

BUILDING THE FUTURE

REFLECTIONS ON THE CONNECTIONS
BETWEEN GREEN INFRASTRUCTURE AND
ECONOMIC DEVELOPMENT

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EXECUTIVE SUMMARY

Rural communities face unique challenges to infrastructure demands and vary in their capacity to deal with aging infrastructure and increases in population. The Corporation of Loyalist Township, a lower tier municipality, has faced the challenge of upgrading infrastructure to accommodate growth by successfully integrating a constructed wetland into the Amherstview Water Pollution Control Plant. This green infrastructure solution was piloted by the Township and has garnered attention from the Federation of Canadian Municipalities.

KEY MESSAGES

- Rural communities have the benefit of space and can use the processes found in the surrounding local environment to successfully manage wastewater effluent, resulting in lower energy cost requirements.
- Existing infrastructure can be repurposed to accommodate growth and can be incorporated into solutions for the future.
- Green infrastructure not only provides economic benefits such as reduced capital and operating costs but supplies communities with social benefits of enjoying wildlife through habitat creation, and environmental benefits of carbon sequestration and healthier wetlands.
- The Provincial Policy Statement supports the use of green infrastructure in complementation with traditional infrastructure creating policies aimed at economic prosperity and environmental stewardship. The constructed wetland initiative supports efficient government spending, sustainable land use and equitable community progress.

KEY LESSONS

1. **Resilience:** Municipalities could look outside the realm of their disciplines to find diversified and innovative solutions to increase infrastructure capacity for population and economic growth.
2. **Partnerships:** Academic partnerships encourage researchers to explore practical yet innovative ideas and offers additional funding pathways and resources.
3. **Building Internal Capacity:** Partnership may lead to employment of knowledgeable staff building internal capacity to manage infrastructure projects.

INTRODUCTION: LOYALIST TOWNSHIP

The Corporation of Loyalist Township has been making waves in the municipal world. Loyalist recently received the 2020 Sustainable Community Award in the water category for its Amherstview Water Pollution Control Plant. The award comes from the Federation of Canadian Municipalities celebrating leaders and trailblazers in sustainable municipal innovations across Canada (Foley, 2020). Municipal engineers at Loyalist are green forward thinking and have incorporated green infrastructure in the form of a constructed wetland into the wastewater treatment plant to build Loyalist's capacity for growth and economic development.

The plant services just over 10,000 people from the communities of Amherstview and Odessa, which are found just west of Kingston, Ontario. Both communities are governed by the lower-tier municipality of Loyalist Township, which has seen a net population growth of 2250 people from 2001 to 2016, primarily focused in the Amherstview community (Hemson Consulting Ltd., 2019). The community is the largest in the Township and is projected to continue its growth, resulting in increased infrastructure demands. With the added population pressures and limited resources often encountered in small rural municipalities, Loyalist Township needed an infrastructure solution that would remedy ongoing compliance issues, be economically viable, and increase plant capacity for future growth. The constructed wetland offered that very solution.

Amherstview historically functioned on a communal sewage treatment lagoon system from approximately 1960 to 1998. With continued growth pressures the lagoon system could no longer meet environmental standards and the construction of a mechanical secondary treatment facility was initiated and completed in 1998. The mechanical treatment facility consisted of aeration and clarification cells and the existing lagoon provided decontamination of the final effluent through natural processes.¹ This addition was able to accommodate increased wastewater flows supporting the growth in Amherstview.

The system continued to encounter occasional treatment problems and in 2008 an autothermal thermophilic aerobic digestion (ATAD) facility was added to the mechanical plant (Ministry of the Environment, 2008). This system treated and eliminated pathogens within the solids of the waste sludge and the lagoons received the secondary liquid effluent. The liquid effluent required decontamination through natural processes in the lagoon, but occasional treatment problems still arose. After the large capital investments, the project team was pushed to look out of the box for a cost-effective solution. Loyalist then initiated a constructed wetland enhancing the natural processes of the lagoon and mimicking the processes found in the existing adjacent wetland, resulting in satisfactory effluent.¹

¹ D. Thompson, personal communication, November 5, 2020.

PLACE BASED & BUILT ON LOCAL ASSETS

In partnership with Queen's University in Kingston, the Township invested in studies on the adjacent wetland. This research was place-based, and indicated that the local, natural wetland had the ability to attenuate the effluent into compliance. The team looked to bring the natural and biological mechanisms inside the plant boundary, resulting in the idea for the constructed wetland, offering an alternative to the typical heavily engineered and power-hungry mechanical solutions.²

Loyalist's infrastructure innovation is based on the local environment and the existing wastewater treatment assets. The team was able to re-use existing infrastructure from their smaller capacity lagoon cell system to build the constructed wetland, where it acted as a tertiary treatment.^{1,2} Loyalist shows resiliency in adjusting their existing infrastructure to accommodate the project, resulting in their ability to build infrastructure for businesses to grow into supporting economic growth. Municipal staff credit the willingness and open-mindedness of Loyalist's Council in moving forward with the idea,³ as with any pilot project, the certainty of success would only be revealed in completion.

TRIFECTA OF POSITIVE IMPACTS

Loyalist has been building its future by strongly supporting settlement areas with infrastructure. New infrastructure implementations have enabled the municipality to re-rate the plant capacity allowing for increased development making way for further growth in residential, commercial and industrial areas.² With Amherstview being a predominately residential area, infrastructure investments allow for continued growth of the thriving business park.⁴ The diversification of land uses and support to the economy through infrastructure ensures a strong economic future.

The wetland not only provides support to existing infrastructure but has an attractive net-zero operational energy requirement. Compare this with the alternative of an energy hungry UV disinfection system, this project provides Loyalist an estimated yearly electricity savings of \$200,000 a year. The pilot project gamble is already paying itself off.

Apart from significant savings in the municipal operation budget, the constructed wetland offers environmental and social benefits, contributing to a trifecta of positive impacts. The wetland acts as a carbon sink, where plants sequester carbon dioxide, which is in stark contrast to a mechanical operation which would draw on additional energy resources and contribute to carbon emissions (Muga & Mihalčić, 2008). In addition to its large-scale

² R. Maassarani, personal communication, November 5, 2020.

³ D. Thompson, personal communication, November 5, 2020.

⁴ B. Wynnyckyj, Personal communication. November 27, 2020.

environmental impacts, the constructed wetland also provides green space and natural habitat for birds and wildlife.

The draw of wildlife has sprung social benefits to the community. The Kingston Field Naturalists enjoy access to the property where they monitor and count waterfowl and shore bird populations in an ongoing survey of migrant birds. The constructed wetland offers the public increased areas for activity and an opportunity for education in the stewardship of land and wetlands in the protection of clean water. The project also embodies Loyalist's community strategy and environmental goals of balancing growth with sustainable environmental management in an ecosystem approach (The Corporation of Loyalist Township, 2020).

RESOURCES, INVESTMENTS, AND COLLABORATION

Innovations such as these do not happen without significant investment. They require the willingness and perseverance of municipal staff to keep digging in a new direction, looking at new possibilities, and questioning the traditional forms of infrastructure. One strong collaboration aiding the project was the research partnership with Queens that began well over 20 years ago.⁵ Loyalist sought out Queens research expertise to participate in studies of the adjoining wetland before and during construction stages of the wetland. In 2013, after the initial research of the adjoining wetland was complete, Queens participated in the constructed wetland design continuing until 2017, with Loyalist investing a total of \$150,000 to Queen's University over the 5 years.⁶ Queens was able to bring further resources to the table by applying for and receiving grants from the Natural Sciences and Engineering Research Council (NSERC).

While Queens commenced the wetland design, the Loyalist engineering team undertook the flow structure design and building of the constructed wetland, opting to keep the project in-house saving an estimated \$1 million in design costs alone.³ A key actor in the design was a Queens alumni who worked on the wetland research at the university prior to beginning work at the Township.⁷ Even with project setbacks and re-designs after the initial launch of the wetland in 2015, the total project costs to the Township were estimated at only \$900,000 upon completion in 2018.⁸

It is clear the project has been a team effort in Loyalist. From conception of the idea, pursuance of funding and research in the nearby academic community, to in-house design and implementation. The partnerships Loyalist has with Queens has offered increased capacity to deal with infrastructure challenges. Staff have been a driving force in investing

⁵ Merrit, M. Personal communication. November 20, 2020.

⁶ The Corporation of Loyalist Township, by-law 2015-109

⁷ D. Thompson, personal communication, November 5, 2020.

⁸ Merrit, M. Personal communication. November 20, 2020.

their time and ideas to the project and have revealed their dedication to innovation and sustainability in municipal infrastructure.

ALIGNMENT TO PROVINCIAL POLICY STATEMENT

Ontario’s Provincial Policy Statement (PPS) is the framework set out by the province to give direction on land-use planning as well as sustainable and efficient population growth management. The constructed wetland innovation adheres to policies in the PPS regarding sewage, water and stormwater (Table 1) (Ministry of Municipal Affairs and Housing [MMAH], 2020).

Table 1: Comparison of the PPS and the implementation of the constructed wetland

Provincial Policy Statement [MMAH, 2020]	The Corporation of Loyalist Township
<i>“Accommodate forecasted growth in a manner that promotes the efficient use and optimization of existing municipal sewage services and municipal water services”(s.1.6.6.1a.1)</i>	With projected growth in Amherstview, the Township efficiently utilizes existing lagoon infrastructure to create the constructed wetland, further building their capacity to grow their business park for local economic development
<i>“Support of energy conservation and efficiency, improved air quality, reduced greenhouse gas emissions, and preparing for the impacts of climate change through land use and development patterns”(s. 1.8.1)</i>	The constructed wetland has a net-zero energy requirement providing energy conservation, while providing carbon sink actions through natural wetland processes.
<i>“Promotion of design and orientation which maximizes energy efficiency and conservation and considers the mitigating effects of vegetation and green infrastructure” (s. 1.8.1(f))</i>	The engineered design of the constructed wetland is not only energy efficient, but directly upholds the provincial policies looking to utilize natural vegetation and green infrastructure solutions to reduce energy demands.
<i>Maximization of vegetation within settlement areas (s. 1.8.1(g))</i>	The implementation of vegetation into the lagoon cell provides additional habitat to the community and attracts notable wildlife and birds.

The PPS places a focus on the promotion of green infrastructure and vegetation in complementation with traditional infrastructure. The constructed wetland falls under the 'Green infrastructure' category and is defined in the PPS as a natural and human-made element that provides ecological and hydrological functions and processes. (MMAH, 2020). It is critical to assess future impacts in the development of our communities and look at projects in terms of overall economic, environmental and social impacts. An approach which combines both economic prosperity, environmental stewardship and social development is a win-win-win solution in terms of government spending, sustainable land use, and equitable community progress. Balancing of these three qualities contributes to overall sustainability within the community.

ECONOMIC RECOGNITION AND CONSIDERATIONS FOR OTHER COMMUNITIES

The Green Infrastructure Ontario (GIO) coalition is an alliance of organizations advocating for the implementation of green infrastructure and the quantification of the triple bottom line benefits (Green Infrastructure Ontario, 2020). The GIO published a report earlier this year outlining the trends and drivers of green infrastructure and offering an [Economic Impact Assessment of the Green Infrastructure Sector in Ontario](#). As of 2018, Ontario's green infrastructure sector contributed \$8.60 billion in gross output and \$4.64 billion in direct gross domestic product, contributing more than the wood product manufacturing sector, computer and electronic product manufacturing sector, or pharmaceutical and medicine manufacturing sector (GIO, 2020).

The case for economic recognition of green infrastructure has been strengthened by Ontario Regulation 588/17: Asset Management Planning for Municipal Infrastructure, where the *municipal infrastructure asset* definition includes green infrastructure (O.Reg 588/17). By quantifying and comparing costs between traditional and green infrastructure this will allow for recognition and validity in investing towards a sustainable future. To facilitate the investigation of various forms of infrastructure the GIO has developed [A Green Infrastructure Guide for Small Cities, Towns and Rural Communities](#).

For municipalities looking to implement constructed wetlands into their infrastructure, a key requirement is space, however, this innovation could be transferred further to other applications. The idea of creating a natural environment to promote water quality could be used to address regional water quality issues resulting from agriculture activities and livestock farms (Tamburini et al. 2020; Fernandez-Fernandez et al. 2020). Huron County's [Clean Water Project](#) is one such example where municipal funding supports the agricultural community in green and traditional infrastructure projects that act to improve regional water quality including; erosion control, stormwater management and wetland creation, among others (Huron County, 2020).

LESSONS FROM THE CONSTRUCTED WETLAND

The constructed wetland pilot project in Loyalist has demonstrated the economic, environmental and social case for bringing green infrastructure solutions to the table in municipal decision making. Often mechanical solutions are the first options assessed, and the wetland project has shown the legitimacy of being an effective solution to infrastructure issues. Loyalist has demonstrated key lessons to municipalities looking for cost-effective and innovative solutions.

LESSON 1: RESILIENCY FOUNDED IN PROJECT DIVERSITY

Loyalist Township's continued perseverance in understanding their local ecosystem and looking for green solutions that made economic sense was a key factor in their found success. The attitude of looking at a problem by way of assessing environmental impacts from the ground up and looking for solutions that mimicked the surrounding environment led them to understand the project on a deeper level. Municipalities could look outside the realm of their disciplines to find diversified and innovative solutions to increase infrastructure capacity for population and economic growth.

LESSON 2: STRONG ACADEMIC PARTNERSHIPS STRENGTHENING SUCCESS

Academic partnerships offer municipalities access to ground-breaking research. The partnership encourages researchers and students to explore innovative ideas which have a real-world benefit; offers additional funding pathways to municipal projects through research grants to get pilot projects moving; and gives municipalities access to additional resources to explore ideas that may otherwise be economically unachievable.

LESSON 3: BUILDING CAPACITY FOR THE FUTURE

The partnership with Queen's not only provided research, funding and expertise, but came full circle as research students were later employed with the Township and continued with their found determination towards green solutions. The partnerships formed by Loyalist enabled connections to build their staff capacity to deal with future infrastructure challenges. Loyalist has demonstrated a capacity to shape their settlement areas supporting the growth of business sectors, resulting in a well-rounded, diversified community with the potential to build their economic future.

REFERENCES

- Asset Management Planning for Municipal Infrastructure*, O Regulation 588/17, s.1(1)
- Fernandez-Fernandez, M.I., Martín de la Vega, P.T., Jaramillo-Morán, M.A., & Garrido, M. (2020). Hybrid constructed wetland to improve organic matter and nutrient removal. *Water*, 12(7), 2023. <https://doi.org/10.3390/w12072023>
- Foley, J. (2020, September 14). Loyalist Township winner of sustainable communities award. *The Kingstonist*. <https://www.kingstonist.com/news/loyalist-township-winner-sustainable-communities-award/>
- Green Infrastructure Ontario. (2017). *A green infrastructure guide for small Cities, Towns and rural communities*. https://d3n8a8pro7vhmx.cloudfront.net/greenbelt/pages/5202/attachments/original/1504021812/Green_Infrastructure_Final.pdf?1504021812
- Green Infrastructure Ontario. (2020). *An economic impact assessment of the green infrastructure sector in Ontario*. https://d3n8a8pro7vhmx.cloudfront.net/greenbelt/pages/12304/attachments/original/1590692335/Economic-Impact-Assessment-of-GI-Sector-in-Ontario_Online.pdf?1590692335
- Hemson Consulting Ltd. (2019). *Population, housing and employment projections to 2046*. <https://www.loyalist.ca/en/council-and-administration/resources/Documents/Growth-Projection-Study-2019.pdf>
- Huron County. (2020). *Huron County: Clean water project*. [Brochure]. https://www.huroncounty.ca/wp-content/uploads/2020/05/Huron_Clean_Water_Brochure_2020.pdf
- Jin, M., Carlos, J., McConnel, R., Hall, G., & Champagne, P. (2017). Peat as substrate for small-scale constructed wetlands polishing secondary effluents from municipal wastewater treatment plant. *Water*, 9, 928. <https://doi.org/10.3390/w9120928>
- Ministry of Municipal Affairs and Housing. (2020). *Provincial Policy Statement*. <https://files.ontario.ca/mmah-provincial-policy-statement-2020-accessible-final-en-2020-02-14.pdf>
- Ministry of the Environment. (2008). *Amended certificate of approval. Municipal and private sewage works (Number 4210-7F3TMW)*. <https://www.accessenvironment.ene.gov.on.ca/instruments/5658-7D3PUT-14.pdf>
- Muga, H.E., & Mihelcic, J.R. (2008). Sustainability of wastewater treatment technologies. *Journal of Environmental Management*, 88(3), 437-447. <https://doi.org/10.1016/j.jenvman.2007.03.008>
- Tamburini, E., Soana, E., Monti, M., Fano, E.A., & Castaldelli, G. (2020). Introducing life cycle assessment in costs and benefits analysis of vegetation management in drainage canals of lowland agricultural landscapes. *Water*, 12(8), 2236. <https://doi.org/10.3390/w12082236>

- The Corporation of Loyalist Township, By-Law 2010-50, *To execute agreement with Kingston Field Naturalists regarding access to the Amherstview Sewage Lagoons* (10 May, 2010).
- The Corporation of Loyalist Township, By-Law 2015-109, *To amend by-law 2013-018 authorizing an agreement with Queen's University at Kingston, Ontario, Canada* (9 November, 2015).
- The Corporation of Loyalist Township. (2020). *Draft Official Plan: Red-line version (November 2020)*. <https://www.loyalist.ca/en/business-and-development/resources/Documents/DRAFT-OP-Red-line-November-2020.pdf>

ADDITIONAL RESOURCES

- Ministry of the Environment & Climate Change. (2017). *Draft low impact development (LID) stormwater management guidance manual*.
https://municipalclassea.ca/files/7_DRAFT_MOECC_LID%20SWM%20Manual.pdf
- Tousignant, E., Fankhauser, O., & Hurd, S. (1999). *Guidance manual for the design, construction and operations of constructed wetlands for rural applications in Ontario*. Stantec Consulting Ltd, Alfred College (University of Guelph), South Nation Conservation.
https://atrium.lib.uoguelph.ca/xmlui/bitstream/handle/10214/15203/FDMR_wetlands_manual.pdf?sequence=1&isAllowed=y
- United States Environmental Protection Agency. (n.d.). *A handbook of constructed wetlands*. <https://www.epa.gov/sites/production/files/2015-10/documents/constructed-wetlands-handbook.pdf>
- United States Environmental Protection Agency. (n.d.). *Constructed Wetlands*. [Webpage].
<https://www.epa.gov/wetlands/constructed-wetlands>