



## Biodiversity Action Manual



Prepared and Submitted by: Bedeque Bay Environmental Management Association | BBEMA | 2019

This manual is intended to be supplementary to the *Summerside Biodiversity Action Plan*. It is composed of reference material for advising the proper management of biodiversity in an urban setting. It is complementary to the Biodiversity Action Plan, providing further detail on biodiversity enhancement methods and issues which may arise with conservation and proliferation of urban biodiversity in mind.

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# Introduction

**Contained in this document is background information on wildlife species, habitats within Summerside, and information pertaining to current wildlife and habitat management and enhancement practices.** This document has been designed to cover a variety of topics with in-depth instructions for hands-on enhancement activities and a contact list for easy reference. It is suggested that this document be updated biannually in the year opposite of the Biodiversity Action Plan. As with the Summerside Biodiversity Action Plan, this manual was originally created by the Bedeque Bay Environmental Management Association (BBEMA) through funding from the Environment Canada Eco-Action Program. At the end of the project in 2019, BBEMA staff will transfer this document and the accompanying material to the City of Summerside.

Information was collected from various sources including the PEI Provincial Government and Summerside city staff. Although BBEMA's role is officially completed in the creation of the Biodiversity Action Plan for Summerside, the organization will remain an active member in maintaining the biological and ecological health of the city. BBEMA welcomes any consultation regarding the content of this document.



It is strongly suggested that the framework laid out in the *Summerside Biodiversity Action Plan* be reinforced by city staff through using **best management practices** to build cumulative effects for wildlife and habitat management. This includes clear, attainable goals such as incorporating:

- measurable objectives;
- ***the precautionary principle***;
- clear limits;
- mandatory action; and
- a focus on proactive action before thresholds are exceeded <sup>1</sup>

The simple points listed above will help to ensure that city staff do not become overwhelmed with the incorporation of environmentally friendly policies and any new management criteria, and to ensure a healthy and productive Summerside with the environment in mind.

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Environment and  
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# NatureNet

It is vitally important that the information on Wildlife, Habitat, and Enhancement be integrated into the city’s website. This will allow residents to easily communicate with the city on urban wildlife issues and stay up-to-date on what the city is doing in enhancement for plant and wildlife species.

By dedicating a small area on the city’s website, a great deal of information can be conveyed to residents and can reduce confusion for anyone looking to report a wildlife issue or inquire about ongoing enhancement projects being undertaken by the city. This will allow for more transparency, greatly benefiting city staff. To make the pages more appealing, eye catching designs and colors should be used. These infographics can convey a great deal of information and are relatively easy to produce for any topic. If a similar layout is kept between topics, it will help to reinforce their message and allow residents to more quickly find the information they require. By having this information on the city’s website, staff time required to answer questions from residents will be reduced, freeing up more time for other important tasks.

Many cities, such as the City of Charlottetown, have this and other natural resource information featured on the main page of their websites.<sup>1</sup> Not only does this convey the image that the city cares about wildlife, but it also conveys a greater sense of community outreach and inclusion.

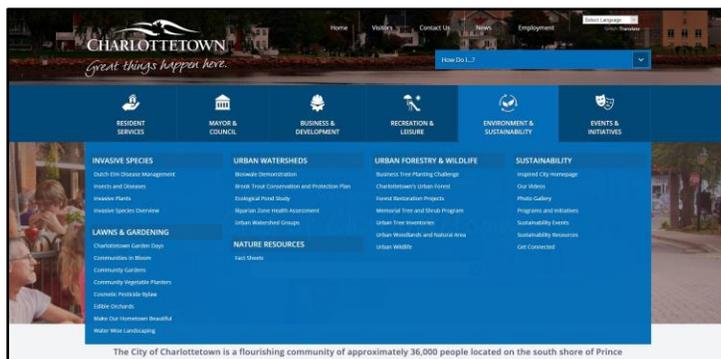


Figure 1 and 2: Examples of wildlife infographics that should be made available to the public

Figure 3: City of Charlottetown’s website, highlighting the section regarding Environment and Sustainability<sup>2</sup>

# Habitat Management

## Urban Forest Strategy and Forest Management

**Urban forests are key areas to be maintained, not only for wildlife and habitat management, but also for overall city health.** These areas encourage residents to explore nature, which has a host of positive physical and mental health benefits. Practices can be undertaken to increase biodiversity, wildlife habitat range, and wildlife health while having positive benefits to the City of Summerside.

### What is an urban forest?

An urban forest includes all the publicly and privately-owned trees and supporting vegetation in an urban area. This includes individual trees and groups of trees located in natural areas, parks, backyards, on streets, and in commercial and industrial zones. Other elements such as plants, water, soil, microorganisms, and wildlife are also part of this forest community. Each of these elements, in addition to people and the built environment, have an influence on the health of the urban forest. Tree canopy cover, the land area shaded by a tree's branches and leaves, is how we measure the many benefits provided by the urban forest.<sup>3</sup>

### Some of the key benefits of an urban forest are:

- **Health and well-being:** Trees clean the air by capturing particulates and through absorption and adsorption of other pollutants. Research also supports that trees and greenspaces provide a broad range of benefits including reduced stress, improved attention span, faster health recovery from sickness or surgery, higher levels of physical activity and community connectivity
- **Environmental health:** The urban forest provides habitat and contributes to urban biodiversity. Trees and vegetation also intercept and clean stormwater before it reaches natural waterways
- **Energy savings:** Trees and green infrastructure, when strategically placed, can provide savings on heating and cooling costs for buildings
- **Comfort/shade/microclimate:** Trees provide comfort by moderating the climate at street level. Trees provide shade and *evapotranspiration* cooling that give people relief on hot summer days<sup>3</sup>

## Tree Planting

When selecting sites for planting it is important to check for landowner permission, as most areas on Prince Edward Island are privately owned. It is also important to contact the provincial nursery to get an updated stock list and plant species appropriate to the sun exposure, moisture, and soil quality on site. Lastly, consider the mature heights and root depth of trees in the planting location, such as planting shrub species (i.e. wild rose, dogwood, or serviceberry) near powerline poles to minimize upkeep and better allocate resources.

Table 1: Tree Species Level of Shade Tolerance <sup>4</sup>

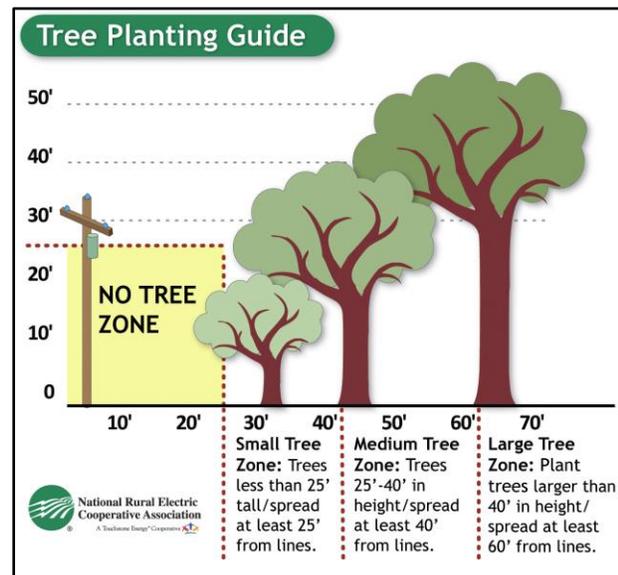
Tolerant	Intermediate	Intolerant
Red Spruce	White Spruce	Eastern Larch
Balsam Fir	White Pine	Red Pine
Eastern Hemlock	Red Oak	Poplar/Trembling Aspen
Beech	Red Maple	White Ash
Eastern White Cedar	Yellow Birch	White Birch
Black Spruce		
Sugar Maple		

A key resource to use is the trees and shrubs species search engine provided by the provincial government. This site has over 700 species of trees and shrubs that can be hardily cultivated on Prince Edward Island. From this page, you can search a database of these species by name, soil type, and preference for sun.<sup>5</sup> See references for website

### Tree Spacing

It is important to consider appropriate spacing between trees and shrubs when planting, especially when planting for mature growth or for density. For mature growth, a shrub will need 2 metres between individuals, while a tree will need 5 metres. For density planting, the spacing can be decreased to approximately 2 metres between all shrubs and trees as the planting is being done with the understanding that some plants will not survive thereby creating gaps. In addition, diversity planting is conducted with future plans of thinning to select for the healthiest or most beneficial trees/shrubs for the given area.

Figure 4: Tree planting guide near power transmission lines <sup>6</sup>



When density planting, many choose to plant complementary species. An example of this would be planting pine and larch with oak, primarily as a **nurse species** to provide shelter for the other as it becomes established. These species are ideal for this purpose, as their growth rates are compatible and avoids overshadowing.<sup>7</sup> This planting style will ensure a greater

survival rate and increased diversity in planting sites. Overtime, as the new area becomes established, pruning or thinning of the trees and shrubs should be considered.



Figure 5: BBEMA Staff planting Notre-Dame Park in Summerside

### Root Establishment

To encourage root establishment, a planting protocol may be used. The morning of or the day prior to planting, plants must be well watered. Holes for potted plants must be twice as large as the plant, ensuring that the hole is deep enough so that the tree's base sits flush with or just below the surface of the hole. Roots should be gently broken up by hand to encourage new growth, and sod should be finely chopped before replacing it back into the hole.

Ensure the tree is vertical and gently pat down the soil around the base of the tree to make sure any air pockets are filled so water does not remove any soil during storm periods.

### Girdle Guards and Staking

Depending on the planting site, the use of additional tree and shrub protection may be considered, such as girdle guards and staking. Sites with tall grasses may pose an increased risk for herbivory and may benefit from using girdle guards, especially hardwood tree species. Caution should be taken when using the guards on deciduous species as they are easily constricted if left on for too long.<sup>8</sup> Sites with increased wind exposure may benefit from stakes to reduce wind damage.<sup>9</sup> The amount of stakes that should be used on a tree depends on the amount of wind at the given site, as areas with increased wind speeds may require more stakes. Stakes should be placed one-third of the height of the tree away from the base to avoid going through the plant's root structure. Locations of newly planted trees and shrubs should be noted and checked on annually to ensure the plants are not outgrowing protection structures.

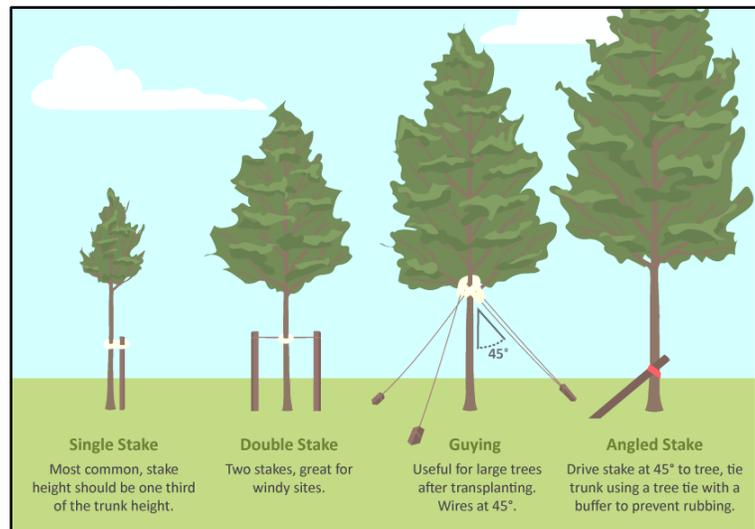


Figure 6: Diagram showing proper staking technique <sup>10</sup>

## Tree Pruning

Tree pruning is the process of removing limbs from a shrub or tree to beautify or to promote further growth. In general, if enhancement is being done for mature trees in a highly visible area or you are trying to promote growth in a shrub, pruning may be considered. This responsibility will most likely fall under the scope of the city's horticulturist or parks department. When conducting enhancement for density, such as in wildlife corridor establishment, pruning is not required as it will better mimic a natural habitat if allowed to grow naturally.

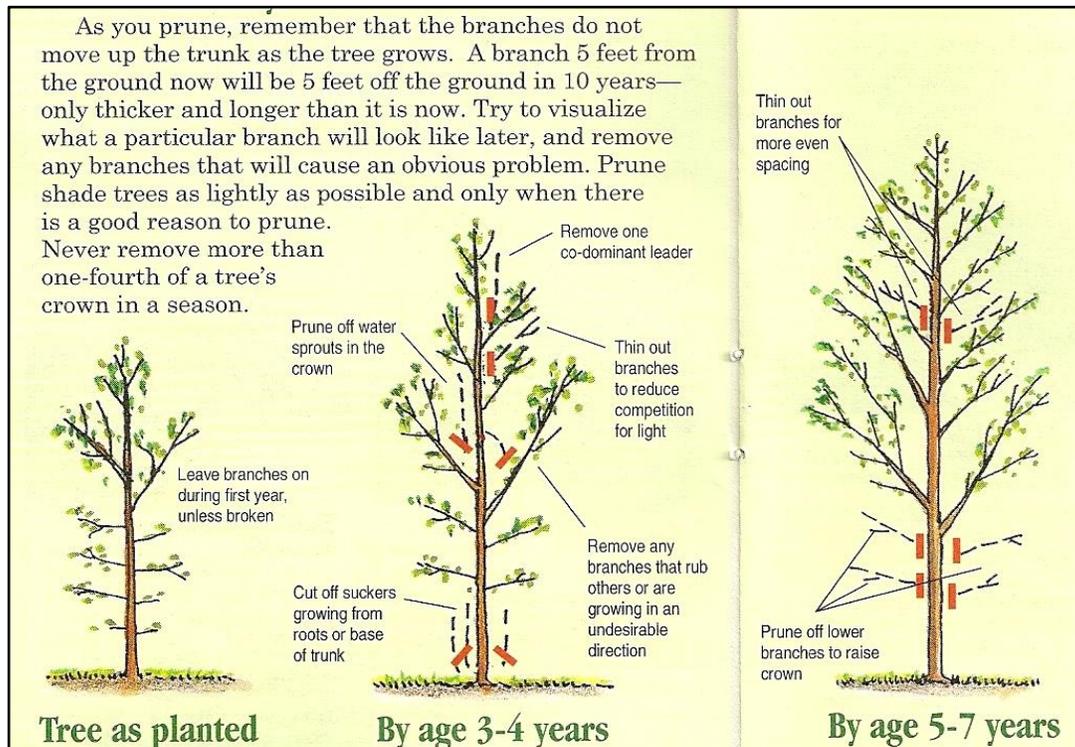


Figure 7: Pruning for future tree shape <sup>11</sup>

## Tree Thinning

Thinning is the practice of removing the smaller, weaker and overall poorer quality trees so that the resources available are concentrated on the strongest trees remaining. This practice is generally common in evergreen stands where spruce trees were used as a **nurse species**. When other species become established, these nurse species can be removed in part or whole to avoid an over acidification of the soil. Generally, thinning of softwood trees is very straightforward as their growth is consistent and predictable. Thinning of hardwoods requires judgement and intuition specific to the area in which the plant is growing and an understanding of the surrounding canopy.<sup>4</sup>

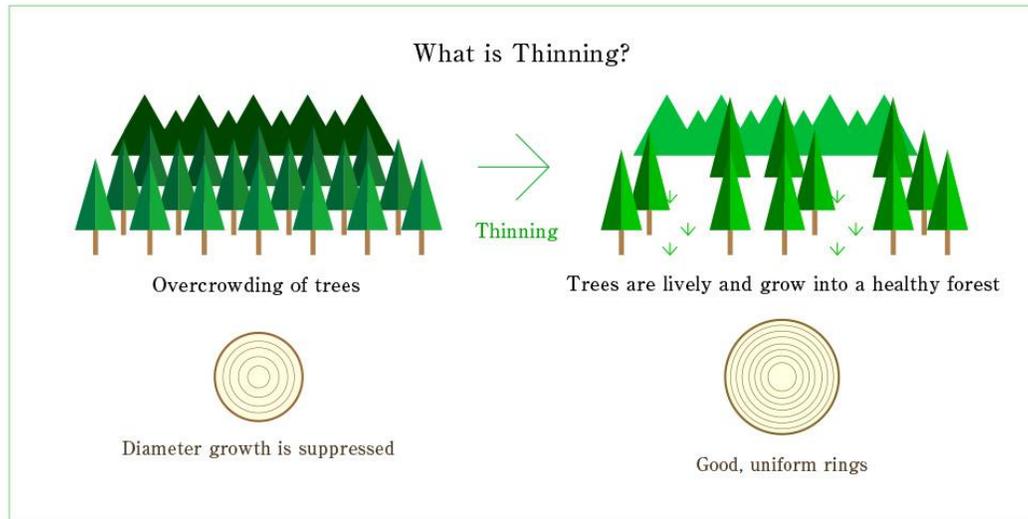


Figure 8: Tree thinning to promote healthy urban forests <sup>12</sup>

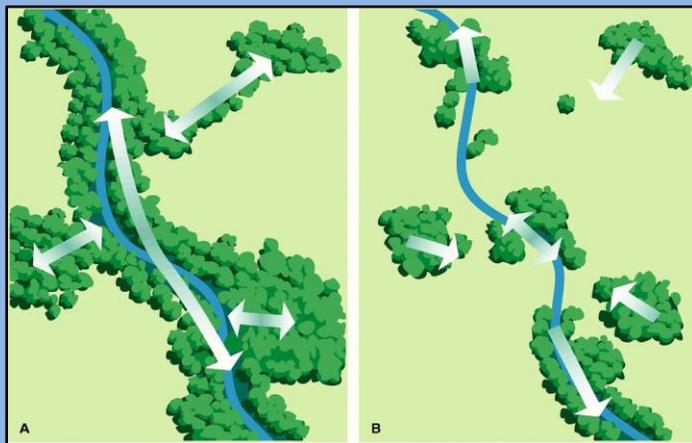
### Recommendations:

It is recommended that city staff begin developing an **urban forest strategy** which clearly lays out long-term goals for Summerside's woodland and is incorporated into community outreach programs. The following points outline some guidelines that should be incorporated into such a strategy.

1. **PROTECT** urban forest and its benefits to our community by:
  - a. Increasing **canopy coverage to 25% - 35% city-wide**
  - b. Protecting existing canopy coverage
  - c. Adapting the urban forest population to a changing climate
2. **ENHANCE** all aspects of the urban forest and its management within Summerside by:
  - a. Updating policy, guidelines and best management practices to support urban forest enhancement
  - b. Enhancing the tree care program by increasing the resourcing and information management system capability
  - c. Improving urban forest diversity by **planting no more than 10% of any species, 20% of any genus and 30% of any family**
  - d. Improving environmental health by establishing goals for **Environmentally Sensitive Areas** and complementary **naturescaping** guidelines for adjacent lands
3. **ENGAGE** all community stakeholders involving issues related to urban forest management by:
  - a. Developing an urban forest stewardship program to build community ownership of the urban forest, and;
  - b. Working with departments internally to improve **integration of trees and green infrastructure** into integrated stormwater management, greenhouse gas and air quality management, and to improve long-term tree health outcomes <sup>2</sup>

## Creation of Wildlife Corridors

**Wildlife or environmental corridors are areas that connect fragmented pieces of habitat together and allow for species to travel from one isolated location to another.** Expansion of these areas can be accomplished by planting native trees, shrubs and ground plants. These corridors should be constructed with biodiversity in mind and thus **use a variety of plant species to increase the variety of nesting and feeding habitat for wildlife.** By doing so, this will reduce the risk of pests or parasites damaging the corridor and promote longevity by not having the corridor reach maturity at one time. Planting for biodiversity also promotes vertical layering and encourages the nesting and movement of songbirds throughout the city.

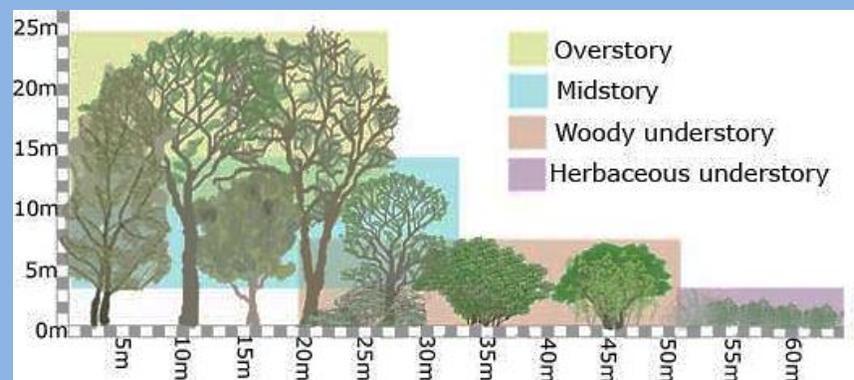


**Vertical layering, or canopy height diversity,** refers to how different plants grow in different layers within a forest community. This is an important aspect of habitat arrangement as it promotes for a bio-rich urban forest.<sup>13</sup>

Figure 9: A depiction of how wildlife move through forest connected with corridors (Image A) and how they will move through disconnected forest patches (Image B) in a riparian habitat <sup>14</sup>

Figure 10 (below): Classification of canopy levels <sup>15</sup>

Forest canopy can be compared to a high-rise apartment complex - the more canopy levels located within a forest, the more habitat for wildlife to live. **A forest composed of one distinct layer of tall trees provides fewer habitats than a forest with a complex variety of layers.** This is especially true of forest birds which have niche habitats.



Uniform dense layering throughout the forest is not ideal, as some forest birds may nest in dense shrub or mid-story but require an open understory for feeding. An open overstory provides space and allows sunlight penetration into the stand to promote the growth of saplings, shrubs and herbaceous plants beneath the canopy. This patchy pattern of vegetation types within the forest subsequently provides a greater variety of food and cover to meet the needs of a wider range of wildlife. Newly established corridors should be constructed with a mature growth outcome in mind. Established corridors should be assessed and if they are found to be overly dense then pruning, thinning and underplanting should be considered.

Fragmented edges and riparian corridors in agricultural landscapes, such as those around Summerside, have been recognized as valuable stopover habitat for migratory birds. However, many of these remnant corridors have been marginalized by human activity. **In order to provide benefits to wildlife and improve ecological services, habitat restoration is required.** A minimum corridor width of 15 metres (50 feet) and a maximum width of 60 metres (200 feet) will provide adequate habitat for species using corridors as a travel lane or for food, nesting or escape cover.<sup>16</sup>

Benefits of these corridors:

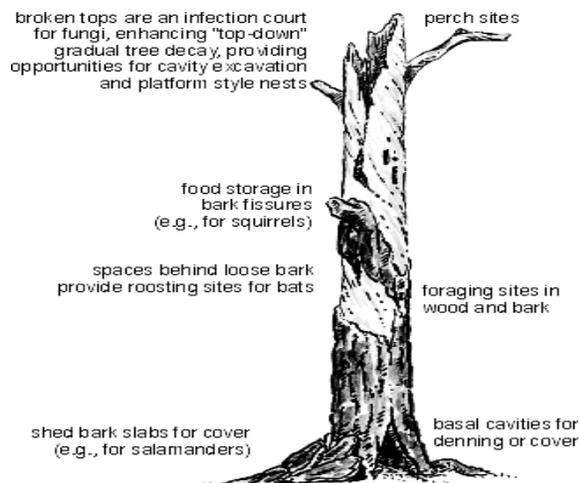
- Provide escape and passage for wildlife and prevents human interaction
- Provide food for wildlife through diversity in fruiting shrubs and trees
- Offer nesting habitat for wildlife

**It is suggested that a few basic principles be followed when considering corridor restoration:**

- Use of **continuous corridors rather than fragmented sections**, providing more area for migratory species
- Increasing corridor width, allowing less intra-species interactions
- **Natural linkages** between habitats should be restored and maintained, with two or more corridor linkages being better than one
- Using **structurally diverse corridors** that possess diverse plants, heights of plants, and natural features

## Deadfall

Annually there will be concerns regarding windfall or felled trees from overwinter damage. If fallen trees, logs or brush are not an immediate public safety concern, the best practice is to delimb damaged areas and leave it where it is, allowing it to become a snag or habitat for wildlife. If severed limbs of a tree are hanging in the overstory, they pose a public safety risk and should be removed by trained staff. Any trees or limbs that are removed can be left on site to rot, providing additional habitat and acting as a long-term form of nutrient release.



A ground log or upright snag can provide habitat for many species of beneficial insects, birds and small mammals. It is advantageous to retain aging trees or encourage the growth of younger ones that will make excellent snags later in their life. Brush piles left in a woodland can also provide habitat for a variety of wildlife such as mice and insects.

Figure 11: Snags and the diverse habitats they can provide <sup>17</sup>

## Pollinator Gardens

Pollinator gardens provide beautification and enjoyment for humans. By installing these gardens, local pollinator populations will benefit by helping to increase overall biodiversity. It is important to emphasize planting a variety of native plant species to support local pollinators by offering nectaring consistency. These sites should have plants that flower during the spring, summer and fall seasons. Examples of native pollinator-friendly plants for PEI include goldenrod, lowbush blueberry, wild chives and red raspberry.<sup>18</sup>



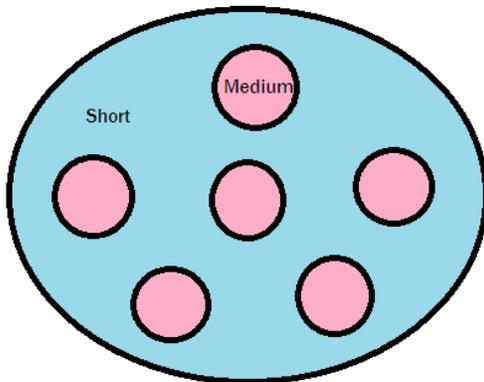
Figure 12: Possible methods to increase pollinator numbers in gardens<sup>19</sup>

A **Pollinator Garden Enhancement Strategy** should consist of the following features<sup>20</sup>:

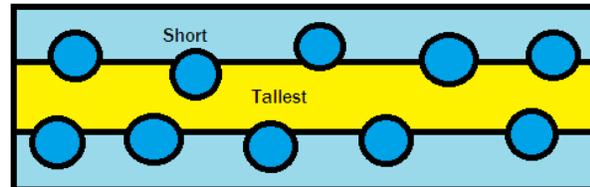
- Diversity in plant species, colours and heights
- Plant species with red to attract birds, yellows and oranges to attract bees, and pale or pastel colours to attract moths
- Plant in groups of at least 3-5 to make plant presence obvious to pollinators
- Create gardens with or near water sources
- Provide woody/pithy plants for overwintering pollinators
- Provide open area for sunning

When designing pollinator gardens, in addition to plant composition and vertical height differentiation, one should take into consideration plant spacing and overall garden design to create a visually appealing area, while still providing open sunspots and low-lying puddle areas. The figure 13 depicts various garden designs for a variety of planting options.

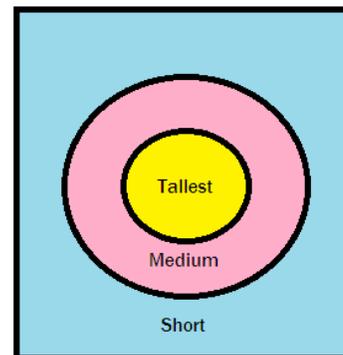
**Patchwork:** Short plants provide even ground cover, patches of medium plants are planted evenly throughout.



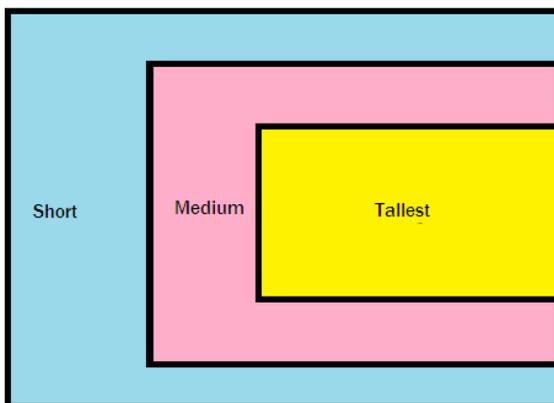
**Narrow Screen:** Tall plants in a strip, with short plants mixed along and throughout for ground cover.



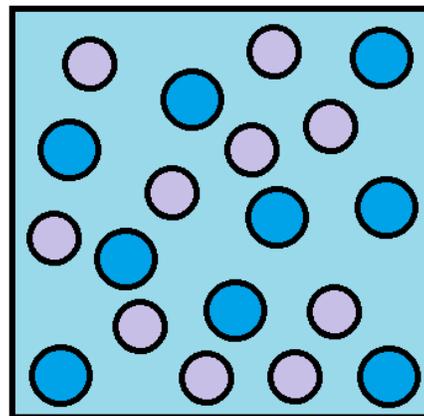
**Concentric:** Plant tallest plants in the middle, surrounded by medium plants, then short plants.



**Stepped:** Tallest plants along a backdrop, with medium plants and short plants surrounding them on sides.



**Carpet:** Plant a wide variety of short plants of the same height, intermixed.



**Garden planting designs, colors indicate different growth heights of plants.**

Figure 13: A range of possible garden planting to maximize sun penetration and diversity <sup>21</sup>

When a pollinator garden site has been selected, the following considerations can help define what type of habitat may be most suitable.

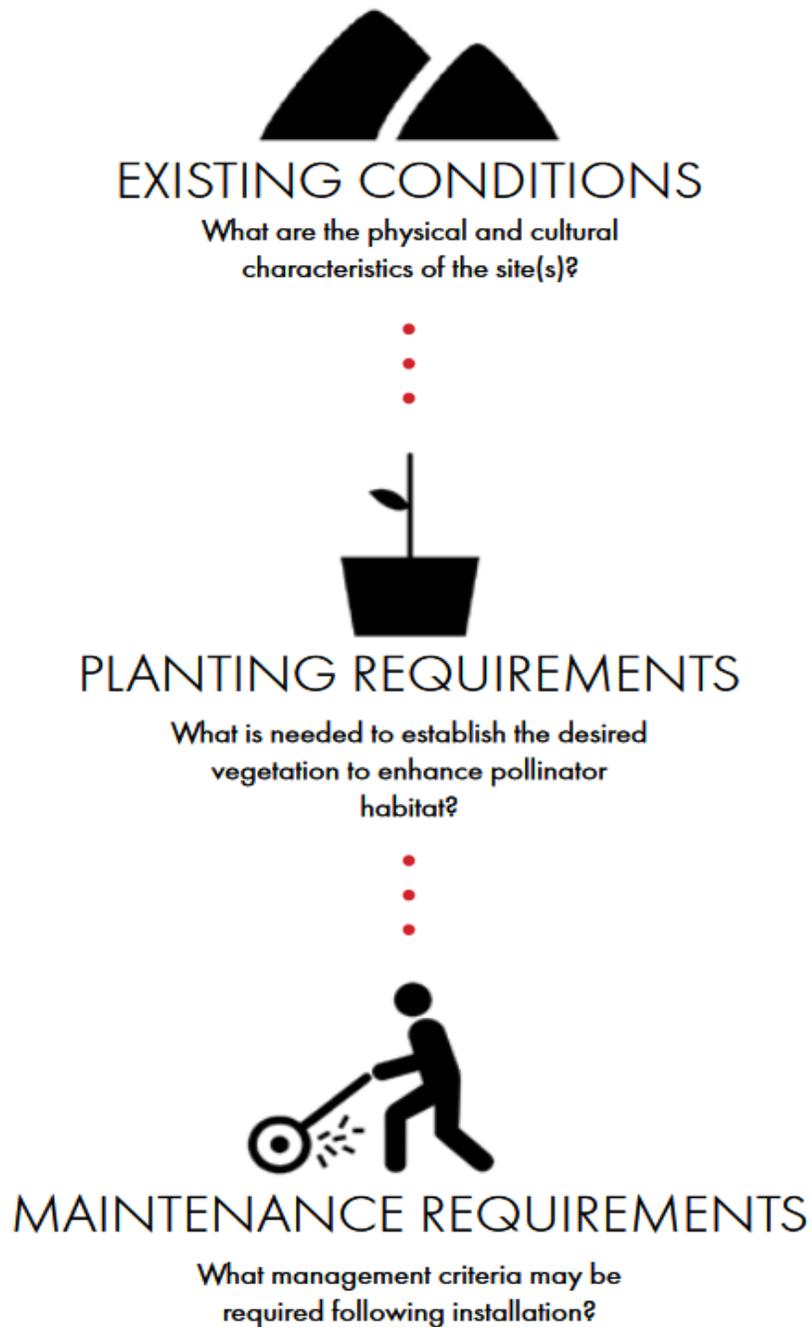


Figure 14: Considerations used to determine sites for pollinator habitat enhancements <sup>22</sup>

## Urban Park Management

“**Tallgrass Communities**” are natural grasslands with a great diversity of native plants and animal life including a fascinating diversity of butterflies and night-flying moths. All butterfly and moth species incorporate **host plants** in their life cycle. The host plant provides nourishment and resources to the developing larva before it undergoes metamorphosis to adulthood.<sup>23</sup>

Bees can be considered one of the most important pollinators and are essential to the reproduction of many plants. Consequently, a decline in the bee population will lead to reduced opportunity for plants to exchange genetic information resulting in reduced reproductive success. The cause of decline in the native bee population appears to be a combination of factors. Most cited reasons include species monoculture, loss of habitat, imported disease, widespread use of insecticide in forestry/agriculture and climate change in which bees emerge from hibernation before early blooming wildflowers are available.

Homeowners can help bees by keeping their garden pesticide-free and planting native flowering plants. Farmers and roadside managers can employ **pollinator strips** to increase local pollinator habitat.<sup>22</sup>

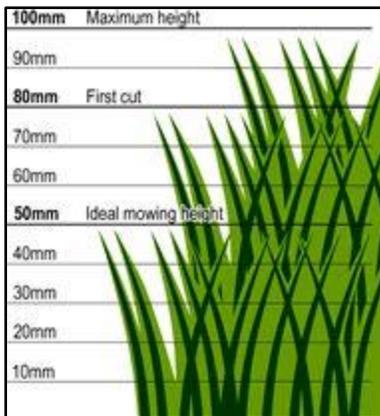


Figure 15: Example of a lawn cutting guide with various heights <sup>24</sup>

When managing parkland, a comprehensive schedule for maintenance should be made to ensure that the grass remains healthy. This would depend on the species of grass planted in a given area, but in general the grass should not be allowed to grow higher than 100mm and no lower than 30mm. This will ensure a mature root system while making it appealing for residents. This schedule should be altered depending on the time of year with a more intensive cutting schedule in the spring and a less intensive cutting schedule in the summer. If a maintenance schedule is not properly kept, it may result in the turf becoming burnt, resulting

in an unpleasant dead grass appearance. Additionally, mower blades should be kept sharp to ensure that the grass is being cut and not torn which reduces the grass' ability to survive.

Figure 16: Example of lawn browning from being cut too low <sup>25</sup>



## Roadside Management

Roadsides can function as linear corridors of flowering vegetation, thus serving an important role in pollinator conservation. Typically, municipal road crews mow valuable blooming plants and apply pesticides to control invasive species. This reduces nectar and pollen food sources, and ultimately contributes to pollinator decline. Changing mowing practices is an important first step considering time and technique. By applying the following techniques, plants can reach a blooming stage faster, bloom longer, and host plants for important insect larvae can remain intact. A regularly mowed narrow strip along the road (labelled “Clear” in Figure 17) will maintain visibility and evidence of care.

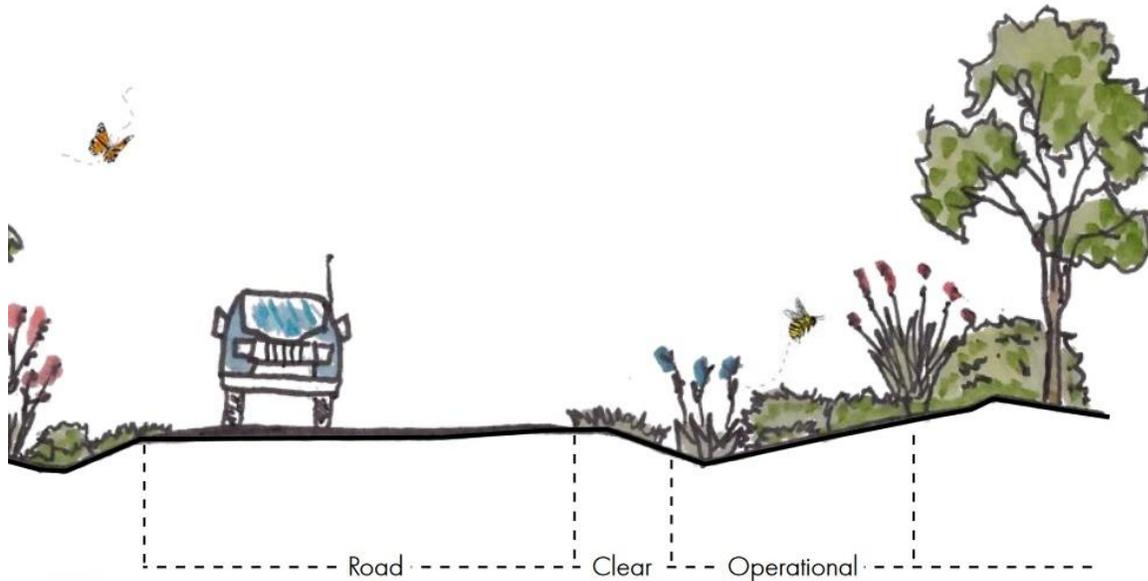


Figure 17: Example of possible roadside pollinator strategy, with areas being marked as 'clear', 'operational', and 'road' <sup>22</sup>

### Three general techniques to support pollinators along roadsides are:

1. **Adjusting mowing schedules** in specific zones to allow plants to flower
2. **Planting buffers** containing a mixture of native flowering plants
3. **Avoiding pesticide** and herbicide use whenever possible

Figure 18: Machinery used to complete roadside cuttings <sup>26</sup>

When completing roadside cutting, it is suggested that only the first 2 metres cleared on a regular basis, any area beyond that should only be trimmed twice a year to maintain plant health. This clearing zone will allow for visibility but will ensure more biodiversity along municipal roads. <sup>26</sup>



### The many added benefits to managing roadsides for pollinators include:

- **Lower cost** due to less frequent mowing reduces labor and fuel costs, as well as carbon emissions
- **Less runoff** as native plant root systems run deep, increasing water infiltration. This reduces runoff and the pollution it carries into local waterways
- **Erosion Control and Invasive Species Reduction.** Once a diversity of native plants is established, they provide a stable ground cover, reduce erosion and control weeds <sup>27</sup>

## Summerside Biodiversity Action Manual

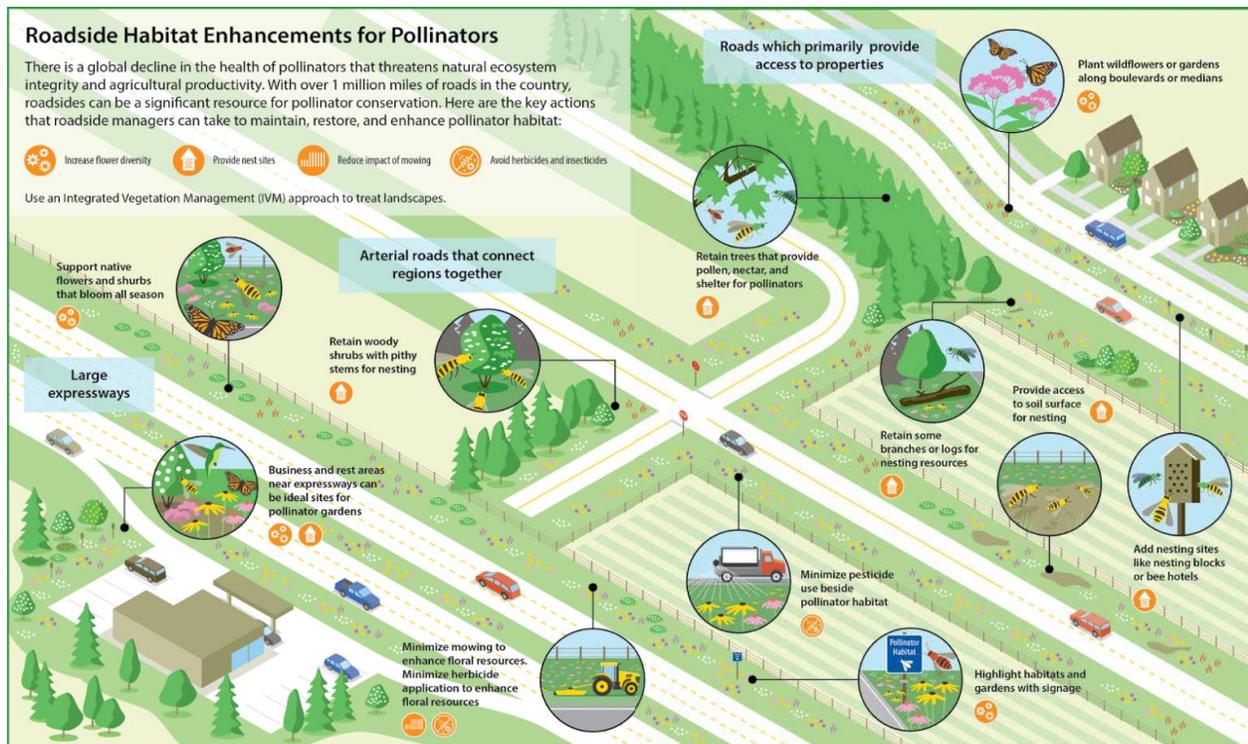


Figure 19: Example of how pollinator enhancements can be implemented in an urban setting <sup>27</sup>

The above figure illustrates how these enhancements can be incorporated into the municipal landscape on a large scale. For additional comprehensive information on Pollinator habitat enhancement or Roadside Management practices, it is suggested that the *Great Barrington Pollinator Action Plan* or the *Technical Manual for Maintaining Roadsides for Pollinators Establishment, Restoration, Management and Maintenance* is referred to. Both sources have been heavily referenced throughout the section and provide a wide variety of pollinator enhancement opportunities.

## Riparian Zone Management

For Prince Edward Island, the riparian or “buffer” zone is defined as the 15-metre area surrounding all watercourses and wetlands.<sup>28</sup> It is prohibited to conduct work within the riparian zones without a permit from the Provincial government. **For work that needs to be done in the riparian zone, it is suggested that the area’s local watershed group be contacted.** For the Summerside area that group is the Bedeque Bay Environmental Management Association (BBEMA), who have expertise working in such areas. The organization has the resources available to assist with riparian related work and would be available to provide assistance. If the group is unavailable to accommodate, the next available option would be to apply for a *Watercourse, Wetland and Buffer Zone Activity Permit* through the *Department of Communities, Land and Environment*.

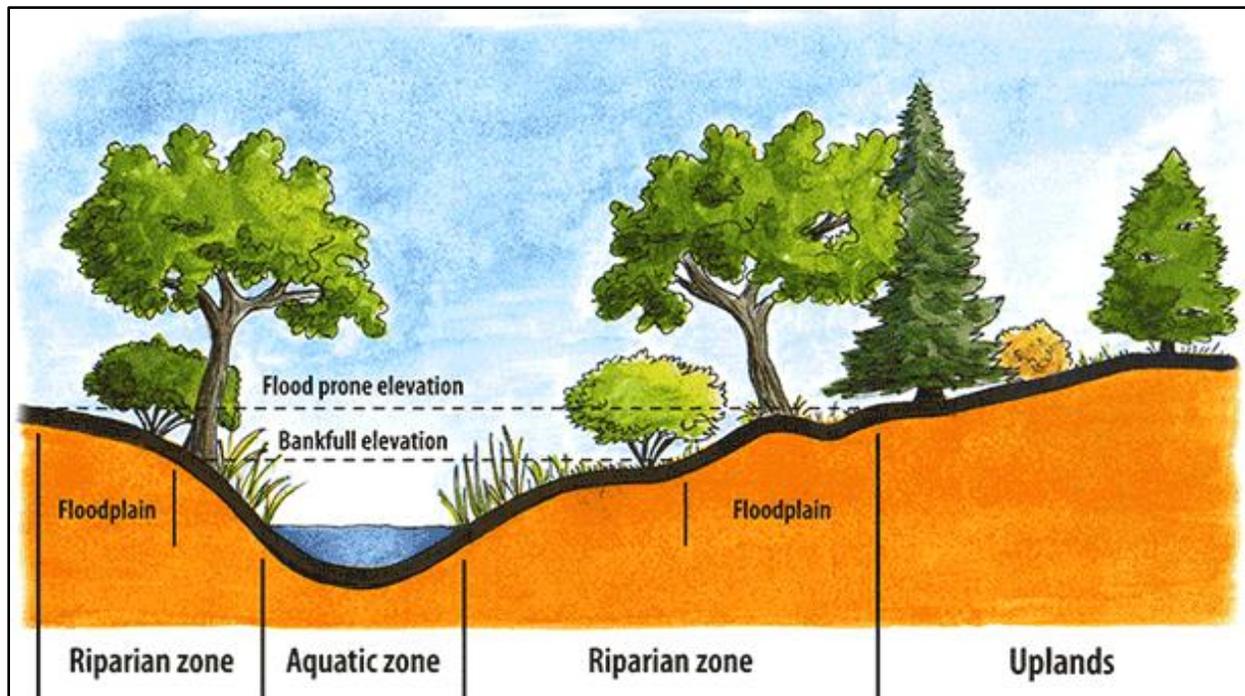


Figure 20: Diagram indicating the riparian zone <sup>29</sup>

## Stream Enhancement

This work can include but is not limited to bank stabilization, in-stream structures, stream-bed enhancement, in-stream dredging, blockage removal, or sediment recapture. Improper alterations of the stream can result in property loss due to erosion or flooding and may lead to **eutrophication** or **anoxia** of the stream, causing a loss of biodiversity and the formation of unpleasant odours. **It is suggested that stream enhancement work be done only in consultation with the local watershed group or a hydrological expert as minor changes in the in-stream environment can have major impacts in other reaches of the stream.**



Figure 21: Examples of stream work  
Left: Brush mats installed in estuary outflows to improve flow-rate and flushing. Right: an example of a pinch point

In 2018, stream enhancement was completed by BBEMA in the stream running adjacent to Mackenzie Drive, across from the Green Shore boardwalk. This was done to increase the flow of the water in the area to allow for better flushing of the eelgrass which was building up in the stream outlet causing a malodorous buildup of organic matter. To combat this, BBEMA staff installed pinch points and brush mats to increase the **natural meander** and flow throughout that section of the stream. During high water events, such as overwinter, the brush mats will begin

collecting sediment, having a greater impact on the stream bed while re-establishing a natural bank. This work will be monitored by BBEMA to ensure there is no environmental damage to the area.

## Culvert Naturalisation

Old culverts in the city have been replaced with a new, large rectangular design to allow for additional drainage during high water rain events, which are expected to occur more frequently due to climate change. Although this design is effective in allowing high water flow and fish passage, the bottom of the culverts are closed-bottom and excessively wide for the streams they are being installed on.

During low flow events, such as during the summer months, this can be considered inhibitory to stream health as water is diverted from its natural meander and spreads along the bottom of the culvert, acting similar to a pond. **This flow alteration has caused an increased rate of sediment deposition, leading to a shallowing of the structure.** Between 2017 and 2018 this occurred with the newly installed culvert below the Summerside Ice Pond, where the sediment deposition was so excessive it caused infilling. **It is suggested that in the future these culverts be lined with rock to help improve flow, ensure fish passage, restore the natural meander and allow for wildlife passage reducing the rate of animal collision on the adjacent road.**

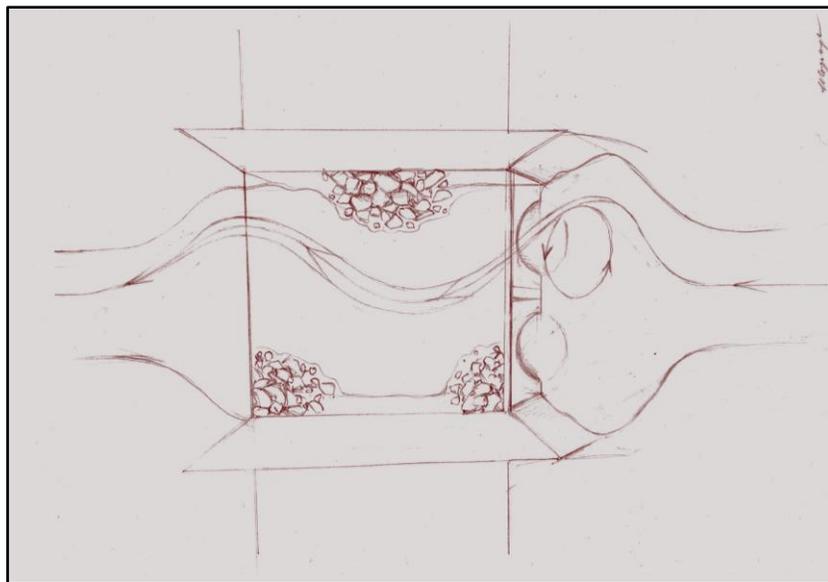


Figure 22: Illustration of rock placement in a square culvert, additionally both or one side could be lined with rock.

## Estuarine Remediation

### Eelgrass Study

Eelgrass beds are important in **helping to minimize coastal erosion and providing important estuarine fish habitat.**<sup>30</sup> However, if eelgrass populations explode out of control due to high nutrient input, the algae's lifecycle will speed up, resulting in a quickened growth-death cycle.

This will create an accumulation of pungent rotting algal biomass. Summerside's Green Shore currently experiences a heavy accumulation of eelgrass and measures are being undertaken to manage it through on-shore dredging. A causation study is ongoing by Island Water Technologies.<sup>31</sup>

Although the true cause of the excessive amounts of organic matter is still yet unknown it is believed by BBEMA staff that the following issues are contributing factors:

- Shallow pools and bars throughout the harbour
- Excessive nutrient supply from streams in the area
- The lack of major tidal flow in the estuary
- Proliferation of the aggressive green crab

Nutrients cause the plants to grow at an increased rate while the invasive crabs and warm shallow waters cause the eelgrass to die quickly, leading to a second generation during a single season. A study by the ecological sciences sector of DFO in Newfoundland found that invasion by green-crab can lead to reductions of 50-100% in eelgrass populations. This is caused by the destruction of the plant's rhizomes while crabs are burrowing for shelter and prey.<sup>32</sup> The build up of decaying organic matter occurs due to ocean currents bringing it into the bays and outflows at high tide, and the low outward flow being unable to flush it back out to sea when the tide in the area recedes. Studies have shown that in PEI estuaries loss of eelgrass can result in significant declines in fish diversity as other nutrient-loving species, *Ulva lactuca* or sea lettuce, replace eelgrass habitat under high-nutrient conditions.<sup>30</sup>

Figure 23: Front end loader working on Green Shore to remove decaying organic matter <sup>31</sup>

**A management plan for this issue may consist of three main parts:**

- 1) Establish an ***Eelgrass Management Threshold***, which consists of determining the running average of eelgrass acreage from a biannual eelgrass survey.
- 2) Establish a ***Best Management Practice (BMP)*** for eelgrass
- 3) Establish an **education program** through the city which promotes manageable levels of eelgrass and implements adaptive management as new information is acquired, and is integrated into the *Biodiversity Action Plan*



It is advised that the city begin working with the inshore fishermen's association (PEIFA), the Aquaculture Alliance, the Department of Aquaculture, the Department of Agriculture, the local watershed group, and the Department of Fisheries and Oceans to take a more proactive role in addressing this problem.

## Nutrient Loading

Nutrient pollution highly impacts salt-marsh habitat. Plants such as cordgrass (*Spartina alterniflora*) do not produce their usual extensive root systems when receiving ample nutrients under heavy nutrient loading. With reduced root systems, stream bank walls become less stable and erosion is increased.<sup>33</sup> A study has shown that microorganism populations are also sensitive to high nutrient densities. Approximately 90% of studied microorganisms go into dormancy while the remaining 10%, being better adapted to N-enriched environments, flourish. Under these conditions, decomposition is accelerated causing stream bank walls to become more unstable. Stream widening occurs creating lower flow and flush rates through that system.<sup>34</sup>

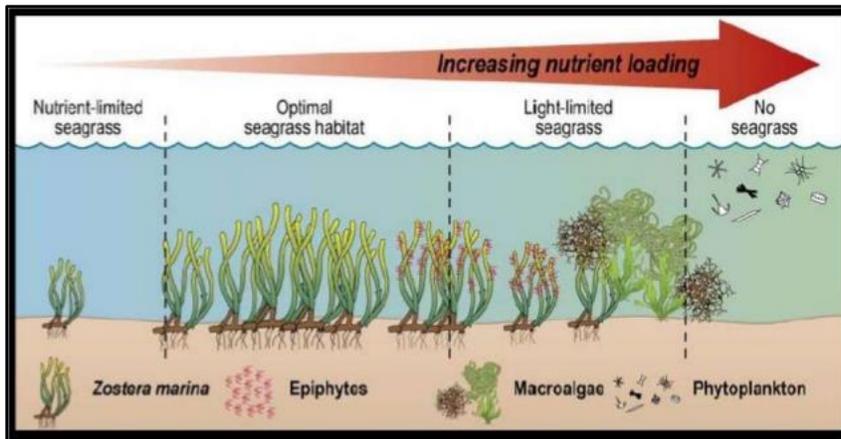


Figure 24: Nutrient loading impact on seagrass communities<sup>35</sup>

Nutrient reduction in the Bedeque Bay through the alteration in farming practices and stream improvements will lead to less nutrients accumulating in the Summerside estuary. These changes can be observable over a 5-year response period.<sup>36</sup>

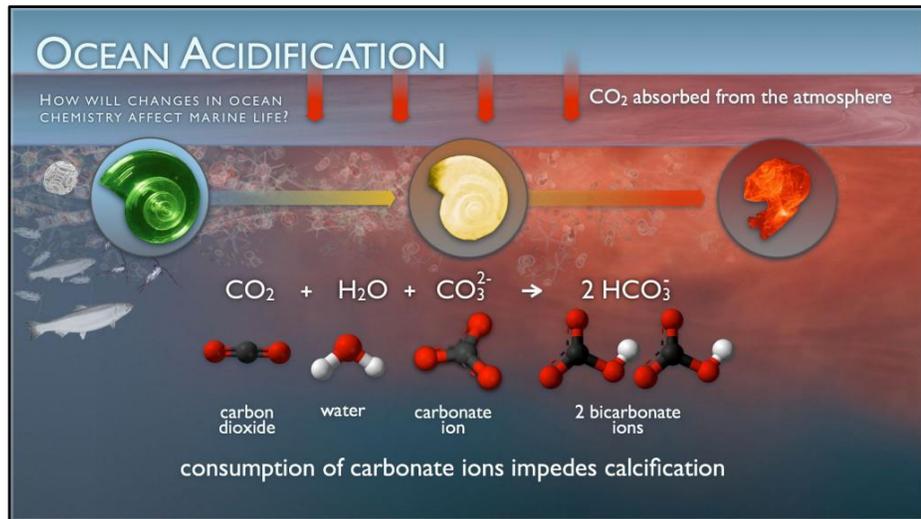
Although major nutrient management is outside the scope of the city's work there are some avenues that city staff can explore to help reduce nutrient pollution:

- Reduce fertilizer use
- Improve soil quality
- Establish a Total Maximum Daily Load (TMDL) for nutrients
- Utilize pump out stations for nutrient-rich sewage
- Effectively treat stormwater with green spaces
- Choose permeable hard surfaces to reduce stormwater
- Fund subsurface infiltration wastewater systems
- Limit disposal of phosphate concentrated cleaning detergents
- Create or expand riparian zones<sup>37</sup>

Nitrogen is of particular interest in aquatic environments as it usually acts as a limiting factor in an aquatic ecosystem. However, this is not the case in systems highly impacted by agricultural run-off. The cost and effort associated with the removal of nitrates from a system is of real concern.

## Summerside Biodiversity Action Manual

Figure 25: Ocean Acidification, carbon loading in marine environments impacting shellfish <sup>38</sup>



Ocean acidification has been a steady concern as CO<sub>2</sub> emissions increase. The ocean uptakes around one third of CO<sub>2</sub> produced from anthropogenic sources<sup>39</sup> leading to a pH decrease in ocean waters. This decreasing pH may lead to the dissolving of calcium carbonate, which is a primary component in the shells of many shellfish and benthic organisms. Localized **benthic** anoxia and related hydrogen sulfide release can occur when solid waste deposition rates surpass aerobic decomposition.<sup>40</sup>

### Nutrient Trading

To help make anthropogenic nutrient loading activities such as aquaculture more sustainable, supporting nutrient removal or recovery programs with **Nutrient Trading** or **Nutrient Trade Credits** can be effective.<sup>40</sup> Watershed sources of pollutants can be broadly broken into two categories:

1. **point sources** are industrial enterprises that have a highly localized pollution impact
2. **non-point sources** are spread throughout a watershed area and are difficult to pinpoint

Most point-source industries have invested in upgrading pollution controls after years of strict environmental regulation. Recent studies have found that non-point sources, in particular agricultural polluters, account for over 80% of nitrogen and phosphorus discharges found in watersheds.<sup>41</sup> Farmers can largely impact their nitrate levels with inexpensive pollution control methods such as;

- Alternating tilling and cutting practices
- Hedgerow and riparian zone planting
- Altering fertilization practices
- incorporating the use of winter cover crops
- Installing berms for water redirection and retention
- Using biocontrol's over chemical applications for pests

When tighter standards are put in place, trading increases flexibility and reduces costs. This flexibility produces a less expensive outcome overall while achieving - and even going beyond - the mandated environmental target.

- Paul Faeth

The result of a **cap and trade system**, such as nutrient trading, is that industrial polluters pay agriculture land owners to reduce their pollution emissions allowing industry to work within pollution goals.

## Integrated Multi-Trophic Aquaculture

**Integrated Multi-Trophic Aquaculture (IMTA)** is a good candidate for Nutrient Trade Credits as it can be considered extractive aquaculture for the removal of phosphorus, nitrogen and carbon. It also helps remove dissolved inorganic and solid organic materials from aquatic systems. **Aquaculture, or fish farming, already provides about 50% of the fish and seafood consumed worldwide.**<sup>40</sup> This number is expected to increase as food demand and specific demand for a consistent source of high-value fish increases. Conventional fish farming, a monoculture production system, relies on the use of food pellets and antibiotics to control pathogens, while waste is released into the surrounding estuary. Existing monocultures of fish or shellfish are often grown in spatially isolated bays and are unable to balance each other out.

This method of cultivation is thought to be a major cause of eutrophication in estuaries and generally is perceived negatively by the public, primarily due to environmental concerns. Not only is single species production an environmental risk, but fluctuating prices in global markets can make it an economic liability, as diversification of products adds stability.<sup>40</sup>

The establishment of **multi-trophic aquaculture systems that include finfish, shellfish and marine plants together in close proximity, following the concept that one species will find a feeding niche in the waste generated by another species, mimicking a natural ecosystem.**<sup>40</sup> When designing an effective IMTA, system species and system design are selected to optimize the recapture of waste products. Fish eat feed pellets while larger organic particles, such as feces and uneaten feed, settle below cages where they are ingested by deposit feeders, such as sea cucumbers and sea urchins. As this occurs, filter-feeders such as mussels, oysters, and scallops draw in fine suspended particles from the water column. Finally, algae or seaweeds are placed further from the site in the direction of main water flow to effectively remove inorganic dissolved nutrients, such as nitrogen and phosphorus, from the water.

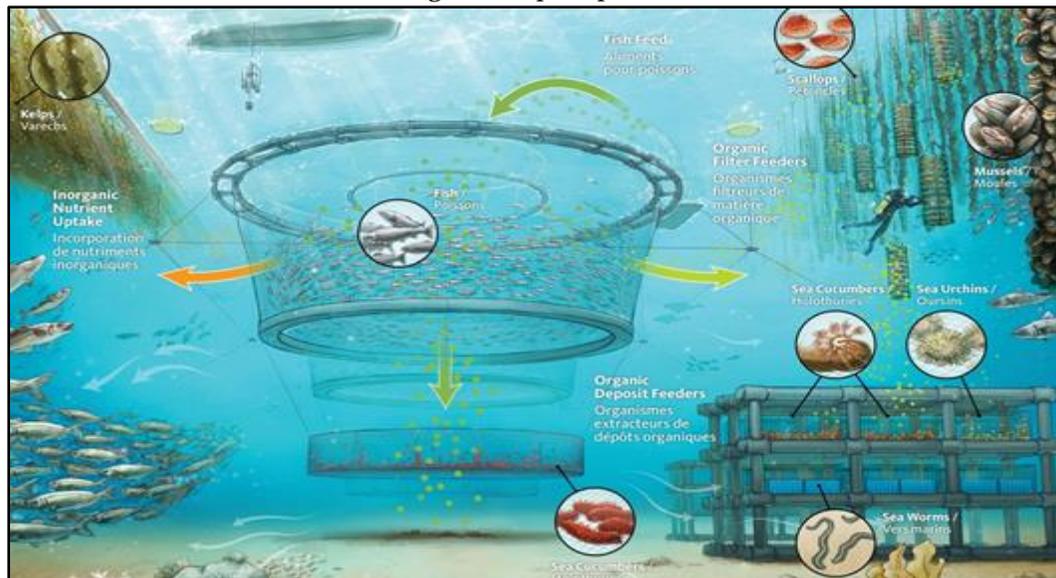


Figure 26: An example of integrated multi-trophic aquaculture <sup>42</sup>

In a study conducted in New Brunswick where salmon (*Salmo salar*), kelp (*Laminaria saccharina* and *Alaria esculenta*) and blue mussels (*Mytilus edulis*) were co-cultivated <sup>42</sup>, fine particulate wastes were extracted by mussels with the kelp absorbing the smallest dissolved inorganic wastes, such as nitrogen and phosphorus.

This type of nutrient recycling leads to a reduction in waste products in the marine environment and reduces the risk of algal blooms and cloudy water. IMTA systems of fish farming incur an improvement in environmental performance. Mussels cultured in this way observed a 50% increased growth rate due to increased food and energy availability. Kelps experienced a 46% increase in growth rate in this type of system.<sup>43</sup>

### Species selection for Integrated Multi-Trophic Aquaculture systems are based on:

- Compatibility of species in the system
- Adaptability in the habitat
- Culturing technologies available
- Environmental conditions
- Efficient and continuous bio-mitigation
- Market demand for aquaculture products
- Commercialization potential
- Contribution to environmental performance of the operation <sup>42</sup>

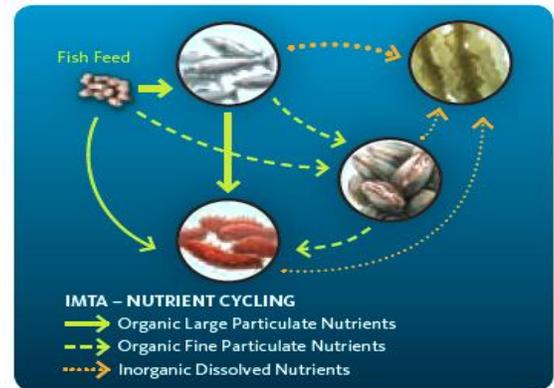


Figure 27: Nutrient cycling in integrated multi-trophic aquaculture <sup>42</sup>

High-value fish and shellfish produced in these systems are safe for human consumption. Some species of algae are popular for consumption, but most can be harvested for use in cosmetics, biofuels or fertilizers. Public perception on food production systems is becoming an increasingly important factor in their establishment in the global market. A public survey on IMTA systems showed that people would be more accepting of IMTA products than traditional aquaculture and half of those surveyed would pay an extra 10% for fish developed in this way.<sup>43</sup>

## Living Shorelines

As sea levels rise from melting glaciers, coastal erosion continues to be a growing concern in many coastal communities. Compounding this is the loss of land due to erosion. This increased erosion can eventually lead to a reduction in property values or even loss of infrastructure. Generally, erosion is prevented through armouring using granite, cement slabs or other hard material to protect the land from wave action. While these structures are effective in preventing the loss of land behind them, they can also have negative impacts as wave energy is reflected, not absorbed, by these hard structures. Unprotected areas next to armouring can experience greater erosion and may cause seaward erosion, leading to the formation of bars, or unwanted deposition of sediment in areas such as boating channels. This increased deposition of sediment increases the need of dredging in these areas. Fish habitat and biodiversity can also suffer from this type of armouring as seaward erosion can scour or bury feeding habitats amongst eelgrass or other benthic vegetation.

**Important steps when designing a living shoreline:**

1. Identify and monitor vulnerable areas through aerial and on the ground surveys
2. Planning of structure placement is critical
3. Permitting through provincial and federal officials is a must
4. Execution of structure installation should be completed in a timely manner
5. Post-project monitoring to measure success or failure
6. Alterations if required <sup>45</sup>

“

Climate change is already having an impact on biodiversity, and is projected to become a progressively more significant threat in the coming decades. Loss of Arctic sea ice threatens biodiversity across an entire biome and beyond. The related pressure of ocean acidification, resulting from higher concentrations of carbon dioxide in the atmosphere, is also already being observed.

Ecosystems are already showing negative impacts under current levels of climate change ... which is modest compared to future projected changes.... In addition to warming temperatures, more frequent extreme weather events and changing patterns of rainfall and drought can be expected to have significant impacts on biodiversity.

”

— Secretariat of the Convention on Biological Diversity (2010), *Global Biodiversity Outlook 3*, May, 2010, p.56

Marshes are capable of growing in elevation through deposition of sediment in tidal waters, serving as an important source of carbon sequestration and giving them an adaptive ability in the face of climate change. **The use of hard structures prevents this natural marsh migration so to combat this issue living shorelines are recommended in substitution or in combination with hard infrastructure.**<sup>46</sup> They harness the natural features of marshes to protect the land and are often made with the goal of maintaining the natural features of the coast, while mitigating the impacts of erosion.

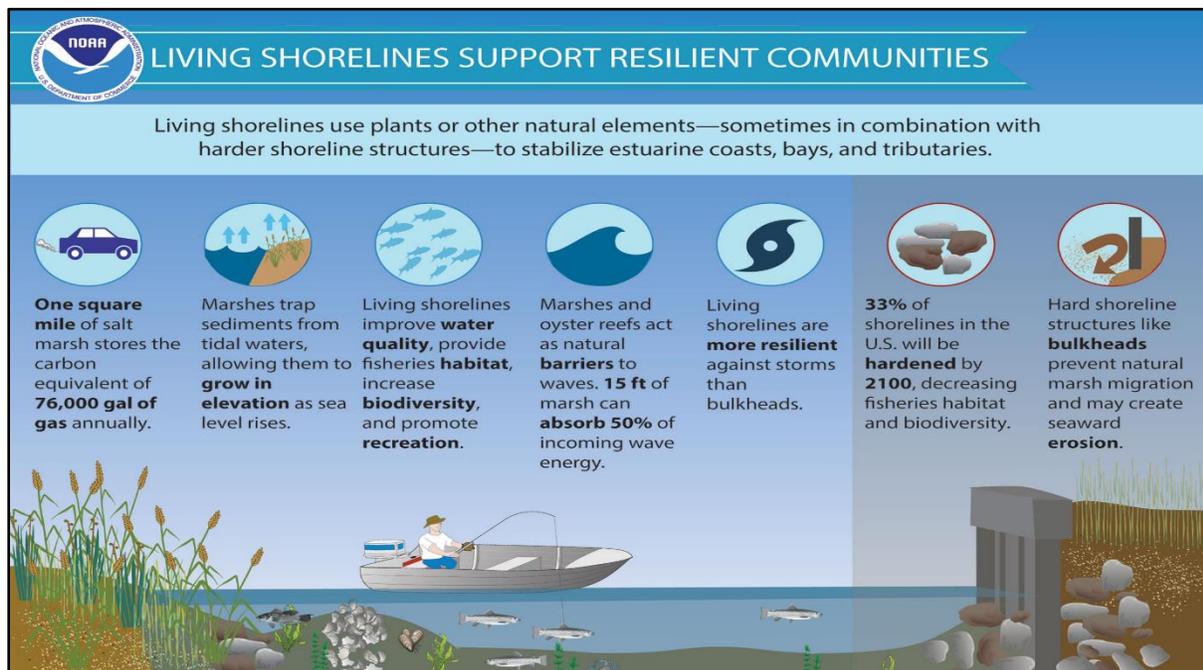


Figure 28: Living shoreline diagram <sup>46</sup>

There are many types of designs for living shorelines. The best design should incorporate features represented in nearby natural shorelines.

**Considerations when selecting the appropriate design include:**

1. Shoreline type and site consideration
2. Strength and type of erosion forces
3. Levels of property protection needed
4. Construction issues and site access
5. Permit issues can take more time to get a permit for a living shoreline than hard infrastructure
6. Maintenance considerations <sup>47</sup>

In very high wave-energy sites, a manmade sill can be augmented to become a breakwater. Breakwaters are made with the goal of slowing wave action before it encounters the shoreline and can either be made of hard materials such as concrete or living materials such as oyster shells.



Figure 29: Terrestrial parameters of a living shoreline <sup>48</sup>

*If looking for more comprehensive information on installing Living Shorelines, refer to the Conservation Gateway website. This website outlines the criteria and parameters for each specific design outlined above and goes into detail beyond the scope of this document.* <sup>48</sup>

# Water Conservation

## Stormwater and Runoff Mitigation

A prevalent feature of urban environments is the abundance of impermeable surfaces such roads, parking lots and buildings. These features prevent water from penetrating into the soil and can cause water runoff to gain speed as it flows along surfaces.

**In a natural environment, approximately 50% of stormwater infiltrates, 40% evaporates and 10% runs off. In sharp contrast, in developed landscapes only 15% of stormwater infiltrates, 30% evaporates and an astounding 55% becomes runoff. This comparison is illustrated in Figure 30 below.<sup>49</sup>**

This fast-flowing water can be an important source of structural erosion and can be a source of wetland and watercourse contamination, leading to negative health effects on amphibian and fish species. To prevent this issue from occurring, maintaining permeable features in the urban landscape, such as gardens and grass headlands, is important. There are also many innovative ways to actively collect and manage stormwater in case of storm surges.

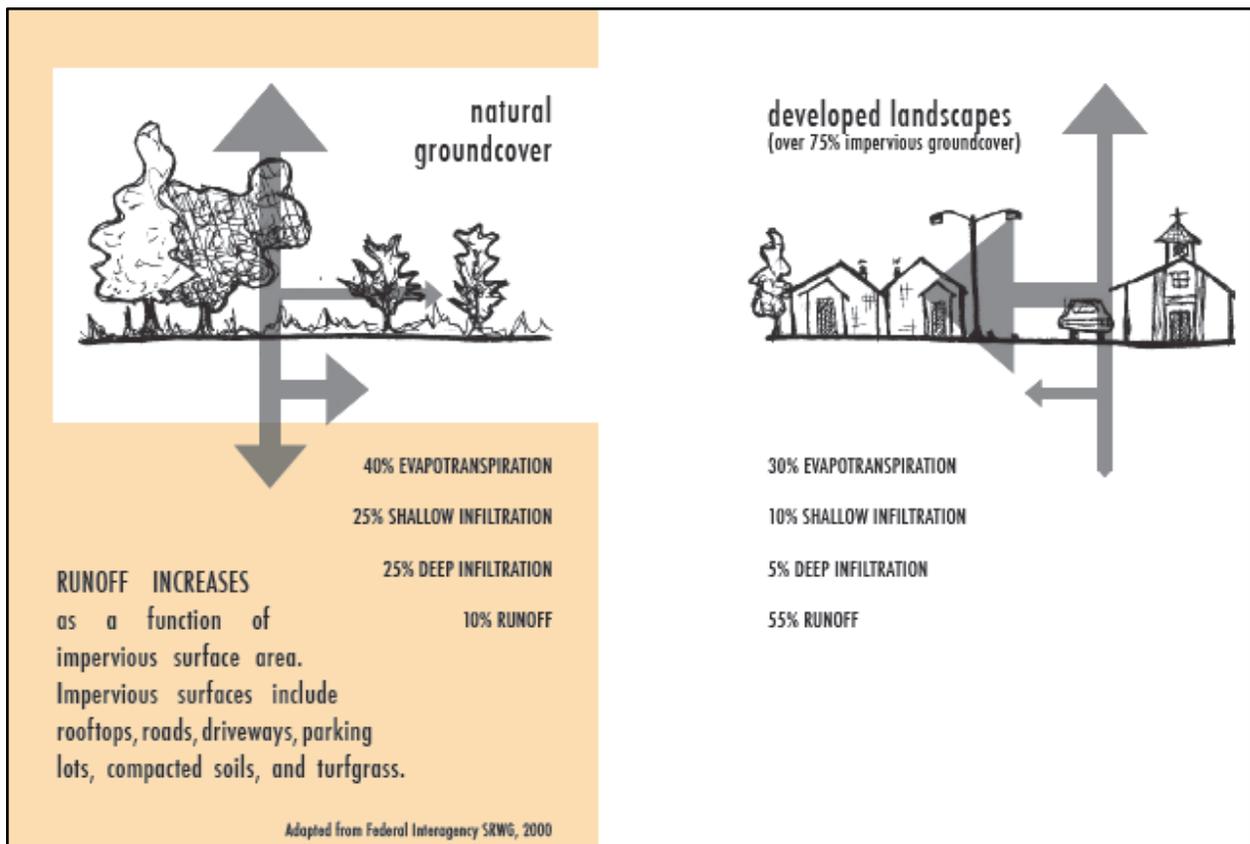


Figure 30: A diagram showing the effect of land urbanization on water infiltration and runoff<sup>49</sup>

## Rain Gardens

An innovative way to collect stormwater includes the use of rain gardens. These are drainage features that can be installed along city roads to collect stormwater and act much like a forest floor or riparian strip. They work by slowing the movement of water, and by filtering out pollutants before they can enter waterways. This also helps replenish aquifers and provides increased habitat for various wildlife species. Not only do they add to a city's aesthetic, but they help reduce the burden on water treatment facilities.

Figure 31: Rain garden installed along a city road; a gradient of plants is apparent <sup>50</sup>

**Rain gardens can provide, but are not limited to, the following benefits:** <sup>51</sup>

- Aiding in limiting the amount of water that enters the local storm drain system
- Reducing the potential for flooding, drainage problems and stream bank erosion by collecting excess water
- Reducing the amount of pollutants that run from yards and roads into waterways
- Restoring and recharging the aquifer and groundwater systems
- Lowering required maintenance
- Attracting birds, butterflies and beneficial insects, such as mosquito-consuming dragonflies
- Complementing any style of landscape and enhancing the beauty of the surrounding area



Some residents may be hesitant to use a rain garden due to concerns about creating mosquito habitat, but water in these areas is designed to drain within 48 hours. This will ensure that there is not enough time for mosquitos to complete their life cycle.

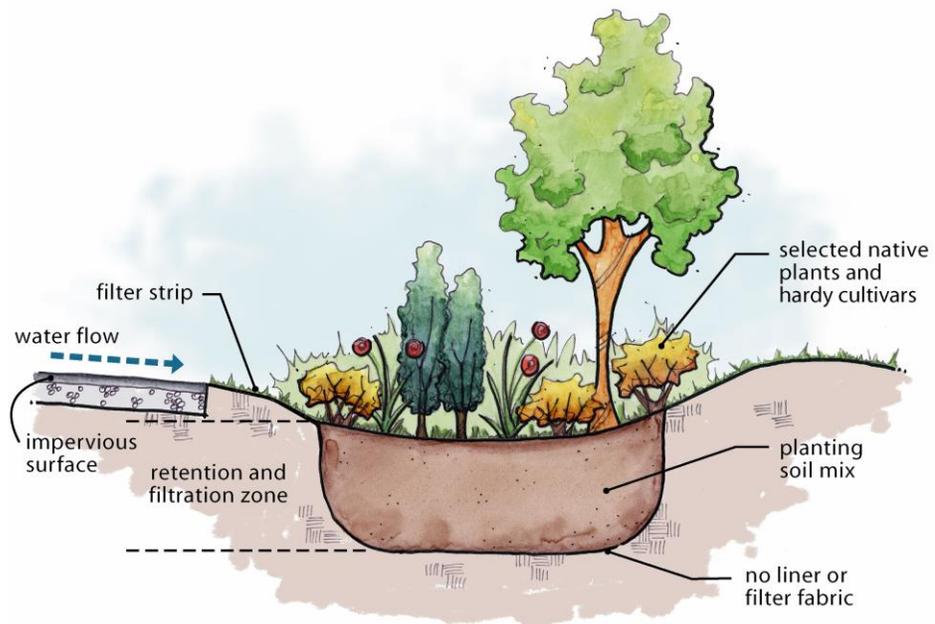


Figure 32: Characteristics of a rain garden <sup>52</sup>

Rain gardens are relatively easy and inexpensive to design and build, but there are a few considerations to ensure that they function effectively. **The two most critical technical considerations are that water must infiltrate and not stand in the bed for more than 48 hours, and water should not create drainage issues on residents' property or in the neighbouring areas.** Rain gardens can be naturalistic or manicured, include a multitude of plants species or only a few, and can be constructed in various shapes and sizes.<sup>53</sup> Rain gardens can be an inexpensive water mitigation technique for city residents or municipal staff to adopt. A network of rain gardens within a community can have cumulative effects by significantly lowering the pressure placed on stormwater sewers and water treatment plants, which ultimately results in lower operating costs and a cleaner environment.

The following diagram outlines the steps for residents looking to constructing a rain garden:



Figure 33: Steps to planning and designing a rain garden <sup>53</sup>

## Vertical Gardens, Green Roofs and Living Fences

Currently gardens, planters and hanging plants installed throughout the city require manual watering, becoming a timely effort for city staff to ensure proper care is given. In many urban areas, the option to plant a large garden may not always be present. **A growing trend is the integration of vertical gardens, green roofs and living fences. These types of planting methods can allow for increased green spaces by making use of confined areas.**<sup>54</sup>

It is important to encourage residents to take full advantage of their gardening space. This is especially important for small plot landowners or apartment dwelling residents. This type of vertical gardening will allow them to live healthier lifestyles, while also providing better air quality to the city in which they live. Designs for vertical walls could be listed on the city's website through the *NatureNet* program, offered as a community school program, community outreach program, or as an information pamphlet.



Figure 34: Example of a green roof in a large city.<sup>55</sup>

On a municipal scale, these simple ideas could be amplified by the incorporation of living fences and green roofs. Living fences can be made from various plant species and can be used to enhance for wildlife, while providing separation in existing park space. Although green roofs are not as highly visible as some other options, they provide a greater benefit as they turn a non-permeable surface into to a living, breathing organism. These gardens will greatly increase the air quality within the city, while requiring little maintenance if constructed properly. Green roofs can also provide vital foraging and stopover habitat for bird and other pollinator species.<sup>54</sup>

**Living structure benefits include:**

1. **Cost-efficiency** through shading lowering temperatures in summer by **up to 23%**. Living walls can be used near intake valves of HVAC units, so less energy is required to cool air
2. **Protection of infrastructure** by reducing temperature fluctuation buffering the wall's surface
3. **Prevents erosion** by capturing a portion of rainwater
4. **Reduces noise pollution** by helping reduce sound reflection, as plants absorb sound
5. **Improved air quality** when used indoors, as they can reduce the burden on air climatization systems, and increased oxygen supply can improve mood and productivity of workers
6. **Provides substantial pollinator habitat** with a small footprint
7. **Can contribute to several LEED credits** (Leadership in Energy and Environmental Design), which are becoming highly sought out in new commercial-building projects <sup>54 56</sup>

## Roofs that really hold water

Green roofs vary in plant types used, size and shape, but may consist of some or all of the following:

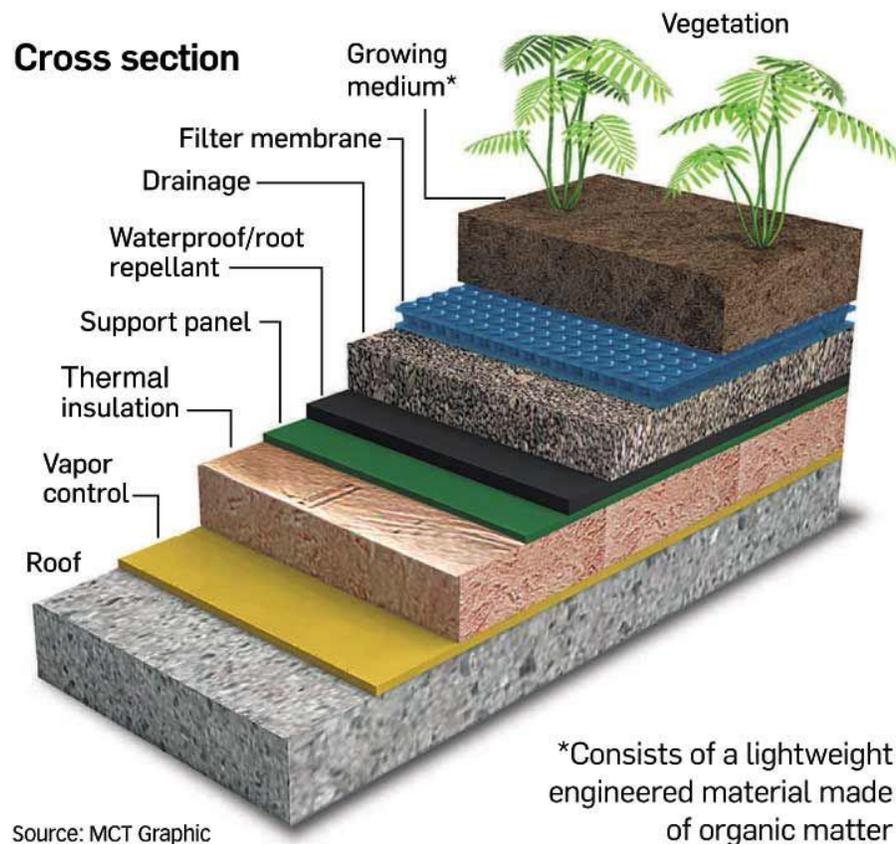


Figure 35: Example of layers in a functional green roof <sup>57</sup>

When choosing plant species for green roofs, it is important to consider the environment in which they are being planted. Although there are many companies that specialize in green roofs, it may be more cost effective to research and construct one with city resources and staff.

Plant species most commonly used for green roofs are:

- *Bouteloua gracilis*
- *Koeleria cristata*
- *Sedum kamtschatikum*
- *Sedum floriferum*
- *Sedum ewersii*
- *Sedum pluricaule*
- *Antennaria rosea*
- *Artemisia frigida*

Although these species are non-native to PEI, they are drought tolerant and are within PEI's "5B" hardiness zone. This will be beneficial as there are some general factors to consider when constructing a green roof. Environment conditions at the site (wind, frost, hardiness zone, microclimate, salinity) are the most important factors to consider. Any plant that does not meet these criteria should not be considered for the area as it will not survive. The goal is to have a low to zero maintenance roof. Factors to consider include: Is there a need for stormwater management? What weight will the structure support? What is the slope of the area, which will determine the size of green roof that can be built? What is the best growing medium to use? Will there be any negative ecological impacts due to the green roof? Finally, will it be aesthetically pleasing, as this will be the most important factor to the happiness of residents.<sup>58</sup> These are important factors as they will help in the development of a cost benefit analysis.

## Rain Barrels

Rain barrels help reduce run-off while collecting rainwater for later use. They aid in the prevention of flooding and in keeping pollutants out of streams. Rain barrels are connected to an existing downspout and have a debris shield which prevents mosquitoes and leaves from entering the water cistern. They are equipped with a spigot to allow dispensing of water into a watering can or attachment of a hose. A dark coloured tank is used to help prevent light penetration and algal growth. It is advised to keep the tank out of direct sunlight if possible to lower bacterial growth. By sitting outdoors rainwater will become sufficiently heated to an ambient temperature which is beneficial to plants. Plants will grow faster with ambient water rather than with cold water from the faucet, which can shock the plant.<sup>59</sup>



Figure 36: Typical rain barrel design, including debris filter, spigot hose, placed under downspout <sup>60</sup>

During the growing season, stored rainwater can be used to water gardens without having to depend on treated water. A city's treated water contains salts and chemicals, such as chlorine, that can be harmful to plants having a hindering effect on plant growth. Rain water also contains organic matter, minerals and nitrates making it slightly acidic, which makes it ideal for plant growth, whereas treated water is intended to be alkaline, or pH neutral, in order to protect metal pipes.<sup>61</sup>

**In Canada, the false perception among many is that freshwater is an abundant resource that will last forever. However, managing the use of treated water is a great way to save on monetary costs, energy costs, and reduce environmental impacts. In 2019, BBEMA is looking to design a program centred around water conservation throughout the City of Summerside.**

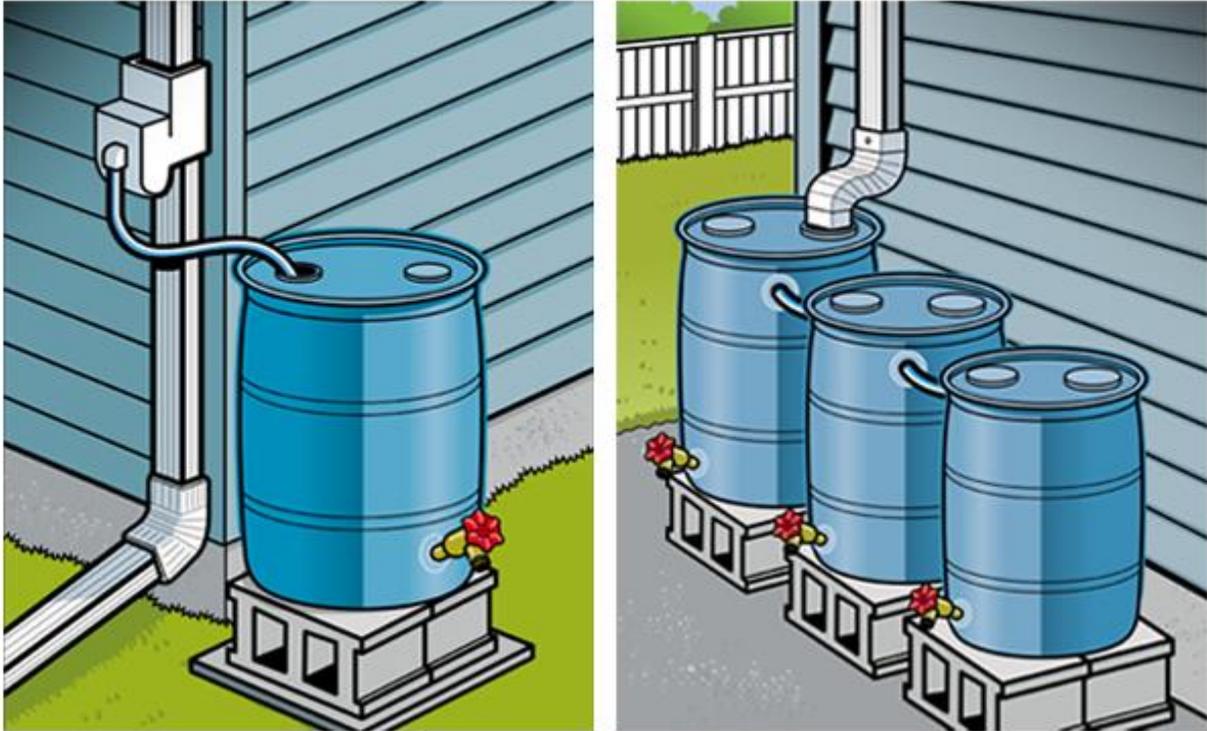


Figure 37: Installation of single rain barrel vs chain installation of rain barrels <sup>62</sup>

Rain barrels can easily be installed singularly or in a series and water can be run directly in the barrel or a diverter can be used so when the barrel is full the water runs out an overflow tube or in the case of the diverter water will continue running off via the downspout. This type of water conservation will allow for the slow release of water during dry periods and will help to reduce stormwater within the city.

# Wildlife Management

**This section of the Summerside Biodiversity Management Manual will focus on specific animal species that can be encountered in an urban environment such as Summerside. It has been designed to provide basic species information and outline some basic enhancement strategies for wildlife management.**

One of the most important pieces of information a wildlife biologist can obtain is the density of animal populations in each area, as well as information about the number of males, females and young. Trends collected from this information can indicate the overall health of the population and help to determine whether further management is required. Without management of wildlife and consideration of resource development, many species would soon disappear.<sup>63</sup> Methods to estimate wildlife population sizes include visual observation (with or without a trap), mating call counts, tracks, fecal matter, and hunter/trapper harvest information. Once a baseline population has been determined, enhancement options can be better considered to help bolster specific populations or to mitigate interactions through enhancement activities.

No one will protect what they don't care about, and no one will care about what they have never experienced.

— David Attenborough —

Wildlife management is more than collecting range and population density data; city staff should examine how wildlife species are interacting with their habitat. How wildlife move within a given area will provide enhancement opportunities where simple structures, such as wildlife crossings, will have a significant impact on wildlife interactions and protection.

*The following **Mitigation Strategies** should be considered for **all wildlife**:*

- Never deliberately feed wildlife; keep pet food and bowls inside
- Clean up fallen fruit from trees and remains from barbeque grills
- Never leave pets unattended outdoors
- Maintain a safe distance from wildlife, as even a 'cute' animal can become aggressive if it feels threatened
- For more information refer to City of Summerside Wildlife Policies

Along with completing enhancements for wildlife species, their habitat and managing invasive species, it is very important for city staff to educate city residents on the importance of wildlife within the city and the benefits they can provide. One way in which to ensure that enhancements are well received and are more protected is to incorporate a sense of ownership or responsibility on a community level. This can be achieved through community outreach programs and youth engagement. Increased signage will make residents more aware of local species, citywide conservation efforts and the importance of wildlife habitat to the ecosystem.

Figure 38: Lighthouse on Green Shore, Summerside<sup>64</sup>



## Herptiles

Herptiles (amphibians and reptiles) are an important *environmental indicator*, as they are highly sensitive to changes in their habitat. Amphibians can be used as a quick reference for water quality and water pollution, as a lack of amphibians in an area can be one of the first indicators of a poor water quality site. Their semi-permeable skin, which is used for breathing, gives them this unique bio-indicator trait. **Not only are pollutants in waterways becoming an increasing hazard, worldwide populations of these sensitive species are drastically declining due to habitat loss.**<sup>65</sup>

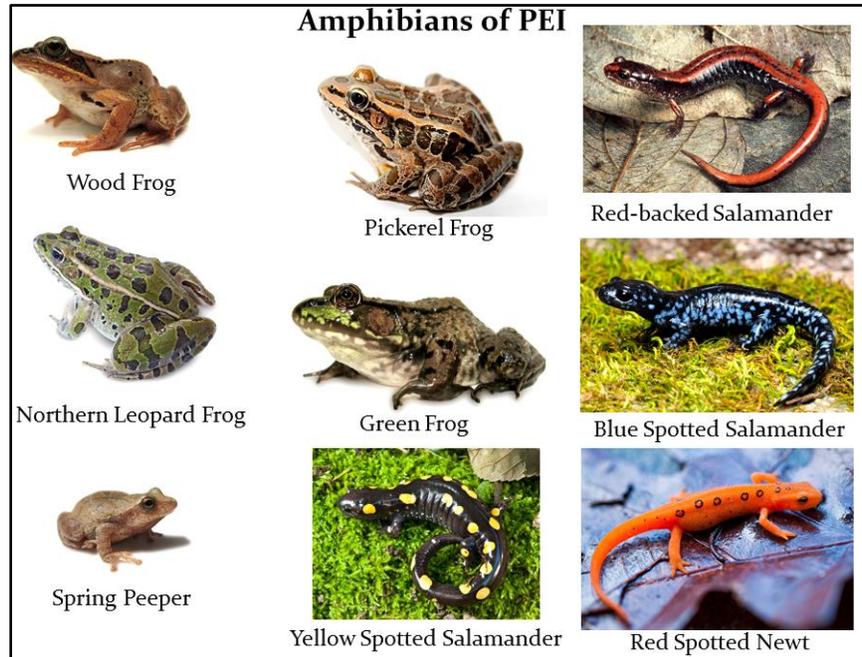


Figure 39: General morphology of native amphibian found on PEI <sup>66-73</sup>

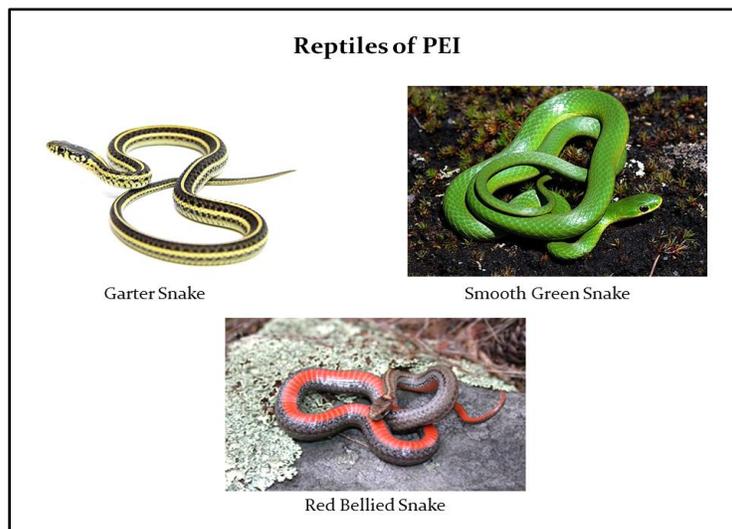


Figure 40: General morphology of native reptiles found on PEI <sup>74-76</sup>

## Enhancement for Herptiles

Each of the species listed in Figures 35 and 36 have slightly different habitat requirements but there are general enhancement methods which can be implemented to increase habitat for both amphibians and reptiles. If looking to enhance habitat for amphibians, pollution free water is key. Many amphibians also require still or very slow-moving water and in-water vegetation to provide an anchoring point for their egg masses.

**When doing enhancement for herptile species, take into consideration that some herptiles prefer specific vegetation. Newts, for example, prefer oxygenating plants while certain frog species, such as the spring peeper, prefer cattails for breeding purposes. In addition to ensuring that the water is pollutant free, it is important to have flowering shrubs and broad leaf plants around pools or ponds to attract insects for the amphibians to feed upon. Another important consideration is the addition of large stones and logs on land around ponds and streams to provide feeding and nesting habitat for newts and salamanders.**



Figure 41: Above left is an example of habitat where you might find amphibians; this includes rocks/logs near shrubs and broad-leaved plants. Above right are Salamander eggs found under a large rock

**Although enhancement for reptiles is similar to work for amphibians, they are less reliant on clean water.** To attract reptile species to an area, enhance the location by leaving tall grasses in open areas for feeding habitat. Use large rock piles or old culverts filled with rocks to mimic **hibernaculums** in dry forest areas for overwintering habitat. These can be as simple or as complex of structures as required but it is important that when installed they are above the water table to ensure the safety of the snakes. Do not use railway ties or pressure-treated lumber as they can also cause harm. Finally, create a monitoring program to ensure the structure's use and to track the local snake population.

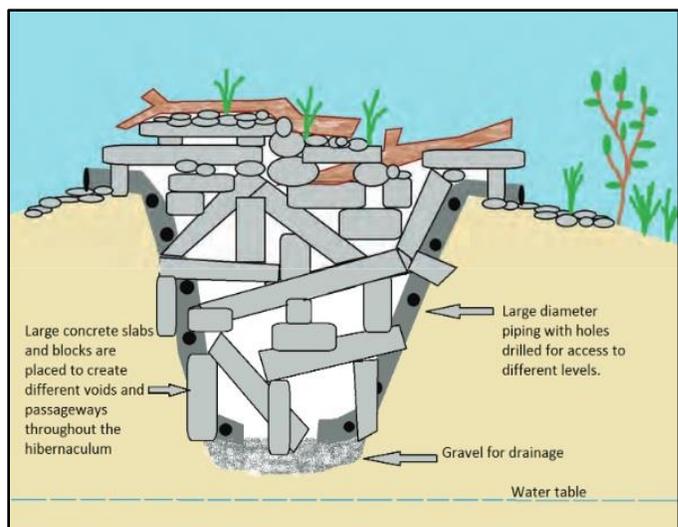


Figure 42: Example of man-made snake hibernaculum <sup>77</sup>

## Bats

In Prince Edward Island, there are two species of non-migratory bats that reside year-round; the little brown bat and the Northern-long eared bat. In addition to these two species, there are also migratory species that frequent the island including the hoary bat, big brown bat and/or silver-haired bat. Research is currently being conducted to determine which of the last two species has been visiting the island, but echolocation sequences for the two are very similar, making it difficult to determine the exact species.

**Bats provide appreciable services to humans, such as eating insects, pollination and seed dispersal. Although one bat can eat up to 10 000 mosquitos in a single night, they generally prefer to feed on higher protein insects.** Habitat for overwintering bats on Prince Edward Island includes abandoned wells, buildings, caves and other natural or man-made structures where they can maintain a constant temperature above freezing.

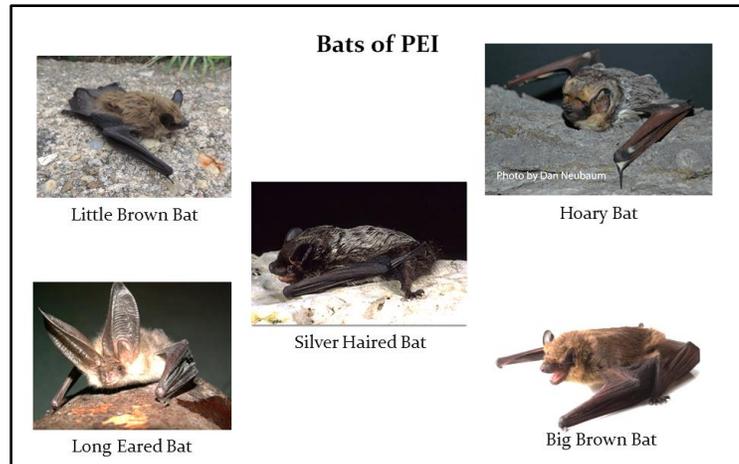


Figure 43: Native bats on Prince Edward Island <sup>78-82</sup>

Bats will generally emerge from their roost about 20 minutes after sunset to forage for insects. The best way to track bat activity is to use harmonics which are set in open fields to record ambient noise and is later processed to identify each bats echolocation and determine bat activity. For additional information contact Jordi Segers, a researcher with the Canadian Wildlife Health Cooperative (CWHC) at the Atlantic Veterinary College (AVC) in Charlottetown.

### White-Nose Syndrome



**White-Nose Syndrome (WNS) has led to the death of over 6 million bats in Canada and the United States.**<sup>83</sup> Although this number is staggering, it is lower than initial estimates had predicted. WNS is caused by a fungus, *Pseudogymnoascus destructans*, which most affects bats during hibernation, when their immune system is too low to withstand the infection.

Figure 44: Photo depicting the appearance of white nose syndrome <sup>84</sup>

The fungus, which appears as a fuzzy white substance, grows on the exposed skin of bats. This fungus is fatal to the bats as it affects hibernation patterns, by causing more activity during the normal rest period. The bats suffer internally and die due to dehydration or starvation as they waste their fat reserves that are not normally used in such high amounts during hibernation.

The following **Strategy** should be considered for proper care and restoration of **bat populations**:

- Be sure to monitor old buildings, wells, attics and cellars for bat activity
- Install bat houses or artificial hibernacula to provide shelter for migratory species that visit the island
- Avoid disturbing hibernating bats, as the unscheduled waking period can expend their energy reserves
- Reporting any sightings to Canadian Wildlife Health Cooperative, and any unusual behaviour or dead bats to Fish and Wildlife

HelpTheBats.ca is an initiative led by the Canada Wildlife Federation to protect our bat populations.<sup>85</sup> They provide bat-boxes which help provide shelter for overwintering and migratory bats. Alternatively, one could consider working with youth organizations or schools to create bat boxes and have them installed by those groups or by city staff, using designs found online.

### Bat removal

If there is a resident who has bats and does not want them, it is important to remember that bats need to be removed by professionals and at the right time to not affect their population. It is a complex and time-consuming process as bats can fit into small holes that need to be covered to avoid further bat populations from inhabiting the area. To report bat sightings, please call the Atlantic Bat Conservation Project at their toll-free number, 1-833-434-BATS (2287).

### Beavers

Beavers are semi-aquatic rodents and significantly affect the habitat and environment in which they reside. Beavers produce dams for protection, to gain access to food (species such as poplar and willow) and to store food over the winter. They normally breed every 3 to 4 years and produce an average litter of 4 kits. This relatively long life-cycle makes them vulnerable to overexploitation, as their numbers do not increase rapidly.

Beavers and their dams provide wetland habitat for a variety of birds, aquatic mammals, fish, and amphibians. They provide natural water purification by filtering out silt and uptake of nitrogen, while also providing nursery areas for trout. However, beaver dams can also lead to damage to roads and other infrastructure, property damage and loss of economic value of timber. Dams can block fish passage, negatively alter fish habitat and lead to warming of water which can be detrimental to fish.

Due to the above reasons, an integrated management approach, such as that outlined in the Beaver Management Policy by the Department of Environment, Energy and Forestry<sup>87</sup> is essential to maintain diverse, healthy, productive fish and wildlife populations while minimizing human conflicts.

Figure 45: American Beaver (*Castor canadensis*)<sup>86</sup>



The following **Mitigation Strategy** should be considered for areas where there is a conflict with residents and a **nuisance beaver**:

- The first is hazing the beaver by continually removing dams; this will cause them to relocate to another area in the river system
- The next would be to install a structure, such as a beaver baffler. This allows the beaver to stay in an area while maintaining a consistent water flow through the dam to prevent flooding into the surrounding area. However, this option will not prevent the beaver from feeding on trees
- The final option is to have the beaver trapped by a professional trapper from the PEI Trappers Association. This should only be explored if the other options are not viable as some residents do not agree with the trapping of animals

## Eastern Coyote

The coyotes found on PEI are much larger than western coyotes, as they have interbred with wolves during their eastward migration. Adults are the size of a medium-size dog, and are distinguishable by their slender, pointed muzzles and pointed ears. In the late 80's and early 90's, cull programs were used to control coyote population. Bounties for hunting coyotes have been attempted with very little success.<sup>88</sup>

**Hunting coyotes helps maintain a fear of humans and should only be done by those properly licensed to do so, with an emphasis on controlling problem animals that have lost their fear of humans and are actively pursuing livestock.** However, hunting coyotes usually does little to reduce their numbers, as fragmenting an established pack results in increased reproduction. In some cases, funding for pick-up of deadstock may be limited, leading to dumping in forests and the attraction of coyotes.

**Although coyote attacks on humans are extremely rare, the majority of the attacks occur in areas where coyotes are being fed by humans. This feeding should be avoided, as they can play host to a variety of parasites as diseases, such as ticks, fleas, intestinal worms, and rabies.** Also, they are opportunistic feeders and will prey upon whatever food source they can scavenge, including small livestock and pets. During the warmer months, coyote activity is usually restricted to the early morning and late-night hours, but during cooler months or in the absence of humans, they may become more active.

Figure 46: Eastern Coyote (*Canis latrans var.*)<sup>89</sup>



Mating pairs, generally consisting of only the alpha pair, will mate for life and occupy a range of up to 50km<sup>2</sup>. Despite this large home range, coyotes are very territorial and are thus self limiting. However, a high availability of food can lead to higher densities of populations throughout an area. On Prince Edward Island, the overall carrying capacity of the coyote is believed to be higher than its surrounding provinces, due to the high density of agriculture and livestock.<sup>88</sup>

For additional information refer to the Summerside Coyote Policy.<sup>90</sup> If a resident is looking for additional information or would like to report a coyote interaction contact PEI Fish and Wildlife.

The following **Mitigation Strategy** should be considered for **nuisance coyotes**:

- If seen, haze coyotes by yelling and waving arms to discourage their habituation of humans
- Coyotes are least afraid of humans during denning season (January to February), so extra caution should be taken to avoid interactions during this period
- To avoid coyotes from denning in your yard, restrict access under wood-piles or other structures that may be used as a den
- If in the agriculture industry, bury deadstock or pets at least 2-3 metres (6-9 feet) deep to prevent scavenging
- In persistent cases consider installing fences, at least 2-3 metres (8 feet) tall, and buried 30cm (12 inches) or extending outward in an L shape

City staff should begin collecting information from sightings within the city to determine if action should be taken. This can be done simply by filling out the following form:

<b>Coyote Incident Report Form</b>	
<b>Date:</b> (date of incident)	
<b>Time:</b> (time of incident)	
<b>Location:</b> (neighborhood, farm field, forest)	
<b>Approximate Distance:</b> (distance from coyote to human)	
<b>Type of Incident:</b> (sighting, hearing, attack)	
<b>Appearance of Coyote:</b> (size, colour, injuries)	
<b>Behavior of Coyote:</b> (calm, nervous, aggressive)	
<b>Location of Den:</b> (if known)	
<b>Animals Present:</b> (livestock, small pets, large pets)	
<b>People Present:</b> (adults, kids, infants)	
<b>Number of Coyotes:</b>	
<b>Other Notes:</b>	

## Rodents

The presence of mice and rats in your home is outlined by shredded cardboard, paper or droppings. They are a source of flea infestations and other diseases to you and your pets and are attracted to pet food and any food left open in your home.

It is not uncommon, especially during the winter months, to have an unpleasant encounter with a rodent who has made its way into a home uninvited.



What many do not realize, however, is that these pests can be much more than a nuisance. **Rodents, such as rats, mice, and hares, are associated with several health risks.**

Diseases carried by rodents can spread to humans indirectly, through fleas, ticks, or mites that have fed on an infected rodent. Rodent droppings can trigger allergies and transmit foodborne illness such as salmonella. As mice are capable of dropping up to 25,000 fecal pellets each year, an estimated 70 times each day. Prevention and prompt removal in any case of an infestation is key.<sup>91</sup>

Figure 47: Brown rat (*Rattus norvegicus*) and white-footed mouse (*Peromyscus leucopus*), two common species in Prince Edward Island <sup>92-93</sup>

*The following Mitigation Strategy should be considered for rodents:*

- An easy and cost-effective way of removing mice from a location is snap-traps baited with Cheese Whiz or peanut butter. If a trap doesn't spring within 48 hours, simply move it closer to where the rodents are believed to be, as mice rarely forage far from their dens
- To prevent the spread of diseases that are harboured by rodents, it is important to clean up droppings as they are found
- As rats are much more aggressive, it is advised that residents call a pest control company to eradicate the animal from the area

## Raccoons

Raccoons are non-native to PEI and were introduced in the 1900's to be farmed for their fur. Raccoons are most active at night when they scavenge. They have a varied diet and will eat just about anything, including trash from garbage cans. They are intelligent mammals and have great problem-solving skills, thus will easily find a way to get into garbage cans as well as rooftops and chimneys.<sup>94</sup>



Figure 48: Raccoon (*Procyon lotor*) ("Raccoon" citation)<sup>95</sup>

## Summerside Biodiversity Action Manual

Raccoons may use trees, attics, sheds and other buildings as dens. Because of their close proximity to humans, one of the major concerns with raccoons, aside from aggression, is the pathogens that they carry in their feces and fur.

**If there is a problem with a live raccoon, contact a pest removal service or Fish and Wildlife. In the case of a dead raccoon within the city limits, call the Department of Transport.**

*The following Mitigation Strategy should be considered for raccoons:*

- To avoid raccoons from rummaging through, garbage lids should be tied shut with bungee straps
- To keep cans from being toppled over bury wooden stakes upright minimizing movement

## Squirrels

There are three species of the *Sciuridae* family native to PEI - the American Red Squirrel, the Northern Flying Squirrel and the Eastern Chipmunk.



Figure 49: *Sciuridae* found on Prince Edward Island <sup>96-98</sup>

Squirrels commonly nest in tree cavities, rock piles or burrows but will nest in homes if their habitat is scarce. They spend the majority of their time gathering and storing nuts and seeds, often storing more than they can eat. This overabundance of food supply often leads to the growth of forests, as seeds are dispersed throughout.

Red squirrels are the largest of the three *Sciuridae* on the island, and are easily recognizable by their red coat, cream underbelly, and large bushy tail. Flying squirrels are nocturnal creatures and the least likely of the family to be seen on PEI. Despite their name, they do not fly but rather glide using skin flaps joining their limbs. Neither red squirrels nor flying squirrels enter hibernation, and both must store a large quantity of food to survive the winter.<sup>99</sup>

Chipmunks are the smallest of the three species and are easily distinguishable from squirrels by their light and dark stripes on their back and heads as well as their much smaller tails. During the winter and until the first warm days of March, chipmunks enter torpor (a state of hibernation

where animals wake up sporadically to consume food) before entering a state of reduced breathing and heart rate to lower their energy consumption.<sup>99</sup>

*The following **Mitigation Strategy** should be considered for **squirrels and chipmunks**:*

- To keep squirrels and chipmunks from becoming dependent on humans, keep pet foods inside and out of reach
- Emphasize physical barriers, such as wire mesh, rather than electric or chemical repellents to deter them from being in the area
- Restrict access to roofs, attics and sheds, and cut back branches of trees that are near buildings to avoid nesting



## Striped Skunks

Figure 50: Striped skunk (*Mephitis mephitis*)<sup>100</sup>

Much like raccoons, skunks are non-native to Prince Edward Island, and were introduced in the 1900's for their pelts. Despite a bounty that was paid for skunks from 1932-1964, their population continued to increase until the 70s, where many cases of distemper (a viral disease) were identified. Skunks are omnivorous, with insect larvae making up the majority of their diet.<sup>101</sup>

Skunks will only spray if they feel their life is in danger and provide many warning signs prior to spraying. Warning signs include stomping, charging and arching their back. Skunks often make their dens under barns, sheds and decks. If you have an unwelcome visitor, live-traps can be rented or purchased from your local hardware store, and placed just outside their denning site.

*The following **Mitigation Strategy** should be considered for **skunks**:*

- A way to reduce the risk of having skunks near your home is to discourage June bugs from laying larvae near your home, as skunks will go looking for them. June bugs are attracted to yard and window lights, so using an amber-coloured light or keeping window blinds drawn at night can discourage their presence
- If a skunk has taken up residence in the area, hazing the individual out is a viable option. Hazing techniques include using a loud radio that can be lowered or placed near a den, using a light such as a flashlight near the den site, or a rag soaked in ammonia or predator urine
- If hazing is being done, put a newspaper over the den entrance. Because the paper is easily torn it allows the animal to escape, while also alerting you if the den is still active. If the paper remains unbroken after a few days, then it can be assumed that the animal has vacated the den.
- A final option of trapping can be considered if hazing does not work

## Urban Foxes



Figure 51: Red fox (*Vulpes vulpes*), a common PEI resident <sup>102</sup>

**Citizens should refrain from feeding foxes to reduce their dependency on human sources for survival and lowering the chances and frequency of undesired interactions.** Outdoor feeding of pets should be avoided, and bird feed should be hung beyond reach. Feeding foxes human food is not a healthy diet and sugary foods can cause cavities, which may lead to infection and higher risk to pets and humans.

Foxes can harbour parasites and diseases that can be harmful to pets and humans. However, healthy foxes pose little threat to humans and are very rarely aggressive. Coyotes do not tolerate and will forcefully exclude foxes from their habitat. This behavior leads to higher risk of fox-human interaction.

*The following Mitigation Strategy should be considered for foxes:*

- To avoid posing a threat, maintain a safe distance and do not approach foxes
- Ensure compost areas and food are secure to avoid feeding
- If the fox is habituated to humans, hazing techniques may be used as an option

To monitor the urban fox population within the City of Summerside, the Urban Fox Program that is currently being run in the City of Charlottetown by the University of Prince Edward Island could be expanded upon. Tracking of the collared foxes could be done via radio telemetry, in tandem with the Holland College Wildlife Technician Program, who train their students on the use of telemetry equipment. This would allow for a low to no cost program for the city, provide a beneficial service for residents and help students obtain critical field experience.

## Tick Monitoring

### Identifying Risk of Ticks

Ticks are a non-mobile species of arachnid which rely on animals such as wildlife or pets for movement. They are most likely to be found in areas that are commonly travelled by animals such as long grassy areas, borders of properties or low-lying shrubs.

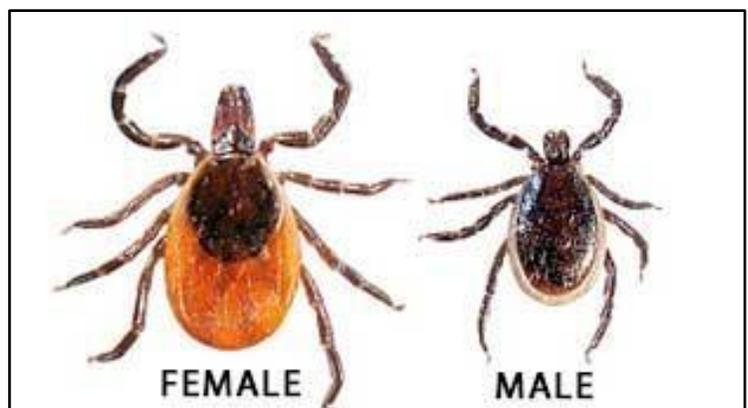


Figure 52: Comparison of female and male black-legged ticks (*Ixodes scapularis*) <sup>103</sup>

## Summerside Biodiversity Action Manual

A “tick drag” is a method used to collect ticks for research purposes. A drag is performed in areas that may house ticks, which are typically found about 18” from the ground on shrubs or tall grasses. To make a tick drag, attach a piece of wood, which will act as a weight, to the bottom of a 1 m<sup>2</sup> piece of cloth, felt or flannel. Tie rope to the upper portion of the cloth so it can be dragged by two people, while remaining at a safe distance from the drag.

Pull the drag across an area of grass or low brush and stop to count the number of ticks at fixed intervals (i.e. 10 m high tick density, 100 m for low density). Doing a drag catches about 10% of ticks in an area but can provide useful data and specimens for further analysis. A tick-drag performed from May through July will yield nymphal (juvenile stage) ticks. Adult stages are most

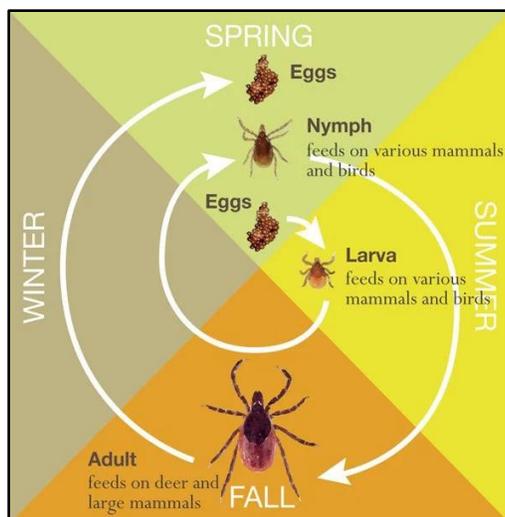
active during late fall and early spring.<sup>7</sup> Alternatively, if only one person is available, a “tick flag” can be constructed. This is made by attaching felt or cloth to one end of a pole and brushing taller vegetation in the understory of wooded areas, shrubs in open areas, property borders or tall grasses.<sup>104</sup>



Figure 53: Tick dragging on the Summerside Boardwalk in 2018 <sup>105</sup>

### Managing Tick Populations

To reduce human interaction with ticks, wear light-colored full-length pants and long-sleeved shirts. Tucking pants into socks to avoid contact when travelling through potential tick habitat. Landscape management, such as proper grass-cutting and plant maintenance, is advised to reduce physical interaction, but can become expensive and should be prioritized in high-traffic areas. Raking leaf-litter, brush, or other materials that retain moisture can also help reduce tick abundance.



Reducing the interaction between wild animals and domestic animals is advised. To do this bird-feeders should be moved away from buildings; this will reduce the risk of tick transfer and is also better for the birds as it will reduce the chance of collision. Reducing cover for rodents can be done by eliminating habitat, such as brush and wood piles. If there is a known risk of ticks, border treatments should be used creating an

Figure 54: Tick life-cycle by season <sup>106</sup>

inhabitable area for the ticks. This is accomplished by creating an area 1 meter or wider of wood chips, mulch or gravel between the turf and woods at the edge of a property. In extreme cases, when tick-vector disease risks are high the edges of trails, sports fields or wooded property can be sprayed with an area-wide tick control pesticide, but such measures should be used sparingly and timed to coincide with peak nymphal populations.

### Removing Ticks

To prevent disease, transfer the best practice is to check oneself and pets for ticks. It can take up to five hours following exposure for ticks to become firmly attached. To remove an attached tick use fine tweezers, or a tick hook, to grasp the tick as close to the skin as possible, then pull upward steadily.

The following precautions should be taken when removing ticks:

- **Do not twist or jerk the tick**, as their mouthparts can remain stuck in the skin
- **Do not squeeze or crush the tick**, as it's bodily fluids may contain infectious bacteria
- **Do not touch the tick with bare hands**, as infectious organisms can enter the skin through mucous membranes or cuts<sup>107</sup>

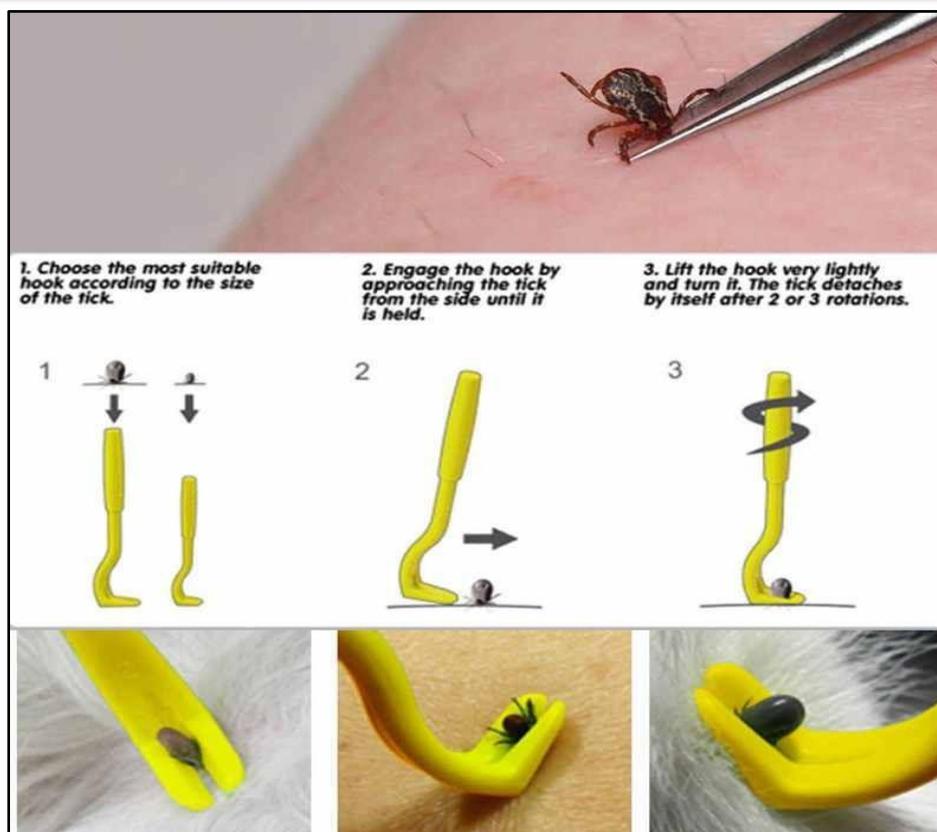


Figure 55: Guidelines for using a tick hook to remove a tick <sup>108</sup>

Once removed, apply alcohol to the bite and wash hands with soapy water. If a red rash in the shape of a bullseye appears, consult a health professional for yourself or pet, as this is the tell-tale sign of Lyme disease infection.<sup>104</sup>

# Invasive Species Management

**If improper control methods are used, many invasive species can incidentally spread further. This section of the manual highlights methods of controlling invasive species of primary concern in Summerside.** Although all invasive species are not covered in full detail, it is advised that city staff become adept at identifying invasive species to help monitor, prevent and manage their spread.

The PEI Invasive Species Council website provides baseline information on invasive plant and insect species on the island, as well as how to identify them. If the plant is believed to be invasive, follow the guidelines listed on their website. Although invasive species within the city are not a major issue at this time those present have the potential to become a major problem if allowed to spread unchecked.



Figure 56: Yellow Flag Iris (*Rhamnus cathartica*), a commonly sold invasive <sup>109</sup>

## Invasive plant species include:<sup>110</sup>

- Bittersweet Nightshade (*Solanum dulcamara*)
- Black Knapweed (*Centaurea nigra*)
- Blackthorn (*Prunus spinosa*)
- Canada Waterweed (*Elodea canadensis*)
- Common Buckthorn (*Rhamnus cathartica*)
- Common Reed Grass (*Phragmites australis ssp. australis*)
- Common Valerian (*Valeriana officinalis*)
- Cypress Spurge (*Euphorbia cyparissias*)
- Flowering Rush (*Butomus umbellatus*)
- Garlic Mustard (*Alliaria petiolata*)
- Giant Hogweed (*Heracleum mantegazzianum*)
- Glossy Buckthorn (*Frangula alnus*)
- Himalayan Balsam (*Impatiens glandulifera*)
- Japanese Knotweed (*Fallopia japonica*)
- Leafy Spurge (*Euphorbia esula*)
- Multiflora Rose (*Rosa multiflora*)
- Oriental Bittersweet (*Celastrus orbiculatus*)
- Periwinkle (*Vinca minor*)
- Purple Loosestrife (*Lythrum salicaria*)
- Scotch Broom (*Cytisus scoparius*)
- Sycamore Maple (*Acer pseudoplatanus*)
- Wild Cucumber (*Echinocystis lobata*)
- Wild Parsnip (*Pastinaca sativa*)
- Woodland Angelica (*Angelica sylvestris*)
- Yellow Flag Iris (*Rhamnus cathartica*)<sup>110</sup>

**Invasive insect species include:**<sup>110</sup>

- Asian Long-horned Beetle (*Anoplophora glabripennis*)
- Brown Spruce Longhorn Beetle (*Tetropium fuscum*)
- Emerald Ash Borer (*Agrilus planipennis*)
- European Gypsy Moth (*Lymantria dispar*)
- Japanese Beetle (*Popillia japonica*)
- Lily Leaf Beetle (*Lilioceris lili*)

Figure 57: Emerald ash borer (*Agrilus planipennis*)<sup>111</sup>**Invasive aquatic species include:**<sup>112</sup>

- Clubbed Tunicate (*Styela clava*)
- European Green Crab (*Carcinus maenas*)
- Golden Star Tunicate (*Botryllus schlosseri*)
- Oyster Drill (*Urosalpinx cinerea*)
- Oyster Thief (*Codium fragile ssp. fragile*)
- Vase Tunicate (*Ciona intestinalis*)
- Violet Tunicate (*Botrylloides violaceus*)<sup>112</sup>

**Purple Loosestrife (*Lythrum salicaria*)**Figure 58: Purple Loosestrife in the height of the growing season, with bright showy flowers<sup>113</sup>

Purple Loosestrife is so prolific and invasive because of the number of seeds it can produce within a single growing season and its ability to out compete other native plants for habitat and resources. **The best time of year to control Purple Loosestrife is during the Summer before the plant goes to seed, late June to early August. During this time Purple Loosestrife is in flower, so it is easily recognized with its large purple spikes and square stem.**<sup>114</sup> Removal can be done after Purple Loosestrife has gone to seed, however it is risky as the seeds are more likely to spread. The plants should be bagged and removed with the roots intact, bags must then be labeled and sent for disposal with Island Waste Management.

The following **Mitigation Strategy** should be considered for **Purple Loosestrife**:

- In areas where there are few plants and ease of access, removing the plants by hand is possible, removing as much of these roots as possible, to prevent new plants developing from rhizomes
- Composting is not an effective control method as the stalks do not decompose well, seeds will subsist, and plant can re-root itself
- Use of a biocontrol species such as purple loosestrife beetle (*Galerucella sp.*)<sup>15</sup>

The *Galerucella sp.* is a species of leaf eating beetles that are being used with great effect to control populations of Purple Loosestrife. This species of beetle is most effective once the beetle population reaches its carrying capacity. To accelerate the process, one method to be considered in the consolidation of Purple Loosestrife into a smaller area by removing outliers. This increases interactions between beetles and encourages reproduction and higher levels of herbivory on the remaining Purple Loosestrife populations.

This control method has been used in the City of Summerside but has not been regularly monitored to ensure the population growth of the beetles. This method has also been approved by researchers in Canada and the United States and has been determined to be safe. The beetle **only eats the Purple Loosestrife** plant and doesn't have any other host, so native species will not be affected.<sup>16</sup>

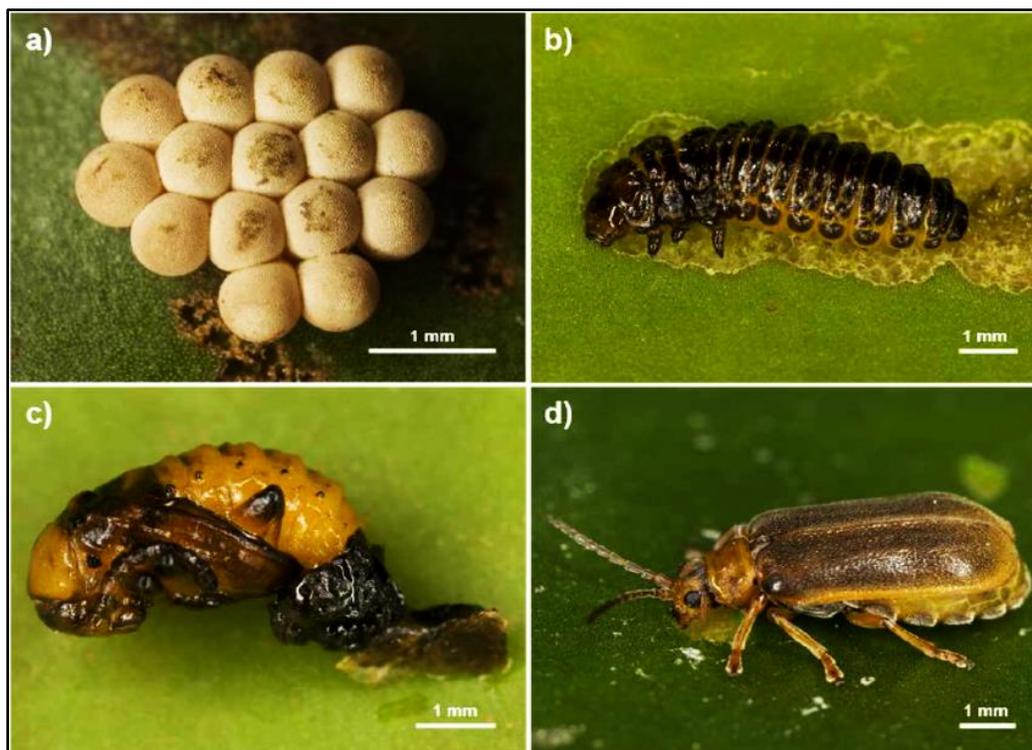


Figure 59: Life stages of the Purple Loosestrife beetle (*Galerucella sp.*) with size comparison, where a) eggs, b) larva, c) pupa, d) adult <sup>17</sup>

Prolonged exposure to the beetle should reduce *fitness* of Purple Loosestrife and cause it to lose vigor, reducing the purple loosestrife's growth rate and potentially stopping its spread, allowing for the re-establishment of native plant species. The success of this *biocontrol* can be monitored through damage to plants from feeding. For comparison, a number can be calculated by taking the *total damaged area* of loosestrife divided by *total area of loosestrife*. At least 3 to 5 unique samples should be taken depending on the size of plot, and percent damage from feeding should be recorded.<sup>116</sup>



Figure 60: Adult *Galerucella* sp. beetle observed on Purple Loosestrife population in Summerside, photo by BBEMA staff

### Bittersweet Nightshade (*Solanum dulcamara*)

This semi-aquatic plant species prefers low lying habitat and will normally be found around streams, ponds and bogs. Nightshade can cause an issue as it grows rapidly within one season and will choke out native species from an area, reducing water flow. Bittersweet Nightshade is somewhat poisonous and has caused loss of livestock and pet poisoning and more rarely sickness and even death in children who have eaten the berries. Fortunately, Bittersweet Nightshade has a strong, unpleasant odor, so most animals will avoid it, and poisonings from this plant are not frequent.<sup>118</sup>



Figure 61: Bittersweet Nightshade with fruit at various states of ripeness and purple flowers<sup>119</sup>

In the City of Summerside there is one major patch of Nightshade located in Heather Moyse Park which should be addressed. This spans approximately 150 meters from the pond in the centre of the park downstream to

the edge of the park and completely blankets the stream. Because very little has been done with this section, there are multiple years of root growth and decaying organic matter filling the entire water column. In 2017, BBEMA staff removed a small section of Nightshade. When this section was reviewed in 2018, water quality in that section was improved and there was little re-colonisation by Nightshade.

It is recommended that this area become a priority for remediation to help improve the health of the stream and the aesthetics of the park. This can be accomplished through manual removal of Nightshade from the stream. However, this can be very time consuming and laborious, so other removal methods should be explored. If accessible, the use of an excavator or other heavy equipment may be the most efficient option.

### Japanese Knotweed (*Fallopia japonica*)

The key to management of Japanese Knotweed is the allocation time and resources, as it will take a prolonged effort to suppress an established stand of this invasive plant.

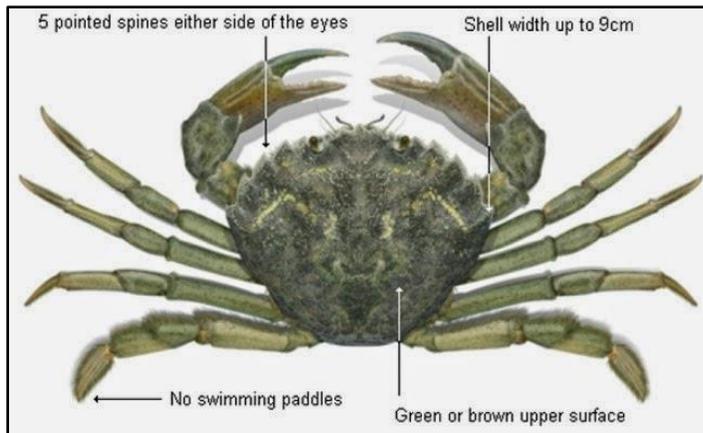


Figure 62: Flowering Japanese Knotweed <sup>120</sup>

*The following Mitigation Strategy should be considered for Japanese Knotweed:*

- Cut all above-ground shoots to lower its ability to photosynthesize
- Dig out the rhizomes of the plant, removing its primary energy source
  - If roots are disturbed, it can trigger additional growth in the plant, any root fragments left behind can remain active and regrow
  - It is important to pair physical removal of plant material with chemical or smothering to improve chances where applicable
- Injecting herbicide such as RoundUp directly into stems and spraying the leaves of new growth in non-riparian areas
  - RoundUp is prohibited from being used in riparian zones
- Smothering areas of the plant with large tarps or old carpet to choke out its access to light
- The larger the area covered the better, as shoots will search for seams and continue to spread
  - Weighing down tarps with fill, soil or other available material can be effective in preventing the plant's sharp stems from puncturing through the tarp
  - Continually monitor the area and cut any new shoots that appear <sup>121</sup>

## Green Crab (*Carcinus maenas*)



Green Crab are much more aggressive than native crabs and outcompete native species for resources, reducing invertebrate and fish diversity, damaging eelgrass beds and posing a threat to shellfish aquaculture. This invasive species is currently being monitored by the Department of Fisheries and Oceans. However, there is currently no mitigation strategies in place.

Figure 63: Green Crab (*Carcinus maenas*), a highly invasive aquatic species <sup>122</sup>

### Some options for populations control are:

- Determine the crabs molting cycle
  - harvesting of soft-shell Green Crab for use as a food resource
- Elimination via consistent trapping of crab, separation of Green Crab and submerging them in freshwater for 24 hours <sup>123</sup>

## Contacts

Bedeque Bay Environmental Management Association (BBEMA)	(902) 886-3211
Bat Removal	1-833-434-BATS (2287)
Fish and Wildlife General Enquiries	(902) 368-4683
PEI Trappers Association	(902) 659-2616
Department of Transportation and Infrastructure Renewal (Prince County)	(902) 888-8275
Injured Animals (during working hours)	(902) 368-4683
PEI J. Frank Gaudet Tree Nursery	(902) 368-4711

## Reporting Wildlife Issues

**If an injured animal is found during working hours**, call (902) 368-4683 or 1-866-368-4683, or leave a detailed message after-hours or on weekends.

**If the animal is located on a rural road or highway**, call the Department of Transportation, Infrastructure for Prince County at (902) 888-8275.

**If abandoned young animals are found**, it is best to leave them where they are found, as the parents are likely away searching for food.

**If a dead animal is found**, you may bury the animal on your own property. If so, wear protective equipment to prevent cuts or infections and dig a hole at least 40 cm deep to prevent other animals from digging it up.

## Closing Statement

This document was created by the Bedeque Bay Environmental Management Association (BBEMA) for the City of Summerside through Environment Canada's Eco-Action program. Information was collected from various sources including the PEI provincial government and Summerside city staff. Its intention is to highlight current best management practices. At the end of the project in 2019, BBEMA staff will transfer this document and the accompanying material to the City of Summerside. Its findings will be presented to city staff department heads and the Summerside city council. It is recommended that the document be reviewed every 2 years to adapt to changing priorities, accentuate Summerside's innovations and monitoring's of the city's progress.

Incorporation of any recommendations is subject to city approval. Although BBEMA's role is officially completed in the creation of the Biodiversity Action Plan, the organization will remain an active member in maintaining the biological and ecological health of the city. BBEMA welcomes any consultation regarding the content of this document.



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Changement climatique Canada

# Definitions

**Algal blooms** - the rapid increase or accumulation in the population of algae (in fresh or marine water systems). Recognizable by the discoloration in the water from the algal pigments.

**Anoxia** - greatly deficient in oxygen; oxygen less

**Anthropogenic** - of, relating to, or resulting from the influence of human beings on nature

**Bank stabilization** - a vegetative, structural or combination treatment of streams designed to stabilize the stream and reduce erosion.

**Beaver baffle** - a structure installed in an existing beaver dam, which allows water to flow through just enough to keep the beaver in that area, while mitigating property damage from overflowing.

**Best management practices** - activities that have been determined to be the most effective and practical way of preventing or reducing nonpoint source pollution to help achieve a goal.

**Biocontrol** - the reduction in numbers or elimination of pest organisms by interference with their ecology (as by the introduction of parasites or disease)

**Biodiversity** - the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems

**Brushmat** - an instream structure built of brush used to collect sediment, and provide future bank stabilization

**Cap and Trade system** - relating to or being a system that caps the amount of carbon emissions a given company may produce but allows it to buy rights to produce additional emissions from a company that does not use the equivalent amount of its own allowance

**Carbon sequestration** - the action of drawing CO<sub>2</sub> from the environment, and storing in a stable form, this is usually described by biological processes such as growing trees or plants

**Coastal erosion** - the wearing away of material from a coast, including the removal of beach, sand dunes, and/or sediment caused by wave action, tides, waves, drainage or high winds.

**Cocultivation** - cultivation of two types of cells of tissue in the same medium

**Deadfall** - a tangled mass of fallen trees and branches

**Eelgrass Management Threshold (EMT)** - The level at which the eelgrass population is sustainable, and used as a guideline to inform management goals while maintaining its beneficial aspects

**Environmentally Sensitive Areas** - locations which have special environmental attributes worthy of retention or special care, these areas are deemed critical for maintaining productive and diverse plant and wildlife populations.<sup>124</sup>

**Environmental Indicator** - a simple measure that helps provide insight on the health of the environment <sup>125</sup>

**Evapotranspiration** - loss of water from the soil by evaporation and transpiration from the plants growing thereon

**Eutrophication** - the process by which a body of water becomes enriched in dissolved nutrients (such as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen

**Fitness** - the capacity of an organism to survive and transmit its genotype to reproductive offspring as compared to competing organisms

**Green Infrastructure** - an approach to water management that protects, restores or mimics the natural water cycle <sup>126</sup>

**Hazing** - the use of deterrents (i.e. noise) to force an animal to move out from an area, or to discourage an undesirable behaviour

**Herptiles** - taxonomic group which includes amphibians and reptiles

**Hibernaculum** - a shelter occupied during the winter by a dormant animal (such as an insect, snake, bat)

**Host plant** - a plant upon which an organism (such as an insect or mildew) lodges and subsists

**Integrated Multi-Trophic Aquaculture (IMTA)** - sustainable aquaculture system emphasizing cycling of waste products from fish and feed to filter feeders, bottom feeders and algae.

**Living wall (vertical garden)** - self sufficient vertical gardens that are attached to the exterior or interior of a building, plants are rooted in a structural support fastened to the wall.

**Living shoreline** - protected, stabilized coastal edge made of natural materials such as plants, sand or rock to reduce erosion; living shorelines grow overtime.

**Microclimate** - the essentially uniform local climate of a usually small site or habitat

**Mitigation strategy** - an approach to reduce the risk of impact severity and/or the probability of an occurrence

**Natural meander** - a turning or winding of a stream; the natural state of water flow

**Naturescape** - a natural landscape

**Nurse species** - a species of tree or shrub that is often large and fast growing, used to shelter smaller, slower growing species

**Nutrient loading** - the accumulation of nutrients such as phosphorus and nitrogen in bodies of water

**Ocean acidification** - a reduction in the pH of the ocean over an extended period of time, caused primarily by uptake of carbon dioxide (CO<sub>2</sub>) from the atmosphere <sup>127</sup>

**Pinch points** - in-stream structures designed to increase water flow by forcing water to flow through a central channel, usually between large logs or boulders installed on either side of a stream

**Pollinator gardens** - areas planted with native flowering species that attract native pollinators

**Precautionary principle** - denotes a duty to prevent harm, when it is within our power to do so, even when all the evidence is not in

**Rain barrel** - a water tank or barrel used to store rainwater, typically running off of rooftops, for later use

**Rain garden** - an urban feature, usually along sidewalks that collect water runoff from hard-features such as pavement, patios, sidewalks, allowing water to slowly absorb through it's layers of plants, mulch and soil; helping to filter out toxic elements in the water.

**Sediment deposition** - results when suspended particles settle down to the bottom of a body of water, usually occurring due to lower flow rate or high sediment load

**Tallgrass community** - communities consisting of various grasses that are characterized by tall stature

**Urban forest** - a dense woodland within city limits

**Vertical layering (forest)** - describes how different plants grow in the same habitat, in layers, at different heights

**Wildlife corridor** - areas that connect fragmented pieces of habitat together and allow for species to travel from one isolated location to another.

*If not otherwise indicated, definitions from this section were sourced from Merriam-Webster dictionary.*

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