well as surface runoff from rainstorms and snow melt. During a heavy **rain event**, the capacity of the combined system may be exceeded, resulting in an overflow, where a mixture of stormwater and waste water are discharged directly into the river. The less stormwater that enters the system, the less likely an overflow situation will occur. For this reason, separate systems are preferable. The older, central region of Winnipeg is served by 1,280 km of combined sewer pipes.



Separate Sewer System:

A system of two pipes where one pipe carries waste water and the other carries land drainage and surface runoff from rainstorms and snow melt. Waste water from homes, businesses, and industries is carried to a water pollution control centre for treatment. Since the 1960s, new property developments in the city have been serviced by a two-pipe system. In both combined and separate systems, it is important to minimize pollutants in runoff as stormwater may get discharged into the river.

Images courtesy of City of Winnipeg Water and Waste
www.winnipeg.ca/waterandwaste/sewage/systemOperation.stm

Water bodies[3]

- Two-thirds of the human body is composed of water.
- Plasma, which constitutes 55% of our blood volume, is 90% water.
- You can survive about a month without food, but only 5 to 7 days without water.
- It is recommended that people drink 2 to 3 litres (about 8 glasses) of fluid every day.

Water world[4]

- 97.3% of the Earth's water supply is in oceans, but is unusable for drinking because of salt.
- Only 2.7% of the earth's water is fresh water, and 2.2% of that is locked up in glaciers and polar ice caps.
- Manitoba has 900 trillion litres of surface water which covers approximately 16% of the province.
- Global warming is expected to influence Manitoba's water resources. For example, warmer air temperatures are likely to increase water temperatures and reduce the length of time of ice-covered conditions.

Chew on this[5]

- Eating water can be as good as drinking it!
- a cucumber is 95% water
- a tomato is 95% water
- an apple is 85% water
- a potato is 79% water
- milk is 89% water
- cheddar cheese is 37% water

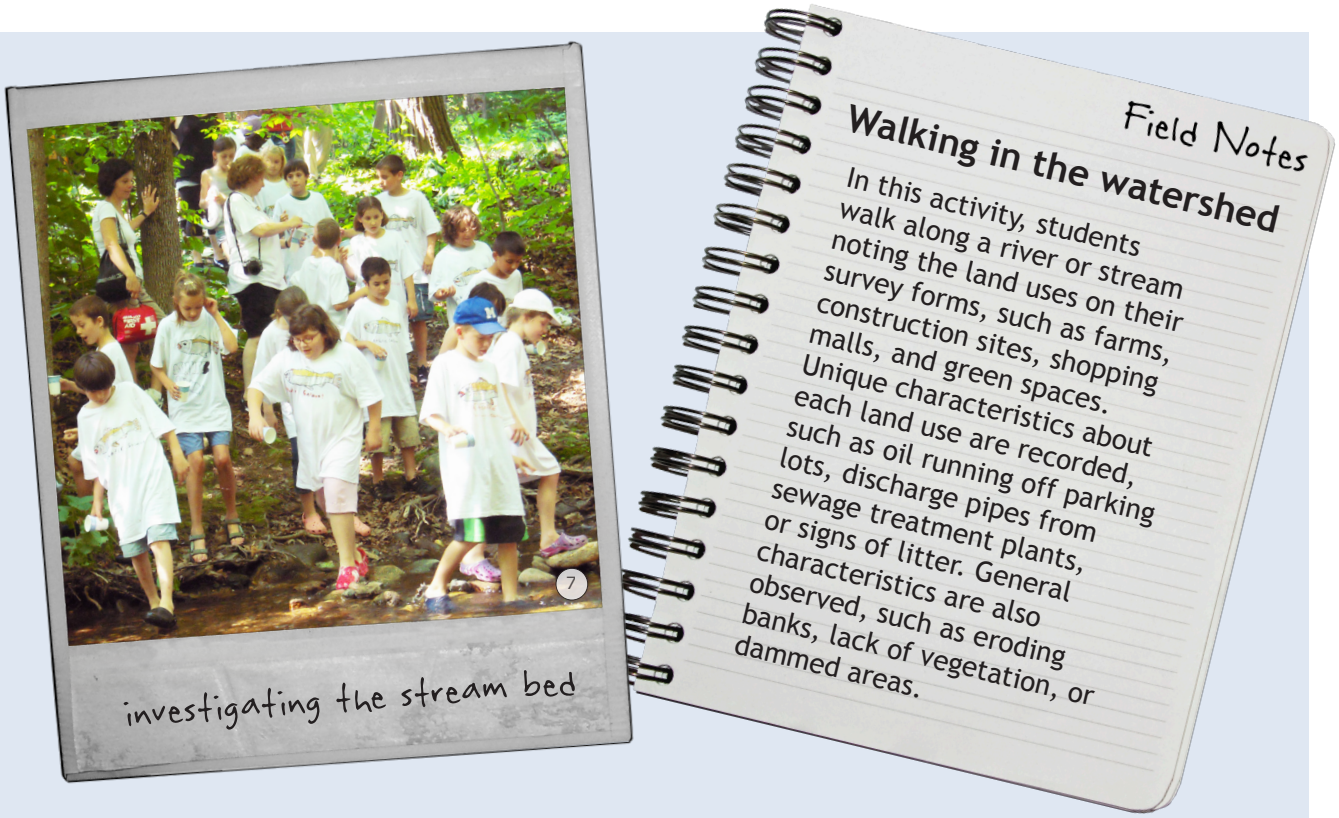
Help reduce nutrients in Manitoba's waterways

- Use permeable materials such as gravel or block paving instead of asphalt and concrete to allow water to percolate into ground.
- Plant native plants, shrubs, and trees to reduce water runoff.
- Use organic fertilizers and repellents in lieu of chemicals.
- Never pour paints, solvents, pesticides, or other chemicals down the drain, storm sewer, or on the ground.
- Use phosphate-free products, soaps, and detergents. Look for environmentally preferable logos and labels; examples of these include the EcoLogo® and the It's Lake Friendly! logo.

5

6

Fun in the field



Stormwater Quality: Lesson and Activity Plans, Salt Lake County Stormwater Coalition, Utah
www.stormwatercoalition.org/pdf/lessonPlans/lesson05.pdf

Watersheds are handy

- Trace your hand and wrist.
- Imagine your fingertips are high mountain tops. Picture rain falling on them, forming a small stream of water that flows down each finger.
- These five small watersheds flow into each other as they run down to your hand. Cup your palm—together the five small watersheds form one larger watershed.
- Imagine this large watershed joined by other large watersheds. Soon they flow together as one river down your wrist.
- The river continues its journey to your lower arm, your larger upper arm, and eventually into the largest part of you: your body, or the largest water body on Earth, the ocean.

Clean Water Education Partnership (lesson plan)
www.nccwep.org/involvement/kids/watersheds.php

2 Stormwater Management Techniques




BRAIN DRAIN

Record your questions, thoughts, and ideas.

Gravity is the underlying force that causes precipitation to fall to the surface of Earth. Earth's surface and subsurface are composed of many different types of matter. Upon and within Earth's surface, the effects of gravity cause movement of water. Its movement is influenced by the characteristics of the material that exists at each specific location. Stormwater management techniques use these principles to control the movement of water.

Construction of the École St. Avila schoolyard sustainable drainage project, Down the Drain *(Winnipeg, Manitoba).*

Stormwater Management Techniques 101

- **Shape the land's surface**
- **Minimize impervious surfaces**
- **Capture stormwater for reuse**
- **Protect catch basins from sediment and pollutants**
- **Plant deep-rooted native species**

Shape the land's surface

One of the most basic techniques for controlling the movement of stormwater runoff is through the shaping of the land's surface. When a building is constructed, it is standard practice to provide a gentle slope away from the perimeter walls to prevent water from entering the building. Steep slopes will increase the speed of surface runoff while gentle slopes will decrease it. Where the slope is steep enough you have a waterfall! **Grading** of the land on a site is used to direct stormwater runoff to **swales** or **catch basins** and drainage pipes or to areas designed to promote **infiltration** and/or to accommodate temporary storage of excess water.

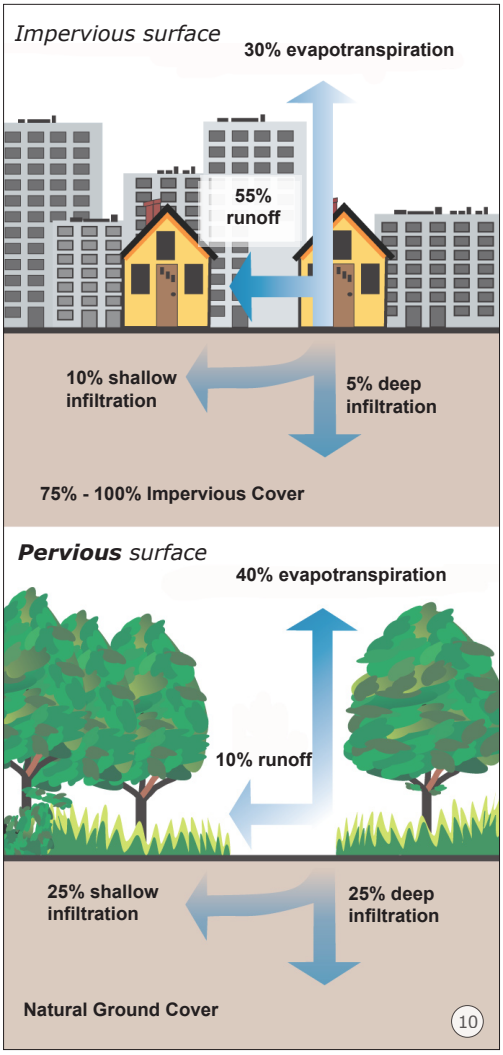
Permits are required to avoid situations where surface water originating on a site flows across property lines to cause damage on a neighbouring property.

At the Linwood Child Centre, a dry stream (dry swale) complete with a timber bridge helps to facilitate site drainage, while focussing on natural play (Winnipeg, Manitoba).

*Sculpted **berms** and rolling hills help direct water flow on site at École St. Avila (Winnipeg, Manitoba).*

Minimize impervious surfaces

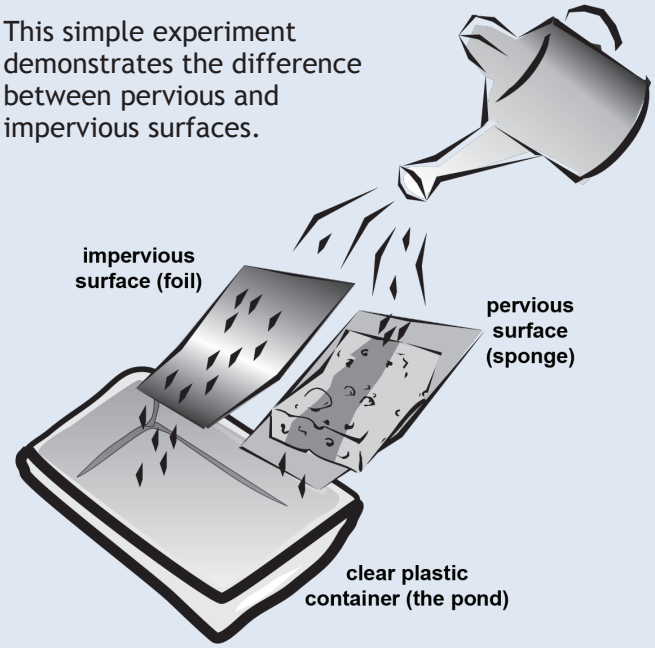
An **impervious** surface is one that promotes runoff of precipitation instead of infiltration into the subsurface. Surface materials have a range of imperviousness. Concrete or asphalt pavements are almost totally impervious, allowing virtually no stormwater to penetrate. Vegetated surfaces are much less impervious, allowing much more precipitation to infiltrate into the soil. The amount of infiltration in vegetated areas will be affected by the type of soil, the type of plants, the slope, and the volume of precipitation. The imperviousness of hard surface areas such as **unit pavers** or gravel falls somewhere in between that of concrete and vegetation. On sites with buildings, the roof of the building represents an area of impervious surface. This is illustrated during a heavy rain event when water can be seen rushing from the downspouts or **scuppers**.



Grass pavers help reduce runoff in areas that traditionally have continuous, impervious surfacing (Winnipeg, Manitoba).

Fun in the field — racing runoff

This simple experiment demonstrates the difference between pervious and impervious surfaces.



SPLASH! Stormwater Pollution Learn and Share! is a curriculum kit developed with local teachers for grades K-8, City of Eugene, Oregon (p.12).

www.happyrivers.org
(go to the *Stormwater and Students* heading)

Capture stormwater for reuse

Rain that falls on impervious surfaces such as rooftops can be captured and used for **non-potable** uses while lowering the water bill at the same time. This can be a simple option such as placing a rain barrel beneath downspouts and using the water for irrigation. Rain barrels should always be covered with a screen to prevent the infestation of mosquito larvae. More sophisticated reuse systems might include building systems that capture rooftop stormwater and store it in a cistern to be used in flushing toilets.

A rain barrel offers a great opportunity to help educate your students, neighbours, or community about water conservation.

FAST FACTS

Non-potable, captured water can be used for

- watering plants
- flushing toilets
- custodial and maintenance purposes

A barrel of fun in the field

Many communities hold rain barrel design competitions, events and fundraisers – a great way to promote water recycling while enhancing artistic abilities!

Protect catch basins from sediment and pollutants

In order to prevent sediment and some contaminants from entering the stormwater sewer system, catch basins can be protected with mechanical filters. These types of filters require maintenance to prevent clogging. A biological filter where stormwater passes through a planted area before flowing to the catch basin can also be used. As well as providing a physical filter, many species of plants will take up some types of contaminants present in the runoff that would not be caught by mechanical filters. Storm drains can also be labelled or marked by placing a clean water message next to them to help make the public storm drain savvy, and less likely to use storm drains for disposing waste.

Fun in the field — stencil it in

Yellow Fish Road™ is a nation-wide environmental education program designed and managed by **Trout Unlimited Canada**. The Yellow Fish Road™ program's goal is to help Canadians understand that storm drains are the doorways to our rivers, lakes, and streams. A downloadable program guide outlines steps to organize your own painting event and contains a registration form (images courtesy of Yellow Fish Road™).

www.yellowfishroad.org/

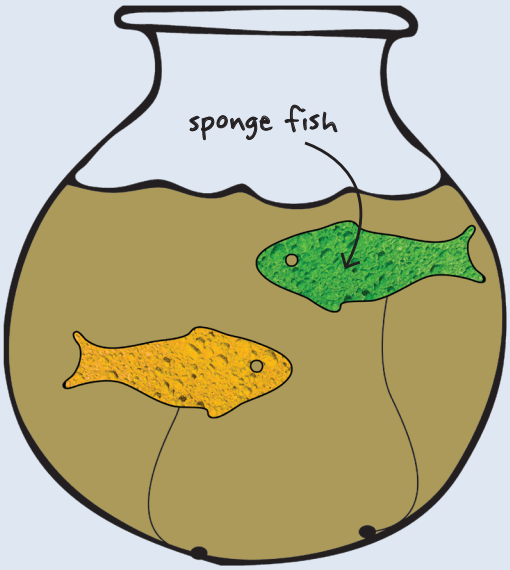
YELLOW FISH ROAD™
TROUT UNLIMITED CANADA

Fun in the field

Fred the Fish and urban stew (early years)

Imagine a clean river as it meanders through a protected wilderness area. In this river lives Fred the Fish. How is Fred? Fred has lived in this stretch of the river all of his life. But now he is going on an adventure travelling downstream.

- Fred swims past a large construction site. There is a lot of loose soil. It begins to rain and soil washes into the river. (Dump soil into Fred's jar.) How is Fred?
- Fred swims under a highway bridge. The rain is washing the oil from cars into the river below. (Pour syrup into Fred's jar.) How is Fred?
- In winter, ice forms on the bridge. City trucks spread salt on the road to prevent accidents. The rain is now washing salty slush into the river. (Put salt in Fred's jar.) How is Fred?

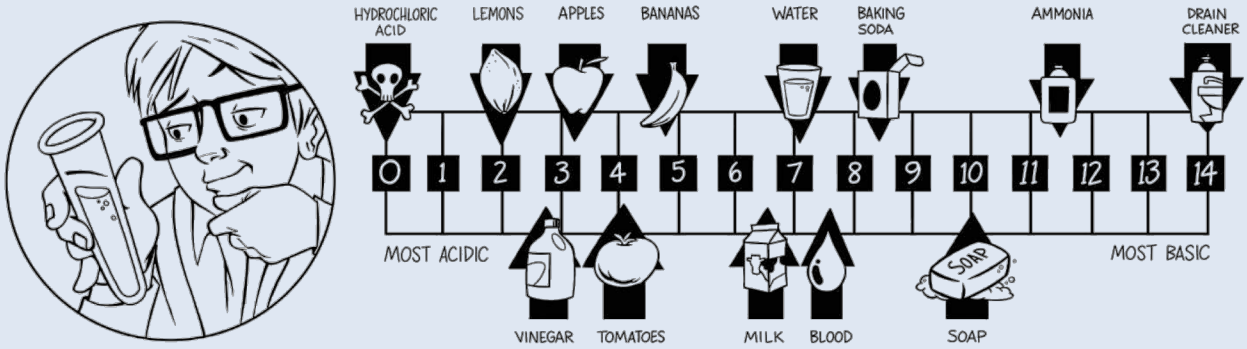


Stormwater Quality: Lesson and Activity Plans, Salt Lake County Stormwater Coalition, Utah
www.stormwatercoalition.org/pdf/lessonPlans/lesson05.pdf

Water quality investigation (grade 8)

Students collect samples of stormwater from their neighbourhoods (e.g., constructed wetland or pond) and conduct a series of investigations in which they measure and/or observe a variety of physical and chemical indicators and form a judgment about the water quality.

Students graph data collected during their investigations, compare their results to those of other students, and draw conclusions. Conclusions may be drawn based on the relationships between the chemical levels and organism growth; e.g., in general: the higher the ammonia, the fewer the organisms; the higher the nitrates, the more abundant the organisms (to a point); the higher the phosphates, the more abundant the organisms (to a point); low pH results in fewer fish.



Treat it Right®: Storm Water: Teacher's Guide, City of Edmonton, Alberta
www.edmonton.ca/environmental/documents/StormWaterGuideGrade8.pdf

Plant deep-rooted native species

All species of grass, plants, and trees enhance the natural beauty of a landscape, help prevent soil erosion and excess runoff, provide shelter from the wind, and help remove carbon dioxide (a greenhouse gas) from the atmosphere and reduce the effects of climate change. Low-growing plants and shrubs also benefit wildlife by providing food and cover, allowing for a greater density and diversity of plant and wildlife.

Tall grass prairie (Rotary Prairie Nature Park, Winnipeg, Manitoba)

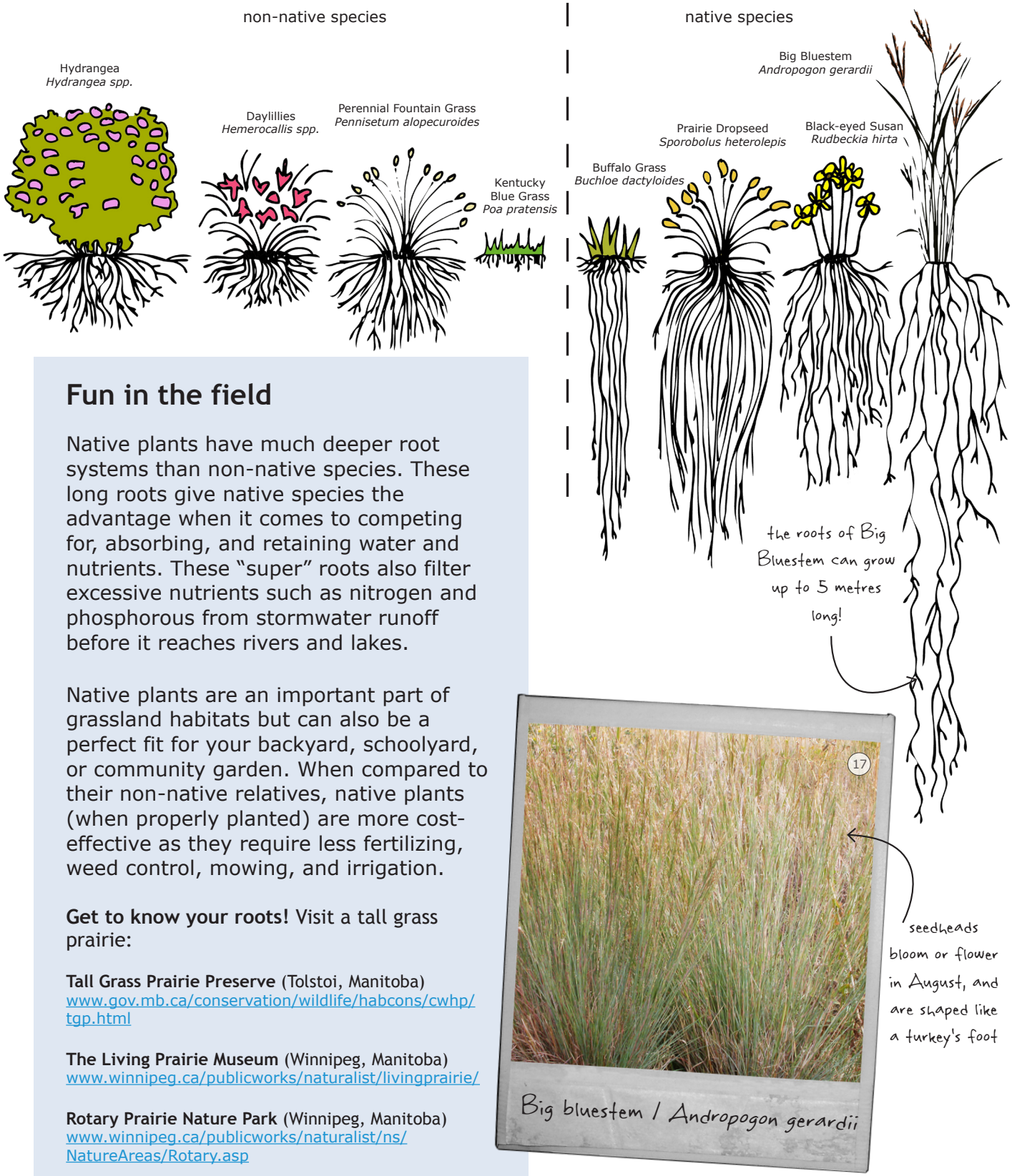
Native or **indigenous plants** provide even greater benefits over non-native vegetation. They are the clear choice for use in bio-retention systems and in the promotion of environmental stewardship. Native species are adapted to their area of origin and therefore have a higher rate of survivability, providing long-lived, low-maintenance, and visually pleasing ground cover in a wide range of environments.

At one time, the tall grass prairie in Manitoba covered over 6,000 square kilometres. Over the last century-and-a-half, agriculture and urbanization have reduced the tall grass prairie to less than half of one percent of its original size. In recent years, there has been a growing trend to use plants native to Manitoba, helping to preserve native species and restore **biodiversity** to the prairies. These plants have evolved and adapted natural defences against tough local conditions such as drought, nutrient-poor soil, severe winters, disease, and insects.

In the École St. Avila Nature Playground (Winnipeg, Manitoba), winter wheat was used as a cover crop to help prevent erosion and deter weeds. These areas were then re-seeded with a blend of native prairie grasses developed by Native Plant Solutions (division of Ducks Unlimited Canada).

Controlled fires or mowing once every four to six years are used to keep prairie grasslands healthy. These techniques are used to manage any size of native prairie, from small community gardens, to large reclaimed agricultural fields.

Non-native species versus native species



Fun in the field

Native plants have much deeper root systems than non-native species. These long roots give native species the advantage when it comes to competing for, absorbing, and retaining water and nutrients. These "super" roots also filter excessive nutrients such as nitrogen and phosphorous from stormwater runoff before it reaches rivers and lakes.

Native plants are an important part of grassland habitats but can also be a perfect fit for your backyard, schoolyard, or community garden. When compared to their non-native relatives, native plants (when properly planted) are more cost-effective as they require less fertilizing, weed control, mowing, and irrigation.

Get to know your roots! Visit a tall grass prairie:

Tall Grass Prairie Preserve (Tolstoi, Manitoba)
www.gov.mb.ca/conservation/wildlife/habcons/cwhp/tgp.html

The Living Prairie Museum (Winnipeg, Manitoba)
www.winnipeg.ca/publicworks/naturalist/livingprairie/

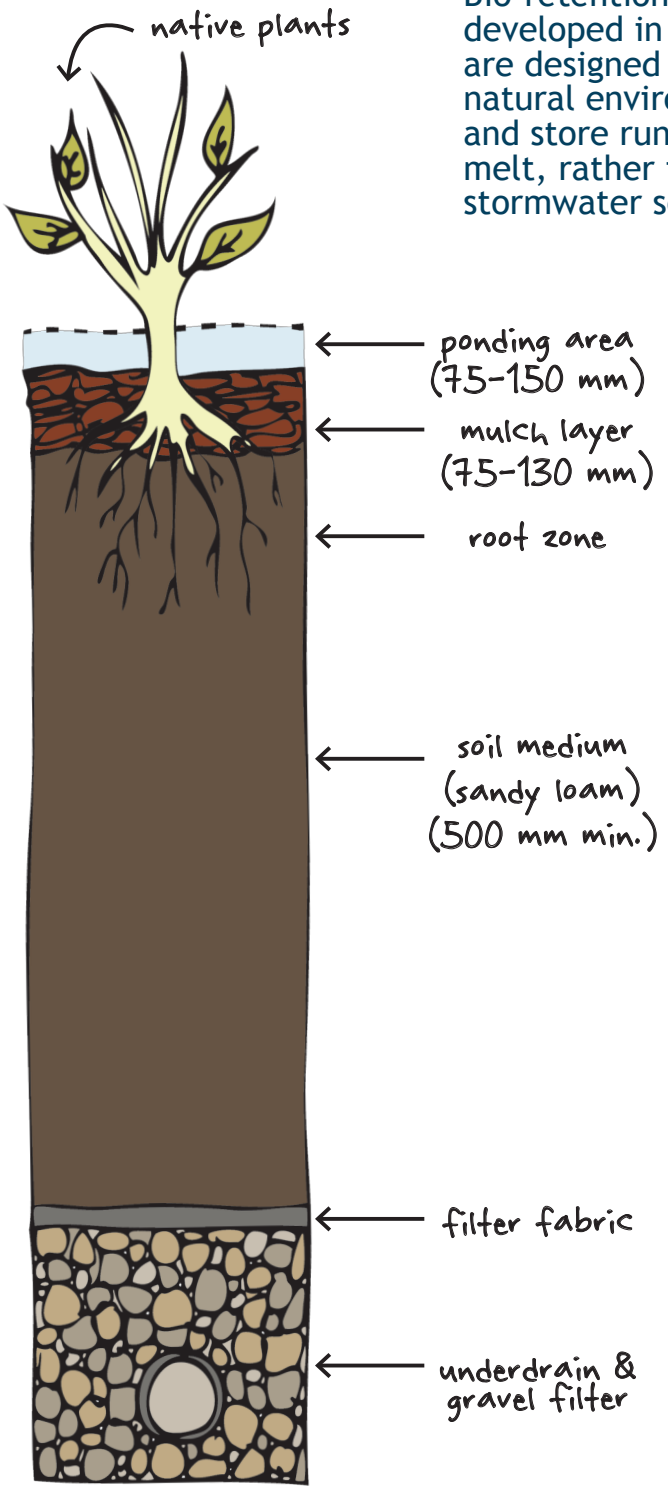
Rotary Prairie Nature Park (Winnipeg, Manitoba)
www.winnipeg.ca/publicworks/naturalist/ns/NatureAreas/Rotary.asp

3 Bio-Retention Systems




BRAIN DRAIN

Record your questions, thoughts, and ideas.



A section showing typical bio-retention components.

Bio-retention is a stormwater management practice developed in the early 1990s. Bio-retention systems are designed to mimic processes that occur in the natural environment. These systems and devices filter and store runoff water from rainstorms and snow melt, rather than letting it be flushed through the stormwater sewer system.

Bio-retention systems are shallow, vegetated areas designed to receive and filter surface runoff. A well-designed system will remove pollutants, improve infiltration, and reduce peak runoff rates. Types of bio-retention systems share similar components (pictured left), but vary in size, shape, and design. Some systems facilitate **ponding**, others rely solely on infiltration and **evapotranspiration**, and some incorporate a mechanical **underdrain**. While many types of bio-retention systems and devices exist, the examples discussed in this guide are the ones most likely to be suitable for home, school, and community projects.

Bio-Retention Systems 101

- **Bio-swales and filter strips**
- **Bio-retention basins and rain gardens**
- **Green roofs**
- **Wetlands**

How does a bio-retention system help?

How it works . . .

1 **Rain and stormwater runoff**

École St. Avila

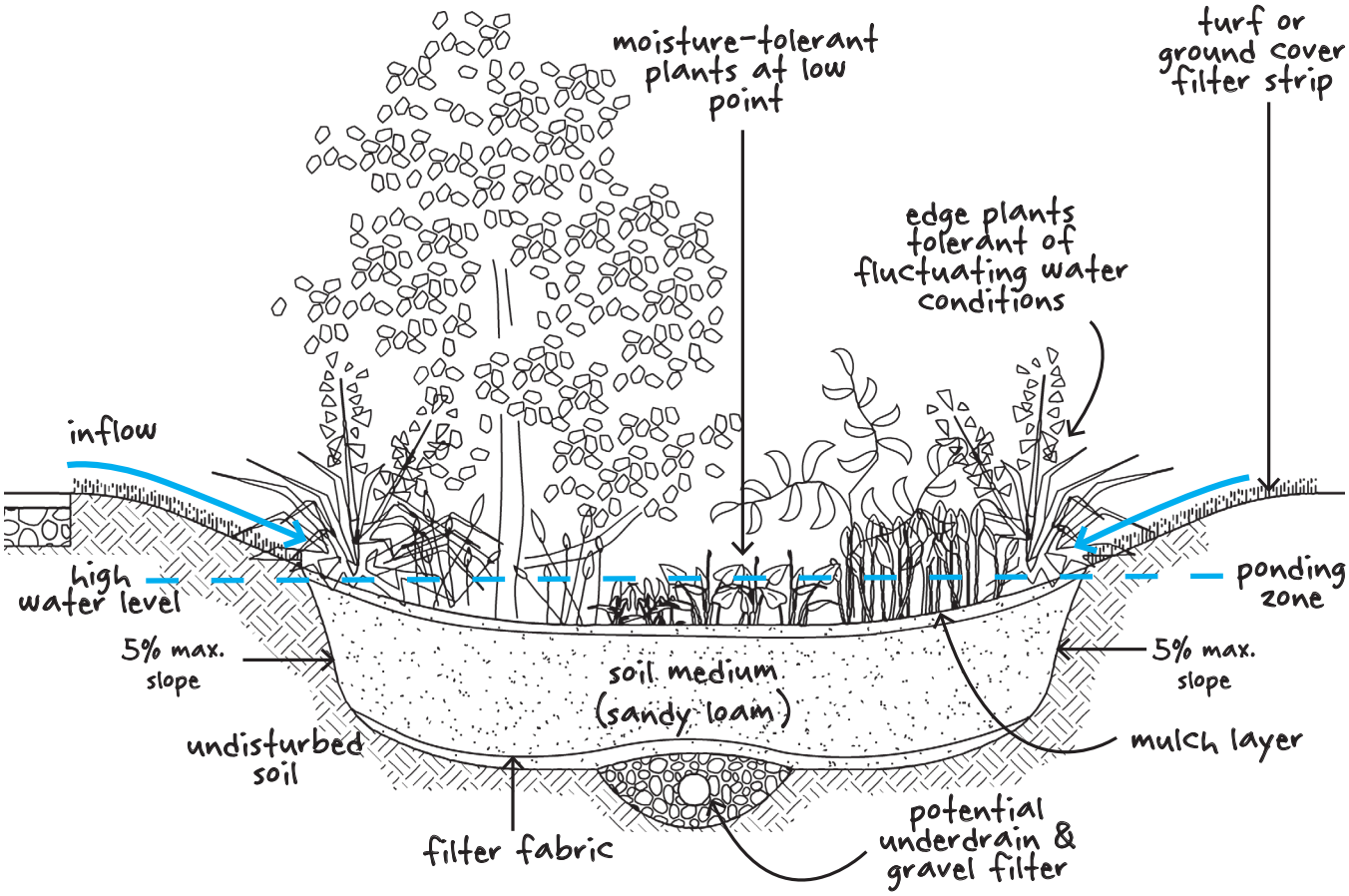
2 **The bio-swale reduces runoff by letting stormwater soak slowly into the ground.**

3 **Harmful substances like salt, minerals, metals, and oils from runoff percolate into the ground.**

4 **The extensive root systems of native plants then filter and remove pollutants, slowing the flow of water before it enters water bodies.**

5 **Filtered water then enters the water system via underground streams and rivers.**

6 **Lake Winnipeg watershed**



Typical cross section of a bio-swale or rain garden (a section of a bio-retention basin would also look similar; however, it would be deeper and larger to facilitate greater water retention).

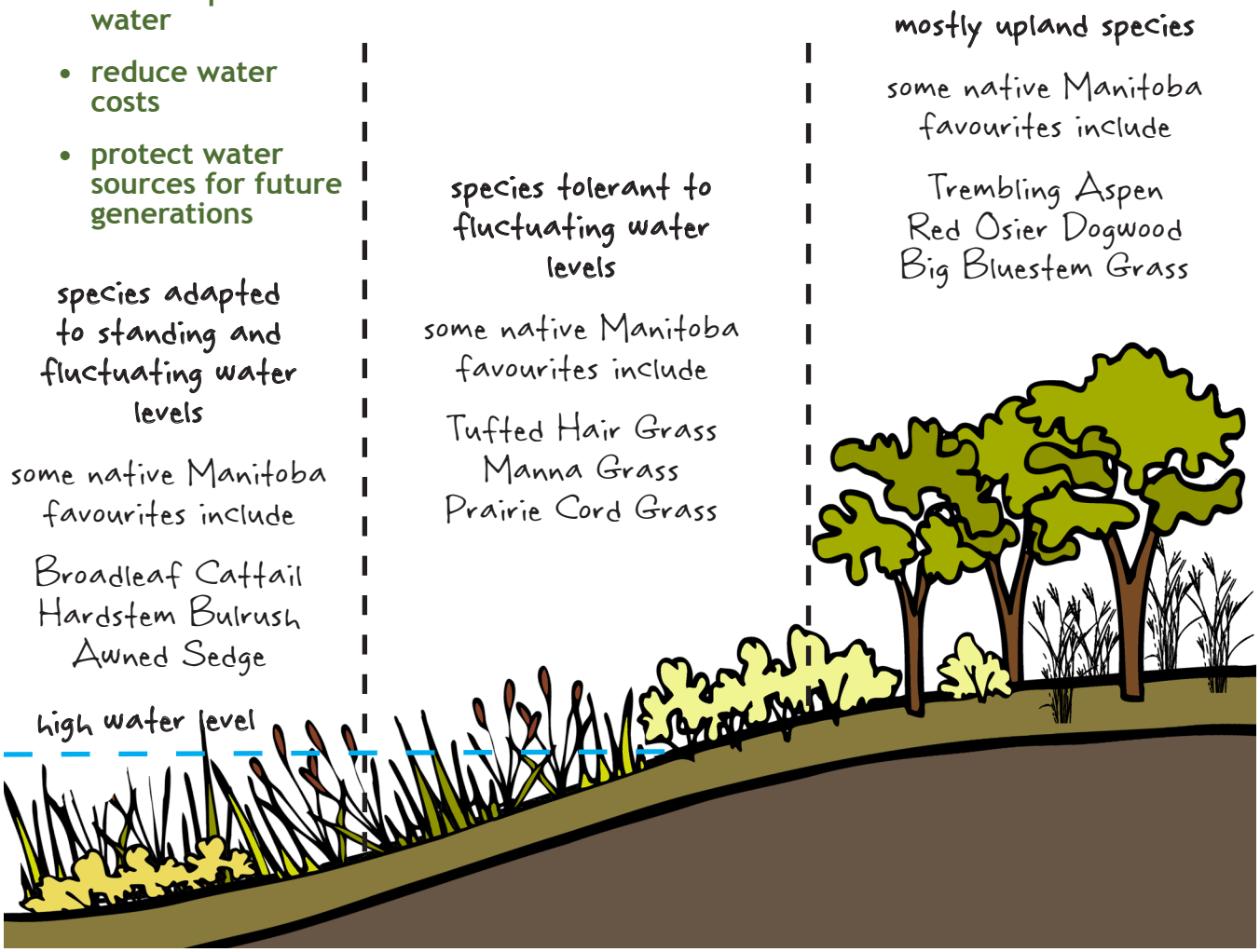
Rain garden, Ritter Public Library, Ohio

FAST FACTS

Native plants offer a more sustainable solution because they

- **attract birds, mammals, and insects**
- **filter more pollutants and require less fertilizer, pesticides, and irrigation**
- **use less potable water**
- **reduce water costs**
- **protect water sources for future generations**

Native plants are always recommended whenever possible for vegetating bio-retention areas, but domesticated non-native species are sometimes used. The specific plant selection should take into account planting zones and the expected depth and duration of ponding after heavy rains. An expert or plant professional (horticulturist, landscape architect, nursery staff, etc.) can lend assistance in choosing appropriate plants for the site and application.



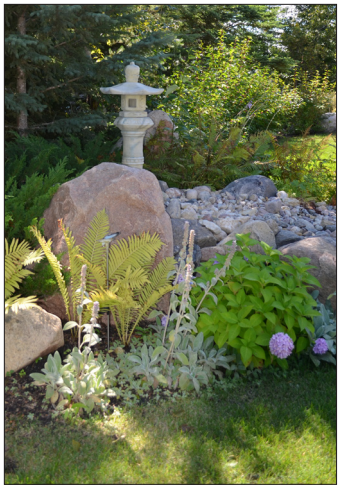
Planting zones for bio-retention systems

FAST FACTS

When designing a rain garden, the two most critical technical considerations are that

- **water must infiltrate and not stand in the bed for more than two days**
- **water should not create drainage problems on your property or neighbouring ones**

It is also important to keep in mind that local municipalities may require permits for grading projects.



Personalize your design by incorporating edging material, stones, or a feature item such as boulders or a sculpture (dry swale, Victoria Beach, Manitoba).

Canada Mortgage and Housing Corporation (CMHC) provides helpful "how to" information for managing stormwater in your yard. Determining if you (or your group) can undertake the project alone, or with the assistance of professionals, will depend on the specifics of the site, as well as the skills and experience of your group members. There are several steps and design variables to consider. The steps below are outlined by CMHC for the design and construction of a rain garden, but would also be applicable for a bio-swale. For a more detailed explanation, refer to the CMHC web link at

www.cmhc-schl.gc.ca/en/co/maho/la/la_005.cfm#_How_to_Install

- **Find a suitable location** based on observations of the drainage areas and paths on the property. Rain gardens should be placed at a low point along the natural flow path. If located on a sloped area, a low berm along the lower side of the slope edge to retain the water will be needed.
- **Calculate slopes and direction of flow** to ensure that water flows away from the building's foundation, septic beds, and neighbouring properties.
- **Determine the depth and size** by calculating inflow and infiltration rates for your site. These calculations are influenced by your region's precipitation data, soil type and permeability rates, and the slope of the selected site. Incorporation of sand, gravel, an overflow pipe, or an underdrain may be necessary in areas with clay or compact soils.
- **Determine the shape** (round or square edges, oval or rectilinear, etc.) according to personal preference.
- **Select plants** that can handle both wet and dry conditions, and that are adapted to your region.
- **Installation** involves a number of steps including digging to the determined depth; grading and shaping of the sloped edges; laying of filter fabric; adding of soil, gravel, and compost; and seeding or planting the bed. Before you dig, call local service providers to locate any underground wires or pipes.
- **Maintain** by keeping the soil moist in the first growing season, and weed-free for the first two to three years to help the plants establish. Soil should occasionally be aerated to help prevent compaction.

Bio-swales and filter strips

A **bio-swale** is a broad, shallow channel with gently sloping sides (less than 5%) filled with dense vegetation, compost, and/or riprap (e.g., stones, gravel). Swales are designed to conduct and retain water and slow the flow of runoff. This allows for infiltration which aids in the trapping of silt and pollutants. In Manitoba, an underdrain is beneficial and often necessary to accommodate excess runoff due to compact clay soils.

The scale and profile of a swale should be appropriate to its surrounding landscape character and context. Its form will vary depending on ground levels, topography, soil condition, orientation, and proximity to other features (building, parking lot, mature trees, etc.). In larger, open green spaces like a schoolyard or park, they should have a natural form that gradually flows into the surrounding areas. Like other bio-retention systems, bio-swales require minor maintenance, such as removal of accumulated sediment or debris, replacement of any dead plants, or replenishment of mulch.

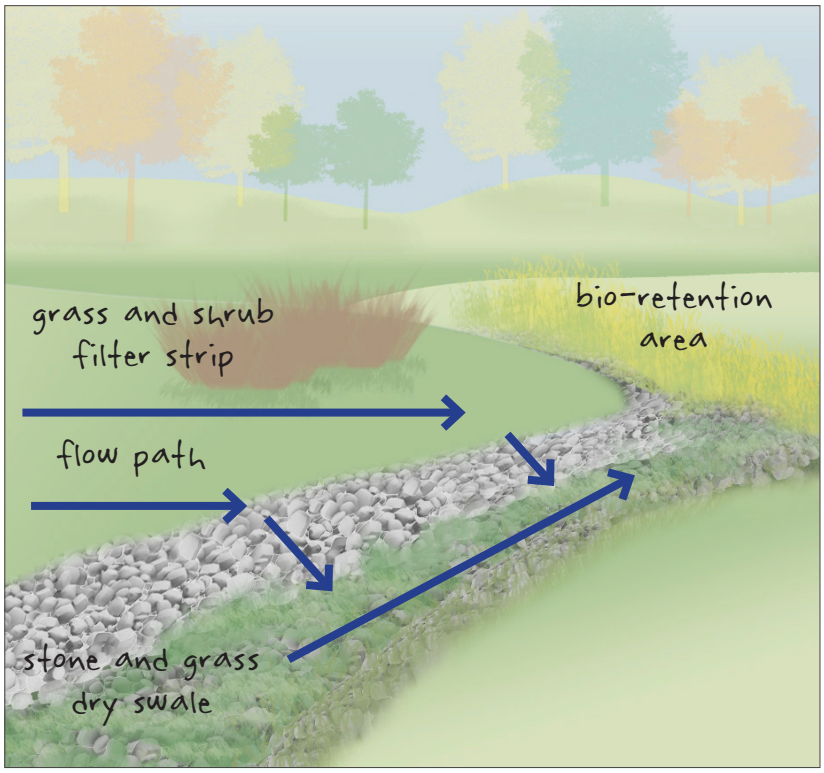
Bio-swale, Seven Oaks subdivision, Winnipeg, Manitoba

FAST FACTS

- **Stormwater runoff collects and drains through bio-swales and filter strips.**
- **A swale can be dry (i.e., stones) or wet (i.e., vegetated).**
- **These systems allow the surrounding ground to dry more quickly for recreational use.**
- **Filter strips are mainly used as a pre-treatment for another bio-retention system.**
- **The East Interlake Conservation District (EICD) is involved in many roadside revegetation initiatives and shoreline erosion prevention projects in eastern Manitoba.**

  www.eicd.net/

EICD seeded native plants along a freshly excavated ditch in the RM of Woodlands, Manitoba. This bio-retention area helps filter runoff and prevent soil erosion.



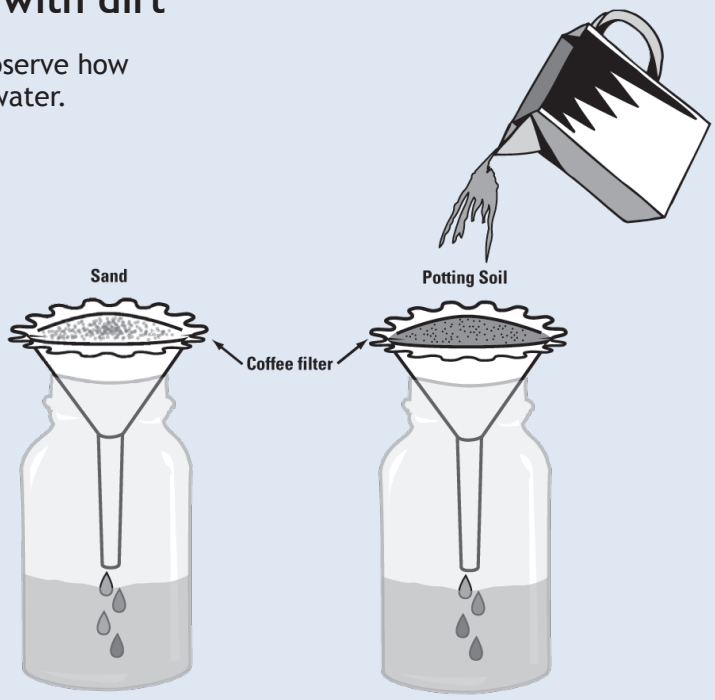
Example of the flow path of water from filter strip, to swale, to bio-retention area.

A **filter strip** is a strip of land that runoff water flows onto and across. Filter strips can consist of grasses, trees, shrubs, or a combination thereof. Water is slowed as it enters a filter strip. Vegetation and root mats filter out sediment which helps prevent other nearby bio-retention systems or drains from clogging. Filter strips are maintained by mowing, trimming, and/or replanting.

Unlike bio-retention basins, filter strips do not have an underdrain system.

Fun in the field — clean it up with dirt

Using sand and potting soil, students can observe how soil (and plants) can filter pollutants from water.



SPLASH! Stormwater Pollution Learn and Share! is a curriculum kit developed with local teachers for grades K-8, City of Eugene, Oregon (p.9).

www.happyrivers.org
(go to the *Stormwater and Students* heading)

Bio-retention basins and rain gardens

A **bio-retention basin** is a shallow, planted depression with a mechanical underdrain, and usually refers to large-scale applications. Surface water is sometimes visible in a bio-retention basin as it retains water for longer periods of time; whereas, the water entering a **rain garden** tends to infiltrate more rapidly. The term "rain garden" refers to a bio-retention area that is typically shallower and smaller in size than that of a bio-retention basin. Many general images and diagrams of rain gardens often do not depict an underdrain; however, in Manitoba, an underdrain is beneficial and often necessary to accommodate excess runoff due to compact clay soils.

Rain garden, École communautaire Aurèle-Lemoine, St. Laurent, Manitoba

Do it yourself

These guides offer basic information about rain gardens. Factors such as soil types and plant selection will vary, as these need to be tailored to local context and site.

- **Rain Garden: Handbook for Western Washington Homeowners**
  http://county.wsu.edu/mason/nrs/water/Documents/Raingarden_handbook.pdf
- **Rain Gardens: A how-to manual for homeowners (Wisconsin)**
  www.learningstore.uwex.edu/assets/pdfs/GWQ037.pdf

Manitoba-made

- **The Seine-Rat River Conservation District provides funding for homeowners who successfully complete a rain garden on their property.**
  www.srrcd.ca/raingardens.php

Bio-retention basin, The Oaks residential subdivision, Winnipeg, Manitoba

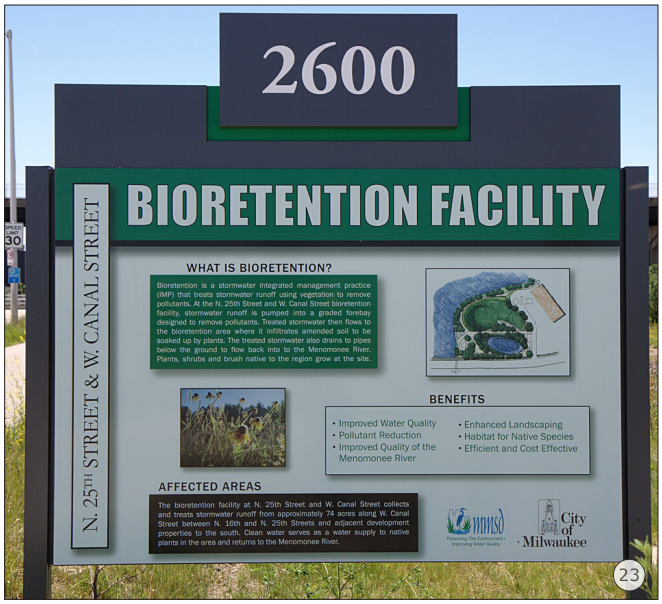
FAST FACTS

- **Bio-retention reduces the amount of stormwater that can flow into waste water treatment plants.**
- **In 2002, the City of Winnipeg estimated it would spend $1.2 billion on waste water treatment facilities over the next 25 years.[6]**
- **See "Get to Know Your Soil Tests" for simple soil testing experiments.**
  www.cmhc-schl.gc.ca/en/co/maho/la/la_001.cfm

Design of a bio-retention basin involves multiple interdependent considerations such as the area available for the basin, the expected inflow rate, the soil infiltration rate, depth of the basin, depth and duration of ponding, and side slope. Generally, the side slope is relatively shallow, not exceeding 5%.

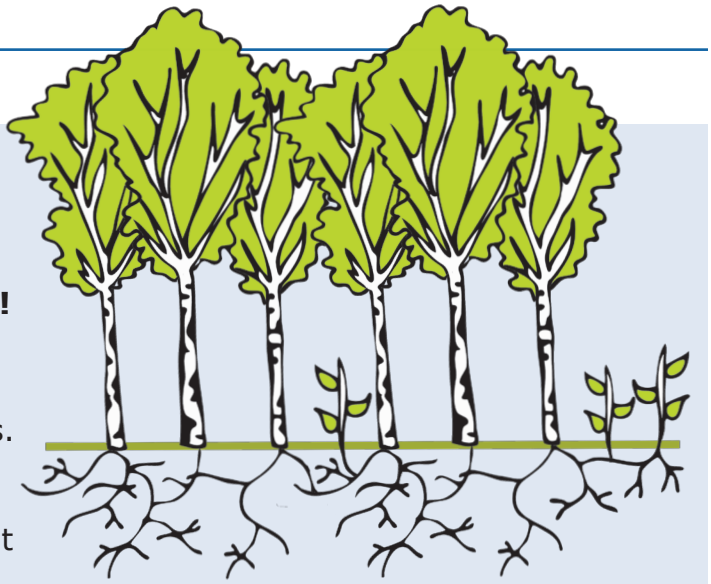
The planting medium at the bottom of the basin typically consists of **sandy loam**, which provides the appropriate infiltration rate. If the existing subsoil has low permeability, often due to compaction or clay content, then the use of an underdrain will be required. The underdrain typically consists of a perforated pipe in a gravel bed that connects to a stormwater sewer drain or to another bio-retention system such as a wetland. Use of an underdrain, particularly one with a collector pipe network, may allow larger flows to be accommodated than in a similarly sized bio-retention system that relies solely on infiltration.

Maintenance requirements will be as required for any landscaped vegetation with reduced mowing, irrigation, and fertilizer requirements for native plants. Accumulated sediment or debris should be removed annually or as required. Underdrain outlets should be inspected for clogs regularly.



All types of bio-retention systems can be a natural fit for interpretive elements like boards and kiosks that help educate the general public about how they work and the benefits they provide.

Tremendous trees



I can't be *leaf* it!

Can you guess how many aspen trees are in this bluff? **It could be just one!**

Aspen are the largest living organisms on earth. One tree can form an aspen grove that covers hundreds of hectares. This is because aspen reproduce underground through a process called suckering. An individual stem sends out roots that create new stems, repeating until a whole stand of trees is produced. These trees appear to be separate individuals above ground. In reality, this collection of trees is actually one large, single genetic organism! The connective roots share water and nutrients, just like a family where all members need and support one another.

FAST FACTS

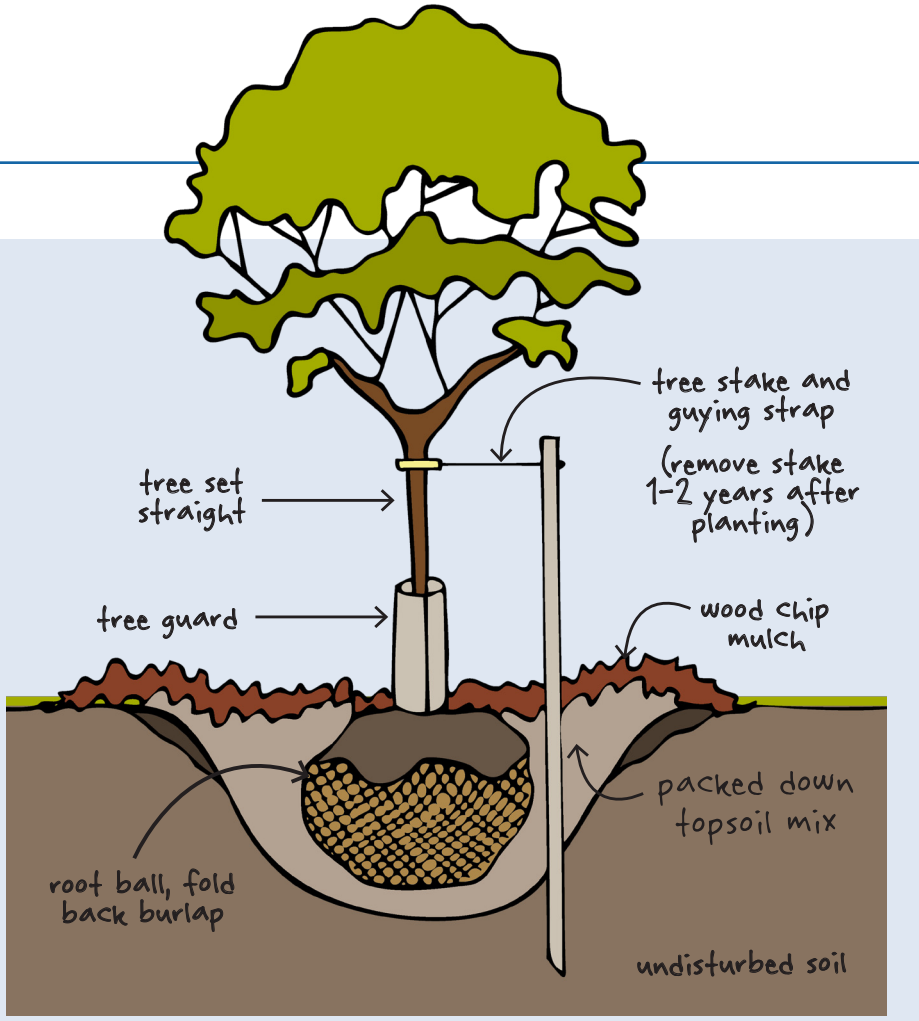
- **Planting trees is an excellent stormwater management technique because the thirsty roots of trees drink up lots of water!**
- **Greening projects are very popular in many Manitoba schools.**
- **According to Evergreen's feedback from schools across the country, kids ask for trees on their school ground more than anything else.**
- **Evergreen's online Native Plant Database can help you choose appropriate native plants and trees by region/province**
  http://nativeplants.evergreen.ca/search/guided.php

Tree planting 101

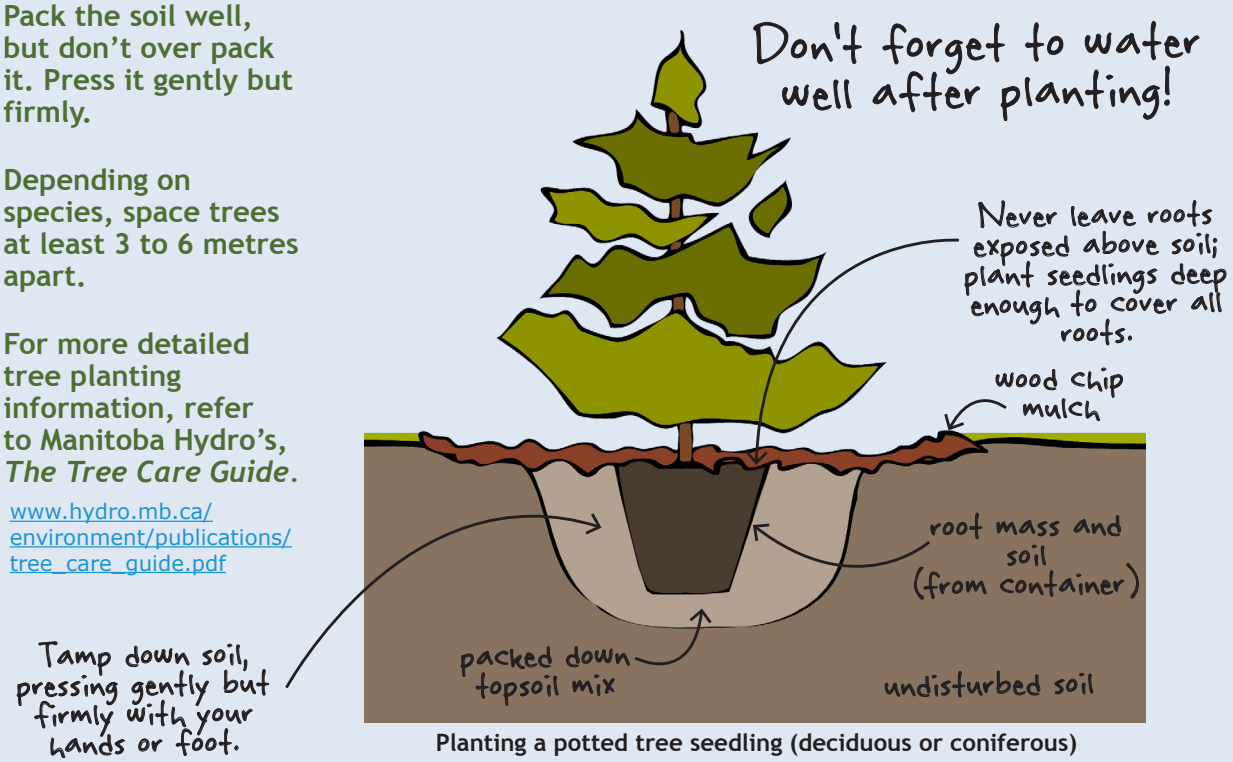
FAST FACTS

- Plant trees in the spring (April to June) or fall (September to October) to avoid the summer heat.
- If planting seedlings with bare roots, spread out the roots in the hole, don't bunch.
- For trees in a container, dig the hole twice as big as the diameter of the root ball, and slightly deeper than the height of the root ball.
- Pack the soil well, but don't over pack it. Press it gently but firmly.
- Depending on species, space trees at least 3 to 6 metres apart.
- For more detailed tree planting information, refer to Manitoba Hydro's, *The Tree Care Guide*.

  www.hydro.mb.ca/environment/publications/tree_care_guide.pdf



Planting a larger, established tree with a burlap root ball (deciduous or coniferous)



Planting a potted tree seedling (deciduous or coniferous)

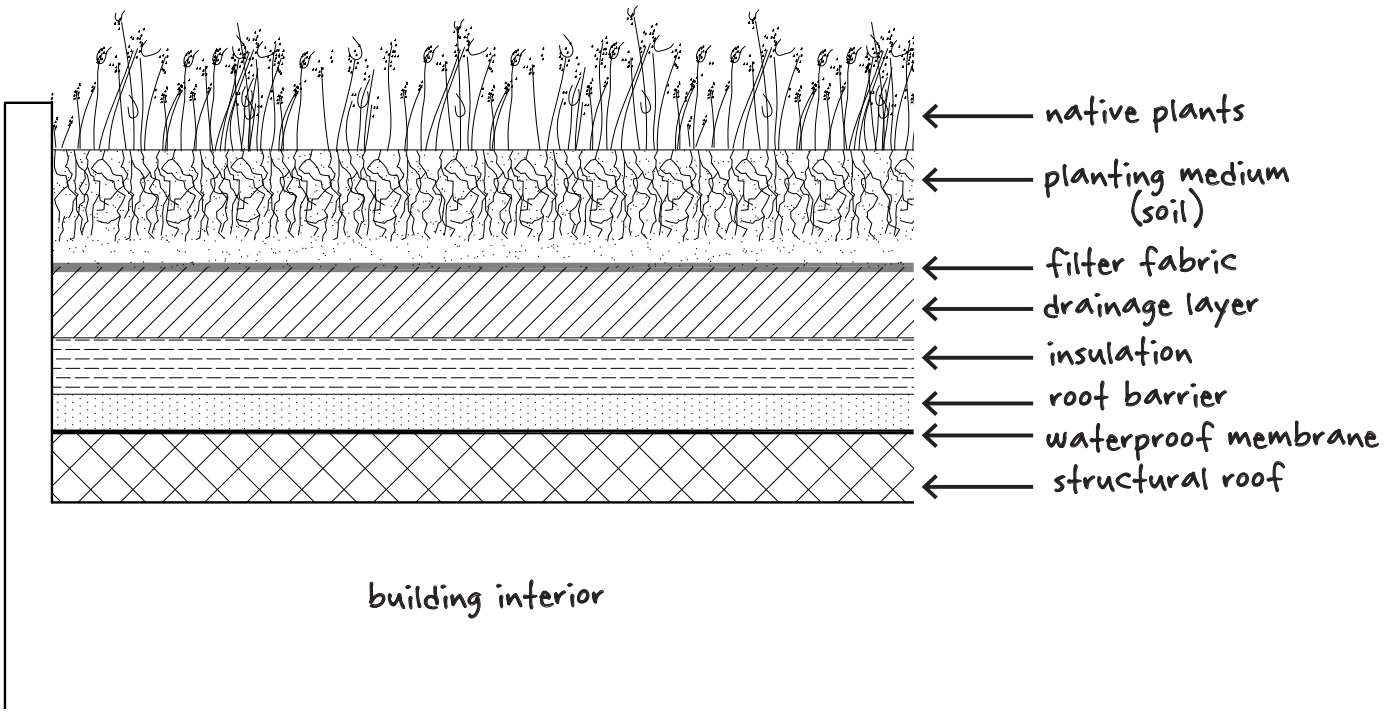
Green roofs

The roof of a building is often the largest area of impervious surface on a site. During heavy rains, rooftop runoff can commonly be seen pouring from downspouts at rates and volumes capable of causing significant erosion. A **green roof** is one which includes a planting medium (soil) and vegetation on top of the structural roof and waterproof membrane. Until recently, green roofs have been much more widely adopted in Europe than in North America. Since the 1990s, interest in Canada and the United States has intensified and green roofs, although still not common, are being much more widely considered both for new buildings and renovations.

One of the major benefits of a green roof is the reduction in roof runoff volume and rate of discharge. Rainwater or snow melt is stored in the soil layer of the green roof where some of it will be taken up by the roots of the plants and returned to the atmosphere through evapotranspiration. Stormwater that exceeds the storage capacity of the soil will percolate through the drainage layer and become runoff of much reduced volume than from an impervious roof. Some buildings with green roofs incorporate a system to capture rooftop runoff for use in irrigation or other non-potable uses within the building.

FAST FACTS

- **"Green" roofs aren't always green in colour. Many green roofs are planted with native grass species that turn brown during their dormant phase.**
- **In addition to reducing runoff, green roofs also preserve biodiversity and create habitat, particularly for birds, bees, and other insects and plants.**



Cross-section of components of a green roof

DID YOU KNOW?

- **The Manitoba government introduced a Green Building Policy in April 2007 that requires all new provincially-funded buildings to meet LEED® (Leadership in Energy and Environmental Design) Silver Certification.**

- **The City of Toronto's Green Roof Bylaw (2010) has already resulted in more than 1.2 million square feet (113,300 square metres) of new green space planned on new commercial, institutional, and multi-unit residential developments across the City.[7]**

Green roofs add additional weight to a building, and the building must have a structure capable of supporting it. The greater the soil depth on a green roof, the greater its range of suitable plants and its capacity for storing stormwater.

As with other stormwater management techniques, native plant selections are often the best choice for the reasons discussed previously. Precipitation picks up pollutants from the atmosphere due to fossil fuel emissions and some of these pollutants will be filtered by the plants and soil on a green roof, another advantage over impervious roofs.

Green roof at Oak Hammock Marsh Interpretive Centre, Stonewall, Manitoba. Green roofs provide habitat for wildlife in the form of cover, food, and nesting places. Each year a number of duck and goose nests hatch on the green roof at Oak Hammock.

Green roof of the Mountain Equipment Co-op (MEC) store, Winnipeg, Manitoba

Green roofs have other benefits in addition to their impact on stormwater management. Another major advantage of green roofs is a reduction in urban heat island effect. This is a condition that occurs when solar energy is absorbed by constructed surfaces such as streets, sidewalks, parking lots, and buildings, resulting in overall warmer temperatures experienced in urban landscapes compared to adjacent rural areas. These warmer outside temperatures lead to higher energy consumption due to air conditioning in buildings. A green roof can extend the life of the roofing membrane by protecting it from damaging ultra-violet rays and can provide sound insulation to the building. The insulating effect of a green roof reduces energy consumption by keeping the building interior cooler in summer, and warmer in winter. Finally, some green roofs can be made accessible to users, providing valuable urban green space.

Fun in the field — build a mini green roof

Students build and plant with grass seed a mini green roof in the lid of a shoebox, milk carton, or plastic bin.

Discussions before and after the building process highlight the benefits of green roofs.

American Society of Landscape Architects (lesson plan)
www.asla.org/sustainablelandscapes/Ed_WaterManagement.html

Green Roof BC (lesson plan)
www.greenroofbc.ca/lesson-plans

The Henry Ford Museum (powerpoint)
www.thehenryford.org/education/erb/MakeaGreenRoofModel.ppt

FAST FACTS

- **Design of a constructed wetland involves lots of calculations!**
- **The designer must use historical precipitation data to predict the inflow of runoff.**
- **Leading up to the flood of 1997, southern Manitoba received almost double the usual amount of snowfall. An estimated 1,000 homes were damaged, and 25,450 evacuees were relocated.[8]**

Healthy **wetlands** and surrounding vegetation filter impurities, reduce flooding, and provide habitat for many plants and animals. They are a rich source of biodiversity and support more than just cattails. Many species of rush, grass, sedge, and even showy flowering plants inhabit wetlands. A combination of open water and vegetation provides a rich source of food and cover for wildlife including marsh wrens, muskrats, mallards, and mayflies.

Since the arrival of the first European settlers in Canada, up to 70 percent of the wetlands that once served as storage for excess rain and snow melt in settled areas have been lost. These have been replaced by cities, towns, and cultivated farmlands. The loss of this natural water storage capacity contributes to spring flooding in Manitoba. When wetlands are drained, greater amounts of water carrying nutrients and sediments enter downstream ditches, streams, rivers, and lakes causing increased algal blooms.

In recent years, the protection, restoration, and construction of wetlands is becoming more widespread as a greater understanding of wetland dynamics and science has shown that they act as natural water filters. Wetlands purify water as it travels through a wetland system. Plants slow water flow and impede the movement of sediment. Chemicals suspended in open water are exposed to sunlight and broken down. Excess nitrogen is removed by natural bacteria, while phosphorous is absorbed and stored by the root systems of wetland plants.

Q: cattail or bulrush?

A: bulrush!

The constructed natural wetlands in Royalwood subdivision (Winnipeg, Manitoba) have replaced standard stormwater retention ponds. Not only are they an environmentally sound solution to water retention, but they also serve as a beautiful focal point and unique recreational and educational resource.

A watershed with a healthy network of wetlands will store runoff from rainstorms and snow melt making flooding and stream bank erosion less likely. Once stored, the clean water can percolate into the ground where it enters the water table and overall watershed.

Remember that a wetland is a body of water and that normal water safety practices must be followed.

Fun in the field

Visiting a nearby wetland such as at Oak Hammock Marsh or FortWhyte Alive is a great opportunity. People can take advantage of the many interpretive programs that demonstrate the importance of biodiversity and protecting our wetlands.

Educating youth about wetlands and waterfowl are key parts of Ducks Unlimited Canada's (DUC) conservation mission. Project Webfoot and other programs help students understand the importance of taking action to protect the environment now and in the future.

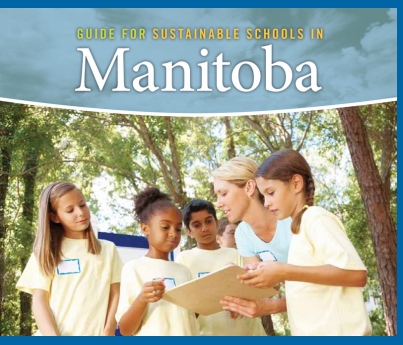
www.oakhammockmarsh.ca/
www.fortwhyte.org/
www.ducks.ca/resource/teachers/index.html

Critter dipping, or a biodiversity walk helps students understand watershed dynamics (FortWhyte Alive, Winnipeg, Manitoba).

FAST FACTS

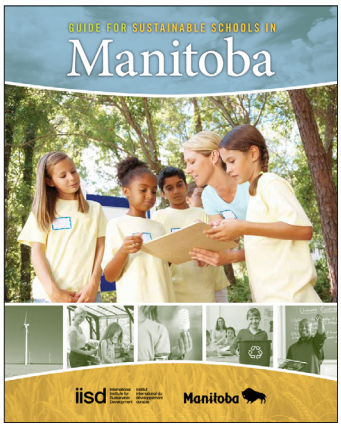
- **Muskrats and geese like to eat the roots and lower leaves of cattails, and the seeds of bulrushes.**
- **Cattail pollen and bulrush roots can be dried, ground, and used as flour.**
- **Chewing the raw roots of a bulrush can help prevent thirst.**

4 Opportunities and Educational Resources



BRAIN DRAIN

Record your questions, thoughts, and ideas.



Guide for Sustainable Schools in Manitoba (page 76 provides links to water related resources)
www.edu.gov.mb.ca/k12/esd/pdfs/sustainable_guide.pdf

FAST FACTS

- **To view Manitoba water curriculum connections, visit the Manitoba Sustainability Initiatives Directory.**
  www.msid.ca/learn
- **Grades 7 and 8 educators should check out *Slow the Flow*, a resource delivered by FortWhyte Alive.**
  www.fortwhyte.org/outreachprograms
- **Project WET is one of Oak Hammock Marsh Interpretive Centre's programs that offers a collection of hands-on water-related activities.**
  www.oakhammockmarsh.ca/programs/educators/project-wet/index.html

Multiple educational benefits can be achieved through the teaching of stormwater management concepts. The *Guide for Sustainable Schools in Manitoba* can be used in conjunction with this document to help present stormwater management issues within the larger context of School Sustainability Plans (SSP) and environmental stewardship. A necessary component of creating a School Sustainability Plan is making curriculum connections.[9]

Outdoor learning — Oak Hammock Marsh Interpretive Centre, Stonewall, Manitoba

As illustrated in the sample of teaching activities provided or referenced throughout this document, the topic of stormwater management can be linked to curriculum areas such as science, mathematics, social studies, geography, language arts, music, art, drama, and physical education.

One of the key characteristics of Education for Sustainable Development (ESD) is "Interdisciplinary and holistic: Learning for sustainable development is embedded in the whole curriculum, not as a separate subject."[10] Stormwater management learning activities can be related to the three pillars of sustainable development: economic, social-cultural, and environmental. Discussion of stormwater management issues creates opportunities for students to practice critical thinking and problem solving and to apply these skills to a subject that is relevant both locally and globally.

Outdoor learning and natural play

Use of the school grounds to demonstrate and investigate stormwater management issues provides an experiential learning opportunity that can reinforce classroom activities and significantly increase learning capacity. It is possible that discussions initiated by the topic may lead to real world changes being implemented, creating valuable student engagement.

By practicing sustainable bio-retention techniques on school grounds, students are led by example, in

- protecting the quality of our water supply by reducing sediment and contaminants at the source
- protecting the quantity of our water supply by promoting infiltration and **aquifer** recharge, and by reducing consumption of potable water for irrigation
- delaying the need for expansion of municipal water treatment plants
- improving the recreational capacity of school yards by finding solutions to existing drainage problems

Stormwater management concepts can be integrated into both indoor and outdoor teaching activities such as: identification of catch basins and mapping of existing drainage patterns; observation and testing of water infiltration on various pervious and impervious surface materials; or field trips to other schools or sites with bio-retention systems.

"Studies suggest that interacting with nature can help children pay attention, motivate them to learn and improve both classroom behaviour and scores on standardized tests."[11]

Discovery Children's Centre, Winnipeg, Manitoba

Outdoor classroom at Oakenwald Elementary School, Winnipeg, Manitoba

Garden club students dig in their butterfly garden. Brock Corydon School, Winnipeg, Manitoba

FAST FACTS

Nature or natural play refers to child-led outdoor play in natural spaces or in playgrounds where natural elements have been incorporated. Natural play spaces enrich play and interest children in learning about the wonders of the natural world.

- **Children and Nature Network**
  www.childrenandnature.org/
- **Child and Nature Alliance of Canada**
  www.childnature.ca/
- **Natural Learning Initiative**
  www.naturalearning.org/
- **Evergreen**
  www.evergreen.ca

Assiniboine Park Nature Playground, Winnipeg, Manitoba

École St. Avila Nature Playground, Winnipeg, Manitoba

Bio-retention systems are an excellent complement to natural playgrounds. At École St. Avila, for example, the bio-swale becomes a play feature with the addition of stepping logs. Natural playgrounds use natural landscapes as their model, incorporating

- topographical landscape elements such as small hills, valleys, and hummocks
- a variety of plant groupings to provide year-round interest and habitat for insects, birds, and wildlife
- movement corridors such as willow tunnels
- consideration of sun angles and prevailing winds to create pleasant outdoor microclimates
- use of natural drainage systems to channel and detain runoff, sometimes creating water features such as streams or ponds
- use of primarily natural materials (e.g., stone, sand, wood) for structures such as benches, bridges, arbours, and pathways to create safe, engaging, accessible, and age-appropriate play areas

Many of these natural playground components can be successfully integrated into a bio-retention system. The core elements of a stormwater management system provide tremendous opportunities to incorporate natural play and outdoor education. These elements can generate significant environmental and recreational improvements to school or community grounds, creating engaging open-air spaces to play and learn about plants, water, and sustainability.

Educational opportunities for the general public

Students can easily extend their new found knowledge beyond the schoolyard and into their homes and the broader community. They could place a rain barrel under the downspout to take care of that lingering mud puddle in the yard. Informational posters could be posted to inform the neighbourhood that it isn't necessary or environmentally responsible to use detergent when washing a car in the driveway because that detergent ultimately enters our watershed. They could let people know that their sump pumps can discharge onto the lawn, instead of the roadway catch basin to filter contaminants and reduce the volume of water to be handled by storm sewers.

The Useful Resources section of this document provides links that contain numerous examples of educational information and activities related to stormwater management for the home, school, and the community.

Fun in the field — at home guide to action

Do you reduce the amount of water that flows into the street from your yard?

- Do you sweep your sidewalks, driveway, or other paved areas rather than washing them with a hose?
- Do you wash the car or your bicycle with a bucket of water rather than a hose, and do it on a grassy area so that the water doesn't run into the storm sewers?

☐ Looking Good! ☐ We need more information. Priority 1 2 3

What we found out.....

.....

We need more info about.....

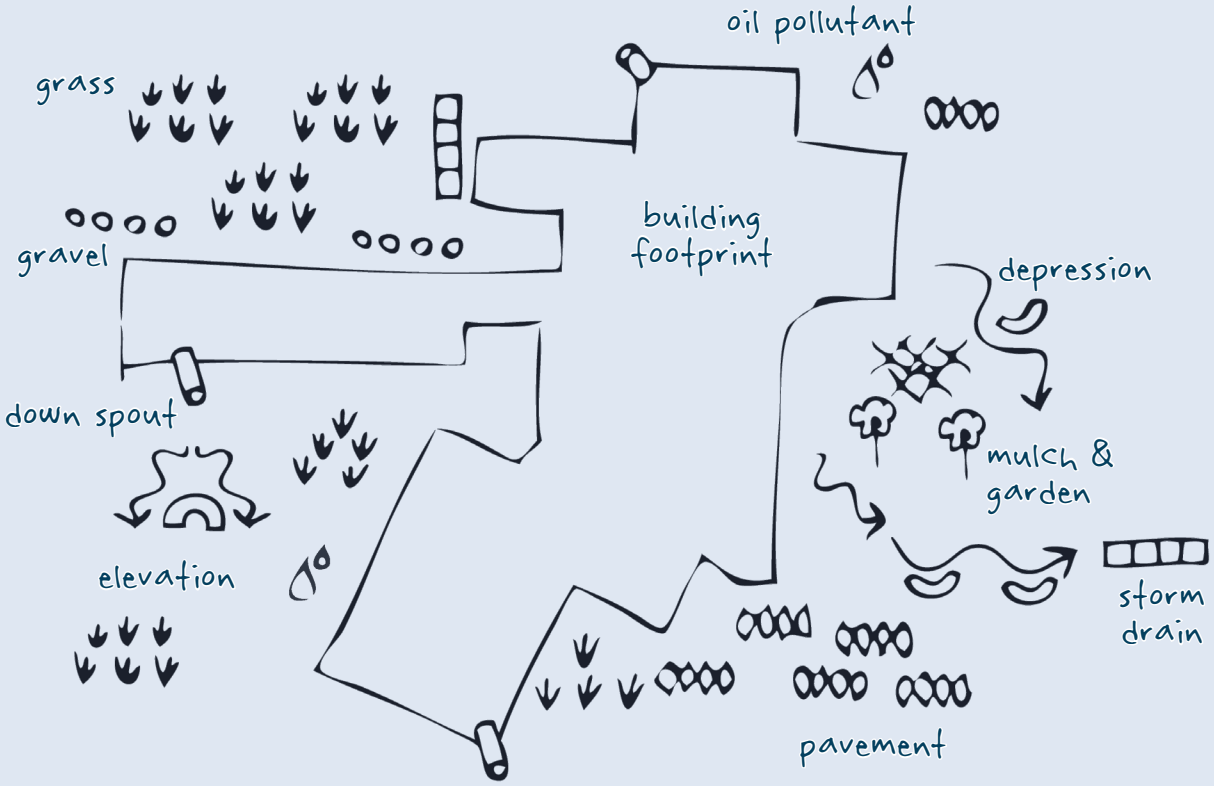
.....

Poor yard care practices *Good yard care practices*

The ***Give Water a Hand Action Guide*** in the ***Stormwater Education Toolkit***, offers comprehensive checklists for home, school, community, and farm sites.

www.stormwater.ucf.edu/toolkit/

Stormwater runoff hunt



On a rainy day, go out and examine and chart how stormwater flows at your school, home or community centre. Using a map of the property and symbols from a legend, note your findings to then create an alternative stormwater management plan.

Ecology Center's *urban runoff activity*
www.ecologycenter.org/tfs/lesson.php?id=13506

Math matters

The City of Edmonton's, *Treat it Right®: Storm Water: Teacher's Guide* includes a lesson on stormwater calculations. These calculations reflect a simplified version of the math involved in determining the quantity of water that is carried by a pipe.

www.edmonton.ca/environmental/documents/StormWaterGuideGrade8.pdf

BRAIN DRAIN

Record your questions, thoughts, and ideas.

5 Getting Started and Funding Opportunities

EVERGREEN
Imagine your city with nature

BRAIN DRAIN

Record your questions, thoughts, and ideas.

A professional designer can illustrate various concepts and options to help you arrive at the best solution (École St. Avila Concept Plan).

Community visioning session — A large roll of paper and markers lets everyone record their thoughts, ideas, and suggestions.

Many communities will find that improvements to stormwater management, including bio-retention systems and/or a natural playground, are a logical component of their plan. To accomplish this successfully, there are steps to take before seeking funding for any home, school, or community project.

The first step is to identify an environmental problem you want to solve and/or benefit you want to attain. Study the problem from every angle and generate alternative solutions, using the help of outside specialists if you encounter tasks outside the skill set of your group.

Evergreen has produced the helpful guide, *All Hands in the Dirt: A Guide to Designing and Creating Natural School Grounds*

www.evergreen.ca/en/resources/schools/all-hands/

Although written with schools in mind, much of the information in this guide can be used by any group planning a stormwater management project.

The major topics covered in the guide are outlined below.

1. Transforming School Grounds: The Guiding Principles of Success
2. Building Momentum: Spreading the Word
3. Developing Your Project Team
4. Mapping: Sizing Up Your Site and Its Uses
5. Setting Your Goals and Objectives
6. Designing Your Dream
7. Developing Your Action Plan
8. Budgeting and Fundraising
9. Preparing for Planting Day
10. Building a Lasting Legacy

During the planning process, other **stakeholders** will be identified. Consultation with all stakeholders is recommended to ensure support for the project and is often a funding requirement. Some stakeholders may be potential partners on the project. For example, an adjacent community centre may partner with a school for improvements to a playground. Contributions from partners can be in the form of money, human resources (paid or volunteer), or in-kind donations of equipment, materials, or professional services.

Local or regional businesses, financial institutions, media, and residents are all potential project sponsors. The corporate community is well aware that financial support for environmentally positive projects is good for business.

Before applying for private or government funding, it is important to research the donor organization, find out who the key contacts are, and meet with them if possible. Above all, know the program criteria, and be able to explain how your project meets them. Have a clear idea of what you are asking for from the funding organization. If you are seeking a cash donation, then how much are you asking for? Clearly demonstrate how the project benefits the community.

If your funding application is unsuccessful, it is worthwhile to follow up with a phone call and find out why. The information may help you to be successful with the next one. There are numerous sources of funding available. New programs are created and others discontinued every year, so it is important to keep current in the search for financial assistance. A sample of programs available at the time of writing is included in this section.

IT TAKES A VILLAGE

- **Start with a rain barrel and work up to a wetland! Projects vary in size and scope, and needn't be extremely costly.**
- **Seek out individuals or local businesses in your community that have experience or qualifications, and who are willing to lend or donate their time and expertise.**

Stakeholder consultation

École St. Avila Nature Playground, Winnipeg, Manitoba

FAST FACTS

- **This was a $600,000 project and incorporated many partners. The key to any project is finding the money. To do a large project in a condensed time frame, the expertise of a professional fund development person is recommended.**

École St. Avila Nature Playground
Winnipeg, Manitoba

École St. Avila, along with its neighbours Agassiz Child Care Centre and the Richmond Kings Community Centre, sought an innovative and ecologically beneficial approach to the drainage issues they were experiencing. The solution that was developed focussed on water conservation and stewardship using a bio-retention system.

Key features include bio-swales, rain gardens, and native turf. The project also incorporates a natural playground through berms and topography, indigenous plantings that provide wildlife habitat, and climbing rocks and logs. Five new play areas were installed, each surrounded by habitat that references a specific animal theme. The play areas are linked by a series of paths and boardwalks that cross the bio-swale. A fossil study area and ampitheatre provide opportunities for using the school grounds as an outdoor classroom.

This volunteer-driven project was initiated by the parent council and is a collaboration between École St. Avila staff and teachers, the Pembina Trails School Division, and 26 public and private organizations.

École St. Avila Nature Playground, Winnipeg, Manitoba

École St. Avila project process checklist

- ☑ Create a vision.
- ☑ Share the vision with teachers, parents, and students.
- ☑ Listen to what others have to say, and mold the vision accordingly.
- ☑ Present the vision to teachers and parents.
- ☑ Develop the vision further, to then present to elected officials, school, other users, and adjacent property owners (those who might be affected).
- ☑ Hire or acquire professionals to develop a master plan and funding strategy.
- ☑ Present the master plan to all involved.
- ☑ Begin pursuit of funding partners.
- ☑ Develop detailed design of the master plan and phasing strategy (this will be done by your consultants).
- ☑ Revise the master plan in response to funding requirements and timing.
- ☑ Begin the first phase of construction with approvals from the school division and partners.
- ☑ Repeat and expand funding strategy.
- ☑ Revise the master plan in response to funding requirements and timing.
- ☑ Begin the second phase of construction.
- ☑ Repeat until complete.

In order to properly develop a solution that merged all input, a landscape architect was hired. The landscape architect did further consultations and then developed a conceptual plan that incorporated an innovative drainage solution, a cost estimate, and phased timeline approach.

Manitoba-made — École communautaire Aurèle-Lemoine

École communautaire Aurèle-Lemoine — LEED® accredited building, St. Laurent, Manitoba

École communautaire Aurèle-Lemoine — LEED® accredited building (and rain garden)

St. Laurent, Manitoba

The new École communautaire Aurèle-Lemoine opened in 2010 and is a 28,632-square-foot kindergarten to grade 12 school that has the capacity to serve 125 students. A daycare facility can also accommodate up to 40 children. This school is the first in a series of new Manitoba public schools designed to meet or exceed the Leadership in Energy and Environmental Design (LEED®) silver building standard, exceeding the requirements of the province's Green Building Policy. The process for this project took place over a period of 10 years.

This state-of-the-art facility has been constructed based on a collaborative approach with community members and depicts their Métis culture and heritage. In the planning phase, community members were included in designing a facility that would meet their needs and their culture.

Features of the school include five classrooms and rooms for kindergarten, science, library, computer, distance education, multi-purpose, daycare, gymnasium, grooming, health, resource, kitchenette, community learning, and an administration area. The creation of the rain garden on the property was created to address drainage issues, provide access for outdoor learning in the fields of science and ecology, as well as increase the LEED designation rating.

Federal funding allowed for the creation of additional community and cultural space.[12]

Rain garden, École communautaire Aurèle-Lemoine, St. Laurent, Manitoba

École communautaire Aurèle-Lemoine project process checklist

- ☑ Create a school planning process based on the community's strategic plan.
- ☑ Include teachers, parents, students, and community in development of vision and project plan based on their core values.
- ☑ Ensure a coherent and relevant link exists between the project's and community's needs.
- ☑ Utilize a research-action process with all stakeholders to develop solutions to existing community challenges based on a needs analysis study.
- ☑ Validate school's strategic planning goals with community and elected officials.
- ☑ Ensure support for capital projects is provided by the school division.
- ☑ Secure land for future building.
- ☑ Begin pursuit of provincial and federal funding partners.
- ☑ Establish a construction committee with the school division.
- ☑ Develop a pilot project with construction stakeholders and LEED® specialists.
- ☑ Hire a consultant to develop a case study to meet requirements of the new community school facility.
- ☑ Hire a consultant to conduct a socio-economic study to ensure buy-in of the entire community for a distinct school.
- ☑ Hire an architectural firm that respects the master school project plan and its core values (culture, respect, environment, cooperation).
- ☑ Develop detailed design and production drawings.
- ☑ Revise drawings in response to funding requirements and timing.
- ☑ Call for tenders.
- ☑ Begin construction of new and existing school and property enhancements.

There are numerous potential sources of funding for sustainable stormwater management projects. Several sources are listed below.

Funding available for schools only

Caring for Our Watersheds Program (Agrium)
An annual environmental educational competition that encourages creativity and rewards students for their solutions to local watershed issues.
www.caringforourwatersheds.com/manitoba/manitoba.jsp

Evergreen (Toyota Evergreen Learning Grounds — School Ground Greening Grants)
Toyota Evergreen Learning Grounds helps schools create outdoor classrooms to provide students with a healthy place to play, learn, and develop a genuine respect for nature.
www.evergreen.ca/en/funding/grants/telg.sn

The site also provides links to other funding resources
www.evergreen.ca/en/funding/other-sources/index.sn

Imagineaction
Imagineaction is a teacher platform with the goal of encouraging a student-driven social action movement.
www.imagine-action.ca/members/Login.aspx?lgtype=T

Manitoba Grants for Education for Sustainable Development

Manitoba Education and Manitoba Hydro want to support schools in which educators work together to plan and teach ESD.
www.edu.gov.mb.ca/k12/esd/grant/esd_11.html#grants

The site also provides links to other funding resources
www.edu.gov.mb.ca/k12/esd/grant/index.html

Project FLOW Fund (Resources for Rethinking)
Through Project FLOW, Canadian teachers have the opportunity to apply for funding to support water-action projects in their classrooms.
www.r4r.ca/en/project-flow

Funding available for schools and the general community

Environment Canada, EcoAction Community Funding Program
Lists a few web-based funding directories.
www.ec.gc.ca/ecoaction/default.asp?lang=En&n=910BBE65-1&utm_source=RCEN+E-Bulletin&utm_campaign=52b8517771-e_Bulletin_june_29_2011&utm_medium=email

Evergreen (Walmart-Evergreen Green Grants)
Walmart Canada and Evergreen have combined to offer this national program funding community-based restoration and stewardship initiatives in urban and urbanizing areas.
www.evergreen.ca/en/funding/grants/walmart.sn

Manitoba Eco-Network Environmental Funding Guide
Comprehensive list of funding opportunities available in Manitoba for environmental initiatives (RBC Blue Water, TD Friends of the Environment, Winnipeg Foundation, etc.).
www.mbeconetwork.org/funding_guide

Manitoba Hydro's Forest Enhancement Program
Funding support is provided to projects that provide present and future benefits to the people of their community, their region, or the province as a whole (forest enhancement/ conservation, climate change, etc.).
www.hydro.mb.ca/environment/forest_enhancement/index.shtml

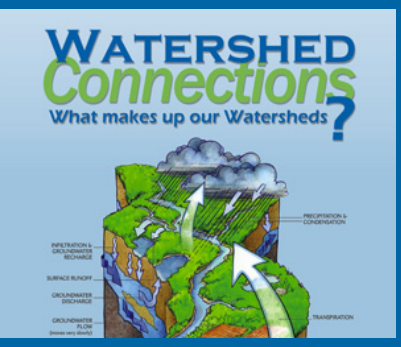
Manitoba Sustainable Initiatives Directory — Funding Database
This searchable database contains a comprehensive listing of sustainability funding opportunities available to all Manitobans.
www.msid.ca/fundingguide

The Seine-Rat River Conservation District Rain Garden Program
Provides funding ($500) for homeowners who successfully complete a rain garden on their property.
www.srrcd.ca/raingardens.php

Waste Reduction and Pollution Prevention (WRAPP) Fund (Government of Manitoba)
The Waste Reduction and Pollution Prevention (WRAPP) Fund supports projects that focus on waste reduction, pollution prevention, and integrated waste management practices.
www.gov.mb.ca/conservation/pollutionprevention/wrapp/wrappfund.html

Water Stewardship Fund (Government of Manitoba)
The WSF provides financial assistance to develop, implement, and promote projects that maintain or improve the stewardship of Manitoba's water.
http://manitoba.ca/waterstewardship/water_info/wsf/index.html

6 Useful Resources



BRAIN DRAIN

Record your questions, thoughts, and ideas.

Useful Resources

A vast assortment of learning materials, lesson plans, activities, and publications are readily available from many governmental, environmental, educational, and not-for-profit groups and organizations.

The online resources provided in this section include topics related to water issues, stormwater, drainage, and a variety of sustainable and environmental themes. While some of these materials may be specific to other places and environments, they are a great starting point and can be tailored to fit your own learning objectives, curricula, and regional or local context. Listed below are a few useful sites to help get you started.

American Society of Landscape Architects, includes lesson plans on bio-swales, rain gardens, and green roofs.
www.asla.org/sustainablelandscapes/Ed_WaterManagement.html

Bluegrass Rain Garden Alliance, lesson plan and rain garden manual.
www.bluegrassraingardenalliance.org/?q=node/47

Calgary Board of Education offers a comprehensive list of environment-related resources. Some are Alberta-based, but many are still applicable, national or universal, such as One Simple Act, David Suzuki Foundation, Ducks Unlimited etc.
www.cbe.ab.ca/community/ecoStewardship/organizations.asp

Canada Mortgage and Housing Corporation's *Rain Gardens: Improve Stormwater Management in Your Yard,* outlines several ways that you can reduce runoff and better use stormwater in your yard while ensuring proper drainage (swales, rain gardens, etc). www.cmhc-schl.gc.ca/en/co/maho/la/la_005.cfm
Get to know your soil tests: www.cmhc-schl.gc.ca/en/co/maho/la/la_001.cfm

Canadian Forestry Association's *Volume 6: Canada's Forest and Wetlands — Our Natural Water Filters*.
www.canadianforestry.com/kits/english/volume6-e.html

Canadian Wildlife Federation Education Resource Centre offers tool kits, posters and videos for school and for home. You can also find activities and lesson plans organized by theme and curriculum fit of learning guides, including a Water Education section. Resources are free for download, but you must set up a login.
www.cwf-fcf.org/en/educate/

Center for Watershed Protection works to protect, restore, and enhance our streams, rivers, lakes, wetlands, and bays. Links and downloads to helpful resources: www.cwp.org/store/free-downloads.html

Child and Nature Alliance of Canada offers comprehensive information and other useful resources related to natural play.
www.childnature.ca/

Children and Nature Network offers comprehensive information and other useful resources related to natural play.
www.childrenandnature.org/

City of Edmonton Drainage Education, Drainage Services offers public education programs for school children and for adults (English and French downloadable materials and lesson plans).
www.edmonton.ca/environmental/wastewater_sewers/drainage-education.aspx
Treat it Right!® Stormwater Teacher's Guide (English only).
www.edmonton.ca/environmental/documents/StormWaterGuideGrade8.pdf

City of Eugene, Oregon, *SPLASH!*, curriculum kit developed with local teachers for grades K-8. www.happyrivers.org

City of Minneapolis, rain garden information and green initiatives in the city.
www.minneapolismn.gov/publicworks/stormwater/green/index.htm

City of Winnipeg Water and Waste. http://winnipeg.ca/waterandwaste/sewage/systemOperation.stm

City of Winnipeg's *Best Management Practices Handbook for Activities In and Around the City's Waterways and Watercourses* (planting and seeding on slopes, pages 76-77).
www.winnipeg.ca/ppd/riverbank/BMPHandbook.pdf

Clean Water Education Partnership, lesson plans and activities. www.nccwep.org/involvement/kids/index.php

Conservation Ontario, water resource graphics.
www.conservation-ontario.on.ca/resources/graphics/index.html

Ducks Unlimited Canada
Educational resources: www.ducks.ca/resource/education/index.php
Resources for teachers: www.ducks.ca/resource/teachers/index.html
Wetland Heroes Action Program: www.ducks.ca/resource/education/wetland-heroes/index.html

East Interlake Conservation District (EICD) is involved in many roadside revegetation initiatives and shoreline erosion prevention projects in eastern Manitoba. www.eicd.net/
EICD conducted a study where they sampled runoff from Gimli stormwater drains after the spring melt and rain events. Report presents the analyzed data. www.eicd.net/assets/documents/gimlistormwaterreport2008.pdf

Environmental Concern works to increase understanding of, foster appreciation for, and encourage the stewardship of wetland systems, accomplished through materials/curriculum development, schoolyard habitat development, and innovative outreach programs. www.wetland.org/

Evergreen school ground greening resources. www.evergreen.ca/en/resources/schools/index.sn

FortWhyte Alive. www.fortwhyte.org/
Slow the Flow: www.fortwhyte.org/outreachprograms

Government of Canada Science and Technology. Muriel's Marsh — Teachers Guide.
www.science.gc.ca/default.asp?Lang=En&n=CDE48C70-1

Green Learning Canada's mission is to create innovative teaching resources and other rich educational experiences that empower Canadians to create positive environmental and social change in their own lives, schools, and communities. www.greenlearning.ca/

Green Manitoba offers water education workshops throughout the province as a professional learning opportunity for educators at a variety of age levels and provides a range of water conservation resource information.
Phone: 1-866-460-3118 or (204) 945-3268 www.greenmanitoba.ca

Green Roof BC, green roof related lesson plans. www.greenroofbc.ca/lesson-plans

Greening Schools, surface runoff lesson plans.
www.greeningschools.org/resources/view_cat_teacher.cfm?id=108

Henry Ford Museum, build a mini green roof powerpoint.
www.thehenryford.org/education/erb/MakeaGreenRoofModel.ppt

The Izaak Walton League of America, provides educational handbooks on wetland and watershed studies.
www.iwla.org/index.php?ht=display/ContentDetails/i/736/pid/203

Lake Friendly is an organization dedicated to protecting our waterways and raising awareness about the threats to fresh water (articles/links, online quiz, teacher materials, videos, online games).
www.lakefriendly.ca/index.php?option=com_content&view=frontpage&Itemid=83&lang=en

Lake Superior Duluth Streams.Org provides information on bio-retention systems, case studies (Minnesota), and resources. www.lakesuperiorstreams.org/stormwater/toolkit/index.html

Lake Winnipeg Foundation is an environmental, non-profit, non-governmental organization trying to restore and protect the health of Lake Winnipeg and its watershed. Protection of its wetlands, recycling of phosphorus, and impacts of climate warming on Lake Winnipeg are some of the very important issues on which its Science Advisory Council provides feedback and advice to LWF. Donations from LWF members and the public provide money for LWF to operate and fund projects like École St. Avila's rain garden. www.lakewinnipegfoundation.org

Learning for a Sustainable Future (LSF's) Resources 4 Rethinking, provides lesson plans, worksheets, and other teaching resources that integrate environmental, social, and economic spheres through learning that is interdisciplinary and action-oriented. http://r4r.ca/
LSF: www.lsf-lst.ca/en/projects/teacher-resources

Living Prairie Museum (Winnipeg, Manitoba). www.winnipeg.ca/publicworks/naturalist/livingprairie/

Low Impact Development (LID) Sustainable School Projects website offers information and activities to improve water quality at your school. www.lowimpactdevelopment.org/school/index.html

Manitoba Conservation Districts Association provides contact information on their website for the 18 conservation districts in the province as well as a map showing their locations. www.mcda.ca/

Manitoba Education for Sustainable Development (ESD). The purpose of the site is to assist Manitoba teachers to integrate sustainability topics, issues, and approaches into their classroom activities.
www.edu.gov.mb.ca/k12/esd/resources.html
Sustainable development student learning outcomes K-10: www.edu.gov.mb.ca/k12/esd/correlations/charts/index.html

Manitoba Hydro's *The Tree Care Guide*. www.hydro.mb.ca/environment/publications/tree_care_guide.pdf

Manitoba Museum offers tailor-made programs for teachers that are related to curriculum-based criteria.
www.manitobamuseum.ca/main/schools/

Manitoba Sustainability Initiatives Directory is an online portal for sustainability initiatives occurring across all sectors in Manitoba. www.msid.ca

Manitoba Water Stewardship, *Manitoba's Water Protection Handbook*.
www.gov.mb.ca/waterstewardship/reports/water_protection_handbook.pdf

Minnesota Pollution Control Agency's *State of Minnesota Stormwater Manual* provides detailed and technical information.
www.pca.state.mn.us/index.php/water/water-types-and-programs/stormwater/stormwater-management/minnesota-s-stormwater-manual.html

National Geographic's *Earth's Freshwater: A Guide for Teaching Freshwater in Grades 3 to 8*, was developed to support teachers in teaching topics about freshwater. Includes numerous education features, such as teaching tips and student thinking, that help to connect the content to classroom practice.
http://education.nationalgeographic.com/education/multimedia/earths-fresh-water/

Natural Curiosity. A resource for teachers to help build children's understanding of the world through environmental inquiry. www.naturalcuriosity.ca/links.php?pgcat=teachers

Natural Learning Initiative offers comprehensive information and other useful resources related to natural play.
www.naturalearning.org/

Natural Playgrounds Company offers comprehensive information and other useful resources related to natural play.
http://naturalplaygrounds.com/

Oak Hammock Marsh Interpretive Centre offers many water-related programs and activities, both for educators and the general public. www.oakhammockmarsh.ca/
Project WET: www.oakhammockmarsh.ca/programs/educators/project-wet/index.html

Peel Water Story has numerous, water-focused lesson plans ready for download in PDF Format. They are organized by grade level. www.peelregion.ca/pw/waterstory/big_w_ideas.htm

Rivers West Red River Corridor Inc./Corridor Rivière Rouge Inc. provides curriculum guides for teachers encouraging hands-on, site-based learning based on local information. www.riverswest.ca/

Rotary Prairie Nature Park (Winnipeg, Manitoba). www.winnipeg.ca/publicworks/naturalist/ns/NatureAreas/Rotary.asp

Safe Drinking Water Foundation (SDWF) supports public policies that help people access safe drinking water. Educational resources includes powerpoint presentations with Canadian water statistics. www.safewater.org/education.html

Salt Lake County Public Works Department: Engineering Division, Utah, *Stormwater Quality: Lesson and Activity Plans*. www.stormwatercoalition.org/index.html
PDF Guide: www.stormwatercoalition.org/pdf/lessonPlans/lesson05.pdf

Sierra Club BC's education program works to empower teachers and other environmental education providers so they can increase their students' environmental awareness, ecological knowledge, and stewardship action skills. *Watershed Connections: An Introductory Guidebook*. www.sierraclub.bc.ca/education/resources-tools/resources-tools www.sierraclub.bc.ca/education/resources-tools/watershed-connection-guidebook_water-shed-works_lesson-plans-and-activities_8-12

Stormwater Education Toolkit. *Protecting Our Water Resources: Student Activities for the Classroom*. Click on "Download Volume III" to obtain complete kit rather than "Open," where you will then have to download each separate component (this a zipped folder that you will have to extract on your desktop). This kit has a variety of plans, activities, worksheets, printable materials, as well as a handy Action Guide. www.stormwater.ucf.edu/toolkit/

Tall Grass Prairie Preserve (Tolstoi, Manitoba). www.gov.mb.ca/conservation/wildlife/habcons/cwhp/tgp.html

U.S. Environmental Protection Agency's (EPA) Polluted Runoff education for kids. www.epa.gov/owow/NPS/kids/otherlinks.html Water Sense for Kids: www.epa.gov/watersense/kids/index.html

Yellow Fish Road is a nation-wide environmental education program designed and managed by Trout Unlimited Canada. www.yellowfishroad.org/

Links for video, online animations, games, and interactive models

Agrium's online games (*Survivor Soak* and *Watershed Detective* and *Explorer*). www.growingthenextgeneration.com/just-for-kids-games.html

CBC's The Nature of Things Documentary (2011) – *Save My Lake* video (produced by Paul Kemp and directed by Jeff Newman for Stornoway Productions in association with CBC's The Nature of Things). www.cbc.ca/documentaries/natureofthings/video.html?ID=1867857094

Canadian Wildlife Federation's *Rivers to Oceans* videos/webisodes**.**
English: www.cwf-fcf.org/en/resources/multimedia/video/rivers-to-oceans/stormwater.html
French: www.cwf-fcf.org/fr/educate/programmes/institut-education/video.html

Clear River County Water Department's online interactive stormwater animations. www.stormwatereducation.com/sample_site/stormwater_info.html

Conservation Ontario's online animated image of the water cycle. www.conservation-ontario.on.ca/resources/graphics/watercycle.swf

EnviroScape® sells a series of portable models that help people better understand the sources and prevention of water pollution through visual, hands-on interaction. www.enviroscapes.com/

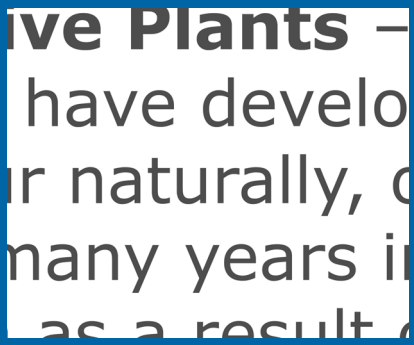
International Institute for Sustainable Development's (IISD) online video, *The Manitoba Challenge: Linking Water and Land Management for Climate Adaptation*. www.iisd.org/publications/pub.aspx?id=1220

Lake Friendly is an organization dedicated to protecting our waterways and raising awareness about the threats to fresh water (videos tab, *Water Wizard* online games). www.lakefriendly.ca/index.php?option=com_content&view=article&id=78&Itemid=56&lang=en

U.S. Environmental Protection Agency (EPA's) online video, *Reduce Runoff: Slow it down, spread it out, soak it in*. http://water.epa.gov/polwaste/green/video.cfm

Water Education Collaborative's (WEC) online games. www.h2ohero.org/landing/forkids.htm

7 Glossary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THE WETLANDS
LES HUMIDES

Glossary

Aquifer — An underground bed or layer of permeable rock, sediment, or soil that yields water.

Berm — A mound of earth.

Biodiversity — The degree of variation of life forms within an ecosystem.

Bio-retention — Stormwater best management practices (BMP) that utilize soil and plants to remove pollutants and reduce volume and rate of flow in a manner that imitates natural processes.

Bio-retention basin — A shallow, planted depression designed to intercept and detain stormwater that utilizes soil and plants to filter pollutants and promote infiltration into the subsurface.

Bio-swale — An open drainage channel designed to intercept and detain stormwater that utilizes soil and plants to filter pollutants and promote infiltration into the subsurface.

Catch basin — A chamber or inlet designed to collect surface runoff.

Ecosystem — A biological community of interacting organisms and their physical environment.

Eutrophication — The process by which a body of water becomes enriched by the addition of nutrients, especially phosphates and nitrates, that stimulate the excessive growth of aquatic plants such as algae, resulting in the depletion of dissolved oxygen and leading to the death of other organisms.

Evapotranspiration — Water that enters the atmosphere from evaporation from the soil or transpiration from plants.

Filter strip — A vegetated strip of land that intercepts surface runoff to reduce rate of flow and capture sediment.

Grading — To level off to a smooth horizontal or sloped surface.

Green roof — A green roof is one which includes planting medium (soil) and vegetation on top of the structural roof and waterproof membrane.

Habitat — Area where a plant or animal lives. A habitat is often defined by traits like vegetation, soils, surface water, ground water, permafrost, and vegetation age. A combination of similar habitat attributes is similarly referred to as a habitat type.

Impervious — A quality of a surface which prevents the infiltration or passage of liquid through it.

Indigenous — Originating in and characteristic of a particular region.

Infiltration — The process by which water penetrates into soil from the ground surface.

Mitigation — Actions taken during the planning, design, construction and operation of works to reduce or avoid potential adverse effects.

Native plants — Plants that have developed, occur naturally, or existed for many years in a given area as a result of natural processes with no human intervention.

Natural play — General term that refers to child-led outdoor play in natural spaces or in playgrounds where natural elements have been incorporated.

Non-potable — Unsafe or unpalatable for drinking due to the presence of pollutants or contaminants.

Outdoor learning — Active learning that takes place in outdoor environments.

Ponding — An accumulation of water due to insufficient drainage.

Potable — Fit or suitable for drinking.

Rain event — A term used in stormwater management to describe a defined minimum quantity of rainfall within a specific period of time.

Rain garden — A vegetated depression that collects stormwater runoff from impervious areas and allows it to infiltrate.

Runoff — Water from rain or snow that does not penetrate into the ground surface.

Sandy loam — Soil mixture composed primarily of sand and silt with minimal clay content, providing high infiltration rates.

Scupper — An opening in a building to allow rainwater to drain from the roof.

Sediment — Material, including soil and organic material, that is deposited on the bottom of a water body.

Stakeholder — A person, group, or organization who is involved in or affected by a project, enterprise, or course of action.

Stewardship — The careful and responsible management of something entrusted to one's care.

Stormwater — Water that comes from rainfall or melting snow.

Stormwater management — Practices and mitigation strategies that reduce the volume of surface runoff or decrease the speed of its flow.

Sustainable — Capable of being maintained at a steady level over the long term without exhausting natural resources or causing ecological damage.

Sustainable development — "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[13].

Swale — An open drainage channel designed to intercept and detain stormwater and promote infiltration into the subsurface.

Topography — The three-dimensional configuration of physical attributes of a land surface.

Ultra-violet rays — Invisible rays within a specific wavelength range that are part of the energy that comes from the sun.

Underdrain — A gravel layer with perforated pipe installed beneath a bio-retention system to collect and remove excess filtered runoff that cannot infiltrate into the subsoil.

Unit paver — A paving stone or brick laid without the use of mortar or grout between adjacent units.

Urban heat island effect — A condition where warmer temperatures are experienced in urban landscapes than in surrounding rural areas due to absorption of solar energy by constructed surfaces.

Vegetation — General term for all plants or plant life of an area or region; it refers to the ground cover provided by plants.

Watershed health — General term used to describe how well ecological systems are functioning within an overall watershed system. Indicators of 'wellness' or health include stream flow patterns, lake characteristics, presence of contaminants, ecological risk factors, and health and diversity of plant and animal communities.[14]

Wetlands — "Lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface."[15]

Wildlife — Free-ranging birds, mammals, and fish living in their natural environment.

8 References and Photo Credits




BRAIN DRAIN

Record your questions, thoughts, and ideas.

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1 Doug Little

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3 Satellite image recorded by the Moderate Resolution Imaging Spectroradiometer (MODIS) now orbiting aboard two of NASA's satellites, Terra and Aqua. Actual colour renditions were prepared by the MODIS Rapid Response Team out of the University of Maryland who provide near-real time colour composite images on their website (http://rapidfire.sci.gsfc.nasa.gov/realtime/), modified by Greg McCullough and obtained from http://home.cc.umanitoba.ca/~gmccullo/LWsat2005.htm

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