

THE ROLE OF GREEN INFRASTRUCTURE IN CLIMATE CHANGE ADAPTATION AND RESILIENCE

A submission to the federal / provincial / territorial working group on adaptation and climate resilience for the pan Canadian framework on clean growth and climate change.

Introduction

As more intense weather events and/or dwindling water supplies stress Canadian communities, living green infrastructure offers an approach to increase resiliency and adaptability. Living green infrastructure consists of both natural capital and vegetative technologies designed to use natural processes. This includes everything from tree-lined streets, wetlands, urban parks and gardens, to green roofs, meadows, woodlots, urban and rural agriculture, soils, bioswales and bio-retention features.



Urban agriculture on a green roof



Urban forest on a residential street



Bioswale in a parking lot



Constructed wetland in an urban park

Living green infrastructure provides a range of services that can make a substantial contribution towards climate change adaptation, and an important contribution towards climate change mitigation and emissions reductions. Such practices are increasingly recognized as a desirable 'win-win' approach to tackling climate change, in part because they also help to deliver multiple other social, economic and environmental benefits.¹ Living green infrastructure has also been shown to have a high return on investment, to create green jobs, and can be a cost-effective complement (or alternative) to traditional grey infrastructure.

The Green Infrastructure Ontario (GIO) Coalition is a multi-sectoral alliance comprised of private sector companies, industry associations, municipal and regional governments, community groups, and not-for-profit organizations. Together, we are successfully promoting the implementation of living green infrastructure across Ontario by providing a united voice for this vital and growing sector.

GIO strongly recommends that the Federal-Provincial-Territorial Working Group on Adaptation and Climate Resilience incorporate policies, programs and financial mechanisms that will support community efforts to build living green infrastructure. Specifically, GIO proposes five recommendations that will help Canada adapt to and become more resilient to the impacts of climate change:

1. Implement a “consider living green infrastructure first” policy.
2. Ensure all levels of government allocate a minimum of 15% of infrastructure funds to living green infrastructure investment for climate change resilience.
3. Support an integrated approach to implementation and maintenance of green infrastructure.
4. Require a green infrastructure life-cycle asset management approach to all infrastructure works.
5. Undertake research and promote green infrastructure to support all recommendations above.

Living Green Infrastructure and Climate Resilient Cities

Living green infrastructure is an important and underutilized tool for increasing community resilience to the effects of climate change. It also helps governments make sensible infrastructure investments in the context of uncertainty and volatility of future climate conditions, as living green infrastructure provides multiple benefits and is adaptable to a variety of conditions. In this manner, it should be a major element of the federal government’s effort to enhance resilience and adapt to the climate challenges facing Canadian communities.

Three Key Challenges:

Urban Water

Urban flooding and rainwater management approaches have evolved to move runoff water rapidly away from developed areas into receiving watercourses using ‘grey’ infrastructure, such as sewers and pumps. These systems have proven expensive to build and maintain, use large amounts of energy, impact the natural environment, and in many cases actually increase the risk of flooding in downstream areas. The current flood management approach of using large storage tanks is costly and serves only a singular purpose with no co-benefits. Grey infrastructure systems are proving ill-suited to address the multitude of environmental impacts from climate change’s unpredictable weather and increasing frequency of extreme rainfall. An issue compounded with older systems not built to handle major storms and the increasing downstream impacts of expanding urbanization. As a result, our cities are experiencing increased flooding and higher sewer overflows, resulting in water quality degradation. Engineering predictive modeling demonstrates continuing ‘business as usual’ will lead to irreparable damage to watershed ecosystems.

Urban Heat Island

In urban areas, the dense concentration of buildings, roads and other surfaces that absorb, retain and release heat make cities much hotter than surrounding areas. This increases energy use with air conditioning and vehicular travel, and leads to negative health impacts such as respiratory problems associated with smog, ozone formation, heat stroke and even death related to heat waves.ⁱⁱ This issue is especially of concern for vulnerable populations such as children, elderly, and physically weak individuals. Extreme heat and its associated effects are being exacerbated by climate change.

Food Security

Climate change also threatens food security and could impact all four dimensions of this important issue: food availability, food accessibility, food utilization and food systems stability. It is expected to have impacts on all components of global, national and local food systems.ⁱⁱⁱ

How Living Green Infrastructure Helps:

Living green infrastructure strengthens climate resiliency of communities by addressing:

- **Water supply (quality and quantity):** Living green infrastructure intercepts, absorbs and holds stormwater, helping to reduce the amount of runoff entering sewers during rain events, thereby decreasing the untreated runoff discharged into water bodies from sewer system overflows. It also filters pollutants, treating runoff before it enters sewers, reducing pollutants such as toxic contaminants, oil and grease, organic material, and other substances.^{iv} By absorbing rain where it falls, living green infrastructure also helps sustain infiltration to aquifers, recharge groundwater reserves and maintain base flow in rivers, relieving stress on local water supplies and reducing the need to import potable water.
- **Flood protection:** Many forms of living green infrastructure, including wetlands and the suite of technologies and practices known as low impact development (LID), intercept and retain rainfall and runoff, lowering the chance of flooding from sewer overflows and reducing flood flows in urban areas, rivers and streams.^v
- **Erosion:** Living green infrastructure reduces soil erosion at source, limits the delivery of sediment to water courses, protects river banks from erosion, and encourages sediment deposition within the floodplain. Woodlots and trees provide this service through canopy cover, which reduces the intensity of the rain when it reaches the ground and acts as a windbreak. The trees root systems also help bind the soil together and decomposition of tree roots improves soil texture, further helping prevent erosion.
- **High temperatures:** Living green infrastructure reduces air temperatures through both shade and evapotranspiration, combating the ‘urban heat island effect’ and the associated environmental and health impacts. It also reduces water thermal pollution by cooling water through the filtering process, before it enters natural waterbodies.^{vi}
- **Energy use:** When less rainwater flows into sewer systems, municipalities reduce their pumping and treatment demand, which saves energy. By reducing temperatures and shading building and surrounding surfaces, living green infrastructure also lowers building energy demands for cooling in the summer. This also creates comfortable microclimates that encourage walking and cycling, resulting in decreased vehicle use and greenhouse gas emissions.
- **Food production:** Living green infrastructure approaches include protection of agricultural lands and supporting local food production in urban and peri-urban centres. Local food production helps reduce the impact of climate change on Canada’s food supply and reduce emissions from the transportation of food to processing plants and markets. Urban agriculture also has the potential to generate revenue and provide long-term employment.

Additional Benefits of Living Green Infrastructure

Living green infrastructure and natural capital approaches offer the opportunity for communities to integrate and support traditional knowledge. These practices can help provide an opportunity for First Nations leadership in terms of affirming the value of traditional ecological knowledge and integrating the capacities for building resilience inherent in traditional ecological knowledge. Using living green infrastructure practices along with traditional knowledge would have significant benefits for community resilience, especially in areas with highly productive riparian/intertidal components of ecosystems that are essential for species of high cultural value for First Nations (eg. moose and salmon).

The living green infrastructure sector is an important source of jobs, and employs over 150,000 people across the country and is growing. This includes people who work as designers, growers, manufacturers, contractors and maintenance professionals.

Living green infrastructure solutions are flexible in terms of scale and can be integrated into retrofit and new projects for buildings and neighborhoods, and as a system of solutions across entire municipalities or watersheds (linking urban, suburban, and rural areas). Co-benefits include supporting biodiversity, and public realm improvements^{vii}, making living green infrastructure a climate change strategy with rapid, multifaceted and visible impact.

Multiple Benefits of Green Infrastructure^{viii}

Environmental

- Carbon storage and sequestration
- Mitigation of urban heat island effect
- Reduced rainwater volume and flood risk
- Improved air quality
- Increased land use efficiency
- Added recreational space
- Protected drinking water
- Replenished groundwater
- Improved watershed health
- Pollination enhancement
- Improved connectivity of green spaces (and habitats for birds and wildlife),

Social

- Improved human health and well-being
- Establishment of urban greenways
- Pedestrian and bicycle access
- Improved health with skin cancer protection from natural tree shade providing protection from ultra-violet radiation
- Improved mental health
- Healthy childhood development with increased access to nature
- Improved aesthetics - creates attractive streetscapes and rooftops that enhance livability
- Educates the public about their role in stormwater management

Economic

- Creates jobs and business opportunities
- Save hundreds of millions of dollars in flood losses^{ix}
- Diversification of local economy

- Reduces hard infrastructure construction costs
- Increases property values
- Encourages economic development
- Reduces energy consumption and associated costs
- Increases hard infrastructure life cycle cost savings

Recommendations

RECOMMENDATION 1: Implement a “consider living green infrastructure first” policy.

The federal government should require infrastructure projects consider whether a living green infrastructure approach will address the community’s need. Instead of defaulting to familiar grey solutions like dikes and pipes, governments should first should look at restoring wetlands or implementing low impact development solutions. Consider conserving sand banks rather than building sea walls, and consider rehabilitating upstream watersheds before building more water filtration systems. Planners should compare green to grey and identify new opportunities for investing in nature, including a combination of green and grey approaches when nature-based solutions alone are insufficient.^x This would also include considerations on a site and building level within the federal government’s own building and development procurement processes.

Rationale

Most public development or redevelopment projects, from road work to buildings, to multi-billion dollar LRTs, have the potential to benefit from integrating green infrastructure, yet the vast majority do not consider its applicability. This recommendation would require it be considered, but not necessarily implemented, in all projects. This would ensure the best approach is taken.

The planning and design phase of infrastructure projects is the most opportune time to consider integrating green infrastructure. This recommendation would result in the integration of living green infrastructure into project proposals from the beginning, rather than as an afterthought. Incorporating resilience during development and redevelopment is more cost-effective than managing for climate change as an after-the-fact problem.

RECOMMENDATION 2: Ensure all levels of government allocate a minimum of 15% of infrastructure funds to living green infrastructure investment for climate change resilience.

Drive investment in climate resilient infrastructure through protection and creation of living green infrastructure assets by allocating a percentage of infrastructure spending to these practices. This would include funding for specific living green infrastructure projects and for projects where living green infrastructure is integrated as a complementary practice (eg. transit, pipe retrofits).

Rationale

None of the funding distributed through the federal green infrastructure fund (2009 – 2014) went directly to living green infrastructure. A dedicated fund would promote green infrastructure as a form of municipal infrastructure and help communities invest in climate change resilience.

This recommendation aligns with other proponents promoting “nature-based green infrastructure”, such as Ducks Unlimited and the Canadian Parks and Wilderness Society.

RECOMMENDATION 3: Support an integrated approach to implementation and maintenance of green infrastructure.

Support cross-departmental collaboration by providing knowledge sharing venues, best practice resources, tools, and learning opportunities.

Rationale

Capital implementation and operations and maintenance of living green infrastructure require a focused and dedicated multi-departmental effort. Living green infrastructure is a relatively new approach to addressing water management and climate change challenges, and the need for integrated planning, new standards, new processes, training and agreements (eg. for maintenance) remains one of the key obstacles to its widespread implementation. Its distributed, conspicuous nature results in the need to develop multidisciplinary workforce skills and cross-departmental collaboration.^{xi} The unique nature of these partnerships and collaborations mean implementers benefit from incentives, knowledge sharing and best practices from higher levels of government. The US federal government, for examples, provides significant support to living green infrastructure implementation across the country, including information on how to build projects, many learning venues, and partnership resources.

RECOMMENDATION 4: Require a green infrastructure life-cycle asset management approach to all infrastructure works.

Continue to promote robust asset management programs by incorporating support for proactive living green infrastructure life-cycle asset management into existing programs. Appropriate operation and maintenance activities supported by asset management planning helps ensure that green infrastructure functions properly and yields expected environmental benefits, protects public safety, meets legal standards, and protects communities’ financial investment. This is necessary to manage the assets in communities currently and to plan for future investments.

Rationale

Relevant agencies, such as transportation or water, can often view living green infrastructure as “someone else’s issue.” Because it involves natural elements, projects tend to be pushed to environmental departments rather than being funded and managed as core infrastructure assets. This recommendation would address this issue.

Funding and support for living green infrastructure should go beyond construction and monitoring to include ongoing operations and maintenance activities. As with traditional infrastructure, long-term maintenance is critical to the longevity and performance of green infrastructure practices.

RECOMMENDATION 5: Undertake research and promote green infrastructure to support all recommendations above.

Conduct and support research on planning, implementing and evaluating green infrastructure systems and build capacity in communities. Promote the results of this research and encourage the use of all government support mechanisms.

Rationale

Early adopters have demonstrated the viability of living green infrastructure approaches for climate change adaptation. Many other communities are receptive to living green infrastructure but still require additional technical and institutional information to integrate it into their current approach. Research and promotion would help encourage the use of living green infrastructure practices.

Conclusion

Living green infrastructure helps communities adapt to climate change while increasing livability and cost-efficiency of projects in communities of all sizes. The Government of Canada can demonstrate important leadership by incorporating living green infrastructure into federal climate change action using one or more of the approaches described above. The GIO Coalition would be pleased to provide any additional information or input that could support this effort.

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Green Infrastructure Ontario Coalition Background

The Green Infrastructure Ontario Coalition is a collaborative alliance working to promote green infrastructure in Ontario. Its steering committee members include:

Conservation Ontario | Evergreen | Green Communities Canada | 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 | Forests Ontario

www.greeninfrastructureontario.org

ⁱ <http://www.greeninfrastructurenw.co.uk/climatechange/>

ⁱⁱ Heat Island Effect: Heat Island Impacts, US EPA. Online: <http://www.epa.gov/heatisland/impacts/index.htm>

ⁱⁱⁱ <http://www.fao.org/forestry/15538-079b31d45081fe9c3dbc6ff34de4807e4.pdf>

^v Rooftops to Rivers. Green Strategies for Controlling Stormwater and Combined Sewer Overflows. Natural Resources Defense Council. Online <https://www.nrdc.org/water/pollution/rooftops/rooftops.pdf>

^{vi} Putting Green to Work: Economic Recovery Investments for Clean and Reliable Water. American Rivers. Online: <http://www.allianceforwaterefficiency.org/uploadedFiles/News/NewsArticles/American-Rivers-Putting-Green-to-Work-Sept2010.pdf>

^{viii} http://www.sustainablecitiesinstitute.org/Documents/SCI/Report_Guide/Guide_EPA_GICaseStudiesReduced4.pdf AND http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructure_broc.pdf

^{viii} <https://www.epa.gov/green-infrastructure/flood-loss-avoidance-benefits-green-infrastructure-stormwater-management>

^x <http://www.eea.europa.eu/publications/exploring-nature-based-solutions-2014>

^{xi} <http://stormwater.wef.org/2015/11/evolving-green-infrastructure-asset-management/>