



GUIDE TO BUILDING RESILIENT SHORELINES

Mitigating the Impacts of Climate Change





IMPACTS OF CLIMATE CHANGE

This manual is intended for landowners wanting to increase the resiliency of their shoreline in light of increased impacts of climate change.

The shoreline area, also known as the ‘ribbon of life’, is made up of the first 30 metres of land that surround lakes and rivers. It is up to 500% more diverse than other areas upland¹. Protecting this area is critical for wildlife like turtles and pollinators and is also critical to ensure your shoreline stays resilient.

This manual outlines several actions that you can take to help create resilient shorelines capable of adapting to changing conditions.

Restoring the *Ribbon* of Life

¹ University of Wisconsin–Extension and Wisconsin Department of Natural Resources. (2002). Shoreland Property: a guide to environmentally sound ownership.

Research shows that Canada's climate is warming at twice the rate of the global average². Climate change is a growing concern for waterfront property owners especially with some of the recent damage to properties from flooding and other severe weather events. The long-term trends anticipated with climate change include temperature increases and changing precipitation patterns. Climate change is predicted to accelerate as the century continues. Therefore, now is the best time to manage your shoreline property so that future impacts can be mitigated.

Climate change will affect shoreline properties in many ways, including:

- Increased extreme weather events such as heavy rain and floods, resulting in increased erosion and land loss;
- More rain during winter months and decreased ice cover;
- Changes in habitat range and spawning seasons for wildlife;
- Decrease in water quality and more frequent algal blooms caused by warmer waters and nutrient-laden surface runoff;
- Spread of invasive species;
- Early spring thaw and longer plant growing seasons; and
- Increased summer drought and drier soils, resulting in increased fire hazards.

Disclaimer: The materials in this manual are intended for information purposes only and should not be viewed as a guaranteed solution to erosion or flooding issues. During extreme weather events, property loss may still occur despite best efforts. Plants are a long-term solution that should be started immediately to give them the time they need to grow and spread. The need for permits for work in or near water, and the governing body responsible for permits, varies by location. Be sure to check with your local regulatory authority for permit inquiries.

² Bush, E. and D.S. Lemmen, editors. (2019). Canada's Changing Climate Report. Government of Canada, Ottawa, ON. p.194-260.

INCORPORATING NATURE-BASED SOLUTIONS

Using nature-based solutions can help to mitigate the effects of climate change.

Nature-based solutions are strategic actions that can be taken to protect or restore terrestrial and aquatic ecosystems. The purpose of nature-based solutions is to address societal challenges while working with nature. This integrated approach helps combat climate change and biodiversity loss while supporting sustainable development. Benefits of nature-based solutions include supporting biodiversity, providing ecosystem services, and slowing further warming³.



³ Seddon, N., A. Chausson, P. Berry, C.A.J. Girardin, A. Smith and B. Turner. (2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. *Phil. Trans. R. Soc. B* (375): 20190120. <http://dx.doi.org/10.1098/rstb.2019.012>

Natural shorelines are an excellent example of how nature-based solutions can provide ecosystem services and cool the surrounding environment.

Over the past several decades, shorelines have been highly developed by humans for industrial, commercial, recreational, and residential purposes. One of these developments includes the engineering of hardened shorelines, such as retaining walls which are made of concrete, steel, or plastic. They are used as a convenient way to prevent flooding and erosion. Hardened shorelines provide short-term benefits to humans but can lead to degradation of wildlife habitat, water quality, and the shoreline itself through erosion. These artificial shorelines produce a lot of stormwater runoff which, when combined with erosion, can degrade water quality over time due to high sediment deposition into the water.

A natural shoreline is a protected and stabilized area made of natural materials such as plants, woody debris, and rock. Natural shorelines, also known as softened shorelines, are a nature-based solution that protects water quality, provides habitat and a critical land-water interface, cools the surrounding environment, and can also increase property values. Another benefit of 'living' shorelines is their ability to sequester carbon and mitigate the effects of climate change⁴.

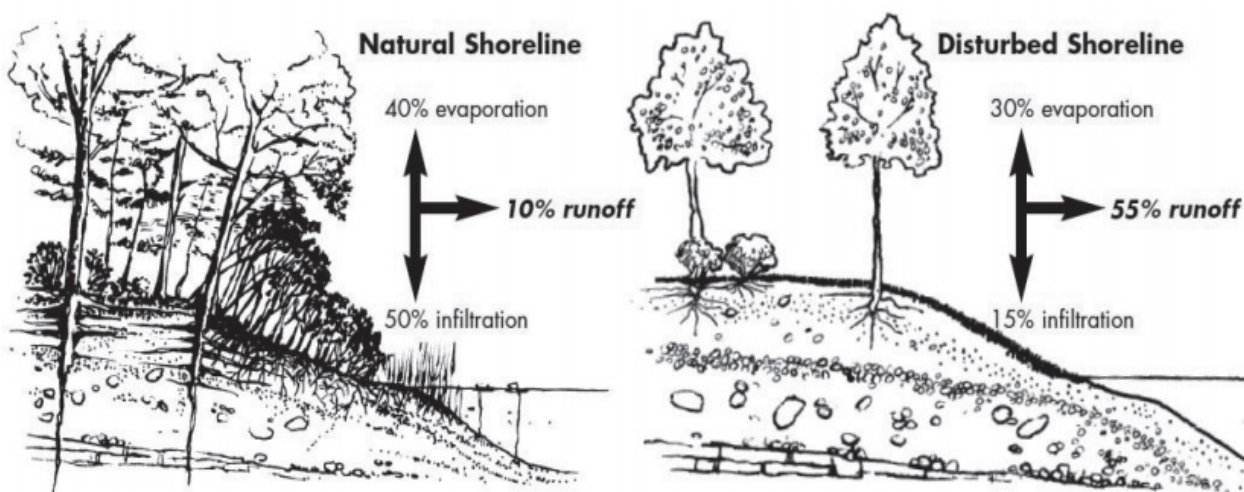


Image: Kipp, S. & C. Callaway, 2003. *On the Living Edge: Your Handbook for Waterfront Living*.

⁴ Davis, J.L., C.A. Currin, C. O'Brien, C. Raffenburg and A. Davis. (2015). Living Shorelines: Coastal Resilience with a Blue Carbon Benefit. *PLoS ONE* 10 (11): e0142595. doi:10.1371/journal.pone.0142595

CREATE A NATURAL, RESILIENT SHORELINE

The best way to protect your shoreline from the impacts of climate change is to keep it natural.



Having a natural shoreline covered with native vegetation, woody debris, natural structures, and aquatic vegetation is your best defence against climate change. Natural vegetation is a crucial part of your shoreline that can help armour against flooding and reduce erosion risks.

Trees and shrubs will also help you recover more quickly from a flood as they transpire water from the soil to the air, drying your property out faster. Trees and shrubs also shade the soil which helps to retain moisture during periods of drought and reduce the risk of fires. Vegetation will also help to improve water quality by filtering out pollutants and provide critical habitat for fish and wildlife.



If your shoreline already has natural vegetation, it is best to leave this undisturbed to maintain the resiliency of your shoreline. If you have a mowed lawn to the water's edge, consider leaving a 30 metre (or as wide as possible) strip of your shoreline unmowed to allow for natural regeneration of native vegetation. Unlike the roots of grass species used in manicured lawns, the roots of trees and shrubs extend deep into the ground. Therefore, they can better hold onto and stabilize the soil along shorelines, reducing the amount of land loss that can occur during flood events. This will allow for your shoreline to better withstand climate change-related impacts.



Any fallen trees, logs, rocks, or woody debris on your shoreline should not be moved. These natural structures absorb wave energy and protect soils along your shoreline from erosion. They also provide cover, shade, and other habitat features for fish and wildlife. The more natural your shoreline is, the greater its ability to withstand sudden changes and impacts associated with the changing climate.

It is also important to leave aquatic vegetation around your property in place. These plants buffer wave action hitting the land and hold sediment in place which helps to prevent erosion and improve water quality. These plants also provide food, shelter, and spawning habitat for fish and wildlife. To learn more about how to increase habitat areas on your property, refer to the Natural Edge's Shoreline Habitat Creation Manual: naturaledge.watersheds.ca/resources



PROTECT AGAINST EROSION

With flooding, the potential for erosion and shoreline property damage increases.

Flooding accelerates the degree of erosion in areas where sufficient root systems are not in place to hold soil particles. Floodwaters can quickly carry soils away, resulting in undercut banks, exposed soils, and decreased shoreline stability. Other factors that can contribute to erosion include steep slopes, retaining walls, wave action, and stormwater runoff. To protect against erosion of your shoreline, you can:

1. Install raised stairs.



Installing stairs is a great way to help avoid erosion that would otherwise occur from foot traffic on sensitive slopes. In contrast, stairs built into the ground and made of hardened materials like concrete or stone can contribute to and accelerate erosion as rainwater runoff concentrates along the sides of the stairs.

The best way to solve this problem is to install a raised wooden staircase without backs and with one-inch gaps between the boards. This allows rainwater and sunlight to reach the ground below the stairs and promote the growth of vegetation. If you have an existing staircase made of hardened materials, consider planting native vegetation at the sides of the stairs so the roots can hold soils in place and prevent erosion.

2. Plant deep-rooted vegetation.

Deep-rooted plants, like trees and shrubs, effectively protect your shoreline against erosion by using their extensive root systems to stabilize the soils. An example is high-bush cranberry (pictured). These plants also provide a barrier to slow the movement of floodwaters, decrease surface runoff, filter out pollutants and excess nutrients, and provide habitat. This approach is a long-term erosion control solution that offers greater benefits than “hard” armoured.



Typical retaining walls made of hardened surfaces deflect the wave energy which can damage the wall itself and erode the surrounding shoreline. If you have an existing retaining wall or gabion basket, you can improve the resiliency of your shoreline by planting a 30 metre buffer (or as wide as possible) behind the existing wall. This will help to hold the soils in place and reduce the risk of erosion occurring around the wall.

Because climate change is predicted to cause increased flooding, as well as dry conditions in the summer, it is best to choose plants that are tolerant to both flooding and drought. You can find plants that will be suitable for your project by referring to the Natural Edge's Canada-wide Native Plant Database: naturaledge.watersheds.ca/plant-database

3. Install vegetated riprap, if necessary.

If an engineer has advised you to implement a stronger approach than plants alone, the best option is to install vegetated riprap, rather than a typical retaining wall. Riprap uses natural stone or rock placed on a gentle slope (3:1 angle) to protect the shoreline from erosion. Planting between the rocks and behind the riprap gives it better erosion control ability and increases habitat.



The root systems will bind the soils and anchor the rocks in place, preventing erosion and damage to the riprap. The rough surfaces of the rocks help to minimize wave action and the riprap is able to absorb wave energy better than a retaining wall.

Vegetated riprap should only be installed by qualified engineers or contractors. Ensure they are taking all necessary precautions to protect your shoreline and the waterbody during construction. Heavy equipment should be used in a responsible manner that does not interfere with habitat and preserves existing vegetation whenever possible. Proper sediment barriers should always be used to prevent water quality issues and damage to fish and wildlife populations.

The need for permits for work in or near water and the governing body responsible for those permits varies from region to region. Be sure to check with your local municipality, conservation authority (if applicable), appropriate provincial ministry and/or appropriate federal department for the permits to do work in or around water.

MONITOR FOR INVASIVE SPECIES

A major threat associated with a changing climate is the potential spread of invasive species from southern climates. Invasive plants, fish, animals, insects, or diseases are introduced to an area and damage the environment. With no natural predators, invasive species outcompete native species.



Zebra Mussels



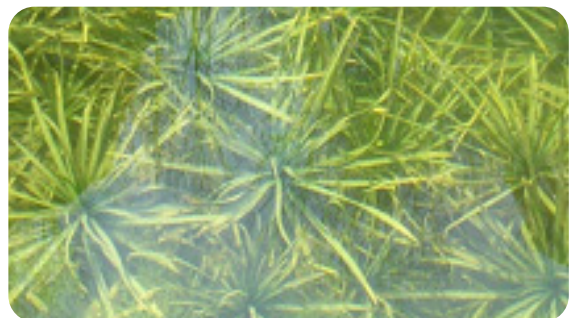
Purple Loosestrife

Climate change is giving invasive species an advantage by causing warmer water temperatures and longer growing seasons. Attaching to boats, trailers, scuba gear, or other equipment is one way invasive species can spread. Be sure to inspect, clean, and thoroughly dry everything before you go to a new water body.

It is important you become familiar with invasive species that may be present in your area and learn how to safely remove them and prevent their spread. Visit invasivespeciescentre.ca for more information.



Fanwort



Water Soldier

MANAGE STORMWATER RUNOFF

Managing stormwater runoff is an important action that will help improve water quality and reduce flooding and erosion.

When paved surfaces such as roads, driveways, and paths are present, the water flows over the surface directly into local rivers, streams, lakes, and wetlands. This sudden increase of fast-moving surface water picks up pollutants like pesticides, sediment, and excess nutrients and carries them into our waterways. The toxins in runoff degrade water quality, can have harmful effects on fish and wildlife species, and can also lead to the growth of unwanted plants and algae. This warmer water with nutrients can result in an increase in the growth of algae. Algal blooms degrade water quality by limiting the amount of oxygen present which has detrimental effects on fish populations. The large volume of surface runoff can also cause banks to overflow, leading to flooding and erosion.



In contrast, when rain falls in a naturally vegetated environment, pollutants are filtered out by plants and rainwater soaks into the soil to replenish groundwater. Canopy layers break up the impact of rain droplets to slow water runoff.

To manage stormwater runoff, you can:

1. Install a rain garden.

Rain gardens are created in a location that catches the natural flow of water from downspouts or gutters. The plants in the garden filter out pollutants and encourage water to infiltrate into the soil which reduces the amount of runoff. You can use a combination of native wildflowers, shrubs, or trees that will tolerate both flooding and drought conditions as irrigation will mainly come from rain events. To find plants suitable for a rain garden, please refer to the Natural Edge Native Plant Database: naturaledge.watersheds.ca/plant-database

Rain gardens limit the amount of surface runoff and pollutants entering the lake or river while also reducing flooding, erosion, and drainage issues. They encourage water to infiltrate into groundwater supply which allows 30% more water to soak into soil compared to a patch of lawn⁵. Due to native plant hardiness and less watering required, rain gardens are low maintenance and can attract birds and pollinators like bees and butterflies.

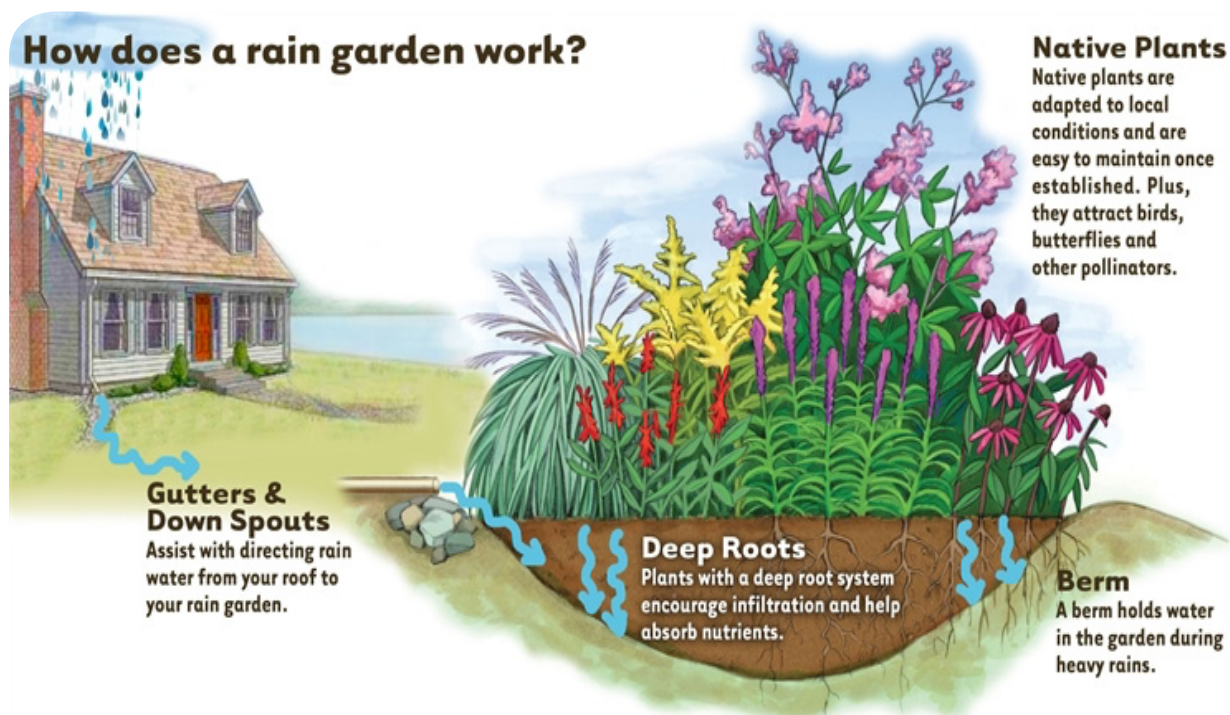


Image: London Middlesex Master Gardeners. (2019). "Rain Gardens - why and how to create one."

⁵ Toronto Region Conservation Authority. (2018). A complete guide to building and maintaining a rain garden. Accessed 20 May 2022. Internet: <https://trca.ca/news/complete-guide-building-maintaining-rain-garden/>

2. Divert water away from homes and paved surfaces.

Ensure that you have a proper system to re-route water to an area where it can soak into the soil. All buildings should have eavestroughs or rain gutters and downspouts installed that direct water away from paved surfaces. Inspect gutters and downspouts at least twice a year, replace old or damaged ones, and clear out any leaves or debris.

You can also direct rainwater from your downspouts into a rain barrel to further limit the amount of runoff on your property. Rain barrels are commercially available or can be constructed from existing barrels. They typically hold 50 to 100 gallons of water that can be used to water your plants. If not used for irrigation, they can also be set-up with a drainage valve that allows water to drain slowly to reduce runoff and encourage better infiltration into the soil.



Image: City of Calgary. (2017). "Rain gardens in Calgary".

3. Use Permeable Materials and Pathways.

Whenever possible, avoid the use of paved surfaces. Use more permeable materials like gravel on driveways, walkways, and paths to reduce surface runoff. Gravel has large spaces that allow water to soak into the ground beneath it at a faster rate.



The best type of pathway to install is a defined one that follows the contours of the slope in an 'S' pattern (see above). The curved shape of the pathway will slow runoff and erosion down the slope and allow the water to soak into the ground more easily. It also helps reduce damage from foot traffic.

In comparison, a straight pathway made of impermeable materials will carry runoff and sediment directly into your lake or river. You can define pathways on gentle slopes using gravel, leaves, pine needles, or woodchips. On moderate slopes, woodchips and crushed gravel should be used. On steep slopes, stairs would be more beneficial.



For more information, contact:

Watersheds Canada

613-264-1244

naturaledge@watersheds.ca



Watersheds
C A N A D A

Watersheds Canada is a federally incorporated non-profit organization and registered Canadian charity. We are committed to providing programs in communities across the country to engage and help shoreline owners enhance and protect the health of lakes and rivers.

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