



An Economic Impact Assessment of the Green Infrastructure Sector in Ontario

April 2020



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Conservation Halton | Conservation Ontario | Ducks Unlimited Canada | Green Communities Canada | Forests Ontario | Greenbelt Foundation | Green Roofs for Healthy Cities | Landscape Ontario Horticultural Trades Association | LEAF (Local Enhancement and Appreciation of Forests) | Ontario Association of Landscape Architects | Ontario Parks Association | Toronto and Region Conservation Authority

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PREFACE

The Green Infrastructure Ontario Coalition (GIO) and the Greenbelt Foundation are very pleased to present this first of its kind economic impact assessment (EIA) of the green infrastructure sector in Ontario. Our aim in commissioning this report was to define the scope of the green infrastructure sector in Ontario, provide a comprehensive assessment of the economic impact of the green infrastructure sector, and demonstrate the potential to stimulate economic growth in Ontario from increased investment in green infrastructure. The results clearly demonstrate the vibrancy of the sector, and the significant impact of green infrastructure on the provincial economy.

This assessment analyzed the direct, indirect, and induced economic impact of green infrastructure in Ontario, looking at the contribution to the province's gross output (revenues), gross domestic product (GDP), and employment across the sector's comprehensive and diverse value chain, from project design, to construction, maintenance, relevant product manufacturing and supply, and other related support services.

Secondary research to support this study included undertaking a broad sweep of more than 60 relevant reports and resources, including a review of industry trends and growth opportunities. Sector profiling work included the collection and analysis of statistical data and trends from a wide range of sources in order to estimate green infrastructure sector employment and GDP; compiling lists of relevant organizations and projects; and performing a value chain assessment of the sector. Consultation was also undertaken through an online survey of GIO members, as well as through a series of 10 key informant interviews with industry leaders and sector experts knowledgeable about the various green infrastructure sub-sectors in Ontario, their value chains, and recent projects and related activities.

This analysis is meant to provide a better understanding of the economic contributions and employment opportunities from Ontario's green infrastructure sector, including the direct impacts and benefits to communities across the province.

We would like to thank the following industry stakeholders who provided important resources, insights, and/or data in support of this project: Aquafor Beech, the Municipal Natural Assets Initiative (MNAI), the Sustainable Technologies Evaluation Program (STEP), and in particular Emmons & Olivier Resources Canada Inc (EOR) who also reviewed and provided feedback on early drafts of this report.

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1. EXECUTIVE SUMMARY

Key Findings

- The green infrastructure sector in Ontario is an important contributor to Ontario’s economy, generating \$8.6 billion in gross output (revenues), \$4.64 billion in direct gross domestic product (GDP), and directly employing approximately 84,400 people in 2018. Factoring in the indirect and induced impacts, Ontario’s green infrastructure sector was responsible for nearly 122,000 jobs and \$8.33 billion in GDP in 2018. The Landscape Horticulture and Open Spaces sub-sector contributes the most in terms of economic returns to the province, generating 62% of the sector’s total direct GDP and 69% of the total direct jobs in 2018.
- Comparatively, in 2018, Ontario’s green infrastructure sector was larger than Ontario’s wood product manufacturing sector (\$1.5 billion in GDP and 18,005 jobs), the computer and electronic product manufacturing sector (\$3.5 billion in GDP and 16,335 jobs), and the pharmaceutical and medicine manufacturing sector (\$3.4 billion in GDP and 26,600 jobs).
- The green infrastructure sector is composed of many different industries with vast upstream and downstream inter-connections, from those involved with design and planning, to engineering and maintenance, including landscape architects, technical and environmental consultants, building contractors, and suppliers such as equipment manufacturers and growing nurseries. It also involves government and non-government stakeholders, such as federal and provincial government departments and ministries, local and Indigenous governments, Conservation Authorities, land trusts, and other environmental non-profits.
- The sector shows significant growth potential driven by current market, industry, technological, and demographic trends, as well as by existing and potential future policy action. Under a “business as usual” growth scenario to 2030, Ontario’s green infrastructure sector is projected to grow by 22% over 2018, potentially generating \$13.2 billion in gross output (revenues), \$7.01 billion in direct GDP, and responsible for more than 103,000 direct jobs.
- Under a more aggressive, yet achievable, “stretch” growth scenario to 2030, Ontario’s green infrastructure sector could grow by 73% over 2018, assuming enhanced policy intervention and innovation, as well as broader awareness of the benefits of green infrastructure among planners and decision-makers to support climate action and resiliency objectives. Under the stretch scenario, Ontario’s green infrastructure sector could potentially generate \$18.56 billion in gross output (revenues), \$10.02 billion in direct GDP, and 250,400 jobs by 2030 (direct, indirect, and induced).

Project Overview & Approach

Green infrastructure refers to the natural vegetative systems and green technologies that collectively provide society with a multitude of economic, environmental and social benefits. Green infrastructure is an important sector of Ontario's economy. With an extensive value chain of inter-related industries, the sector supports various organizations and provides significant employment throughout Ontario.

This study evaluates the current and potential future economic impact of Ontario's green infrastructure sector by profiling its seven distinct sub-sectors including:

- Landscape Horticulture and Open Spaces
- Green Roofs and Walls
- Green Stormwater Management
- Urban Forests
- Parks
- Natural Heritage
- Cross Sectoral Support Services

The report includes an overview of the key trends and drivers impacting the sector, an assessment of the current (2018) size of the sector's supply chain (including jobs, GDP, and revenues), and models the projected future growth potential of the sector under "business as usual" and "stretch" scenarios.

Primary and secondary research and statistical analyses were undertaken as a part of this study and a definitional framework was developed to help profile the sub-sectors and identify the most relevant industries found within each sub-sector. Key informants and leading stakeholders from the sector were interviewed, with a survey distributed to a broader group of GIO members. Reports, policy documents, websites, data sets, membership lists, and other sources, including asset management plans, were reviewed and analyzed to inform the development of the sub-sector profiles.

Economic impact modelling leveraged Statistics Canada input-output tables and multipliers to estimate employment, GDP, and gross output contributions from relevant industries. In addition, intensity ratios were estimated for each industry within the seven sub-sectors. Intensity ratios represent the amount of green infrastructure-related economic activity taking place within each industry (essentially the market penetration of green infrastructure activity within relevant industries). Two growth scenarios were developed based on "business as usual" (BAU) trends and a "stretch" target based on more aggressive policy action.

Trends and Drivers

Urbanization of Southern Ontario and the impacts of climate change have been important factors resulting in a re-assessment of the value provided by green infrastructure assets in recent years. This ongoing paradigm shift, along with supportive cross-sectoral support services, are contributing to the increased awareness of the economic value of green infrastructure.

For example, Ontario Regulation 588/17: *Asset Management Planning for Municipal Infrastructure* (O. Reg 588/17), a provincial policy that requires municipalities to produce Strategic Asset Management Plans accounting for all municipal assets, including green infrastructure assets. The regulation strives to standardize municipal asset planning while ensuring decision-makers consider the strategic benefits and drawbacks of assets, including natural / living green infrastructure.¹ This policy has the potential to drive greater investment into the green infrastructure sector.²

The green infrastructure sector is embedded into Ontario's supply chains of local producers and suppliers of products and services, from green infrastructure materials (such as trees, flowers, soil, and garden and landscaping equipment), to construction contractors, and maintenance service providers. The sector not only sources from local suppliers, but also supports a range of local industries indirectly, such as the outdoor recreation and tourism sectors.

¹ See: <https://www.ontario.ca/laws/regulation/r17588#BK3>

² See: https://mnai.ca/media/2020/01/MNAI_MNAPOntario.pdf

As the sector matures, organizations providing essential goods and services to the sector find new avenues to grow and build expertise. New technologies are enabling further deployment of green infrastructure solutions, such as soil cells enabling the efficient growth of urban forests and street trees.

Economic Impact

In 2018, Ontario’s green infrastructure sector was responsible for generating \$8.60 billion in gross output (revenues) and \$4.64 billion in direct GDP, directly employing approximately 84,400 people (see Table ES1).

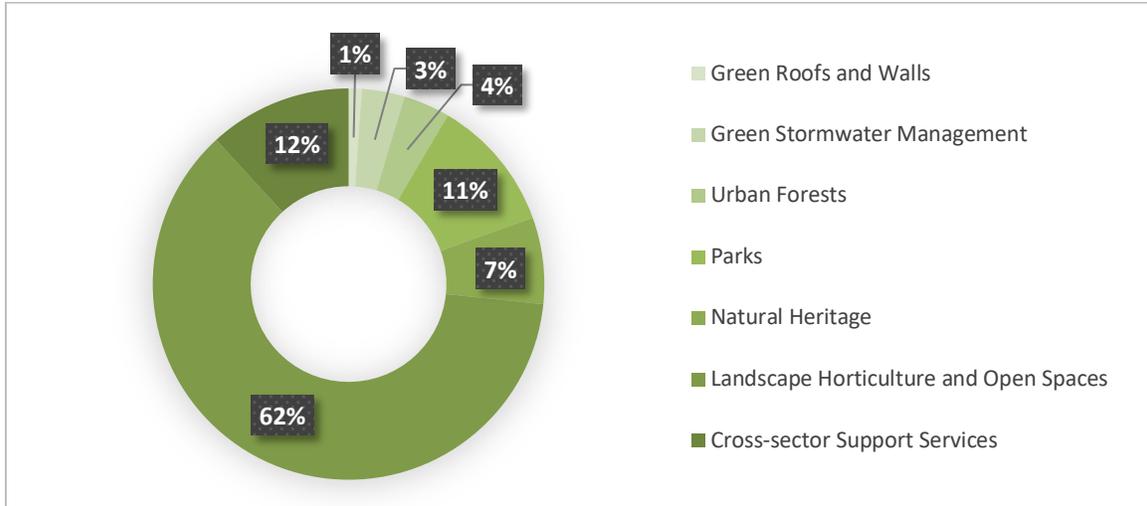
Factoring in the indirect and induced impacts, Ontario’s green infrastructure sector was responsible for nearly 122,000 jobs and approximately \$8.33 billion in GDP in 2018. Comparatively, as examples, the green infrastructure sector in 2018 was larger than Ontario’s wood product manufacturing sector (\$1.5 billion in GDP), computer and electronic product manufacturing sector (\$3.5 billion in GDP), and the pharmaceutical and medicine manufacturing sector (\$3.4 billion in GDP).

Figure ES1 shows the breakout by sub-sector as a percentage of total direct GDP related to Ontario’s green infrastructure sector in 2018. The Landscape Horticulture and Open Spaces sub-sector is responsible for nearly two-thirds of GDP (62%), followed by the Cross-Sector Support Services (12%) and the Parks sub-sectors (11%). While relatively small in terms of their overall contribution to jobs and GDP, the Green Roofs and Walls, Green Stormwater Management, and Urban Forests sub-sectors constitute important and growing contributions in terms of employment and investments in Ontario’s urban environments.

Table ES1: Economic contribution (jobs, GDP, and gross output) from Ontario’s green infrastructure sector, 2018.

Green Infrastructure Sub-sector	GI Jobs (Direct Only)	GI Gross Output \$ thousands	GI GDP (Direct Only) \$ thousands	GI Jobs (Direct, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ thousands
Green Roofs and Walls	842	\$93,072	\$51,186	1,213	\$88,729
Green Stormwater Management	1,347	\$237,828	\$163,384	2,111	\$239,865
Urban Forests	3,417	\$323,625	\$177,990	4,780	\$315,764
Parks	8,923	\$877,900	\$511,209	12,772	\$885,601
Natural Heritage	5,321	\$552,414	\$331,360	7,510	\$553,787
Landscape Horticulture and Open Spaces	58,733	\$5,578,654	\$2,852,774	82,558	\$5,217,352
Cross-sector Support Services	5,852	\$940,231	\$547,304	10,637	\$1,026,272
TOTAL	84,434	\$8,603,724	\$4,635,208	121,581	\$ 8,327,371

Source: The Delphi Group



Source: The Delphi Group

Figure ES1: Direct GDP attributed to Ontario's green infrastructure sector in 2018.

Sub-sector Profiles

The table below provides a high-level profile of each of the seven sub-sectors.

Sub-Sector	Key Take-Aways
Landscape Horticulture and Open Spaces	<ul style="list-style-type: none"> Ontario's Landscape Horticulture and Open Spaces sub-sector was responsible for an estimated 58,730 direct jobs in 2018, with a gross output (revenues) of over \$5.6 billion and a direct contribution to provincial GDP of \$2.9 billion. As the largest sub-sector, landscape horticulture and open spaces includes natural assets not found in parks (e.g., fields, gardens) and supportive industries, including horticulture production, nurseries, and related products and services across the supply chain.
Green Roofs and Walls	<ul style="list-style-type: none"> Ontario's Green Roof and Walls sub-sector was responsible for an estimated 840 direct jobs in 2018, with a gross output of \$93 million and a direct contribution to provincial GDP of \$51.2 million. This sub-sector incorporates a specialized supply chain that includes designers and landscapers, nurseries and plant growers, roofing and other contractors, as well as materials producers (e.g., plastic liner producers) used in the construction and maintenance of living green roofs and walls.
Green Stormwater Management	<ul style="list-style-type: none"> Ontario's Green Stormwater Management sub-sector was estimated to employ 1,350 direct jobs in 2018, with a gross output of over \$237.8 million and a direct contribution to provincial GDP of \$163.4 million. This diverse sub-sector refers to the green infrastructure assets used to collect, and at times treat and filter excess stormwater runoff, including bioswales, soil cells, cisterns, rain gardens, and stormwater ponds, among other key assets.
Urban Forests	<ul style="list-style-type: none"> Ontario's Urban Forests sub-sector was estimated to employ 3,420 direct jobs in 2018, with a gross output of over \$323.6 million and a direct contribution to provincial GDP of \$178.0 million.

	<ul style="list-style-type: none"> • The Urban Forests sub-sector is made up of forests and woodlots found in urban areas not classified as parks.
Parks	<ul style="list-style-type: none"> • Ontario's Parks sub-sector was estimated to employ 8,920 direct jobs in 2018, with a gross output of \$877.9 million and a direct contribution to provincial GDP of \$511.2 million. • Parks include all legislated park lands managed by all levels of government, as well as those owned and/or managed by private and non-profit organizations. This sub-sector relies on maintenance services, planners, engineering and specialized environmental services, landscaping services, material and equipment suppliers, and supports businesses such as botanical gardens and campgrounds.
Natural Heritage	<ul style="list-style-type: none"> • Ontario's Natural Heritage sub-sector was estimated to employ 5,320 direct jobs in 2018, with a gross output of \$552.4 million and a direct contribution to provincial GDP of \$331.4 million. • This sub-sector includes the large areas of land and water located outside of urban areas that are not designated as "park" lands. This includes forests, natural wetlands, ravines, lakes, rivers, and creeks and relies on forest management services, suppliers such as tree nurseries, environmental and technical consultants, and landscaping services. Forestry work relevant to this subsector focuses on replanting and forest management.
Cross-Sectoral Support Services	<ul style="list-style-type: none"> • Ontario's Cross-sector Support Services sub-sector was estimated to employ 5,850 direct jobs in 2018, with a gross output of \$940.2 million and a direct contribution to provincial GDP of \$547.3 million. • This sub-sector encompasses a variety of organizations that provide the supportive framework to enable green infrastructure to flourish, including Conservation Authorities, land trusts, Indigenous organizations, industry associations, education and training organizations, and public administration from all levels of government.

Growth Potential

Under the current BAU scenario, Ontario’s green infrastructure sector is forecast to see a growth in direct GDP to \$7.0 billion in 2030 and 103,000 direct jobs by 2030 (see Table ES2), representing a total growth of 22% between 2018 and 2030. Under the more aggressive, policy-driven “stretch” scenario, direct GDP could grow to \$10.0 billion by 2030, with more than 146,000 direct jobs, equal to 73% growth for the sector as a whole between over that 12-year period.

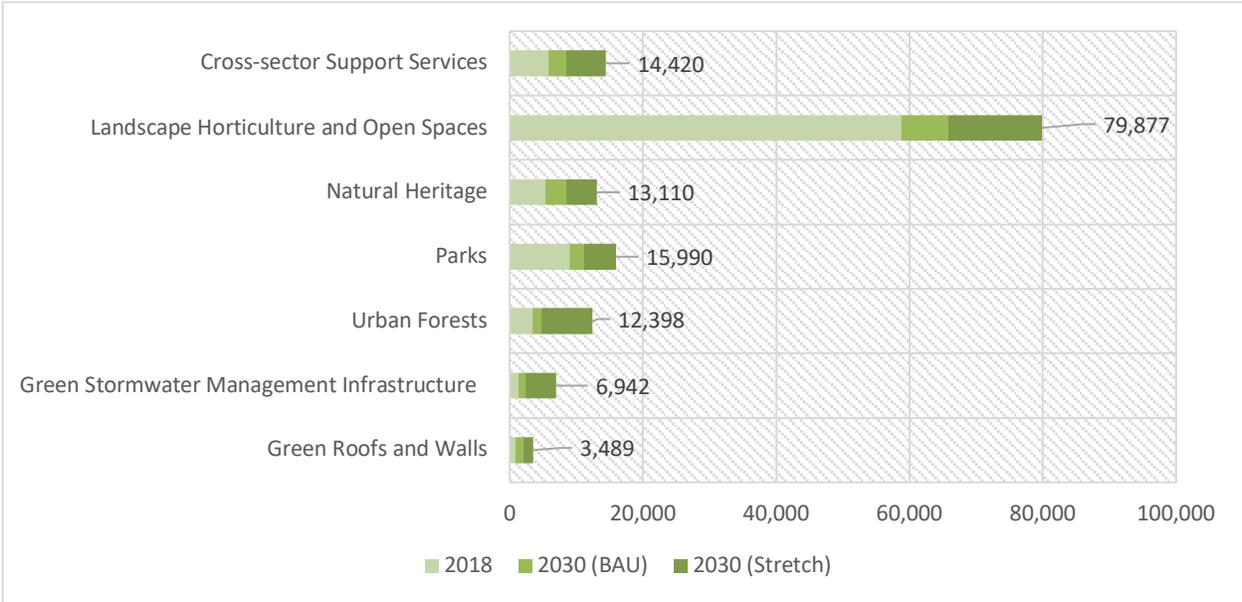
Table ES2: Direct jobs, gross output, and GDP for Ontario’s green infrastructure sector under two growth scenarios (2018-2030).

Year	GI Jobs (Direct)	GI Gross Output \$ thousands	GI GDP (Direct) \$ thousands	% Growth (2018-2030)
2018	84,434	\$8,603,724	\$4,635,208	
2030 (BAU)	103,077	\$13,179,170	\$7,011,122	22.1%
2030 (Stretch)	146,225	\$18,555,527	\$10,023,416	73.2%

Source: The Delphi Group

The economic impact on direct jobs under the two scenarios in Ontario’s green infrastructure sector are illustrated further by sub-sector in Figure ES2. Under the BAU scenario, the Green Roofs and Walls sub-sector is projected to see the highest relative growth rate based on current trends, equal to 108% growth over that 12-year period, followed by the Green Stormwater Management sub-sector at 60% overall growth.

Under the Stretch scenario, the Green Stormwater Management sub-sector is projected to see the greatest potential growth, equal to 360% between 2018 and 2030, followed by the Green Roofs and Walls (270%) and Urban Forests (224%) sub-sectors. This is due in part to the fact that these sub-sectors are relatively small in size, but also have the large potential to be influenced by more aggressive policies and regulations at the provincial and local government levels in Ontario.



Source: The Delphi Group

Figure ES2: Direct Job Growth in Ontario’s Green Infrastructure Sector under BAU and Stretch Scenarios (2018-2030).

In Summary

The increasing recognition of the risks posed by climate change have led to a re-evaluation of natural assets, both in terms of their ecosystem services and for their application to support efforts to sequester carbon and provide resiliency to extreme weather events. As such, green infrastructure presents a transformative economic sector opportunity for Ontario, leading to more integrated and effective asset planning and management processes and opportunities.

In order to maximize the full potential triple-bottom-line benefits that can be provided by Ontario's green infrastructure sector, a coordinated approach across industries and sub-sectors is required in areas that include:

1. Better data collection and increased information sharing amongst decision-makers across the supply chain to demonstrate the clear value and benefits of green infrastructure to communities across Ontario.
2. Improved policy and regulatory frameworks that encourage the development and adoption of green infrastructure.
3. More inclusive funding and flexible financing options to support the capital costs and ongoing maintenance of green infrastructure.
4. Enhanced workforce skills and capacity development, including broader awareness amongst industry practitioners and decision-makers for the adoption of green infrastructure best practices.

2. INTRODUCTION

Defining Green Infrastructure

GIO defines green infrastructure as: “The natural vegetative systems and green technologies that collectively provide society with a multitude of economic, environmental, and social benefits. This includes:

- Urban forests and woodlots
- Bioswales, engineered wetlands, and stormwater ponds
- Wetlands, ravines, waterways, and riparian zones
- Meadows and agricultural lands
- Green roofs and green walls
- Urban agriculture
- Parks, gardens, and grassed areas

It also includes soil in volumes and qualities adequate to sustain green infrastructure and absorb water, as well as technologies like porous pavements, rain barrels, and cisterns, which are typically part of green infrastructure support systems. The green technologies in this definition replicate the functions of ecosystems, such as stormwater storage and filtration.”

For the purposes of this economic impact assessment, green infrastructure was considered in line with GIO’s definition above, split out across the following seven sub-sectors in order to support the statistical data collection and analysis:

1. Landscape Horticulture and Open Spaces
2. Green Roofs and Walls
3. Green Stormwater Infrastructure Systems
4. Urban Forests
5. Parks
6. Natural Heritage
7. Cross-Sectoral Support Services

The first six of the sub-sectors listed above are supported by several cross-sector government and non-governmental organizations which are essential to Ontario’s green infrastructure value chain, including:

- Federal government departments
- Provincial government ministries and supporting agencies
- Local, municipal, and regional public administration (including regulatory and protective services)
- Indigenous public administration
- Conservation Authorities
- Environmental non-governmental organizations

Benefits of Green Infrastructure

Green infrastructure assets are increasingly recognized by science for the multitude of benefits they provide. In recent years, the public, private, and non-profit sectors have been re-assessing how green infrastructure is valued and incorporated into planning and decision-making processes in line with traditional infrastructure investments, increasingly recognizing green infrastructure's triple-bottom-line benefits (i.e., economic, social, and environmental).

As one example, a watershed with sufficient green infrastructure can provide drinking water for nearby residents³ while serving to protect built assets from flooding by retaining runoff and mimicking natural hydrology.⁴ Green infrastructure can also benefit communities by increasing coastal resiliency, reducing the urban heat island effect,⁵ and acting as carbon sinks in support of climate change adaptation and mitigation,⁶ and by providing other services.⁷

Green infrastructure also provides positive social and health benefits to communities by providing green spaces that improve air quality,⁸ creating areas for recreation, decreasing noise pollution, and creating spaces that increase community cohesion, which has positive impacts on mental health.⁹ In addition to these positive environmental and social benefits, green infrastructure provides economic and employment opportunities across the value chain.

There is also evidence that shows green infrastructure and natural assets can reduce the need for new capital expenditures and operating costs, providing benefits to governments, taxpayers, and other stakeholders over more traditional grey infrastructure in some applications.¹⁰ In Ontario, for example, the cities of Toronto,¹¹ Mississauga, London, and others have been evaluating various infrastructure revitalization projects (such as for stormwater management) using a triple-bottom-line approach and developing supporting policies to encourage green infrastructure development.

It is worth noting that many Indigenous communities have historically worked with green infrastructure assets for subsistence and to protect the environment, valuing them as foundational components of their societies. For example, the Maori Indigenous peoples in New Zealand exercise values-based management of their environmental assets.¹² More specifically, they apply a quadruple-bottom-line approach that evaluates economic development based on criteria across environmental stability, social stability, cultural stability, and economic stability.¹³

About this Report

This study quantified the economic impact of green infrastructure in Ontario, as per the definitional framework above, and includes estimates of current revenues, jobs, and contributions to GDP by Ontario's green infrastructure sub-sectors across the value chain. In addition, this assessment includes a forward-looking analysis on areas of potential growth for Ontario's green infrastructure sector. The report is broken out into the following sections:

- **Trends & Drivers:** Provides an overview of the macro-trends and drivers for Ontario's green infrastructure sector
- **Ontario's Green Infrastructure Sector Profile:** Provide profiles of the seven green infrastructure sub-sectors

³ See: <https://link.springer.com/article/10.1007/s10021-016-9986-x>

⁴ See: <https://www.epa.gov/file/green-infrastructure-climate-resiliency-infographic>

⁵ Ibid.

⁶ See: https://greeninfrastructureontario.org/app/uploads/2016/04/HPS_GI.pdf

⁷ See: https://waterbucket.ca/gi/files/2011/01/The-Value-of-Green-Infrastructure_Jan2011.pdf

⁸ Municipal Natural Assets Initiative (<https://mnai.ca/about/>)

⁹ Ibid.

¹⁰ Municipal Natural Assets Initiative (<https://mnai.ca/about/>)

¹¹ See: <https://www.ryerson.ca/content/dam/cur/pdfs/JohnsGlandSWMTorontoFinalDec18.pdf>

¹² See: Values led management: the guidance of place-based values in environmental relationships of past, present and future. <https://www.ecologyandsociety.org/vol23/iss3/art35/ES-2018-10357.pdf> [download link]

¹³ See: Maori Sustainable Economic Development in New Zealand: Indigenous Practices for the Quadruple Bottom line

- **Ontario's Green Infrastructure Growth Potential:** Analyzes the growth potential of Ontario's green infrastructure sector
- **Summary:** Summarizes the key take-aways

3. TRENDS & DRIVERS

Through key informant interviews, a survey of relevant stakeholders in Ontario, and secondary research, five trends and sector drivers influencing Ontario's green infrastructure sector were identified and are described below.

3.1 Climate Action Supporting Green Infrastructure

Climate change is increasing the frequency and severity of storms, flooding, wildfires, droughts, and the number of record-breaking temperature days, impacting the services and infrastructure that people depend on and resulting in major financial impacts. For example, in Ontario, the 2018 May windstorm cost \$380 million in insured damage and the tornadoes and storms in September 2018 resulted in another \$295 million in losses.¹⁴ In the first three months of 2019, insured damages in Ontario were \$281 million from winter storms and thaws.¹⁵

The impacts of climate change are expected to continue and carry health risks for Ontarians, notably increasing the risk of heat-related illness, especially in urban centres due to the urban heat island effect, and increasing the risk of disease from mosquitoes, ticks, and other insects as summers are longer and winters shorter.¹⁶

Insured losses in Canada have been over CAD \$1 billion/year for the past five years, with payouts in 2018 reaching nearly CAD \$2 billion.¹⁷ As a result, investors and insurance agencies, such as the Insurance Bureau of Canada, are increasingly advocating for green infrastructure in order to mitigate the risks and costs associated with severe weather, as well as for its capacity to sequester carbon.¹⁸

The understanding of the value that green infrastructure can provide in terms of sequestering greenhouse gas (GHGs), as well as in support of climate change adaptation measures and resiliency, is growing. Government and other stakeholders have an obligation to protect communities from the impacts of flooding, and the opportunity exists within this obligation to proactively build more resilient communities by investing further in green infrastructure. Many governments across Ontario at all levels are developing plans laying out their goals and strategies for addressing climate change impacts and developing more resilient communities and infrastructure (e.g., Toronto's TransformTO program).¹⁹

Cost-benefit analysis of street trees in five American cities, for example found a benefit of CAD \$1.79-\$4.03 annually for every dollar spent on tree management.²⁰ A TD Bank analysis similarly found that, for every dollar spent in Toronto on urban forestry, the benefits in return ranged from \$1.35-\$3.20 annually.²¹

Analysis on wetlands has found that not only do they help in the management of stormwater and with reducing flood damage, but they also extend the life of grey infrastructure.²² Wetlands in Ontario's Greenbelt, alone were, estimated to provide \$380 million in flood mitigation per year.²³ As climate change continues to impact on

¹⁴ See: <https://www.canadianunderwriter.ca/catastrophes/what-caused-this-1-9-billion-insured-loss-1004150861/>

¹⁵ See: <https://www.newswire.ca/news-releases/ontario-thaw-causes-over-70-million-in-insured-damage-826747861.html>

¹⁶ Ibid.

¹⁷ Canadian Underwriter. Why the Global Protection Gap is the Lowest its Been in 14 years.

<https://www.canadianunderwriter.ca/insurance/why-the-global-protection-gap-is-the-lowest-its-been-in-14-years-1004151048/>

¹⁸ See: <http://assets.IBC.ca/Documents/Resources/IBC-Natural-Infrastructure-Report-2018.pdf>

¹⁹ See: <http://www.mah.gov.on.ca/AssetFactory.aspx?did=7035>

²⁰ See: <https://www.epa.gov/green-infrastructure/green-infrastructure-cost-benefit-resources>

²¹ See: <https://www.td.com/document/PDF/economics/special/UrbanForests.pdf>

²² See: <https://www.ducks.ca/natural-infrastructure/>

²³ See: <https://davidsuzuki.org/wp-content/uploads/2018/02/ontario-wealth-canada-future-value-greenbelt-eco-services.pdf>

communities and people across Ontario, sustained interest and growing investments in the green infrastructure sector are expected.

3.2 Policy Driving Green Infrastructure Investment

Policies that recognize the value of green infrastructure and place an emphasis on its importance as part of community resiliency are also serving to further drive investment in the sector. Outside of Canada (particularly in Europe), the value of green infrastructure has long been recognized through policy. For example, in 1994, Berlin developed and implemented a Biotope Area Factor (BAF) as a way to account for the ratio of “ecologically effective surface area” as part of its total land area within the city’s jurisdiction.²⁴ This ratio is used to meet targets set out by the city for land use within Berlin. For example, residential units have a target of between 0.3 and 0.6 BAF, and an intensive green roof offers 0.8 BAF per square meter. The policy targets have been driving investment in green infrastructure as a result.

Policies supporting the adoption of green infrastructure in Ontario are more recent and some of the leaders in North America. As one example, the City of Toronto’s Green Roof Bylaw was adopted in 2009 and was the first of its kind in North America.²⁵ As another example, the Province of Ontario has drafted a Low Impact Development Stormwater Management Guidance Manual, although the final version has yet to be published.²⁶

As climate change and related impacts are increasingly felt across Canada, including in Ontario, jurisdictions are rolling out policy tools to address the challenges and opportunities. The Government of Canada has designed policy to support Ontario with climate mitigation and adaptation efforts. For example, the Federal Government has invested \$384 million into the Port Lands Flood Protection Project in Toronto, a green infrastructure stormwater management solution.²⁷ Separately, the Government of Canada is allocating resources over five years to support infrastructure projects across Canada, including green infrastructure projects in Ontario.²⁸ It is important to note that the federal government’s definition of green infrastructure is different from GIO’s definition, as it includes non-natural assets such as renewable energy,²⁹ whereas GIO defines green infrastructure as natural vegetative systems and green technologies that fall in the seven subsectors covered in this report.³⁰

The Provincial Government in Ontario is also supporting green infrastructure investments across multiple streams.³¹ Under Ontario Regulation 588/17: *Asset Management Planning for Municipal Infrastructure*, which is a part of the Infrastructure for Jobs and Prosperity Act of 2015, municipalities are required by the Province to prepare Strategic Asset Management Policies (SAMP) by 2019 and asset management plans that includes requiring a valuation of their green infrastructure assets by 2023.³² This policy leads municipalities to evaluate their assets, including green infrastructure assets, and also requires municipalities to consider as a part of their planning processes the “mitigation approaches to climate change”, “disaster planning”, and the vulnerabilities to which climate change may expose assets being evaluated.³³ As climate change continues to exacerbate the risk of flooding in Ontario,³⁴ and due to the stormwater management and climate mitigating benefits of green infrastructure, this policy is expected to further drive investments in the sector at the local government level across Ontario.³⁵

²⁴ See: <https://climate-adapt.eea.europa.eu/metadata/case-studies/berlin-biotope-area-factor-2013-implementation-of-guidelines-helping-to-control-temperature-and-runoff>

²⁵ See: <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-bylaw/>

²⁶ See: <https://ero.ontario.ca/notice/012-9080>

²⁷ Ibid.

²⁸ See: <https://www.infrastructure.gc.ca/plan/qi-iv-eng.html>

²⁹ See: <https://www.canada.ca/content/dam/themes/environment/documents/weather1/20170125-en.pdf>

³⁰ See: <https://greeninfrastructureontario.org/>

³¹ See: <https://news.ontario.ca/moi/en/2019/10/ontario-investing-in-green-infrastructure-to-help-smaller-communities.html>

³² See: <https://www.ontario.ca/laws/regulation/r17588#BK0>

³³ Ibid.

³⁴ <https://www.ontario.ca/page/climate-change-and-natural-resources>

³⁵ See: <https://greeninfrastructureontario.org/stormwater-systems/>

Furthermore, as referenced above, the Ontario Ministry of Environment, Conservation, and Parks (MECP)'s Low Impact Development Stormwater Management Guidance Manual has been in draft form for some time.³⁶ This guidance document, once published, will serve to complement a 2003 manual on the same topic, guiding users to engage in holistic assessments of stormwater management solutions, including green infrastructure options such as low impact development (LID).³⁷

Finally, municipal policies and strategies play a central role in driving green infrastructure through their creation of asset management plans, the development of urban forest strategies,³⁸ as well as municipal stormwater management plans,³⁹ as examples. These policy-driven efforts recognize the value of green infrastructure assets and explicitly lay out how green infrastructure assets will be managed, enabling industry and the supporting ecosystem of organizations across the value chain to plan and invest accordingly.

The City of Toronto's Green Roof Bylaw is a great example of a policy recognizing the value of green infrastructure.⁴⁰ The Bylaw requires that green roofs must be included for all new developments or new additions to commercial, institutional, and residential buildings, as well as for industrial buildings with new gross floor area over 2,000 square meters, for between 20%-60% of the available roof space.⁴¹ This Bylaw has led to many green roofs being constructed across the City of Toronto. In fact, about 80% of all green roofs built in Ontario on an annual basis in the last several years have been built in Toronto.⁴² This supportive policy enables the city to reap the benefits of green infrastructure, while creating new investment and employment opportunities across the value chain.

3.3 Maturing of Local Value Chains

Support for green infrastructure projects has value chain ripple effects wherein the economic, environmental, and social benefits largely remain inside Ontario. With a maturation of Ontario's green infrastructure sector, key stakeholders across the local value chain are benefitting, given that work must largely be performed within the province and cannot be outsourced due to its nature (e.g. landscaping work).

Non-profits involved in the management of green infrastructure projects and assets, as well as the administration of funding programs, include Conservation Authorities, land trusts, Indigenous-owned organizations, and other capacity building groups. Many of these organizations rely on suppliers, sub-contractors, and volunteers for the design, construction, installation, and maintenance of related projects and green infrastructure assets. These include local environmental and scientific or technical consultants, water resource and civil engineers, landscape architects, specialized trades, and other groups needing to conduct fieldwork in support of green infrastructure.⁴³ Conservation Authorities and other cross-sector service agencies also play a role in connecting contractors and service providers with collaborators and clients.⁴⁴

In the Green Roof and Walls sub-sector as one example, nurseries grow plants, seeded and vegetative mats, growing substrates, and other living elements used for Ontario's green roofs, creating and supporting an industrial symbiosis

³⁶ See: <https://ero.ontario.ca/notice/012-9080>

³⁷ See: <https://tricia.com/app/uploads/2016/07/6-A-1-Chris-Denisch-John-Antoszek-2017-LID-Stormwater-Management-Guidance-Manual.pdf>

³⁸ See: <https://www.london.ca/residents/Environment/Trees-Forests/Documents/London%20Urban%20Forestry%20Strategy%20Final.pdf>, and https://www.kitchener.ca/en/resourcesGeneral/Documents/INS_PARKS_Sustainable_Urban_Forest_Strategy_DRAFT_SPREAD.pdf

³⁹ See: <https://www.kitchener.ca/en/city-services/stormwater-management.aspx>

⁴⁰ See: <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-bylaw/>

⁴¹ See: <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-bylaw/>

⁴² Green Roofs for Healthy Cities

⁴³ Key informant interview, multiple key informants

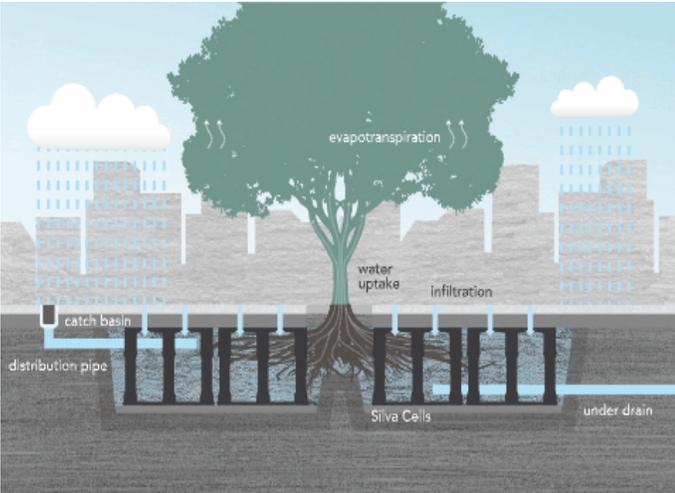
⁴⁴ Key informant interview, Conservation Authority

between nurseries, material suppliers, roofers, landscape architects, engineers, and other key stakeholders across the supply chain.⁴⁵

3.4 Innovation Enabling New Green Infrastructure Solutions

Green infrastructure is innovative, both in the way it encourages decision-makers to re-think how to value infrastructure assets, and in the way it relies on and encourages innovation in technology and systems-based solutions.

Technology is improving across all of the green infrastructure sub-sectors, enabling efficient and effective planning, development, and maintenance of projects and assets. Examples of these technologies include stormwater modelling using geographic information system (GIS) and the mapping of trees and forest assets using Light Detection and Ranging (LiDAR) technology.⁴⁶



Source: Deeproot, 2019

Figure 1: Silva Cells® enable urban forests and street trees.

Stormwater modelling helps support conservation and remediation work. Sometimes this work is completed in-house by Conservation Authorities or environmental non-profits themselves while, in other cases, the work is undertaken by consultants.⁴⁷ Improvements in recent years enable non-technical users to better understand and inform their work based on tools such as ArcGIS mapping programs created to understand and visualize stormwater in specific regions.⁴⁸ This technological improvement supports the efforts of natural asset managers and others working in the sub-sector, including on projects related to wetlands and to support decisions related to capital allocation.⁴⁹

As another example, soil cells (e.g., silva cells) are an innovation that supports the maintenance of urban trees and forests. As shown in Figure 1, soil cells enable stormwater management by directing stormwater into underground chambers filled with media that support urban trees, and sometimes utilize permeable surfaces. Part of the captured water is absorbed by trees, which are free to grow and spread their roots. The remainder of the water continues into the city’s drainage systems.

The soil cells can enhance urban tree growth and their benefits (e.g., shade, rainfall interception, stormwater infiltration, evapotranspiration), without being limited by or damaging grey infrastructure such as sidewalks.⁵⁰ This innovation benefits stormwater management through LID and facilitates the inclusion of street trees in urban centres. Innovation is also happening through special projects, such as work being led by the University of Toronto’s Green Roof Innovation Testing (GRIT) Laboratory, which has been conducting green roof and wall research to better understand stormwater retention, evaporative cooling, biodiversity, and the life-cycle cost of the City of Toronto’s

⁴⁵ Key informant interview, Green Roofs for Healthy Cities
⁴⁶ Key informant interview, and see: <https://www.citylab.com/environment/2018/12/urban-tree-canopy-maps-artificial-intelligence-descartes-labs/578701/>
⁴⁷ Key informant interview, Green Roofs for Healthy Cities
⁴⁸ See: <http://proceedings.esri.com/library/userconf/water18/papers/Water-40.pdf>
⁴⁹ Ibid.
⁵⁰ See: <https://www.deeproot.com/products/silva-cell.html>

Green Roof Construction Standard.⁵¹ Efforts like this enable innovative and informed policy-making, which is important to the green infrastructure sector's continued growth.

3.5 Increased Public Awareness and Support for Green Infrastructure

Green infrastructure is becoming more popular, as can be seen by public and organizational attitudes towards the sector. As one example, a 2019 study about public attitudes towards Parks Canada found that 89% of respondents in Ontario are supportive of the agency's mandate, up from 87% in December 2018.⁵² The Parks Canada mandate reads as follows: "On behalf of the people of Canada, we protect and present nationally significant examples of Canada's natural and cultural heritage, and foster public understanding, appreciation and enjoyment in ways that ensure the ecological and commemorative integrity of these places for present and future generations."⁵³

Due in part to the social benefits of green infrastructure, there is increased citizen engagement in favour of green infrastructure development.⁵⁴ More requests for proposals (RFPs) are asking project proponents to demonstrate social impact of their developments, and engagement around these issues supports inclusive participation as part of new green infrastructure projects.⁵⁵

Climate change is an increasing concern among Canadians, with 67% of voters in the 2019 federal election wanting climate change policies to be enacted, and 78% supporting a large-scale investment in clean energy and green infrastructure.⁵⁶ Although the federal government's definition of green infrastructure is more expansive and includes renewable energy assets, it still includes green infrastructure as defined by the GIO.⁵⁷

As public awareness and attitudes towards the sector evolve, in part as a result of increased awareness of the benefits of green infrastructure, the sector is seeing increased engagement from key stakeholders across the value chain, from planners, to developers, suppliers, capacity building organizations, policy-makers, and investors.⁵⁸

⁵¹ See: <http://grit.daniels.utoronto.ca/about/areas-of-investigation/>

⁵² See: http://publications.gc.ca/collections/collection_2019/pc/R62-557-2019-eng.pdf

⁵³ See: <https://www.pc.gc.ca/en/agence-agency/mandat-mandate>

⁵⁴ Key informant interview, Emmons & Olivier Resources, Inc.

⁵⁵ Ibid.

⁵⁶ See: <https://cleanenergycanada.org/poll-two-thirds-of-canadians-want-to-continue-or-increase-climate-efforts-under-minority-government/>

⁵⁷ See: <https://greeninfrastructureontario.org/>

⁵⁸ Ibid.

4. SECTOR PROFILE: ECONOMIC IMPACT OF GREEN INFRASTRUCTURE IN ONTARIO

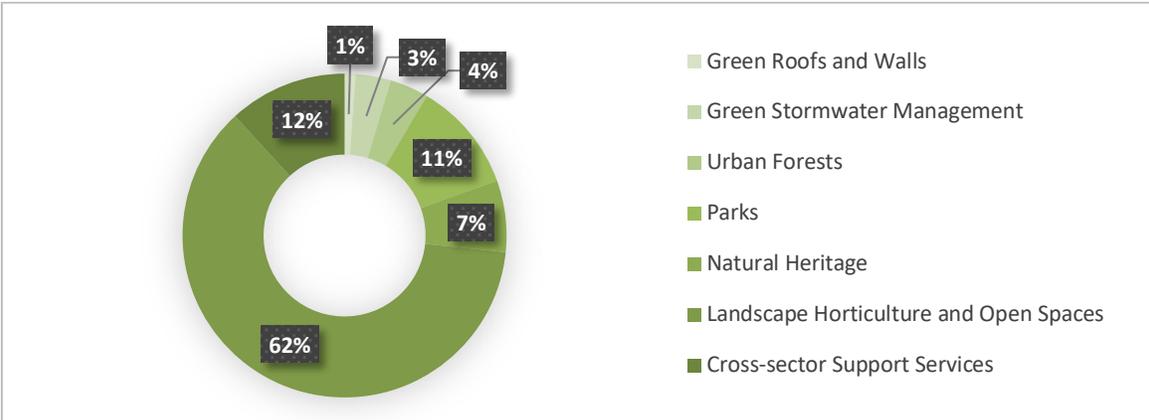
Ontario’s green infrastructure sector has strengths that span all seven sub-sectors. In 2018, it is estimated that Ontario’s green infrastructure sector was responsible for generating \$8.6 billion in gross output (revenues) and \$4.63 billion in direct gross domestic product (GDP), directly employing approximately 84,400 people (see Table 1). Factoring in the indirect and induced impacts, Ontario’s green infrastructure sector was responsible for more than 122,000 jobs and nearly \$8.33 billion in GDP in 2018.

Table 1: Economic contribution (jobs, GDP, and gross output) from Ontario’s green infrastructure sector in 2018.

Green Infrastructure Sub-sector	GI Jobs (Direct Only)	GI Gross Output \$ thousands	GI GDP (Direct Only) \$ thousands	GI Jobs (Direct, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ thousands
Green Roofs and Walls	842	\$93,072	\$51,186	1,213	\$88,729
Green Stormwater Management	1,347	\$237,828	\$163,384	2,111	\$239,865
Urban Forests	3,417	\$323,625	\$177,990	4,780	\$315,764
Parks	8,923	\$877,900	\$511,209	12,772	\$885,601
Natural Heritage	5,321	\$552,414	\$331,360	7,510	\$553,787
Landscape Horticulture and Open Spaces	58,733	\$5,578,654	\$2,852,774	82,558	\$5,217,352
Cross-sector Support Services	5,852	\$940,231	\$547,304	10,637	\$1,026,272
TOTAL	84,434	\$8,603,724	\$4,635,208	121,581	\$8,327,371

Source: The Delphi Group

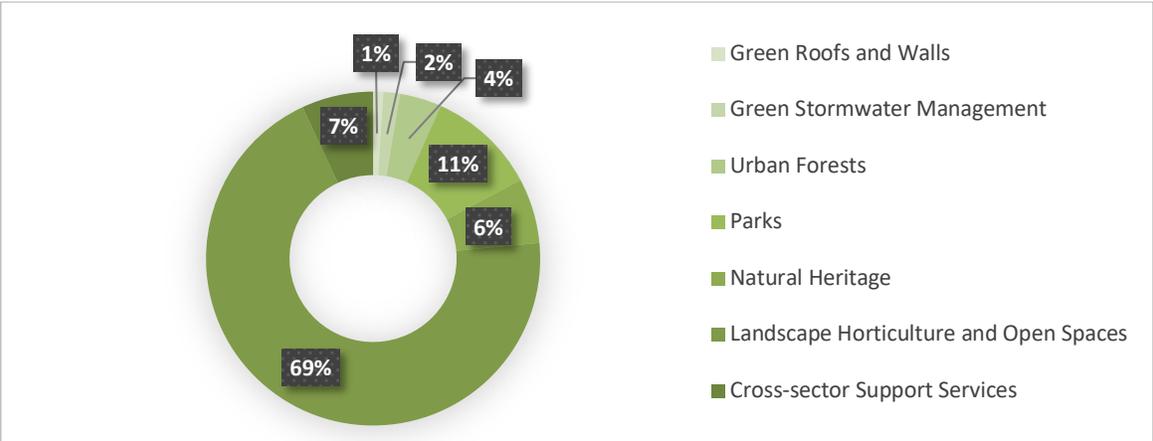
Figures 2 and 3 below show the breakout by sub-sector as a percentage of total direct GDP and jobs related to Ontario’s green infrastructure sector in 2018, respectively.



Source: The Delphi Group

Figure 2: Direct GDP attributed to Ontario’s green infrastructure sector in 2018.

The Landscape Horticulture sub-sector is responsible for nearly two-thirds of GDP (62%), followed by the Cross-Sector Support Services (12%) and the Parks sub-sectors (10%). While relatively small in terms of their overall contribution to jobs and GDP, the Green Roofs and Walls, Green Stormwater Management, and Urban Forest sub-sectors constitute important and growing contributions in terms of employment and investments in Ontario’s urban centers. The following sections provide further detail on each of Ontario’s green infrastructure sub-sectors.



Source: The Delphi Group

Figure 3: Direct jobs attributed to Ontario’s green infrastructure sector in 2018.

4.1 Landscape Horticulture & Open Spaces

Landscape horticulture and open spaces are living infrastructure that are distinct from parks and urban forests. Natural assets commonly found in the Landscape Horticulture and Open Spaces sub-sector include:

- Green recreational areas
- Fields and turfgrass
- Parkways and boulevards
- Landscaping and gardens



The landscape horticulture industry is made up of four key segments:

- Horticulture production (including plants, shrubs, and trees)
- Related materials and equipment (e.g., lawn and garden equipment, compost, sod, wood chips, etc.)
- Horticultural services (e.g., engineering, landscape architecture, landscaping services)
- The distribution supply chain (e.g., wholesalers and retail stores / nurseries)⁵⁹

Ontario is home to the largest ornamental horticulture producers in Canada, and Canadian producers are typically larger than their American counterparts, second only to Florida and California.⁶⁰ When landscape horticulture and open spaces are created and maintained, vegetation is often sourced from local nurseries and greenhouses,

⁵⁹ See: https://cnla.ca/uploads/pdf/Deloitte_The-impact-of-ornamental-horticulture-on-Canada%E2%80%99s-economy.pdf

⁶⁰ Ibid.

supporting local industry to produce in-province economic benefits. In addition to serving local clients, these growers also export the United States and elsewhere.⁶¹

In addition, a number of supporting organizations play a key role in the Landscape Horticulture and Open Spaces sub-sector, such as environmental non-profits that support the creation and maintenance of green open spaces and industry associations that promote the landscape horticulture industry, such as Landscape Ontario and the Ontario Association of Landscape Architects (OALA).⁶² These organizations promote the industry and support their stakeholders, which are active in the design, landscaping, and management of open spaces (e.g., irrigation, lawn care), as well as its suppliers (e.g., garden centres).⁶³ Industry associations respond to member concerns, and support regulations that encourage the development of the landscape horticulture sector.

Municipalities also play an important role, both in quantifying and creating strategies relating to open spaces. As one example, the City of Kitchener has laid out its design and development plan as part of the city’s 2019 Business Plan.⁶⁴ This Plan highlights the important role that the Parks and Open Spaces Design and Development team has as it relates to the planning, development, and management of the city’s open spaces. It is also tasked with policy and planning for landscape architecture and design, among other things.⁶⁵

Key Economic Indicators

Ontario’s Landscape Horticulture and Open Spaces sub-sector was responsible for an estimated 58,730 direct jobs in 2018, with a gross output (revenues) of over \$5.58 billion and a direct contribution to provincial GDP of \$2.85 billion (see Table 2).

Table 2: Jobs and Economic Output for Ontario’s Landscape Horticulture and Open Spaces Sub-sector in 2018.

Industry	GI Jobs (Direct Only)	GI Gross Output \$ Thousands	GI GDP (Direct Only) \$ Thousands	GI Jobs (Directs, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ Thousands
111421 - Nursery and tree production	1,020	\$120,210	\$57,701	1,491	\$107,612
111422 - Floriculture production	17,631	\$2,076,973	\$996,947	25,760	\$1,859,306
325314 - Mixed fertilizer manufacturing	210	\$130,585	\$36,825	603	\$83,961
332311 - Prefabricated metal building and component manufacturing	72	\$21,516	\$8,004	155	\$16,768
333110 - Agricultural implement manufacturing	535	\$186,476	\$66,572	1,168	\$137,604
411130 - Nursery stock and plant merchant wholesalers	1,130	\$166,130	\$96,521	1,818	\$166,210
417110 - Farm, lawn and garden machinery and equipment merchant wholesalers	3,018	\$430,155	\$214,841	5,372	\$401,852
444220 - Nursery stores and garden centres	4,833	\$329,135	\$206,038	6,471	\$368,808
541320 - Landscape architectural services	2,028	\$310,439	\$210,788	3,424	\$354,124

⁶¹ Ibid.
⁶² See: <https://landscapeontario.com/what-is-lo>, and <https://www.oala.ca/>
⁶³ See: Ibid
⁶⁴ See: https://www.kitchener.ca/en/resourcesGeneral/Documents/CAO_CORPSTRAT-2019-Business-Plan-Online-Publication.pdf
⁶⁵ Ibid

541330 - Engineering services	114	\$17,437	\$11,839	192	\$19,890
561730 - Landscaping services	28,140	\$1,789,599	\$946,698	36,103	\$1,701,216
Subtotal	58,733	\$5,578,654	\$2,852,774	82,558	\$5,217,352

Source: The Delphi Group based on Statistics Canada business count and employment data, 2018

The Landscape Horticulture and Open Spaces sub-sector is responsible for the largest contribution of all the green infrastructure sub-sectors to Ontario's economy, representing nearly two thirds (64%) of the direct GDP contribution of the sector as whole. Nursery, tree, and floriculture production are key segments of the sector, providing approximately 34% of the sectors economic output. Landscaping services provide a large portion of the balance at 30% of the sector's direct GDP contribution and employing more than 28,000 people across the province. All told, in 2018, the direct, indirect, and induced GDP output from the Landscape Horticulture and Open Spaces sub-sector amounted to over \$5.2 billion and more than 82,000 jobs.

As a further snapshot of economic activity, the nursery and greenhouse segments in Ontario service the Landscape Horticulture and Open Spaces sub-sector. As shown in Table 3 below, in 2018, total nursery sales in Ontario amounted to \$323.4 million, with total greenhouse sales equal to \$1.76 billion (although it is important to note that some of this value falls outside of the Landscape Horticulture and Open Spaces sub-sector).⁶⁶

Other economic benefits of the sub-sector include the increase in property values, and, at a societal level, public health benefits (mental and physical), as well as the community and ecosystem health benefits, which translate into additional indirect economic value.⁶⁷

Table 3: Ontario greenhouse and nursery data (2014-2018).

	2014	2015	2016	2017	2018
Total Ornamental and Plant Sales	\$757,620,000	\$795,359,000	\$790,504,000	\$774,859,000	\$797,508,000
Total Greenhouses	1,035	1,012	999	931	895
Total Greenhouse Sales	\$1,563,049,000	\$1,630,480,000	\$1,651,200,000	\$1,693,768,000	\$1,760,629,000
Total Greenhouse Employees (Seasonal & Permanent)	15,314	15,682	15,714	16,055	16,000
Sod Area Grown for Sale Acres)	12,957	11,553	10,559	10,394	9,793
Total Sales of Nursery Stock	\$309,065,000	\$312,285,000	\$303,645,000	\$290,367,000	\$269,911,000
Value of Sod Sold	\$70,210,000	\$61,179,000	\$56,931,000	\$59,148,000	\$54,513,000
Total Nursery Sales	\$379,275,000	\$373,464,000	\$360,576,000	\$349,515,000	\$324,424,000

Source: Ontario Ministry of Agriculture, Food and Rural Affairs, 2019⁶⁸

⁶⁶ See: <http://www.omafr.gov.on.ca/english/stats/hort/index.html>

⁶⁷ See: <https://greeninfrastructureontario.org/parks-and-open-spaces/>

⁶⁸ See: <http://www.omafr.gov.on.ca/english/stats/hort/index.html>

Supply Chain

The Landscape Horticulture and Open Spaces sub-sector has a value chain that spans multiple industries that are all essential to the success of the green infrastructure sector. Key industries include floriculture production, nursery and tree production, mixed fertilizer manufacturing (which includes organic compost and soil production), prefabricated metal sheds, and lawn and garden equipment and machinery manufacturing.⁶⁹

Landscaping services are supported by upstream suppliers, including material providers of turfgrass, compost, soil, sod, wood chips, and gravel, as well as downstream players such as garden centres and other retailers. Equipment manufacturers (such as garden equipment producers of sprinklers, irrigation systems, tractors, lawn mowers, wheelbarrows, etc.) and the distribution supply chain of wholesalers and retailers enable landscapers to carry out their work, weaving an economically interdependent and beneficial relationship across the sub-sector and related industries. Many of these organizations mainly operate as small to medium-sized enterprises (SMEs).⁷⁰

4.2 Green Roofs & Walls

Green roofs and walls are contained areas of vegetation – such as trees, shrubs, crops, or grasses (increasingly ones that are resilient to drought and heat)⁷¹ – planted on human-made structures, such as government buildings, schools, libraries, community centres, private residences, commercial buildings, or as a living wall within a public or commercial building. While green roofs are often considered a component of broader stormwater management or low impact development (LID) efforts, for the purpose of this project’s analysis, they have been classified and analyzed as a separate sub-sector.



A green roof typically incorporates a high-quality waterproofing and root repellent system, a drainage system, filter cloth, a lightweight growing medium, and the plants themselves. Green roofs can also complement man-made “grey” infrastructure by absorbing rainwater polluted runoff and can also mitigate urban heat island effect.⁷² During the summer months, green roofs can retain 70-90% of precipitation that falls and, in winter months, can absorb 25-40% of snowfall.⁷³

There are three major types of green roofs:

- Extensive green roofs that are shallow in depth, require no irrigation, and consist of relatively small plants.
- Semi-Intensive green roofs, which are deeper, require some irrigation, and have larger plants.
- Intensive green roofs, which are the deepest type of green roof, have the highest capacity for irrigation, and can hold the largest plants.⁷⁴

There are a wide variety of benefits that stem from green roofs and walls which are becoming better understood in North America. One of the largest drivers of green roof and wall installations are municipally led priorities around

⁶⁹ Key Informant Interview: Landscape Ontario

⁷⁰ Statistics Canada. Table 33-10-0106-01 Canadian Business Counts, without employees, December 2018.

⁷¹ See: Key informant interview with green roof business

⁷² See: <https://greeninfrastructureontario.org/green-roof/>

⁷³ See: <https://greenroofs.org/about-green-roofs>

⁷⁴ See: <https://greeninfrastructureontario.org/green-roof/>

climate change adaptation and mitigation, net zero building targets, and the need to address stormwater management through increased vegetation.⁷⁵

In Europe, the benefits of green roofs and walls are better understood and span across waste diversion, the moderation of urban heat island effects, improved air quality, improved biodiversity, local job creation, and improved health and well-being for those who inhabit buildings designed with green walls and roofs.⁷⁶ These benefits, as they become better understood among businesses, tenants, and developers, are driving the uptake of green roofs in Ontario and across other parts of Canada.

Key Economic Indicators

Ontario's Green Roofs and Walls sub-sector was responsible for a total of 842 direct jobs in 2018, with a gross output of \$93 million and a direct contribution to provincial GDP of \$51.2 million (see Table 4). Table 4 highlights the importance of landscaping services and floriculture production, which together represent slightly less than 40% of the sector's direct economic output. This growing sector has a direct, indirect, and induced GDP contribution of over \$88 million.

Table 4: Jobs and economic output for Ontario's Green Roof and Walls Sub-sector in 2018.

Industry	GI Jobs (Direct Only)	GI Gross Output \$ Thousands	GI GDP (Direct Only) \$ Thousands	GI Jobs (Direct, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ Thousands
111422 - Floriculture production	118	\$13,846	\$6,646	172	\$12,395
238160 - Roofing contractors	100	\$10,113	\$7,302	140	\$11,266
238190 - Other foundation, structure and building exterior contractor	20	\$2,032	\$1,467	28	\$2,263
238990 - All other specialty trade contractors	15	\$1,528	\$1,103	21	\$1,702
326198 - All other plastic product manufacturing	50	\$16,189	\$5,569	94	\$10,508
411130 - Nursery stock and plant merchant wholesalers	70	\$10,300	\$5,984	113	\$10,305
444220 - Nursery stores and garden centres	15	1,022	\$640	20	\$1,145
541310 - Architectural services	52	\$7,912	\$5,372	87	\$9,025
541320 - Landscape architectural services	51	\$7,761	\$5,270	86	\$8,853
561730 - Landscaping services	352	\$22,370	\$11,834	451	\$21,265
Subtotal	842	\$93,072	\$51,186	1,213	\$88,729

Source: The Delphi Group based on Statistics Canada business count and employment data, 2018

⁷⁵ See: GIO EIA Industry Survey.

⁷⁶ See: Green Roofs for Healthy Cities. <https://greenroofs.org/about-green-roofs>

Between 2013 and 2017, an average of 58,900 m² of green roofs were installed in Ontario, largely in urban centres of Toronto, as well as to smaller degrees in cities including Hamilton, Ottawa, and London. This amounts to a value of approximately \$25.4 million worth of installed green roofs per year, based on an assumed average installed cost of CAD \$431/m².⁷⁷ The majority of green roofs were installed in commercial / institutional buildings followed by multi-unit residential buildings.

Of the total planted area in 2017, approximately 60% were pre-planted modules, with the balance installed as vegetative mats. With increased market demand, economies of scale, and experience in green roof installation and maintenance, costs per square meter are expected to decrease over time.

Supply Chain

The Green Roofs and Walls sub-sector relies on a value chain of upstream and downstream suppliers and service providers, from the ideation coming from designers and engineers, to the implementation of these projects that rely on specific vegetation, which in and of itself depends on upstream suppliers for seeds and sod, all the way to the installation and maintenance of the green roofs by contractors.

There are four main areas of the green roof and wall supply chain: floriculture producers; roofing contractors and installers; materials producers; and landscapers. Floriculture products include plants, sourced from nurseries which rely on soils and fertilizers. Contractors (which include roofing contractors, specialty trade contractors, and other specialized building contractors) rely on molds and linings for the soil and vegetation to be installed on walls or roofs. Landscape architects / designers and landscapers support in the design, installation, and maintenance of the green roofs and walls.⁷⁸

There are generally two types of companies who operate within Ontario's green roof sector: (1) small-medium sized enterprises (SMEs) whose primary business is green infrastructure; and (2) those who offer services that are relevant to specific aspects of green roofs and walls (e.g., nurseries who provide plants, those who blend soils for various applications, or manufacturers of components such as mats, and drainage systems).⁷⁹

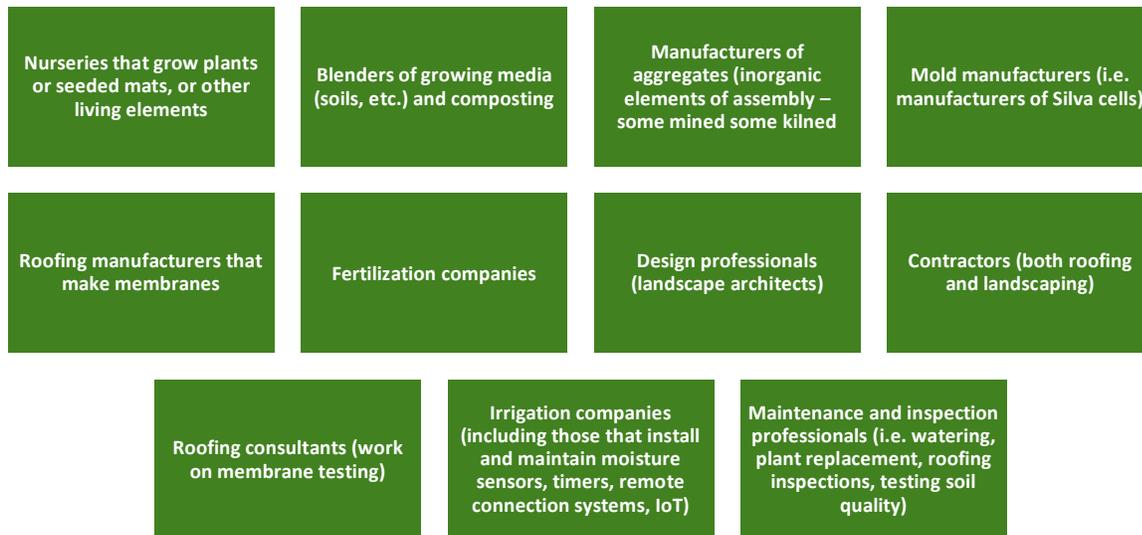
Figure 4 outlines examples of the key players / service providers who operate across Ontario's green roof supply chain. The growing trend among customers of green roofs and walls is to seek out companies that offer full green roof installation.⁸⁰

⁷⁷ Green Roofs for Healthy Cities database; cost estimated at CDN \$40 per square meter.

⁷⁸ Key informant interview: Green Roofs for Healthy Cities

⁷⁹ See: Key informant interview from Ontario green roof business

⁸⁰ See: Key informant interview from green infrastructure technology organization



Source: The Delphi Group

Figure 4: Key Stakeholders in Ontario’s Green Roofs and Walls sub-sector

Esri Canada Green Roof⁸¹

Esri Canada, a geographic information systems company based in Toronto, chose to build a green roof as a result of reading a Ryerson University study that concluded that the increased greening of roofs in the City of Toronto could reduce the City’s ambient air temperatures by up to 2 degree Celsius. The company selected Live Roof Canada to supply the pre-vegetated modules and Scott Torrance Landscape Architect Inc. to design the green roof layout. The result was an extensive green roof that now diverts 393,353 L of stormwater from municipal systems and reduces an estimated 88 kilograms of CO₂ equivalent from the air each year. Spanning 18 months of design and planning, with an installation period of 2 weeks, the project cost just under \$200,000 and spans 704 m². Over time, the design of the green roof is also expected to reduce heating and cooling costs, provide improved sound and weather insulation, and improve employee productivity and well-being.



Esri’s Garden in the Sky
Source: GreenRoofs.com

⁸¹ See: https://esri.ca/sites/default/files/2016-11/ecorooft_esri.pdf

University of Ottawa Social Science Building⁸²

An example of an innovation installation is NEDLAW's green wall project at the University of Ottawa's Faculty of Social Sciences building. The wall now stands as one of the tallest living (or green) walls in North America, spanning six storeys and covering 1,300 sq. ft. The wall is made up of over 2,000 plants, designed to be fully-integrated with the building's air system, and providing 80% of the building's fresh air intake. This not only significantly reduces energy costs but improves the health of inhabitants by reducing the amount of airborne bacteria, dust, and other allergens. The implementation of the green wall was done as part of the University's goal to increase the amount of functional indoor and outdoor green space and reach LEED Silver standards for major new construction projects on campus.



uOttawa Social Science Building
Green Wall

Source: University of Ottawa

4.3 Green Stormwater Management

Stormwater refers to precipitation that drains across or accumulates on the ground or built surfaces because it cannot be absorbed by soil due to pavement or other hard or impermeable structures (e.g., roads). Left unaddressed, excess stormwater can cause millions of dollars in damage to existing infrastructure and can negatively impact both environmental and human health in both urban and rural settings.⁸³ Green stormwater infrastructure is designed to intercept, absorb, and hold stormwater.



For this report, components of green infrastructure stormwater systems can take the form of naturalized and/or engineered green infrastructure, both of which can be used in a hybrid design with grey infrastructure to achieve effective results. The components that are most widely used as part of LID stormwater projects include:

- Bioretention cells
- Bioswales
- Cisterns
- Constructed Wetlands
- Curb inlets
- Gravel diaphragms
- Infiltration chambers
- Permeable pavement
- Rain barrels
- Rain gardens
- Stormwater planters
- Stormwater ponds
- Underdrains

⁸² See: <http://nedlawlivingwalls.com/wp-content/uploads/sites/4/2019/07/Ottawa-PDF.pdf>, <https://sustainable.uottawa.ca/buildings-and-green-space>

⁸³ See: Stormwater Markets: Concepts and applications. IISD Report. December 2017.

As cities continue to develop and expand to accommodate the influx of people in urban centres, the loss of permeable surfaces is resulting in new development projects that are utilizing rainwater harvesting and bio-retention technologies which build vegetation into the urban landscape in order to capture and store water, allowing it to slowly infiltrate into the soil.⁸⁴

While the requirements around the use of the specific components vary across jurisdictions in Ontario (for example, some jurisdictions only require the use of water management ponds), the components listed above are used in a range of project types and capacities, from the retrofit of parking lots and roadways, to more multi-functional parks.⁸⁵

That being said, green stormwater or LID projects are generally bundled as part of larger capital-intensive infrastructure projects aimed at driving multiple benefits across development, flood protection, and infrastructure upgrades.

Stormwater infrastructure is also being increasingly designed to not only collect excess runoff, but to also treat it before it is discharged into water bodies and minimize combined sewer system overflow events. Stormwater that discharges to land or surface water is also considered a threat to drinking water. Pollutants can also be filtered by green stormwater infrastructure which, in turn, serve as valuable tools for improving water quality.⁸⁶

As a result, measures outlined in the 2006 Clean Water Act (CWA) in Ontario require organizations charged with protecting drinking water to devise plans for reducing the threat posed by stormwater runoff.⁸⁷ The benefits of stormwater are another reason the Low Impact Development Stormwater Management Guidance Manual, which has yet to be published by the Province of Ontario, will be valuable. Guidance can inform decision-making in planning about the inclusion of green stormwater management infrastructure in new developments.

Conservation Authorities and municipalities have also recognized the value of green infrastructure in managing stormwater.⁸⁸ Credit Valley Conservation, for example, has authored Grey to Green Retrofit guides targeting municipalities and laying out the business case of LID in managing stormwater. The guides are designed to explain the application of green stormwater management and the monetary benefits.⁸⁹

Key Economic Indicators

Ontario's Green Stormwater Management sub-sector was responsible for an estimated 1,347 direct jobs in 2018, with a gross output of over \$237.8 million and a direct contribution to provincial GDP of \$163.4 million (see Table 5).

Green stormwater infrastructure provides 3% of the total GDP contribution of the green infrastructure sector to Ontario's economy. The construction of green water and sewer infrastructure projects (including ditches and ponds), as well as the related engineering, environmental, and technical design and consulting services supporting work in this sub-sector, provided 69% of the direct jobs within the sub-sector in 2018.

⁸⁴ Ibid

⁸⁵ Key informant interview from stormwater engineering firm

* includes hard (construction) costs, soft costs (such as design, engineering, and approvals), taxes, and a contingency of 30 per cent to address escalation and risk.

⁸⁶ See: <https://greeninfrastructureontario.org/stormwater-systems/>

⁸⁷ See: <https://www.ontario.ca/page/policy-review-municipal-stormwater-management-light-climate-change>

⁸⁸ See: <https://institute.smartprosperity.ca/sites/default/files/stormwaterreport.pdf>

⁸⁹ See: <https://cvc.ca/wp-content/uploads/2013/09/SWI-ROWDraft-Complete1.pdf>

Table 5: Jobs and economic output for Ontario's Green Stormwater sub-sector in 2018.

Industry	GI Jobs (Direct Only)	GI Gross Output \$ Thousands	GI GDP (Direct Only) \$ Thousands	GI Jobs (Direct, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ Thousands
221310 - Water supply and irrigation systems	72	\$13,582	\$8,027	122	\$13,156
237110 - Water and sewer line and related structures construction	251	\$52,925	\$40,329	345	\$49,322
237990 - Other heavy and civil engineering construction	205	\$43,204	\$32,922	281	\$40,263
238910 – Site preparation contractors	25	\$6,554	\$2,549	56	\$5,871
332420 – Metal tank (heavy gauge) manufacturing	21	\$5,327	\$2,152	37	\$3,951
541330 - Engineering services	342	\$52,310	\$35,518	577	\$59,671
541490 – Other specialized design services	53	\$3,626	\$1,907	72	\$3,784
541620 - Environmental consulting services	127	\$20,217	\$13,404	208	\$21,406
541690 - Other scientific and technical consulting services	252	\$40,083	\$26,575	413	\$42,440
Subtotal	1,347	\$237,828	\$163,384	2,111	\$239,865

Source: The Delphi Group based on Statistics Canada business count and employment data, 2018

Table 6, below, summarizes some of the key benefits and costs associated with green infrastructure that address stormwater management.

Table 6: Benefits and costs of green stormwater infrastructure.

Green Infrastructure Measure	Description of Application for Stormwater Runoff Management	Benefits	Costs
Planter boxes (stormwater / infiltration planters)	Bio-infiltration-based structures with vertical walls. Located in transportation corridors or parking areas.	Capture and retention of urban runoff generated on sidewalks and roadways or capture from runoff from downspout disconnection efforts. Planters can exfiltrate directly to underlying soils or can be tied into drainage infrastructure.	CAD 50-108 per m ² of IA
Permeable pavement	Different types: porous, asphalt, permeable concrete, permeable pavement, open matrix pavement.	Enablement of water to soak through paved areas.	CAD 70-98 per m ² of IA

Bioswales	Different types: Roadside and Parking Lot, collects runoff, including stormwater	Water absorption, and filtration.	CAD 210.47/m ²
Rain gardens	Collects stormwater	Water absorption and filtration	CAD 26.70/m ²
Rain barrels	Near buildings, connected to downspouts to connect stormwater	Water collection	CAD 98.24/m ²

Source: International Institute for Sustainable Development. Stormwater Markets: Concepts and applications. December 2017, and CNT, Green Values, National Stormwater Management Calculator

Supply Chain

The key players across Ontario’s Green Stormwater Infrastructure sub-sector include municipal governments, engineering and environmental consulting firms, contractors, Conservation Authorities, as well as many suppliers and wholesalers of materials. In Ontario, Conservation Authorities play an important role in connecting key players across regional supply chains.

Green stormwater projects are generally led by engineering and/or technical consultants in partnership with municipal governments, and services are then sought out from wholesale suppliers for plants and materials such as aggregates, soil, porous concrete, asphalt, and wood fibre. In consultation with a leading engineering firm who focuses on stormwater management projects related to bioswales, nearly 90% of their purchases for projects relates to aggregate soil, with the remaining 10% consisting of a mix of the other key materials listed above.⁹⁰

Canadian innovation is also present across this sub-sector. As one example, companies such as Imbrium are designing and manufacturing filters and separation systems to help remove oil, sediment, and other pollutants from stormwater runoff.⁹¹

Another component of stormwater systems are constructed wetlands, which are similar to stormwater management ponds, but differ in that they are designed to incorporate shallow zones for wetland plants.⁹² Vegetation is an essential part of constructed wetlands, specifically trees, bushes, and aquatic plants.⁹³ As such, constructed wetlands rely on nurseries for plants as part of developments.

The development of constructed wetlands also relies on inspection and maintenance services to ensure long-term, efficient operations.⁹⁴ The sub-sector also relies on technical equipment such as meters, housing, cameras, computers, and other equipment that are used by organizations, such as Conservation Authorities, to understand, model, and manage the constructed wetlands in their jurisdictions.⁹⁵

⁹⁰ Key informant interview: Aquafor Beech

⁹¹ See: <http://www.imbriumsystems.com/applications/id/67>

⁹² See: https://sustainabletechnologies.ca/app/uploads/2018/04/SWMFG2016_Guide_April-2018.pdf

⁹³ Ibid.

⁹⁴ See: https://sustainabletechnologies.ca/app/uploads/2018/04/SWMFG2016_Guide_April-2018.pdf

⁹⁵ See: Key Informant Interview, Conservation Authority

4.4 Urban Forests

According to the Canadian Urban Forestry Strategy put together by Tree Canada, urban forests are: “trees, forests, greenspace, and related abiotic, biotic, and cultural components in areas extending from the urban core to the urban-rural fringe.”⁹⁸ In this report, urban forests are distinct from parks in that they fall outside of legislated park lands. Natural assets commonly found in urban forests include:

- Forests and woodlots
- Green streets and street trees
- Soil and soil cells⁹⁹

The 50 Million Tree Program, administered by Forests Ontario, is a program designed to increase tree cover across the province by supporting tree planting in various areas, including but not limited to urban forests.¹⁰⁰ Between 2009 and 2018, the 50 Million Tree Program led to over 2.3 million trees planted per year on average, although in the last few years, the number has been slightly under 2 million.¹⁰¹ Outside of this program, an additional 180,000 trees on average are planted in Southern Ontario.¹⁰²

The organizations mentioned above play key roles in programs aimed at expanding urban tree cover, such as the Toronto Community Housing Corporation Planting and Stewardship Initiative, which increases tree cover on Toronto Community Housing Corporation properties.¹⁰³ The City of Toronto’s Backyard Tree Planting Program is an additional initiative supporting an increased urban tree cover in Ontario.¹⁰⁴

In addition, several municipalities have urban forest strategies. As one example, the City of Ottawa, has a 20-year strategic urban forest management plan, approved by City Council, to provide guidance and ensure a sustainable urban forest cover exists within the municipality.

Key Economic Indicators

Ontario’s Urban Forests sub-sector was responsible for a total of 3,417 direct jobs in 2018, with a gross output of over \$323.6 million and a direct contribution to provincial GDP of \$178.0 million (see Table 7).

The Urban Forests sub-sector provided approximately 4% of the total direct GDP contribution to Ontario’s green infrastructure sector overall. Supporting healthy environments in urban settings, the management and maintenance of urban forests requires the growing of trees in nurseries prior to planting, leading to the relatively large economic



⁹⁸ See: <https://treecanada.ca/wp-content/uploads/2018/10/TC-CUFS-2019-2024-Eng-1.pdf>

⁹⁹ See: <https://greeninfrastructureontario.org/app/uploads/2016/06/UF-Toolkit-Part-2-Asset-Management-Primer-Final.pdf>

¹⁰⁰ See: <https://www.forestsonario.ca/planting/programs/50-million-tree-program/>

¹⁰¹ See: <https://www.forestsonario.ca/wp-content/uploads/2019/03/Green-Analytics-Report-The-Economic-Value-of-Tree-Planting-in-Southern...-1.pdf>

¹⁰² See: <https://www.forestsonario.ca/wp-content/uploads/2019/03/Green-Analytics-Report-The-Economic-Value-of-Tree-Planting-in-Southern...-1.pdf>

¹⁰³ See: <https://www.torontohousing.ca/news/whatsnew/Pages/Toronto-Community-Housing-and-partners-celebrate-innovative-tree-planting-initiative-.aspx>

¹⁰⁴ See: <https://www.toronto.ca/311/knowledgebase/kb/docs/articles/parks,-forestry-and-recreation/urban-forestry/tree-planting-on-private-property-backyard-tree-planting-program-leaf.html>

contribution of the nursery and tree production industry to the sub-sector’s total GDP impact at approximately 33% of total GDP.

Table 7: Jobs and Economic Output for Ontario’s Urban Forests Sub-sector in 2018.

Industry	GI Jobs (Direct Only)	GI Gross Output \$ Thousands	GI GDP (Direct Only) \$ Thousands	GI Jobs (Direct, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ Thousands
111421 - Nursery and tree production	1,020	\$120,210	\$ 57,701	1,491	\$107,612
113210 - Forest nurseries and gathering of forest products	12	\$1,388	\$666	17	\$1,243
115310 - Support activities for forestry	144	\$ 16,498	\$10,427	203	\$16,537
541320 - Landscape architectural services	254	\$38,805	\$26,349	428	\$44,266
541330 - Engineering services	228	\$34,873	\$23,679	385	\$39,781
561730 - Landscaping services	1,759	\$111,850	\$59,169	2,256	\$106,326
Subtotal	3,417	\$323,625	\$ 177,990	4,780	\$ 315,764

Source: The Delphi Group based on Statistics Canada business count and employment data, 2018

Additional economic benefits from the sub-sector include an increase in property values, and public health benefits. Positive health impacts result from the presence of increased shade and the reduction of the heat island effect, as well as from a reduction of air pollution, all of which have indirect economic benefits to Ontario’s healthcare system.¹⁰⁵ In fact, the City of Toronto estimates that urban forests provided approximately \$55 million of annual ecosystem services in 2018, up from \$28.2 million in 2008, an annual value of \$18.80 per resident.¹⁰⁶

Supply Chain

Urban forest spaces rely on a range of industries for their design, construction, and maintenance. The sub-sector includes companies managing nurseries that largely grow trees for urban areas in Ontario, as well as those involved in managing the health of these forests and tree populations (such as inventories, health assessments, pruning and tree removals, etc.). Earthgen International and Whiffletree Farm and Nursery are examples of nurseries that play important roles in this value chain. Ferguson Tree Nursery, as another example, is the largest supplier for the 50 Million Tree Program.¹⁰⁷

Additional supporting organizations contributing to the sub-sector include the Ontario Urban Forest Council, which acts as a resource to support and advocate for urban forest development across Ontario, Local Enhancement and Appreciation of Forests (LEAF), which leads multiple collaborative projects to expand and maintain urban forests, and Forests Ontario, which works to expand tree cover through planting and educational programs.

¹⁰⁵ See: <https://treecanada.ca/wp-content/uploads/2018/10/TC-CUFS-2019-2024-Eng-1.pdf>
¹⁰⁶ See: <https://www.toronto.ca/legdocs/mmis/2020/ie/bgrd/backgroundfile-141364.pdf>
¹⁰⁷ See: <https://nationalpost.com/news/canada/ontario-cancels-program-that-aimed-to-plant-50-million-trees>

4.5 Parks

For the purpose of this report, parks are considered as designated or legislated “park” lands, including municipal, regional, provincial, federal, and non-profit owned parks lands.

Parks include green infrastructure as they often consist of large, naturally permeable surfaces, open spaces supporting local biodiversity in non-urban park settings, act as carbon sinks, and reduce the urban heat island effect in urban settings.¹⁰⁸ In addition, parks bring co-benefits to their communities, including positive health impacts¹⁰⁹ and the creation of public and recreational spaces. They also support a varied economic network of groups that design, maintain, and operate them, serving as key revenue and employment generators to Ontario’s economy.



Parks covered by this sub-sector definition include municipal parks, such as Walden Park in Windsor, provincial parks like Polar Bear Provincial Park, federal parks such as Bruce Peninsula National Park, and those managed by non-profit organizations and trusts, such as Ireland Park which is managed by the Ireland Park Foundation. Approximately 3.4 million hectares of park lands are operating under provincial management and 26,500 hectares are operating under federal management.¹¹⁰

An example of an Ontario park project is The Meadoway. Located in Toronto, this future park will provide 16 kilometers of parkland, including a multi-use trail, connecting the Don Valley Park to the Rouge National Park.¹¹¹ Forty of the 500 hectares of native meadow habitat have already been restored as part of the ongoing Meadoway Park project.¹¹² The park project work is being led by the Toronto and Region Conservation Authority (TRCA), with a total estimated project budget of \$85 million.¹¹³

Planning and restoring 16 kilometres of park lands includes many different actors, from those conducting environmental assessments to study the impact and feasibility of the restoration, to those conducting stakeholder engagement, to the actual restoration work including landscape architects and engineers.

The Meadoway is a good example of the collaboration needed for green infrastructure development. While the Province of Ontario owns the land, the land is currently maintained by Hydro One Networks Inc., and, once the park project is completed, the TRCA and the City of Toronto will work together to maintain the park.¹¹⁴

Another example is Algonquin Provincial Park. This large park in Ontario includes 772,300 hectares of land accessible for various purposes including hiking, camping, and canoeing.¹¹⁵ The park plays a role in supporting the local tourism industry as an indirect economic generator.¹¹⁶

Key Economic Indicators

Ontario’s Parks sub-sector was responsible for a total of 8,923 direct jobs in 2018, with a gross output of \$877.9 million and a direct contribution to provincial GDP of \$511.2 million (see Table 8). Table 8 also highlights the

¹⁰⁸ See: <https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect>

¹⁰⁹ See: <https://greeninfrastructureontario.org/parks-and-open-spaces/>

¹¹⁰ Secondary research

¹¹¹ See: <https://themeadoway.ca/faqs/>

¹¹² Ibid.

¹¹³ Ibid.

¹¹⁴ See: <https://themeadoway.ca/faqs/>

¹¹⁵ See: <http://www.algonquinpark.on.ca/foap/projects/>

¹¹⁶ See: http://www.algonquinpark.on.ca/pdf/management_plan.pdf

economic impact of the various industries supporting the Parks sub-sector. Engineering and landscaping services represent over half of the sub-sector's contribution to direct GDP. In total, the direct, indirect, and induced GDP impact of the parks sub-sector was estimated to be \$885.6 million, supporting more than 12,770 jobs.

Table 8: Jobs and Economic Output for Ontario's Parks Sub-sector in 2018.

Industry	GI Jobs (Direct Only)	GI Gross Output \$ Thousands	GI GDP (Direct Only) \$ Thousands	GI Jobs (Direct, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ Thousands
111421 - Nursery and tree production	1,020	\$120,210	\$57,701	1,491	\$107,612
115310 - Support activities for forestry	288	\$32,997	\$20,854	406	\$33,074
326198 - All other plastic product manufacturing	32	\$10,251	\$3,526	60	\$6,654
541330 - Engineering services	1,538	\$235,394	\$159,833	2,596	\$268,519
541490 – Other specialized design services	88	\$6,044	\$3,179	119	\$6,307
541620 - Environmental consulting services	509	\$80,869	\$53,616	833	\$85,625
712190 - Nature parks and other similar institutions	927	\$74,087	\$39,933	1,311	\$71,880
721211 - Recreational vehicle (RV) parks and campgrounds	297	\$37,934	\$23,823	444	\$38,545
712130 - Zoos and botanical gardens	706	\$56,414	\$30,407	999	\$54,733
561730 - Landscaping services	3,517	\$223,700	\$118,337	4,513	\$212,652
Subtotal	8,923	\$877,900	\$511,209	12,772	\$ 885,601

Source: The Delphi Group based on Statistics Canada business count and employment data, 2018

Parks provide multiple key climate and community benefits to the areas in which they are found and also provide economic benefits through recreation and tourism activities, such as camping, fishing, and wildlife viewing, as well as to the supply chains that support these activities.¹¹⁷

Previous economic impact studies have quantified the impact of a singular park, Algonquin park, as contributing millions in wages, and the equivalent to over 800 years of provincial employment.¹¹⁸ Parks support ongoing tourism activities, and projects are needed to maintain and improve parks and their nearby infrastructure. This work has a real economic impact and a benefit to employment in the Province. As a recent example, in 2016, Hydro One conducted maintenance work along a hydro corridor passing through Algonquin park. This work involved over 80 staff and 17,000 hours of work to manage the vegetation around 82 structures.¹¹⁹

Supply Chain

Parks rely on different industries for their design, construction, maintenance, and operation. The key parts of this sub-sector include:

¹¹⁷ See: <https://www.pc.gc.ca/en/agence-agency/bib-lib/rapports-reports/econo2011>

¹¹⁸ Ibid.

¹¹⁹ See: <https://www.hydroone.com/about/corporate-information/our-stories/algonquin-park-project>

- Landscape architectural services
- Engineering services
- Environmental consulting services
- Landscaping services
- Public sector administration
- Nursery and tree production
- Park, campground, zoo, and botanical garden administration

The key players across Ontario’s Parks sub-sector include governments at all levels, environmental non-profits (including Conservation Authorities and land trusts), and suppliers, contractors, and volunteers that support the maintenance activities, including support activities such as landscaping and engineering.

The indirect supply chain includes industries that benefit from the operation and maintenance of parks, including goods and services related to activities such as camping, fishing, and other outdoor recreational activities taking place in these designated areas.

4.6 Natural Heritage

For the purpose of this report, the Natural Heritage sub-sector refers to the vast swaths of green infrastructure that are located outside of built up areas and that are not designated or legislated as “park” lands, including:

- Forests
- Natural wetlands
- Ravines
- Lakes
- Rivers and creeks



Forest cover provides positive health and climate benefits, including improved air quality and carbon sequestration.¹²⁰ Of Ontario’s 107.6 million hectares, approximately 66% are covered in forests.¹²¹

Natural heritage is conserved, maintained, and supported by a range of organizations. Land trusts are one example, working to protect natural heritage across Ontario. The Ontario Land Trusts Association (OLTA) represents member land trusts, helping them secure funding and providing other supports as required. Ontario Nature is another capacity building organization that works to support grassroots organizations focused on the protection of natural heritage.

In addition to organizations supporting advocacy, many organizations in Ontario are focused on leading conservation and land restoration projects. The Greenbelt Foundation, for example, finances green infrastructure projects in and around Ontario’s Greenbelt, including the enhancement and protection of natural heritage assets. Similarly, Ducks Unlimited Canada works to conserve, restore, and manage natural wetlands. As part of its work in 2018, Ducks Unlimited Canada directly conserved 105,902 acres of habitat in Ontario and helped influence the protection of another 5.2 million acres of habitat.¹²²

¹²⁰ See: <https://psmag.com/environment/young-trees-suck-up-more-carbon-than-old-ones>

¹²¹ See: <http://www.ofia.com/from-the-forest/forestry-facts.html>

¹²² See: <https://www.ducks.ca/about/financials-reports/duc-annual-report-2019/>

The Scugog WATER Fund, run by Kawartha Conservation, is an example of a program supporting natural heritage conservation. The program provides financial assistance to property owners who contribute to the health of the watershed through individually-led restoration projects.¹²³

Another example of a program supporting natural heritage in Ontario are the monitoring, research and reporting programs of the Conservation Authorities and Conservation Ontario including watershed report cards released every five years. These report cards provide information on Ontario’s lakes, rivers, streams, groundwater, forests, wetlands and other natural ecosystems that helps make better management decisions for healthy watershed and communities.

The forestry industry plants approximately 68 million trees to replace trees that are harvested every year on Crown lands.¹²⁴ It should be noted that the full economic contribution of the forestry sector in Ontario is not included in this impact assessment, but rather just the forest management and replanting activities relevant to the green infrastructure sector.

Key Economic Indicators

Ontario’s Natural Heritage sub-sector was responsible for a total of 5,321 direct jobs in 2018, with a gross output of \$552.4 million and a direct contribution to provincial GDP of \$331.4 million (see Table 9).

Table 9: Jobs and Economic Output for Ontario’s Natural Heritage Sub-sector in 2018.

Industry	GI Jobs (Direct Only)	GI Gross Output \$ Thousands	GI GDP (Direct Only) \$ Thousands	GI Jobs (Direct, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ Thousands
111421 - Nursery and tree production	408	\$48,084	\$23,080	596	\$43,045
113210 - Forest nurseries and gathering of forest products	224	\$26,371	\$12,658	327	\$23,608
115310 - Support activities for forestry	2,162	\$247,476	\$156,405	3,045	\$248,058
541330 - Engineering services	570	\$87,183	\$59,197	962	\$99,451
541620 - Environmental consulting services	198	\$31,449	\$20,851	324	\$33,299
561730 - Landscaping services	1,759	\$111,850	\$59,169	2,256	\$106,326
Subtotal	5,321	\$552,414	\$331,360	7,510	\$553,787

Source: The Delphi Group based on Statistics Canada business count and employment data, 2018

Providing 7% of the green infrastructure’s total direct GDP contributions, the Natural Heritage sub-sector is another important piece of the economic engine that is green infrastructure in Ontario. The largest economic driver of this sub-sector is related to forest management activities, including forest fire suppression and control, pest management, forest thinning, and other related initiatives. These support activities account for over 45% of the sub-sector’s direct contribution to GDP. In total, the direct, indirect, and induced contribution to GDP in 2018 was \$553.8 million, with more than 7,500 jobs.

The maintenance of natural wetlands, riparian environments, and watersheds are other important components to the sub-sector. As one example, according to a 2016 Green Analytics study, Ontario’s Greenbelt is estimated to

¹²³ See: <https://www.kawarthaconservation.com/scugog-water-fund>

¹²⁴ See: <https://www.forestsontario.ca/blog/2019/05/15/frequently-asked-questions-about-the-50-million-tree-program/>

provide ecosystem services of just under \$3.2 billion annually.¹²⁵ The study found that in the Greenbelt, the average wetland provides over \$1 million annually in property protection (e.g., flood mitigation), and that the forest cover provided \$18 million worth of health benefits annually.¹²⁶

Conservation Authorities support work on stream restoration and stabilization; the Toronto Region Conservation Authority (TRCA) recently completed the Alfred Kuehne Stream Restoration Project, a natural channel design and stream restoration project in the Etobicoke Creek watershed in the city of Brampton. The project has transformed the waterway from a concrete channel to riparian vegetation following natural meanders and reconnected the flood plain, which created both flood relief and wetland habitat.¹²⁷

Supply Chain

Maintenance, conservation, restoration, and education relating to Ontario's natural heritage assets are important activities and rely on a diversity of actors across the value chain. Some of the key players across Ontario's Natural Heritage sub-sector include forest nurseries and tree production and planting companies, support activities for forest management (as described above), and organizations involved in related natural asset management, conservation, and restoration.

The related equipment and materials supply chain, including water control structures, culverts, wood for boardwalks and bridges, and fencing used in habitat restoration, as examples, are also important. Similar to parks, natural heritage supports the indirect supply chains supplying the industries that benefit from its existence, including for recreation activities such as fishing and hunting that take place in these areas.

Natural heritage provides additional economic benefits by providing an area to support hunting, fishing, recreation, and tourism, supporting an indirect supply chain that relies on a healthy natural ecosystem.

¹²⁵ See:

https://d3n8a8pro7vhm.cloudfront.net/greenbelt/pages/2825/attachments/original/1485878510/OP_20_Web_version_2017.pdf?1485878510

¹²⁶ See:

https://d3n8a8pro7vhm.cloudfront.net/greenbelt/pages/2825/attachments/original/1485878510/OP_20_Web_version_2017.pdf?1485878510

¹²⁷ See: <https://trca.ca/conservation/restoration/streams-valley-lands/>

4.7 Cross-Sectoral Support Services

Green infrastructure relies on multiple cross-sectoral support services that play essential roles across the six green infrastructure sub-sectors. There are three major types of supporting agencies / organizations:

- Public administration at all levels of government (federal, provincial, and municipal), including regulatory authorities and conservation departments and agencies.¹²⁸
- Indigenous public administration, including Band Councils and tribal courts.¹²⁹
- Conservation Authorities (of which there are at total of 36 in Ontario) supporting a variety of educational, research, and conservation programs which center around green infrastructure.¹³⁰
- Social advocacy organizations, including environmental non-governmental organizations (ENGOs), natural resource preservation organizations, and public interest advocacy groups (e.g., environment, conservation, and wildlife groups).¹³¹



Activities in this sub-sector include: policy development and support, protection and conservation services, education of various stakeholders, advocacy, research, program design and implementation, communication, financing of initiatives related to green infrastructure, and other activities that provide the financial, policy and regulatory, and non-profit support structures around green infrastructure in Ontario.¹³² It is important to also note that organizations involved in this sub-sector often play more than one role.

Public administration at all levels of government – federal, provincial, municipal – plays a critical role in driving and supporting Ontario’s green infrastructure sector, as highlighted earlier in the Trends and Drivers section. At the federal level, for example, the 2017 Budget “Investing in Canada: Canada’s Long-Term Infrastructure Plan”, calls for \$29.1 billion to be spent on green infrastructure.¹³³

The federal government defines green infrastructure differently, but the definition still includes projects and policies / regulations relevant to the green infrastructure sector as defined by GIO.¹³⁴

Municipal-level public administration supports the green infrastructure sub-sectors, including activities related to parks, urban forests, and stormwater management. Policies such as the City of Toronto’s Green Roof Bylaw are driving investment and job creation in this sector.

Social advocacy organizations include environmental non-profits supporting green infrastructure, such as GIO. As referenced above, GIO assists and advocates for policies in support of green infrastructure. For example, GIO has assisted the Province of Ontario by providing recommendations and responses to relevant policy proposals.¹³⁵ In

¹²⁸ See: <https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=137714&CVD=137719&CPV=91315&CST=01012007&CLV=4&MLV=6>, among others

¹²⁹ See: <https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=1181553&CVD=1181576&CPV=914&CST=01012017&CLV=2&MLV=5>

¹³⁰ See: <https://conservationontario.ca/>

¹³¹ See: <https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getAllExample&TVD=1181553&CVD=1182718&CPV=813310&CST=01012017&CLV=4&MLV=5&V=370633&VST=01012017>

¹³² See: <https://greeninfrastructureontario.org/our-work/>, and <https://conservationontario.ca/about-us/conservation-ontario/>, and <https://cvc.ca/about-cvc/>, and <https://www.ontario.ca/page/ministry-environment-conservation-parks>, and <https://mnai.ca/about/>

¹³³ See: <https://www.infrastructure.gc.ca/plan/gi-iv-eng.html>

¹³⁴ See: <https://greeninfrastructureontario.org/green-infrastructure-2017-federal-budget/>

¹³⁵ See: <https://greeninfrastructureontario.org/recent-provincial-government-submissions/>

fact, thanks in part to the GIO and its coalition members, over the past ten years, the Government of Ontario has rolled out policies and regulations supportive of the green infrastructure sector.¹³⁶ The organization and its members play a variety of roles and are active in all of the green infrastructure sub-sectors to varying degrees, including with education, advocacy, program administration, and green infrastructure asset management across Ontario.

Conservation Ontario, the non-profit organization that represents Ontario's 36 Conservation Authorities, provides many resources, both around the role of Conservation Authorities, and on the importance of nature and its benefits.¹³⁷ Conservation Authorities educate local communities, including municipalities and other levels of government about the value and benefits of the natural areas under their jurisdiction.

For example, Credit Valley Conservation publishes LID case studies as a resource to practitioners and policy-makers, growing the understanding around the benefits of green infrastructure such as improved water filtration and stormwater management, as well as the barriers to broader adoption.¹³⁸ Conservation Authorities also act as stewards of the land and water resources (e.g., watersheds) in their jurisdictions, and may support planning, project development, and management activities by providing environmental advisory services.¹³⁹

Another example of relevant work led by public administration is the development of the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health, an agreement on which GIO commented due to its relevance to the green infrastructure sector.¹⁴⁰ GIO has called for federal funding for the agreement, a portion of which would target green infrastructure in line with GIO's position in the Ontario Provincial Policy Statement. GIO has also called for updates to policy, including the release of the Low Impact Development Stormwater Management Guidance Manual, and the implementation of a "green infrastructure first" policy.¹⁴¹

Indigenous groups, including tribal councils, play active roles by providing supporting services to the green infrastructure sector. This role is similar to that of other public administration bodies in that they provide policy and strategic guidance and decision-based frameworks within Indigenous jurisdictions that drive further green infrastructure development and investment. For example, the Sagamok Anishnawbek Community Plan, published in 2013 as part of concurrent community plan developments across the North Shore Tribal Community communities, highlights the health and community benefits of green and open spaces.¹⁴²

Educational programs also support the sector by training workers and producing and disseminating knowledge and best practices. Examples include Niagara College's Horticultural Technician co-op program¹⁴³, Ryerson University's Urban Water program which hosts a Green Roof Working Group¹⁴⁴, the Horticulture Technician program at Mohawk College¹⁴⁵, and various schools of Forestry across the province, such as at the University of Toronto which offers a Forest Conservation Science program as one example.¹⁴⁶

Key Economic Indicators

Ontario's Cross-sectoral Support Services sub-sector was responsible for a total of 5,852 direct jobs in 2018, with a gross output of \$940.2 million and a direct contribution to provincial GDP of \$547.3 million (see Table 10). Table 10 highlights the important contribution of the Cross-Sectoral Support Services sub-sector, accounting for 11% of direct GDP to Ontario's green infrastructure sector in 2018. Key to this sub-sector are both the public administration projects, policies, and initiatives that support the sector, and the social advocacy led by groups such as Conservation

¹³⁶ See: <https://greeninfrastructureontario.org/resources/policy-progress/>

¹³⁷ See: <https://conservationontario.ca/about-us/conservation-ontario/>

¹³⁸ See: <https://cvc.ca/low-impact-development/low-impact-development-support/green-technology-projects/lid-case-studies/>

¹³⁹ See: <https://cvc.ca/about-cvc/>

¹⁴⁰ See: <https://greeninfrastructureontario.org/app/uploads/2019/09/GIO-COA-submission-Final.pdf>

¹⁴¹ See: *Ibid.*

¹⁴² See: https://sagamok.ca/documents/assets/uploads/files/en/sagamok_community_plan.pdf

¹⁴³ See: <https://www.niagaracollege.ca/environment/program/horticultural-technician-coop/>

¹⁴⁴ See: <https://www.ryerson.ca/water/think-tanks/greenroof-group/>

¹⁴⁵ See: <https://www.mohawkcollege.ca/programs/skilled-trades/horticulture-technician-441c>

¹⁴⁶ See: <https://forestry.utoronto.ca/undergraduate-programs/>

Authorities and land trusts that inform decision-makers based on research, case studies, and their experience managing green infrastructure assets.

Table 10: Jobs and Economic Output for Ontario’s Cross-sectoral Support Services Sub-sector in 2018.

Industry	GI Jobs (Direct Only)	GI Gross Output \$ Thousands	GI GDP (Direct Only) \$ Thousands	GI Jobs (Direct, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ Thousands
813310 – Social advocacy organizations	2,114	\$177,566	\$125,539	3,069	\$217,308
911910 - Other federal government public administration	239	\$52,385	\$36,093	466	\$59,048
912910 - Other provincial and territorial public administration	467	\$244,319	\$79,648	1,932	\$238,546
913150 - Municipal regulatory services	176	\$28,695	\$19,254	305	\$31,769
913190 - Other municipal protective services	23	\$3,778	\$2,535	40	4,183
913910 - Other local, municipal and regional public administration	2,387	\$389,245	\$261,184	4,132	\$430,953
914110 - Aboriginal public administration	446	\$44,243	\$23,050	693	\$44,464
Subtotal	5,852	\$940,231	\$547,304	10,637	\$1,026,272

Source: The Delphi Group based on Statistics Canada business count and employment data, 2018

Social advocacy organizations contributed over 20% of the sub-sector’s GDP, while other municipal, local, and regional public administration accounted for over 47% of the sub-sector’s economic activity. Overall, accounting for direct, indirect, and induced contributions to Ontario’s GDP, these support services accounted for over \$1 billion in GDP contributions in 2018.

Conservation Authorities employ about 2,000 people permanently and have jurisdiction over an area greater than 100,000 square kilometers, where they focus on water and land management, and have important support functions such as administration and communication. In addition to permanent staff, Conservation Authorities leverage many volunteers to help guide and implement projects. This labour and the initiatives they support are of great value to Ontario’s green infrastructure assets, providing the same types of benefits as work undertaken by paid staff. Conservation Authorities bring additional value by acting as intermediaries between volunteers and site-relevant projects.

Supply Chain

The supply chain for the sub-sector primarily focuses around the people employed to do the advocacy, policy, administrative, and funding work for supportive activities and programs. For example, in 2017-2018, the Ministry of Environment, Conservation, and Parks spent \$322.9 million, of which \$270 million went to administration, policy, sciences and standards, compliance and operations, and assessment and permissions.¹⁴⁷ Together, these activities create part of the regulatory environment for Ontario’s green infrastructure sector.

¹⁴⁷ See: <https://www.ontario.ca/page/expenditure-estimates-ministry-environment-conservation-and-parks-2019-20#vote6>

5. GROWTH POTENTIAL OF ONTARIO'S GREEN INFRASTRUCTURE SECTOR

Given current market, industry, technological, and demographic trends, combined with existing and potential future policy drivers, Ontario’s green infrastructure sector is projected to see measurable growth over the next decade to 2030. To estimate the growth potential, two possible growth scenarios were modelled, which are described below.

Under a current “business as usual” (BAU) scenario, Ontario’s green infrastructure sector is forecast to see a growth in direct GDP from \$4.6 billion in 2018 to \$7.0 billion in 2030, and an increase of direct jobs from 84,400 in 2018 to more than 103,000 by 2030 (see Table 11). This represents a total growth of 22% over that 12-year period.

Under a more aggressive, policy-driven “stretch” scenario, direct GDP could grow to over \$10 billion by 2030, with more than 146,000 direct jobs, equal to 73% growth for the sector as a whole between 2018 and 2030. This “stretch” scenario assumes that policy across all levels of government align to drive further adoption and integration of green infrastructure asset management above and beyond current market and industry trends through incentives, regulation, and funding support that complements information and other tools to help with planning decisions.

Factors and influencers include expanded integration of green infrastructure solutions into stormwater, watershed, and natural asset management planning; standardization of green roofs and other green infrastructure components into new construction across Ontario (e.g. building off of Toronto’s bylaw); increasing investment into the maintenance, protection, expansion, and restoration of natural heritage ecosystems and parks; and more proactive investment into tree planting and forest management in urban and peri-urban regions in Southern Ontario.

Table 11: Direct jobs, gross output, and GDP for Ontario’s green infrastructure sector under two growth scenarios (2018-2030).

Year	GI Jobs (Direct)	GI Gross Output \$ thousands	GI GDP (Direct) \$ thousands	% Growth (2018-2030)
2018	84,434	\$8,603,724	\$4,635,208	
2030 (BAU)	103,077	\$13,179,170	\$7,011,122	22.1%
2030 (Stretch)	146,225	\$18,555,527	\$10,023,416	73.2%

Source: The Delphi Group

Table 12 provides a breakout of the projected total growth by sub-sector between 2018 and 2030 for the BAU and Stretch growth scenarios. Under the BAU scenario, the Green Roofs and Walls sub-sector is projected to see the highest growth based on current trends (equal to 108% growth over that 12-year period), followed by the Green Stormwater Management sub-sector at 60% total growth.

Under the Stretch scenario, the Green Stormwater Management sub-sector shows the greatest potential growth, equal to 360% between 2018-2030, followed by Green Roofs and Walls (270%) and Urban Forests (224%). This is in part due to the fact that these sub-sectors are relatively small in size, but also have the greatest opportunity to be influenced by more aggressive policies and regulations at the provincial and municipal levels in Ontario.

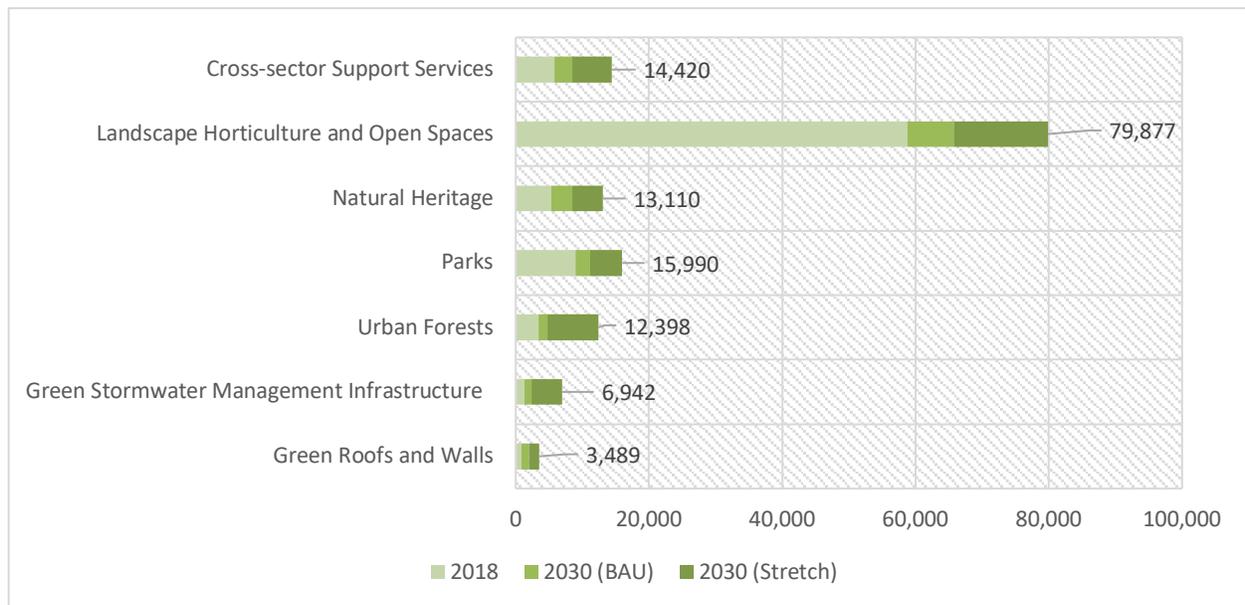
Table 12: Estimated growth of Ontario’s green infrastructure sub-sectors under the two scenarios (2018-2030).

Green Infrastructure Sub-sector	BAU Growth (2018-2030)	Stretch Growth (2018-2030)
Green Roofs and Walls	108%	270%
Green Stormwater Management	60%	360%
Urban Forests	24%	224%
Parks	12%	60%
Natural Heritage	42%	120%
Landscape Horticulture and Open Spaces	12%	36%
Cross-sector Support Services	30%	120%

Source: The Delphi Group

The economic impacts under the two scenarios on direct jobs in Ontario’s green infrastructure sector are illustrated further by sub-sector in Figure 5. More details on these two scenarios are described below, as well as in the Methodology section provided Appendix A.

It is important to note that these scenarios are merely meant to act as guideposts for what is possible for Ontario’s green infrastructure sector. While not every local government may choose to implement the full suite of policy-related drivers identified within the “stretch” scenario, additional efforts not highlighted in this report will also support sector growth that is greater than under the BAU scenario and, as such, the stretch scenario should be considered highly achievable with the right combination of measures.



Source: The Delphi Group

Figure 5: Direct Jobs in Ontario’s Green Infrastructure Sector under BAU and Stretch Scenarios (2018-2030).

5.1 Business-as-Usual Scenario

Under the BAU scenario, Ontario's green infrastructure sector continues along its historical trajectory. In the Landscape Horticulture and Open Spaces sub-sector, growth is largely in line with population projections for Ontario, estimated at a conservative growth rate of 1% per year based on Statistics Canada forecasts. This natural growth rate is expected to impact the labour force, as well as the demand in areas such as residential landscaping, recreation facilities (e.g., new soccer fields, etc.), and other landscaping related services.

In the Green Roofs and Walls sub-sector, growth continues at its historical rate of 9% per year, with additional projects being driven by the City of Toronto's bylaw and interest from other urban centers coming as a result of the growing awareness of the benefits these solutions provide. It is assumed that installation costs decrease over time as expertise is further developed in this space and economies of scale continue to build in Ontario.

In the Green Stormwater Management sub-sector, growth is driven by climate resiliency and adaptation measures and grows at a rate of 5% on average per year. Average costs remain in the range of \$250,000 to \$300,000 for projects such as rain gardens, bioswales, permeable pavement, and other LID projects. Ontario industry stakeholders and governments continue to manage the 3,400 stormwater management facilities, ponds, and stormwater wetlands, as well as its 64,000 kilometers of open stormwater ditches, in the same way they have been in recent years. Growth is compounded as education and awareness increases, with municipalities and other stakeholders identifying better practices over time for stormwater project development and maintenance.

For the Urban Forests sub-sector, investment continues largely as it has for the last several years, with approximately 2 million trees being planted in Southern Ontario (largely in urban and peri-urban regions), and forest coverage in Southern Ontario's urban and peri-urban regions increasing slowly at a rate of approximately 0.3% per year from its current total coverage of 26%. However, the Federal Government's commitment to planting 2 billion trees¹⁴⁸, combined with growing tree planting efforts on private property and by municipalities through their urban forestry programs, driven in part by the *Asset Management Planning for Municipal Infrastructure* regulation (O. Reg. 588/17), leads to a 2% growth per year to 2030. These investments in afforestation and urban tree asset management employ more arborists, landscape architects, specialized technicians, bylaw officers, and others as examples.

Growth in the Parks sub-sector continues with expenditures (capital and operating) in line with historical averages estimated to be approximately 1% per year. Within the Natural Heritage sub-sector, growth continues at an average of 5% per year, based on historical average of expenditures by Conservation Authorities in this area, split evenly between water and land management activities. Forestry activities on Crown lands stay more or less constant.

Finally, within the Cross-sectoral Support Services sub-sector, growth in spending by government and supporting agencies (such as Conservation Authorities and non-profits) on natural green infrastructure related initiatives (including those related to policy, regulation, administration, education, and other support services) is assumed to grow at 2.5% per year on average.

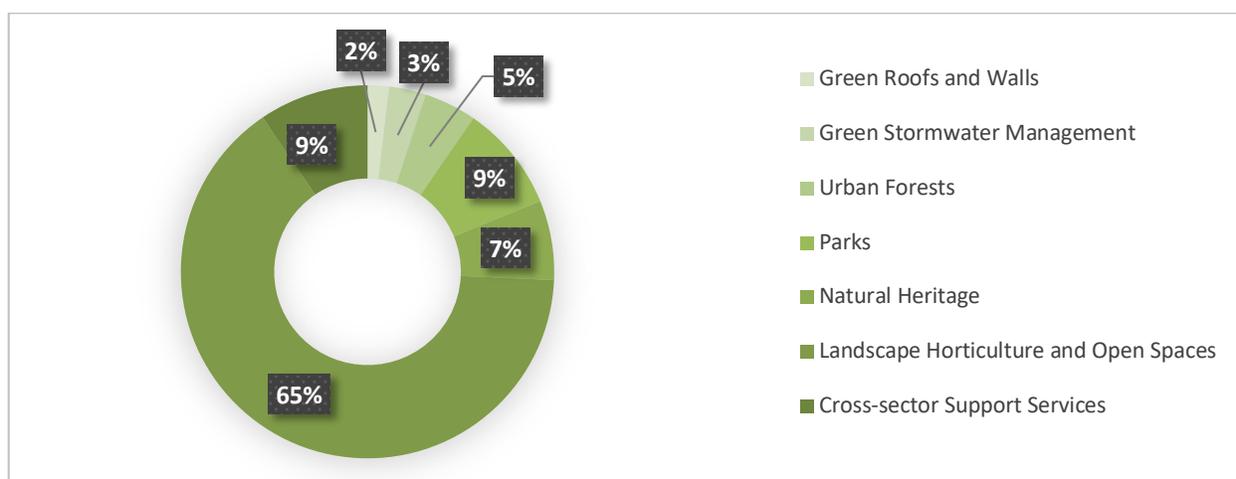
Under the BAU scenario, Ontario's green infrastructure sector is projected to employ more than 103,000 direct workers in 2030, generate \$13.2 billion in gross output (revenues), and contribute \$7.0 billion to provincial GDP in 2030 (see Table 13). When direct, indirect, and induced economic impacts are considered, the sector would be responsible for nearly 178,300 jobs and more than \$12.9 billion in GDP. The relative GDP contribution by sub-sector as a percentage of total GDP remains relatively similar to its 2018 breakout, as illustrated in Figure 6.

¹⁴⁸ See: <https://www.liberal.ca/liberals-move-forward-to-plant-two-billion-trees/>

Table 13: Projected green infrastructure jobs, gross output, and GDP in Ontario in 2030 under the BAU scenario.

Green Infrastructure Sub-sector	GI Jobs (Direct Only)	GI Gross Output \$ Thousands	GI GDP (Direct Only) \$ Thousands	GI Jobs (Direct, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ Thousands
Green Roofs and Walls	1,961	\$ 214,336	\$130,402	2,976	\$222,335
Green Stormwater Management	2,415	\$369,692	\$223,567	3,949	\$375,303
Urban Forests	4,745	\$537,804	\$319,226	7,236	\$553,210
Parks	11,193	\$1,161,936	\$645,920	16,835	\$1,137,724
Natural Heritage	8,462	\$846,459	\$483,743	12,382	\$840,088
Landscape Horticulture and Open Spaces	65,781	\$8,934,870	\$4,542,889	118,693	\$8,561,740
Cross-sector Support Services	8,521	\$1,114,072	\$665,373	16,242	\$1,237,770
TOTAL	103,077	\$13,179,170	\$7,011,122	178,313	\$12,928,170

Source: The Delphi Group



Source: The Delphi Group

Figure 6: Direct GDP breakout by green infrastructure sub-sector in Ontario in 2030 under the BAU scenario.

5.2 Stretch Scenario

Under the more aggressive, yet still plausible Stretch scenario, Ontario’s green infrastructure sector is projected to grow by more than 70% by 2030, with several sub-sectors more than doubling in size and economic impact. The development and implementation of policies and regulations at all levels of government increasingly incorporate living green infrastructure as a priority, recognizing its potential to drive significant triple-bottom-line benefits to communities across Ontario.

As an example, through previous policy advocacy work, GIO has called for the allocation 15% of annual infrastructure spending to be dedicated to funding in support of living green infrastructure projects, as well as for projects where

living green infrastructure is integrated as a complementary practice (e.g., transit, street retrofits).¹⁴⁹ GIO has also stated that: “Municipalities should be permitted to use at least some of this dedicated funding towards long-term maintenance in order to maximize cost savings... Funding and support for living green infrastructure should go beyond construction and monitoring to include ongoing operations and maintenance activities.”¹⁵⁰

In the Green Roofs and Walls sub-sector, the growth rate increases to 22.5% per year in 2030, equal to approximately 2.5 times the number of projects and square footage currently being installed on an annual basis. This is driven in part by increased awareness of the benefits of green roofs and walls, as well as additional policies adopted by public sector building owners and municipalities outside of Toronto.

In terms of the Green Stormwater Management sub-sector, average annual growth increases to 30% in terms of increased spending by 2030. This is driven in part by the Strategic Asset Management Policies requirement for municipalities (included in O. Reg 588/17), although it is enhanced through additional policy drivers that include a greater focus on wetland storage potential for downstream runoff and flooding control, lake water quality efforts, as well as the further development of flood mitigation and adaptation protocols. New construction, replacement, and maintenance spending on green stormwater management grows to nearly \$110 million per year province-wide, equal to 11% of sewage related infrastructure spending in Ontario (based on 2018 estimates accounting for inflation).

Investments in the Urban Forests sub-sector continue to grow, supported by the Federal Government's commitment to planting 2 billion trees combined with municipal government efforts to support afforestation in urban areas. Further investments are dedicated to tree planting in line with the goal to grow the current 26% forest cover in Southern Ontario to the 40% forest cover needed as a minimum in line with Forest Ontario's definition of a sustainable, healthy forest. As such, tree planting efforts triple and conservation efforts increase so that forest cover grows on average by 0.9% per year in Southern Ontario (particularly in urban and peri-urban areas).

Within the Parks sub-sector, expenditures (capital and operating) into designated park areas of all types in Ontario increases on average by 5% per year. This increase includes efforts to create and maintain new parks through site rehabilitation.

Furthermore, investments into the broader Natural Heritage sub-sector and related asset conservation and restoration activities increases by 10% on average per year. An example of an effort supporting this growth includes the Greenbelt Foundation supported Positively Green program, a collaboration with 13 conservation authorities that, once fully funded, will transform the health of Greenbelt forests, wetlands, grasslands, rivers and lakes. Within the Landscape Horticulture and Open Spaces sub-sector, investment increases at a faster rate than population growth at 3% per year on average, largely as a result of more intensive landscaping in urban areas, but also driven by aggressive efforts to support brownfield redevelopment.

Finally, growth in the Cross-sectoral Support Services sub-sector results from increased spending by the public sector, as well as by Conservation Authorities and ENGOS, on administration and management, with an average of 10% growth per year over 2018 levels. This includes increased spending related to conservation activities, protection services, policy support, and education and awareness building efforts.

Under the stretch growth scenario, Ontario's green infrastructure sector would employ more than 146,200 direct workers in 2030, generate \$18.6 billion in gross output (revenues), and contribute \$10.0 billion to provincial GDP in 2030 (see Table 14). When direct, indirect, and induced economic impacts are considered, the sector would be responsible for 250,400 jobs and more than \$18.3 billion in GDP. The relative GDP contribution by sub-sector as a

¹⁴⁹ See: <https://greeninfrastructureontario.org/app/uploads/2016/10/GIOs-Submission-for-Phase-2-of-the-Government-of-Canada%E2%80%99s-Infrastructure-Plan.pdf>

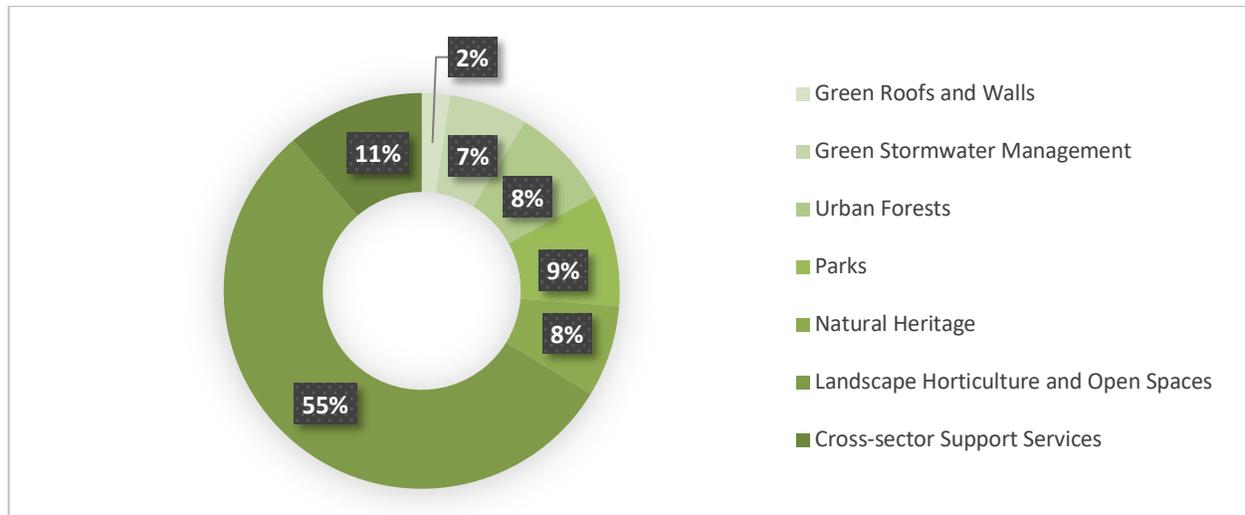
¹⁵⁰ Ibid.

percentage of total GDP under this scenario results in the growing importance of the Green Stormwater Management and Urban Forests sub-sectors, as illustrated in Figure 7.

Table 14: Projected green infrastructure jobs, gross output, and GDP in Ontario in 2030 under the Stretch scenario.

Green Infrastructure Sub-sector	GI Jobs (Direct Only)	GI Gross Output \$ Thousands	GI GDP (Direct Only) \$ Thousands	GI Jobs (Direct, Indirect, Induced)	GI GDP (Direct, Indirect, Induced) \$ Thousands
Green Roofs and Walls	3,489	\$381,271	\$231,965	5,293	\$395,501
Green Stormwater Management	6,942	\$1,062,864	\$642,756	11,353	\$1,078,995
Urban Forests	12,398	\$1,405,229	\$834,107	18,907	\$1,445,483
Parks	15,990	\$1,659,909	\$922,744	24,050	\$1,625,320
Natural Heritage	13,110	\$1,311,416	\$749,461	19,183	\$1,301,544
Landscape Horticulture and Open Spaces	79,877	\$10,849,486	\$5,516,366	144,128	\$10,396,399
Cross-sector Support Services	14,420	\$1,885,353	\$1,126,016	27,486	\$2,094,689
TOTAL	146,225	\$18,555,527	\$10,023,416	250,400	\$18,337,931

Source: The Delphi Group



Source: The Delphi Group

Figure 7: Direct GDP breakout by green infrastructure sub-sector in Ontario in 2030 under the Stretch scenario.

6. CONCLUSIONS

Green infrastructure is a sector of growing importance and opportunity in Ontario, responsible for contributing significant economic and employment benefits to the province. In 2018, Ontario’s green infrastructure sector generated \$8.6 billion in gross output (revenues), \$4.64 billion in direct GDP, and employed 84,400 people. Comparatively, the green infrastructure sector in 2018 was larger than Ontario’s wood product manufacturing sector (\$1.5 billion in GDP and 18,005 jobs), the pharmaceutical and medicine manufacturing sector (\$3.4 billion in GDP and 16,335 jobs), and the computer and electronic product manufacturing sector (\$3.5 billion in GDP and 26,600 jobs).

Ontario’s green infrastructure sector includes expertise that spans government and non-governmental agencies (such as Conservation Authorities and land trusts), Indigenous-owned organizations, research and development agencies, engineering firms, landscape architecture firms, suppliers and wholesalers (such as garden equipment manufacturers and nurseries), and a wide range of small businesses offering a wealth of experience in design, planning, maintenance, and other specialized and technical services.

The increasing recognition of the risks posed by climate change have led to a re-evaluation of natural assets, both in terms of their ecosystem services and the importance of conserving them as a means to support efforts to sequester carbon and enhance climate resiliency. Integrating green infrastructure assets into new developments, as well as work to conserve existing assets, requires new ways of thinking, planning, engineering, building, and operating.



Human capital development is key to sector advancement, and training programs such as the International Green Infrastructure Certification Program and others provided by Ontario’s colleges, universities, industry associations, and professional development agencies mentioned throughout this report are examples of programs that help further expertise among workers in the green infrastructure sector.

Creating policy and a supportive regulatory environment that encourages development of green infrastructure, as well as funding options to support upfront capital costs and ongoing maintenance, will be important for the sector. Ontario's *Asset Management Planning for Municipal Infrastructure* regulation for municipalities is a good example of a supportive policy that enables the evaluation of green infrastructure for its benefits. Other examples include the Low Impact Development Stormwater Management Guidance Manual, still in draft form, and the City of Toronto's Green Roof bylaw. Funding includes the Federation of Canadian Municipalities' Green Municipal Fund as one example. Supportive policy and funding are essential components that need to work in harmony to fully support growth across the sector.

Increased data collection and data openness across all levels of government on current and planned expenditures, and from industries in the green infrastructure sector identified in this report, can help to inform ongoing education and stakeholder engagement efforts, supporting the case for capital allocation toward the sector, as well as laying out the positive economic benefit of the sector to Ontario and to Canada more broadly. Future economic analysis can further help grow the understanding for the benefits of the current value, as well as the direct and indirect economic impacts of the green infrastructure sector, in addition to its natural capital and ecosystem services contribution.

Moving forward, realizing the full potential of Ontario's green infrastructure sector will require policy leadership, collaboration, and information sharing across the supply chain, including building greater awareness for the co-benefits of green infrastructure across all seven sub-sectors amongst key decision-makers.

6. APPENDIX A: Methodology

Developing a Definitional Framework for Ontario's Green Infrastructure Sector

The Delphi project team worked to establish a clear definition and overarching statistical framework for Ontario's green infrastructure sector. Slight changes were made to the definition of Ontario's green infrastructure sector as currently defined by GIO to ensure clarity for statistical and data collection purposes to support the economic impact assessment.

The Delphi project team undertook secondary research and a high-level literature scan of online reports, websites, and other sources, in Ontario and select regions across Canada, North America, and globally to identify various definitional frameworks for the green infrastructure sector. As part of the review, the Delphi project team examined various priorities and programs relevant to green infrastructure published by the Ontario government, federal departments in Canada, and select regional and local government efforts in line with the GIO Coalition's current definition of green infrastructure and the initial proposed framework above.

The Delphi project team also examined relevant definitions and information from various industry associations, NGOs, and other leading authorities on green infrastructure, as well as international sources such as the United Nations Environment Programme (UNEP) and the US Environmental Protection Agency (EPA). Based on this high-level scan and secondary research effort, a revised definitional structure was developed.

Concurrently, the Delphi project team developed a statistical framework, based on industry codes (i.e., North American Industry Classification System or NAICS codes at the 6-digit level) where appropriate, to put statistical rigour around the qualitative definitional structure. This definitional framework and the related NAICS codes are presented in Table A1.

Undertaking Industry Outreach

The Delphi Group conducted a series of in-depth, key informant interviews by telephone, allowing for contact with respondents in geographically dispersed locations. The Delphi team interviewed 10 key informants that built on the GIO and Greenbelt teams' existing knowledge, filled in research gaps, reviewed and identified relevant and previous economic impact assessments, reviewed the definitional framework, and identified key players in Ontario's green infrastructure ecosystem.

To compliment the key informant interviews, a short online survey was developed and distributed to GIO's newsletter subscribers and member network. This survey enabled a broader reach than was possible within the scope of the key informant interviews and allowed further information gaps to be filled and insights to be gathered in support of the research. The survey sought to answer questions including:

- What resources and data does the organization collect or have access to that might support the economic impact analysis?
- What reports could the organization share with respect to previous work done to analyze the economic impact of the green infrastructure sector or sub-sectors?
- What are the key trends they see related to the green infrastructure sector in Ontario or for any related sub-sectors?
- What opportunities do they see for growing Ontario's green infrastructure sector?
- Where do they see the greatest amount of activity in Ontario related to engineered green infrastructure projects? In what geographic regions?
- What private sector organizations would they list as leaders in Ontario's green infrastructure sector?

Assessing the Economic Impact of Ontario's Green Infrastructure Sector in 2018

Business counts for relevant firms and organizations operating either fully or partially in the green infrastructure value chain were summarized using Statistics Canada Business Counts. These business counts provide the numbers of businesses (by employment size groups) operating at the highly detailed six-digit NAICS code level. These counts

were organized by employment size groupings and by a weighted average of these size groups in order to estimate average employment and provide a tabulation of the potential business activity associated with green infrastructure developments in Ontario.

Delphi estimated the current state and value (i.e., GDP, revenues or gross output, and jobs) of the green infrastructure sector in Ontario in 2018 by developing “intensity ratios” for the various industry NAICS codes relevant and inline with the agreed to definitional and statistical framework. Intensity ratios are essentially the amount or percentage of green infrastructure activity occurring within each of the broader traditional industry NAICS codes (i.e., market penetration of activities).

This intensity ratio analysis was based on both secondary research and analysis of green infrastructure project spending by category as a percentage of total spending (a high-level summary of the results is included at the end of Appendix A). The Delphi team estimated the amount of activities on green infrastructure projects and initiatives in Ontario where data was available or could be estimated under a set of reasonable assumptions. This included examining available databases for green infrastructure projects and assets in Ontario, including detailed assets and investments on green infrastructure (where relevant and inline with the agreed upon definition) from various publications by the Ontario government, various municipalities, and other key players within the sector, including Infrastructure Ontario, Green Roofs for Healthy Cities, Conservation Ontario, and others. These estimates were complemented by a review of companies active in key industries, as well as from relevant industry association and supporting organization websites and through the stakeholder interview.

The final intensity ratios by industry were then applied to the specific NAICS codes in order to estimate the macro economic impact and activity in terms of current GDP, gross output, and the number of jobs (direct, indirect, and induced) related to the green infrastructure sector and relevant sub-sectors in Ontario. The value of green infrastructure assets and investments was converted to direct, indirect, and induced jobs, GDP, and gross output through the Statistics Canada Input-Output multiplier Tables.

It is important to note that given the fact that traditional statistical frameworks were not designed to effectively capture the complexities and cross-cutting and evolving nature of the green infrastructure sector, information and data gaps were identified and assumptions developed in order to fill these gaps. Key information and data gaps include:

- Publicly available data and information on the number and types of green infrastructure projects and/or coverage of natural heritage and green infrastructure assets (e.g., inventories of green roofs, forest cover, etc.);
- Data tracking the amount of investment at a provincial level into green infrastructure projects across the various sub-sectors;
- Breakouts on the amount of green infrastructure related activities within more traditional industries (as defined by the North American Industry Classification System or NAICS); and
- Information and data on the supply chain of products and materials that support the various green infrastructure sub-sectors.

In order to improve knowledge on the sector and track its economic performance in the future, efforts to collect more complete information and close the data gaps identified above would help further enhance the value of the sector, including the key strengths and opportunities for Ontario and the related supply chain.

Assessing the Growth Potential of Ontario’s Green Infrastructure Sector to 2030

Two growth scenarios were developed for Ontario’s green infrastructure sector for the period of 2018 to 2030, as described below. Assumptions and modelling were developed for each of the seven sub-sectors under the two scenarios. A 1% average annual growth rate was applied to the total 2018 green infrastructure jobs by sub-sector out to 2030, based on the average population forecast published by Statistics Canada over this period.¹⁵¹ Average GDP, gross output, and indirect / induced employment and GDP multipliers for each sub-sector were then used to convert 2030 jobs under the two scenarios to conservative rate to these additional economic impact factors.

¹⁵¹ See: <https://www150.statcan.gc.ca/n1/daily-quotidien/190917/dq190917b-eng.htm>

- **Business as Usual (BAU):** Based on historic trends and established policies that have been implemented in Ontario and expected to continue to generate demand and investment to 2030.
- **Stretch Growth:** Based on new policies and regulations in Ontario, and/or new funding programs and additional investments that would enable more widespread implementation above business as usual, including green roof bylaws and stormwater management requirements linked to climate resiliency, efforts to meet targets for sustainable urban forest coverage, and increased spending on conservation, restoration, and green infrastructure asset management activities.

Green Infrastructure Sub-sector	2030 (BAU)		2030 (Stretch)	
	12-year Growth (2018-2030)	Assumptions & Rationale	12-year Growth (2018-2030)	Assumptions & Rationale
Green Roofs and Walls	108%	Growth continues in line with 2014-2017 trend of 9% per year. Assume cost per install decreases to \$30/sq. ft. installed by 2030 from \$40/sq. ft. in 2018.	270%	Growth of 22.5% per year (2.5 times the square footage installed and/or projects). Assume cost per install decreases to \$30/sq. ft. installed by 2030 from \$40/sq. ft. in 2018. Based on increased awareness of benefits and additional policies adopted by municipalities outside TO, as well as on other public buildings.
Green Stormwater Management	60%	Growth of 5% in projects and spending annually. Driven in part by Stormwater Asset Management Plan requirement for municipalities.	360%	Average growth of 30% annually in terms of the number of projects and spending by 2030. Includes more focus on wetland storage for downstream runoff and flooding control, as well as flood mitigation and adaptation protocols. Driven in part by Stormwater Asset Management Plan requirement for municipalities.
Urban Forests	24%	Ontario continues to plant approx. 2 million trees per year in Southern ON (urban and peri-urban regions), with coverage increasing by 0.3% per year. In combination with the Federal Government's commitment to planting 2 billion trees, planting on private property and natural areas and increased efforts by municipalities through tree inventories and afforestation efforts driven in part by asset management regulation, leads to a 2% growth per year to 2030.	224%	Urban tree planting to increase coverage by 0.9% per year in Southern Ontario urban / peri-urban areas (from 26% in 2019 to 37% by 2030). The Federal Government's commitment to planting 2 billion trees combined with municipal government efforts increases afforestation in urban areas in Southern Ontario.
Parks	12%	Growth in spending on parks (capital and operating) of 1% per year, based on historical average.	60%	Growth in spending on parks (capital and operating) of 5% per year (CAGR).
Natural Heritage	42%	Growth in spending on natural heritage assets of 3.5% per year, based on historical average of expenditures by Conservation Authorities and activities by forestry companies on Crown lands.	120%	Growth in spending on natural heritage assets of 10% per year (CAGR). Restoration efforts increase using native vegetation, more planting of riparian areas and marginal farm landscapes, pit and quarry site rehabilitation (including abandoned sites) using native plantings to restore former vegetation systems.
Landscape Horticulture and Open Spaces	12%	Assumed minimal growth potential. Growth in line with population projections for Ontario (approx. 12% increase between 2018-2030, or 1% per year), which will impact on residential landscaping, new recreation facilities (e.g., soccer fields), etc.	36%	Assumed more aggressive efforts with respect to brownfield redevelopment. Growth slightly higher than population forecasts for Ontario, at 3% per year.
Cross-sector Support Services	30%	Growth in spending by government and supporting agencies / non-profits (including policy, administration and support services) of 2.5% per year (CAGR), based on historical average of CA expenditures.	120%	Growth in spending on administration and support services of 10% per year (CAGR). Growth largely in conservation spending, protection services, restoration, management, policy support, education / awareness spending.

Table A1: Green infrastructure sub-sectors and related supply chain industries (by 6-digit NAICS code).

Sector	Assets	NAICS
Green Roofs and Walls	Green roofs Green walls	111422 - Floriculture production
		238160 - Roofing contractors
		238190 - Other foundation, structure and building exterior contractor
		238990 - All other specialty trade contractors
		326198 - All other plastic product manufacturing
		411130 - Nursery stock and plant merchant wholesalers
		444220 - Nursery stores and garden centres
		541310 - Architectural services
		541320 - Landscape architectural services
Green Stormwater Management	Bioretention cells Bioswales Cisterns Curb inlets Gravel diaphragms Infiltration chambers Permeable pavement Rain barrels Rain gardens Stormwater planters Stormwater ponds Underdrains	221310 - Water supply and irrigation systems
		237110 - Water and sewer line and related structures construction
		237990 - Other heavy and civil engineering construction
		238910 – Site preparation contractors
		332420 – Metal tank (heavy gauge) manufacturing
		541330 - Engineering services
		541490 – Other specialized design services
		541620 - Environmental consulting services
		541690 - Other scientific and technical consulting services
Urban Forests	Urban forest/tree canopy Urban trees	111421 - Nursery and tree production
		113210 - Forest nurseries and gathering of forest products
		115310 - Support activities for forestry
		541320 - Landscape architectural services
		541330 - Engineering services
Parks	Urban parks Rural parks Marine parks	561730 - Landscaping services
		111421 - Nursery and tree production
		115310 - Support activities for forestry
		326198 - All other plastic product manufacturing
		541330 - Engineering services
		541490 – Other specialized design services
		541620 - Environmental consulting services
		712190 - Nature parks and other similar institutions
		721211 - Recreational vehicle (RV) parks and campgrounds
721213 - Zoos and botanical gardens		
Natural Heritage	Forests Natural wetlands Ravines Lakes Rivers and Creeks Fields	561730 - Landscaping services
		111421 - Nursery and tree production
		113210 - Forest nurseries and gathering of forest products
		115310 - Support activities for forestry
		541330 - Engineering services
541620 - Environmental consulting services		

		561730 - Landscaping services
Landscape Horticulture and Open Spaces	Green streets Parkways and boulevards Gardens Turfgrass Fields	111421 - Nursery and tree production
		111422 - Floriculture production
		325314 - Mixed fertilizer manufacturing
		332311 - Prefabricated metal building and component manufacturing
		333110 - Agricultural implement manufacturing
		411130 - Nursery stock and plant merchant wholesalers
		417110 - Farm, lawn and garden machinery and equipment merchant wholesalers
		444220 - Nursery stores and garden centres
		541320 - Landscape architectural services
		541330 - Engineering services
		561730 - Landscaping services
Cross-sector Support Services	All	813310 – Social advocacy organizations
		911910 - Other federal government public administration
		912910 - Other provincial and territorial public administration
		913150 - Municipal regulatory services
		913190 - Other municipal protective services
		913910 - Other local, municipal and regional public administration
		914110 - Aboriginal public administration

Green Roofs and Walls

Industry	Intensity Ratio	Rationale & Assumptions
111422 - Floriculture production	0.005	This industry includes companies managing nurseries and greenhouses that largely grow flowers and plants for urban areas in Ontario. 0.5% of this industry involved in producing products for green roofs and walls. Intensity ratio = 0.005
238160 - Roofing contractors	0.006	- On average, 635,000 sq. ft. of green roof installed per year in Ontario (2014-2017) at \$40/sq.ft. - Equal to \$25.4 million spend - Add in supporting activities including green wall work - Assume \$10 million spend in an average year - Assume a \$50,000 salary per FTE, for 300 jobs on average per year - Split out jobs: Design - 30 jobs, Materials - 135 jobs, Installation Labour - 135 jobs - Roofing contractors fall in the Installation Labour category, and have a majority of the work in this sector, assume 100 jobs. Companies include Sika Sarnafil
238190 - Other foundation, structure and building exterior contractor	0.002	- On average, 635,000 sq. ft. of green roof installed per year in Ontario (2014-2017) at \$40/sq.ft. - Equal to \$25.4 million spend - Add in supporting activities including green wall work - Assume \$10 million spend in an average year - Assume a \$50,000 salary per FTE, for 300 jobs on average per year - Split out jobs: Design - 30 jobs, Materials - 135 jobs, Installation Labour - 135 jobs - Other contractors fall in the Installation Labour category, and have a some of the work in this sector, assume 20 jobs
238990 - All other specialty trade contractors	0.001	- Only trade listed in NAICS description related to green roofs & walls is "living wall installation" - On average, 635,000 sq. ft. of green roof installed per year in Ontario (2014-2017) at \$40/sq.ft. - Equal to \$25.4 million spend - Add in supporting activities including green wall work - Assume \$10 million spend in an average year - Assume a \$50,000 salary per FTE, for 300 jobs on average per year - Split out jobs: Design - 30 jobs, Materials - 135 jobs, Installation Labour - 135 jobs - Assume overlap between green roof contractors and green wall contractor. Specialty trade contractors fall in the Installation Labour category, and have a some of the work in this sector, assume 15 jobs
326198 - All other plastic product manufacturing	0.004	- On average, 635,000 sq. ft. of green roof installed per year in Ontario (2014-2017) at \$40/sq.ft. - Equal to \$25.4 million spend - Add in supporting activities including green wall work - Assume \$10 million spend in an average year - Assume a \$50,000 salary per FTE, for 300 jobs on average per year - Split out jobs: Design - 30 jobs, Materials - 135 jobs, Installation Labour - 135 jobs - Plastics fall into products - assume some jobs related to plastic liner and casing production: 50 jobs
411130 - Nursery stock and plant merchant wholesalers	0.031	- On average, 635,000 sq. ft. of green roof installed per year in Ontario (2014-2017) at \$40/sq.ft. - Equal to \$25.4 million spend - Add in supporting activities including green wall work - Assume \$10 million spend in an average year - Assume a \$50,000 salary per FTE, for 300 jobs on average per year - Split out jobs: Design - 60 jobs, Materials - 135 jobs, Installation Labour - 135 jobs - Plastics fall into products - assume most plant sourcing comes from wholesale nurseries - assume 70 jobs. Companies include LiveRoof Ontario (Hillen Nursery parent company). LiveRoof Ontario has supplied hundreds of public and private vegetative roofs in Toronto, Ottawa, Thunder Bay, Windsor and many other cities.
444220 - Nursery stores and garden centres	0.003	- On average, 635,000 sq. ft. of green roof installed per year in Ontario (2014-2017) at \$40/sq.ft. - Equal to \$25.4 million spend - Add in supporting activities including green wall work - Assume \$10 million spend in an average year - Assume a \$50,000 salary per FTE, for 300 jobs on average per year - Split out jobs: Design - 60 jobs, Materials - 135 jobs, Installation Labour - 135 jobs - assume little plant sourcing comes from retail garden centres / nurseries - assume 15 jobs Companies include Sheridan Nurseries.
541310 - Architectural services	0.005	- On average, 635,000 sq. ft. of green roof installed per year in Ontario (2014-2017) at \$40/sq.ft. - Equal to \$25.4 million spend - Add in supporting activities including green wall work - Assume \$10 million spend in an average year - Assume a \$50,000 salary per FTE, for 300 jobs on average per year - Split out jobs: Design - 30 jobs, Materials - 135 jobs, Installation Labour - 135 jobs
541320 - Landscape architectural services	0.020	- On average, 635,000 sq. ft. of green roof installed per year in Ontario (2014-2017) at \$40/sq.ft. - Equal to \$25.4 million spend - Add in supporting activities including green wall work - Assume \$10 million spend in an average year - Assume a \$50,000 salary per FTE, for 300 jobs on average per year - Split out jobs: Design - 30 jobs, Materials - 135 jobs, Installation Labour - 135 jobs Companies include Greenteriors, NEDLAW, By Nature Design, Green Over Grey
561730 - Landscaping services	0.009	All activities in this NAICS code are related to green infrastructure, minus administrative functions. Most firms in the industry have less than 50 employees. Some may do out of province work, but most work is local to Ontario due to the necessary proximity to work sites that the equipment entails. Percentage of landscaping services dedicated to this sub-sector estimated at 1%. Intensity ratio: 0.90 X 0.01 = 0.009

Green Stormwater Management

221310 - Water supply and irrigation systems	0.040	Ontario (urban and rural areas) has 3,400 stormwater management facilities, ponds, and stormwater wetlands, as well as 64,000 kms of open stormwater ditches. New construction, replacement, and maintenance spending estimated at \$30M / year province-wide, equal to 4% of total infrastructure spending on water related infrastructure in 2018 (equal to \$740M). Intensity ratio: 0.04
237110 - Water and sewer line and related structures construction	0.030	Ontario (urban and rural areas) has 3,400 stormwater management facilities, ponds, and stormwater wetlands, as well as 64,000 kms of open stormwater ditches. New construction, replacement, and maintenance spending estimated at \$30M / year province-wide, equal to 3% of total infrastructure spending on sewerage / stormwater related infrastructure in 2018 (equal to \$975M). Intensity ratio: 0.03
237990 - Other heavy and civil engineering construction	0.030	Ontario (urban and rural areas) has 3,400 stormwater management facilities, ponds, and stormwater wetlands, as well as 64,000 kms of open stormwater ditches. New construction, replacement, and maintenance spending estimated at \$30M / year province-wide, equal to 3% of total infrastructure spending on sewerage / stormwater related infrastructure in 2018 (equal to \$975M). Intensity ratio: 0.03
238910 - Site preparation contractors	0.001	Ontario (urban and rural areas) has 3,400 stormwater management facilities, ponds, and stormwater wetlands, as well as 64,000 kms of open stormwater ditches. New construction, replacement, and maintenance spending estimated at \$30M / year province-wide, equal to .2% of total infrastructure spending in 2018 (equal to \$24B). Intensity ratio: 0.0012
332420 - Metal tank (heavy gauge) manufacturing	0.015	Assume 15% of production is related to water management Assume grey infrastructure accounts for 90% of demand (green infrastructure = 10%) - Intensity ratio: $0.15 \times 0.10 = 0.015$
541330 - Engineering services	0.006	Engineering related services and activities dedicated to the maintenance and management of green stormwater management infrastructure across Ontario. 5% of engineering services in Ontario are focused on GI sector, of which 12.5% is focused on stormwater management infrastructure. Intensity ratio = $0.05 \times 0.125 = 0.006$
541490 - Other specialized design services	0.030	Specialized design services and activities dedicated to the maintenance and management of green stormwater management infrastructure across Ontario is estimated to employ approx. 50 people. Intensity ratio = 0.03
541620 - Environmental consulting services	0.023	Environmental consulting related services dedicated to the maintenance and management of green stormwater management infrastructure sub-sector across Ontario. 15% of environmental consulting focused on GI sector, of which 15% is focused on stormwater management infrastructure. Intensity ratio = $0.15 \times 0.15 = 0.0225$
541690 - Other scientific and technical consulting services	0.015	Other scientific and technical consulting services dedicated to the maintenance and management of green stormwater management infrastructure across Ontario is estimated to employ approx. 250 people. Intensity ratio = 0.015

Urban Forests

111421 - Nursery and tree production	0.250	This industry includes companies managing nurseries that largely grow plants, shrubs and trees for urban areas in Ontario. ~2M trees planted in Southern ON on average per year, 80% for urban forests, streets spaces, etc. (~80% of which were planted outside of urban parks). Example company is Ferguson Tree Nursery (largest supplier for the 50M Tree Program. 25% of this industry involved in producing products for urban forests. Intensity ratio = 0.25
113210 - Forest nurseries and gathering of forest products	0.050	This industry includes companies largely involved with nurseries for forestry sector and reforestation activities on Crown land. Very small amount of activity for urban forests. Intensity ratio = 0.05
115310 - Support activities for forestry	0.050	This industry includes companies largely involved with forestry management activities in more rural areas across Ontario, including: forest fire prevention, forest firefighting, forest management plans preparation, forestry services, forest pest control services, and reforestation. More of a non-urban focus. Non green infrastructure related activities in this NAICS code include cruising timber and timber valuation. Includes companies such as BioForest Technologies. Intensity ratio = 0.05
541320 - Landscape architectural services	0.100	Assume 10% of this industry focused on urban forest sub-sector. Intensity ratio = 0.10
541330 - Engineering services	0.004	Engineering related services and activities dedicated to the maintenance and management of urban forests sub-sector across Ontario. 5% of engineering services in Ontario are focused on GI sector, of which 8% is focused on urban forests. Intensity ratio = $0.05 \times 0.08 = 0.004$
561730 - Landscaping services	0.045	All activities in this NAICS code are related to green infrastructure, minus administrative functions. Most firms in the industry have less than 50 employees. Some may do out of province work, but most work is local to Ontario due to the necessary proximity to work sites that the equipment entails. Percentage of landscaping services dedicated to this sub-sector estimated at 10%. Intensity ratio: $0.90 \times 0.05 = 0.045$

Parks

111421 - Nursery and tree production	0.250	- Nurseries used to replant, and in new developments - Much activity in new park creation (relative to maintenance of natural heritage) - Some demand from this sector goes to residential, and other development assume ~30% - Assume 25% of demand comes from parks
115310 - Support activities for forestry	0.100	This industry includes companies largely involved with forestry management activities in more rural areas across Ontario, including: forest fire prevention, forest firefighting, forest management plans preparation, forestry services, forest pest control services, and reforestation. Non green infrastructure related activities in this NAICS code include cruising timber and timber valuation. - Assume 10% of work is related to parks
326198 - All other plastic product manufacturing	0.002	- Plastics mostly used as liners for basins, water management and covers for supplies (e.g. tool storage, covering mulch piles, etc.) - Very little of production in this NAICS code is green infrastructure related. Assume 0.25% - Assume most green infrastructure demand for this product comes from Parks - 95% - $0.0025 \times 0.95 = 0.0024$
541330 - Engineering services	0.027	Engineering related services and activities dedicated to the maintenance and management of the parks sub-sector across Ontario. 5% of engineering services in Ontario are focused on GI sector, of which 55% is focused on parks. Intensity ratio = $0.05 \times 0.55 = 0.027$
541490 - Other specialized design services	0.050	- Note that this industry is broad, from marketing to pipeline inspection - Park design is assumed to account for 5% of all activity in the sector
541620 - Environmental consulting services	0.090	Environmental consulting related services dedicated to the maintenance and management of park ecosystems across Ontario. 15% of environmental consulting focused on GI sector, of which 60% is focused on parks. Intensity ratio = $0.15 \times 0.60 = 0.09$
712190 - Nature parks and other similar institutions	1.000	All jobs affiliated with this NAICS code are related to Parks or Natural Heritage, and as a result they are all green infrastructure jobs
721211 - Recreational vehicle (RV) parks and campgrounds	0.100	RV parks are adjacent to parks and natural heritage sites. Most work is related to administration of campground, and maintaining enabling grey infrastructure - assume 10% green infrastructure related (e.g. maintaining green spaces, etc.)
712130 - Zoos and botanical gardens	0.414	80% of organizations in industrial sector rely on primarily green infrastructure parks (e.g. zoos & botanical gardens, as opposed to aquariums). The Toronto Zoo spends ~52% of their budget on green infrastructure-related activities. Take that as a base line for organizational expenditures: $0.80 \times 0.517 = 0.4136$
561730 - Landscaping services	0.090	All activities in this NAICS code are related to green infrastructure, minus administrative functions. Most firms in the industry have less than 50 employees. Some may do out of province work, but most work is local to Ontario due to the necessary proximity to work sites that the equipment entails. Percentage of landscaping services dedicated to this sub-sector estimated at 10%. Intensity ratio: $0.90 \times 0.10 = 0.09$

Natural Heritage

111421 - Nursery and tree production	0.100	This industry includes companies largely involved with nurseries growing plants, shrubs and trees planted urban areas, although some activity is related to the restoration of natural heritage sites. ~2M trees planted in Southern ON on average per year, 20% in natural heritage / rural settings. 5% of this industry involved in producing products for natural heritage restoration. Intensity ratio = 0.10
113210 - Forest nurseries and gathering of forest products	0.950	This industry includes companies largely involved with nurseries for forestry sector and reforestation activities on Crown land. ~68M trees planted on Crown land by forestry companies in Ontario / year. 10 companies with employees in Ontario active in 2016. Companies include Drysdale Tree Nursery, Somerville Nurseries, and Sloans Nursery. Intensity ratio = 0.95
115310 - Support activities for forestry	0.750	This industry includes companies largely involved with forestry management activities in more rural areas across Ontario, including: forest fire prevention, forest firefighting, forest management plans preparation, forestry services, forest pest control services, and reforestation. Non green infrastructure related activities in this NAICS code include cruising timber and timber valuation. Intensity ratio = 0.75
541330 - Engineering services	0.010	Engineering related services and activities dedicated to the maintenance and management of the natural heritage sites and areas across Ontario. 5% of engineering services in Ontario are focused on GI sector, of which 20% is focused on parks. Intensity ratio = $0.05 \times 0.20 = 0.01$
541620 - Environmental consulting services	0.035	Environmental consulting related services dedicated to the maintenance and management of natural heritage sites and ecosystems across Ontario. 15% of environmental consulting focused on GI sector, of which 23% is focused on natural heritage. Intensity ratio = $0.15 \times 0.23 = 0.035$
561730 - Landscaping services	0.045	All activities in this NAICS code are related to green infrastructure, minus administrative functions. Most firms in the industry have less than 50 employees. Some may do out of province work, but most work is local to Ontario due to the necessary proximity to work sites that the equipment entails. Percentage of landscaping services dedicated to this sub-sector estimated at 5%. Intensity ratio: $0.90 \times 0.05 = 0.045$

Landscape Horticulture and Open Spaces

111421 - Nursery and tree production	0.250	This industry includes companies managing nurseries that largely grow plants, shrubs and trees for urban areas and the landscape horticulture sector in Ontario. 25% of this industry involved in producing products for landscape horticulture sub-sector. Intensity ratio = 0.25
111422 - Floriculture production	0.750	This industry includes companies managing nurseries and greenhouses that largely grow flowers and plants for urban areas in Ontario. 75% of this industry involved in producing products for the landscaping industry in Ontario. Intensity ratio = 0.75
325314 - Mixed fertilizer manufacturing	0.350	Includes soil and compost manufacturing. Assume 50% of this industry involved with soil and compost manufacturing, which is only partially focused on supplying landscape horticulture sub-sector in Ontario. Intensity ratio = 0.35
332311 - Prefabricated metal building and component manufacturing	0.050	Includes metal garden shed and greenhouse manufacturers. Assume 10% of this industry involved with metal shed and greenhouse manufacturing, which is only partially focused on supplying landscape horticulture sub-sector in Ontario. Intensity ratio = 0.05
333110 - Agricultural implement manufacturing	0.100	Includes lawn and garden equipment manufacturers. Assume 10% of this industry involved with lawn and garden equipment manufacturing, which is primarily focused on supplying landscape horticulture sub-sector in Ontario. Intensity ratio = 0.10
411130 - Nursery stock and plant merchant wholesalers	0.500	Assume 50% of this industry focused on supplying landscape horticulture sub-sector in Ontario. Intensity ratio = 0.50
417110 - Farm, lawn and garden machinery and equipment merchant wholesalers	0.500	Assume 50% of this industry focused on supplying landscape horticulture sub-sector in Ontario. Intensity ratio = 0.50
444220 - Nursery stores and garden centres	0.950	Assume 95% of this industry focused on landscape horticulture sub-sector in Ontario. Intensity ratio = 0.95
541320 - Landscape architectural services	0.800	Assume 80% of this industry focused on landscape horticulture sub-sector in Ontario. Intensity ratio = 0.80
541330 - Engineering services	0.002	Engineering related services and activities dedicated to the landscape horticulture and open spaces across Ontario. 5% of engineering services in Ontario are focused on GI sector, of which 4.5% is focused on parks. Intensity ratio = 0.05 x 0.045 = 0.002
561730 - Landscaping services	0.720	All activities in this NAICS code are related to green infrastructure, minus administrative functions. Most firms in the industry have less than 50 employees. Some may do out of province work, but most work is local to Ontario due to the necessary proximity to work sites that the equipment entails. Percentage of landscaping services dedicated to this sub-sector estimated at 75%. Intensity ratio: 0.90 X 0.80 = 0.72

Cross-sector Support Services

813310 – Social advocacy organizations	0.250	Not all organizations in this group focus on green infrastructure (as per 2013 sector profile). 36 Conservation Authorities in Ontario, employing approximately 2,000 people (assume 90% of these people are focused on green infrastructure assets in Ontario). Intensity ratio = .25
911910 - Other federal government public administration	0.012	Assume similar amount of spending by federal government in Ontario as provincial as a percentage of total budget. Intensity ratio = .012
912910 - Other provincial and territorial public administration	0.012	2017-2018 Ontario % of budget spent on Parks: 0.59%. Assume same amount invested into broader green infrastructure / natural asset related programming and spending. Intensity ratio = 0.012
913150 - Municipal regulatory services	0.050	Assume 1% of local government spending for regulatory services goes toward green infrastructure assets in Ontario. Intensity ratio = 0.05
913190 - Other municipal protective services	0.050	Assume 5% of local government spending for protective services goes toward green infrastructure assets in Ontario. Intensity ratio = 0.05
913910 - Other local, municipal and regional public administration	0.032	Ontario municipalities average budget spend on parks and green spaces equal to 3.21% (select municipalities sampled). Intensity ratio = 0.0321
914110 - Aboriginal public administration	0.032	Assume similar amount of spending by Aboriginal public administration on green infrastructure in Ontario as local government as a percentage of total budget. Intensity ratio = .0321

7. APPENDIX B: Supporting Economic Impact Data Analysis

Six Digit NAICS Business Counts Derived Jobs				Direct Only (2018)			Direct, Indirect & Induced	
Sector	Industry	Intensity Ratio	Total Jobs	GI Jobs	GI Gross Output (\$ Thousands)	GI GDP (\$ Thousands)	Green Jobs	Green GDP (\$ Thousands)
Green Roofs and Walls	111422 - Floriculture production	0.005	23,509	118	\$13,846	\$6,646	172	\$12,395
	238160 - Roofing contractors	0.006	16,383	100	\$10,113	\$7,302	140	\$11,266
	238190 - Other foundation, structure and building exterior contractor	0.002	9,125	20	\$2,032	\$1,467	28	\$2,263
	238990 - All other specialty trade contractors	0.001	29,035	15	\$1,528	\$1,103	21	\$1,702
	326198 - All other plastic product manufacturing	0.004	13,186	50	\$16,189	\$5,569	94	\$10,508
	411130 - Nursery stock and plant merchant wholesalers	0.031	2,260	70	\$10,300	\$5,984	113	\$10,305
	444220 - Nursery stores and garden centres	0.003	5,087	15	\$1,022	\$640	20	\$1,145
	541310 - Architectural services	0.005	10,339	52	\$7,912	\$5,372	87	\$9,025
	541320 - Landscape architectural services	0.020	2,536	51	\$7,761	\$5,270	86	\$8,853
	561730 - Landscaping services	0.009	39,083	352	\$22,370	\$11,834	451	\$21,265
	Subtotal		150,543	842	\$93,072	\$51,186	1,213	\$88,729
Green Stormwater Management Infrastructure	221310 - Water supply and irrigation systems	0.040	1,802	72	\$13,582	\$8,027	122	\$13,156
	237110 - Water and sewer line and related structures construction	0.030	8,367	251	\$52,925	\$40,329	345	\$49,322
	237990 - Other heavy and civil engineering construction	0.030	6,831	205	\$43,204	\$32,922	281	\$40,263
	238910 - Site preparation contractors	0.001	20,677	25	\$6,554	\$2,549	56	\$5,871
	332420 - Metal tank (heavy gauge) manufacturing	0.015	1,373	21	\$5,327	\$2,152	37	\$3,951
	541330 - Engineering services	0.006	56,965	342	\$52,310	\$35,518	577	\$59,671
	541490 - Other specialized design services	0.030	1,766	53	\$3,626	\$1,907	72	\$3,784
	541620 - Environmental consulting services	0.023	5,652	127	\$20,217	\$13,404	208	\$21,406
541690 - Other scientific and technical consulting services	0.015	17,333	252	\$40,083	\$26,575	413	\$42,440	
	Subtotal		120,765	1,347	\$237,828	\$163,384	2,111	\$239,865
Urban Forests	111421 - Nursery and tree production	0.250	4,082	1,020	\$120,210	\$57,701	1,491	\$107,612
	113210 - Forest nurseries and gathering of forest products	0.050	236	12	\$1,388	\$666	17	\$1,243
	115310 - Support activities for forestry	0.050	2,883	144	\$16,498	\$10,427	203	\$16,537
	541320 - Landscape architectural services	0.100	2,536	254	\$38,805	\$26,349	428	\$44,266
	541330 - Engineering services	0.004	56,965	228	\$4,873	\$23,679	385	\$39,781
	561730 - Landscaping services	0.045	39,083	1,759	\$111,850	\$59,169	2,256	\$106,326
	Subtotal		105,784	3,417	\$323,625	\$177,990	4,780	\$315,764

Sector	Industry	Intensity Ratio	Direct Only (2018)				Direct, Indirect & Induced	
			Total Jobs	GI Jobs	GI Gross Output (\$ Thousands)	GI GDP (\$ Thousands)	Green Jobs	Green GDP (\$ Thousands)
Parks	111421 - Nursery and tree production	0.250	4,082	1,020	\$120,210	\$57,701	1,491	\$107,612
	115310 - Support activities for forestry	0.100	2,883	288	\$32,997	\$20,854	406	\$33,074
	326198 - All other plastic product manufacturing	0.002	13,186	32	\$10,251	\$3,526	60	\$6,654
	541330 - Engineering services	0.027	56,965	1,538	\$235,394	\$159,833	2,596	\$268,519
	541490 - Other specialized design services	0.050	1,766	88	\$6,044	\$3,179	119	\$6,307
	541620 - Environmental consulting services	0.090	5,652	509	\$80,869	\$53,616	833	\$85,625
	712190 - Nature parks and other similar institutions	1.000	927	927	\$74,087	\$39,933	1,311	\$71,880
	721211 - Recreational vehicle (RV) parks and campgrounds	0.100	2,974	297	\$37,934	\$23,823	444	\$38,545
	712130 - Zoos and botanical gardens	0.414	1,706	706	\$56,414	\$30,407	999	\$54,733
	561730 - Landscaping services	0.090	39,083	3,517	\$223,700	\$118,337	4,513	\$212,652
	Subtotal		129,224	8,923	\$877,900	\$511,209	12,772	\$885,601
Natural Heritage	111421 - Nursery and tree production	0.100	4,082	408	\$48,084	\$23,080	596	\$43,045
	113210 - Forest nurseries and gathering of forest products	0.950	236	224	\$26,371	\$12,658	327	\$23,608
	115310 - Support activities for forestry	0.750	2,883	2,162	\$247,476	\$156,405	3,045	\$248,058
	541330 - Engineering services	0.010	56,965	570	\$87,183	\$59,197	962	\$99,451
	541620 - Environmental consulting services	0.035	5,652	198	\$31,449	\$20,851	324	\$33,299
	561730 - Landscaping services	0.045	39,083	1,759	\$111,850	\$59,169	2,256	\$106,326
	Subtotal		205,256	5,321	\$552,414	\$331,360	7,510	\$553,787
Landscape Horticulture and Open Spaces	111421 - Nursery and tree production	0.250	4,082	1,020	\$120,210	\$57,701	1,491	\$107,612
	111422 - Floriculture production	0.750	23,509	17,631	\$2,076,973	\$996,947	25,760	\$1,859,306
	325314 - Mixed fertilizer manufacturing	0.350	601	210	\$130,585	\$36,825	603	\$83,961
	332311 - Prefabricated metal building and component manufacturing	0.050	1,445	72	\$21,516	\$8,004	155	\$16,768
	333110 - Agricultural implement manufacturing	0.100	5,350	535	\$186,476	\$66,572	1,168	\$137,604
	411130 - Nursery stock and plant merchant wholesalers	0.500	2,260	1,130	\$166,130	\$96,521	1,818	\$166,210
	417110 - Farm, lawn and garden machinery and equipment merchant wholesalers	0.500	6,036	3,018	\$430,155	\$214,841	5,372	\$401,852
	444220 - Nursery stores and garden centres	0.950	5,087	4,833	\$329,135	\$206,038	6,471	\$368,808
	541320 - Landscape architectural services	0.800	2,536	2,028	\$310,439	\$210,788	3,424	\$354,124
	541330 - Engineering services	0.002	56,965	114	\$17,437	\$11,839	192	\$19,890
561730 - Landscaping services	0.720	39,083	28,140	\$1,789,599	\$946,698	36,103	\$1,701,216	
	Subtotal		146,954	58,733	\$5,578,654	\$2,852,774	82,558	\$5,217,352
Cross-sector Support Services	813310 - Social advocacy organizations	0.250	8,455	2,114	\$177,566	\$125,539	3,069	\$217,308
	911910 - Other federal government public administration	0.012	19,906	239	\$52,385	\$36,093	466	\$59,048
	912910 - Other provincial and territorial public administration	0.012	38,928	467	\$244,319	\$79,648	1,932	\$238,546
	913150 - Municipal regulatory services	0.050	3,519	176	\$28,695	\$19,254	305	\$31,769
	913190 - Other municipal protective services	0.050	463	23	\$3,778	\$2,535	40	\$4,183
	913910 - Other local, municipal and regional public administration	0.032	74,357	2,387	\$389,245	\$261,184	4,132	\$430,953
	914110 - Aboriginal public administration	0.032	13,908	446	\$44,243	\$23,050	693	\$44,464
	Subtotal		159,537	5,852	\$940,231	\$547,304	10,637	\$1,026,272