

Resilient Parks, Resilient City

The role of green infrastructure and parks in creating more climate-adaptive cities



Rain garden at Coxwell and Fairford in Toronto. Photo by Marc Yamaguchi.

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Park People

Park People is an independent charity that builds strong communities by animating and improving parks, placing them at the heart of life in cities. Park People's Park Solutions series explores the challenges and opportunities facing city parks in Canada by offering inspiration, best practices, and key strategies for moving forward. To read more visit www.parkpeople.ca/park-people-reports

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Climate change is causing extreme weather and impacting Canadian cities



Impacts from July 2013 flood in Calgary. Photo by James Tworow (FlickrCC)

It's become a familiar urban experience. Heavy rain, flash floods, rising water levels, and, ultimately, flooded parks, streets, and homes. With climate change leading to extreme weather—both hot, dry periods and heavy rain—it's imperative that we design our urban environments to mitigate these impacts. As one expert noted, Toronto is going to get “hotter, wetter, and wilder” with the effects of climate change.ⁱ Vancouver is expected to see dryer summers and wetter winters.ⁱⁱ

We only have to look at the last five years to see this playing out. In July 2013, the Greater Toronto Area experienced its most severe storm in 60 years. The 126mm of rain that fell in a two-hour period overwhelmed stormwater systems—the drains, pipes, and channels built to whisk water to treatment facilities—causing roads, railways, and basements to flood. It ultimately ended up costing \$1 billion in damage.ⁱⁱⁱ There are also negative impacts on the health of people and ecosystems.

Also in July 2013, Calgary saw heavy rain that caused the city's rivers, like the Bow River, to breach their banks, flooding neighbourhoods and causing evacuation orders and several deaths. This was explored in greater detail in a previous Park People report, *Green City*, written by University of Calgary Professor Bev Sandalack, which advocates for a landscape approach to

parks planning that recognizes and enhances the important ecological services provided by parks.^{iv}

This year, Toronto is again feeling the effects of climate change. Heavy and frequent spring rainfalls and high water levels in Lake Ontario meant much of the highly popular Toronto Island was closed due to flooding—a loss that many in the city acutely feel. The rain also resulted in large pools of standing water in many parks and reduced beachfront in waterfront areas. Parts of Quebec were also inundated with water from heavy rains this year that flooded streets and damaged property in and around Montreal and Gatineau.^v

Heavy rain causes visible damage from flooding, but it also has a more invisible effect. Many cities were built with systems that combine sewage and stormwater into the same pipes. When heavy rain overwhelms the system, its designed to release partially treated sewage and stormwater into our waterways as a safety valve to protect the system from flooding.^{vi} This is called a combined sewer overflow. Many cities are actively working to reduce these through investing in new stormwater infrastructure that reduces the amount of water entering the system as these overflows have damaging environmental effects and impact water quality.

But what does this have to do with our parks?

We can intentionally design our parks as climate-resilient infrastructure

Parks are essential for increasing natural habitat in cities, providing space for recreation and social connection, and improving our mental and physical well-being—benefits laid out in more detail in recent reports by Toronto Public Health^{vii} and Park People^{viii}. But as the primary “soft” landscapes in our urban environments, parks are also critical pieces of stormwater infrastructure.

Green spaces help soak up and filter rain where it falls rather than allowing it to run off hard surfaces like paved roads into storm sewers and, ultimately, into our waterways—along with the garbage, bacteria, and other pollutants it has picked up along the way. Absorbent landscapes, like parks, can reduce runoff by 8 to 10 times compared to impermeable surfaces like roads or parking lots.^{ix}

However, not every park soaks up rain just because it’s green. The soil in parks can become heavily compacted from use—like people running back and forth playing soccer—reducing the amount of water that can filter through the soil.

There is a solution. We can design our parks and public spaces as sponges, or with sponge-like elements, by using “green infrastructure” to help parks be more effective at capturing, retaining, and treating stormwater. This helps cool cities through natural shade and water evaporation from trees and plants, reduce flooding, and ultimately creates more climate resilient cities.

Essentially the idea behind green infrastructure is to engineer spaces to mimic or enhance nature's ability to slow down, soak up, and clean water where it falls, instead of whisking it away as fast as possible through drains to underground pipes—often called “grey” infrastructure. Green infrastructure in parks can include daylighted streams, rain gardens, and wetlands that filter pollutants and hold water or channel it to underground tanks.

Even small projects help. A green infrastructure demonstration project in Mississauga along Elm Drive reduced water entering the stormwater system by 30% during the heavy July 2013 storm.^x By lessening the amount of water flowing into the system, the project reduced the possibility that the system would be overwhelmed.

Many cities are directly incorporating green infrastructure into their climate change resiliency planning to ensure cities can weather the weather. Vancouver's new rainfall management plan argues that “as we experience changing climate and rainfall patterns, green infrastructure working in conjunction with the piped storm network will provide better service levels across the rainfall spectrum now and into the future.”^{xi}

Common Green Infrastructure Elements in Parks and the Public Realm

Rain garden. A depression filled with vegetation, trees, and rocks that collects and stores stormwater, using it as a water source for plants and allowing it to filter into the ground. These can be found in strategic locations within a park or along the edges of roadways where a drain allows stormwater from the curb to drain into the rain garden. New York City has invested heavily in creating rain gardens as part of their overall green infrastructure plan, resulting in the spin-off benefit of street beautification and increasing urban nature.

Stormwater management pond. An area designed to hold stormwater during heavy rainfalls. These can be designed as both wet and dry. A wet retention pond, like a wetland, is designed to always contain water, while a dry detention pond, like a basketball court or playing field, is designed to fill and hold water only during storms.

Daylighted streams. The practice of bringing streams that have been buried in pipes, back to the surface and renaturalizing them. For example, Vancouver is currently working on a plan to “create an ecologically diverse stream” through Tatlow and Volunteer Parks that will feed into English Bay.^{xii}

Bioswale. A depression or groove like a miniature stream, sometimes filled with vegetation and rocks, that channels stormwater to a drain, water body, or retention area, like an underground tank or aboveground pond.



Bioswale. Photo by Aaron Volkening (FlickrCC)

Bioretention storage areas. Underground stormwater treatment and storage areas using soil mixes designed to hold and infiltrate water. These can be used to create healthy conditions for trees, with engineered systems called soil cells to support paving above.

Permeable paving. Pavement that allows water to infiltrate to the ground below, rather than runoff of it, including materials like porous concrete and permeable interlocking concrete pavers. One study noted that permeable pavement is helpful in winter as it allows snowmelt to filter through, reducing the amount of freezing ice on the actual surface.^{xiii} Ideally these paving solutions are also designed to provide water for trees and planting areas through underground bioretention areas, expanding their benefit.

Green infrastructure provides multiple benefits

A key feature of green infrastructure is its multiple and layered benefits, unlike traditional grey infrastructure that performs a single function, such as conveying water in a pipe.^{xiv} Green infrastructure can:

- **Perform important environmental functions.** This includes decreasing water runoff, improving water quality, mitigating and prevention erosion, and cleaning the air. It can also reduce the urban heat island effect by increasing green areas that don't absorb heat like hard surfaces—an important cooling benefit to cities as climate change results in hotter weather.
- **Improve and expand urban nature and habitat.** Green infrastructure can include native plants that provide critical habitat and food for pollinators, such as native bees and butterflies, and other wildlife that are under threat, helping to promote urban biodiversity and healthier ecosystems.
- **Create new community gathering and recreational spaces.** Green infrastructure can increase public space and recreational areas in cities. These projects can enhance existing parks, but they can also be opportunities for creating new green spaces and plazas from underused areas like roadways and traffic islands.
- **Save money.** By reducing the amount of money a city spends on expensive infrastructure like pipes, green infrastructure can help save money. For example, Copenhagen estimated that its green infrastructure approach to stormwater management was estimated to cost half the price over time of a more traditional “grey” infrastructure-only approach.^{xv}
- **Create safer roads.** If included within traffic calming measures such as traffic islands and bump-outs that increase pedestrian space or separate bike lanes with planting areas, green infrastructure can help slow down cars and improve traffic safety.^{xvi} Toronto's new Complete Streets guidelines, for example, contain a section on green infrastructure.



Cycling and green infrastructure. Rendering from NACTO

A great example of the multiple benefits of green infrastructure projects can be found in Toronto's **Raindrop Plaza**. Designed as a Green Streets pilot project in conjunction with the city's new green street technical guidelines, this 2018 project will transform a wide turning lane and traffic island into a new permeable plaza with rain gardens. The plaza will feed stormwater runoff from the street through a shallow swale meant to highlight the many rivers in Toronto that were buried in the city's development. The plaza will use the captured rainwater to help water trees onsite, with bioretention areas in soil cells below the permeable paving. Through this project, the city will create a new green community gathering space, increase natural habitat, provide opportunities for learning about ecological systems, and, of course, reduce stormwater run-off. In fact, a cost-benefit analysis of the project done by the Carleton Centre for Community Innovation at Carleton University for the City of Toronto found over \$200,000 in benefits—almost a third of the overall construction cost.^{xvii}



Raindrop Plaza. Rendering by Schollen & Company.

Of course, there are challenges to green infrastructure as well. Some of the key areas that need to be carefully considered are:

- **A strong emphasis on maintenance.** Often there are concerns that the maintenance costs for green infrastructure will be higher than traditional parkland because it can require special training. But a study by Credit Valley Conservation found that when park staff were included within the process of choosing plants for green infrastructure projects, the maintenance requirements were similar to traditional parkland development.^{xviii}
- **Balancing the needs of park users.** Green infrastructure elements, such as rain gardens and wetlands, require space within parks—space that is often at a premium in urban environments. It's important to balance designs and consider how features can double as recreational park amenities, like soccer fields and skateboard bowls that can also store water during storms.
- **The need for new monitoring and evaluation programs.** Some parks are designed with green infrastructure elements to capture only the rain that falls within the park, while others are designed with special systems to actual divert water from surroundings streets. It's important to determine the performance of these spaces, such as how much water the park can handle and how often maintenance needs to be done.

Five things Canadian cities can do to improve green infrastructure in parks

1. Include green infrastructure where possible when undertaking park redesigns and building new parks and public spaces

Green infrastructure should be more formally integrated as part of park planning and design so that opportunities are considered upfront in both park redesigns and new parks, with agreements or funds secured for ongoing maintenance, rather than as an after thought. This also ensures green infrastructure elements are integrated seamlessly into the design and can actually become amenities and recreational features of the park.

As Andy Frank, environmental engineer for Montgomery County in Maryland, said in an interview with the National Parks and Recreation Association: “Every agency has parks and facilities that they must renovate or retrofit, and every new park project offers opportunities to integrate green stormwater management early on. In fact, the earlier you integrate it into the project the easier and less expensive it is.”^{xix}

Take **Toronto’s Corktown Common**. Children playing in the park’s splash pad or people picnicking on the grass may not know that they are actually on a flood protection berm that is designed to protect the lower-lying areas of the city to its west from the Don River flooding to its east. The park is a gem of a space, complex and rich with biodiversity and landscape, including winding pathways, water features, and a wetland.^{xx} But these features are also functional, helping to capture and filter rainwater, which is then treated with ultraviolet light and stored in tanks underneath the park to be used for irrigation.^{xxi}



Corktown Common. Photo by Jake Tobin Garrett

The redevelopment plan for **Calgary's Bowmont Natural Environment Park** focuses on incorporating green infrastructure into the park to protect the Bow River, which was the source of major flooding during the 2013 storm. "The park's location in the floodplain offers a rare opportunity to protect the Bow River by incorporating green stormwater treatment as a functional element of the park," the City notes. "The stormwater elements will also provide a major park amenity that contributes to visitors' experience in the park."^{xxii} Green infrastructure elements like a wetland are being incorporated into wildlife habitat and also walking and cycling trails.

In **Vaughan**, plans for **Edgeley Pond and Park** are a critical part of the city's overall plans to develop a new downtown community in the Vaughan Metropolitan Centre. The project will create a new 7.5-hectare passive and active open space for community use that also doubles as essential green infrastructure and flood protection—critical for unlocking new land for development in the area.

2. Create a comprehensive plan for rolling out green infrastructure

Many cities continue to experiment with pilot projects, one-off projects, and small-scale green infrastructure initiatives, but it's important to provide resources and staff to invest in a strategic implementation plan that can provide guidance on how to roll-out green infrastructure in a more comprehensive manner. These plans may require green infrastructure in new developments and also assess the current park system to understand where the best opportunities are found.

As **Vancouver's** recent **Rainfall Management and Green Infrastructure Plan** notes, green infrastructure projects in the city have mainly been "staff-led pilot initiatives" that were "developed only when opportunities arose and resources were available, rather than an integral part of City capital programs or development requirements."^{xxiii} The new plan changes that, building on what the City has learned through many pilot projects and laying out broad targets—such as capturing, filtering, and treating 90% of rainfall before it reaches the ocean—and specific strategies about how to accomplish this.

Montreal's Towards Sustainable Municipal Water Management plan includes an emphasis on green infrastructure, including the city's green alleys program where partnerships with residents transform alleys from paved surfaces to green landscapes. The plan also includes building rain gardens and stormwater ponds at the edges of parking lots and parks, such as the city's central park, Mont Royal.

But it's **Philadelphia's Green City, Clean Waters** plan that is a leading example of comprehensive green infrastructure planning in North America. The city just celebrated the fifth anniversary of this 20-year plan by announcing that the projects completed in its first five years are now diverting 1.5 billion gallons of polluted water annually from rivers.^{xxiv} The plan includes a partnership with Philadelphia Parks and Recreation to include green infrastructure

within city parks, such as the recently renovated **Ralph Brooks Park**, which includes rain gardens and a storage tank beneath a basketball court that can hold 16,000 gallons of water.^{xxv}

3. Make green infrastructure playful and visible to encourage ecological literacy

So many of the critical systems in our city operate underground or out of sight—only becoming a topic of conversation when there is a problem, like flooding from a storm or a power outage. By making stormwater infrastructure visible through wetlands, bioswales, and other green infrastructure elements, we are also creating educational opportunities for learning about our natural environment and city systems. Interpretive signage, playful elements, tours, and educational programming can raise awareness and support.

Copenhagen has really taken this to heart with a new urban park it has developed called **Tåsinge Plads**. Billed as the city’s first “climate-adapted urban space,”^{xxvi} the park transformed what was once mostly pavement into a multi-levelled public space that captures and holds rainwater from 4,300 square metres of the surrounding neighbourhood. Sculptural elements like upturned umbrellas capture rain and provide water for plants. The park is part of a wider climate adaptation plan that aims to create a more climate resilient Copenhagen through the type of green infrastructure and park investments seen in Tåsinge Plads.^{xxvii}



Tåsinge Plads in Copenhagen. Photo by Klimakvarter

But it doesn't have to be complicated. In **Vancouver's, John Hendry Park**—locally known as Trout Lake—a swale of plants and rocks directs stormwater from the roof of the adjacent community centre through the park and into the lake, creating a unique feature within the park and a visible indication of hydrological systems. A forthcoming redesign of the park will include even more green infrastructure elements, including meandering streams that feed water into the lake.

4. Involve community members and create job training and skill development opportunities

Green infrastructure park projects can offer opportunities for communities to be involved in creating a vision for the park, but also in the stewardship of those spaces. As with any park project, it's critical to involve community members early on and throughout the process, but also ensure there are opportunities for people to stay engaged after the project is completed. **Philadelphia's Green Parks** program, for example, allows community members to nominate a park in their neighbourhood for consideration of green infrastructure improvements.^{xxviii}

Local organizations or volunteer groups, such as a park friends group, could also become involved in assisting with the maintenance of green infrastructure elements or running educational programming. An adopt-a-rain garden program could be modelled after other programs where garden spaces are adopted like Vancouver's Green Streets or Montreal's Green Alleys.

Green infrastructure projects can also be used to foster local economic development by incorporating job training and skill building for local communities. The organization **Park Pride** in **Atlanta**, for example, has worked with community service organizations to hire local youths to work on green infrastructure projects in parks.^{xxix}

5. Create financial tools to help fund green infrastructure projects in parks and the public realm

Some cities are turning to dedicated stormwater fees to fund green infrastructure projects. Rather than a tax, these are structured as "user fees" that are charged to properties based on their amount of impermeable surface and thus how much they contribute to stormwater runoff. These can be an important new source of funding for park projects that include green infrastructure elements, both in their construction and maintenance.

As noted within a recent Credit Valley Conservation report: "In cases where municipalities have implemented stormwater management rate systems, putting [green infrastructure] features into parks can be an incentive for parks and recreation staff. Operational costs for maintaining [green infrastructure] landscape features and permeable parking lots are generally paid through the stormwater rate instead of from the park's budget."^{xxx}

Philadelphia, for example, has a stormwater fee based on the amount of impermeable surface on a property that helps fund stormwater management infrastructure, like the city's many green infrastructure developments in parks and public spaces.^{xxx} **Mississauga** recently approved a similar stormwater charge that took effect in 2016.^{xxxii} Unfortunately, **Toronto** shelved a plan in 2017 to create a dedicated fee that could fund stormwater projects.^{xxxiii}

Green infrastructure is about more than stormwater

Green infrastructure at its core is about creating spaces that help manage stormwater, but these projects also bring a host of other benefits—from habitat creation to providing new spaces for people to gather. Much like parks, the benefits of green infrastructure are deep and layered, touching on the environment, economic, and social.

Green infrastructure can be used as a method of park and public space creation, turning leftover bits of roadway and other spaces into beautiful multi-functional community spaces, like Raindrop Plaza. It can also be used to unlock land for development by providing flood protection, like Toronto's plan to renaturalize the mouth of the Don River to open up the Portlands for development.

It can be used to create playful, whimsical urban spaces that also provide opportunities for learning about our ecological systems. It can provide ways to save money, especially when coupled with a stormwater fee that incentivizes green infrastructure development. And, critically, it does all this while providing a way to create more climate-resilient cities that are better able to weather the impacts of climate change. Investing in green infrastructure in our parks and public spaces just makes sense.

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- ^v See <http://www.ctvnews.ca/canada/documenting-the-ravages-of-flooding-in-quebec-1.3409153>
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- ^x Credit Valley Conservation, p.12
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- ^{xii} See <http://vancouver.ca/parks-recreation-culture/tatlow-and-volunteer-park-stream-restoration.aspx>
- ^{xiii} Credit Valley Conservation, p. 25
- ^{xiv} Green Infrastructure Ontario Coalition. *A Green Infrastructure Guide for Small Cities, Towns and Rural Communities*. 2016. p. 4
- ^{xv} See <http://citiscopes.org/story/2016/why-copenhagen-building-parks-can-turn-ponds>
- ^{xvi} Credit Valley Conservation, p. 10
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- ^{xxi} See <http://blog.waterfrontoronto.ca/nbe/portal/wt/home/blog-home/posts/torontos+next+generation+stormwater+infrastructure+01>
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- ^{xxxii} See <http://www.mississauga.ca/portal/stormwater/charge>
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