Constraints on the consideration of environmental alternatives for wastewater management

By

Bria Aird, BA, the University of King's College and Dalhousie University, 2015

A Major Research Paper

Presented to Ryerson University

In fulfillment of the requirements for the degree of

Master of Planning
in
Urban Development

Toronto, Ontario, Canada, 2018

AUTHOR'S DECLARATION FOR DIGITAL SUBMISSION OF A MRP

I hereby declare that I am the sole author of this MRP. This is a true copy of the MRP, including any required final revisions.

I authorize Ryerson University to lend this MRP to other institutions or Individuals for the purpose of scholarly research.

I further authorize Ryerson University to reproduce this MRP by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

I understand that my MRP may be made digitally available to the public.

TITLE
Subtitle

Master of Planning
in
Urban Development

Ryerson University

ABSTRACT

Major projected population increases in Ontario's Greater Golden Horseshoe (GGH) are compelling municipalities to plan and construct wastewater infrastructure that will underlie growth for decades. This research investigated whether the municipal planning processes for these systems adequately consider long-term environmental risk, ecological context, financial sustainability and citizen participation. Emerging responses to the threat of climate change suggest that the principle of resilience should shape infrastructure, challenging the logic that has historically driven wastewater planning. Municipal councillors and local activists from three lower-tier municipalities in the outer ring of the GGH (Cavan Monaghan, Innisfil and Wellington North) were interviewed. Documents produced by the Environmental Assessment Process (EA) – the primary planning mechanism for new wastewater infrastructure – were analysed. This analysis indicated that the EAs excluded robust consideration of climate risk, broad environmental impact, and alternative systems. Based on participant interviews, this research concluded that low awareness of alternative options, the desire to encourage/accommodate population growth, and existing funding options effectively narrowed wastewater planning and outcomes.

Key words: wastewater, infrastructure planning, infrastructure resilience, Greater Golden Horseshoe,

Contents

Figures

1. Introduction

1.1. The Challenge

Large-diameter sewage pipes underlie most of the Greater Golden Horseshoe's growth over the last century.[1] Largely unchallenged, this centralized sanitation infrastructure has allowed massive increases in population while almost eliminating outbreaks of waterborne illness.[2] Now, however, there are multiple rising challenges to infrastructure orthodoxy, largely fuelled by environmental uncertainty, but also by shifting economic trends, increased attention to local governance and new attention to resilience and adaptability.

Over the past twenty years, calls and proposals for alternative approaches to wastewater management have come from a number of quarters – national government agencies, local governments, applied sanitation researchers and engineers, academics and environmentalists.[3],[4] One major call to action comes from the climate change adaptation community – conventional centralized infrastructure may be more vulnerable to cascading failure triggered by drought and extreme precipitation events.[5] Alternative approaches to wastewater, they claim, can be more easily adapted as user demands and the climate changes; encourage water efficiency; mitigate the damages of development on water resources; lower financing burdens for sanitation

[1] J. Thompson, "Growing with the Flow: Planning for Smart Growth in Ontario Through Water & Wastewater Infrastructure" (Major Research Project, Ryerson University, 2012).
[2] Martin V. Melosi, "Path Dependence and Urban History: Is a Marriage Possible?" in *Resources of the City: Contributions to an Environmental History of Modern Europe,* eds. by Bill Luckin, Geneviève Massard-Guilbaud and Dieter Schott (Routledge: Google Books, 2017).
[3] Environmental Protection Agency. "Response to Congress on Use of Decentralized Wastewater Treatment Systems," *Decentralized Wastewater Treatment Project* (Washington, D.C.: US EPA Office of Water, 1997). https://www.epa.gov/sites/production/files/2015-06/documents/septic_rtc_all.pdf
[4] ECO (Environmental Commissioner of Ontario), *Redefining Conservation Annual Report 2009/2010* (Toronto: Environmental Commissioner of Ontario, 2010). https://eco.on.ca/our-reports/environmental-protection/
[5] AECOM and C40 Cities, "C40 Infrastructure Interdependencies + Climate Risks Report" (C40 Cities, Spring 2017)

infrastructure; encourage resource recovery and stimulate better water governance.[6] In particular, alternative approaches are appropriate both in rural areas where economies of scale do not support a centralized treatment approach, and in dense urban centres, where existing infrastructure is at capacity and upgrading it is prohibitively expensive.[7] Why then, this research asks, do wastewater planning processes in the Greater Golden Horseshoe focus so narrowly on traditional, centralized approaches to sanitation?

Many small and primarily rural municipalities at the edge of the Greater Toronto and Hamilton Area's commuter-shed are undergoing a rapid transformation due to major forecasted population increases.[8] Driven both by underlying migration trends and provincial policy as embedded in the Growth Plan for the Greater Golden Horseshoe (2006, 2017), many of these communities are projected to increase in population by 30-100% over the next 15 years.[9] These communities generally manage wastewater through private septic systems, or a mix of private septic systems and a small municipally-run centralized system, and many have undertaken planning processes to determine the best approach to managing the wastewater of their future populations. Given the primarily rural, low-density character of these settlements, the scope of impending change, investment in alternative wastewater research in Ontario, and the strong planning framework in

---

[6] S. Panebianco, and C. Pahl-Wost, "Modelling socio-technical transformations in wastewater treatment—A methodological proposal," *Technovation* 26 (2006).
Gunilla Öberg, Maria G. Merlinzky, Alicia Lavalle, Margaret Morales and Melina M. Tobias, "The Notion of Sewage as a Waste," *Ecology and Society* 19, no.2 (2014). doi: 10.5751/ES-06531-190219
R. Beveridge, T. Moss and M. Naumann, "Sociospatial Understanding of Water Politics: Tracing the Multidimensionality of Water Reuse" *Water Alternatives* 10, no.1 (2017).

[7] Panebianco, "Modelling socio-technical transformations."

[8] Rian Allan and Philippa Campsie, "Implementing the Growth Plan for the Greater Golden Horseshoe," (Report, Toronto, ON: The Neptis Foundation, October 2013).

[9] For example, in the lower-tier municipality of Wellington North, one community is projected to grow by 30% while the other is projected to grow by 80%. GSP Group Inc. | Curtis Planning Inc. "Wellington North Community Growth Plan," (Final Report, Township of Wellington North, 2018).

place in this region, these municipalities would seem to be strong candidates for a broader range of approaches to wastewater management.

In practice, very few municipalities in Southern Ontario have chosen this route. In each of the three case studies examined for this paper, the range of wastewater management approaches considered was very narrow, even where environmental advocacy shaped local decisions. In each of these case studies, distributed, decentralized or innovative wastewater management approaches may have been preferable to conventional systems in terms of financing, social license, and overall environmental impact, but they were not evaluated, or were only perfunctorily evaluated in the wastewater planning process.

It is not the purpose of this research to establish what the best wastewater management approach is for any particular municipality. Instead, this research examines how the construction of current planning and decision-making processes in small municipalities frame a narrow set of alternatives and exclude potentially feasible and even preferable alternatives from consideration. Ultimately, this research concludes that the narrow framing of wastewater planning processes does not adequately consider broad environmental impacts, equity, and future change. The exclusion of these concerns from consideration means that alternative wastewater management approaches that may better address them are not fully considered.

1.2. Methodology

This research project takes a case study approach to determine whether Ontario municipalities are empowered to consider alternative wastewater management approaches, and if not, what the barriers are to broader consideration of wastewater management options. Potential case studies were considered if they were lower-tier municipalities in the Greater Golden Horseshoe with

populations less than 50,000 and had completed a major wastewater management decision process within the past half-decade. A scan of municipal websites and local news sites for information about recent wastewater projects was used to identify municipalities that met both these inclusion criteria. Discretionary decision criteria were used to rank the eight municipalities that were selected in the previous step. Specifically, municipalities facing greater growth pressure and with evidence of greater community opposition or involvement were ranked higher. Beyond that, an effort was made to represent a range of affluence levels and population sizes. The three municipalities selected for further analysis were Wellington North, in Wellington County; Cavan Monaghan, in the County of Peterborough; and Innisfil, in Simcoe County.

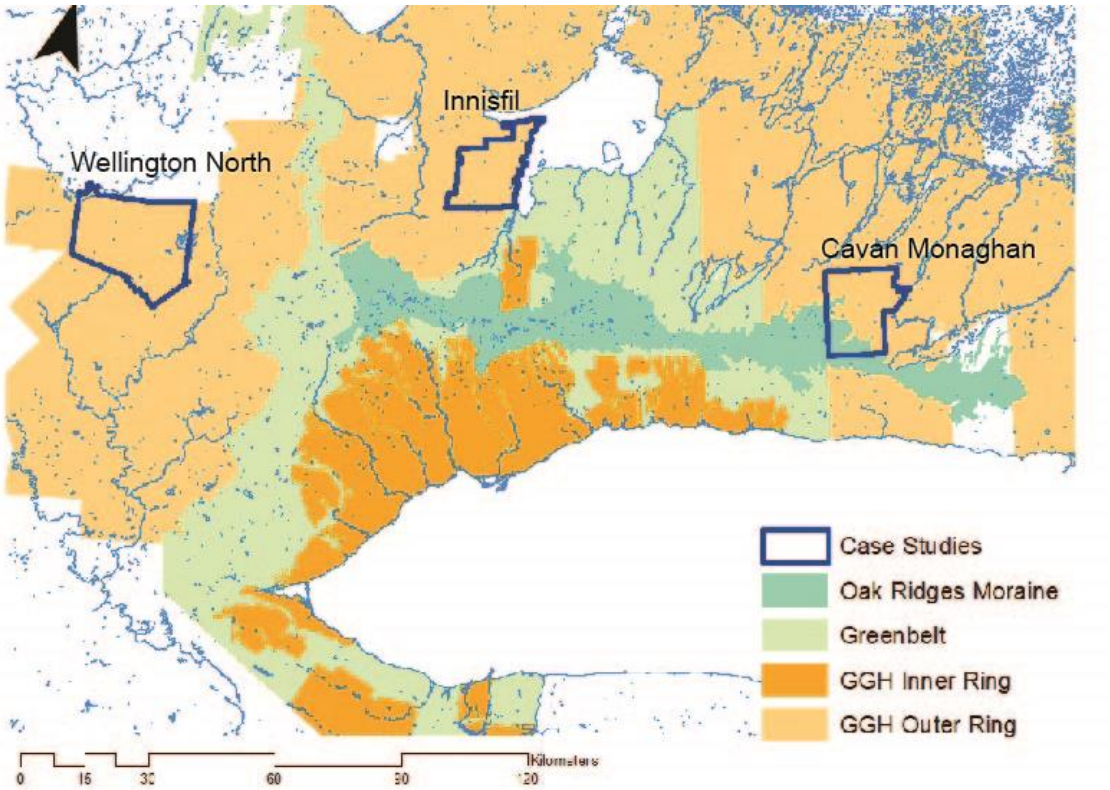

Figure 1: Case Study Municipalities[10]

[10] Maps based on open data from Land Information Ontario. Data layers include: "Lower and Single Tier Municipalities," "Ontario Hydro Network 10M Shoreline," "Oak Ridges Moraine Planning Area," and "Greenbelt Designation."

Each case study was further examined through a review of published reports, municipal council minutes, contemporary news articles, blog posts and documents associated with the Class Environmental Assessment (Class EA) process for the wastewater treatment system. Local actors were also contacted for interviews. Members of council who were sitting during the decision process were recruited for interviews. Where community advocates, members of local organizations and representatives of local bodies were listed in planning documents or in local news articles, they were also contacted. Wastewater consultants who had worked on projects in the eight municipalities that met the initial inclusion criteria were also contacted for interviews.

Ultimately, two consultants and nine separate local actor respondents participated in phone interviews, giving a response rate of 34%. The interviews were structured, but in many cases valuable evidence was offered by the participants outside the specific questions asked. Respondents were given the opportunity to review quotes and statements.

Table 1: Research participants

Municipality	Members of Council	Advocates
Cavan Monaghan, Peterborough County	2*	1
Wellington North, Wellington County	2	0
Innisfil, Simcoe County	3	1

* One respondent was a water advocate who was subsequently elected to council.

This local, case-specific information was contextualized through a broader review of wastewater and growth management policy, legislation and regulations in the Greater Golden Horseshoe. Specifically, the Provincial Policy Statement, the Growth Plan for the Greater Golden Horseshoe, the Lake Simcoe Protection Plan, the Clean Water Act, the Ontario Water Resources Act and the Environmental Assessment Act were reviewed for relevance to the case studies. The

case study approach was also complemented by a wider literature review, which examined water governance approaches, alternative wastewater management options, barriers to holistic wastewater management and the history and financing of wastewater infrastructure in Ontario.

1.2.1. Theoretical guides

The theoretical approach of this research was strongly influenced by the work of John Forester and Bent Flyvbjerg. Both of these planning theorists justify the validity of case studies and careful listening to practitioners' stories as a meaningful and rigorous research technique.

According to Flyvbjerg, ostensibly rational planning processes are in fact driven by the "rationality of power."[11] That is, planning evidence and arguments are inevitably shaped by the existing attitudes of those who command economic, political and institutional power. If this is the case, analyses of planning decisions that ignore the intimate, daily exchanges of power over the length of the decision process will fail to truly explain how the process generated the outcome it did. Case studies, involving detailed interviews with actors, are appropriate and necessary to understand how the dynamics of local planning processes shape outcomes.[12]

Likewise, Forester, quoting Iris Murdoch, argues that "at crucial moments of choice, most of the business of choosing is already over." [13] While more optimistic than Flyvbjerg that fairer democratic planning can be conducted through a deliberative approach, Forester agrees that planning decisions do not really happen at the junctures that they appear to. Rather, planners, technical experts, politicians and activists shape what information is included in the decision

[11] Bent Flyvbjerg, *Rationality and Power* (Chicago: University of Chicago Press, 1998): 113.
[12] Bent Flybjerg, "Five Misunderstandings about Case Study Research," *Qualitative Inquiry* 12 no.2 (2006).
[15] John Forester, *The Deliberative Practitioner* (Cambridge, MA: The MIT Press, 1999): 43.

narrative based on implicit attitudes, such that certain choices appear to be rational and others impracticable, or "out of left field."[14]

Following these theorists, this research hypothesizes that the attitudes of local actors shape wastewater planning decisions as much as explicit regulatory requirements, technical feasibility and financial cost. This is the rationale for the primary interviews with municipal decision-makers and external actors. Fundamentally, this research assumes that wastewater planning is a socially produced outcome. The research attempts to elucidate how the attitudes of local actors and the structures of the decision-making process shape this outcome.[15]

1.3. Case Studies

1.3.1. Wellington North

This case study focuses on the community of Arthur in the municipality of Wellington North. Approximately two hours northwest of Toronto, in Wellington County, Arthur has a population of about 2,725 people.[16] Arthur is the smaller of two communities in Wellington North, both of which are served by municipal wastewater systems[17] and together house 75% of the municipality's population. The rest of the municipality is agricultural and rural in character and is serviced by private systems.[18]

Prior to 2010, Wellington North Municipal Council became aware that the existing wastewater treatment plant for Arthur was approaching its average daily flow (ADF) capacity. Compounding

---

[14] Forester, *The Deliberative Practitioner*: 43.
[15] See Bent Flyvbjerg in *Making Social Science Matter* (Cambridge, UK: Cambridge University Press, 2001) for an intensive philosophical discussion of the significance of conflict and power to social inquiry.
[16] GSP Group Inc. | Curtis Planning Inc. "Wellington North Community Growth Plan."
[17] XCG Consultants, "Arthur Wastewater Treatment Plant Class Environmental Assessment Environmental Study Report" (Wellington North, Township of Wellington North, 2016).
[18] XCG Consultants, "Arthur WWTP ESR."

this issue is the municipality's ambition to grow the population of Arthur by one third by 2041, as per the provincially imposed growth projections in Schedule 3 of the Growth Plan for the Greater Golden Horseshoe.[19]

Arthur's existing wastewater treatment plant discharges effluent that has undergone tertiary treatment into the Conestoga River. It is connected by a forcemain to effluent storage lagoons on the opposite side of town.[20] Sewage is stored here during the winter and summer, for discharge in the Spring and Fall. There was broad consensus among the community that additional sewage treatment capacity was needed. The option selected through the Class Environmental Assessment process was an expansion and upgrade to the existing plant.[21]

1.3.2. Innisfil

Innisfil is a municipality of approximately 35,000 people in the County of Simcoe, on the shores of Lake Simcoe.[22] It is experiencing major development pressures, as per the Growth Plan 2012 Simcoe Sub-Area amendment and Schedule 3 of both the original and 2017 update to the Growth Plan. It contains a number of smaller communities, some of which are centrally serviced. The remainder of the population uses private septic systems.[23]

Political dynamics in Innisfil around water issues are fraught. Highly motivated environmental advocacy coalitions oppose projects they believe would adversely affect the health of the lake. The most significant of these was the development of a resort at Big Bay Point and Marina.

---

[19] GSP Group Inc. | Curtis Planning Inc. "Wellington North Community Growth Plan."
[20] XCG Consultants, "Arthur WWTP ESR."
[21] XCG Consultants, "Arthur WWTP ESR."
[22] Genivar. "Town-Wide water & Wastewater Master Servicing Plan" (Innisfil, ON: Town of Innisfil, 2012).
[23] Genivar. "Town-Wide Plan."

Environmental advocates including the Innisfil District Association, Environmental Defence, and Rescue Lake Simcoe Coalitions feared the development's direct impact on the lake.[24] They also worried that increased wastewater treatment capacity necessitated by the Resort would trigger ongoing residential development in the area, and thus cumulative environmental damage.

This conflict extended for close to 15 years and involved protracted and nasty legal battles – in the initial Ontario Municipal Board hearing for the case, the developer requested an award of costs from its opponents that the Board ultimately ruled would "create a chilling effect" on public participation.[25]

In 2012, Innisfil Council approved a Water and Wastewater Servicing Master Plan, intended to coordinate wastewater planning in the town to 2031, and avoid inefficiencies due to lack of planning.[26] One of the key components of the plan was servicing to the Innisfil Heights employment area, which was identified as a 'Strategic Settlement Employment Area' in Amendment 1 (2012) to the Growth Plan for the Simcoe Sub-area. Despite being a high priority for some members of Council, and considerable efforts to find alternative funding to extend wastewater servicing to this area to permit large-scale commercial development, there is no immediate plan to service the area.[27]

Innisfil remains a complex case study. One of the key arguments centres on whether the growth associated with new wastewater treatment capacity will outweigh the water quality benefits to

[24] James Rusk, "Wave of protest swelling over Lake Simcoe resort," *The Globe and Mail,* August 7, 2007. Updated March 27, 2017.
[25] Rick Vanderlinde, "Anti-SLAPP law reminder of fight to build Innisfil's Friday Harbour," *Innisfil Journal,* Nov 12, 2015.
[26] Genivar, "Town-Wide Plan."
[27] Janis Ramsay, "Innisfil Heights pipe dream dies," *Innisfil Journal,* 8 June 2017.

Lake Simcoe of replacing private septic systems with sewer system connections. Another question is whether lack of water and wastewater servicing is the primary limiting factor for commercial development. Finally, the cost of centralized services is also a point of contention.

Important conflicts and decisions in this case study are:

- Servicing of the Big Bay Point development (Friday Harbour) and the expansion of the Lakeshore Wastewater Treatment Plant (WWTP);
- Development of the 2012 Town-wide Water and Wastewater Master Servicing Plan;
- Wastewater servicing for the Innisfil Heights Strategic Settlement Employment Area.

1.3.3. Cavan Monaghan

Cavan Monaghan is a small municipality of approximately 8,800 people, located on the Toronto side of Peterborough.[28] As of 2006, approximately 1,650 people lived in Millbrook, the only municipally serviced community in the Township.[29] In 2005, Council approved a plan to construct municipal water and wastewater facilities to facilitate greenfield development adjacent to the existing hamlet of Fraserville and the Kawartha Downs racetrack and slots facility.[30] Following the discovery that Fraserville's groundwater resources were contaminated, council approved an alternate proposal to pipe water from Millbrook wells, located on the Oak Ridges

[28] Statistics Canada, Cavan Monaghan Township [Census Subdivision] Population. Accessed through the Census Program Data Viewer, 2016 Census. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/dv-vd/cpdv-vdpr/index-eng.cfm

[29] Statistics Canada. *Millbrook, Ontario (Code 1308) and Canada (Code 01)*(table). *Census Profile*. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E (accessed April 8, 2018).

[30] Cavan-Millbrook-North Monaghan, *Fraserville Secondary Plan* (Millbrook, ON: The Township of Cavan-Millbrook-North Monaghan, 2005).

Moraine.[31] The project was fully funded at a cost of $30 million, through the Building Canada Fund.[32]

This decision triggered massive community opposition to the proposed Fraserville project. As indicated by the name of the central campaign, 'It's About Water,' local advocates' primary concern was the impact on water resources, particularly ground water in the Oak Ridges Moraine.[33] Residents were also concerned about development on agricultural and natural heritage land, the proximity of the proposed development to the Peterborough municipal airport, and the impact of extending the water pipe across sensitive lands.[34] The 'It's About Water' campaign coordinated widespread participation in the formal approval processes for the project. Other environmental groups, like Save the Oak Ridges Moraine and Council of Canadians lent their support, while professional ecologists and hydrogeologists lent their pro-bono advice.[35] Local water advocates also organized a popular campaign, involving lawn signs, t-shirts, events and a march along the pipeline route.[36]

Despite the unpopularity of the Fraserville development, it maintained majority support on the council of the time. However, council also discovered the need to upgrade the 40-year-old wastewater treatment plant at Millbrook.[37] The existing plant was near treatment capacity, and

---

[31] Josh Garfinkel and Josh Kohler, "Millbrook water fight runs deeper," Opinion, *The Peterborough Examiner*, 5 Feb. 2010). Reproduced by EarthRoots: https://earthroots.org/news/192-millbrook-water-fight-runs-deeper.
[32] Cavan Monaghan, "Water and Wastewater Services," Accessed at 22 February 2018 http://www.cavanmonaghan.net/en/servingyou/waterandwastewaterservices.asp?hdnContent=
[33] Council of Canadians, "WIN! Millbrook, Ontario water diversion defeated," *Council of Canadians Blog,* August 4, 2010, Accessed at https://canadians.org/node/5747
[34] Online archive of citizen letters at "Speak Out Cavan Monaghan" blog, accessible at http://www.youronlineagents.com/cavanmonaghan/viewcustompage.php?id=4598
[35] Participant interview.
[36] Photographic record of the "Human Pipeline Walk" available at "Speak Out Cavan Monaghan" blog, http://www.youronlineagents.com/cavanmonaghan/viewcustompage.php?id=6685
[37] Participant interview.

water quality downstream of the plant was below Provincial standards for phosphorous concentration.[38]

Ultimately, the 'It's About Water' campaign succeeded through the popular vote. The 2010 election swept 4 out of the 5 incumbents out of office, replacing them with anti-Fraserville candidates.[39] The new council promptly voted to cancel the proposed drinking water extension to Fraserville, effectively halting the whole project.[40] Instead, a portion of the Building Canada funding – $21 million – was transferred to a new plan to expand and upgrade the wastewater treatment capacity of the existing Millbrook plant, as well as water servicing expansions. That project underwent a full Class EA process and is complete as of summer 2016.[41]

[38] R.V. Anderson Associates Limited, "Millbrook Wastewater Treatment Expansion Class Environmental Assessment Environmental Study Report" (Millbrook, ON: The Township of Cavan Monaghan, 2013).
[39] Participant Interviews.
[40] Cavan Monaghan, "Minutes for the Regular Meeting of Council," Tuesday August 3, 2010. Retrieved from http://www.cavanmonaghan.net/uploads/105/Doc_634842503391814981.pdf
[41] J. Kovack, "New $21M wastewater treatment plant in Millbrook," *Peterborough Examiner*, 30 Jul 2016). Retrieved from https://www.thepeterboroughexaminer.com

2 Literature Review: Wastewater Management Choices

The wastewater projects undertaken in the three case study municipalities reflect 150 year old trends towards centralized wastewater management.[42] The shift away from poorly managed decentralized systems towards centralized treatment has drastically improved public health, the environmental health of receiving water bodies, and unlocked urban growth.[43] At the same time, centralized treatment has enabled urban sprawl and reinforced an end-of-pipe approach to water management.[44]

Conventional systems pipe wastewater from individual buildings towards a centralized plant, which treats the wastewater to a specified quality level and discharges it, most often to a surface waterbody. The capital cost of plant construction, as well as the laying and maintenance of collection infrastructure, is high.[45] In smaller, less dense municipalities, these systems are harder to finance.[46] Often, municipalities plan for greater growth to justify higher infrastructure costs, and then plan for greater infrastructure capacity to accommodate more growth. This circular reasoning has driven infrastructure planning in multiple Ontario municipalities.[47]

---

[42] S.J. Burian, S.J. Nix, R.E. Pitt, and S.R. Durrans, "Urban Wastewater Management in the United States: Past, Present and Future," *Journal of Urban Technology* 7 no.3 (2000).
Panebianco and Pahl-Wostl, "Modelling socio-technical transformations."
[43] Burian et al., "Urban Wastewater Management."
[44] ECO, *Redefining Conservation (*2010).
[45] K.A. Schaefer, and J.M. Hurst, "Municipal Water Use and Pricing in Ontario, 1983–1994," *Canadian Water Resources Journal* 22, no. 4 (1997.
[46] H.F. Swain, F. Lazar and J. Pine, *Watertight: The case for change in Ontario's water and wastewater sector* (Toronto, ON: Ministry of Public Infrastructure Renewal - Water Strategy Expert Panel, 2005).
[47] Forthcoming Neptis report, "Capacity and Constraints on Water and Wastewater Systems in the Greater Golden Horseshoe."

2.1 The weight of wastewater

Despite the strong benefits of centralized treatment systems, current approaches to wastewater management face a rising set of challenges. Perhaps the largest concern that is least addressed in contemporary practice is the unpredictable threat of climate change.[48] More traditional environmental concerns are also present, including the cumulative impact of new systems, water conservation, and energy use.[49] This subsection describes how these concerns have been raised in the Ontario context.

Climate Uncertainty + Resilience

A new approach to the governance of socio-ecological systems has emerged in response to the existential threat of climate change. This approach is encapsulated in the word 'resilience.'[50] Contemporary resilience theory follows the ground-breaking work of Canadian ecologist C.S. Holling, who realised that stability and predictability are not inherent qualities of natural systems. Instead, he investigated ecosystem resilience: the capability of systems to absorb fluctuations and pressures without severing critical relationships.[51] Since human systems – wastewater infrastructure being a prime example – exist within a larger ecological context, resiliency is a critical quality for them too.

---

[48] AECOM and C40 Cities, "C40 Infrastructure Interdependencies."
[49] ECO, *Losing Touch/ Losing our Touch: Annual Report 2011/2012* (Toronto, ON: Environmental Commissioner of Ontario, 2012).
Neptis (forthcoming), "Capacity and Constraints."
[50] AECOM and C40 Cities, "C40 Infrastructure Interdependencies."
[51] C.S. Holling, 'Resilience and Stability of Ecological Systems,' Annual Review of Ecology and Systematics Vol. 4, pp. 1-23, (1973).

Climate change will bring both stresses and shocks to human and ecological systems.[52] Water and wastewater systems will be challenged with unpredictable droughts and extreme precipitation events, exacerbating the existing negative environmental impacts of wastewater.[53] Centralized wastewater management infrastructure has already been impacted by climate change. Recent major storm events like Hurricane Sandy have damaged water treatment plants, and resulted in the release of untreated sewage to urban waterways and millions of dollars in repairs to wastewater infrastructure.[54] Closer to home in Toronto, the July 13, 2013 storm caused over one million cubic metres of raw sewage to be released into Toronto waterways from three treatment plants, exposing people to e-coli levels three times the provincial maximums.[55] Conventional infrastructural logic attempts to build capacity to deal with the "100 year storm," but climate change means these events are less predictable than they were before.[56] Conventional infrastructure is vulnerable to catastrophic failure.[57]

Conventional wastewater infrastructure is also a cause of climate change. The Environmental Commissioner of Ontario found that water and wastewater infrastructure produced about 40% of

---

[52] S. Lavoral et al., "Ecological mechanisms underpinning climate adaptation services," *Global Change Biology* 21 no.1 (18 Aug 2014).
[53] R Sandford and K. Freek, *Flood Forecast: Climate Risk and Resiliency In Canada* [e-book] (Victoria, British Columbia: Rocky Mountain Books; 2014).
[54] J. Matthews, "Disaster Resilience of Critical Water Infrastructure Systems," *Struct. Engineering* 142 no.8 (2016).
A. Kenward, D. Yawitz and U. Raja, *Sewage Overflows from Hurricane Sandy*, (Princeton, NJ: Climate Central, 2013).
55 K. Tully and M. Mattson, "Application for Review: Toronto Sewage Bypass Alerts," *Ministry of Environment Application for Review,* (Toronto, ON, Canada: Lake Ontario WaterKeeper, July 7, 2014).
[56] AECOM and C40 Cities, "C40 Infrastructure Interdependencies."
[57] T. Taylor and R. Goldstein, *Sustainable Water Resources Management, Volume 3: Case Studies on New Water Paradigm,* (Report, Palo Alto, CA: Electric Power Research Institute, 2010).

Ontario municipalities' greenhouse gas emissions. Wastewater treatment and pumping produced half of the total greenhouse gas emissions for municipal water management.[58]

Decentralized, ecologically integrated, "safe-to-fail" systems offer the ability to build resilience into infrastructure.[59] Small-scale and decentralized wastewater treatment add redundancy and diversity to wastewater management approaches. These qualities are a benefit in the face of climate uncertainty, because they limit the risk of cascading failure.[60] Individual components of a resilient system might be overwhelmed and fail, but redundancy in other parts of the system mean that there are multiple barriers to prevent widescale damage or catastrophic failure.[61] It is also critical to implement systems that are adaptable to future conditions. It is hard to predict future conditions and prohibitively expensive to prepare for all eventualities. Therefore, hard and soft infrastructure systems should be adaptive to changing social, ecological and economic conditions.[62] Reflecting a broader interest in adaptive systems, the American Environmental

---

[58] ECO, *Every Drop Counts: Reducing the Energy and Climate Footprint of Ontario's Water Use* (ECO 2016/2017 Annual Report, Toronto, ON: Environmental Commissioner of Ontario, 2017).
[59] Nina Marie Lister and Chris Reed, "Evolutions - Parallel Genealogies," In Projective Ecologies, eds. Nina Marie Lister and Chris Reed (Cambridge, MA: Harvard Graduate School of Design, 2014).
Falco, G. J. and W.R. Webb, "Water Microgrids: The Future of Water Infrastructure Resilience," *International Conference on Sustainable Design, Engineering and Construction* (50-57) (Chicago, IL: Procedia, 2015).
Matthews, "Disaster Resilience."
K. Jones et al. "The Urban Microgrid: Smart Legal and Regulatory Policies to Support Electric Grid Resiliency and Climate Mitigation," *Fordham Urban Law Journal* 41 no.5 (2015).
T. McPhearson, Z.A. Hamstead and P. Kremer, "Urban Ecosystem Services for Resilience Planning and Management in New York City," Ambio 43 (2014).
[60] AECOM and C40 Cities, "C40 Infrastructure Interdependencies."
[61] Matthews, "Disaster Resilience."
[62] Johanna Sorensen et al., "Re-Thinking Urban Flood Management—Time for a Regime Shift," *Water* 8 (2016).

Protection Agency[63] and the Environmental Commissioner of Ontario have called for investigation into decentralized wastewater treatment approaches.[64]

Environmental Concerns

Climate change will exacerbate existing environmental risks and impacts. However, current wastewater planning practices are not environmentally benign.[65] Increasing regulatory standards, long-term water quality monitoring, and engineering expertise have greatly improved the quality of effluent that is discharged into waterbodies. Even so, the mass discharge of wastewater can be detrimental to receiving waterbodies.[66] Even treated effluent can have harmful effects 10-20 kilometres downstream of the discharge point. The Environmental Commissioner of Ontario estimates that 15% of rivers & lake ecosystems in Great Lakes Basin damaged by sewage effluent.[67]

Water and wastewater management in Canada has historically been based on the assumption that water supplies are limitless.[68] This is not the case. Nearly a third of Canadian faced threats to water quality or quantity in the early years of the millenium.[69] Freshwater sources, whether groundwater or surface water, are connected to the waterbodies which receive effluent. Low

---

[63] Significant research on decentralized wastewater planning at a municipal level has been undertaken by the Decentralized Water Resources Collaborative, (funded by the EPA). The EPA also consults on decentralized systems. See https://www.epa.gov/sites/production/files/2015-06/documents/20130306mou_webinar_casey.pdf

[64] ECO, *Redefining Conservation*.

[65] A.I. Racoviceanu, B.W. Karney, C.A. Kennedy and A.F. Colombo, "Life-Cycle Energy Use and Greenhouse Gas Emissions Inventory for Water Treatment Systems," *Journal of Infrastructure Systems* 13 no.4 (2007).

[66] G. Tjandraatmadja, S. Burn, M. McLaughlin et al, "Rethinking urban water systems - Revisiting concepts in urban wastewater collection and treatment to ensure infrastructure sustainability," *Water Science and Technology: Water Supply* 5 no.2 (2005).

[67] ECO, *Redefining Conservation*.

[68] Oliver M. Brandes and David B. Brooks, "The Soft Path for Water: A Social Approach to the Physical Problem of Achieving Sustainable Water Management," Backgrounder. *Horizons.gc.ca*.

[69] Brandes and Brooks, "The Soft Path for Water."

water in a receiving waterbody reduces its capacity to assimilate waste.[70] Loading of excess nutrients like phosphorous can lead to eutrophication and serious environmental damage.

Cumulative loading from multiple sources also threatens ecosystem health. The Lake Simcoe Protection Plan recognizes the importance of accounting for cumulative loading.[71] The Environmental Commissioner of Ontario warns that the significant pace of population growth across the Greater Golden Horseshoe threatens watershed health due to the cumulative impacts of development. Neptis, an independent research institution, and the Environmental Commissioner of Ontario have called for assessments of infrastructure and ecosystem carrying capacity to be completed in advance of growth planning.[72]

2.2 Principles for good wastewater governance

Scale is a critical factor in wastewater governance.[73] Local management has been theorized to promote greater efficiency, access and sustainability. This belief has driven the trend towards smaller-scale management over recent decades.[74] In Ontario, as in other jurisdictions, the 'watershed' has been emphasized as the appropriate scale for water governance.[75] Provincial legislation and policy, reviewed below, emphasises the importance of developing watershed management plans, and evaluating individual project proposals in the context of the watershed.

[70] ECO, Losing Touch.
[71] Ontario, Lake Simcoe Protection Plan (Toronto, ON: Queen's Printer, July 2009): 28.
[72] ECO, Losing Touch.
[73] Emma S. Norman, Karen Bakker and Christina Cook, "Introduction to the Themed Section: Water Governance and the Politics of Scale," *Water Alternatives*, 5 no.1 (2012).
[74] Norman et al., "Introduction."
[75] K. McFarlane, L. Harris and K. Bakker, Features of Institutions and Governance Processes that Enable Efficient, Effective, and Equitable Water Management (Vancouver, BC: UBC program on Water Governance, 2015).

The use of ecologically-relevant scales is critical for good water governance.[76] For example, major transfers of water from one watershed "basin" to another are ecologically risky.[77] Using the watershed as a scale of analysis, the Ontario government passed the Safeguarding and Sustaining Ontario's Water Act in 2007, limiting transfers from one Great Lakes watershed to another. This legislation impacted how York Region, which straddles two basins, planned major upgrades and expansions to its water and wastewater treatment system.[78] However, the literature warns that "watershed" itself is a contested and socially produced concept – watersheds are nested and interconnected.[79]

While Ontario has had watershed-level management agencies since the introduction of Conservation Authorities in 1946, their authority to establish and enforce watershed planning has been limited. Much of the Province-led watershed planning has been ad-hoc, with poor coordination between jurisdictions.[80] Watersheds – and their Conservation Authorities – are not aligned with existing jurisdictional boundaries, so water governance happens at multiple levels of authority, and across ecologically relevant scales.[81] One of the central principles of good watershed governance is coordination across scales and actors, so the coordination gaps in water governance in the Greater Golden Horseshoe are troubling.[82]

---

[76] McFarlane et al., "Features of Institutions."
[77] Deepak Kumar Das, "Environmental Impact of Inter-Basin Water Transfer Projects: Some Evidence from Canada," *Economic and Political Weekly* 41, no. 17 (2006).
[78] York, "The Regional Municipality of York, Water and Wastewater Master Plan." York Region, 2016.
[79] Norman et al., "Introduction."
[80] Charley Worte, "Integrated watershed management and Ontario's conservation authorities," *International Journal of Water Resources Development* 33 no.3 (2017).
[81] Worte, "Integrated watershed management."
[82] McFarlane et al., "Features of Institutions."

Problems of scale, jurisdiction and coordination are not unique to Ontario and water theorists offer several potentially useful framings of water governance. Because the actions of any one organization are insufficient to ensure good governance of water systems, especially where a resilience is sought, water challenges must be approached through a shared governance model.[83] One potentially productive method for understanding effective shared governance is the 'inter-organizational domain.' In this framing, multiple stakeholders are able to work effectively together only when they recognize their interdependence. Through collaborative problem-setting, these stakeholders create a shared domain of governance that adapts as the problem shifts and parties drop in and out of active governance.[84]

This recognition of shared responsibility and collaborative problem-setting can help multiple actors to coordinate across scales, jurisdictions and organizational contexts. However, attention must be paid to equity. Community actors and members of marginalized groups, including Indigenous groups, must not be excluded from the process.[85]

2.3 Barriers

Technical feasibility is one of the critical precursors for the adoption of new wastewater management approaches. While many alternative systems have been successfully implemented, municipal decision-makers' awareness of these options and confidence in their feasibility may be low. Municipalities, particularly smaller municipalities, rely on the advice of professional consultants, many of whom may not be aware of or comfortable with alternative systems.[86] This

[83] S. Bertels and H. Vredenburg, "Broadening the Notion of Governance from the Organization to the Domain: A Study of Municipal Water Systems in Canada," *The Journal of Corporate Citizenship* 15 (2004).
[84] Bertles and Vredenburg, "Broadening the Notion."
[85] McFarlane et al., *Features of Institutions.*
[86] ECO, *Redefining Conservation.*

has been a major barrier to implementation across jurisdictions.[87] Borrowing from Burch's assessment of barriers to climate change adaptation in British Columbian municipalities, this research recognizes that even after technical/capacity barriers have been overcome, regulatory/legislative barriers, cultural/behaviour barriers and structural/operational barriers can impede consideration and implementation of innovative adaptive solutions.[88] Regulatory and legislative barriers include official decision-making and are discussed in Section 3.2.

New institutional theory suggests that humans use the 'logic of appropriateness' rather than a rational cost-benefit calculus to make decisions. Therefore beliefs, institutional norms and personal and organizational values form cultural and behavioural barriers to or enablers of change.[89] For example the entrenched belief that centralized wastewater management is better than distributed infrastructure delayed implementation of small-scale systems in Brandenburg Germany, despite the environmental and economic benefits of the latter.[90] The entrenched idea that sewage is a waste limits the alternatives that system planners and operators are willing to consider. In Buenos Aires, municipal engineers laughed at the idea that higher-quality sewage treatment would reduce the need for future expenditures to clean up pollution. At the same time, these managers praised an expensive reverse-osmosis drinking water treatment plant as an innovative solution.[91]

Organizational relationship dynamics among politicians, staff, different departments, consultants and publics can also form a cultural barrier to change. Finally, entrenched practices, funding

---

[87] Öberg, "The Notion of Sewage as a Waste," 20.
[88] Sarah Burch, "In pursuit of resilient, low carbon communities: An examination of barriers to action in three Canadian cities," *Energy Policy* 38 (2010).
[89] Burch, "In pursuit."
[90] Panebianco and Pahl-Wostl, "Modelling socio-technical transformations."
[91] Öberg, "The Notion of Sewage as a Waste."

formulas, existing investment and jurisdictional conflicts can entrench the status quo. [92] These structural and operational barriers can manifest in several ways. These are discussed below and in Sections 3.2 and 3.3.

One complementary explanation for the persistence of centralized systems, even where alternative systems may be preferable, is *path dependence*.[93] The concept is theoretically contested[94] and has been defined in multiple ways,[95] but is useful in explaining how historical wastewater decisions constrain contemporary ones. Investment in existing infrastructure provides a strong incentive to perpetuate status quo solutions. New investments face pressure to be compatible with existing infrastructure.[96] Designers and operators also benefit from the wealth of knowledge and incremental improvements to well-established systems.[97]

Some scholars have argued that our basic approach to treating water is a strong case of path dependence.[98] When centralized wastewater was first implemented in the 19th century, the 'germ' theory of disease was not yet dominant. Instead, many believed that disease was caused by putrefaction and odours – "miasmas".[99] Therefore, early drinking water and sanitation systems brought 'clean' drinking water from far-away sources, and diluted and evacuated waste

[92] Burch, "In pursuit."
[93] Melosi, "Path Dependence."
[94] Stan J. Liebowitz and Stephen E. Margolis, "Path Dependence, Lock-In, and History," *Journal of Law, Economics and Organization* 11 no.1 (1995).
[95] Christia List, "A Model of Path-Dependence in Decisions over Multiple Propositions," *The American Political Science Review* 98 no.3.
[96] M. Sapotka et al., "An Overview of Hybrid Water Supply Systems in the Context of Urban Water Management: Challenges and Opportunities," *Water* 7 (2015).
[97] Megan Meacham, "Path Dependency of Infrastructure: implications for the sanitation system of Phnom Penh, Cambodia" (Master's Thesis, Stockholm, Sweden: Stockholms Universitet Stockholm Resilience Centre, 2009).
[98] Melosi, "Path Dependence."
[99] S. Halliday, "Death and miasma in Victorian London: an obstinate belief," *BMJ: British Medical Journal*, *323*(7327) (2001): 1469–1471.

as far from dwellings as possible, in an attempt to minimize odours and decomposition.[100] This approach did mitigate urban disease epidemics,[101] and as germ theory gained dominance, water and wastewater managers were able to modify drinking water and wastewater treatment systems to treat biological pathogens.[102] Because of this, systems for managing sanitary waste still follow the underlying logic developed in the 19th century even though other options exist to sterilize and manage human waste.[103]

2.4 Alternatives

The theoretical literature on wastewater governance offers compelling reasons to look beyond traditional approaches to wastewater management. In practice, several alternative approaches have been implemented in jurisdictions across the globe, from Bangkok, Thailand to Jackson Meadow, Minnesota.[104] These alternatives include innovative technologies, new onsite treatments, reuse and recovery systems, and comprehensive methodologies for managing human water use. [105] Because of the diversity of these solutions, it is the purpose of this section to highlight some of the types of alternative approaches and their potential value, rather than assess any individual solution's feasibility or desirability.

---

[100] Melosi, "Path Dependence."
[101] Halliday, "Death and Miasma."
[102] Melosi, "Path Dependence."
[103] Melosi, "Path Dependence."
[104] Chamawong Suriyachan, Vilas Nitivattananon, and A.T.M. Nurul Amin, "Potential of decentralized wastewater management for urban development: Case of Bangkok," *Habitat International* no.36 (2012).
ECO, *Redefining Conservation.*
[105] Taylor and Goldstein. "Sustainable Water Resources."
Panebianco and Pahl-Wost, " Modelling socio-technical transformations."

One of the best-established alternative approaches to water and wastewater management is the 'Soft Path for Water.'[106] In opposition to conventional 'supply-management' approaches to water and wastewater, which focus on human need, the Soft Path approach centres on ecosystem health. Soft Path takes the capacity of the local watershed as the starting point for managing human water use, and employs a wide range of technologies, programs and management techniques to stay within those natural limits.[107]

Another key attribute of the Soft Path is that it frames water as a service. Rather than calculating the quantum of water or wastewater treatment capacity needed, Soft Path practitioners ask whether water is the best way to service the need. Soft Path questions whether human waste needs to be transported via water, and whether highly treated potable water is necessary for all our water uses, for instance.[108] Other innovative frameworks for alternative wastewater management exist.[109] For example, "Water Sensitive Urban Design" is another umbrella framework that advances water stewardship through better built form.[110]

Guelph, Ontario has employed the Soft Path for water to great success. The city was faced with significant population projections but was limited by the assimilative capacity of the Speed River to assimilate additional wastewater. Guided by the Soft Path, Guelph pivoted its Water Management strategy to focus on water conservation. This had the effect of reducing effluent flow. To address the gap between current wastewater treatment capacity and future quantity and

---

[106] M. Binstock, *Moving toward a soft path approach? A case study of water management in Guelph, Ontario* (Toronto, ON: Canadian Institute for Environmental Law and Policy, 2010).
[107] Brandes and Brooks. http://www.horizons.gc.ca/en/content/backgrounder-%E2%80%93-soft-path-water-social-approach-physical-problem-achieving-sustainable-water?wbdisable=true
[108] Brandes and Brooks, "The Soft Path.
[109] Sapotka et al., "An Overview of Hybrid Water Supply Systems."
[110] R.L. France. *Handbook of Water Sensitive Planning and Design* (Washington, D.C.: CRC Press LLC, 2002, [e-book]).

quality requirements, Guelph invested in its system operators. By increasing operator skill and optimizing their wastewater treatment facilities, rather than expanding or upgrading them, Guelph was able to defer $11 million in wastewater infrastructure costs.[111]

Decentralized

Many households in rural communities in Ontario rely on private septic systems for wastewater management.[112] Unfortunately, old or poorly managed septic systems have negative impacts on ground and surface water quality – measured failure rates in American states range from 18-30%.[113] Therefore the Government of Ontario has attempted to shift wastewater management away from septic systems, especially in environmentally sensitive areas like Lake Simcoe.[114] Septic systems also require large lots and ongoing maintenance, and are not compatible with the high-density development patterns promoted in the Growth Plan.[115] However, decentralized and private systems allow for incremental growth, which may be more appropriate in many areas.[116]

Achieving better onsite and decentralized treatment may be as simple as instituting collective management of private septic systems to ensure adequate maintenance and standards, as has been piloted in Thurston County, Washington, and Loudon County, Virginia.[117] It may involve small-scale or cluster treatment plants with innovative and advanced treatment capacity, as in Brandenburg, Germany.[118] Either of these options may prove to be more socially acceptable,

---

[111] Binstock, "Moving towards a Soft Path."
[112] Schaefer and Hurst, "Municipal Water Use."
[113] Sridhar Vedachalam, Veeravenkata S. Vanka, and Susan J. Riha, "Reevaluating onsite wastewater systems: Expert recommendations and municipal decision-making," *Water Policy*, 17 no.6 (2015).
[114] Ontario, *Lake Simcoe Protection Plan,* 30.
[115] Ontario, *Growth Plan for the Greater Golden Horseshoe* (Approved by the Lieutenant Governor in Council, Order-in-Council No. 1024/2017, Toronto, ON: Queen's Printer, May 2017): Section 2.2.6.
[116] Vedachalam et al., "Reevaluating onsite wastewater systems."
[117] Taylor and Goldstein, *Sustainable Water Resource Management,* 49.
[118] Öberg, "The Notion of Sewage as a Waste."

economically palatable and environmentally benign than either connection to a large-scale treatment system or continued use of traditional private septic systems.[119]

Resource Recovery

Conventional wastewater management systems often reuse the biological sludge generated by the treatment process as an agricultural soil supplement.[120] By and large, however, conventional wastewater management is based on the assumption that wastewater is only waste.[121] Many alternative and innovative wastewater management approaches, by contrast, incorporate some level of resource recovery, which can lessen environmental impact.[122] For example, recovering biogas from digesting waste generates energy and converts stronger greenhouse gasses into the less potent CO_2.[123] Systems that reuse greywater reduce water consumption and may lessen energy costs because less treatment is needed.[124] Resources, like ammonia and fertilizer can be sold to offset treatment costs and can be used within the local economy. [125]

Resource recovery schemes can vary in technological complexity, from a biogas harvester in Vancouver[126] to composting toilets in the outskirts of Mexico City that eliminate the need for water entirely.[127] Because resource-recovery approaches generally require a higher level of

---

[119] S. Gray and N. Booker, "Wastewater services for small communities," *Water Science and Technology* 47 no.7-8 (2003).
[120] XCG Consultants, "Arthur WWTP ESR."
[121] Öberg, "The Notion of Sewage as a Waste."
[122] Taylor and Goldstein, *Sustainable Water Resource Management.*
[123] S. Tilmans, A. Diax-Hernandex, E. Nyman and J. Davis, "The potential for financing small-scale wastewater treatment through resource recovery: experience from Bocas del Toro, Panama," *Journal of Water, Sanitation and Hygiene for Development* 4 no,3 (2014): 457.
[124] Tjadraatmadja et al., "Rethinking urban water systems."
[125] T. A. Nanninga et al., "Discussion on Sustainable Water Technologies for Peri-Urban Areas of Mexico City: Balancing Urbanization and Environmental Conservation," *Water* no.4 (2012)
[126] Öberg, "The Notion of Sewage as a Waste."
[127] Nanninga et al., "Discussion on Sustainable Water Technologies."

involvement from the user, and more experienced system operators, it is important to develop support and 'buy-in' from users and operators.[128]

Landscape-Based Solutions

Landscape-based solutions for wastewater treatment are a form of green infrastructure. Like other forms of green infrastructure, landscape-based wastewater treatment can be multifunctional, integrated, adaptable, resilient, and a producer of social, economic and ecological benefits.[129] Some treatment approaches can realize direct ecological benefits by mimicking natural systems.[130] That is, some landscape-based treatment approaches, like constructed wetlands, can add habitat, ecosystem function and diversity back into the landscape.[131] Biological and landscape-based systems can also have lower energy costs.[132] Advocates for these types of approaches argue that using biological processes, building in redundancy, and scaling-down systems have many benefits, from decreasing capital and operating costs, to re-engaging residents at the community level.[133]

Summary of treatment options

Wastewater governance should be broad, rather than narrow. Water governance theory tells us that wastewater decision-processes which explicitly and comprehensively address lifecycle cost; the triple bottom-line; long-term system adaptability; ecosystem capacity; potential for resource

---

[128] Beveridge Moss and Neuman, "Sociospatial Understanding."
[129] R. Hansen and S. Pauleit, "From Multifunctionality to Multiple Ecosystem Services? A Conceptual Framework for Multifunctionality in Green Infrastructure Planning for Urban Areas," *Ambio* 43 (2014).
[130] D'Amato, V. E. Clerico, E. Dietzmann, E. Striano and M.K. Clark. *Distributed Water Infrastructure for Sustainable Communities: A Guide for Decision Makers.* (WERF Stock No. DEC3R06, Decentralized Water Resources Collaborative, http://www.ndwrcdp.org/): p5.
[131] W. Thomas, "From waste to wetlands (Arcata, California)," *Ecodecision,* no.14 (1994).
[132] D'Amato et al., "Distributed Water Infrastructure."
[133] Lister and Reed, "Evolutions – Parallel Genealogies."

recovery; resilience in the face of climate unpredictability; future development patterns; collaboration between multiple stakeholders; and appropriate scale are more likely to produce wastewater systems that are efficient, equitable and environmentally sound. Consideration of these factors is also likely to support exploration of a wider range of wastewater management options, whereas exclusion of these factors from consideration is likely to reinforce status-quo solutions. The risk with status quo solutions is that they will continue to have impacts that are not consistent with long-term sustainability.

3 Literature Review: Greater Golden Horseshoe Context

3.1 History of Water and Wastewater Servicing in Ontario

Prior to 1956, wastewater treatment systems in Ontario were largely established by municipalities in response to health crises, with some oversight from the Provincial Board of Health.[134] In 1956 the Province reacted to shelter municipalities from a wave of water-related lawsuits by creating the Ontario Water Resources Commission (OWRC).[135] The newly established OWRC had regulatory and approval powers for all municipal water and wastewater works. It amalgamated water systems as it deemed appropriate, offered advice to all municipalities, conducted regular randomized inspections of treatment systems, and had an extensive research wing.[136]

In the early 1970s, increasing environmental concern led the provincial government to amalgamate the OWRC with several divisions of the Department of Health into the Ministry of

[134] Ontario Sewer and Watermain Construction Association (OSWCA), *Drinking Water Management in Ontario: A Brief History* (OSWCA, 2009).
[135] OSWCA, *Drinking Water Management.*
[136] Ontario Water Resources Commission, "Ontario Water Resources Commission Report," (1958).

the Environment.[137] This was quickly followed by a reorganization in 1974 that shifted delivery programs to smaller geographic units. Responsibility for these programs was then shifted to the Ontario Clean Water Agency (OCWA) in 1990. This body was responsible for operations and maintenance, construction and financing of municipal wastewater systems, and administration of provincial grants and loans. It was also the owner and operator of single facilities and systems.[138]

Provincial austerity politics begun under the NDP Bob Rae government and continued under Mike Harris's infamous 'Common Sense Revolution' led to further of downloading of wastewater planning responsibilities to local governments.[139] The Harris administration divested OCWA of its grant-administration and ownership roles. The resulting agency was essentially a contract manager that today operates water systems for 60% of Ontario municipalities, including Wellington North.[140] During this period, Provincial grants for water infrastructure were essentially ended. This period also saw significant cuts to the Ministry of Environment, limiting its ability to support municipalities in planning, governance and regulatory activities.[141] This period in water management ideology ended following the Walkerton tragedy. In response to the tragedy, Provincial and national standards have been made more stringent and comprehensive.[142] Ontario has also invested in water research and technological development.[143]

---

[137] OSWCA, *Drinking Water Management.*
[138] OSWCA, *Drinking Water Management.*
[139] Prudham, "Poisoning the Well: Neoliberalism and the Contamination of Municipal Water in Walkerton, Ontario."
[140] Ontario Sewer and Watermain Construction Association (OSWCA), "Drinking Water Management in Ontario: A Brief History."
[141] S. Prudham, "Poisoning the Well: Neoliberalism and the Contamination of Municipal Water in Walkerton, Ontario," *Geoforum* 35 no.3 (2004).
[142] Michael Fenn and Harry Kitchen, *Bringing Sustainability to Ontario's Water Systems : A Quarter-Century of Progress, with Much Left to Do,* (Report, Ontario Sewer and Watermain Construction Association of Ontario, 2016).
[143] L.M. Herstein, *Adding Value: Recognizing the Link Between Engineers and Municipal Finance and Governance* (Presentation, Toronto, ON: Institute of municipal Finance and Governance, n.d).

The Growth Plan for the Greater Golden Horseshoe, first published in 2006, is the overarching policy document intended to manage growth in the arc of land stretching around Lake Ontario from Northumberland to Niagara. The intent of the Growth Plan is to manage patterns of growth to support efficient human systems – like transportation, servicing infrastructure, employment and social health – while preserving and enhancing the ecological functions of the region – like watershed health, soil health and ecosystem resilience to climate change.[144]

While the Greater Golden Horseshoe (GGH) as a whole houses two thirds of Ontario's population and GDP, the population and urbanization is focused on the 'inner ring' of municipalities, roughly bounded by the Greenbelt.[145] The case studies in this research are located in the less-urbanized 'outer ring.' Following the 'intensification first' principles of the Growth Plan, these municipalities should intensify and support dense growth to preserve existing natural heritage and agricultural land use in the 'outer ring.' Water and wastewater servicing in the outer ring of the GGH often falls to individual municipalities. Regardless of location within the GGH, the Growth Plan instructs municipalities that the bulk of new development should be located in areas with municipal sewage works, which exclude the septic systems and other individual or private services covered by the Building Code Act.[146]

The 2006 Growth Plan and the 2014 Provincial Policy Statement instructed municipalities to support water conservation, including water demand management and water resource reuse.[147] The Growth Plan also recommended energy conservation at municipal facilities, opportunities

[144] Ontario, *Growth Plan for the Greater Golden Horseshoe, 2017,* Section 1.1.
[145] Allen and Campsie, "Implementing the Growth Plan," 6.
[146] Ontario, *Growth Plan for the Greater Golden Horseshoe, 2017,* Section 2.2.1.2.b; definitions.
[147] Ministry of Municipal Affairs and Housing. (2014). Provincial Policy Statement. Section 1.6.6.1.c.; 2.2.1.f. Ontario, *Growth Plan for the Greater Golden Horseshoe*, 2006. Office Consolidation June 2013. Section 4.2.4.

for alternative energy generation, and energy use reduction through land use patterns, all of which are potential grounds to consider a broader set of approaches to wastewater management. The policy directions were clarified and strengthened in the 2017 update to the Growth Plan.[148]

3.2 Regulatory and Approvals Framework

Ontario has a complex regulatory and approvals framework for wastewater planning, largely shaped by Provincial Policy. It is the intent of this discussion to highlight policy directions towards a broader wastewater planning approach. This section also explains the existing framework under which wastewater projects are planned and approved.

The existing regulatory environment for wastewater management is largely shaped by two pieces of legislation. Section 53 of the Ontario Water Resources Act, 1990, requires an Environmental Compliance Approval (ECA) for any discharge of effluent into a water body. The Environmental Assessment Act, 1990, requires that municipalities undertake a Schedule C Class Environmental Assessment (Class EA) to plan and construct a wastewater treatment facility.[149]

The quality of effluent discharged into the receiving water body is controlled in several ways. First, it must meet minimum standards published by the Ontario Ministry of the Environment in 1983.[150] The second mechanism is through issuance of the ECA. To be granted an ECA, the the Ontario Ministry of Environment and Climate Change (MOECC) must be satisfied that the plant as designed will not discharge a quality and quantity of effluent that would lower the receiving

[148] Ontario, *Growth Plan for the Greater Golden Horseshoe, 2017,* Sections 3.2.6.2 a-c.
[149] Canadian Environmental Law Association, "Fact Sheet on Drinking Water Legislation,"(2012), retrieved 5 April 2018 from http://www.cela.ca/sites/cela.ca/files/FactSheet-DrinkingWaterLegislation2012.pdf
[150] ECO, *Redefining Conservation.*

body's water quality below the Provincial Water Quality Objectives, published in 1994.[151] The local Conservation Authority is also involved in this process. For example, in Wellington North, the MOECC and the Grand River Conservation Authority are involved in yearly monitoring to measure and regulate the quantity and quality of the discharged effluent.[152] However, the Environmental Commissioner of Ontario (ECO) investigated one case where the Ministry's initial issuance of the ECA and its review of the initial approval were technically flawed and significantly overrated the system's capacity. The ECO is concerned that this may be a systemic issue, due to limited budget and staff at the Ministry.[153]

Municipalities must also undertake a Schedule C Class Environmental Assessment to construct or significantly expand or upgrade wastewater treatment facilities. The Class EA process has been highly criticized as an 'automatic approval' for projects.[154] However, in most municipalities, the Class EA process is, for better or for worse, the mechanism through which the planning for wastewater management is conducted. It is also the means by which local wastewater planning can be aligned with provincial directives and requirements, municipal plans and water management programs initiated by the conservation authority.

[151] Ministry of Environment and Energy. *Water Management: Policies, Guidelines, Provincial Water Quality Objectives (1994)* Published 28 September 2016 at https://www.ontario.ca/page/water-management-policies-guidelines-provincial-water-quality-objectives
[152] Interview with member of council.
[153] ECO, *Losing Touch/ Losing our Touch,* 116-120
[154] Canadian Environmental Law Association, "Fact Sheet."

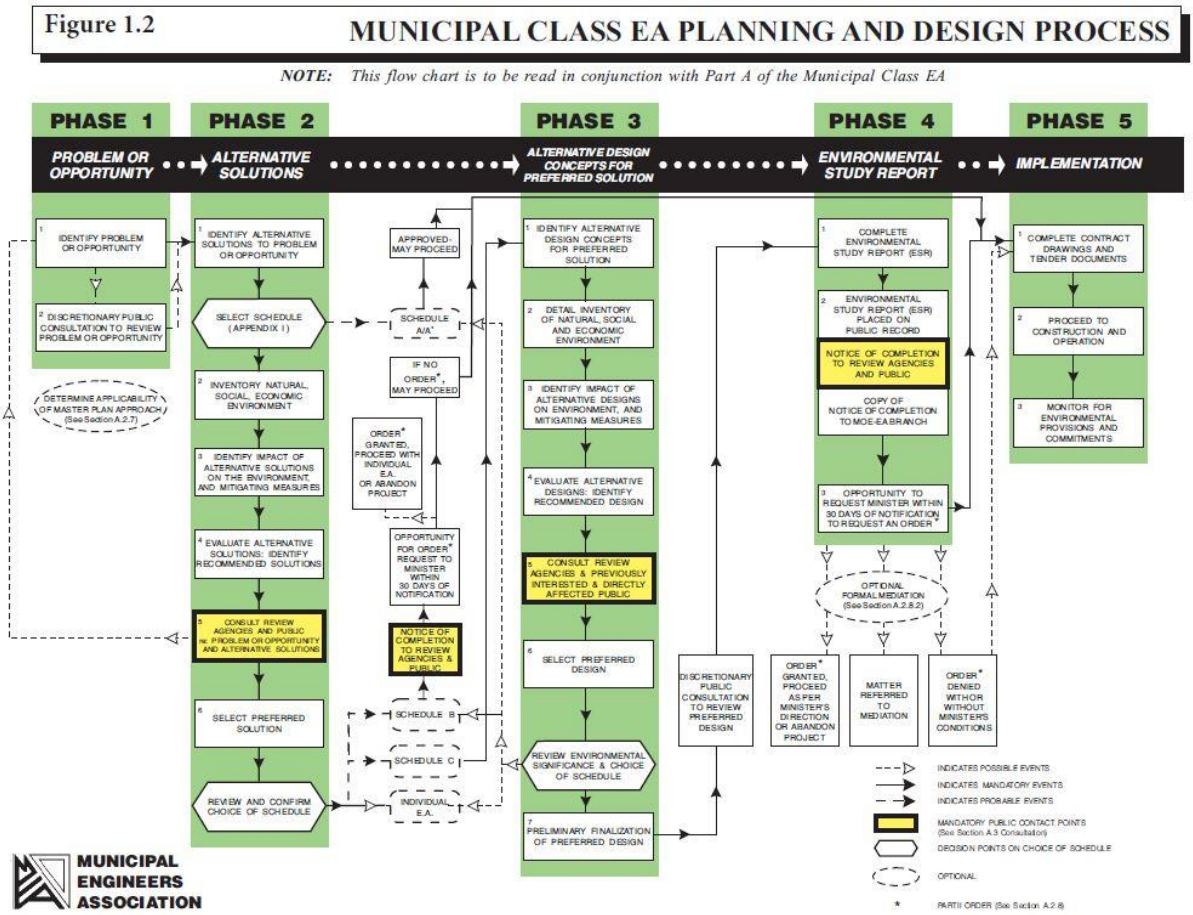

Figure 2: Schematic flow chart outlining the Class Environmental Assessment Process; this chart is reproduced in the Environmental Study Reports for each of the case studies.[155]

This, then, is the standard planning and implementation framework for wastewater planning at a local level in Ontario, upon which more recent steps towards more holistic water management are layered. In the past two decades the Provincial government has taken a number of policy steps towards watershed level planning, source protection, and water technology innovation.

[155] Municipal Engineers Association. "Exhibit A.2 - MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS". Reproduced in XCG Consultants. (2016) Arthur Wastewater Treatment Plant Class Environmental Assessment Environmental Study Report. P4.

The Ontario Low Water Response Plan published in 2010, encouraged Conservation Authorities to establish minimum flow thresholds for aquatic ecosystem health, considering the impact of wastewater effluent in low water conditions.[156] Also in 2010, the Ontario Water Opportunities Act and Water Conservation Act allowed for regulations to require municipalities to create 'municipal water sustainability plans.'[157] The 8th Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health, signed in 2012, committed Ontario to take measures to reduce the quantity and improve the quality of municipal and industrial wastewater.[158] These policy documents and plans contain few concrete obligations to undertake climate change adaptation measures. The majority of this legislation is permissive, rather than mandatory.

The legal framework for holistic water management is somewhat stronger in Innisfil, because it falls under the jurisdiction of the Lake Simcoe Protection Act, 2008.[159] Some measures related to water management have been implemented under the Lake Simcoe Protection Plan. Unlike the other two case studies, Innisfil has a Water Conservation and Efficiency Strategy.[160] The 2012 Master Servicing Plan Environmental Study Report for Innisfil reflects this more involved approach to water management: the evaluation criteria include impacts on a range of natural features, impact on source protection, and consistency with land use designations.[161]

---

[156] ECO, *Losing Touch/ Losing our Touch.*
[157] Canadian Environmental Law Association, "Fact Sheet."
[158] ECO (Environmental Commissioner of Ontario), *Small Things Matter (*Annual Report 2014/2015, Toronto, ON: Environmental Commissioner of Ontario, 2015).
[159] Ontario, "Lake Simcoe Protection Act, 2008," (Consolidation December 15, 2009, S.O. 2008, c.23). https://www.ontario.ca/laws/statute/08l23
[160] Innisfil Water Conservation Strategy, (2014).
[161] Genivar. "Town-Wide water & Wastewater Master Servicing Plan."

Concrete obligations to adapt to climate change are lacking in provincial policy for water governance. The Provincial Policy Statement, the Ontario Water Opportunities Act and Water Conservation Act, the Great Lakes Agreement and the Lake Simcoe Protection Plan discuss climate change. The Great Lakes Strategy instructs municipalities to consider the energy implications of water and wastewater management systems.[162] The Lake Simcoe Protection Plan calls for a Climate Change Adaptation Strategy, which was published in July 2017.[163] This adaptation strategy contains broad directives around water governance, but no specific wastewater management measures.

In sum, a number of high-level policy directions towards more holistic and environmentally sensitive wastewater planning have been introduced over the past decade and a half. These policies indicate an increasing awareness of the importance of sustainable wastewater planning. However, the piecemeal implementation of these policies indicates that they are not well integrated with actual contemporary wastewater planning and approval processes.

3.3 Financing

The means by which wastewater management is financed has massive implications for water use and the types of systems that can be considered. Historically in Ontario, municipalities have funded wastewater from three sources. Municipalities are permitted to use general revenues. Beginning in 1943, user fees were introduced. From the late 1960s, the Province began

[162] Ministry of the Environment and Climate Change, *Ontario Great Lakes Strategy 2016 Progress Report (*Updated April 20, 2017).
[163] Ontario Ministry of the Environment and Climate Chang, *Lake Simcoe Climate Change Adaptation Strategy,* (19 July 2017). Retrieved from https://www.ontario.ca/page/lake-simcoe-climate-change-adaptation-strategy

to provide direct grants, particularly for smaller municipalities.[164] Of these sources, user fees and provincial grants have historically been the most important. The Province was heavily involved in funding wastewater infrastructure from the first OWRC grants in 1969 until the early 1980s.[165] The Ministry of Environment water budget for the 1978/79 fiscal year was $50M ($178.14M in today's dollars), a value nearly double what it was 5 years before.[166] After 1982, Provincial funding for new systems effectively dropped off, partly because the need for major new systems was mostly satisfied, but also because the costs of water infrastructure had drastically increased.[167] Between 1970 and 2004, grants from the Province of Ontario made up 23% of capital investment on wastewater; this decreased to 11% between 2004 and 2016.[168]

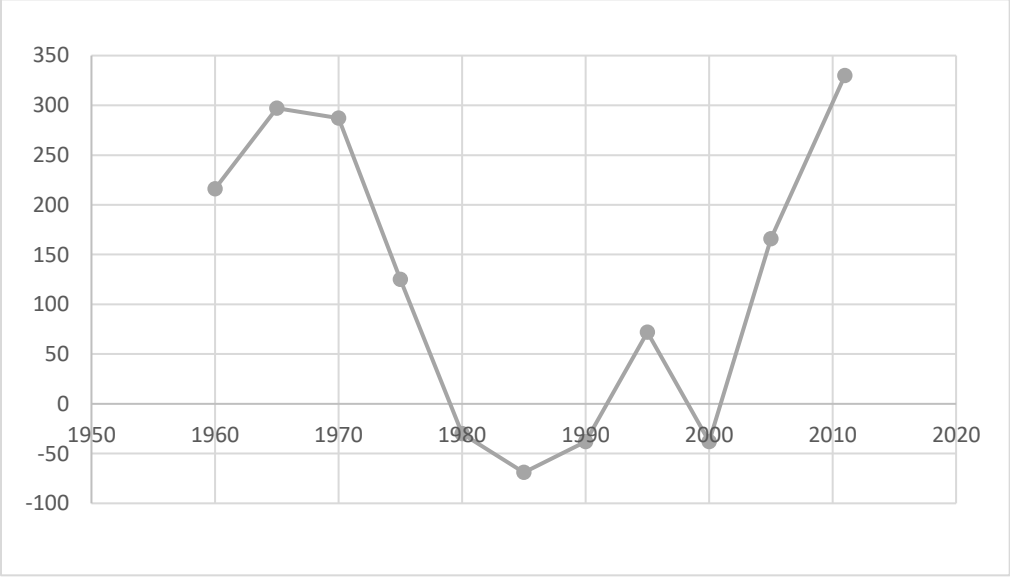

Figure 3: Changes in per-capita net public capital stock, ON. Adapted from Ontario Ministry of Infrastructure (2016) "Building together – Guide for municipal asset management plans", accessed at https://www.ontario.ca/page/building-together-guide-municipal-asset-management-plans.

[164] OSWCA, *Drinking Water Management.*
K. Furlong, *Leaky Governance: Alternative Service Delivery and the Myth of Water Utility Independence*, (Vancouver, BC: UBC Press, 2016).
[165] OSWCA, *Drinking Water Management.*
[166] OSWCA, *Drinking Water Management.*
[167] OSWCA, *Drinking Water Management.*
[168] Furlong, *Leaky Governance*.

Decreasing provincial investment in municipal water systems in the later decades of the 20th century strained a municipality's ability to provide safe, inexpensive water resources and wastewater treatment. Municipalities and local utility managers adapted to this challenge in several ways. Some of these approaches were positive: exploration of Alternative Financing and Procurement models; adoption of Alternative Service Delivery; a focus on water-conservation, and movement towards full-cost accounting. Other strategies, like deferment of repairs, were maladaptive.[169] In either case, the recent increases in available federal and provincial funding for wastewater projects may seem like a boon to struggling utility managers. This is not the case, as discussed below. Reliance on large grants and transfer payments to fund expected water system expansions and repairs has negative impacts on water conservation and local economic sustainability.

This is because water user rates do not reflect the full cost of treating, distributing, collecting and re-treating water.[170] This means that current pricing schemes in Canada subsidize waste: not only does Canada have some of the lowest water charges among OECD countries, its user fees do not even cover the cost to the municipality or local utility of supplying, treating and collecting that water.[171] Often, the difference is made up by grants from senior levels of government. Effectively, this means that the government subsidizes excessive water use. Multiple reports have strongly recommended that Ontario municipalities recover the full lifecycle cost of water and wastewater management through user fees that reflect the marginal

[169] Swain, Lazar, and Pine, "Watertight."
[170] Schaeffer and Hurst, "Municipal Water Use."
[171] Herstein, "Adding Value."

cost of water use.[172] This will promote water conservation and long term fiscal responsibility.[173] As discussed in Section 3.2, Ontario municipalities are obliged by regulation to implement full-cost accounting for drinking water systems, but not for wastewater systems. Given that the cost of wastewater management is increasingly larger than the cost for drinking water, this is a significant missed opportunity.[174]

Managing wastewater through construction of a large, centralized treatment plant and collection infrastructure involves a very high capital cost. Given the major capital costs involved, municipalities should account for the opportunity cost of investing in wastewater infrastructure, as well as repair costs and capital replacement costs over a planning horizon.[175] A review of the economic competitiveness of decentralized systems as compared to centralized systems indicated that decentralized options are cost-competitive over the long run.[176] While construction and operation costs averaged over 60 years may be equivalent between both types of system, the need to finance the massive up-front cost of a centralized plant and infrastructure means that decentralized options may in fact be less expensive over the lifetime of the system.[177]

Even traditional full-cost accounting may not be a sustainable approach. As discussed in Section 2.4, conventional wastewater treatment relies on ecological services, like the ability of the waterbody to assimilate effluent, and generates environmental costs. These costs and benefits are

---

[172] Fenn and Kitchen, "Bringing Sustainability;" Swain, Lazar and Pine, "Watertight."
[173] Tracy Mehan and Ian Kline. "Pricing as a Demandside Management Tool: Implications for Water Policy and Governance" *Journal (American Water Works Association)* 104, no. 2 (2012).
[174] Schaeffer and Hurst, "Municipal Water Use."
[175] Stephen Renzetti and Joseph Kushner, "Full Cost Accounting for Water Supply and Sewage Treatment: Concepts and Application," *Canadian Water Resources Journal* 29, no. 1 (2004).
[176] Vedachalam et al., "Reevaluating onsite wastewater systems."
[177] R.D. Pinkham, J. Magliaro, J. and M. Kinsley. *Case Studies of Economic Analysis and Community Decision Making for Decentralized Wastewater Systems.* (Snowmass, CO, USA: Rocky Mountain Institute, 2004).

not necessarily captured in a full-cost accounting exercise. Some wastewater management systems may also provide ecological or social benefits that would not be captured through traditional accounting; a naturalized wastewater treatment wetland might provide habitat for important species.[178] To properly consider the full costs and benefits of any given wastewater treatment approach, a Triple Bottom Line analysis should be done.[179] A Triple Bottom Line analysis quantifies the economic *and* social and environmental costs and benefits of a project.[180] Because many of the costs of conventional wastewater systems are hidden as economic externalities, and because many alternative wastewater management approaches create indirect social, environmental and economic benefits, using a Triple Bottom Line accounting approach may help to more fairly compare different types of systems.[181]

4 Analysis

The analysis of these three case studies, in the broader context of water and wastewater governance in Ontario, reveals patterns of actions that reinforce conventional approaches as the preferred solution to the servicing dilemma. Taken together, these patterns reinforce each other in such a way that alternative approaches seem, as Forester says, to come "out of left field."[182] Following Forester, this research assumes that the knowledge held by local actors and the power relationships and exchanges of information among local actors are the important shaping factors

[178] W. Thomas, "From waste to wetlands."
[179] Taylor and Goldstein, *Sustainable Water Resource Management.*
[180] T. McPhearson, Z.A. Hamstead and P. Kremer, "Urban Ecosystem Services."
[181] Taylor and Goldstein, *Sustainable Water Resource Management.*
[182] Forester, *The Deliberative Practitioner.* 43.

for planning decisions, above and beyond specific regulatory practices and technical or financial limitations.

All local actors interviewed expressed a sense of responsibility to make good long-term choices. At the same time, all of the wastewater planning processes studied in this research excluded a robust consideration of alternatives. As will be explored below, this was not due to overt or malicious exercises of power. Rather, the technological, political and institutional contexts for wastewater planning make it extraordinarily difficult for actors to identify and fully evaluate non-conventional approaches to wastewater planning.

4.1 Contradictory policy direction from the Province

New high-level policies, as described in section 3.2, instruct municipalities to undertake more holistic water management. These policies are layered over an existing regulatory and policy framework that is highly biased towards conventional, centralized wastewater management. The progressive policies ostensibly broaden the scope of water and wastewater management beyond end-of-pipe planning and should therefore provide grounds for consideration of alternative wastewater management approaches. They have not had this impact.

Policies promoting holistic wastewater management lack regulatory force. For example, regulations passed under the Safe Drinking Water Act (2002) require full cost accounting for drinking water systems, but merely recommends it for wastewater systems.[183] The Sustainable Water and Sewage Systems Act (2002), which would have instituted full-cost accounting for

[183] Watson and Associates, *Water Ontario Regulation 453/07 Financial Plan #136-301* (Millbrook, ON: Township of Cavan Monaghan, 2016).

wastewater systems, was never proclaimed.[184] The Ontario Low Water Response Program, established in 2010, *encourages* rather than requires Conservation Authorities to discover the minimum flow thresholds to maintain aquatic ecosystem health in receiving streams.[185] The program also encourages municipalities to undertake water conservation programs. Follow-up by the Environmental Commissioner of Ontario in 2017 found that 73% of municipalities no water conservation programs.[186] One participant in the Lakeshore Water Pollution Control Plant Class EA in Innisfil noted that even basic mitigative alternatives, like public education around water conservation, were not in place at the time of the proposed expansion of the plant.

The Class EA process, incorporating the Environmental Compliance Approvals,[187] is the implementation pathway for wastewater policy in Ontario. Through this process, consultants and municipalities work with stakeholders, provincial Ministries, and the local conservation Authority to ensure compliance with environmental standards, largely relating to water quality.[188] It also provides the opportunity to consider consistency with other documents in the municipal and provincial planning ecosystems – the Provincial Policy Statement, applicable Provincial Plans, the Official Plan, any growth management strategy, the source water protection plan, infrastructure plans, any sustainability planning documents and other infrastructure strategies. In practice, EAs tend to address a narrow set of concerns.

---

[184] Canadian Environmental Law Association, "Fact Sheet on Drinking Water Legislation,"(
[185] ECO*, Losing Touch/ Losing our Touch.*
[186] ECO, *Every Drop Counts*.
[187] Ministry of the Environment and Climate Change (2018). Guide to applying for an environmental compliance approval. Province of Ontario. https://www.ontario.ca/document/guide-applying-environmental-compliance-approval-0
[188] Ontario Ministry of Environment and Energy. *Water Management*

Even within these narrow confines, however, there is some scope to consider cumulative impact, through the Environmental Compliance Approval process. The consultant conducting the EA works with the MOECC and the local conservation authority, using water body monitoring data, to determine the impact that the proposed discharge will have on that waterbody. Based on those calculations, the consultant will determine how much effluent can be discharged into the waterbody and what quality standards it must meet. In the words of one consultant referring to a controversial project, "we had a limiting number [for effluent discharge capacity], and that was the stream talking to us."

The Millbrook Class EA in Cavan Monaghan, and the Arthur Class EA in Wellington North largely failed to conform to the 2014 Provincial Policy Statement's instruction for municipalities to conduct "integrated and long-term planning" on a watershed basis.[189] The decision matrix to select the 'preferred alternative' for Millbrook WWTP is revealing. Environmental impacts overall are weighted at 30% in the matrix. Within that, the ability to meet environmental regulations (i.e. provincial water quality objectives) is weighted at 14%, while "Long term impacts on terrestrial and aquatic environment – what would be considered under a watershed planning approach – is only weighted at 6%. This consideration is weighted equivalently to consideration of impact on heritage and archeological features. Moreover, each alternatives' environmental impacts are described in terms of effluent quality and quantity. The broader impacts of development on the watershed, including increased impervious area, increased water-taking and habitat conversion, are not considered. The broader impacts of development *are*

[189] Ministry of Municipal Affairs and Housing, *Provincial Policy Statement 2014,* Section 2.2.1.a

considered in relation to socio-economic factors, like the value of increased development to local business operations.[190]

The narrow construction of environmental concerns was reflected in the attitudes shared by most municipal council respondents, although not by local wastewater advocates. While most members of council discussed the environmental impacts of the wastewater management system, and expressed the importance of minimizing negative environmental impact, these concerns were largely framed in terms of the direct impact of wastewater effluent on the receiving water body. That is, while Provincial legislation, regulations and policy documents address watershed health, water conservation, and cumulative impacts, following contemporary scientific and governance trends, these attitudes have not necessarily filtered down to local actors. Rather, local actors, despite their genuine concerns that environmental health and water quality be protected, generally expressed trust in the wastewater consultant, the Ministry of Environment, and the conservation authority to address environmental impact adequately through the Class EA process.

Nevertheless, there is evidence that strong local environmental advocacy can influence local decision-makers to consider environmental impacts more broadly. In Cavan Monaghan, for example, one councillor said of the 'It's About Water' campaign, "[T]hey did a fantastic job. They worked hard. They came up with a lot of information." One of the things that the campaign highlighted was a hydrogeological report regarding the piping of water from the Millbrook wells to Fraserville. This report indicated that the water pressure in the artesian wells would drop from six feet above ground level to several feet below but did not flag this as a sufficient concern to

[190] R.V. Anderson, *Millbrook WWTP Class EA ESR*.

halt the project. For the councillor in question, the uncertainty about groundwater quality and quantity was a major reason to challenge the piping of water to Fraserville. The work done by 'It's About Water' highlighted the broader ecological and hydrogeological effects of the project and helped influence the ultimate decision.

By contrast, despite the significant attention to the environmental health of Lake Simcoe, environmental advocates criticized the narrow focus of the wastewater planning process. One staff member for Environmental Defence expressed frustration at the Class EA process for the Lakeshore Wastewater Pollution Control Plant, intended to service the Big Bay Point development project. Environmental Defence was concerned that "the developers would make it a sprawl development – development where there was no existing water and sewer servicing. […] contrary to the Growth Plan." Environmental Defence and others also were concerned about the impact of land conversion for this project – the Lake Simcoe Protection Plan (2009) targets that 40 percent of the watershed should be maintained with high quality natural vegetative cover.[191] While both these concerns relate to wastewater management and its environmental impacts, they weren't included in the Environmental Assessment process, because the scope was narrowly defined. In the words of the Environmental Defence staff member, "The problem with EAs, as far as I can see, is that they are almost always piecemealed, even though there is an explicit direction that they not be piecemealed."

Despite justification in senior policy documents, local wastewater planning processes often fail to consider the serious long-term and spatially diffuse environmental effects of wastewater servicing, including land conversion due to higher development rates, excess water use, and

[191] Ontario, *Lake Simcoe Protection Plan*.

cumulative loading. In a particularly glaring omission, climate change was never mentioned in the Class EA Environmental Study Reports for the Millbrook and Arthur WWTPs. The 2012 Water and Wastewater Master Servicing Plan for Innisfil made one reference to climate change – noting that climate change adaptation was a goal of the Lake Simcoe Protection Plan. Environmental experts are clear: climate change will seriously impair the health of watersheds, and so climate change has important implications for wastewater management. The Senior government policy, including the Growth Plan, directs municipalities to plan for climate change. However, these facts were not well reflected in the EA documents, or in the attitudes of municipal respondents. Environmental protection advocates have concluded that the directions towards environmental protection embedded in legislation and policy "won't do much without the involvement of a concerned, environmentally responsible public."[192] Consistent with watershed governance theory and theory about institutional change in the context of climate change, regulations and policy are only one component of governance.[193]

Broadly speaking, recent provincial policies regarding watershed planning and wastewater planning tend to be permissive rather than mandatory, and do not have a clear home in the existing wastewater planning and approval process. Because of this, they do not have sufficient weight to overcome the strong cultural and organizational bias towards business-as-usual wastewater planning.

---

[192] Steve Barber, *Greenlands Preservation in the Lake Simcoe Watershed: A Citizen's Guide to Public Policy for the Protection and Enhancement of Lake Simcoe's Natural Heritage,* Eds Mark Winfield and Claire Malcolmson (Simcoe County, ON: Rescue Lake Simcoe Coalition, 2014).

[193] Bertels and Vredenburg, "Broadening the Notion of Governance"
Burch, "In pursuit."

4.2 Pro-growth Attitudes

The logic of growth lends weight to centralized wastewater management approaches. It is not the purpose of this research to question the growth paradigm or to investigate whether population growth delivers a net benefit to the studied communities. Rather, pro-growth attitudes, shared by almost all of the respondents, created a framing for wastewater discussion that implicitly excluded alternative approaches to wastewater governance. In some cases, these attitudes lent an unwarranted weight to wastewater servicing proposals that vastly increased development capacity but were environmentally and economically unwise.

The issue of growth and development was touched on in every interview. Each of the members of council save one explicitly framed growth as inevitable. In Arthur, one councillor relayed messaging from the Province: “They’re warning us the first two counties to get hit are going to be Dufferin and Wellington.” For the Mayor of Innisfil, planned residential and industrial growth presented an imperative, “We had to increase [our wastewater treatment capacity] and make the plant more up to [date].” The decision-maker respondents also generally shared a belief that increased development would be economically and socially beneficial for their communities. Multiple councillor respondents were concerned that future residents, and the value that they might bring to the community, would not move in unless the lack of additional servicing capacity was addressed. According to one councillor, “the limit on development was limiting the ability of new people to come to Arthur.” According to another, “Wartime baby-boomers […] want to come back home to that local butcher, local barber, but now they have a million and a half [to spend on housing here].”

In each case study, respondents framed wastewater servicing as a limiter or enabler of growth. While the scale of development varied in each of the three case studies – from 20-30 homes over five years in Wellington North, to 300 homes in a new subdivision in Cavan Monaghan, to thousands of homes at the Friday Harbour development in Innisfil – in each case, local decision-makers cited the need for additional wastewater capacity to service development as the primary motivation for changes to the wastewater management system. Alternative wastewater management practices, like the Soft Path approach identified in Section 2.4 of this paper, are still very capable of supporting significant population growth.[194] However, where actors are certain of population growth and weight it as the primary goal, the potential benefits of alternative approaches – "pay as you go" expansion, lower cumulative environmental impact, economic benefits from resource recovery – may hold less weight.

There is also evidence that the contradictory goals of growth and sustainability in the Growth Plan may exacerbate water management challenges in the Greater Golden Horseshoe.[195] The Environmental Commissioner of Ontario, as well as the Regional research organization Neptis, have called attention to the fact that the population allocations in the Growth Plan preceded any coordinated study of existing system servicing capacities or watershed planning to illuminate ecosystem capacity.[196] That is, the Growth Plan, and particularly the population allocations in Schedule 3, counter its earlier directions to plan on a watershed basis.

---

[194] Binstock, *Moving toward a soft path approach*.
[195] Binstock, *Moving toward a soft path approach*. 18.
[196] ECO*, Losing Touch/ Losing our Touch*.
Neptis. (unpublished). *Capacity and Constraints on Water and Wastewater Systems in the Greater Golden Horseshoe.*

The population allocations were the most commonly cited feature of the Growth Plans by municipal respondents. The statement of one Cavan Monaghan member of council is fairly representative: "Municipalities have a responsibility to allocate growth; the question is the right location." The second most commonly referenced aspect of the Growth Plan was the importance of accommodating growth on municipally serviced land. The aspects of the Growth Plan that promote population growth held more weight for local decision makers than aspects of the growth plan that promote newer, more holistic approaches to infrastructure planning.

The attempt to municipally service lands around Innisfil Heights is one particularly strong example of how the appeal of growth can narrow the planning process in unhelpful ways. Innisfil Heights is a partially-developed commercial and industrial area three kilometres from the urban boundary of Barrie and about five kilometres from Innisfil. As one former councillor said, "the number one issue is we were looking to expand our Highway 400 industrial area." Developing a servicing strategy for this area, and thus increasing employment, commercial activity, and the local tax base, was one of the central goals of the 2012 Water and Wastewater Master Plan.[197] The designation of Innisfil Heights seems to contradict the policy directions in the Growth Plan to foster "complete communities," to support transit-supportive greenfield development, and most importantly, to direct growth to existing settlement areas with municipal services.[198] Nevertheless, Innisfil Heights was incorporated into the Simcoe Sub-Area Amendment to the Growth Plan (2012) which designated it as a "Strategic Settlement Employment Area."[199]

---

[197] Genivar, *Town-Wide water & wastewater Master Servicing Plan*.
[198] Ministry of Municipal Affairs and Housing, *Provincial Policy Statement*.
Ontario Ministry of Infrastructure, *Growth Plan for the Greater Golden Horseshoe, 2006,* Section 2.2.2.
[199] Ministry of Municipal Affairs and Housing, *Growth Plan for the Greater Golden Horseshoe, 2006,* Amendment 1 (2012). Accessible at https://www.placestogrow.ca/index.php?option=com_content&task=view&id=387&Itemid=14

Since the publication of the 2012 Growth Plan Amendment 1 and the 2012 Innisfil Servicing Master Plan, Innisfil council has made a number of efforts to follow the Master Plan and service the area. In May 2016, the Town of Innisfil borrowed $57.5-million from the County of Simcoe to service Innisfil heights, expecting to recoup much of that in "upfront costs" from landowners. However, the landowners – mostly large corporate groups including Cortel, Great Canadian Gaming and Smart REIT – had no agreement prior to the loan about how to cover those costs and were unable to arrive at one after the loan was confirmed.[200] Ultimately, that money was not invested in servicing, and the land remains unserviced.

While there had been some conversation in the community about onsite servicing or decentralized wastewater management for this land, given the struggles of financing and cost recovery for traditional sewage servicing,[201] this option was rejected by interviewed members of council. "That's not land efficient, it's not economically efficient, and it's not what the town envisioned for our community," said one councillor, while pointing out the development financing challenges that might arise if landowners had to allocate a portion of their property to wastewater treatment. While critics could argue that the designation of this area as a place for growth at all is problematic, it remains a strong example of where pro-growth attitudes are in fact hindering exploration of alternative options that might allow growth.

The genesis of the Millbrook-Fraserville water servicing extension is a powerful example of the way the unquestioned logic of growth can distort deliberations. After plans had been made for municipal water servicing using wells in Fraserville, contamination was found in them.

---

[200] Rick Vanderlinde, "Landowners ponder how to help Innisfil pay back $57.7-million loan from Simcoe County," *Innisfil Journal*, 30 Aug 2016.
[201] Mike Richard, "Energy, Waste and Water." Blog, 18 May 2016. Posted on OurInnisfil.wordpress.com/tag/innisfil-heights/

According to a Cavan Monaghan water activist, the idea to pipe municipal water 10 kilometres from Millbrook to Fraserville was instigated by an offhand comment by a councillor. This project, despite its profound financial and ecological risks, was only halted after a massive community campaign. The level of effort required by the community to halt a project with profound ecological risks demonstrates the bias towards growth and conventional wastewater solutions.

4.3 The EA and consideration of Alternatives

The structuring of the decision process, particularly through the Class EA, means that at the moments when alternative management approaches might be considered, decisions or actions that support centralized wastewater management are already in motion. One of the major components of the Class Environmental Process is the assessment of a set of alternatives to select the 'preferred alternative' for further investigation and implementation. In the idealized EA process, the consultants work with the municipality in phase 1 to generate a problem or opportunity statement. In phase two, alternative solutions are generated, evaluated, and reviewed by the public before the preferred solution is identified. In theory, then, the Class EA process promotes consideration and evaluation of alternatives; in practice the 'preferred alternative' solutions vary little from typical centralized wastewater planning. There are *process* reasons why this is the case, which are illustrated in the two case studies that involved a full Class EA.

The first problematic component of this process is the assumptions that are made before the initiation of the Class EA. In Cavan Monaghan, decision to upgrade the Millbrook wastewater treatment plant preceded the initiation of the Environmental Assessment. A recently elected council voted to cancel the Fraserville servicing expansion and was under pressure to come up with an alternative course of action very quickly. Senior government funding had been

committed to the Fraserville project, and there was a strong and reasonable desire to "not abandon" that funding. Councillors were also concerned with looming water quality issues at the Millbrook plant, and so there was a sentiment that "it made more sense to expand the existing system." This strong political direction effectively constrained the Class EA process.

The initiation of the Arthur Wastewater Treatment Plant expansion and upgrade had a similarly constrained genesis, despite the lack of both community conflict and senior government funding. As one councillor stated, the project was initiated by council because "A new plant was needed if there was going to be any sort of growth in the Village of Arthur." The relative influence of developers in shaping municipal council's course of action should also be considered – councillors in both Arthur and in Innisfil mentioned formal and informal delegations by developers as a significant motivator for council to investigate new wastewater management capacity. The orientation towards supporting development also constrained the alternatives considered in the EA process from its inception.

A second challenge relates to the comfort level and experience of the consultants conducting the Environmental Assessment. A tension in the EA process, reaching back several decades, is between the engineering and planning aspects of the process. As one consultant says, "I had to convince the engineers that the Class EA process wasn't meant to be only an engineering exercise – it is a *planning* and engineering exercise. […] but over the years that's gotten a lot better." The greater focus on planning today means that "it is easier [… to] start with broad-based alternatives" before narrowing the focus.

Despite this increased focus on planning alternatives, consultants are extremely reluctant to expose their clients and themselves to the perceived increased risk associated with innovative and alternative wastewater management approaches:

> It's risky and our engineers are risk averse – I mean they're not going to jump in and say "let's investigate that, let's be the first in Ontario" – because if it fails, you're getting sued, and you really had no technical ability to make that, to build this design.

Over the years, this consultant had multiple clients, community members and stakeholders recommend various types of alternative, innovative and decentralized wastewater treatment. After investigating these systems the consultant felt that they were not operationally viable and would not result in the hoped-for cost savings. A second consultant echoed this statement, more bluntly: "typically decentralized doesn't work;" existing approaches are "pretty well laid out".

A third set of process constraints relate to the relative timing of various parts of the decision process. The Arthur Wastewater Treatment Plant Expansion Class EA is particularly illustrative. The Arthur Class EA identified eight alternative solutions, one of which was "Reduce Wastewater Flows", and another "Optimize Plant Capacity." These were both rejected as potential stand-alone solutions, although they were nominally included in the final preferred alternative.

The potential solution of reducing wastewater flows to the plant to create capacity for additional development was rejected because "the flow reduction cannot be quantified,"[202] and therefore additional capacity for increased development could not be determined. Closer examination of

[202] XCG Consultants, *Arthur WWTP Class EA ESR,* 21.

the methodology used by the consultants to determine the necessary future treatment capacity revealed some problematic assumptions.

Recognizing that there was a significant amount of inflow and infiltration into the sanitary sewer system from non-point sources, the consultants assessed the average per-capita daily flow on dry days. By comparing this to the total per capita average daily flow, they arrived at a per-capita daily effluent amount of 369 L/cap-d, and an inflow rate of 97L/cap-d. The calculated inflow is above Ministry of Environment guidelines from the 1980s. This is partially due to the partially combined sewer system in Arthur.[203]

This methodology may have underestimated infiltration. A graphic from the Grand River Conservation Area shared in a presentation on the 24th of March, 2016, prior to the publication of the Environmental Study Report, appeared to show a strong correlation between the flow in the Conestoga River and increased flow in the sanitary sewer system. Indeed, this correlation partially explains jumps in system usage that are not explained by precipitation.

However, the most troubling aspect of the capacity calculations is the fact that *existing* per-capita wastewater generation rates are used to estimate the per-capita needs of future residents.[204] This is concerning for multiple reasons. First, residents of Ontario have an astonishingly high rate of water usage as compared to other developed countries.[205] The Province of Ontario has directed municipalities to encourage reduced water usage in a number of ways, some of which are

---

[203] XCG Consultants, *Arthur WWTP Class EA ESR,* Appendix B.
Interview with municipal councillor described the combined sewers along traditional main street in Arthur.
[204] XCG Consultants, *Arthur WWTP Class EA ESR,* Appendix B.
[205] Environment Canada, *2011 Municipal Water Pricing Report: Municipal Water Pricing 2009 Statistic* (Government of Canada, 2012).

described in the literature review above. The capacity requirements used in this report assume that new residents will have equally wasteful water usage, despite the opportunity to encourage conservation measures in new-build homes, like low-flow toilets. By 'baking in' high water usage rates into the decision-process, this EA assumes that basic demand management practices will not be instituted. Further, unnecessarily high water treatment capacity calculations eliminate a range of alternative wastewater management practices.

The second alternative wastewater management approach – plant optimization – was rejected as a stand-alone solution, although it was incorporated into phase 1 of the selected alternative. In late 2014, the Grand River Watershed-Wide Wastewater Optimization Program conducted a Comprehensive Performance Evaluation at the Arthur plant, revealing a potential to re-rate the facility, but noting significant data gaps. At this point, the preferred alternative had already been decided and revealed as of the first Public Information Centre, on the 13th of March 2013. The Optimization Program's timing happened too late to meaningfully influence the evaluation of the alternatives, although it has had influence on subsequent refinement of the preferred alternative and phasing. This disconnect is reflected in the perspectives of the Wellington North members of council interviewed. While both praised the Grand River Conservation Authority's role in assuring high quality effluent and minimal impact on the river, neither specifically mentioned the GRCA's optimization program as a factor in the decision process.

Overall, the community advocates interviewed for this research expressed considerable distrust of the EA process. One interviewee from Cavan Monaghan confided that MOECC staff had told her, privately, that the Fraserville proposal was deeply flawed, but that because all of the appropriate procedures had been followed, it had to be approved. Activists in both Cavan Monaghan and in Innisfil supported their input to the EAs with testimony by appropriate

professionals. However, this seemed to have little influence on the EA process. In the words of one activist, “As a member of the public, the response to the questions that you raise was always ‘that’s outside the scope.’ It was really frustrating; I feel like we spent a lot of time and energy on this and got nothing.”

The ostensible consideration of broad-based alternatives in the EA process is severely restricted by several factors. First is the initial framing by council, whose members likely already have some sense of the preferred solution. The second is the experience and preferences of the professional consultants hired. Finally, because of a lack of coordination between different initiatives, jurisdictions and organizations, vagaries of timing can eliminate consideration of potential options.

4.4 Lack of knowledge about alternatives

Most actors in municipal wastewater management are not aware of a full range of wastewater management approaches. Where that knowledge is held, it is often peripheral or superficial compared to the level of knowledge about conventional approaches. This was established through the interviews with municipal actors. Of the seven interviews with municipal decision-makers, the majority did not speak to specific alternatives considered. One spoke about technical alternatives considered in the EA process. One spoke about the possibility of onsite treatment only to reject it as a feasible option. In Cavan Monaghan, one council member spoke about the broad alternative decision to upgrade the Millbrook plant rather than construct a new plant in Fraserville.

Only one of the councillors interviewed for this research thoroughly discussed alternative wastewater treatment options. This Cavan Monaghan councillor undertook a semi-independent

search for alternate options. In his words, "I talked to a lot of people – I chose those who had a background, were independent and didn't have a vested interest." The alternative options that he investigated – including energy generation through wastewater and experimental treatment options investigated by researchers at the Centre for Alternative Wastewater Treatment in Lindsay Ontario – were not examined in the EA.

This may be partially due to the attitude of consultants towards wastewater management options without a history of implementation in Ontario. One of the original motivations for the Environmental Assessment process was to investigate innovative alternatives. However, this goal is not fully reflected in the contemporary process. According to one consultant respondent, "In sewage treatment, innovative means new and untried." In many projects in small municipalities, stakeholders and councillors may suggest innovative treatment options, like running wastewater through a greenhouse, or treating sewage by turning it into artificial snow. However, the attitude of this consultant was that these solutions are generally not feasible, and it is easy for people without technical understanding to "get sucked in."

Soft path management theory offers one explanation why basic consideration of alternative options is so limited. For soft path practitioners, the narrow focus on capacity in wastewater planning is limiting.[206] Soft path water management determines peoples' various water-use needs and potential management solutions, which generally cannot be averaged down to a single volume of wastewater.[207] By contrast, the traditional approach to wastewater management considers capacity at a treatment plant, which includes wastewater from inflow/infiltration,

[206] Pacific Institute, "Issues we work on: Soft Path for Water". Accessed 17 March 2018. http://pacinst.org/issues/sustainable-water-management-local-to-global/soft-path-for-water/
[207] Binstock, *Moving toward a soft path approach*.

sanitary waste, greywater and commercial/industrial wastewater at one plant. Viewing wastewater in volume per-capita terms may discourage investigation of alternatives, especially where users and planners conceptualize sewage as a dirty and dangerous waste product only.[208]

4.5 Power Plays

The experiences of environmental activists are shaped by the fear of unjust and malicious displays of power. Two of the studied municipalities – Innisfil and Cavan Monaghan – did indeed see strong exercises of power. While these power plays shaped the decision process and outcome, they are not sufficient to explain the outcomes of those processes.

Innisfil

Water and wastewater planning in Innisfil is a highly charged subject, due to major community conflicts dating back almost fifteen years. The full history of wastewater planning conflict in Innisfil is far beyond the scope of this paper, but there are several incidents where individuals or organizations attempted to use power to accelerate wastewater plans in the face of opposition.

Geranium Corporation, the company behind the Big Bay Point development, launched nine lawsuits against project opponents totalling $150-million in claims, all of which were settled outside of court.[209] Environmental Defence Canada, which was involved in the "Rescue Lake Simcoe" coalition that opposed the development, labelled these "Strategic Lawsuits Against Public Participation. Also in 2009, the Mayor of Innisfil, Brian Jackson, was charged with

[208] Öberg, "The Notion of Sewage as a Waste."
[209] Chris Simon, "Geranium Settles Big Bay Point Lawsuits," *Innisfil Scope*, 30 July 2012. Reproduced by Environmental Defence. Available at: https://environmentaldefence.ca/2012/07/31/geranium-settles-big-bay-point-lawsuits/

assault of Councillor Bill Pring over a motion on the composition of a wastewater negotiating committee.[210]

In this context, in 2010, Councillor Bill Pring, said, in relation to a letter written by a staff member of Environmental Defence, "I find this letter libelous, […] I suggest the town begin taking legal action against the authors."[211] The letter critiqued the EA process for the plant intended to service Friday Harbour. It argued that cumulative phosphorous loading, water conservation, and concerns about septic systems were not being addressed by the town, especially because the sub-watershed plan for Innisfil was not yet complete. The letter pointed to Guelph's success using the Soft Path as a best practice comparator.[212] Another Environmental Defence Staff member, who was interviewed for this research, told the interviewer that Environmental Defence played a critical role in a context where public participation had been significantly chilled. Because Environmental Defence was a larger organization, with paid staff and a staff lawyer, the respondent said, they were able to speak up when individuals might have been too intimidated to step forward.

In this context, members of the Rescue Lake Simcoe coalition were perceived to be using objections to the EA process to delay and frustrate development by the developer of Friday Harbour and several members of the council. The concerns directly raised by Environmental

---

[210] Madeleine White, "Innisfil mayor charged with assault after council meeting," *The Star (Toronto),* 4 July 2009. Available at https://www.thestar.com/news/ontario/2009/07/04/innisfil_mayor_charged_with_assault_ after_council_ meeting.html

[211] Pring, Bill. Quoted in article by Chris Simon, "Lobbyist accused of writing libelous letter to town," *Innisfil Scope,* 07 September 2010. Reproduced by Environmental Defence. Available at: https://environmentaldefence.ca/2010/09/07/lobbyist-accused-of-writing-libelous-letter-to-town/

[212] Binstock, *Moving toward a soft path approach*.

Defence and its allies can be perceived in this light. They can also be perceived as challenges to the municipality to take a broader approach to wastewater management in the area.

The 2012 Innisfil Water and Wastewater Master Servicing Plan was developed in this highly charged atmosphere. The document itself displays little of this political turmoil. Instead, it appears to be a rational planning document describing the optimal servicing of the multiple communities that make up the town of Innisfil. This view of the document, as a rational-comprehensive planning document, was reinforced by the members of council interviewed for this research.

> Respondent 1: "What you do is consult experts […] and realize that to build out a town and have an industrial area and take into account the four corners of town, you have to have a certain size pipe, and know where to run it and the best place where to run it so you use the least amount of pipe […] and get the most coverage. That's really what you're looking for in the wastewater study, what it's all based on."
>
> Respondent 2: "In the true sense of what a master plan is, it is something that takes a look, with no prejudice involved, and asks 'how would we do this if we were starting to grow today?'"
>
> Respondent 3: "You've got to plan for 50 years, not 10 years"

The framing of the Master Planning process was divorced from the political realities of Innisfil, including and especially the strong calls from residents' associations and environmental advocacy groups to consider alternative wastewater management paradigms. While the Master Plan addresses a Lake Simcoe-specific regulation, especially concern about phosphorous loading, the Master Planning outcome did not reflect the concerns expressed by Environmental Defence and other local community organizations. Nor did it address the real threats of climate change. Perhaps as a result of the disconnect between the goals and product of the Master Planning process, there have been implementation challenges with various aspects of the plan.

Cavan Monaghan

In Cavan Monaghan, grassroots organizing powerfully shaped the water and wastewater planning process, successfully preventing a proposal for water servicing that was likely to cause significant negative environmental impacts. However, community activists had to exert a huge effort to defeat a wastewater servicing plan with evident environmental and social problems. Some of this can be attributed to pro-growth attitudes and the structure of the Environmental Assessment process, as explored above. However, respondents also called attention to the impacts of vested interests on the decision process.

One water advocate interviewed made reference to a previous "Green Hills" advocacy group. According to this respondent, members of that group were threatened with lawsuits and obliged to disband. In her words, "The people involved will still not talk about what happened and were frankly terrified at first to join in the new campaign started in 2009." While this research was not able to independently verify the facts, the threat of lawsuits, as it did in Innisfil, chilled participation by some members of the public. The respondent to this research noted that the experience of members of this previous group shaped how the "It's About Water Campaign" organized itself.

4.6 Funding and finances

The common financing model for wastewater infrastructure is one of the most significant mechanisms that reinforces conventional approaches. This happens in several ways. There is a perception that the full cost of wastewater management cannot be imposed on existing users, despite the strong economic and environmental arguments for doing so. There is the desire on the part of municipal decision-makers to distribute some of that cost to new users, via development

charges, and to senior levels of government, through funding. As a corollary, there is the perception that upgrades to existing wastewater infrastructure are only feasible if significant capacity upgrades justify senior government funding and the collection of development charges from new development.

Municipal councillor respondents communicated the political obstacles to raising wastewater costs. One council member in Wellington North noted that the political viability of funding a hospital was much greater than funding wastewater services, because of the invisibility of wastewater services in the day-to-day. In Innisfil, one council member shared her tactic of comparing septic replacement costs to the long-term economic benefits of connecting to municipal services to convince constituents to buy in.

Full cost accounting has not been implemented in any of the municipalities studied for this research. Full cost recovery can be an alternative wastewater management tool in itself, as it encourages water efficiency on the part of users.[213] Where full cost recovery through user fees has not been implemented, other funding sources can create distortions in the market.

In the case studies, municipalities primarily sought funding from two other sources: development charges and senior government funding. Finding the financing capacity within the existing reserves of the municipality was a challenge expressed by several councillors. In Wellington North, for example, one councillor stated: "For a city of 11,000 people, a sewer system that costs $15M takes a lot of planning." Increasing the tax base is important, but "you need user fees or grants."

[213] Mehan and Kline, "Pricing as a Demandside Management Tool."

Under conventional wastewater management and funding models, and given the lack of full-cost accounting, the financial burden on existing users to upgrade existing systems without expanding capacity is perceived to be too high. In Innisfil, one councillor stated, "If Gilford is ever going to have municipal sewer service, development has to happen in that area to help pay for the major cost to get it to the homeowners, without them having to sell their house to pay for it." While some alternative wastewater systems are more pay-as-you-go, and may allow incremental upgrading at moderate costs, these approaches were not considered by councillors.

In traditional wastewater management systems, capacity can only be increased in fairly large discrete quantities.[214] In order to ensure enough capacity for a growing population, treatment systems are designed for over-capacity.[215] As shared by a consultant respondent, this incentivizes municipalities to maximize their projected capacity needs in order to justify a larger government grant. Municipalities can also recoup much of the cost of servicing expansions through development charges and other development-related fees; this perspective underlay most municipal councillors' responses. Therefore, municipalities are financially incentivized to maximize planned system capacity. Maximizing capacity beyond short-term need favours centralized, conventional infrastructure, as opposed to alternative, 'soft' or decentralized approaches, which tend to increase capacity more incrementally.

The effect of both federal funding and development charges on consideration of wastewater alternatives is particularly stark in Cavan Monaghan. The original failed Fraserville servicing extension received a $30 million Infrastructure Stimulus Grant through the Build Canada Fund,

[214] Kitchen, Harry, *Municipal Revenue and Expenditure Issues in Canada* (Issue 107, Canadian Tax Foundation, 2002).
[215] Tjandraatmadja et al., "Rethinking Urban Water Systems."

split between three levels of government – the largest grant awarded in Ontario. After the Fraserville project was rejected, council was eager to re-leverage this funding for another project.

Council had identified necessary upgrades to the Millbrook plant, and engaged Watson and Associates to provide pricing for two options. According to the deputy mayor at the time, under the first option, only the necessary upgrades to the Millbrook plant were conducted. Because no additional capacity was generated, this project would not qualify for the Build Canada fund and no costs could be recouped in the form of development charges. As such, the total cost would have been approximately $6 million, and this would have been shared between existing users. Under the option that was ultimately selected, which upgraded the Millbrook plant and extended its capacity by about 300 households, senior governments would provide $14 million in funding, with the remaining $7 million shouldered by the municipality. However, most of that amount would be recoupable through development fees, leaving only $2 million to be paid by existing users.

This plan ultimately made financial sense for the municipality and delivered high quality wastewater treatment to residents at the lowest per-capita costs. However, the impact that the Build Canada Fund had on the consideration of wastewater management alternatives was less than salutary. The Cavan Monaghan councillor who had actively sought out alternative wastewater treatment approaches and technologies ended up fully supporting the Millbrook expansion and upgrade. In his words, “it made sense.” While he made the best decision for its constituents, the effect of government funding on this project was to curtail consideration of potentially lower-impact approaches to wastewater management. In the words of one local water advocate, “If the government had not provided the massive Build Canada grant, the village of Millbrook would likely have chosen to expand in a more sustainable way.”

5 Conclusion

This research investigated wastewater decision-making processes in three communities. These processes were narrower than they should have been according to high-level Ontario policy, environmental advocates and wastewater governance theory best-practices. The Class Environmental Assessment processes used as the main planning mechanism in each of the case studies incorporated many assumptions about the environment and wastewater.

In each municipality studied, plans to allow development and growth preceded and shaped wastewater planning. In Innisfil, the desire to accommodate a large development apparently drove the Lakeshore WWTP Class EA. In Cavan Monaghan, environmentally risky water and wastewater plans were approved by a Council determined to proceed with the Fraserville development and were only halted by a concerted grassroots campaign. The Environmental Commissioner of Ontario has warned that planning for development before understanding local infrastructure and ecosystem capacity can lead to growth that overburdens local infrastructure and ecosystems and causes real environmental and economic harm. Existing local processes which municipalities use to plan for wastewater infrastructure failed to consider these broader questions.

Additionally, local councillors were keenly aware of the need to permit residential and commercial development to ensure the long-term economic and social viability of their communities. The obligation to meet the population allocations handed down by the Growth Plan also figured heavily in some council members' decision-making. However, the Class EA processes examined in this research did not meaningfully investigate wastewater management

options that would allow incremental increases in wastewater treatment capacity to match growth as it happens.

While almost all research participants expressed the strong desire to protect the environment, this desire was largely focused on the water quality of the waterbody proposed to receive the effluent. The reviewed Class EA documents and participant responses did not address the very real risk that climate-change induced drought and extreme weather events will impact the ability of water bodies to assimilate effluent.

Concern about inflow and infiltration from combined sewer systems was addressed by respondents, most strongly in Wellington North, which has an above-average rate of inflow. However, although the preferred alternative in the Class EA for the Arthur WWTP in Wellington North nominally included water conservation and inflow and infiltration reduction, the potential savings of these approaches were not quantified. The calculations to determine the additional capacity needed to accommodate population growth assumed that neither existing or new homes would achieve any level of water conservation. Similarly, in Innisfil, the Environmental Defence staff member working in Innisfil expressed frustration that the decision-process to expand the Lakeshore WWTP was completed before the municipality had implemented even basic water conservation measures. The wastewater decision-making processes failed to meaningfully consider how water conservation and flow reduction measures could form a major component of a wastewater management strategy.

Existing financing methods reinforce large-scale centralized treatment, and large-scale centralized treatment approaches reinforce existing attitudes towards financing. Council members in each case study embraced the ‘user pays’ principle of wastewater treatment.

However, because conventional wastewater treatment infrastructure – whether an upgrade, and expansion or a new build – requires major capital investment, several respondents felt that the only way to fund new wastewater infrastructure was to build the capacity to service major new development, allowing municipalities to access senior government funding and recoup some of the capital cost through development charges.

The way in which the Building Canada funding influenced Council's decision to expand the Millbrook WWTP in Cavan Monaghan is a particularly clear example. While this decision made sense at the local level, it represented a missed opportunity for Provincial and Federal governments to support the implementation of a wider range of wastewater treatment options in municipalities.

The dynamics that narrow wastewater decision making were relatively consistent across the three case studies that were examined. The clusters of barriers investigated were mutually reinforcing and persistent. However, this does not mean that change is impossible. Important lessons can be drawn from those working on climate change adaptation.

Sarah Burch, investigating climate change adaptation activities in British Columbian municipalities noted that there were multiple, entrenched barriers to adaptive action. However, because these barriers were tightly interconnected, a well-planned strategic intervention had the possibility to echo throughout the planning system.[216] For example, City of Toronto staff have had success developing climate change adaptation measures with internal and external stakeholders by demonstrating the interdependencies among infrastructure systems, and the risks

[216] Burch, "In pursuit."

of cascading failures.[217] Understanding how local actors interact with the social, technical and ecological components of wastewater systems is critical to understanding how these systems might transform in response to different scenarios.[218] Therefore, the final section of this paper highlights some of the possible leverage points to broaden wastewater planning processes in small municipalities.

5.1 Positive directions

One of the starkest outcomes of this research was simply that most municipal councillors were not aware of viable wastewater management alternatives. While one of the explicit goals of the Environmental Assessment process is to investigate alternatives, the Class EA processes investigated in this research proffered a narrow set of alternatives. Finally, the existing funding ecosystem for wastewater projects still relies heavily on grants or loans from senior levels of government. The mutually reinforcing relationship between this type of funding and large-capacity centralized project excludes alternative, more incremental wastewater approaches. These are significant barriers to full consideration of wastewater alternatives, but they are also potential leverage points.

The first key leverage point is simply awareness about better solutions. Over the past decade, Ontario has seen significant growth in the water innovation sector, thanks partially to investment by the Province of Ontario – for example in WaterTAP (technology acceleration program).[219] This research revealed some of the preliminary ways that investment might be succeeding. For

[217] AECOM and C40 Cities, "C40 Infrastructure Interdependencies."
[218] Panebianco and Pahl-Wostl, "Modelling socio-technical transformations."
[219] WaterTAP (2017). Ontario's Water Innovation Ecosystem v11. Brochure. Retrieved from http://watertapontario.com/wp-content/uploads/2016/12/WTClusterMap_Final2017_Print.pdf http://watertapontario.com/

example, Ontario funded the Grand River Conservation Authority to develop a watershed management plan through the "Showcasing Water Innovation" grants,[220] and the Grand River Conservation Authority's watershed-wide wastewater optimization project had limited influence on the Arthur WWTP Class EA in Wellington North. Similarly, when the former councillor from Cavan Monaghan sought alternative treatment approaches, he was able to find a wealth of experts in Ontario. Educating local actors about the innovative wastewater treatment approaches developed in Ontario is a critical first step towards robust inclusion of these alternatives in wastewater planning processes. Multiple municipal councillors described educating, negotiating with and persuading residents of the economic and environmental benefits of connecting to centralized treatment systems; this skill and goodwill could be harnessed to promote a wider range of waste management options.

The EA process, though flawed, is a powerful vehicle for examination of alternatives. While activist respondents expressed frustration with the 'piecemeal' nature of the process, consultant respondents shared a different view. In one consultant's words, "The EA process allows you to take a look at all [of the technical, environmental, social and fiscal factors]." Indeed, another consultant noted that whereas 20 years ago, engineers led Environmental Assessments that were narrow technical exercises, today his firm and others framed the Class EA process as a engineering *and* planning process. Similarly, multiple municipal councillors credited the EA process for making the wastewater planning process more comprehensive. This transformation in Environmental Assessments over the past 20 years suggests that the process could continue to be broadened to more fully address high-level policy directions regarding climate change,

[220] Ontario. (9 February 2016). Showcasing Water Innovation: wastewater projects. Retrieved from https://www.ontario.ca/page/showcasing-water-innovation-wastewater-projects

cumulative impact, and watershed capacity, and to better include members of the public, particularly environmentalists and local activists.

The final major constraining factor on wastewater planning identified in this research was senior government funding. As addressed in Section 4.6, the ability to levy development charges and access large grants incents decision-makers to approve projects that significantly increase the number of system users. This is reinforced by the belief, shared by many respondents, that large centralized projects are the only way to upgrade or expand wastewater treatment. The high cost of centralised treatment was cited multiple times in interviews as a significant burden. However, alternative wastewater management models that allow for capacity increases in smaller increments might make the cost of upgrades easier to bear. Given that multiple respondents affirmed the 'user pays' principle, interest in these alternatives may be high.

Ultimately, all participants in this research stated their desire to make the right decisions that would benefit their community and the communities they were working in. It is true that some of the actors interviewed were in conflict with each other. Most participants expressed frustration with some aspect of wastewater planning, particularly the two community activist/environmental advocate participants who were not satisfied with the formal process or the outcomes. However, the commitment of all actors to make good decisions about wastewater is the foundation on which a better planning process can be built. In the words of the former mayor of Innisfil, the goal of wastewater planning is "[f]or our grandchildren and their children to say, 'they did what was environmentally the safest at the time, and they left it in a position where we can upgrade it.'

6 Bibliography

AECOM and C40 Cities. "C40 Infrastructure Interdependencies + Climate Risks Report." C40 Cities, Spring 2017. Retrieved April 2018 from https://unfccc.int/files/cooperation_and_support/financial_mechanism/standing_committee/application/pdf/report_c40_interdependencies_.pdf

Allen, Rian and Philippa Campsie. "Implementing the Growth Plan for the Greater Golden Horseshoe." Report. Toronto, ON: The Neptis Foundation (October 2013). Retrieved from http://www.neptis.org/sites/default/files/growth_plan_2013/theneptisgrowthplanreport_final.pdf

Barber, Steve, Greenlands Preservation in the Lake Simcoe Watershed: A Citizen's Guide to Public Policy for the Protection and Enhancement of Lake Simcoe's Natural Heritage, edited by Mark Winfield and Claire Malcolmson. Simcoe County, ON: Rescue Lake Simcoe Coalition, 2014.

Bertels, S. and H. Vredenburg. "Broadening the Notion of Governance from the Organization to the Domain: A Study of Municipal Water Systems in Canada." The Journal of Corporate Citizenship. 15 (2004):33-47.

Beveridge, R., T. Moss and M. Naumann. "Sociospatial Understanding of Water Politics: Tracing the Multidimensionality of Water Reuse." Water Alternatives 10 no 1 (2017):22-40.

Binstock, M. Moving toward a soft path approach? A case study of water management in Guelph, Ontario. Toronto, ON: Canadian Institute for Environmental Law and Policy, 2010. [e-book]. http://books1.scholarsportal.info.ezproxy.lib.ryerson.ca/viewdoc.html?id=/ebooks/ebooks0/gibson_cppc/2010-08-06/6/10385353#tabview=tab1

Brandes, Oliver M. and David B. Brooks. "The Soft Path for Water: A Social Approach to the Physical Problem of Achieving Sustainable Water Management." Backgrounder. Horizons.gc.ca. http://www.horizons.gc.ca/en/content/backgrounder-%E2%80%93-soft-path-water-social-approach-physical-problem-achieving-sustainable-water

Burch, Sarah. "In pursuit of resilient, low carbon communities: An examination of barriers to action in three Canadian cities." Energy Policy. 38 (2010):7575-7585. doi:10.1016/j.enpol.2009.06.070

Burian, S. J., Nix, S. J., Pitt, R. E., and Durrans, S. R. "Urban Wastewater Management in the United States: Past, Present and Future." Journal of Urban Technology, 7 no.3 (2000): 33-62.

Canadian Environmental Law Association. "Fact Sheet on Drinking Water Legislation."(2012). Retrieved 5 April 2018 from http://www.cela.ca/sites/cela.ca/files/FactSheet-DrinkingWaterLegislation2012.pdf

Cavan-Millbrook-North Monaghan [Township of]. “Fraserville Secondary Plan.” Millbrook, ON: The Township of Cavan-Millbrook-North Monaghan, 2005. Retrieved from http://cavanmonaghan.net/en/resources/FraservilleSecondaryPlanApprovedApril2005.pdf

Cavan Monaghan [Township of]. “Minutes for the Regular Meeting of Council,” Tuesday August 3, 2010. Retrieved from http://www.cavanmonaghan.net/uploads/105/Doc_634842503391814981.pdf

Cavan Monaghan [Township of]. “Water and Wastewater Services.” Accessed at 22 February 2018 http://www.cavanmonaghan.net/en/servingyou/waterandwastewaterservices.asp?hdnContent=

D’Amato, V. E. Clerico, E. Dietzmann, E. Striano and M.K. Clark. Distributed Water Infrastructure for Sustainable Communities: A Guide for Decision Makers. WERF Stock No. DEC3R06. Decentralized Water Resources Collaborative. http://www.ndwrcdp.org/

Das, Deepak Kumar. "Environmental Impact of Inter-Basin Water Transfer Projects: Some Evidence from Canada." Economic and Political Weekly 41, no. 17 (2006): 1703-707. http://www.jstor.org/stable/4418149.

Environment Canada. 2011 Municipal Water Pricing Report: Municipal Water Pricing 2009 Statistics. Government of Canada, 2011.

ECO (Environmental Commissioner of Ontario). Redefining Conservation. Annual Report 2009/2010. Toronto, ON: Environmental Commissioner of Ontario, 2010.

ECO (Environmental Commissioner of Ontario). Losing Touch/ Losing our Touch. Annual Report 2011/2012. Toronto, ON: Environmental Commissioner of Ontario, 2012.

ECO (Environmental Commissioner of Ontario). Small Things Matter. Annual Report 2014/2015. Toronto, ON: Environmental Commissioner of Ontario, 2015.

ECO (Environmental Commissioner of Ontario). Every Drop Counts: Reducing the Energy and Climate Footprint of Ontario’s Water Use. ECO 2016/2017 Annual Report. Toronto, ON: Environmental Commissioner of Ontario, 2017.

Environmental Protection Agency (the American). “Response to Congress on Use of Decentralized Wastewater Treatment Systems.” Decentralized Wastewater Treatment Project. Washington, D.C.: US EPA Office of Water, 1997. Retrieved from https://www.epa.gov/sites/production/files/2015-06/documents/septic_rtc_all.pdf

Falco, G. J. and W.R. Webb. “Water Microgrids: The Future of Water Infrastructure Resilience.” International Conference on Sustainable Design, Engineering and Construction (50-57). Chicago, IL: Procedia, 2015.

Fenn, Michael and Harry Kitchen. Bringing Sustainability to Ontario’s Water Systems : A Quarter-Century of Progress, with Much Left to Do. Report. Ontario Sewer and Watermain Construction Association of Ontario, 2016.

Flyvbjerg, Bent. Rationality and Power. Chicago: University of Chicago Press, 1998.

Flybjerg, Bent. “Five Misunderstandings about Case Study Research.” Qualitative Inquiry, 12 no.2 (2006):219-245.

Forester, John. The Deliberative Practitioner. Cambridge, MA: The MIT Press, (1999).

France, R. L. Handbook of Water Sensitive Planning and Design. Washington, D.C.: CRC Press LLC, 2002. [e-book] Retrieved from https://books.google.ca/books?id=4_29hLqCTpEC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false.

Furlong, K. Leaky Governance: Alternative Service Delivery and the Myth of Water Utility Independence. Vancouver, BC: UBC Press, 2016. https://books.google.ca/books?hl=en&lr=&id=517lCgAAQBAJ&oi=fnd&pg=PP1&dq=%22Leaky+Governance%22&ots=RRAdC3HLNt&sig=sooXjFr3CuJzZ3OdFOlHHKDM2Ro.

Genivar. “Town-Wide water & Wastewater Master Servicing Plan.” Innisfil, ON: Town of Innisfil, 2012. Retrieved January 2018 from https://innisfil.ca/getFileByName/Town_Wide-MSS_2012_FINAL.pdf

Gray S., and N. Booker. “Wastewater services for small communities.” Water Science and Technology. 47 no.7-8. (2003):65-71. http://www.ncbi.nlm.nih.gov/pubmed/12793663

GSP Group Inc. | Curtis Planning Inc. “Wellington North Community Growth Plan.” Final Report. Wellington North: Township of Wellington North, 2018.

Halliday, S. “Death and miasma in Victorian London: an obstinate belief.” BMJ: British Medical Journal, 323 no.(7327) (2001): 1469–1471.

Hansen, R. and S. Pauleit. “From Multifunctionality to Multiple Ecosystem Services? A Conceptual Framework for Multifunctionality in Green Infrastructure Planning for Urban Areas.” Ambio 43 (2014):516-529. DOI 10.1007/s13280-014-0510-2

Herstein, L M. Adding Value: Recognizing the Link Between Engineers and Municipal Finance and Governance. Presentation. Toronto, ON: Institute of municipal Finance and Governance, n.d.

Holling, C.S. ‘Resilience and Stability of Ecological Systems.’ Annual Review of Ecology and Systematics, Vol. 4, (1973):1-23. Stable URL: http://pure.iiasa.ac.at/id/eprint/26/1/RP-73-003.pdf

Innisfil [Corporation of the Town of]. Water Conservation Strategy. (2014). Accessible at; https://innisfil.ca/getFileByName/1%20Water%20Conservation%20Strategy%20-%20Combined%20Document.pdf

Jones, K, S. Bartell, D. Nugent et al. “The Urban Microgrid: Smart Legal and Regulatory Policies to Support Electric Grid Resiliency and Climate Mitigation.” Fordham Urban Law Journal, 41 no.5: (2015): 1696-1757.

Kenward, A., D. Yawitz and U. Raja. Sewage Overflows from Hurricane Sandy. Report. Princeton, NJ: Climate Central, 2013.

Kitchen, Harry. Municipal Revenue and Expenditure Issues in Canada. Issue 107. Canadian Tax Foundation, 2002.

Lavoral, S., M.J. Collof, S. Mcintyre, M.D. Doherty, H.T. Murphy, D.J. Metcalfe, M. Dunlop, R.J. Williams, R.M. Wise and K.J. Williams. "Ecological mechanisms underpinning climate adaptation services." Global Change Biology. 21, no.1 (18 Aug 2014). https://doi-org.ezproxy.lib.ryerson.ca/10.1111/gcb.12689

Liebowitz, Stan J. and Stephen E. Margolis. "Path Dependence, Lock-In, and History." Journal of Law, Economics and Organization. 11 no.1 (1995):205-226. http://www.jstor.org/stable/765077?origin=JSTOR-pdf

List, Christia. "A Model of Path-Dependence in Decisions over Multiple Propositions." The American Political Science Review. 98 no.3 (2004):495-513.

Lister, Nina Marie, and Chris Reed. "Evolutions - Parallel Genealogies." In Projective Ecologies edited by Nina Marie Lister and Chris Reed. Cambridge, MA: Harvard Graduate School of Design, 2014.

Matthews, J. "Disaster Resilience of Critical Water Infrastructure Systems." Structural Engineering, 142 no.8 (2016): C6015001.

McFarlane, K., L. Harris and K. Bakker. Features of Institutions and Governance Processes that Enable Efficient, Effective, and Equitable Water Management. Vancouver, BC: UBC program on Water Governance, 2015. Retrieved from https://watergovernance.ca/wp-content/uploads/2015/08/McFarlane-Harris-and-Bakker-2014-Features-of-governance-institutions-and-processes_formatted.pdf.

McPhearson, T., Z.A. Hamstead and P. Kremer. "Urban Ecosystem Services for Resilience Planning and Management in New York City." Ambio 43 (2014):502-515. DOI 10.1007/s13280-014-0509-8

Meacham, Megan. Path Dependency of Infrastructure: implications for the sanitation system of Phnom Penh, Cambodia. Master's Thesis. Stockholm, Sweden: Stockholms Universitet Stockholm Resilience Centre, 2009.

Mehan, Tracy, and Ian Kline. "Pricing as a Demandside Management Tool: Implications for Water Policy and Governance." Journal (American Water Works Association) 104, no. 2 (2012): 61–66. http://www.jstor.org/stable/jamewatworass.104.2.61.

Melosi, Martin V. "Path Dependence and Urban History: Is a Marriage Possible?" In Resources of the City: Contributions to an Environmental History of Modern Europe edited by Bill Luckin, Geneviève Massard-Guilbaud and Dieter Schott. Routledge: Google Books, 2017.

Nanninga, Tiemen A., Iemke Bisschops, Eduardo López, José Luis Martínez-Ruiz, Daniel Murillo, Laura Essl and Markus Starkl. "Discussion on Sustainable Water Technologies for Peri-Urban Areas of Mexico City: Balancing Urbanization and Environmental Conservation." Water no.4 (2012): 739-754.

Norman, Emma S., Karen Bakker and Christina Cook. "Introduction to the Themed Section: Water Governance and the Politics of Scale." Water Alternatives, 5 no.1 (2012):52-61.

Öberg, Gunilla, Maria G. Merlinzky, Alicia Lavalle, Margaret Morales and Melina M. Tobias. "The Notion of Sewage as a Waste." Ecology and Society 19 no 2 (2014). doi: 10.5751/ES-06531-190219.

Ontario. Growth Plan for the Greater Golden Horseshoe. Approved by the Lieutenant Governor in Council, Order-in-Council No. 1024/2017. Toronto, ON: Queen's Printer, May 2017. Retrieved from http://placestogrow.ca/images/pdfs/ggh2017/en/growth%20plan%20%282017%29.pdf.

Ontario. "Lake Simcoe Protection Act, 2008." Consolidation December 15, 2009. S.O. 2008, c.23. https://www.ontario.ca/laws/statute/08l23

Ontario. Lake Simcoe Protection Plan. Approved by the Lieutenant Governor in Council, Order-in-Council No. 977/2009. Toronto, ON: Queen's Printer, July 2009. Retrieved from https://www.ontario.ca/page/lake-simcoe-protection-plan.

Ontario Ministry of Environment and Energy. Water Management: Policies, Guidelines, Provincial Water Quality Objectives (1994). Ministry of Environment and Energy. Published 28 September 2016 at https://www.ontario.ca/page/water-management-policies-guidelines-provincial-water-quality-objectives

Ontario Ministry of the Environment and Climate Change. Ontario Great Lakes Strategy 2016 Progress Report. (Updated April 20, 2017). Retrieved March 2018 from Ontario Great Lakes Strategy 2016 Progress Report.

Ontario Ministry of the Environment and Climate Change. Lake Simcoe Climate Change Adaptation Strategy. (19 July 2017). Retrieved from https://www.ontario.ca/page/lake-simcoe-climate-change-adaptation-strategy

Ontario Sewer and Watermain Construction Association (OSWCA). Drinking Water Management in Ontario: A Brief History. OSWCA, 2009. Retrieved from http://www.archives.gov.on.ca/en/e_records/walkerton/part2info/publicsubmissions/pdf/drinkingwaterhistorynew.pdf

Ontario Water Resources Commission. "Ontario Water Resources Commission Report." (1958). Accessed through archive.org.

Panebianco,S. and C. Pahl-Wost. "Modelling socio-technical transformations in wastewater treatment—A methodological proposal." Technovation 26 (2006): 1090-110. doi: 10.1016/j.technovation.2005.09.017

Pinkham, R. D., Magliaro, J. & Kinsley, M. Case Studies of Economic Analysis and Community Decision Making for Decentralized Wastewater Systems. Snowmass, CO, USA: Rocky Mountain Institute, 2004.

Prudham, Scott. "Poisoning the Well: Neoliberalism and the Contamination of Municipal Water in Walkerton, Ontario." Geoforum 35, no. 3 (2004): 343–59. https://doi.org/10.1016/j.geoforum.2003.08.010

Racoviceanu, A.I., B.W. Karney, C.A. Kennedy and A.F. Colombo. "Life-Cycle Energy Use and Greenhouse Gas Emissions Inventory for Water Treatment Systems." Journal of

Infrastructure Systems 13 no.4 (2007):261-270. DOI: 10.1061/(ASCE)1076-0342(2007)13:4(261)

Ramsay, Janis. “Innisfil Heights pipe dream dies.” Innisfil Journal, June 8, 2017. https://www.simcoe.com/news-story/7361016-innisfil-heights-pipe-dream-dies/

Renzetti, Steven, and Joseph Kushner. “Full Cost Accounting for Water Supply and Sewage Treatment: Concepts and Application.” Canadian Water Resources Journal 29, no. 1 (2004): 13–23.

Rusk, James. “Wave of protest swelling over Lake Simcoe resort.” The Globe and Mail, August 7, 2007. Updated March 27, 2017. Retrieved 21 Feb 2018 from https://www.theglobeandmail.com/news/national/wave-of-protest-swelling-over-lake-simcoe-resort/article4092686/

R.V. Anderson Associates Limited. “Millbrook Wastewater Treatment Expansion Class Environmental Assessment Environmental Study Report.” Millbrook, ON: The Township of Cavan Monaghan, 2013.

Sandford R, and K. Freek. Flood Forecast : Climate Risk And Resiliency In Canada [e-book]. Victoria, British Columbia: Rocky Mountain Books; 2014. Available from: eBook Collection (EBSCOhost), Ipswich, MA. Accessed April 11, 2018.

Sapotka, M., M. Aurora, H. Malano, M. Moglia, A. Sharma, B. George and F. Pamminger. “An Overview of Hybrid Water Supply Systems in the Context of Urban Water Management: Challenges and Opportunities.” Water. 7 (2015): 153-174.

Schaefer, K.A., and J.M. Hurst. “Municipal Water Use and Pricing in Ontario, 1983–1994.” Canadian Water Resources Journal 22, no. 4 (1997): 417–31. https://doi.org/10.4296/cwrj2204417.

Sorensen, Johanna, Andreas Persson, Catharina Sternudd, Henrik Aspegren, Jerry Nilsson, Jonas Nordström, Karin Jönsson, Misagh Mottaghi, Per Becker, Petter Pilesjö, Rolf Larsson, Ronny Berndtsson and Shifteh Mobini. “Re-Thinking Urban Flood Management—Time for a Regime Shift.” Water 8 no.332 (2016). doi:10.3390/w8080332

Suriyachan, Chamawong, Vilas Nitivattananon, and A.T.M. Nurul Amin. “Potential of decentralized wastewater management for urban development: Case of Bangkok.” Habitat International. no.36 (2012): 85-92.

Swain, H, F. Lazar and J. Pine. Watertight: The case for change in Ontario’s water and wastewater sector. Toronto, ON: Ministry of Public Infrastructure Renewal - Water Strategy Expert Panel, 2005.

Taylor, T. and R. Goldstein. Sustainable Water Resources Management, Volume 3: Case Studies on New Water Paradigm. Report. Palo Alto, CA: Electric Power Research Institute, 2010.

Tilmans, S., A. Diax-Hernandex, E. Nyman and J. Davis. “The potential for financing small-scale wastewater treatment through resource recovery: experience from Bocas del Toro, Panama.” Journal of Water, Sanitation and Hygiene for Development. 4 no,3 (2014):449-459. DOI: 10.2166/washdev.2014.138

Tjandraatmadja, G., S. Burn, M. McLaughlin et al. “Rethinking urban water systems - Revisiting concepts in urban wastewater collection and treatment to ensure infrastructure sustainability.” Water Science and Technology: Water Supply 5 no.2 (2005): 145-154.

Thomas, William. “From waste to wetlands (Arcata, California).” Ecodecision. no.14 (1994): 82-84.

Thompson, J. “Growing with the Flow: Planning for Smart Growth in Ontario Through Water & Wastewater Infrastructure”. Major Research Project. Ryerson University, 2012.

Tully, K., and M. Mattson. “Application for Review: Toronto Sewage Bypass Alerts.” Ministry of Environment Application for Review. Toronto, ON, Canada: Lake Ontario WaterKeeper, July 7, 2014.

Vanderlinde, Rick. “Anti-SLAPP law reminder of fight to build Innisfil's Friday Harbour.” Innisfil Journal, November 12, 2015. Retrieved from https://www.simcoe.com/news-story/6115795-anti-slapp-law-reminder-of-fight-to-build-innisfil-s-friday-harbour/

Vanderlinde, Rick. “Landowners ponder how to help Innisfil pay back $57.7-million loan from Simcoe County.” Innisfil Journal, 30 Aug 2016. Retrieved from Simcoe.com

Vedachalam, Sridhar, Veeravenkata S. Vanka, and Susan J. Riha. “Reevaluating onsite wastewater systems: Expert recommendations and municipal decision-making.” Water Policy. 17 no.6 (2015):1062-1078. DOI: 10.2166/wp.2015.159

Watson and Associates. Water Ontario Regulation 453/07 Financial Plan #136-301. Millbrook, ON: Township of Cavan Monaghan, 2016. Retrieved from http://www.cavanmonaghan.net/en/resourcesGeneral/Financial_Plan_136-301_Township_of_Cavan_Monaghan.pdf

White, Madeleine. “Innisfil mayor charged with assault after council meeting.” The Star (Toronto), 4 July 2009. Available at https://www.thestar.com/news/ontario/2009/07/04/innisfil_mayor_charged_with_assault_after_council_meeting.html

Worte, Charley. “Integrated watershed management and Ontario’s conservation authorities.” International Journal of Water Resources Development. 33 no.3 (2017):360-374. doi: 10.1080/07900627.2016.1217403

XCG Consultants. “Arthur Wastewater Treatment Plant Class Environmental Assessment Environmental Study Report.” Wellington North, Township of Wellington North, 2016. Retrieved from https://wellington-north.com/content/government/departments/public-works/water-sewer/arthur-wastewater-treatment-plant-environmental-study-report/xcg-report-1-sept-1.pdf

York (the Regional Municipality of). The Regional Municipality of York, Water and Wastewater Master Plan. York, ON, 2016. Retrieved from https://www.york.ca/wps/wcm/connect/yorkpublic/9602fc09-22ec-4202-8ce6-f2287a7b1aee/York+Region+Water+and+Wastewater+Master+Plan+2016pdf.pdf?MOD=AJPERES