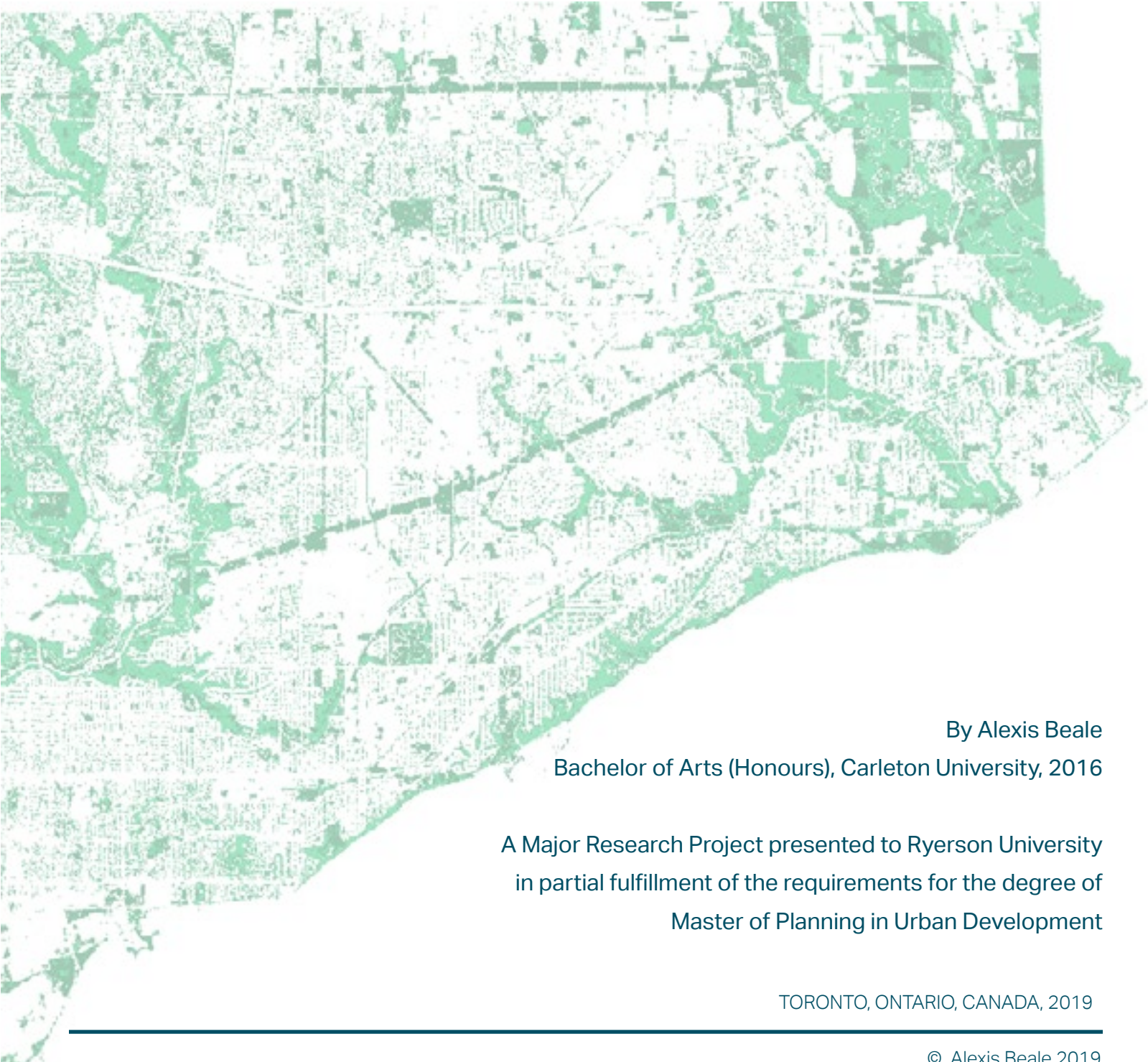


# A Renewed Approach

*Exploring Toronto's relationship to biophilia*



By Alexis Beale  
Bachelor of Arts (Honours), Carleton University, 2016

A Major Research Project presented to Ryerson University  
in partial fulfillment of the requirements for the degree of  
Master of Planning in Urban Development

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**A Renewed Approach**  
*Exploring Toronto’s relationship to biophilia*

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Master of Planning in Urban Development  
Ryerson University

**ABSTRACT**

The positive benefits of biophilia in cities is well documented. Furthermore, the positive relationship between human well-being and nature plays an important role in cities. This paper will discuss the role of nature in cities and how it promotes both environmental and human health, with the ultimate goal of developing a framework that will help Toronto become a partner city of the Biophilic Cities Network.

**KEYWORDS**

biodiversity, biophilia, biophilic cities network, green Infrastructure, green roofs, health, policy, Toronto

# Acknowledgments

Thank you to my supervisor, Nina-Marie Lister, and second reader Jane Weninger for providing valuable insight and guiding me in the right direction.

# Dedication

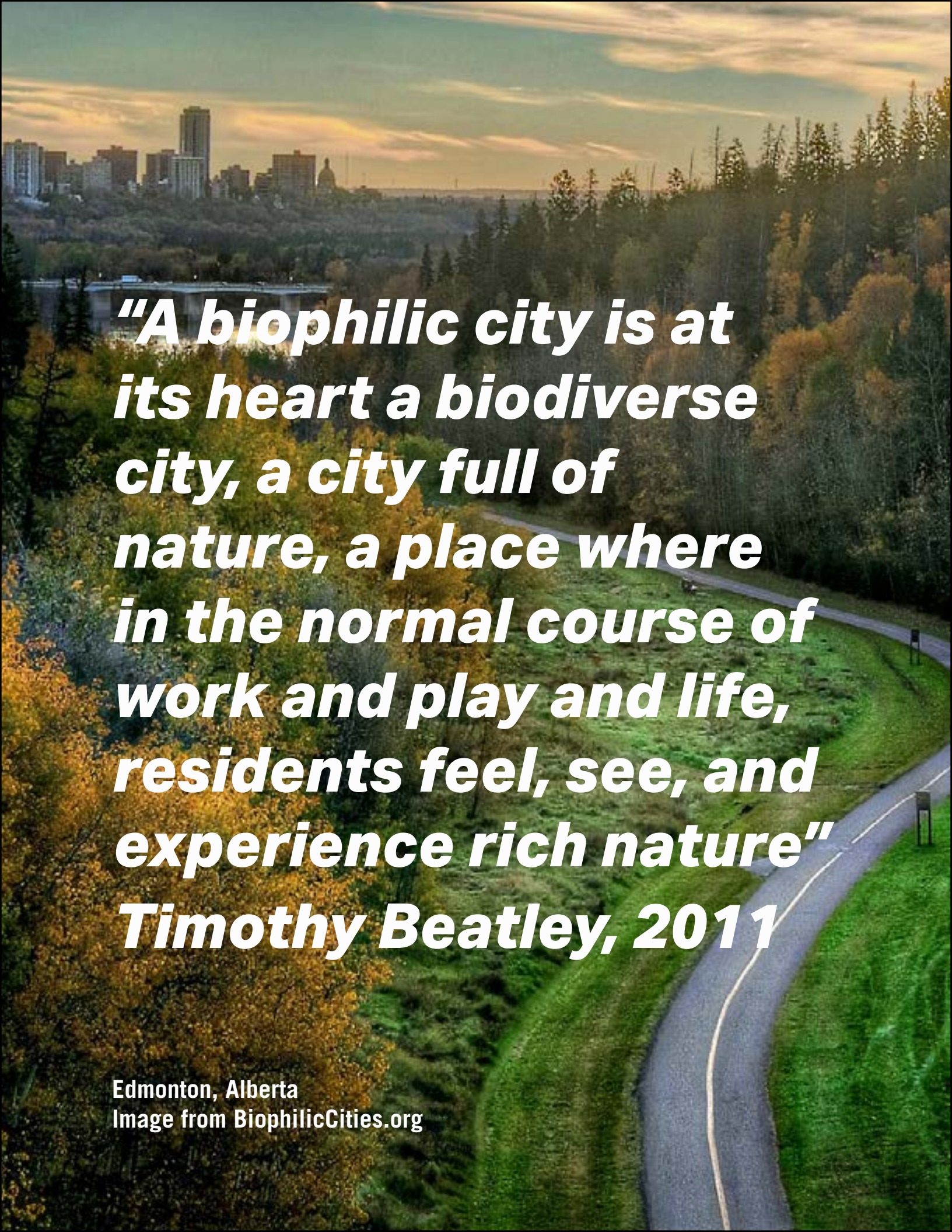
To my mom and dad, who have provided me with endless support every step of the way.

To Jackie, Jennifer and Luba - thank you for putting up with me throughout this entire process, even when it was difficult.

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An aerial photograph of a city skyline, likely Edmonton, Alberta, viewed from a distance across a large, green, forested hill. A winding paved path curves through the lower right portion of the hill. The sky is filled with soft, golden light, suggesting a sunset or sunrise. The text is overlaid on the left side of the image, in a bold, white, italicized font.

***"A biophilic city is at its heart a biodiverse city, a city full of nature, a place where in the normal course of work and play and life, residents feel, see, and experience rich nature"***  
***Timothy Beatley, 2011***

Edmonton, Alberta  
Image from [BiophilicCities.org](http://BiophilicCities.org)



# 1 | Introduction

The word biophilia comes from **bio** meaning life, and **philic** meaning type of love, fondness or tendency towards something specific. The concept of Biophilia is attributed to the work of biologist E.O Wilson and his book Biophilia (1984), where he describes the importance of humanity and our innate connection to the natural world. The concept was further developed through a collaboration with E.O Wilson and Professor Stephen R. Kellert in their book The Biophilia Hypothesis (1993). The Biophilia Hypothesis expands upon Wilson's original views that humans need a connection to the natural world and focuses on the biological and psychological aspects of nature and humanity (Kellert & Wilson, 1993).

A Biophilic City is a "city that puts nature first in its design, planning, and management [and] recognizes the essential need for daily human contact with nature" (Beatley, 2011, p.45). A Biophilic City is aware of the environmental, economic, and health benefits that are provided by nature and natural systems and strives to better them to create more welcoming urban environments (Beatley & Newman, 2013).

Dr. Timothy Beatley founded the Biophilic Cities Network in 2013 as a way to promote the value and share the benefits of green infrastructure<sup>1</sup> as a necessary investment in planning for cities (Beatley, 2013). The growing trend of biophilia promotes greener and 'natureful' cities and speaks to the importance of nature in urban environments, and the creation of more inclusive green spaces in cities across the world (Beatley, 2011).

Toronto is a "natureful city" with an extensive ravine system, growing tree canopy, and commitment to green infrastructure (i.e. green roofs). Around the world, Toronto is known for its parks and natural environment. The city is home to over 1,600 parks covering 7,700 hectares of land and provides 28 square metres of parkland per person (Garrett, 2017). Despite Toronto's strong connection to nature and being known as the 'city within a park,' the City is not yet an official partner of the Biophilic Cities Network. The Biophilic Cities Network is currently partnered with 16 cities worldwide that promote the value and share the benefits of green infrastructure as a necessary investment in planning for urban resilience and climate change' (Biophilic Cities, n.d.-a)

**The purpose of this applied project is to develop a document that can assist Toronto in applying to become a partner city of the Biophilic Cities Network. It will emphasize the importance of green space in our cities and support the City's goals in resilience, sustainability and urban green space.**

<sup>1</sup> Green infrastructure can be defined as the natural and human-made elements that provide ecological and hydrological functions and processes (City of Toronto Official Plan, 2002). Examples of green infrastructure include street trees, green roofs and green walls.

**2** Chapter 2 will provide an overview of the research methods that were used throughout this applied project.

**3** Chapter 3 will provide an overview of Toronto's historical planning context, and the environmental features that make Toronto a strong candidate to be a partner city of the Biophilic Cities Network.

**4** Chapter 4 will provide a review of the emerging literature surrounding biophilic design, green infrastructure and the importance of nature in cities.

**5** Chapter 5 includes a policy and design overview for the Province of Ontario and the City of Toronto.

**6** Chapter 6 will provide relevant comparative case studies of other cities that are partner cities of the Biophilic Cities Network

**7** This project concludes with a vision for how the City of Toronto could amplify and strengthen the city's existing green space, and why becoming a partner city of the Biophilic Cities Network would help Toronto reach its goals. This chapter will outline the biophilic indicators, how Toronto meets them, and how the city could improve.

## 2 | Methods

This study describes and analyzes the City of Toronto and its commitment to green infrastructure and seeks to provide clarity on the importance of biophilia in urban cities. There is ample information available on biophilia and biophilic design, including academic journals, and books surrounding the topic of the importance of nature in our cities and how it is incorporated into the urban fabric. This study will employ traditional qualitative research methods such as a literature review to conduct background research that will be used in preparing the justification for Toronto's bid to become a partner city of the Biophilic Cities Network. The methods include a literature review, site review, policy overview, and precedent studies. The goal of these methods is to help answer the questions:

- *What are the benefits of biophilic cities?*
- *Why do cities participate in the Biophilic Cities Network?*
- *How might membership advance the City of Toronto's goals in resilience, sustainability, and city building?*

### City of Toronto Context

A spatial analysis of parks and green space in the City of Toronto was undertaken to gain a better understanding of the current conditions and existing biophilic features within the City. This review was used to ensure the viability of Toronto becoming a partner city of the Biophilic Cities Network based on existing environmental features. This was completed by using Google Earth and Google Streetview, the City of Toronto website, and additional secondary research that speaks to Toronto's commitment to nature.

### Literature Review

There is a well-developed literature on biophilia and the positive impacts that trees, parks and green space have on our urban environments. A review of the literature surrounding biophilia and biophilic cities was conducted to help identify existing research and any potential gaps that exist in understanding biophilia. Literature and background information was collected through a review of academic journal articles and reports related to biophilia and biophilic cities, nature and the important relationship to health, and the benefits of trees, green space and nature in urban centres.

### Policy and Design Overview

Key municipal and provincial planning documents discuss the importance of green space in our cities. These documents include The Planning Act, The Provincial Policy Statement (PPS), the City of Toronto Official Plan and Zoning By-law, The Growth Plan for the Greater Golden Horseshoe, and the Greenbelt Act. These documents were chosen because they provide the important planning framework that is followed in Toronto and Ontario, and how

they govern significant planning decisions. It is essential to determine how these documents address biophilia [or nature] in our cities to determine if it is a key priority outlined by the province and the City. The application of these documents will be explored in chapter 5 of this report.

There are also several policies, by-laws and regulations published by the City of Toronto that discuss forestry, tree planting, parkland dedication and green infrastructure. These documents are useful in providing a background context about the existing green infrastructure in Toronto, and the City's specific plans and related policies to acquire, maintain and improve urban greenspaces, including the City's tree canopy, the frequency of green roofs, and development of new parks. Emphasis was placed on gaining a comprehensive understanding of what policies and guidelines lend themselves towards becoming a partner city of the Biophilic Cities Network.

### Best Practices

An initial high-level review of partner cities of the Biophilic Cities Network was undertaken, and four notable projects were selected and studied further to provide insight into biophilia. Environmental strategies and programs were reviewed and evaluated in these cities to determine comparability and compatibility to Toronto and the Biophilic Cities Network. Recommendations based on these programs are proposed in Chapter 7, and how they can be applied to the City of Toronto. These projects were chosen due to their geographic location, demonstrating the importance of biophilia worldwide. Additional examples were chosen due to their applicability to the City of Toronto in terms of climate and weather.

### Discussions with Biophilic Cities Network

Fact-finding professional-practice interviews were undertaken with members of the Biophilic Cities Network to gain insight into the program and help to determine whether Toronto would be a suitable partner city, and from this, to provide a rationale to City's planners and parks staff as the potential benefits to Toronto in joining the Network.

# 3 | City of Toronto Context

## History of Green Space in Toronto

The City of Toronto is often referred to as a city within a park (City of Toronto, 2013d). Neighbourhood parks, ravines, and trails have been a critical aspect of understanding Toronto's planning history dating back to 1909 and the Toronto Guild of Civic Art. The Toronto Guild of Civic Art was a citizens group that recognized the value of Toronto's parks and made a plea for their protection after realizing "the regions intrinsic character would be lost without deliberate planning" of the City (Reeves, 2017, p. 223).

In the early 1940s, a series of sketches provided the conceptual basis for a regional parks system (Reeves, 2017). The fundamentals of these ideas were included in the city's 1943 Master Plan, which saw the development of the 'Inner Greenbelt,' but not of additional parks (White, 2016). The 'Inner Greenbelt' was described as "a ring of protected ravine lands that would roughly circumscribe the existing built-up area" which were protected because they were considered to be "an exceptional public asset" (White, 2016). The Master Plan recommended that all trees located within the ravine system be preserved, and that dumping, grading, and filling in the ravines be prohibited (White, 2016). It wasn't until 1955 that the Metro Toronto Parks department was formed. Parks commissioner Tommy Thompson outlined the basic philosophy and scope of the regional park system stating that:

- The City of Toronto is the capital of Ontario, and the largest city in Canada with a population of approximately 2.9 million people (City of Toronto, 2017g)
- Toronto is regarded as being one of the most multicultural cities in the world with over half of the current population being born outside of Canada
- Toronto is part of the larger biophysical region that is bordered by the Oak Ridges Moraine, the Niagara Escarpment and Lake Ontario and is ecologically connected to many surrounding communities from the watersheds found in the broader region (City of Toronto Official Plan, 2002).

*"Recreationally they will provide those things that the neighbourhood park seldom offers, but which people increasingly demand. The tempo of modern living and the density of our population make it essential that nature be preserved in those areas where it still exists. Metropolitan parks should offer opportunities for an outdoor experience- a basic need of people- in a manner which they can enjoy. But in addition to the day camps, council rings, extensive picnic facilities, bridle paths, nature trails and wilderness areas, they will serve as the laboratories for outdoor education and conservation. Indeed, the whole concept of Metropolitan parks should be consistent with the highest ideals of conservation itself"* (Reeves, 2017, p. 224)

## History of Ravines in Toronto

Toronto's expansive system of ravines was formed thousands of years ago when glaciers compressed the land, and water wore away the soil (Vincent, 2016). Toronto's landscape is primarily shaped by its extensive ravine system that covers 17% (or 11,000 hectares) of the total area of the City (City of Toronto, 2017c). Toronto's network of ravines is among the largest in the world and provides solace from busy city life through 300 km of rivers, 6 km of creeks and tributaries, 232 km of roads, and 316 km of trails (City of Toronto, 2017c). Ravines make up a substantial part of Toronto's green infrastructure system and provide extensive habitat for the City's wildlife. In addition, Toronto's ravines remain some of the best quality natural spaces throughout the city providing significant impacts to the city's biodiversity<sup>1</sup> and ecological health. However, ravines have experienced a great deal of change in recent history, including the significant environmental impacts from Hurricane Hazel<sup>2</sup>. Hurricane Hazel made landfall in October 1954 bringing with it extreme wind speeds and significant rainfall (City of Toronto, 2017c). The magnitude of the hurricane caused \$25 million worth of damage in 1954 dollars (Toronto and Region Conservation Authority, n.d.), and remains the regions most severe flood in recorded history. The hurricane incited an exaggerated sense of the hydrological significance of ravines in the city. Following Hurricane Hazel, the Toronto and Region Conversation Authority (TRCA) was expanded to include the protection of natural heritage features, such as ravines, from natural disasters, like flooding (Toronto and Region Conservation Authority, n.d.). The expansion of the TRCA also resulted in new mandates that prohibited construction in heavily flooded areas, barring any future development on the land, further transforming the area into an extensive park system along Toronto's Rivers (Gifford, 2004). Because of these initiatives, ravines make up a significant part of Toronto's green infrastructure along with the city's tree canopy, parks, gardens, and green roofs.

<sup>1</sup> Biodiversity can be defined as

<sup>2</sup> By the time Hurricane Hazel hit Toronto, it was downgraded to a tropical storm



*Toronto and Trees*

Filling the city’s parks, ravines, streets and residential properties is over 10 million trees. These trees collectively make up Toronto’s urban forest which plays a vital role in making Toronto a clean and beautiful city. While trees enhance the context for all new development and renewal projects, there are also several quantifiable benefits such as reducing stormwater management run-off, reducing the impacts of urban heat islands, and improving air and water quality.

*Toronto and Parks*

Toronto’s vast system of parks is inherently tied to the City’s geography and history. The amalgamation of the City’s seven boroughs in 1998 brought with it a unified environmental perspective, which resulted in enhanced protection for all natural areas across the city (Reeves, 2017). Following the amalgamation, Toronto City Council established an environmental task force which resulted in the city’s Clean, Green and Healthy: A Plan for an Environmentally Sustainable Toronto. The plan mandated that more parks and naturals areas be developed across the city and more trees be planted (Reeves, 2017). As a result of the plan, the city’s park system expanded to cover 8000 hectares (or 12.7%) of the city’s land base and is home to over 1600 parks (City of Toronto, 2013d).

With several environmental programs, the City of Toronto sets itself apart with policies and guidelines for creating a natureful and environmentally friendly city. For further review of these documents, policies and reports, see Chapter 5.



*Figure 1 - Map displaying Toronto’s existing tree canopy.  
Prepared by: Alexis Beale*



***The city’s earliest permanent parks date back to the mid-1800s and include Riverdale Park (1856), Allan Gardens (formerly Horticultural) (1858) Queens Park (1860) High Park (1873), and Stanley Park (Reeves, 2017).***

**Image Credit: Muhammad\*  
‘Tommy Thompson Park’**



# 4 | Literature Review

## 4.1 Understanding Biophilic Cities

A Swedish study titled 'Face the beast and fear the face' (1986), noted that people acted adversely to snakes and spiders, but not to handguns and frayed electric wires. This is in part because people have become accustomed to modern living in a primarily constructed setting. The biological tendency of humans to affiliate with nature is 'weak,' not 'hard-wired.' In order for people to benefit from the positive experiences of nature, there must be ongoing contact with the natural world, especially during the vital period of childhood development (S. Kellert, 2016, p. 5). This study suggests the importance of biophilia in order to overcome fears. It further suggests that in order to overcome these fears, it is essential to be immersed in nature and have direct experiences with the natural environment. This adverse reaction to snakes and spiders signifies that people have become afraid of nature and the outdoors, a phenomenon that needs to change. Timothy Beatley, founder of the Biophilic Cities Network, strives to conquer these fears of nature by creating a network of cities across the world where nature surrounds people. Beatley (2011) defines a biophilic city as a city that puts nature first in its design, planning and management. Biophilic cities are full of biodiversity and recognize the importance of allowing residents to experience nature first hand and regularly. There is a growing recognition that people require daily contact with nature to lead happy, productive and meaningful lives (Beatley & Newman, 2013). A significant range of research suggests that regular contact with nature presents a wide range of vital benefits including improved health, enhanced learning, better social relations, improved work performance, increased productivity (S. Kellert, 2016).

Additionally in hospitals, nature and green space has been shown to reduce stress, lower blood pressure, provide pain relief, improve illness recovery, accelerate healing, enhance staff morale and performance, and result in fewer conflicts between patients (S. Kellert, 2016). Biophilia is a growing movement worldwide, and cities and urban environments contain a variety of ecological and green assets such as parks, trees, rivers, and in the case of Toronto, ravines. Research has found that efforts are being made to enhance green elements in cities across the world further. For example, Chicago and San Francisco have modified their planning and zoning codes to permit urban agriculture, Chicago and Portland have implemented incentives and subsidies for the installation of green features (Beatley & Newman, 2013), Montreal is actively encouraging the greening of laneways (Marotte, 2018), and Toronto implemented a Green Roof By-law requiring green roofs on all new buildings with a Gross Floor Area exceeding 2,000 square metres (City of Toronto, 2017b). Beatley and Newman (2013) believe that if the conditions of a biophilic city are met, it will help to "foster social and landscape resilience in the face of climate change, natural disasters and economic uncertainty and various other shocks that cities will face in the future" (p. 3328).

## 4.2 Designing for a Biophilic City

### *Indicators of a Biophilic City*

There are three primary ways that biophilia can be determined and achieved in cities:

1. Beatley's (2011) 'Indicators of a Biophilic City';
2. Terrapin Bright Green '14 Patterns of Biophilic Design' (Browning et al., 2014); and
3. Kellert and Calabrese (2015) Five Principles and Benefits of Biophilic Design.

### *Indicators of a Biophilic City*

Beatley developed 20 indicators of a Biophilic City, that range from quantitative to qualitative measures and are merely emphasized as qualities that may be found in biophilic cities. They "are an initial attempt to flesh out some of the dimensions and some of the measures by which [humans] might judge the biophilic bona fides of a city" (2011, p. 46). See Table 1 for the 'Indicators of a Biophilic City'

Despite many of Beatley's indicators being quantitative, they lack providing specific targets that biophilic cities should be meeting.

### *Five Principles and Benefits of Biophilic Design*

Kellert and Calabrese (2015) believe that in order to achieve meaningful and effective biophilic design, five criteria or principles must be met. These criteria, identified below, represent the fundamental conditions for effective biophilic design.

1. Biophilic design requires repeated and sustained engagement with nature
2. Biophilic design focuses on human adaptations to the natural world that over evolutionary time have advanced people's health, fitness and well-being
3. Biophilic design encourages an emotional attachment to particular settings and places
4. Biophilic design promotes positive interactions between people and nature that encourage an expanded sense of relationship and responsibility for the human and natural communities
5. Biophilic design encourages mutual reinforcing, interconnected, and integrated architectural solutions.

Table 1: Indicators of a Biophilic City

<b>Biophilic Conditions + Infrastructure</b> <ol style="list-style-type: none"><li>1. Percentage of the population within 100 metres of a park or green space</li><li>2. The existence of a connected, integrated ecological network; green urbanism from rooftop to region</li><li>3. Percentage of city land area in wild or semi-wild nature</li><li>4. Percentage of forest cover in the city</li><li>5. Extent and number of green urban features (e.g., green rooftops, green walls, trees)</li><li>6. Miles per capita of walking trails</li><li>7. Number of community gardens and garden plots (absolute and per capita); access to community garden area</li></ol>
<b>Biophilic Activities</b> <ol style="list-style-type: none"><li>8. Percentage of the population that is active in nature or outdoor clubs or organizations; the number of such organizations active in the city</li><li>9. Percentage of the population engaged in nature restoration and volunteer efforts, as well as the absolute number</li><li>10. Percentage of time residents spend outside (may vary depending on climate)</li><li>11. Percentage of residents who actively garden (including balcony, rooftop, and community gardens)</li><li>12. The extent of the recess and outdoor playtime in schools</li></ol>
<b>Biophilic Attitudes + Knowledge</b> <ol style="list-style-type: none"><li>13. Percentage of the population that can recognize common species of native flora and fauna</li><li>14. The extent to which residents are curious about the natural world around them (as measured by a proxy such as a survey question or community experiment).</li></ol>
<b>Biophilic Institutions + Governance</b> <ol style="list-style-type: none"><li>15. Adoption of a local biodiversity action plan or strategy</li><li>16. The extent of local biophilic support organizations, for example, the existence of an active natural history museum or botanical garden</li><li>17. Priority is given to environmental education</li><li>18. Percent of the local budget devoted to nature conservation, recreation, education, and related activities</li><li>19. Adoption of green building and planning codes, grant programs, density bonuses, greenspace initiatives, and dark-sky lighting standards</li><li>20. Number of city-supported biophilic pilot projects and initiatives</li></ol>

*The 14 Patterns of Biophilic Design*

Terrapin Bright Green's '14 Patterns of Biophilic Design' "articulates the relationships between nature, human biology and the design of the built environment so that [people] may experience the human benefits of biophilia" (Browning et al., 2014, p. 3).

*Nature in the Space Patterns*

1. Visual Connection with Nature
2. Non-Visual Connection with Nature
3. Non-Rhythmic Sensory Stimuli
4. Thermal & Airflow Variability
5. Presence of Water
6. Dynamic and Diffuse Light
7. Connection with Natural Systems

*Natural Analogues Patterns*

1. Biomorphic Forms & Patterns
2. Material Connection with Nature
3. Complexity and Order

*Nature of the Space Patterns*

11. Prospect
12. Refuge
13. Mystery
14. Risk/Peril

These 14 patterns have been studied and shown to improve reducing stress, cognitive performance, emotion and mood enhancement, and the human body (Browning et al., 2014).



### *Effective Biophilic Design*

An Australian study was undertaken by Gray and Burrell (2014) where they designed a site that included an open plan workplace with natural lighting, proper ventilation, lots of plants, and enhanced views. The site was primarily constructed from recycled and non-synthetic materials. The purpose of this study was to determine if biophilic design increased productivity in the workplace. Preliminary results show a “strong positive effect from incorporating aspects of biophilic design to boost productivity, ameliorate stress, enhance well-being, foster a collaborative work environment and promote workplace satisfaction” (Gray & Birrell, 2014, p. 12204). These results suggest a strong relationship between biophilic design and productivity, indicating the importance of incorporating biophilia into the urban fabric of cities.

## **4.3 What Makes a Green City?**

### *Urban Heat Islands and Green Roofs*

Urban heat islands are a product of increased concrete, asphalt, pavement, and buildings in urban centres. As landscapes become urbanized, they begin to change, and land that was once open, permeable and moist become impermeable and dry. Additionally, these surfaces absorb heat and then release that heat back into the atmosphere causing increased temperatures. Due to this phenomenon, urban centres can experience temperatures between 1-3 degrees Celsius higher during daylight, and up to 12 degrees Celsius higher at night than what might be experienced in more rural areas. Urban heat islands have a significant impact on the environment in creating higher than average temperatures. It is essential that citizens are made aware of this phenomenon to understand how urbanization can ameliorate or adapt to the adverse effects of climate change. Citizens living in urban centres are negatively affected by increased heat, and the effects are felt throughout the warmer months, primarily in dense cities with a population exceeding 1 million people (Susca et al., 2011).

Planting with vegetation also plays a vital role in mitigating urban heat islands. Trees and other vegetation lower air temperatures by providing shade, and as a result, if the trees are planted strategically, they can shade homes and decrease the necessity for air conditioning and reduces energy bills. With increased urbanization, it is difficult to find appropriate places to plant trees. There are new techniques to help with soil volume and compaction that will lead to an increase in trees planted in urban areas. The effects of this are immeasurable in protecting against urban heat islands

Green roof technology has a history that predates the modern era, but modern green roof technology was developed in Germany in the 1960s. Green roofs are beneficial to the urban environment and “provide significant economic benefits...particularly in the area of stormwater management and reducing the urban heat island and associated energy use for cooling” (City of Toronto, 2017h). Additional benefits associated with green roofs include improved urban air quality, an extension of roof life, and enhanced architectural interest and biodiversity (Castleton, Stovin, Beck, & Davison, 2010).

A green roof is a planting bed grown on a rooftop. It is a layered system that is comprised of a waterproof membrane, a growing medium, and a layer of vegetation (Castleton et al., 2010). Green roofs “provide shade and remove heat from the air through evapotranspiration, reducing temperatures of the roof surface and the surrounding air.” Green roofs improve insulation properties of buildings and homes, and as a result, reduce energy consumption related to heating and cooling buildings (Castleton et al., 2010). They also add a thermal mass which helps to stabilize indoor temperatures year-round (Castleton et al., 2010), which improves indoor comfort and lowers heat stress commonly associated with heat waves. On hot days, the surface temperature of a green roof can be cooler than the air temperature, whereas the surface of a conventional rooftop can be up to 50°C warmer (U.S.

Environmental Protection Agency, 2008). In cold climates, green roofs increase internal heat retention, and in hot climates, they keep the heat out.

There are two types of green roofs: extensive and intensive. Extensive green roofs are typically lighter, use a variety of drought-tolerant species, and support minimal biodiversity (City of Toronto, 2013a). Species used on extensive green roofs are generally smaller and grow across, instead of up, providing good coverage of the roof membrane (Castleton et al., 2010). Intensive green roofs have a deeper substrate layer, supporting deeper rooting plants such as shrubs and trees (Castleton et al., 2010), promoting a greater variety of habitat and biodiversity. The majority of green roofs in the City of Toronto constructed under the Green Roof By-law are extensive (City of Toronto, 2013a).

The positive impacts of green roofs on the urban environment are well established, and this is seen in a study completed by Liu and Minor (2005) in the City of Toronto. The study evaluated three roofs, two green roofs and one reference roof. The reference roof was constructed from a steel deck with thermal insulation, but with no greening. The study determined that the green roofs reduced the heat flow through the roof by 70-90% in the summer and 10-30% in the winter. Both green roofs also successfully reduced the roof membrane temperature in the summer by more than 20 degrees Celsius and also demonstrated a significant reduction in stormwater runoff in both runoff volume and rates of flow (Liu & Minor, 2005).

### *Benefits of Trees*

Trees provide several benefits to urban centres including increasing attractiveness of communities, reducing noise, improving wildlife habitat and providing recreational opportunities, which has demonstrated to foster psychological well-being (Millward & Sabir, 2011). Toronto's urban forests are valued at over \$7 billion and provide an additional \$80 million of environmental benefits. Every dollar that is spent maintaining Toronto's urban forest returns \$1.35 - \$3.20 worth of benefits to the City of Toronto Residents (Alexander & McDonald, 2014).

Trees and urban forests play an essential role in cities. Examples of this include increased tree canopies helping to ease burdens of managing snow, rain, and other wet weather. As precipitation falls, tree canopies act as a guard that absorbs the water or snow before it falls to the ground. On average, trees can absorb nearly 30% of precipitation through their leaves, and another 30% into the root structure (Burden, 2006). With trees absorbing almost 60% of rain or snowfall, it removes partial reliance on stormwater management drains, which saves municipalities money on maintenance. According to Alexander and McDonald (2014), Toronto's urban forests intercept approximately 25 million cubic metres of wet-weather flow, which helps to mitigate infrastructure and property damage. The estimated savings is approximately \$53.95 million of damage to city property. In addition to this, the presence of trees decreases runoff water volume which in turn reduces flooding

hazards, and help to prevent washing surface pollutants into rivers and lakes (Millward & Sabir, 2011).

In warmer climates, such as California, street trees have been shown to improve the lifespan of costly asphalt by 40-60%. While no studies were found for Canadian climates, it could be anticipated that similar results would be present, which in turn lowers the cost of maintaining sidewalks.

The presence of urban trees and urban forests also reduce the effects of the urban heat island. Trees and other vegetation lower air temperatures by providing shade, and as a result, if the trees are planted strategically, they can shade homes and decrease the necessity for air conditioning by one third in summer months, and heating requirements by one quarter in colder seasons, resulting in reduced energy bills (Alexander & McDonald, 2014). Another study found that the presence of urban trees and other vegetation can lower air temperatures by 3 degrees Celsius in summer months (Millward & Sabir, 2011). With increased urbanization, it is difficult to find appropriate places to plant trees. There are new techniques to help with soil volume and compaction that will lead to an increase in trees planted in urban areas. The effects of this are essential in protecting against urban heat islands (U.S. Environmental Protection Agency, 2008). Trees help the city save approximately \$6.42 million in energy savings for businesses and households. This reduced energy consumption prevents approximately 17,000 tonnes of greenhouse gas emissions from entering the atmosphere each year, which translates to an annual savings of \$400,000 to \$600,000 (Alexander & McDonald, 2014).

### *Trees and Property Value*

Several studies discuss the impact that trees have on property value, particularly in urban centres. According to the TD Economics article previously cited, trees and urban forests increase property values, support higher rents and generate more property tax revenue, and in some locations, rental rates of commercial office properties are about 7% higher on sites having a high-quality landscape that includes trees (2014). For example, Millward and Sabir (2011) conducted a study on Allan Gardens Park, located in downtown Toronto. The park was first established in the 1860s, covers 6.1 ha and is home to 309 mature trees. The purpose of this study was to determine the economic and environmental value that large parks and trees can have on an urban environment. The study determined that in 2008, the trees at Allan Gardens Park saved the city \$29,251, with 63% of these relating to environmental benefits. While the environmental benefits hold significant value, such as the trees intercepting nearly 1,920 cubic metres of stormwater in 2008 (valuing \$3701, or \$12 per tree), the most significant single monetary value was the aesthetics that the trees brought to the neighbourhood. Aesthetic benefits associated with increased property value due to the presence of trees was found to total \$10,734 (or \$35 per tree). This research strongly suggests that residents of Toronto place a high value on the aesthetics



of neighbourhoods and believe that trees play an important role in determining value. This phenomenon is not exclusive to Toronto, and major cities such as New York, New York and Perth, Australia have seen an increase in property value due to increased green space in neighbourhoods. Another study completed by the Pacific Northwest Research Station found that having a tree in front of a house increases property value by an average of \$7,130 (Donovan, 2010). The same study states that the mere presence of street trees increased sale prices in Portland, Oregon neighbourhoods by an average of \$8,870 and decreased time spent on the market by 1.7 days. Citywide, street trees add \$1.1 billion to Portland's property value, or \$45 million annually, with maintenance costs at only \$4.6 million yearly. These numbers indicate significant value to having trees in cities, not solely because of the environmental benefits they provide, but because of the positive influence, they have on people's moods. Similar studies were completed in Sacramento, California, with a focus on shade trees. Shade trees in Sacramento save residents approximately \$25.16 during the summer months. It is important to note, that while this number does not seem significant, it saves the city and the environment because each kilowatt saved means less fossil fuel burned and less CO2 released into the air (Donovan, 2010).

Realtors estimate that streets that have a vast tree canopy increase the value of a home or business by \$15,000 to \$25,000 (Burden, 2006). This increase in price impacts property values through an increased tax base. The increased tax base adds to the city's operating budget allowing for added street maintenance (Burden, 2006). This demonstrates the critical value that residents place upon beauty and shows that trees do not only provide monetary values such as reducing air conditioning and heating costs, but that street trees can benefit cities through increased taxes.

### *Increasing Trees*

Greene et al., (2018) conducted a study focusing on the inequality of nature in Toronto. Findings indicate that there is a measurable inequality of access to the urban tree canopy based on median household income (p. 30). This signals the need for new municipal government efforts to enforce more tree planting in some regions of the city. However, financial resources are scarce at the Toronto municipal level (Greene, Millward, & Ceh, 2011), and management of Canadian urban forests is primarily governed by the municipal governments instead of the federal government (Natural Resources Canada, 2019). Greene et al., (2018) notes that municipal governments often lack the coordination that is necessary for the development of strong regional strategies designed to protect and enhance city trees. It is essential to not only maintain but expand our urban forest in all areas of the city, regardless of socio-economic status. Preserving this natural resource often requires citizen engagement that is supported by the government and non-profit leadership (Greene et al., 2011). These support maintenance and enhancement efforts to have long-term viability.

### *Accessibility of Green Space*

Significant literature exists on the topic of accessibility and disability in the field of urban planning. However, much of this research comes from Europe and the United Kingdom. This research is not exclusive to the issues surrounding disability such as wheelchair uses but enters more extensive areas such as learning differences, mental illness, and chronic illness. Disability can be defined as a physical and/or mental impairment, and the interactions between society and the capacity of disabled people to function as independent individuals (Gleeson, 1998). It is essential to ensure that people with physical and mental disabilities are not excluded from social life in public urban green space.

### *Physical Disability*

People that struggle with physical or mental handicaps are often excluded from social life in public urban green space because the spaces are not accessible (Seeland & Nicolè, 2006). When designing social infrastructure, it is essential to include all members of the public to ensure that public spaces are designed considering specific needs and necessary adaptations. Cities are designed for non-disabled people, and it is important to move away from the concept of social integration (granting access to the disabled) towards social inclusion. Social inclusion is the process "of improving the terms for individuals and group to take part in society while improving the ability, opportunity, and dignity of those disadvantaged on the basis of their identity to take part in society" (The World Bank, n.d.). The physically disabled should be encouraged to take advantage of green space because of the physical and mental benefits that are associated with nature, and a policy of social inclusion could help facilitate this vision.

In order to combat this, Toronto has developed several policies to ensure a more accessible city for the physically disabled. For example, in accordance with the City of Toronto Accessibility Design Guidelines, "public parks, parkettes, and playgrounds should be designed to be used by people with varying abilities/disabilities and with universal access in mind" (City of Toronto, 2004). Policies such as this are meant to be in place throughout the city, but this is not entirely the case. While many new parks are created with accessibility in mind, the existing parks are not seeing significant changes. Out of the existing 1,435 parks listed on the City of Toronto website (City of Toronto, 2017i), only 13 are considered accessible (i.e. accessible washrooms, walkways, parking) (City of Toronto, n.d.). These numbers do not indicate that the remaining 1,422 parks are not accessible to the physically disabled, but rather that the parks were not designed with their needs in mind. In August 2017, the Toronto Star revealed that, in 2015, ten years after the AODA was enacted, the government admitted that it fell behind their targets, but assured voters that it would still meet the 2025 goal of a fully accessible Ontario (Star Editorial Board, 2017).

Sensory gardens are designed, so all components such as landscape, colour and texture are carefully planned to provide maximum sensory stimulation (Trojanowska, n.d.). Plant selection is aimed at stimulating the five senses of the human body to "offer a conscious and deeper perception of the outdoor space (Hitter, Cantor, Buta, & Vasiu, 2016, p. 55). Sensory gardens are used for both therapeutic and educational effects. Owinska, Poland has designed a 'Spatial Orientation Park' to help visually impaired children learn orientation skills. These gardens are designed to engage senses by employing a multisensory design and are proven to improve well-being. Biophilia, defined as a set of principles, attributes and practices for cities to bring nature into urbanites' daily life (Söderlund & Newman, 2017), plays an important role when designing sensory gardens due to the healing effect of nature on human life. This park is open to the general public during morning hours so that everyone can enjoy the benefits of nature within the park. Research states that a sensory garden should be a welcoming place for everyone, not just those who have differences. Currently, the City of Toronto has two sensory gardens, including the Sarah and Morris Feldman Sensory Garden at Earl Bales Park, and the sensory garden at the Centre for Addiction and Mental Health (CAMH). The purpose of these gardens in the City of Toronto is to employ unique features that enhance the development of children living with cognitive and developmental disabilities, (Queen, 2011) and reminds Planners that Toronto needs to continue to develop for the physically disabled and mentally ill.

### ***Mental Health***

Dating back to the late 1800s "the ideology of the public park was predicated on the importance of open, public green space to health and vitality of urban population" (Eisenman, 2013, p. 289).

Over the years, this ideology has been maintained, and significant literature has been published regarding the relationship between mental health and green space. In 2008, the World Health Organization (WHO) reported that by 2020, mental health disorders are expected to be one of the major contributors to illness in all parts of the world (Akpinar, Barbosa-Leiker, & Brooks, 2016). As of 2017, mental illness has been regarded as the leading cause of disability globally, and countries, like Canada, are now promoting mental wellbeing as a way of preventing, and complimenting the treatment of mental illness (Wood, Hooper, Foster, & Bull, 2017). WHO (2004) has emphasized that mental health is not merely the absence of mental illness, but rather "the foundation for well-being and effective functioning for an individual and for a community" (p. 10).

Research shows that people who benefit most from green space in urban centres are those that struggle with depression, anxiety, high blood pressure and anti-social behaviours (Faculty of Public Health, 2010).

Public green space includes parks, reserves, sporting fields, riparian areas (such as streams and river banks), trails, community gardens, street trees, and nature conservation areas.

Green spaces also include less conventional spaces such as green walls, green roofs, and cemeteries. Also included are private green spaces such as private backyards, communal grounds of apartment buildings, and university campuses (Wolch, Byrne, & Newell, 2014). According to the Public Health Agency of Canada, 1 in 3 Canadian's experience mental illness during their lifetime (2015). Positive mental health is associated with parks that have a nature focus, and green spaces that are characterized by recreational and sporting activity. A study evaluating types of green space determined that parks in urban settings and forests are associated with fewer mental health day complaints (Akpinar et al., 2016).

Urban parks are an example of a type of green space that is positively linked to mental health. The therapeutic benefits stemming from contact with nature include reductions in stress, depression, anxiety, anger and aggression (Akpinar et al., 2016). Additionally, visiting parks can facilitate interaction and the development of social ties (Wood et al., 2017).

Wood et al., (2017) conducted a study in 2012 with the aim of determining if the quantity or quality of neighbourhood parks had a more significant association with mental health. The study evaluated the relationship between mental health and parks with a particular focus on the size of park and distance (1.6 km) from participants homes. The findings indicate that both the quality and quantity of parks have positive benefits relating to mental health. The study results are not contingent on residents using the park and suggest that the mere presence of parks may yield mental health benefits and improve well-being (Wood et al., 2017, p. 64).

Studies, such as those identified above, outline the incredible value associated with green space in cities and their relationship with mental health. It is vital that policymakers continue to enforce the development of urban parks in order to experience the valuable results associated with them.

### ***Biophobia***

Studies suggest that today's youth are suffering from 'nature-deficit disorder' due to a reduction in time spent playing outdoors, potentially as a result of increased use of technology, parental and societal fears for child safety, and aversion to nature", or 'biophobia' (Douglas, Lennon, & Scott, 2017). Richard Louv (2008) believes that these restrictions are causing a wide range of behaviour problems, and research suggests children that lack access to urban green space often suffer from Attention Deficit Hyperactivity Disorder (ADHD) (Wolch et al., 2014). When these children are given access to green space, their symptoms were reduced. Similar studies show that "subjects concentrated better after a walk in the park than after a downtown walk or a walk in the neighbourhood" (Douglas et al., 2017), indicating that easily accessible greenspace is a crucial aspect to treating symptoms of ADHD.



# 5 | Policy + Design Overview

*This section provides an overview of relevant documents that speak to Toronto's biophilic commitment. The goal of this section is to provide a framework that establishes and emphasizes the City's commitment to maintaining and expanding natural systems while promoting biodiversity.*

## 5.1 Provincial Plans + Legislation

### *The Planning Act*

The *Planning Act* (1990, as amended) promotes sustainable economic development in health and natural environments. It provides the province with a land use planning system that is rooted in provincial policy.

Specifically, Section 42 of the *Planning Act*, Conveyance of land for park purposes, identifies parkland requirements for the Province of Ontario. In conjunction with the City of Toronto's Official Plan, the Planning Act allows the City of Toronto to promote parkland development by requiring all new developments contribute to the expansion and enhancement of the city's parks and open space system (City of Toronto, 2018b).

Parkland requirements are dependent on the type of development:

- Non-residential development requires that two percent of the proposed development site be reserved for parkland
- The rate differs for residential development based on location but can range from five percent in non-priority areas, or 0.4 hectares per 300 units in parkland acquisition priority areas.

*The Planning Act is a valuable document in promoting parks and green space across the province. However, it should include more substantial parkland requirements, especially in terms of condominiums in the downtown core.*

### *The Provincial Policy Statement*

The 2014 Provincial Policy Statement (PPS) came into effect on April 30, 2014, and provides policy direction on matters of provincial interest related to land use planning and development. The PPS is issued under Section 3 of the *Planning Act* and requires that decisions affecting planning matters be "consistent with" the policy statements issued under the Act. As a key part of Ontario's policy-led planning system, the PPS provides the policy foundation for regulating development and use of land.

The Provincial Policy Statement seeks to strike a balance between the province's economic, social, and environmental interests through the following:

- Promoting cost-effective development patterns which stimulate economic growth;
- Protecting resources for their economic use and/or environmental benefits; and
- Directing development away from areas where there is a risk to public health and safety or of property damage.

Part IV: Vision for Ontario's Land Use Planning System identifies that healthy communities are sustained by promoting efficient, cost-effective development to accommodate an appropriate range of uses to meet long term needs. Growth is generally focused within settlement areas and away from significant or sensitive resources and areas which may pose a risk to public health and safety.

**Section 1.1** Managing and Directing Land Use to Achieve Efficient and Resilient Development and Land Use Patterns includes policies to sustain healthy, livable, resilient and safe communities. **Section 1.1.3.1** confirms that cities, such as Toronto, are settlement areas and that settlement area shall be the focus of growth and development, as well as the promotion of their vitality and regeneration. **Policy 1.1.3.2 (a)** states that land use patterns within settlement areas shall be based on densities and a mix of land uses which:

1. Efficiently use land and resources;
2. Are appropriate for, and efficiently use, the infrastructure and public service facilities which are planned or available, and avoid the need for their unjustified and/or uneconomical expansion;
3. Minimize negative impacts on air quality and climate change;
4. Support active transportation; and
5. Are transit-supportive, where transit is planned, exists or may be developed.

**Policy 1.5.1 (a)** states that healthy, active communities should be promoted by "planning public streets, spaces and facilities to be safe, meet the needs of pedestrians, foster social interaction a facilitate active transportation and community connectivity."

Additionally, Policy 1.5.1 (b) provides direction for the planning and provision for a range and equitable distribution of publicly-accessible built and natural setting for recreation, including parklands, public spaces, open space areas, trails and linkages, and water-based resources where practical. Policy 1.5.1 also ensures that impacts to other protected areas and conservation reserves are minimized.

Section 2.0, Wise Use and Management of Resources promotes conserving biodiversity as a means of preserving environmental health and social well-being. Accordingly, Policies 2.1.1 and 2.1.2 state that natural features shall be protected for the long-term and linkages between natural heritage features shall be promoted. Additionally, the diversity and connectivity of natural features should be maintained, restored, or improved to protect the long-term ecological function and biodiversity of the natural heritage system.

In 2010, the Province prepared the Natural Heritage Reference Manual. The manual provides recommended technical criteria and approaches for being consistent with the PPS goals of protecting natural heritage features.

Ontario's Provincial Policy Statement supports municipal decision-making as they strive to enhance green space and nature in Toronto. It is an important document

The Greenbelt Plan (2017)

Ontario's Greenbelt was established in 2005 as a means of protecting green space, farmland, communities, forests, wetlands, and watersheds across southern Ontario. The Greenbelt currently includes two million acres of land and extends 325 km from the eastern end of the Oak Ridges Moraine to the western edge of the Niagara River. The Greenbelt Plan and the Growth Plan for the Greater Golden Horseshoe are two of the four provincial plans that are used to protect the lands governed under Ontario's Greenbelt. The goal of the plans is to determine where and how growth should be accommodated in the region (Ministry of Municipal Affairs and Housing, 2018). The two other provincial plans that govern the Greenbelt are the Oak Ridges Moraine Conservation Plan, and the Niagara Escarpment Plan, neither of which apply to the City of Toronto.

The Greenbelt Plan protects agricultural land, open space, natural heritage, and ecological features by identifying areas where development should not occur. As the region continues to grow, the Province will continue to explore opportunities to expand the Greenbelt to protect sensitive areas from development pressures.

While the majority of the City of Toronto does not fall within the boundaries of the Greenbelt, Urban River Valleys and the Rouge National Park are subject to the policies outlined in the Plan.

Urban River Valleys were not included in the Plan's initial 2005 approval but were added as a means of identifying key linkages between the Greenbelt and Lake Ontario. Urban River Valleys act as critical habitat and passage for flora and fauna to live and travel through

urban areas. The Urban River Valleys provide additional protection to lands designated parks and open space under the City of Toronto Official Plan.

The Urban River Valley designation aims to:

- Protect natural and open space lands along river valleys in urban areas;
- Protect natural and hydrologic features; and
- Provide a range of natural setting on publicly owned lands for recreational, cultural and tourism uses, including parkland, open space land, and trails.

(Ministry of Municipal Affairs and Housing, 2017a)

The Rouge National Urban Park, located in Scarborough, and was established to protect the agricultural, natural and cultural heritage of the park. The park also plays a vital role in promoting urban connections within the Greenbelt. In accordance with policy 3.3.2, the province, in partnership with the City of Toronto and the TRCA, should “encourage the development of a system of publicly accessible parkland, open space and trails...and support connectivity of the Natural Heritage System” (Ministry of Municipal Affairs and Housing, 2017a, p. 31).

There is minimal legislation promoting connections among urban parkland and natural systems identified in the Greenbelt Plan. Policies of this nature would be useful in expanding Toronto's network of ravines and natural systems with existing parks. Despite the majority of the City of Toronto not falling within the designated boundaries of the Greenbelt Plan, the essential policies that are outlined in the plan provide a framework that could be applied to the City.

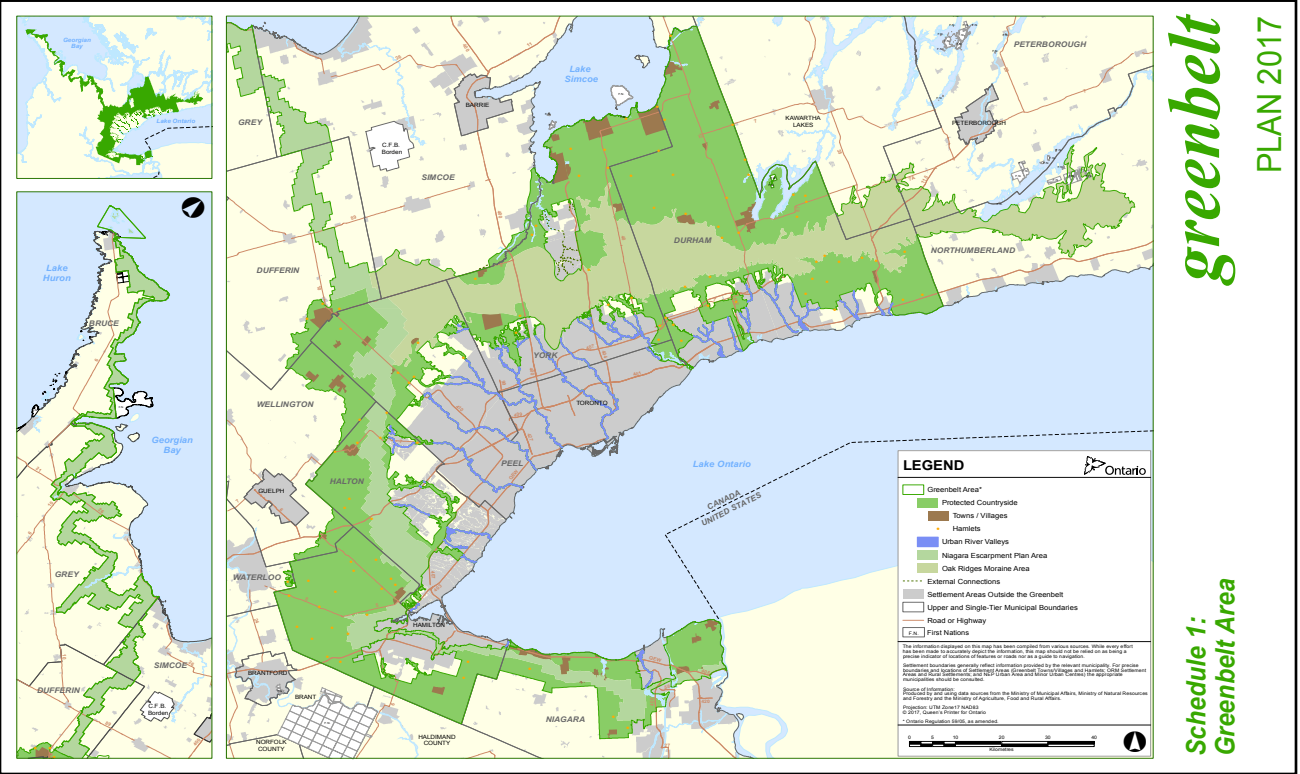


Figure 2 - Greenbelt Map of Ontario



*The Growth Plan for the Greater Golden Horseshoe (2017)*

The Growth Plan for the Greater Golden Horseshoe (GGH) came into effect on July 1, 2017, and provides guidelines for how growth and intensification should be managed in the Greater Golden Horseshoe Area.

The Growth Plan outlines a vision of a healthy natural environment with clean air, land, and water for the Greater Golden Horseshoe. This vision encompasses the goal to protect and maintain access to Ontario’s rivers, streams, forests, parks, and natural heritage areas for residents to enjoy while creating a sense of place.

**Section 4** states that natural heritage features are “essential for the long-term quality of life, economic prosperity, environmental health, and ecological integrity of the region” (Ministry of Municipal Affairs and Housing, 2017b, p. 39).

**Section 4.2.2** of the Growth Plan identifies principles that will guide municipalities to incorporate the Province’s defined natural heritage system into municipal policy. It states that “municipalities will incorporate the natural heritage system as an overlay in official plans, and will apply appropriate policies to maintain, restore, or enhance the diversity and connectivity of the system” (Ministry of Municipal Affairs and Housing, 2017b, p. 41).

**Section 4.2.5** of the Growth Plan identifies guiding principles that should be followed for Public Open Space. The principles state that municipalities, like Toronto, are encouraged to develop a system of publicly-accessible parkland, open space, and trails. In addition, municipalities should be seeking opportunities to incorporate urban agriculture, rooftop gardens, communal courtyards, and public parks within settlement areas.

*The language used in the Growth Plan is only suggestive, as opposed to a requirement. It is essential that the province mandate the inclusion of biophilic opportunities.*

**5.2 Municipal Policies and Initiatives**

*City of Toronto Official Plan*

The intent of the City of Toronto Official Plan (OP) is to ensure that the City evolves, improves, and realizes its full potential in transit, land use development, and environmental areas. The OP aims to do this for parks, open space and natural environmental features by outlining detailed policies identifying the importance of these features to the City.

The important objectives pertaining to the value of urban parks, green space, and natural environmental features are included in several chapters throughout the OP, but they all echo the same sentiment. Toronto recognizes the importance of existing green spaces and natural environmental features and the essential benefits they provide such as improved health and well-being for both residents and the cities natural ecosystem. Several policies throughout the Plan encourage that these spaces are protected, restored, enhanced, or expanded when possible (City of Toronto Official Plan, 2002).

**Section 3.2.3**, Parks and Open Spaces, outlines and addresses the need for city parks to expand as Toronto continues to grow and evolve. Toronto is a very multicultural city that is growing rapidly. The OP states that the parks system should be expanded while considering the diverse and complex needs of people and neighbourhoods across the City.

**Section 3.4**, The Natural Environment, recognizes the importance of a healthy natural environment in promoting strong communities and a competitive economy. In accordance with **Section 3.4 and Map 9** of the Official Plan, the natural heritage system consists of areas where “protecting, restoring and enhancing the natural features and functions should have high priority in our city-building decisions...and protecting [these features] should not be compromised by growth, insensitivity to the needs of the environment, or neglect” (City of Toronto Official Plan, 2002, pp. 3–32).

Additionally, **Policy 3.4.1** states that any changes to the built environment will be environmentally friendly based on protecting, improving, restoring, and enhancing the health of the natural ecosystem by promoting a variety of key environmental initiatives, such as creating natural linkages between natural heritage systems and other green spaces.

*Toronto’s fast-growing population and increasing urbanization will increase the need for parks and natural heritage systems. The City’s Official Plan policies support the expansion of city parks, green space and the natural environment as a way of promoting health and well-being. The city’s policies lend themselves to cities that are already partners in the Biophilic Cities Network.*

# Regulations and By-laws

## Toronto's Green Standard

Toronto Green Standard (TGS) is a tiered set of performance measures with guidelines that require and promote sustainable site and building design. The TGS was first introduced in 2006 as a voluntary standard for new development. In 2010, the TGS was restructured into two tiers, with Tier One being mandatory, and Tier Two voluntary. Today, the TGS has four tiers, each with different performance requirements. Tier One remains mandatory through the planning approval process, and tiers 2-4 include voluntary standards associated with financial incentives (City of Toronto, 2017j).

- Improve air quality and reduce the urban heat island effect
- Reduce energy use and greenhouse gas emissions from new buildings while making buildings more resilient to power disruptions, and encourage the use of renewable and district energy
- Reduce stormwater runoff and potable water consumption while improving the quality of stormwater draining to Lake Ontario
- Protect and enhance ecological functions, integrate landscapes and habitats and decrease building-related bird collisions and mortalities
- Divert household and construction waste from going to landfill sites.

(City of Toronto, 2017j)

*Toronto's Green Standard is a necessary requirement that promotes the development of sustainable buildings across the city and enforces the environmental policies outlined in the Official Plan. Toronto's Green Standard lends itself to biophilia through the recognition that sustainable building practices promote cleaner and more natureful environments.*

## Ravine and Natural Feature Protection By-law

The Ravine and Natural Feature Protection By-law, enforced by the TRCA and the City of Toronto, provides a policy framework for the protection of Toronto's designated ravine features. The by-law is intended to protect natural features and encourage environmentally responsible management in Toronto (City of Toronto, 2016b).

*Toronto's Ravine Strategy and Ravine and Natural Feature Protection By-law both provide important guidelines in protecting and maintaining Toronto's urban forest. This strategy promotes several of the 'Biophilic Cities Indicators' and patterns outlined in Chapter 4, including a visual connection to nature, extensive tree canopy coverage, and promoting residents to be active and engage with the space.*

## Green Roof By-law

In 2009, the City of Toronto passed a by-law requiring green roofs be included on all new development or building additions with a gross floor area exceeding 2,000 square metres. Green roofs provide several benefits to the city including reducing the urban heat island effect, managing stormwater runoff, improving air quality, conserving energy, and providing habitat for wildlife.

As of 2014, the City of Toronto was recognized as having the second largest square footage of green roofs in North America. The policy that was put in place regarding green roof development in the City plays a significant role in this. By 2016, the City of Toronto has received approximately 400 applications for green roofs constructed under the Green Roof Bylaw (City of Toronto, 2017b).

*The City of Toronto Green Roof By-law is an important precedent outlined and implemented by the City. The Green Roof By-law ensures that green roofs are developed in the City, which helps to enforce fundamental biophilic principles such as Connection with Natural Systems.*



Image Credit: Jackman Chiu  
'Doors Open Toronto 2012: Mountain Equipment Co-op

Figure 3 - One of the more popular green roofs in Toronto is at Mountain Equipment Co-op, where they offer free tours of the roof.



# Guidelines

## Design Guidelines – Streetscape + Public Space

### Complete Streets and Green Streets

Complete Streets are designed with the user in mind, regardless of age or level of ability. In addition to placing an important emphasis on people who walk, bike, take transit or drive, they consider other uses like street trees, utilities, and stormwater management (City of Toronto, 2017c). The concept of complete streets ties into the City’s Official Plan through the importance of the public realm. In accordance with the City’s Official Plan, the public realm should be “beautiful, comfortable [and] safe and [where] accessible streets, parks, open spaces and public buildings are a key shared asset” (City of Toronto Official Plan, 2002, pp. 3–2). These are all key aspects when considering the public realm and the importance of maintaining it. The fact that the City understands this is important and includes it in their Official Plan emphasizes their commitment to complete streets and maintaining spaces that “draw people together, creating strong social bonds at the neighbourhood, city and regional level” (City of Toronto Official Plan, 2002, pp. 3–2).

*Chapter 7* of the ‘Toronto Complete Street Guidelines’ discusses street design for green infrastructure and outlines several design features, such as natural heritage features and systems, parklands, stormwater management systems, and street trees that should be incorporated when designing Complete Streets in the City. In collaboration with the ‘Toronto Green Streets Technical Guidelines,’ the city aims to use green infrastructure solutions as a means of supporting human health and well-being and to help relieve urban pressures on ecological systems, air quality, energy efficiency and water resources (City of Toronto, 2017c).

*Complete Streets Design Guidelines provide valuable insight into designing city streets, so they are beneficial to the environment and residents. Extensive value should be placed on these policies, and the city should look at incorporating them into all city streets. Several of the guidelines pertaining to Green Streets meet the vision for biophilic cities outlined in Chapter 1, primarily supporting human health and well-being by implementing natureful design.*

### Privately Owned Publicly Accessible Spaces

Privately Owned Publicly Accessible Spaces (POPS) are open spaces that can be used by the public but remain privately owned and maintained (City of Toronto, 2017f). POPS play a key role in Toronto due to the increasing need and demand to revitalize existing parks and open spaces while creating new parks and open spaces.

In order to provide this much needed open space within Toronto’s dense urban landscape, the City often negotiates with private developers to include POPS as part of the development application and review process.

*The existence of POPs in the City of Toronto provides additional opportunity for the creation of green space, which lends itself to creating a more biophilic city.*

## Bird-Friendly Development Guidelines

The City’s Bird-Friendly Development Guidelines provide a variety of strategies to help make new and existing buildings safer for birds. The original guidelines were released in 2007 and set an important precedence across North America on the importance of protecting migratory birds.

Best Practices for Bird-Friendly Glass and Best Practices for Effective Lighting were produced to support Toronto’s Green Standard and provide a variety of guidelines that are intended to protect migratory birds from unnecessary fatalities (City of Toronto, 2017a).

*Bird Friendly design is an important component of biophilic cities. Toronto’s efforts to protect migratory birds is admirable, and sets a strong examples for other North American cities.*

## ‘Greening’ Surface Parking Lots

The City of Toronto has a set of design guidelines in place to help developers and designers ensure that parking lot design includes greenery. The standards that the city sets out includes:

- planting trees;
- providing good quality soil and generous landscaped areas;
- enhancing pedestrian and cycling infrastructure;
- managing stormwater on-site;
- reducing the urban heat island effect; and
- using sustainable materials and technologies.

(City of Toronto, 2013b)

*The city’s design guidelines for greening surface parking lots promotes vegetation and across the city. These guidelines acknowledge the importance of nature in reducing stormwater and enhancing the public realm and lends itself to the biophilic cities model.*



Figure 4 - This example of bird-friendly design is found downtown at the Ryerson Student Learning Centre. Visual markers are incorporated into the exterior glass which protects birds from colliding.



## Strategies

### *Draft Biodiversity Strategy*

The City of Toronto Draft Biodiversity Strategy was developed to help increase both the quality and quantity of natural habitats by enhancing and expanding the existing habitat, restoring natural areas, raising awareness of plants and animals that call the city home, and identifying a series of actions that encourage biodiversity. The Strategy hopes to position Toronto as a leader in supporting and conserving urban biodiversity.

The actions identified in the draft Biodiversity Strategy span across three categories – Restore, Design, and Engage.

**Restoring** biodiversity in the city will protect species at risk and promote healthy habitat. Restoring habitats can include planting native trees and shrubs, restoration and adaptive management of our forests and wetlands, enhancing the health of soil and water, improving the diversity of native vegetation; and removing non-native invasive species.

**Designing** our built form to support biodiversity can be accomplished by promoting green connections across the city. These connections can be achieved by designing buildings and structure to reduce bird collisions, providing more wildlife crossings, and promoting the growth of biodiversity across streets, rooftops, gardens, and backyards.

**Engaging** the public is a crucial factor in promoting the draft Biodiversity Strategy. It is vital that the public is aware of how the Strategy aims to promote a healthier biodiverse ecosystem by protecting Toronto’s fragile natural environment.

### *Every Tree Counts*

Every Tree Counts – A Portrait of Toronto’s Urban Forest (2013c) was prepared by the City of Toronto Parks, Forestry and Recreation division, and provides the necessary framework for expanding Toronto’s urban tree canopy to reach the target of 40% <sup>1</sup>.

Currently, the City of Toronto has approximately 10.2 million trees representing 27% of the city that is covered by an ‘Urban Tree Canopy’ (UTC)<sup>2</sup>. Of the 10.2 million trees, 0.6 million (6%) are city street trees<sup>3</sup>, 3.5 million (34%) are located in the city’s natural areas, and 6.1 million (60%) are on private property.

1 In 2004, the Parks, Forestry and Recreation Strategic Plan set this goal to be accomplished in 50 years (by 2054). At the time, the existing tree canopy was between 17-20%  
2 An urban tree canopy is the leaves, branches and stems that cover the ground when viewing from above. They provide several benefits such as improved water quality, energy conservation, reduced air pollution, lower temperatures, and wildlife habitat.  
3 Trees that are established and maintained in the city’s Right-of-Way (ROW) and managed by the City of Toronto. They have difficult growing conditions and contend with poor soil quality, salt and chemical runoff and mechanical damage due to infrastructure replacement.

### *Toronto’s Ravine Strategy*

In 2015, the City of Toronto launched a study to develop a strategy for Toronto’s ravines. This city-lead initiative was completed in 2017 and provides actions that will help in maintaining a natural and connected sanctuary that is essential for the health and well-being of the city (City of Toronto, 2017d).

The Strategy outlines five guiding principles:

**Protect:** The Strategy provides guidelines that will help to protect these critical spaces by maintaining and improving their ecological health.

**Invest:** Toronto ravines should be considered an ongoing priority for investment due to the multiple surrounding pressures impacting them. These include population growth, increased recreational uses, climate change, and significant weather events.

**Connect:** The Ravine Strategy strives to provide more opportunities for individuals to connect with nature. Additionally, The Strategy aims to ensure that people understand and appreciate the critical value of the city’s extensive ravine system.

**Partner:** The Strategy wants to create an inclusive environment where individuals and organizations can be involved with the care and enhancement of Toronto’s Ravines.

**Celebrate:** The Ravine Strategy wants the city to celebrate and recognize the extensive ravine system as a vital city asset.

*Toronto Pollinator Protection Strategy*

Toronto is home to a varying range of pollinators including bees, wasps, flies, butterflies, moths, beetles, and birds. However, they are threatened by habitat loss, pesticides, invasive species, disease, and climate change.

The Toronto Pollinator Protection Strategy was introduced in April 2018 with the goal of protecting this diverse community. The Strategy identifies a set of guiding principles that the city and community can implement to protect the diverse, native pollinator community.

**Plans**

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*Downtown Parks and Public Realm Plan*

City council adopted the Downtown Parks and Public Realm Plan in May 2018 as part of the city’s TOCore initiative. This plan sets out a vision for the future of downtown Toronto’s parks, public spaces and streets and will guide the development of an expanded, improved, connected and accessible network. Downtown parks are among the most intensely used in the city, and parkland provision has not been able to keep up with the rapid growth, leaving most of downtown with less than 0.45 hectares per 1000 residents. The Plan envisions a city where ‘green’ and ‘nature’ are reintroduced creating desirable spaces in the downtown core.

**5.3 Summary**

While this overview of Toronto policies and programs does not capture all of them, it does provide a strong base in determining the city’s commitment to preserving, and expanding natural systems. This section outlines the steps that the City of Toronto is taking towards becoming a more environmentally friendly and green city. The policies and programs show that the city understands and values the importance of having a natureful city.

# 6 | Best Practices

The Biophilic Cities Network has 16 partner cities worldwide that are dedicated to improving the relationship that residents share with nature. Four of these cities were chosen to help identify best practices towards becoming a partner city of the Biophilic Cities Network. The table below outlines four cities that were chosen based on geographic location, important precedence, and a climate that is similar to Toronto. Singapore has been included because of their ongoing commitment and initiatives to educate the public on the importance of clean, healthy, and nature-ful environments (Newman, 2014). Each of these examples provides a unique outlook on how different cities take the initiative to create a vital connection between residents and nature. The ‘best practice’ cities are accompanied by a brief overview of the most relevant programs and policies that are pioneered by the cities. It is important to note that several not-for-profit organizations focus on trees and green space across these four partner cities, but for this research municipal and government documents provide more value when determining policies that could be implemented in Toronto.

Two other cities have set important precedents in the biophilic cities movement. Portland, Oregon and San Francisco, California have both demonstrated the key values associated with biophilic urbanism, and both cities continue to enhance and improve their urban green space.

Identifying best practices of biophilia is an essential component of this research because it provides the necessary framework, which helps to determine how biophilia may be implemented in Toronto.

Each of these ‘best practices’ were obtained from the *Biophilic Cities Network* and supplemented with additional research from the cities website.

## BIRMINGHAM, UK

Member Since: 2013




Image Credit: Miroslav Petrasko  
'Green Wall'

### Overview

Birmingham is the United Kingdom's first and only biophilic city and is home to an impressive network of rivers, canals, trails, pathways, and parks. Historically, the City has been viewed as grey and industrial, but in reality, the city has ample green space with many local nature reserves (Biophilic Cities, n.d.-b).

Birmingham has long understood the importance of green space and wanting to expand their network of natural features. The city realized that they did not need to wait for the government to develop a set of green guidelines in order to incite change (McEwan, 2014), and in 2013, the City of Birmingham developed the Green Living Spaces document. The document was set to outline the city's ambitions to become one of the world's leading green cities and was prepared in anticipation of becoming a partner city of the Biophilic Cities Network (Littke, 2016). During this time, the city also declared its intention to be a green and sustainable city. Birmingham has been a leader in making vital connections between health and nature (Biophilic Cities, n.d.-b).

### Key Programs

1

The Green Living Spaces Plan provides a framework that encourages the city to secure, enhance and ensure that natural green spaces and water bodies are protected and maintained in the long term. Birmingham is the first city in the UK to undertake such a comprehensive plan (Birmingham City Council, 2013).

2

The Nature Conservation Strategy provides comprehensive advice and guidance for the conservation of the city's biodiversity through preserving open space and parkland (Birmingham City Council, 1997)



Image Credit: John Garghan  
'305-365 year2 The End of The Season'



# Edmonton, AB

Member Since: 2016



Image Credit: Jeff Wallace  
'Sunrise, Edmonton, Alberta'

## Overview

Edmonton is the capital of Alberta and Canada's only partner city of the Biophilic Cities Network. The City is home to a wide variety of parks, open spaces and trails, and has a green network that strives to support healthy ecosystems that exceed the communities needs by providing year-round opportunities to learn, commute, recharge, recreate, gather and celebrate (City of Edmonton, 2011). It is a city with abundant wildlife and biodiversity and has been working towards a more connected network of habitats and green areas. Notably, Edmonton has taken great strides in protecting wildlife by implementing the installation of wildlife passages across major roadways allowing animals to co-inhabit without the danger of cars (Biophilic Cities, n.d.).

Edmonton is also home to Canada's largest urban park. River Valley Park is an urban park with more than 160 kilometres of trails, and 18,000 acres of space. The park provides residents and tourists with unparalleled opportunities to connect with nature in an urban setting (Biophilic Cities, n.d.).

## Key Programs

1. Edmonton's Green Network Strategy, Breathe is a transformative strategy that ensures as the city grows, each neighbourhood will be supported by a network of open space for the next 30 years. The primary goal of the Green Network Strategy is to plan and sustain a healthy city by encouraging connection and integration of open space at the site, neighbourhood, city and regional levels. The strategy aims to ensure that future planning of all neighbourhoods are supported by high-quality, accessible, and connected open spaces (City of Edmonton, 2019a).
2. Natural Connections Integrated Conservation Plan is Edmonton's plan for the protection, management and restoration of local natural areas and biodiversity, and the engagement of the community in that effort. The plan focuses on strengthening connections between natural areas and the movement of wildlife, and between people and Edmonton's natural systems (City of Edmonton, 2007).
3. The Way We Green is the City of Edmonton's 30-year environmental strategic plan with an emphasis on resilience and sustainability. The Way We Green sets 12 goals that the city hopes to achieve in order to have a sustainable and resilient future (City of Edmonton, 2011)
4. Edmonton's WinterCity Strategy encourages residents to reclaim the outdoors during the winter months by providing useful tips and activities to help conquer living in a winter city (City of Edmonton, 2012).
5. Root for Trees is Edmonton's tree planting initiative. The initiative hopes to increase tree planting throughout the city by encouraging partnerships with businesses, individual residents, and community groups. Roots for Trees anticipates planting 45,000 trees annually.
6. The Just So You Know initiative is aimed at raising awareness about the various forms of flora and fauna in Edmonton. The initiative aims to provide residents with tools that can facilitate a strong connection with nature by fostering an understanding of the natural world (City of Edmonton, 2019b)
7. River for Life is the cities core initiative that addresses improving water quality. Building on 'The Way We Green' strategic plan, the city aims to reduce pollutants from entering stormwater sewers (City of Edmonton, 2012b)
8. yegTreeMap is an online map database of trees in Edmonton. The database allows individuals, community groups, and governments to upload data in hopes of creating an accurate and informative inventory of trees in Edmonton. The database provides valuable 'Eco Benefits' that allows users to determine total annual benefits (\$), energy conserved (kwh/per year), stormwater filtered (gal/per year), air quality improved (lbs/per year), carbon dioxide removed (lbs/per year), and carbon dioxide stored (lbs/per year) for each tree in the database.
9. The Urban Forest Management Plan is a 10-year strategy aimed at sustainably managing and enhancing Edmonton's Urban Forest. The plan provides strategic direction for the entirety of the cities urban forest and aims to engage the community in protecting and managing the important resource (City of Edmonton, 2012c)



# SINGAPORE

Member Since: 2013



Image Credit: dronepicr  
'Supertrees Singapore'

## Overview

The island of Singapore, located in Southeast Asia, expands 700 square kilometres and is home to 5.6 million people (Statistics Singapore, 2018). Since the early days of independence in 1965, Singapore has placed substantial value on the creation of a 'garden city' and educating the public on the importance of maintaining a clean and green environment (Newman, 2014). In 2012, Prime Minister Lee Hsien Loong announced that Singapore would be changing their motto from 'garden city' to 'city in a garden' (Newman, 2014). This was done to increase environmental protection awareness across the country and as a result the concept of building a garden around the city and was replaced with the concept of building the city within a garden.

Singapore has over 150 kilometres of trails and pathways that connect parks and green spaces together (Newman, 2014) enabling residents to walk, bike or run throughout the city without ever leaving vegetated areas (Biophilic Cities, n.d.-c). In addition, the city prioritizes the integration of nature into vertical spaces including apartments, office buildings, and hotels. The significant vegetation has had many positive impacts on Singapore including a healthier and happier community, and a reduced effect from urban heat islands (Biophilic Cities, n.d.-c).

# SINGAPORE

Member Since: 2013



## Key Programs

- 1 The National Parks Board (NParks) is dedicated and committed to providing and enhancing the greenery of Singapore. National Parks Board is responsible for four nature reserves and more than 300 parks sprawled across the City. The city's extensive streetscape of roadside greenery has helped to create the City in a Garden. National Parks Board is continually working to "engage the community with nature by providing a wide range of nature-related opportunities"(National Parks Board, 2019). The National Parks Board is dedicated to creating a green city where residents can live, work and play.
- 2 The Garden City Fund is a charity that was established by the National Parks Board but managed independently. The Garden City Fund works with the National Parks Board in efforts towards fulfilling Singapore's' City in a Garden vision by optimizing the green space, supporting urban biodiversity conservation, engaging the community, and enhancing competencies of the landscape industry in Singapore (Garden City Fund, 2017)
- 3 Conserving Our Biodiversity, Singapore's Biodiversity Strategy and Action plan provides a framework to guide biodiversity conservation efforts in Singapore (National Parks Board, 2009)



# WASHINGTON, DC

Member Since: 2015



Image Credit: Miroslav Petrasko  
'Green Wall'

## Overview

"Washington DC is known for its many parks and trees. The City has become known for its progressive environmental policies, especially in the areas of energy and the built environment.

However, the City still faces significant challenges in human health and environmental quality. Access to nature access is not equally spread across neighbourhoods, and asthma and obesity are chronic problems in many parts of the city. Public health problems tend to coincide with poverty and poor connections with (or lack of) green space, and poor access to fresh, healthy foods.

Biophilic DC works closely with City agencies and non-profit partners to create a more nature-ful city, where people and species thrive."(Biophilic Cities, n.d.-d)

## Key Programs

- 1 The Sustainable DC Plan was developed with the goal of making Washington the "healthiest, greenest, and most livable city in the United States." Among other measures, the Plan calls for the restoration of the City's tree canopy to 40%, and access to parkland or natural space within a 10-minute walk for all residents (Washington, DC, 2019b).
- 2 The Green Area Ratio is an environmental zoning regulation enforced by the Department of Energy and Environment that sets standards for landscape and site design to help reduce stormwater runoff, improve air quality, and keep the city cooler (Washington, DC, 2019a).
- 3 RiverSmart is a program that helps to reduce stormwater runoff by providing financial incentives to help property owners install green roofs, rain gardens, permeable pavers, and shade trees.
- 4 Canopy 3,000 is a public-private partnership aimed at expanding Washington's tree canopy to 40% by the year 2032 (Washington, DC, n.d.).

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# 7 | Thinking Forward

This project had two intentions, **1) determining the benefits of incorporating nature into urban design, 2) creating a justification as to why the City of Toronto would be a suitable partner city for the Biophilic Cities Network.** This was done by attempting to address the following questions.

- What are the benefits of biophilic cities?
- Why do cities participate in the Biophilic Cities Network?
- How might membership advance the City of Toronto's goals in resilience, sustainability, and city building?

The Biophilic Cities Network suggests that all cities are biophilic to a certain extent, and Toronto is no exception. Toronto has several policies and guidelines in place to ensure the city continues to grow in an environmentally conscious, and green manner.

The following section will summarize the benefits associated with being a partner city of the Biophilic Cities Network. It will identify key benefits of being a partner city and how they relate to city staff and residents. The final section will conclude with recommendations and next steps for the city. The goal is to provide a clear framework for how Toronto can enhance its biophilic qualities, improve staff morale, and promote resident inclusivity.

## 7.1 Why is the Biophilic Cities Network Important?

Research conclusively points to the benefits of biophilia, and the positive impacts that a strong connection and relationship with nature has on individuals, especially those living in urban environments.

The Biophilic Cities Network aims to connect residents, urban leaders, and cities across the world that have the desire to welcome 'more nature and a greater love of nature, into urban life' (Beatley et al., 2015). While several other networks supporting biodiversity in urban cities exist (Urban Sustainability Directors Network, the Wild Cities Project, the C40 Cities Climate Leader Group), none of these prioritize the essential and inherent connection that exists between humans and nature. On this note, the primary focus of the Biophilic Cities Network is to inspire "people and cities to incorporate nature more explicitly into design and planning decisions and connect local citizens and leaders with like-minded people and initiatives" (Beatley et al., 2015, p. 4). This is done through the promotion of 'urban greening,' and the introduction of nature in unconventional ways, which includes initiatives like Toronto's Green Roof and Green Streets strategies. The network also promotes the conservation of existing flora and fauna, which Toronto does through many of its initiatives like the Bird Design Guidelines, the Pollinator Strategy, Ravine Strategy, and the draft Biodiversity Strategy.

## 7.2 Requirements of the Biophilic Cities Network

A condition of becoming a partner of the Biophilic Cities Network is preparing a statement that summarizes the existing biophilic qualities and current initiatives undertaken by the city. In part 2, the Biophilic Cities Network asks for a set of goals and aspirations for the future of the city to help enhance the position of nature in the community. Toronto has several biophilic qualities and initiatives that could be included in the application process, most notably the draft Biodiversity Strategy, the Bird Design Guidelines, the Ravine Strategy, and the Green Roof By-law.

In order to evaluate Toronto's compatibility with the Biophilic Cities Network, it is essential to revisit Beatley's (2011) 'Indicators of a Biophilic City' that were introduced in Chapter 4. Applicant cities must demonstrate that they meet a minimum of five of biophilic indicators, identifying one from each category. Based on available data, Toronto does not meet the requirement of identifying a biophilic indicator from each category. **Table 2** outlines how Toronto meets these indicators and will be discussed further in 'Next Steps and Recommendations.'

### Time Commitment

When considering joining an organization like the Biophilic Cities Network, time commitment is an important consideration for city staff. There needs to be a level of comfort for city staff that membership will not consume a substantial amount of time. Fortunately, the time commitment associated with being a partner city of the Biophilic Cities Network is minimal and consists of the following on an annual basis:

- Partner cities must share a minimum of one blog post, short best practice case, or video report;
- Partner cities must participate in a minimum of one webinar, workshop or skype/ conference call;
- When feasible, partner cities should respond to requests for assistance from other partner cities;
- Partner cities should host potential visits from other partner cities;
- If possible, city staff should try and attend the yearly or semi-yearly biophilic cities world conference
- When possible, city staff should attend the yearly or semi-yearly biophilic cities world conference; and
- Most importantly, consistently act as a global leader in the biophilic cities movement.

### Cost

There is a minimal financial cost associated with becoming a partner of the Biophilic Cities Network. Once confirmed a partner city, there is a one-time membership fee of \$250 USD, and there are no other associated costs.

Additionally, the city would not need to prepare any new documents or create any additional initiatives, which alludes to Toronto's suitability to be a partner city.

### 7.3 Why Would This Benefit City Staff?

There is a substantial amount of work relating to the biodiversity, green infrastructure, and the protection of natural systems and animals, that is completed by city staff annually. The several policies, guidelines and documents, as outlined in Chapter 5, are difficult to locate and may go unnoticed to the general public. Being a partner city of the Biophilic Cities Network will celebrate the work that city staff have already completed. As discussed above, there is no significant cost to the city in terms of time or money because many of these policies and guidelines already exist. Being a partner city of the Biophilic Cities Network is about promoting staff morale and celebrating the substantial amount of work that the city has already done. It is about telling a story of what already exists.

### 7.4 Why Would This Benefit City Residents?

Toronto residents would benefit from a city partnership with the Biophilic Cities Network. One of the goals of the network is to incite change and bring awareness to residents about the value of incorporating nature into the city's urban fabric. If Toronto were a partner city, it would shine a light on the work that has already been completed and raises awareness on the values associated with biodiversity and biophilia in the city. The network promotes spending time outdoors, away from technology, to help enhance well-being (Beatley et al., 2015). This idea is critical when considering Toronto's climate and colder winter months. Edmonton is a strong example that promotes seasonal changes through the development of the 'Winter City Strategy.' As referenced in Chapter 6, Edmonton successfully implemented a strategy that reminds people that there are many activities outside during the winter months and that it is important to 'embrace winter.' Other city's that promote outdoor activities during the winter months include Ottawa's annual festival 'Winterlude' and Quebec City's 'Carnaval de Quebec.'

## 7.5 Next steps and Recommendations

If Toronto chooses to put forward an application to become a partner city of the Biophilic Cities Network, there are five key recommendations derived from this research that should be considered by city staff.

### *Recommendation 1*

Toronto should focus on making policies, guidelines, documents, and open data relating to biophilia, biodiversity, green infrastructure, and sustainability more accessible to the public. Locating city documents is a challenge as they are not grouped according to environmental benefits. When evaluating the city for biophilic indicators, it became clear that a significant amount of the information could not be found on the city's website. This speaks measures to the availability of Toronto's data, and it is important that this information is made available when determining the suitability for Toronto's partnership in the Biophilic Cities Network.

Additionally, public education about the importance and presence of nature within the city should be promoted through a variety of public programs and workshops.

All documents, public programs and workshops should be referenced and accessible from one page on the City of Toronto website. Having this information in one central location would also promote public participation based on available environmental programs operating in the city.

### *Recommendation 2*

Toronto could also consider implementing a Winter City Strategy, like the one discussed in Edmonton. Winter City Strategies effectively get people outside in the colder months. Being outside during the colder months is not always enjoyable, but Edmonton has done a successful job in implementing a strategy that brings people outside in the winter. Toronto should consider developing a similar strategy that shines a light on the benefits of being outside during the colder months.

### *Recommendation 3*

The city should increase the availability of green roof data. Currently, the only way to determine the existing green roofs in Toronto is by accessing the open data file 'Building Permits – Green Roofs.' The city should consider looking to Chicago, Illinois and London, England for strong examples of how green roof data can be displayed. Both cities have implemented a GIS approach that shows the location, type and size of green roofs in the city. The city could also implement a similar program to Edmonton's yegTreeMap, where information on the eco-benefits of trees can be found. This information, which is discussed in Chapter 6, includes total annual benefits, energy conserved, stormwater filtered, air quality improved, carbon dioxide removed, and carbon dioxide stored for each tree in the city.

It is recommended that the city create an interactive 'green roof and tree map' highlighting information related to:

- Location;
- Size;
- Type;
- If it is accessible to the public; and
- The annual benefits, such as those outlined above from the yegTreeMap

It is important that Toronto continues promoting green roofs, especially in the downtown core, where green space is becoming increasingly sparse, and the urban heat island effect is more noticeable.

**Recommendation 4**

The City of Toronto has experienced significant development. From 2013-2017, nearly 376,500 residential units and over 10 million square metres of non-residential development was proposed, with the Downtown and Central Waterfront area holding the largest percentage (City of Toronto, 2018a). It is recommended that the city continue coming up with innovative ways to incorporate nature into the increasingly densifying downtown core. The city could implement a similar approach that has been successful in Singapore where the City's Landscape Replacement Policy requires that new development incorporate nature vertically to help reduce the loss of nature at the ground level (Beatley, 2017).

**Recommendation 5**

City staff should request information from existing partners of the Biophilic Cities Network like Edmonton or Washington to determine the benefits associated with being a partner city.

Based on the research conducted for this project, the following questions are proposed based on information that was publicly inaccessible from the partner cities.

- Has the city found that there is a significant time commitment that comes with being a partner city?
- How has being a partner of the Biophilic Cities Network impacted the city? Has the city experienced positive or negative impacts?
- Has the city implemented any new environmental policies since joining the Biophilic Cities Network?
- Are residents aware of the environmental policies that exist in the city?
- Are residents aware of the city's partnership with the Biophilic Cities Network?
- Has there been a noticeable increase in resident participation since partnering with the Biophilic Cities Network?

*Table 2 - Biophilic indicators and how the city meets them*



## 8 | Conclusion

Toronto is a biophilic city, and this research paper has helped to enforce the city's viability of joining the Biophilic Cities Network. However, there is more work to be done. This research was meant to provide the framework for what Toronto would need to accomplish in order to become a partner city of the Biophilic Cities Network and provides several recommendations on the best way to get there.

# Works Cited

Akpınar, A., Barbosa-Leiker, C., & Brooks, K. R. (2016). Does green space matter? Exploring relationships between green space type and health indicators. 12. <http://dx.doi.org/10.1016/j.ufug.2016.10.013>

Alexander, C., & McDonald, C. M. (2014). Special Report, Urban forests: the value of trees in the City of Toronto [Special Report]. Retrieved from TD Economics website: [www.td.com/economics](http://www.td.com/economics)

Beatley, T. (2011). *Biophilic Cities - Integrating Nature Into Urban Design and Planning*. Island Press.

Beatley, T. (2013, December 4). Launching the Global Biophilic Cities Network. Retrieved March 30, 2019, from The Nature of Cities website: <https://www.thenatureofcities.com/2013/12/04/launching-the-global-biophilic-cities-network/>

Beatley, T. (2017). Biophilic Cities and Healthy Societies. *Urban Planning*, 2(4). <https://doi.org/10.17645/up.v2i4.1054>

Beatley, T., Jones, C., & Triman, J. (2015). Standards and Protocol for Participation in the Biophilic Cities Network: Expectations and Submittal Requirements for Partner Cities (pp. 1–13). Retrieved from <http://www.austintexas.gov/edims/document.cfm?id=254961>

Beatley, T., & Newman, P. (2013). Biophilic Cities Are Sustainable, Resilient Cities. *Sustainability*, 5(8), 3328–3345. <https://doi.org/10.3390/su5083328>

Biophilic Cities. (n.d.-a). Our Vision - Connecting Cities and Nature. Retrieved March 30, 2019, from Biophilic Cities website: <https://www.biophiliccities.org/our-vision>

Biophilic Cities. (n.d.-b). Partner Cities - Birmingham, UK. Retrieved March 28, 2019, from Biophilic Cities website: <https://www.biophiliccities.org/birmingham-uk>

Biophilic Cities. (n.d.-c). Partner Cities - Edmonton, Canada. Retrieved March 28, 2019, from Biophilic Cities website: <https://www.biophiliccities.org/edmonton>

Biophilic Cities. (n.d.-d). Partner Cities - Singapore. Retrieved March 28, 2019, from Biophilic Cities website: <https://www.biophiliccities.org/singapore>

Biophilic Cities. (n.d.-e). Partner Cities - Washington, DC. Retrieved March 28, 2019, from Biophilic Cities website: <https://www.biophiliccities.org/washington-dc>

Birmingham City Council. (1997). Nature Conservation Strategy for Birmingham. Retrieved from [https://www.birmingham.gov.uk/downloads/file/1023/nature\\_conservation\\_strategy\\_for\\_birmingham](https://www.birmingham.gov.uk/downloads/file/1023/nature_conservation_strategy_for_birmingham)

Birmingham City Council. (2013). Green Living Spaces Plan.

Browning, W., Ryan, C., & Clancy, J. (2014). 14 Patterns of Biophilic Design: Improving Health &

Well-Being in the Built Environment (pp. 1–60). Retrieved from <https://www.terrabinbrightgreen.com/reports/14-patterns/>

Burden, D. (2006). Urban Street Trees. Michigan. Gov, 21–21.

Castleton, H., Stovin, V., Beck, S., & Davison, J. (2010). Green roofs: Building energy savings and the potential for retrofit. *Energy and Buildings*, 42(10), 1582–1591. <https://doi.org/10.1016/j.enbuild.2010.05.004>

City of Edmonton. (2007). Natural Connections Strategic Plan (p. 48).

City of Edmonton. (2011). The Way We Green: The City of Edmonton's Environmental Strategic Plan (p. 90). Retrieved from [https://www.edmonton.ca/city\\_government/documents/PDF/TheWayWeGreen-approved.pdf](https://www.edmonton.ca/city_government/documents/PDF/TheWayWeGreen-approved.pdf)

City of Edmonton. (2012a). For the Love of Winter - Strategy for Transforming Edmonton into a World-Leading Winter City. Retrieved from [https://www.edmonton.ca/city\\_government/documents/PDF/COE-WinterCity-Love-Winter-Summary-Report.pdf](https://www.edmonton.ca/city_government/documents/PDF/COE-WinterCity-Love-Winter-Summary-Report.pdf)

City of Edmonton. (2012b). River For Life Strategic Framework (p. 36).

City of Edmonton. (2012c). Urban Forest Management Plan: Edmonton's Urban Forest - Taking Root Today for a Sustainable Tomorrow (p. 38).

City of Edmonton. (2019a, March 28). Breathe. Retrieved March 28, 2019, from [https://www.edmonton.ca/city\\_government/initiatives\\_innovation/breathe.aspx](https://www.edmonton.ca/city_government/initiatives_innovation/breathe.aspx)

City of Edmonton. (2019b, March 28). Just So You Know. Retrieved March 28, 2019, from [https://www.edmonton.ca/city\\_government/initiatives\\_innovation/just-so-you-know.aspx](https://www.edmonton.ca/city_government/initiatives_innovation/just-so-you-know.aspx)

City of Toronto. (2004). City of Toronto Accessibility Design Guidelines. Retrieved from Equity, Diversity & Human Rights website: [www.toronto.ca/diversity/accessibilityplan2003](http://www.toronto.ca/diversity/accessibilityplan2003)

City of Toronto. (2013a). City of Toronto Guidelines for Biodiverse Green Roofs. Retrieved from City Planning website: <https://web.toronto.ca/wp-content/uploads/2017/08/8d24-City-of-Toronto-Guidelines-for-Biodiverse-Green-Roofs.pdf>

City of Toronto. (2013b). Design Guidelines for "Greening" Surface Parking Lots. Retrieved from City Planning website: <https://web.toronto.ca/wp-content/uploads/2017/08/9642-Design-Guidelines-for-Greening-Surface-Parking-Lots.pdf>

City of Toronto. (2013c). Every Tree Counts : A Portrait of Toronto's Urban Forest. Retrieved from Parks, Forestry and Recreation website: <https://www.toronto.ca/wp-content/uploads/2017/12/92de-every-tree-counts-portrait-of-torontos-urban-forest.pdf>

City of Toronto. (2013d). Parks Plan: 2013-2017. Retrieved from Parks, Forestry and Recreation website: <https://www.toronto.ca/wp-content/uploads/2017/10/98f1-parksplan.pdf>

City of Toronto. (2016a). Bird-Friendly Best Practices: Glass. Retrieved from City Planning website: <https://www.toronto.ca/wp-content/uploads/2017/08/8d1c-Bird-Friendly-Best-Practices-Glass.pdf>

City of Toronto. Ravine and Natural Feature Protection By-law. , Chapter 658 Toronto Municipal Code § (2016).

City of Toronto. (2017a). Best Practices for Effective Lighting. Retrieved from City Planning website: <https://www.toronto.ca/wp-content/uploads/2018/03/8ff6-city-planning-bird-effective-lighting.pdf>

City of Toronto. Green Roof By-law. , Chapter 492 Toronto Municipal Code § (2017).

City of Toronto. (2017c). Toronto Complete Streets Guidelines (No. Edition 1. Volume 1). Retrieved from <https://www.toronto.ca/services-payments/streets-parking-transportation/enhancing-our-streets-and-public-realm/complete-streets/complete-streets-guidelines/>

City of Toronto. (2017d). Toronto Ravine Strategy. Retrieved from Parks, Forestry and Recreation website: <https://www.toronto.ca/wp-content/uploads/2017/10/9183-TorontoRavineStrategy.pdf>

City of Toronto. (2017e, September 7). Biodiversity in the City. Retrieved April 1, 2019, from City of Toronto website: <https://www.toronto.ca/explore-enjoy/parks-gardens-beaches/ravines-natural-parklands/biodiversity-in-the-city/>

City of Toronto. (2017f, September 7). Privately-Owned Publicly Accessible Spaces (POPS) [Government]. Retrieved March 27, 2019, from City of Toronto website: <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/design-guidelines/privately-owned-publicly-accessible-spaces-pops/>

City of Toronto. (2017g, November 14). Toronto at a Glance [Government]. Retrieved March 27, 2019, from City of Toronto website: <https://www.toronto.ca/city-government/data-research-maps/toronto-at-a-glance/>

City of Toronto. (2017h, November 17). Green Roof Overview [Government]. Retrieved March 27, 2019, from City of Toronto website: <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-overview/>

City of Toronto. (2017i, November 17). Parks & Recreation Facility Listings [Government]. Retrieved March 27, 2019, from City of Toronto website: <https://www.toronto.ca/services-payments/venues-facilities-bookings/booking-park-recreation-facilities/parks-and-recreation-facilities/>

City of Toronto. (2017j, November 17). Toronto Green Standard: Overview [Government]. Retrieved March 27, 2019, from City of Toronto website: <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/toronto-green-standard/toronto-green-standard-overview/>

City of Toronto. (2018a). City Council Issues Notes: 2018-2022. Retrieved from <https://www.toronto.ca/wp-content/uploads/2018/12/9598-City-Council-Issue-Notes-2018-2022.pdf>

City of Toronto. (2018b). Toronto 2018 Budget - Parks, Forestry and Recreation. Retrieved from Parks, Forestry and Recreation website: <https://www.toronto.ca/wp-content/uploads/2017/12/8deb-PFR-2018-Op-Budget-Notes-V2.pdf>

City of Toronto. (2018c, February 28). Parkland Dedication [Government]. Retrieved March 27, 2019, from City of Toronto website: <https://www.toronto.ca/city-government/planning-development/application-forms-fees/building-toronto-together-a-development-guide/parkland-dedication/>

City of Toronto. (n.d.). Accessible City of Toronto parks and programs. Retrieved March 31, 2019, from City of Toronto website: <https://www.toronto.ca/311/knowledgebase/kb/docs/articles/>

[parks,-forestry-and-recreation/parks/accessible-city-of-toronto-parks-and-programs.html](https://www.toronto.ca/parks-forestry-and-recreation/parks/accessible-city-of-toronto-parks-and-programs.html)

City of Toronto Official Plan. (2002). City of Toronto Official Plan.pdf. Retrieved from City Planning website: <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/>

Donovan, G. H. (2010). Calculating the green in green: what's an urban tree worth? *Science Findings*, (126), 1–6.

Douglas, O., Lennon, M., & Scott, M. (2017). Green space benefits for health and well-being: A life-course approach for urban planning, design and management. *Cities*, 66, 53–62. <https://doi.org/10.1016/j.cities.2017.03.011>

Eisenman, T. S. (2013). Frederick Law Olmsted, Green Infrastructure, and the Evolving City. *Journal of Planning History*, 12(4), 287–311. <https://doi.org/10.1177/1538513212474227>

Faculty of Public Health. (2010). Great Outdoors : How Our Natural Health Service Uses Green Space An action report (pp. 1–18). London, England.

Garden City Fund. (2017). About GCF. Retrieved March 28, 2019, from Garden City Fund website: <https://www.gardencityfund.org/who-we-are/about-gcf>

Garrett, J. T. (2017, December 13). What is Toronto's Parkland Strategy and why does it matter? Retrieved March 30, 2019, from Park People website: <https://parkpeople.ca/archives/8533>

Gifford, J. (2004). Hurricane Hazel: Canada's Storm of the Century. Toronto: Dundurn Group.

Gleeson, B. (1998). *Geographies of disability*. Routledge.

Gray, T., & Birrell, C. (2014). Are biophilic-designed site office buildings linked to health benefits and high performing occupants? *International Journal of Environmental Research and Public Health*, 11(12), 12204–12222. <https://doi.org/10.3390/ijerph111212204>

Greene, C. S., Millward, A. A., & Ceh, B. (2011). Who is likely to plant a tree? The use of public socio-demographic data to characterize client participants in a private urban forestation program. *Urban Forestry & Urban Greening*, 10(1), 29–38. <https://doi.org/10.1016/j.ufug.2010.11.004>

Greene, C. S., Robinson, P. J., & Millward, A. A. (2018). Canopy of advantage: Who benefits most from city trees? *Journal of Environmental Management*, 208, 24–35. <https://doi.org/10.1016/j.jenvman.2017.12.015>

Hitter, T., Cantor, M., Buta, E., & VasIU, R. A. (2016). Landscape Architecture Planning Proposal for Visually Impaired in Cluj-Napoca. *ProEnvironment*, 9, 53–61.

Kellert, S. (2016). Biophilic urbanism: the potential to transform. *Smart and Sustainable Built Environment*, 5(1), 4–8. <https://doi.org/10.1108/SASBE-10-2015-0035>

Kellert, S. R., & Calabrese, E. F. (2015). *The Practice of Biophilic Design*. Retrieved from [www.biophilic-design.com](http://www.biophilic-design.com)

Kellert, S. R., & Wilson, E. O. (Eds.). (1993). *The Biophilia Hypothesis*. Shearwater.

Litke, H. (2016). Becoming biophilic: Challenges and opportunities for biophilic urbanism in urban planning policy. *Smart and Sustainable Built Environment*, 5(1), 15–24. <https://doi.org/10.1108/>



SASBE-10-2015-0036

Liu, K., & Minor, J. (2005). Performance evaluation of an extensive green roof. Greening Rooftops for Sustainable Communities. Presented at the Greening Rooftops for Sustainable Communities, Washington, D.C.

Louv, R. (2008). Last Child in the Woods - Saving Our Children from Nature-Deficit Disorder. Algonquin Books of Chapel Hill.

Marotte, B. (2018, August 6). Montreal's green laneway trend is paved with good intentions. The Globe and Mail. Retrieved from <https://www.theglobeandmail.com/real-estate/article-montreals-green-laneway-trend-is-paved-with-good-intentions/>

McEwan, G. (2014, April). British first for Biophilic Cities Network. Horticulture Week.

Millward, A. A., & Sabir, S. (2011). Benefits of a forested urban park: What is the value of Allan Gardens to the city of Toronto, Canada? Landscape and Urban Planning, 100(3), 177–188. <https://doi.org/10.1016/j.landurbplan.2010.11.013>

Ministry of Municipal Affairs and Housing. (2017a). Greenbelt Plan (2017). Retrieved from <http://www.mah.gov.on.ca/Page13783.aspx>

Ministry of Municipal Affairs and Housing. (2017b). Growth Plan for the Greater Golden Horseshoe (2017). Retrieved from [http://placestogrow.ca/index.php?option=com\\_content&task=view&id=430&Itemid=14](http://placestogrow.ca/index.php?option=com_content&task=view&id=430&Itemid=14)

Ministry of Municipal Affairs and Housing. (2018, July 11). Greenbelt Protection. Retrieved March 27, 2019, from <http://www.mah.gov.on.ca/Page187.aspx>

National Parks Board. (2009). Conserving our Biodiversity: Singapore's National Biodiversity Strategy and Action Plan (p. 24). Singapore.

National Parks Board. (2019). National Parks - About Us. Retrieved March 28, 2019, from National Parks Board website: <https://www.nparks.gov.sg/about-us>

Natural Resources Canada. (2019, January 18). Forest land ownership [Government]. Retrieved March 31, 2019, from Government of Canada website: <https://www.nrcan.gc.ca/forests/canada/ownership/17495>

Newman, P. (2014). Biophilic urbanism: a case study on Singapore. Australian Planner, 51(1), 47–65. <https://doi.org/10.1080/07293682.2013.790832>

Öhman, A. (1986). Face the beast and fear the face: animal and social fears as prototypes for evolutionary analyses of emotion. Psychophysiology, 23.

Public Health Agency of Canada. (2015). Report from the Canadian chronic disease surveillance system: Mental illness in Canada 2015. <https://doi.org/10.1002/ycd.20038>

Queen, L. (2011, June). Kids of all abilities play in sensory garden. North York Mirror. Retrieved from <https://www.toronto.com/news-story/65308-kids-of-all-abilities-play-in-sensory-garden/>

Reeves, W. (2017). Imagining, Creating, and Sustaining Toronto's Natural Parklands: A Short

History. In An Enduring Wilderness: Toronto's Natural Parklands (pp. 221–229). Toronto, Ontario: ECW Press.

Seeland, K., & Nicolè, S. (2006). Public green space and disabled users. Urban Forestry and Urban Greening, 5(1), 29–34. <https://doi.org/10.1016/j.ufug.2006.03.001>

Söderlund, J., & Newman, P. (2017). Improving Mental Health in Prisons Through Biophilic Design. Prison Journal, 97(6), 750–772. <https://doi.org/10.1177/0032885517734516>

Star Editorial Board. (2017, August). On accessibility, Ontario needs less secrecy, more action: Editorial. Toronto Star. Retrieved from <https://www.thestar.com/opinion/editorials/2017/08/06/on-accessibility-ontario-needs-less-secrecy-more-action-editorial.html>

Statistics Singapore. (2018). Population and Population Structure - Latest Data. Retrieved March 28, 2019, from Department of Statistics Singapore website: <http://www.singstat.gov.sg/find-data/search-by-theme/population/population-and-population-structure/latest-data>

Susca, T., Gaffin, S. R., & Dell'Osso, G. R. (2011). Positive effects of vegetation: Urban heat island and green roofs. Environmental Pollution, 159(8–9), 2119–2126. <https://doi.org/10.1016/j.envpol.2011.03.007>

The World Bank. (n.d.). Social Inclusion. Retrieved March 31, 2019, from World Bank website: <http://www.worldbank.org/en/topic/social-inclusion>

Toronto and Region Conservation Authority. (n.d.). Hurricane Hazel - History. Retrieved March 28, 2019, from Toronto and Region Conservation Authority (TRCA) website: <https://trca.ca/conservation/flood-risk-management/history/>

Trojanowska, M. (n.d.). Sensory gardens inclusively designed for visually impaired users. 10.

U.S. Environmental Protection Agency. (2008). Reducing Urban Heat Islands: Compendium of Strategies. Retrieved from United States Environmental Protection Agency website: <https://www.epa.gov/heat-islands/heat-island-compendium>

Vincent, D. (2016, August 7). Why our ravines are the city below Toronto. The Toronto Star. Retrieved from <https://www.thestar.com/news/gta/2016/08/07/why-our-ravines-are-the-city-below-toronto.html>

Washington, DC. (2019a). Green Area Ratio Overview | ddoe. Retrieved March 28, 2019, from <https://doee.dc.gov/service/green-area-ratio-overview>

Washington, DC. (2019b). Sustainable DC. Retrieved March 28, 2019, from Sustainable DC website: <https://www.sustainabledc.org/>

Washington, DC. (n.d.). Canopy 3000. Retrieved March 28, 2019, from <https://doee.dc.gov/service/canopy-3000>

White, R. (2016). Planning Toronto: The Planners, The Plans, Their Legacies, 1940-80. Vancouver: UBC Press.

WHO. (2004). Promoting Mental Health: Concepts, Emerging Evidence, Practice: Summary Report. Retrieved from World Health Organization website: [https://www.who.int/mental\\_health/evidence/en/promoting\\_mhh.pdf](https://www.who.int/mental_health/evidence/en/promoting_mhh.pdf)

Wolch, J. R., Byrne, J., & Newell, J. P. (2014). Urban green space, public health, and environmental justice: The challenge of making cities "just green enough." Landscape and Urban Planning, 125,

234–244. <https://doi.org/10.1016/j.landurbplan.2014.01.017>

Wood, L., Hooper, P., Foster, S., & Bull, F. (2017). Public green spaces and positive mental health – investigating the relationship between access, quantity and types of parks and mental wellbeing. *Health and Place*, 48(November 2016), 63–71. <http://dx.doi.org/10.1016/j.healthplace.2017.09.002>



