Infrastructure Masterplan

Appendix Section 1: Technical Memoranda

Loyalist Township 2024

Infrastructure
Master Plan

How to navigate this document

This document has been created as a binder in Adobe Acrobat. For easy navigation, please expand the Bookmarks toolbar in Adobe Acrobat or Reader.

Additionally, the Technical Memoranda titles in the Table of Memos are clickable links which will jump to the first page of each memorandum.

If you require any of these memos in an alternate format, please contact Loyalist Township at 613-386-7351, ext. 100#, during office hours, or email info@loyalist.ca.

Glossary of Acronyms

Acronym	Meaning
AADT	Annual average daily traffic
AMP	Asset management plan
ATAD	Autothermal thermophilic aerobic digestion
AWPCP	Amherstview Water Pollution Control Plant
BWTP	Bath Water Treatment Plant
C&D	Collection (sewage) and distribution (water)
CLI-ECA	Consolidated Linear Infrastructure Environmental Compliance Approval
CSC	Correctional Services of Canada
DC	Development Charges
DWQMS	Drinking Water Quality Management Standard
DWS	Drinking water system
EA	Environmental assessment
ECA	Environmental compliance approval
FM	Forcemain (sanitary)
FWTP	Fairfield Water Treatment Plant
GHG	Greenhouse gas(es)
I&I	Inflow and infiltration
IDF	Intensity-frequency-duration
IMP	Infrastructure Masterplan
LEBP	Loyalist East Business Park
LID	Low impact development
MCEA	Municipal Class Environmental Assessment
MECP	Ministry of Environment, Conservation, and Parks
MMS	Minimum Maintenance Standards
O.Reg.	Ontario Regulation
OP	Official Plan
PLC	Programmable logic control
PRV	Pressure-reducing valve
QMS	Quality Management System
SCADA	Supervisory control and data acquisition
STP	Sewage treatment plant
SWMF	Stormwater management facility
SWP	Sourcewater protection
TKIP	Taylor-Kidd Industrial Park
TWAS	Thickened waste activated sludge
UCRC	Uncommitted reserve capacity
WAS	Waste activated sludge
WDS	Water distribution system
WM	Watermain

WPCP	Water pollution control plant
WTP	Water treatment plant

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IMP Technical Memorandum: Climate Change

Asset Class: Variously applicable to most asset classes

Objective: To determine what vulnerabilities and risks the Township faces as a result of climate change and inform how the Township can better prepare for projected impacts and increase our resilience to them.

Background

Loyalist Township has a responsibility to maintain safe, secure, and resilient infrastructure. This includes being prepared to face environmental stressors in whatever form they take.

Assumptions

Uncertainty is an integral part of the study of climate change. Uncertainty is factored into climate change scenarios, models, and data, and reflects the complex reality of environmental change and the evolving relationship between humans and the planet. Climate change cannot be predicted with absolute certainty in any given case, and all data must be considered with this in mind. However, climate change scenarios help to create plausible representations of future climate conditions. These conditions are based on assumptions of future atmospheric composition and on an understanding of the effects of increased atmospheric concentrations of greenhouse gases (GHG), particulates, and other pollutants.

Methodology

In 2021, a climate science report was commissioned by Loyalist Township (ICLEI, 2021). Localized climate change data for that foundational report was collected from three online tools:

- Climate Change Data and Scenarios Tool (Government of Canada, 2017)
- Climate Atlas of Canada Tool (Prairie Climate Centre, 2019)
- Computerized Tool for the Development of Intensity-Duration-Frequency Curves under Climate Change Version 3.0 (Simonivic, Schardong, Srivastav, & Sandink, 2015)

The data presented in the ICLEI report projects temperature and precipitation changes, based on global climate models (GCMs) and emission scenarios defined by the Intergovernmental Panel on Climate Change (IPCC), drawing from both the Fourth Assessment Report (AR4) and Fifth Assessment Report (AR5) publications.

Three scenarios were compiled in the ICLEI report, with attendant characteristics:

Table 1 Climate Change Scenario Characteristics

Scenario	**Description**	
RCP4.5	Moderate projected GHG concentrations, resulting from substantial climate change mitigation measures. It represents an increase of 4.5 W/m^2 in radiative forcing to the climate system. • RCP 4.5 is associated with 580-720ppm of CO_2 and would more than likely lead to 3°C of warming by the end of the 21st century.	Overshoot*
RCP6.0	Moderate projected GHG concentrations, resulting from some climate change mitigation measures. It represents an increase of 6.0 W/m^2 in radiative forcing to the climate system. • RCP 6.0 is associated with 720-1000ppm of CO_2 and would likely lead to 4°C of warming by the end of the 21st century.	Overshoot*
RCP8.5	Highest projected GHG concentrations, resulting from business-as-usual emissions. It represents an increase of 8.5 W/m^2 in radiative forcing to the climate system. • RCP 8.5 is associated with >1000ppm of CO_2 and would more than likely lead to warming greater than 4°C by the end of the 21st century.	Rising

*The term ‘overshoot’ refers to scenarios in which the international goal of limiting global warming to 2°C by the end of the century, as set out by the UNFCCC in the Paris Agreement, is not met.

This technical memorandum draws comparisons between RCP4.5 and RCP8.5, respectively the best- and worst-case scenarios, depending on the global approach to reduce GHG emissions throughout the next several decades.

Analysis

Timelines

Climatic projections are typically provided within time periods of 20-30 years. Additionally, a consistent baseline period is established so that projections can be accurately compared with historical trends. In this report, the time periods of 2021-2050 and 2051-2080 are used most frequently. In some cases, timeframes are divided into three: “2020s” (2016-2035); “2050s” (2046-2065); and “2080s” (2081-2100). Many climate indices are also divided into seasonal periods, defined below:

Table 2 Seasonal divisions

Season	Months
Winter	December, January, February
Spring	March, April, May
Summer	June, July, August
Fall	September, October, November

Temperature

In Loyalist, there is a projected annual mean temperature increase between 2.1°C in the immediate future and 4.3°C by 2080 from the baseline mean under scenario RCP8.5.

Maximum and minimum temperature trends show the average high temperatures and the average low temperatures for a given season.

In terms of minimum temperatures, the baseline mean minimum temperatures across each season were 0.7, 13.8, 4.5, and -11°C for spring, summer, fall and winter respectively. Minimum seasonal temperatures under an RCP8.5 scenario are projected to increase substantially, with an increase of 3.8°C in spring, 4.2°C in summer, 4 °C in fall and 5.5°C in winter 2051-2080.

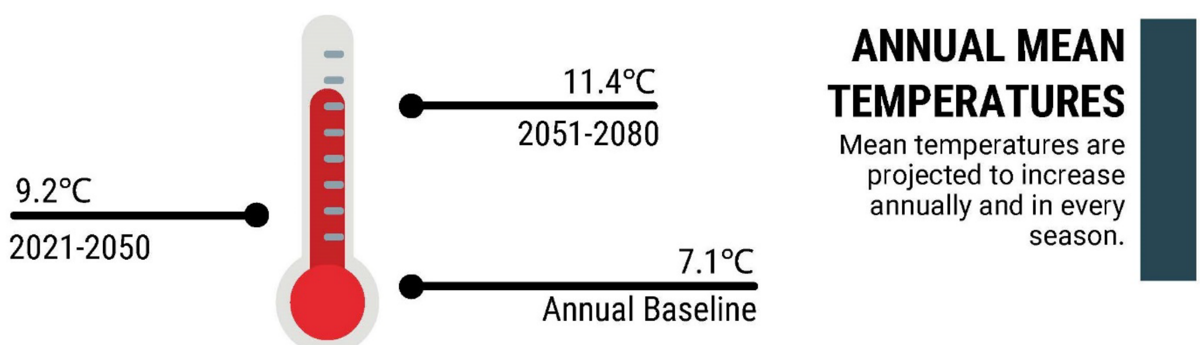


Figure 1 Annual mean temperature projections

Table 3 Projected average seasonal minimum temperatures for Loyalist Township

Emissions Scenario	T Mean (°C)	Baseline (1976-2005)	2021-2050			2051-2080		
			Low	Mean	High	Low	Mean	High
RCP4.5	Spring	0.7	0.4	2.4	4.4	1.2	3.3	5.7
	Summer	13.8	14.2	15.5	16.8	14.8	16.5	18.2
	Fall	4.5	4.7	6.3	7.8	5.5	7.1	8.8

	Winter	-11.0	-11.8	-8.6	-5.4	-10.5	-7.2	-3.9
	Annual	**2.1**	**2.7**	**4.0**	**5.3**	**3.5**	**5.0**	**6.7**
RCP8.5	Spring	0.7	0.5	2.6	4.9	2.4	4.5	7.0
	Summer	13.8	14.5	15.8	17.2	16.4	18.0	19.9
	Fall	4.5	5.0	6.6	8.2	6.8	8.5	10.2
	Winter	-11.0	-11.5	-8.4	-5.0	-8.7	-5.5	-2.4
	Annual	**2.1**	**2.9**	**4.2**	**5.6**	**5.0**	**6.5**	**8.2**

In terms of Average Seasonal Maximum Temperatures, seasonal average baseline temperatures for the Township are 11, 25.2, 13.7, and -1.9˚C for spring, summer, fall and winter respectively. Loyalist Township is projected to experience an increase in all seasonal maximum temperatures, with Average Summer Maximum Temperatures reaching nearly 30˚C in the years 2051-2080 under RCP8.5. Average Winter Maximum Temperatures will reach positive digits for the Township, with an increase of 3.9˚C by 2051-2080 according to RCP8.5.

Table 4 Projected average seasonal maximum temperatures for Loyalist Township

Emissions Scenarios	**T Mean (C˚)**	**Baseline (1976-2005)**	**2021-2050**			**2051-2080**		
			Low	Mean	High	Low	Mean	High
RCP4.5	Spring	11	10.6	12.9	15.4	11.2	13.8	16.7
	Summer	25.2	25.4	27.1	28.7	26.2	28.2	30.2
	Fall	13.7	13.9	15.8	17.6	14.7	16.7	18.6
	Winter	-1.9	-2.5	0.0	2.5	-1.6	1.0	3.7
	Annual	**12.1**	**12.6**	**14.0**	**15.4**	**13.3**	**15.0**	**16.6**
RCP8.5	Spring	11	10.5	13.0	15.6	12.3	15.0	17.9
	Summer	25.2	25.9	27.4	29.0	27.6	29.8	31.9
	Fall	13.7	14.2	16.0	17.8	16.2	18.1	20.1
	Winter	-1.9	-2.4	0.1	2.8	-0.4	2.3	5.0
	Annual	**12.1**	**12.8**	**14.2**	**15.6**	**14.7**	**16.4**	**18.2**

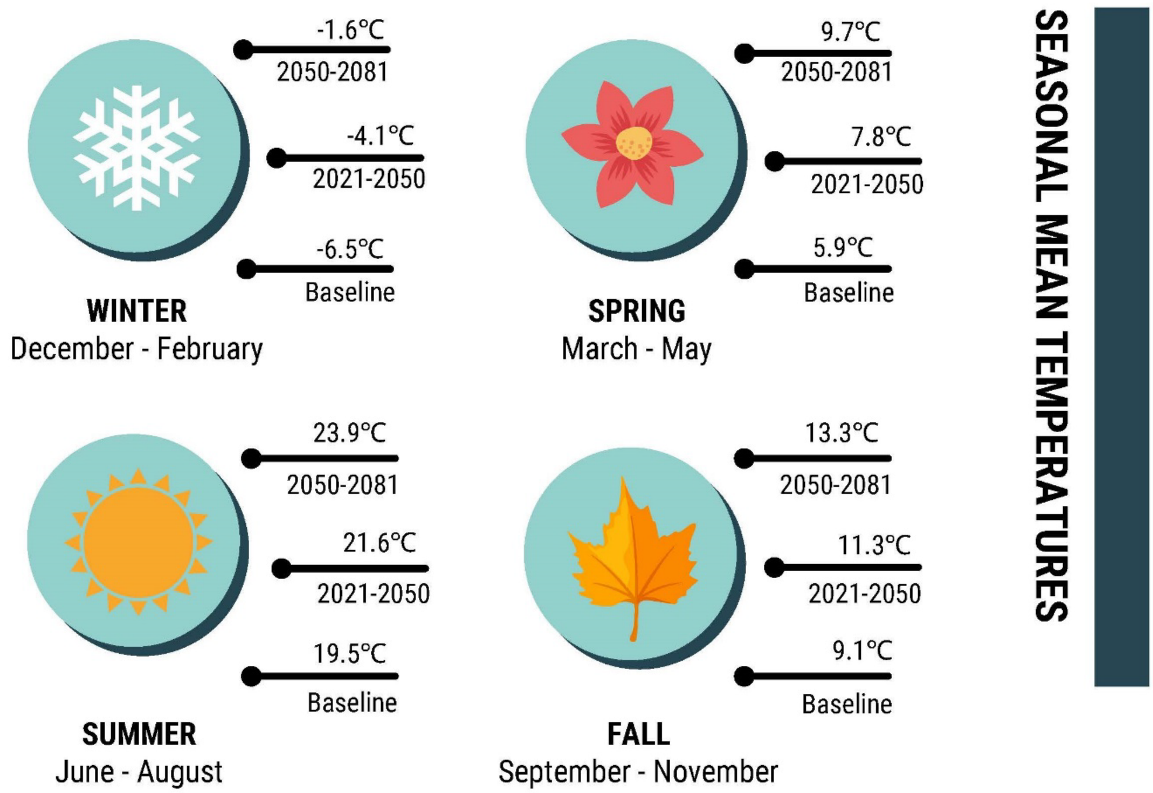


Figure 2 Seasonal mean temperatures

A freeze-thaw cycle is any day where the minimum temperature is below 0˚C and the maximum temperature is above 0˚C. The RCP8.5 ensembles project that freeze-thaw cycles will decrease due to overall warmer temperatures. This is likely because overall, the days are getting warmer, and Loyalist is likely to experience a decrease in the number of days that reach a minimum temperature below 0°C.

Under these conditions, it is likely that some water at the surface is both liquid and ice at some point during the 24-hour period.   Freeze-thaw cycles can have major impacts on infrastructure. Water expands when it freezes, so the freezing, melting, and re-freezing of water can over time cause significant damage to roadways, sidewalks, and other outdoor structures. Potholes that form during the spring, or during mid-winter melts, are good examples of the damage caused by this process.

Table 5 Average annual freeze-thaw days for Loyalist Township

Emissions Scenarios	Baseline 1976-2005	2021-2050			2051-2080		
		Low	Mean	High	Low	Mean	High
RCP4.5	71.3	51.0	66.3	81.4	49.7	64.5	79.0
RCP8.5	71.3	50.9	66.2	81.4	43.7	59.7	75.3

Extreme Weather Events – Precipitation

Across the Township, heavy precipitation days are expected to increase by approximately 4 days for 10 mm days and 2 days for 20 mm days according to RCP8.5 by 2051-2080. Maximum 1-Day and 5-day events are also expected to increase across the Township, with the greatest increase in 5-day events. For example, Maximum 5-Day events are projected to increase from a baseline of 63mm to 73mm by 2051-2080 for RCP8.5.

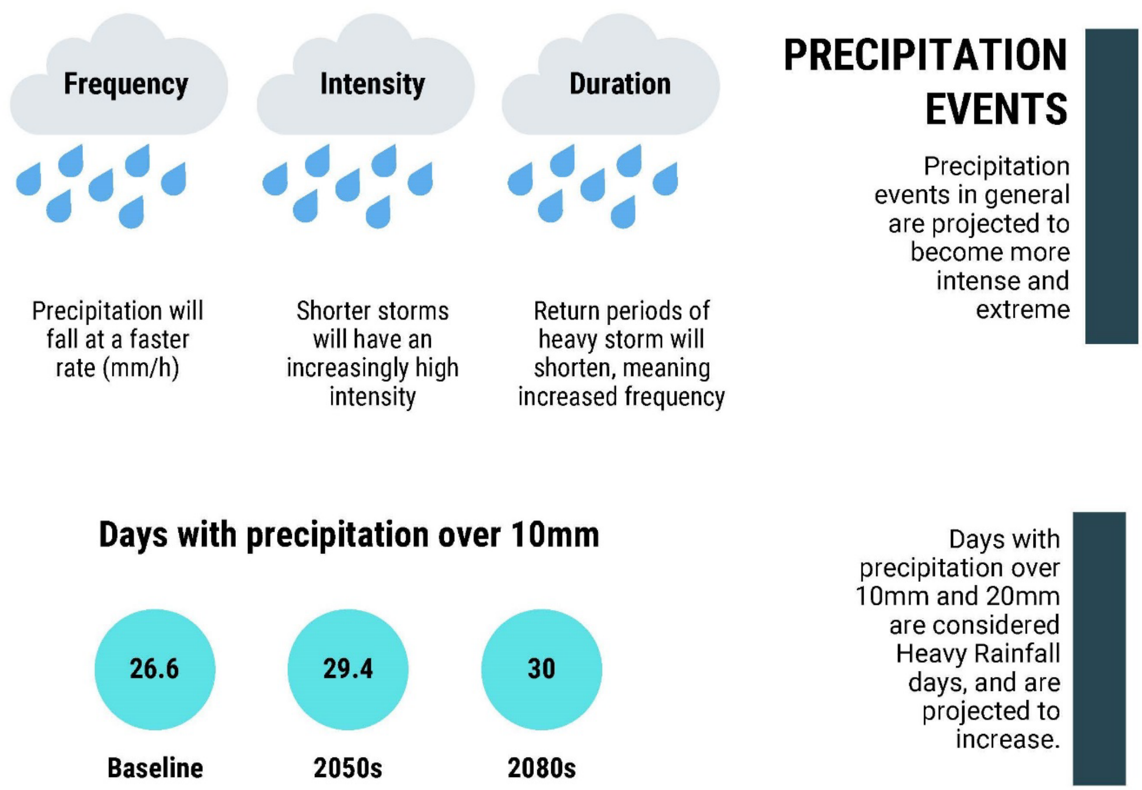


Figure 3 Projected impact on precipitation events - intensity, duration, frequency

Intensity-duration-frequency (IDF) curves represent one way to analyze and predict heavy precipitation under a changing climate. They provide a graphical representation of the probability that a given average rainfall intensity will occur. Projected IDF curves demonstrate that the intensity (mm/h) of rainfall will increase, with more rain falling in shorter time periods. Storms that occur less frequently (e.g., 100-year storms) are projected to see the greatest increase in intensity. Furthermore, such heavy precipitation events are projected to become more common than they once were.

Extreme Weather Events – Freezing Rain

A study conducted by the Meteorological Service of Canada and the Science and Technology branch of Environment Canada observed the possible impacts of climate change on freezing rain using downscaled future climate scenarios for Eastern Canada. This study used climate scenarios from the IPCC AR4 report.

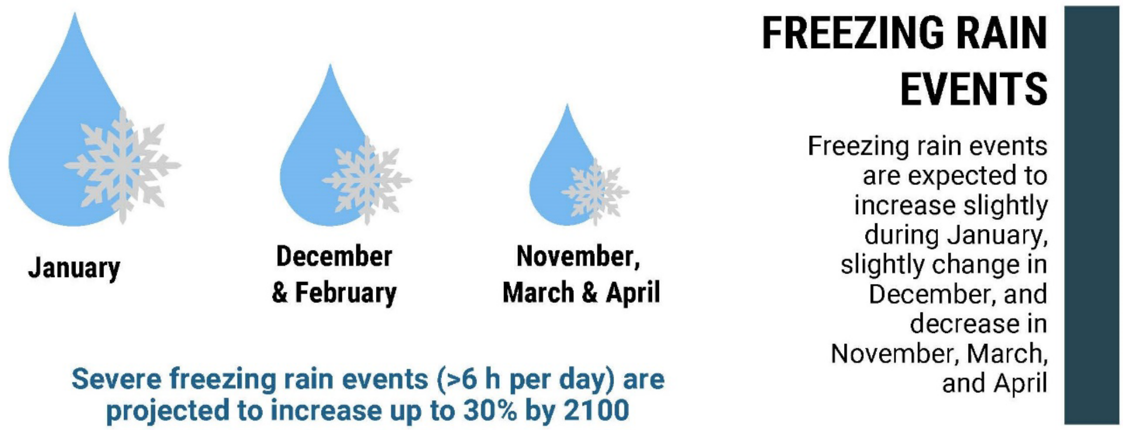


Figure 4 Projected impact on freezing rain events

Region 2 of the study encompasses a portion of Southeastern Ontario, including Loyalist Township. The study conducted analysis on the projected average percentage change in the number of daily freezing rain events. For Region 2, the percentage increase is most pronounced in the month of January, with slight changes in the months of December and February, and an overall decrease in the months of November, March and April. The relatively high number of severe freezing rain events (>6 h per day) that Region 2 currently experiences are projected to increase 20-30% by 2100.

Water Levels

Due to recent increases in the volume of glacial melt water, precipitation changes, and increased evaporation, water resources across much of Canada have been altered. In the Great Lakes, a 1°C change in mean annual air temperature has been associated with a 7-8% increase in the actual evapotranspiration (AET) rates, resulting in lower water availability. Lake Ontario is expected to see its water levels decrease by 0.5 meters by 2050.

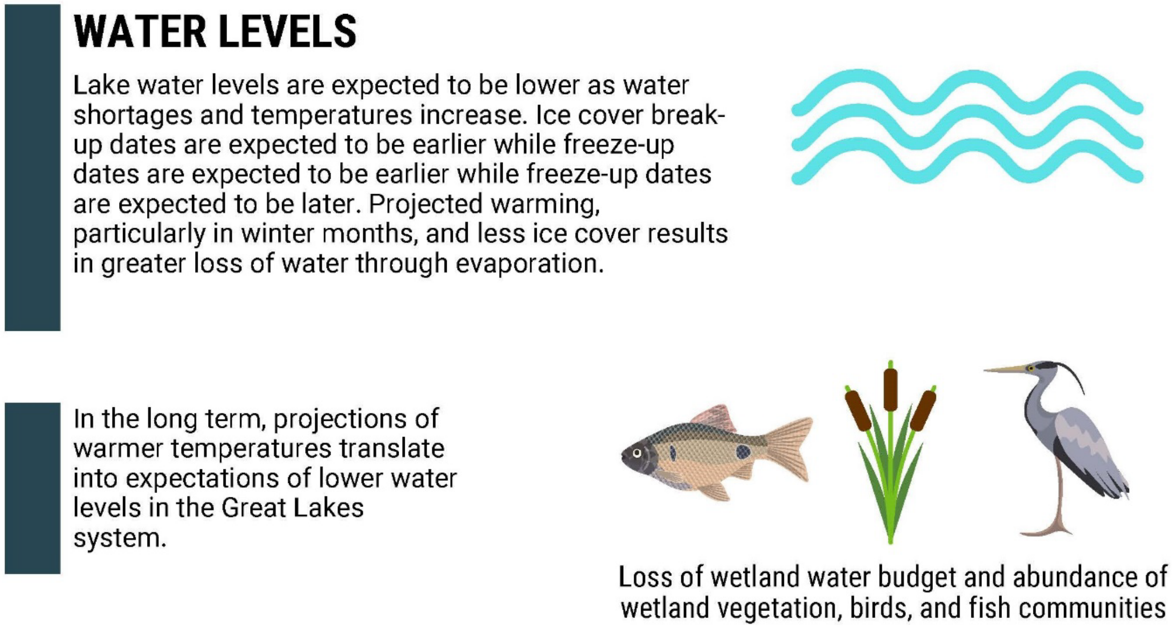


Figure 5 Projected impacts of water level change

Water shortages have been documented in regions of Southern Ontario and projections indicate that shortages will occur more frequently as summer temperatures and evaporations rates increase. Ice cover break-up dates are expected to advance in the range of 1 to 3-1/2 weeks, while freeze-up dates are expected to be delayed by up to 2 weeks. The resulting ice cover duration is expected to decrease by up to a month depending on the depth of the lake, with greater reductions found for deeper lakes. Projected warming in the region, particularly in winter months, is expected to further change the duration and extent of ice cover on the lakes. Less ice cover results in great loss of water through evaporation and enhanced shoreline erosion during winter storms.

Financial

Each project within the Infrastructure Masterplan will include separate sections on both financial and climate change related impacts of the project.

Linkages

Most technical memoranda in this IMP draw a link with the impacts of climate change.

References

Government of Canada. (2017). *Canadian climate data and scenarios*. Retrieved from Government of Canada: https://climate-scenarios.canada.ca/?page=main

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Prairie Climate Centre. (2019). *Climate Atlas*. Retrieved from https://climateatlas.ca/map/canada/plus30_2030_85#

Simonivic, S. P., Schardong, A., Srivastav, R., & Sandink, D. (2015). *IDF_CC Web-based Tool for Updating Intensity-Duration-Frequency Curves to Changing Climate - ver 3.0*. Retrieved from Western University Facility for Intelligent Decision Support and Institute for Catastrophic Loss Reduction: https://www.idf-cc-uwo.ca

Conclusions

The various impacts predicted by climate change will impact Loyalist Township in many ways. This document has examined these impacts and has attempted to address any concerns through analysis of the impacts on a by-project basis. It will be important for the Township to monitor trends and compare with baseline conditions and design assumptions for each infrastructure asset. Where necessary additional effort will be required to achieve resiliency. Some of this work is not new. Based on the predictions, impacts will increase in frequency over the next few decades. Loyalist Township must be ready to face these changes.

IMP Technical Memorandum: Population and Dwelling Growth

Asset Class: Not applicable

Objective: The purpose of this technical memorandum is to present the projected growth of Loyalist Township over the course of the study period covered by the Infrastructure Masterplan. Areas of discussion will focus on population and residential growth, broken down by geographical location within the Township.

Background

In 2016, Loyalist Township was home to 17,390 residents living in 6,430 households. Much of this population, approximately 80%, was spread out over the Township's three main urban centres – Amherstview, Bath, and Odessa – with the balance residing on Amherst Island or in rural areas and hamlets spread out across the Township.

Loyalist Township commissioned a housing and employment projections study (Hemson Consulting Ltd., 2019). The study, hereinafter referred to as the "Growth Study", found that the Township experienced moderate growth between 2001 and 2016, with housing growth outpacing population growth. The disparity between these growth rates was attributed to a reduction in average household size, which can be an indicator of an aging demographic.

The Growth Study went on to project moderate growth in Loyalist Township between 2016 and 2046, with housing growth predicted to outpace population growth due to a continued anticipated decline in average household size. Modest employment growth was also expected over the same period, reflecting a continued shift towards service-based sectors and some growth in traditional industries. Figure 1 below illustrates the projected population, household, and employment growth rates in Loyalist Township over the period covered by the growth study.

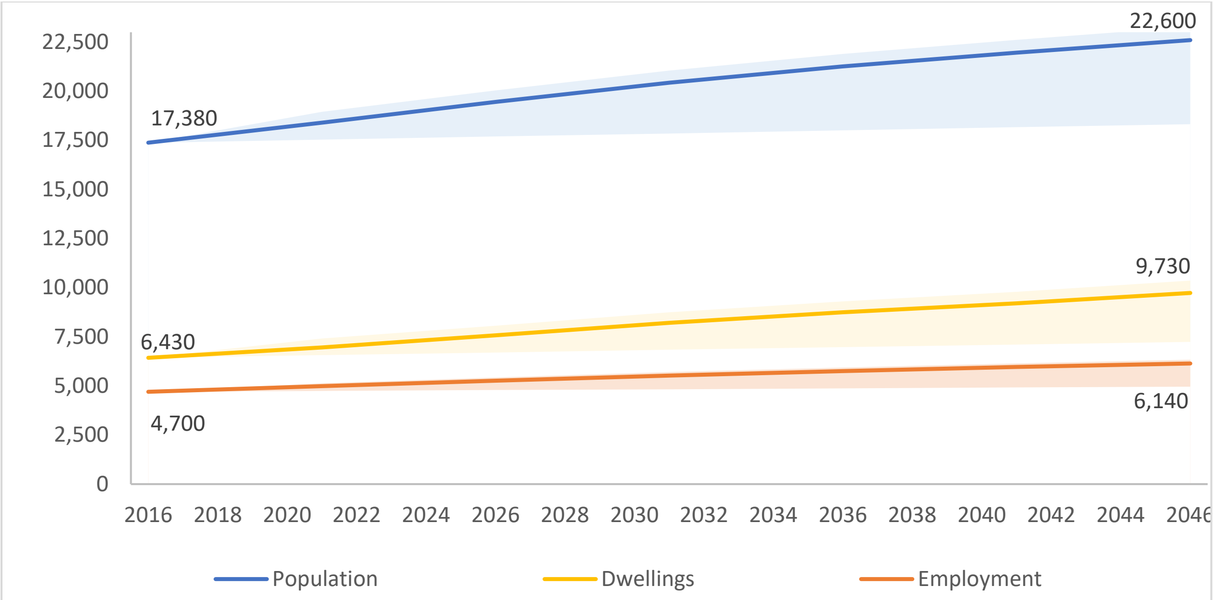


Figure 1 - Loyalist Township - Projected change in population, households, and employment between 2016 and 2046 (Hemson, 2019)

It should be noted that the above projections were sourced from the Growth Study's Reference Scenario, which can be described as the most likely projected outcome. Low and high scenarios were also presented in the Growth Study and represent the range within which the projections can fall.

Trends observed in the number of building permits issued each year by the Township since 2016 suggested that the number of new residential dwellings has increased at a faster rate than projected by the Growth Study's reference scenario. The release of the 2021 Canadian Census of Population confirmed these observations (Government of Canada, 2021).

Table 1 – Comparison of residential dwellings as estimated by the 2016 Census of Population, the Growth Study's Reference Scenario, and the 2021 Census of Population.

	2016 Census	2021 Projections (Growth Study Reference Scenario)	2021 Census	% Difference
Population	17,390	18,390	18,352*	-0.2%
Households	6,430	6,960	7,145	3%
Persons per Household	2.7	2.64	2.5	

**2021 Census values adjust to account for undercounting*

The Growth Study projected 6,960 households in Loyalist Township by 2021; however, the 2021 Census estimated that this figure was likely closer to 7,145, approximately 3% higher than anticipated. Conversely, population growth within Loyalist was very close to what was predicted by the Growth Study, which projected 18,390 residents by the year 2021. The discrepancy between population and household growth can likely be attributed to a reduction in persons per household over that time, from 2.7 to 2.5 persons per household in 2016 and 2021, respectively.

As such, the purpose of this technical memorandum is to update the projections presented in the Growth Study based on data collected over the past few years. The document will primarily focus on the projected household growth within Loyalist Township over the study period, given that this factor will have more of an impact on infrastructure needs than population growth.

Assumptions

The following assumptions were made when developing these documents:

- Given recent growth trends within Loyalist Township, it is assumed that household growth is more likely to follow the “high” scenario presented in the Growth Study. The incremental growth was primarily assigned to Odessa and the rural areas of the Township, as those regions grew at a faster rate than the rest of the Township. Bath was also assumed to grow at the rate presented in the “high” scenario of the Growth Study. Finally, Amherstview was assumed to grow at the same rate as the “reference” scenario presented in the Growth Study, given that data collected between 2016 and 2021 supported this claim.
- Although the Growth Study anticipates a further reduction in the number of persons per household, a factor of 2.5 persons per household will be used to estimate population size over time.
- Population, household, and employment growth rates are presented in five-year increments. It is assumed that growth between these points is linear.

Methodology

Data Sources

The data used to develop the figures presented in these documents were obtained from the Hemson Growth Study, the 2021 Canadian Census of Population, and building permit data collected by the Township.

The Growth Study includes population and household projections for different areas of the Township. These include the urban settlement areas of the Township (Odessa, Amherstview, Bath), as well as rural areas and Amherst Island.

Population and household projections will be broken down into the following four areas to maintain consistency with the Growth Study:

- Amherstview

- Odessa
- Bath
- Rural and Amherst Island

Dwellings

The number of households in each of the four study areas in the year 2016 based on the 2016 Population Census was used as a starting point for these calculations. Dwellings each year were calculated by adding the number of dwellings in the previous year to the number of new building permits issued in that same year.

$$HH_t = HH_{t-1} + BP_{t-1}$$

where

$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$
$$BP_{t-1} = Building\ permits\ issued\ in\ previous\ year$$

This process was repeated to estimate the number of households in each of the four areas for the years 2017, 2018, 2019, 2020, and 2021.

Population

Population growth within Loyalist Township over the course of the study period was estimated as a function of the projected number of dwellings.

According to the 2021 Canadian Census of Population, the average dwelling in Loyalist Township houses approximately 2.5 people. This is down from approximately 2.7 persons per unit in 2016.

Although the Growth Study suggests that household size is likely to further decrease over time, a factor of 2.5 persons per household was used to estimate population over the course of the study period. This will allow for a more conservative estimate of population.
As such, the population in a given year can be calculated as follows:

$$Pop_t = \mathrm{HH_t} * 2.5$$

where

$$Pop_t = Population\ in\ year\ t$$
$$HH_t = \text{Households in year t}$$
$$2.5 = estimated\ average\ persons\ per\ household$$

Analysis

Dwellings

The calculated number of households for the year 2021 was compared to the number of households projected under the Reference Scenario of the Growth Study, as summarized in the following table:

Table 2 – Comparison of residential dwellings as estimated by the 2016 Census of Population, the Growth Study's Reference Scenario, and calculated estimates.

	2016 Census	2021 Projections (Growth Study Reference Scenario)	2021 Calculated (based on building permits)	Difference
Amherstview	3,450	3,770	3,743	-0.7%
Odessa	490	510	652	22%
Bath	1,150	1,310	1,214	-8%
Rural & Amherst Island	1,340	1,370	1,396	2%
Total	6,430	6,960	7,005	0.6%

The following observations can be made from the table above:

- Growth in Amherstview matched the projections presented in the reference scenario of the Growth Study;
- Observed household growth in Odessa was substantially higher than predicted by the Growth Study;
- Growth in Bath was lower than predicted by the Growth Study; and
- Growth in the rural areas of the Township and on Amherst Island were slightly higher than anticipated.

Based on the findings above, and in addition to observed growth trends in the area, it was concluded that a modified version of the High Scenario presented in the Growth Study should be developed to support the Infrastructure Masterplan.

The high growth rates observed in certain areas of the Township in the previous two-to-three years, most notably in Odessa, would suggest that more aggressive growth models should be used to forecast upcoming growth. However, historical data suggest that, while growth rates for a few years between 2016 and 2021 may have been higher than usual, overall growth in that five-year period was within range of what has previously been experienced, as demonstrated by Table 3 below.

Table 3 – Historical Population Growth in Loyalist Township between 2001 and 2021.

Year	Population*	5-year Growth %	Yearly Growth %
2001	15,140		
2006	15,570	2.8%	0.6%
2011	16,630	6.4%	1.3%
2016	17,390	4.3%	0.9%
2021	18,352	5.3%	1.1%

**adjusted to account for undercounting*

As such, it was determined that, the High Growth Scenario presented in the Growth Study, with a few modifications, would be suitable to model growth within Loyalist Township until 2046 for the purposes of the infrastructure Masterplan. The revised model includes the following assumptions:

- The overall dwelling growth in Loyalist Township will follow the high growth scenario presented in the Growth Study. However, growth within individual areas was be redistributed to better represent recent historical trends.
- Growth in Amherstview will continue to follow the projections laid out in the Growth Study Reference Scenario. This is consistent with the assumptions made as part of the Amherstview West Secondary Plan review.
- Growth in Bath will follow the high growth scenario from the Growth Study. Although observed data suggests that growth in this area has been lower than initially projected, conversations with local developers indicate that rapid growth is expected in the near future. As such, planning for higher growth rates in Bath would be prudent.
- Growth in Odessa will follow the High Growth Scenario for the Growth Study.
- The incremental growth in Amherstview (i.e., the difference in projected dwellings under the reference scenario and high growth scenario) would be redistributed to Odessa.
- A portion, approximately 30%, of the incremental growth in Amherst Island and rural areas of the Township (i.e., the difference in projected dwellings under the reference scenario and high growth scenario) would also be redistributed to Odessa.
- The following table summarizes the number of projected dwellings in the year 2046 under the Growth Study's Reference Scenario and the Revised High Growth Scenario

Table 4 – Comparison of residential dwellings in Amherstview, Odessa, Bath, and Amherst Island and rural areas of the Township under the Growth Study's Reference Scenario and the Revised High Growth Scenario

	Projected dwellings (2046)	
	Growth Study Reference Scenario	Revised High Growth Scenario
Amherstview	5,310	5,310
Odessa	690	1,107
Bath	2,250	2,406
Rural and Amherst Island	1,480	1,539
Total	**9,730**	**10,362**

Growth projections in each of the four study areas will be presented in further detail below.

For the Infrastructure Masterplan, it is generally assumed that linear growth will occur between 2021 and 2046. While growth is unlikely to occur in a linear fashion over the course of 25 years, this assumption will be sufficient to plan for the Township's infrastructure needs over the course of the study period.

Amherstview

The increase in dwellings observed in Amherstview between 2016 and 2021 closely follows the Reference Scenario presented by the Growth Study, as illustrated in Figure 2 below. As such, it can be assumed that the Reference Scenario presented by the Growth Study for Amherstview between 2021 and 2046 remains applicable.

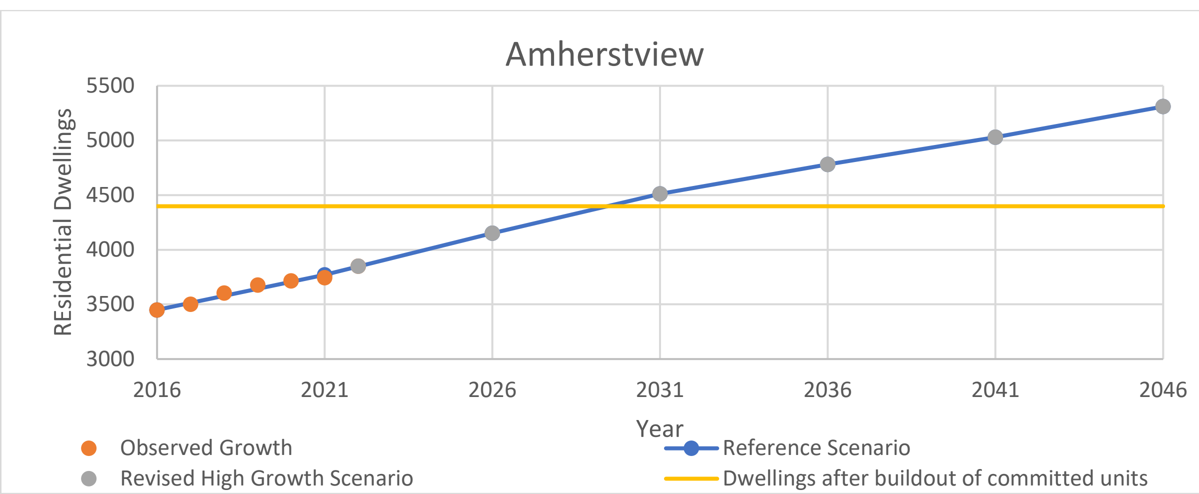


Figure 2 - Observed and projected dwelling growth in Amherstview between 2016 and 2046

As of the end of 2021, approximately 554 committed-but-unbuilt residential units remained in Amherstview.

Based on the projected increase in dwellings for this area, it is expected that these units will be built out by the year 2030.

Odessa

The increase in dwellings observed in Odessa significantly surpassed the expected growth rates presented in the Growth Study's Reference Scenario

Approximately 650 residential dwellings were estimated in the area by 2021, compared to the 510 projected by the Growth Study's Reference Scenario. As additional context, the 650-dwelling threshold for Odessa was not predicted to be passed until 2041 under the Reference Scenario presented in the Growth Study.

As such, a Revised High Growth Scenario was developed for Odessa.

Figure 3 below illustrates the observed growth in residential dwellings in Odessa between 2016 and 2021 and compares the Reference Scenario to the Revised High Growth Scenario which will be used as part of the Infrastructure Masterplan.

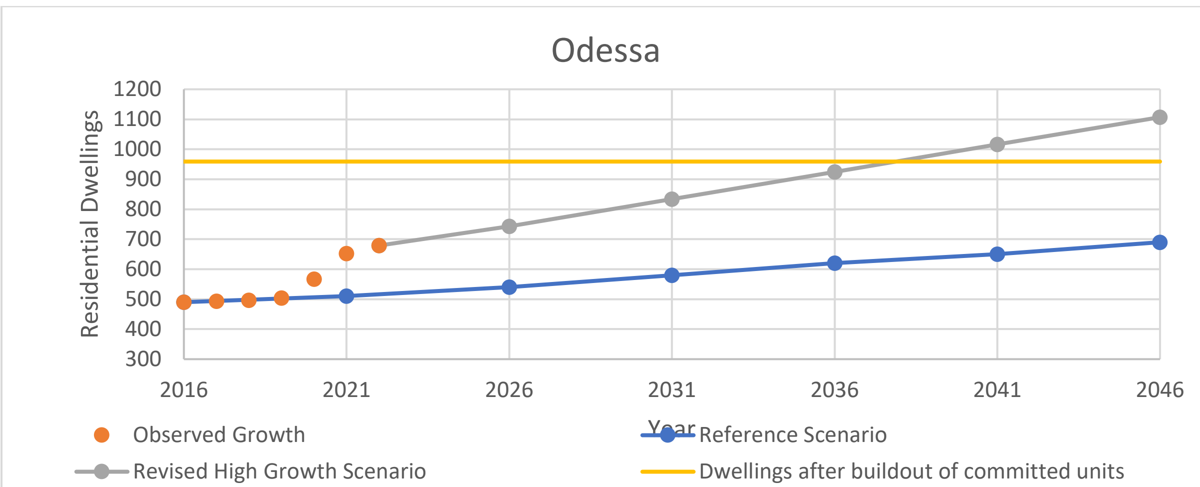


Figure 3 - Observed and projected dwelling growth in Odessa between 2016 and 2046

As of the end of 2021, approximately 244 committed-but-unbuilt residential units remained in Odessa.

Based on the projected increase in dwellings for this area, it is expected that these units will be built out by the year 2036.

Bath

The increase in dwellings observed in the Bath between 2016 and 2021 was slightly lower than what was projected in the Growth Study's Reference Scenario.

Approximately 1,214 residential dwellings were estimated in the area by the end 2021, compared to projected 1,310 projected by the Growth Study's Reference Scenario.

However, based on conversations with local developers, rapid growth is expected in Bath in the near future. As such, planning for higher growth rates would be prudent. A Revised High Growth Scenario was therefore developed for Bath.

Figure 4 below illustrates the observed growth in residential dwellings in Bath between 2016 and 2021 and compares the Reference Scenario to the Revised High Growth Scenario which will be used as part of the Infrastructure Masterplan.

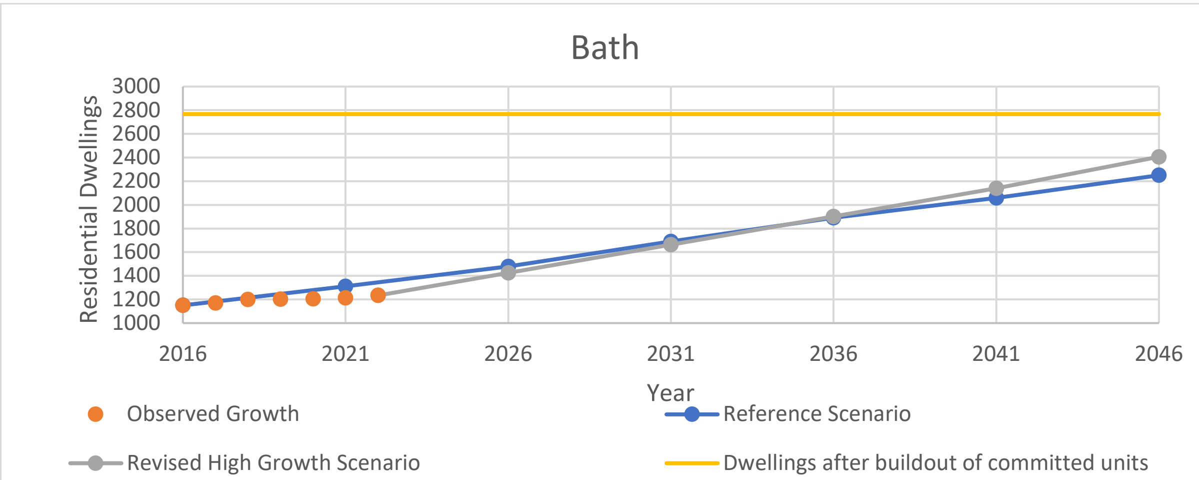


Figure 4 - Observed and projected dwelling growth in Bath between 2016 and 2046

As of the end of 2021, approximately 1,533 committed-but-unbuilt residential units remained in Bath. It should be noted that this figure is larger than the number of existing residential dwellings in Bath as of 2021. Once these committed-but-unbuilt units are constructed, Bath will have effectively doubled in size. Furthermore, most of these committed units are under the control of closely linked development corporations, as opposed to multiple entities. As such, growth in Bath will likely be controlled, to a degree, by these corporations.

Based on the projected increase in dwellings for this area, it is expected that the committed-but-unbuilt units will not be constructed in their entirety by the end of the study period.

Rural Areas and Amherst Island

The increase in dwellings observed in Amherst Island and rural areas of the Township between 2016 and 2021 was higher than the growth rates was projected in the Growth Study's Reference Scenario.

Approximately 1,396 residential dwellings were estimated in these areas by the end 2021, compared to projected 1,370 projected by the Growth Study's Reference Scenario.

As such, a Revised High Growth Scenario was developed for Amherst Island and rural areas of the Township.

Figure 4 below illustrates the observed growth in residential dwellings in Amherst Island and rural areas of the Township between 2016 and 2021. The Figure also compares the Reference Scenario to the Revised High Growth Scenario which will be used as part of the Infrastructure Masterplan.

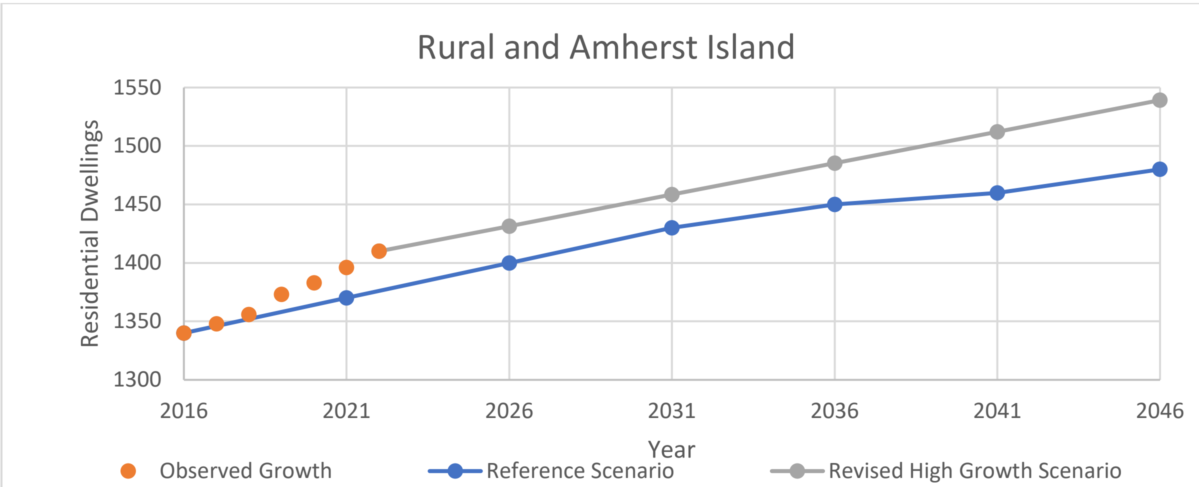


Figure 5 - Observed and projected dwelling growth in Amherst Island and rural areas of the Township between 2016 and 2046

It should be noted that much of the growth experienced in this study area was experienced on the mainland. Specifically, out of the 70 new building permits issued between 2016 and 2021, only 4 of them were issued on Amherst Island.

Population

Based on the residential dwelling projections developed as part of the Revised High Growth Scenario, population growth in Loyalist Township can also be estimated over the course of the study period.

As previously noted in the Methodology section of these documents, an average 2.5 persons per dwelling is assumed to be the average household size in Loyalist Township between 2021 and 2046.

Table 5 below presents a summary of the population in each of the four areas of study, as estimated by the 2016 and 2021 Statistics Canada Surveys of Population, as well as the projected population growth for those same areas up to 2046.

Table 5 – Historical and Projected Population Growth in Loyalist Township

	Amherstview	Odessa	Bath	Amherst Island and Rural	Total
2016	9,150	1,270	3,420	3,540	**17,380**
2021	9,446	1,311	3,531	3,655	**17,943**
2026	10,141	1,857	3,562	3,579	**19,139**
2031	10,925	2,085	4,158	3,646	**20,814**
2036	11,708	2,312	4,754	3,713	**22,488**
2041	12,492	2,540	5,350	3,781	**24,162**
2046	13,275	2,767	6,016	3,848	**25,906**

Based on these projections, it is estimated that the overall population in Loyalist Township will be just under 26,000 residents by the year 2046. This contrasts with the original estimate of 22,600 presented in the Reference Scenario of the Growth Study.

Summary

Recent trends have suggested that household and population growth in certain areas of Loyalist Township (Odessa, Bath, and rural areas) is expected to occur at a higher rate than was predicted by the Reference Scenario in the Growth Study conducted by the Hemson Consulting Ltd. Group in September 2018.

As such, a Revised High Growth Scenario was developed, based on the High Growth Scenario presented in Hemson's Growth Study.

The revised residential dwelling and population projections for Amherstview, Odessa, Bath, as well as Amherst Island and rural areas of the Township can be found in Figure 6 and Figure 7, respectively.

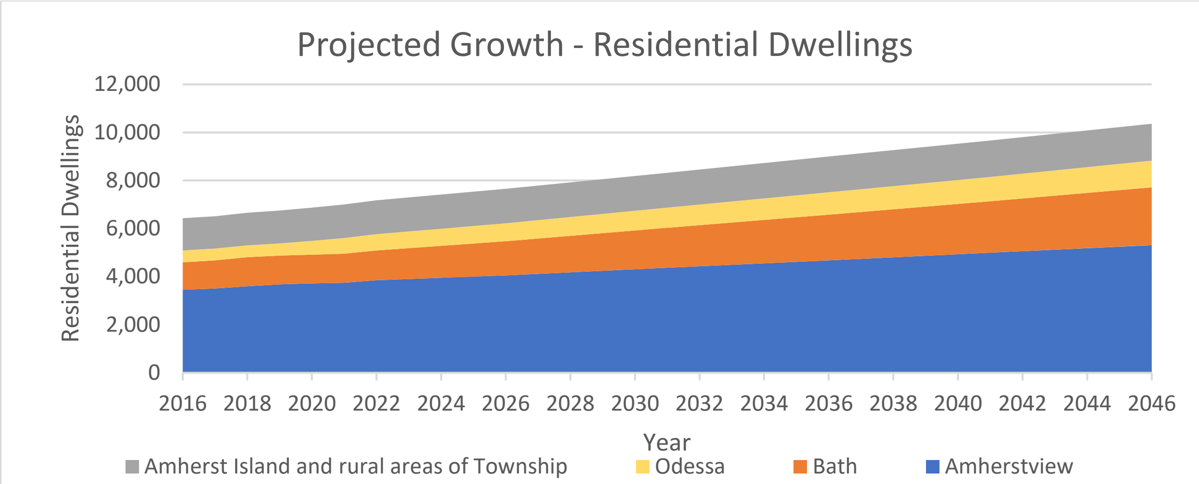


Figure 6 – Projected residential dwelling growth in Amherstview, Odessa, Bath, and Amherst Island and rural areas of the Township over the course of the study period covered by the Infrastructure Masterplan

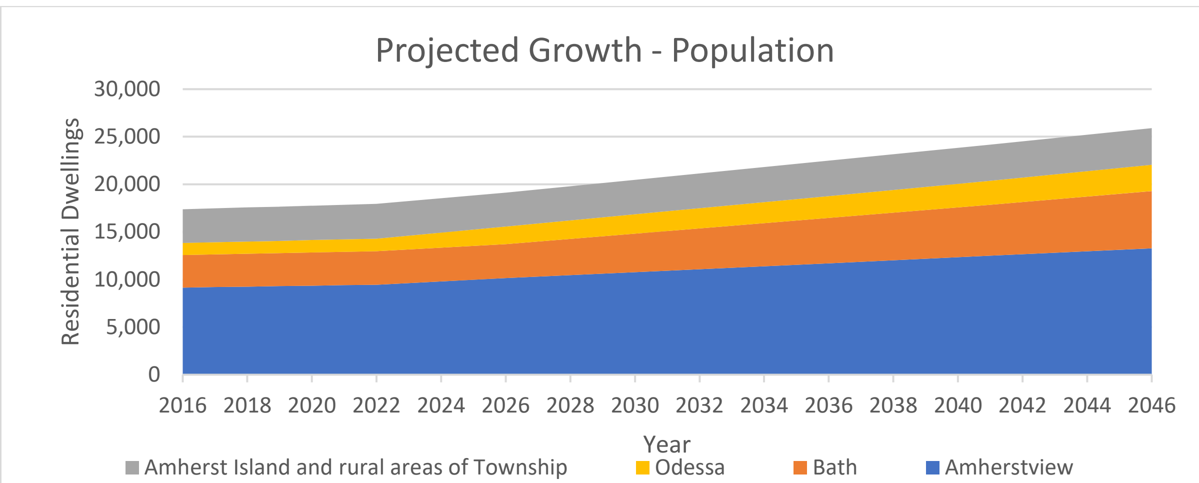


Figure 7 - Projected population growth in Amherstview, Odessa, Bath, and Amherst Island and rural areas of the Township over the course of the study period covered by the Infrastructure Masterplan

These revised projections consider the higher than anticipated growth rates that have been observed in Loyalist Township and surrounding communities since 2020 and will be used to inform the Infrastructure Masterplan process.

Limitations

The projections presented in this document rely on several assumptions and external factors outside of the Township's control. For example, recent trends have indicated that the Township is experiencing higher-than-anticipated growth.

As such, the residential dwelling and population forecasts were updated to ensure that the Township's Infrastructure needs were met until 2046 and beyond. However, these growth rates could significantly decline, or increase, in any given year, significantly impacting these forecasts.

It would be prudent to review the figures presented in this technical memorandum on a regular basis and update them as necessary.

Climate Change Considerations

The effects of climate change are not expected to significantly impact residential dwelling or population growth within Loyalist Township.

Linkages

Not applicable.

References

Government of Canada. (2021). *Loyalist Township Profile Table*. Retrieved from Census of Population: https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?Lang=E&SearchText=loyalist&DGUIDlist=2021A00053511005&GENDERlist=1,2,3&STATISTIClist=1,4&HEADERlist=0

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

Conclusions

The number of building permits issued by the building division over the past few years suggests that Loyalist Township was experiencing higher-than-anticipated growth rates.

Updated residential dwelling and population projections were developed to better reflect these trends to assist in the Infrastructure Masterplan process for Loyalist Township.

The revised figures project a total of 10,362 residential dwellings in Loyalist Township by the year 2046, as compared to the original estimate of 9,730.

Similarly, the revised figures project a population of 25,906 residents by the year 2046, compared to the original estimate of 22,600.

It is therefore recommended that the revised projections be used to inform the Infrastructure Masterplan.

These updated projections are subject to change based on several factors outside the Township’s control. They should therefore be revisited on a regular basis and updated as necessary.

IMP Technical Memorandum: Fairfield Water Treatment Plant Needs Assessment

Asset Class: Water

Objective: The objective of this technical memorandum is to provide an overview of the physical and process needs of the Fairfield Water Treatment Plant (WTP). These needs have been identified through a capacity assessment. The assessment highlights where potential process upgrades may be needed to accommodate flows up to both 10,750 m^3/day and 15,000 m^3/day.

Background

The Fairfield WTP services the communities of Amherstview and Odessa. The population in these areas is projected to increase by over 30% by 2046, inevitably creating an increased demand for potable water. The plant has a rated capacity of 8,000 m^3/day. Based on the Fairfield WTP Projections technical memorandum, future flows will not surpass the rated capacity of the plant within the 25-year horizon of the IMP. However, plant capacity has been assessed to confirm what upgrades will be required when demand surpasses 80% of the rated capacity.

The plant draws raw water from Lake Ontario which is treated using a membrane ultrafiltration system. This system consists of two treatment trains, each containing a series of membrane cassettes for filtration. Through the installation of additional cassettes to the existing treatment trains, the plant capacity could be increased to 10,750 m^3/day. If the membrane system was expanded to include more modules the capacity could be increased to 15,000 m^3/day. To assess plant capacity, the remaining process units have been evaluated against the two potential membrane expansions, to see where upgrades would be required.

Assumptions

The following assumptions were made when developing these documents:

- The potential capacities of the ultrafiltration system are 10,750 m^3/day and 15,000 m^3/day as stated by the manufacturer
- Component descriptions are based on historical operational data (Treated Flows – 3 year trends)

Methodology

To assist the Township in determining the system needs to reach both 10,750 m^3/day and 15,000 m^3/day, J.L. Richards & Associates (JLR) provided an assessment of the current capacity of the plant (J.L. Richards & Associates Limited, 2023). The assessment illustrates where upgrades would be needed to reach each target flow.

Township staff involved with water and sanitary sewage operations provided input with respect to plant deficiencies and operational needs in addition to the JLR assessment.

Data Sources

The data used to evaluate system capacity and form the recommendations presented in this document were obtained from:

- Historical operational data
- MECP Design Guidelines for Drinking-Water Systems
- Equipment technical documentation

Desktop Assessment

The following water treatment systems were evaluated based on guidelines from the Ministry of Environment Conservation and Parks (MECP) and other standard industry guidelines.

- Raw water intake structure.
- Raw water screening.
- Raw water pumping.
- Raw water conveyance.
- Membrane system effluent conveyance.
- Granular Activated Carbon (GAC) contactors.
- Residuals management.
- Filtered water conveyance.
- Disinfection.
- High lift pumping.
- Dechlorination.
- Sampling.
- Emergency backup power generator.
- Electrical systems.

The systems listed above were compared against 10,750 m^3/day and 15,000 m^3/day to determine if upgrades would be required to operate at each flow.

Analysis

The information presented in Table 1 is highlights what systems would need upgrades to meet 10,750 m^3/day and 15,000 m^3/day, along with the associated upgrades.

Table 1. Overview of process units in need of upgrades to meet 10,750 and 15,000 m^3/day.

Process Unit	Process Upgrades Required	
	10,750 m^3/day	15,000 m^3/day
Raw Water Intake	Yes – higher capacity intake structure	Yes – higher capacity intake structure
Raw Water Screening	None anticipated	None anticipated
Raw Water Pumping	None anticipated	Yes – higher capacity pumps and piping/appurtenances.
Raw Water Conveyance	None anticipated	None anticipated

Membrane Permeate Conveyance	None anticipated	None anticipated
GAC Contactors	Yes – additional GAC contactors may be required	Yes – additional GAC contactors may be required
Residuals Management	None anticipated	None anticipated
Filtered Water Conveyance	None anticipated	None anticipated
Disinfection (Chlorination)	Yes – additional chlorine cylinder for chlorination system	Yes – additional chlorine cylinder for system AND larger capacity post-chlorination chlorinator
Disinfection (Contact Time)	Yes – contact tank and clearwell baffling improvements	Yes – contact tank and clearwell baffling improvements AND 250 m3 clearwell working volume expansion
High Lift Pumping	None anticipated	Yes – higher capacity pumps and piping/appurtenances.
De-chlorination System (Sodium Bisulphate)	None anticipated	None anticipated
Electrical Systems	None anticipated	Yes - MCC 1B, MCC 2 modification, electrical conductors, system integration services
Backup Power	None anticipated	Yes - 350 kW generator

Aside from disinfection, these process unit upgrades are straightforward and should not require expansion of the plant footprint when implemented. To avoid potential building expansion for the clearwell, process optimizations could be implemented.

Plant Footprint Expansion

To meet the disinfection requirements for 15,000 m^3/day the clearwell would need to be expanded. There is limited space for expansion at this site. There is a small area that could be used for expansion in the area north of the existing clearwell. To avoid this difficult expansion, other disinfection options may be considered when upgrades are required. If it is determined that expansion of the clearwell is the best option, staff will need to consult with the MTO regarding the location of the expansion.

Optimization of Operations

Additional GAC units would be required to meet 10,750 m^3/day and 15,000 m^3/day. If these units are added, it is recommended to backwash the vessels one at a time during low demand periods. Using this method will eliminate the need to upgrade the GAC backwash conveyance piping.

It is also recommended that the Township reviews the minimum water level and free chlorine residual maintained in the clearwell. Changes to these values improve the contact time (CT), delaying the need clearwell expansion or disinfection upgrades. Township staff should investigate the option to increase the minimum clearwell water level and minimum free chlorine residual. A tracer study is recommended to determine baffling factors.

Energy Optimization and GHG Reduction

To reduce the GHG emissions related to water treatment, it is recommended that pumps be replaced with more efficient models during lifecycle activities. Pump control with variable frequency drives (VFDs) is also recommended.

System Water Loss

The Fairfield Water System Water Loss Reduction memo provides an overview of how available plant capacity could be affected if the volume of water lost throughout the distribution system was reduced. Reduced water loss would increase the amount of capacity available, further delaying the need for plant expansion. Although plant expansion is not projected to be required within the IMP study period, it is recommended that the Township initiate a water loss reduction program. This type of program is not only beneficial for plant capacity, but also improves distribution system efficiency.

Plant Capacity Expansion

The Fairfield WTP will need to be expanded within the IMP study period. Current growth projections estimate that the plant will reach 80% capacity around 2033, at which point the process for plant expansion will be initiated. If growth continues at the current rate the plant will likely need to be expanded to the 10,750 m^3/day scenario. The scale of the plant expansion will be confirmed using updated growth projections when 80% capacity is reached. The following process upgrades will be required to reach 10,750 m^3/day:

- Raw water intake upgrades (The results of the raw water intake study will inform if structural improvements to the intake are required)
- GAC upgrades – third GAC unit
- Additional chlorine cylinder
- Contact tank and clearwell baffling improvements

Depending on growth, in 2046 (end of the IMP study period), the plant may be approaching 80% capacity again. At this time careful analysis should be conducted, and if needed the plant could be upgraded to 15,000 m^3/day.

Financial

A complete opinion of probable costs for the upgrades needed to meet each target flow is provided in the Fairfield WTP Capacity Assessment document from JLR. The projects and associated costs listed below are items that are being recommended through the IMP prior to plant expansion.

Upgrade	Estimated Cost
Raw water intake structure assessment (Remedial)	$50,000
Chlorine contact tanks and clearwell assessment (Growth)	$50,000
VFDs on pumps (Remedial)	$40,000 to $60,000 (x3 high lift pumps)

The following table shows the costs associated with plant expansion to 10,750 m^3/day.

Upgrade	Estimated Cost
GAC upgrades – third GAC unit	$850,000

Climate Lens

Potential upgrades to the Fairfield WTP to increase production to meet future demand include an increase in the capacity of the raw water intake, additional GAC contactors, an additional chlorine cylinder for the chlorination system, and improvements to the contact tank and clearwell baffling.

Climate conditions that will most likely impact the needs of the Fairfield WTP in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021)
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline I the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms is projected to significantly increase (ICLEI, 2021).

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change/impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials with the general aim of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials and using recycled materials when possible.

- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020)
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers etc.
- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Increase in water temperature throughout the year may affect the efficacy of the GAC filters in their ability to remove taste and odours. Increases to the empty bed contact time may be required (Yuan, Huang, Nie, & Hofmann, 2020).
- Calculations for construction of conveyance and treatment infrastructure will consider potential increases in user demand as a result of increased temperatures and a decline in raw water quality (i.e., harmful algal blooms).
- Modifications to the raw water intake should consider possible decrease in lake levels as a result of climate change.
- Increase in capacity of the contact chamber or clear wells and conveyance piping and equipment should consider increased water usage/demand as a result of increased temperature.

Linkages

Fairfield Water System Water Loss Reduction Technical Memorandum

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

J.L. Richards & Associates Limited. (2023). *Fairfield WTP Capacity Assessment.*

Yuan, J., Huang, Y., Nie, Z., & Hofmann, R. (2020). *The effect of water temperature on the removal of 2-methylisoborneol and geosmin by preloaded granular activated carbon.*

Conclusions

The capacity of each process unit at Fairfield WTP was evaluated to determine if there are any capacity needs at the plant. Based on the evaluation with current growth projections, it was determined that the plant will need upgrades within the IMP study period.

The following recommendations have been made to improve efficiency and provide insight to staff before upgrades are needed in the future.

It is recommended that a chlorine contact time and clearwell assessment be conducted to determine operational changes that could further delay the need for clearwell expansion.

It is recommended that a raw water intake structure assessment is conducted to provide more insight into the current condition of the intake and what upgrades would be required to increase capacity.

It is recommended that VFD provision for the pumps be prioritized at the Fairfield WTP.

Staff should monitor flows from FWTP annually. When flows reach 80% of plant capacity the expansion process should be initiated.

IMP Technical Memorandum: Bath Water Treatment Plant Needs Assessment

Asset Class: Water

Objective: The objective of this technical memorandum is to provide an overview of the physical and process needs of the Bath Water Treatment Plant (WTP). These needs have been identified through a capacity assessment. The assessment highlights where potential process upgrades may be needed to accommodate flows up to 7,200 m^3/day. Technologies to address taste and odour concerns are also reviewed.

Background

The Bath WTP services the village of Bath as well as several Correctional Services of Canada (CSC) facilities. The plant has a rated capacity of 6,000 m^3/day. Through previous agreements, 2,672 m^3/day of potable water is allocated to CSC, leaving 3,328 m^3/day to service Bath. The population in this area, along with the number of residential dwellings, is projected to increase by over 40% between 2021 and 2046, inevitably creating an increased demand for potable water. Based on the Bath WTP Projections technical memorandum, future flows will not surpass the plant's rated capacity. However, plant capacity was assessed to confirm what upgrades will be required when demand surpasses 80% of the rated capacity.

The plant draws raw water from Lake Ontario which is then treated using a membrane gravity filtration (MGF) system. The MGF consists of two parallel treatment trains, each containing a series of membrane cassettes used to filter water. The capacity of these treatment trains could be increased to 7,200 m^3/day through the installation of additional cassettes. The remaining treatment steps were evaluated to determine what upgrades would be required to match the maximum MGF capacity of 7,200 m^3/day.

Assumptions

The following assumptions were made when developing these documents:

- The potential capacity of the MGF system is 7,200 m^3/day as stated by the manufacturer
- Component descriptions are based on historical operational data (Treated Flows – 3-year trends)

Methodology

To assist the Township in determining the system needs to reach 7,200 m^3/day at Bath WTP, J.L. Richards & Associates (JLR) conducted an assessment of the current capacity of the plant (J.L. Richards & Associates Limited, 2023). The assessment examined where upgrades would be needed to reach the target flow.

Township staff involved with water and wastewater operations provided input with respect to plant deficiencies and operational needs in addition to the JLR assessment.

Data Sources

The data used to evaluate system capacity and form the recommendations presented in this document were obtained from:

- Historical operational data
- MECP Design Guidelines for Drinking-Water Systems
- Equipment technical documentation

Desktop Assessment

The following water treatment systems were evaluated based on guidelines from the Ministry of Environment Conservation and Parks (MECP) and other standard industry guidelines:

- Raw water intake.
- Raw water screening.
- Raw water pumping.
- Raw water conveyance.
- Membrane permeate conveyance.
- Disinfection.
- High lift pumping.
- Residuals management.
- Coagulant addition.
- Sodium hypochlorite addition.
- De-chlorination.
- Emergency backup power generator.
- Electrical systems.

The systems listed above were compared against 7,200 m^3/day to determine if upgrades would be required to operate at that flow.

Analysis

Based on the results from the desktop analysis, Table 1 was produced. This table highlights what systems need upgrades to meet 7,200 m^3/day, along with the associated upgrades.

Table 1. Overview of process units in need of upgrades to meet 7,200 m^3/day.

Process Unit	Process Upgrades Required
Raw Water Intake	Yes – higher capacity intake structure.
Raw Water Screening	None anticipated
Raw Water Pumping	Yes – higher capacity pumps and piping/appurtenances.
Raw Water Conveyance	None anticipated
Membrane Permeate Conveyance	None anticipated

Disinfection[1] (Contact Time)	Yes – clear well expansion or additional disinfection options.
Disinfection (Chlorination)	None anticipated
High Lift Pumping	Yes – higher capacity pumps and piping/appurtenances.
Residuals Management	Yes – higher capacity pumps, piping/appurtenances, settling tanks and decanting system.
Chlorine Storage System	None anticipated
Sodium Hypochlorite System	None anticipated
Dechlorination System (Calcium Thiosulphate)	None anticipated
Electrical Systems	Yes – MCC modifications, electrical conductors, system integration services.
Backup Power	Yes – 400-500 kW generator.

(1) Disinfection upgrades are required to meet the current rated capacity of the plant.

Aside from disinfection, these process unit upgrades are straightforward and should not require expansion of the plant footprint when implemented. The current capacity of the disinfection system for contact time is below the plants rated capacity. Upgrades will be required to meet the current rated capacity, as well as to reach 7,200 m^3/day. Methods for meeting disinfection needs were investigated further by JLR, along with taste and odour control.

Disinfection & Taste and Odour

There have been taste and odour concerns with the treated water that enters the distribution system in Bath. As presented in Table 1 the disinfection system will need to be upgraded to reach the plants rated capacity. The technologies evaluated by JLR can be used to address these disinfection and taste & odour concerns (J.L. Richards & Associates Limited, 2023).

Option 1: Pressurized Granular Activated Carbon (GAC) System and New Chlorine Contact Tank
Option 2: Pressurized GAC System and UV Disinfection System
Option 3: Ozone Injection System

Upgrade Option	Advantages	Disadvantages
Option 1	• GAC addresses taste & odour concerns (proven to work in the past) and will improve water quality • Would meet current and future disinfection requirements	• Expansion of the contact tank is not practical in the current footprint • Construction would likely need to be outside of the existing building footprint (in floodplain)

Option 2	• GAC address taste & odour concerns (proven to work in the past) and will improve water quality • Would meet current and future disinfection requirements • Provides primary disinfection without expanding contact tanks	• Challenges with construction in limited space/floodplain
Option 3	• Addresses both disinfection and taste & odour • Would meet current and future disinfection requirements	• High energy consumption and production of an off gas • Complex operations • Could negatively impact MGF performance

Based on the evaluation and discussion with operations staff, Option 2, pressurized GAC system and UV disinfection system, is the preferred option. It was noted by JLR that increasing the minimum clearwell water level and raising the minimum free chlorine residual could delay the need for disinfection capacity upgrades. It is recommended that an assessment of the contact tank and clearwell be conducted to determine what operational changes could be made to delay the need for upgrades. Option 2 is the recommended upgrade option when required. The timing of these upgrades will be dependent on the outcome of the contact tank and clearwell assessment.

Plant Footprint Expansion

With the addition of GAC filters and UV disinfection, there may be a need for expansion of the plant footprint. Expansion at Bath WTP is challenging due to the plant being located within a flood plain. There is potential for expansion to take place on the north side of the building, where there is currently a covered concrete slab. The washrooms located adjacent to the park could also be used for small plant expansions. Any expansions would require consultation with the Cataraqui Region Conservation Authority (CRCA). The assessment conducted by JLR suggests that the GAC filters and UV disinfection systems could fit in the space north of the building, however, this would need to be evaluated further and discussed with CRCA ahead of detailed design.

Optimization of Operations

As noted above, changes to the minimum water level and free chlorine residual maintained in the clearwell improve chlorine contact time (CT), delaying the need for clearwell expansion or disinfection upgrades. Township staff should investigate these adjustments.

Energy Optimization and GHG Reduction

To reduce the greenhouse gas (GHG) emissions related to water treatment it was recommended that pumps are replaced with more efficient models during lifecycle activities. Pump control with variable frequency drives (VFDs) was also recommended.

Raw Water Intake

There are operational challenges with the raw water intake at Bath WTP. The intake is relatively shallow and short, which can result in elevated levels of suspended solids in the raw water during storm events. It is recommended that the intake structure is evaluated to determine what upgrades would be required in the future.

System Water Loss

The Bath Water System Water Loss technical memorandum provides an overview of how available plant capacity could be affected if water loss in the distribution system was reduced. Reduced water loss would increase the amount of capacity available, further delaying the need for plant expansion. Although plant expansion is not projected to be required within the IMP study period, it is recommended that the Township initiates a water loss reduction program. This type of program is not only beneficial for plant capacity, but also improves distribution system efficiency.

Plant Capacity Expansion

The Bath WTP will need to be expanded within the IMP study period. Current growth projections estimate that the plant will reach 80% capacity around 2039. At this point the process for plant expansion will be initiated. The scale of the plant expansion will be confirmed using updated growth projections when 80% capacity is reached. Assuming the UV disinfection and GAC upgrades have taken place, several process upgrades will still be required to reach 7,200 m^3/day:

- Low-lift pump upgrades
- High-lift pump upgrades
- Backwash pump upgrades
- Generator upgrades

The results of the raw water intake study will inform if structural improvements to the intake are required.

Financial

The upgrades outlined in this document are initial recommendations. While further investigation and design will be required before determining the best course of action, the costs presented below are estimates based on these initial recommendations. They may not be representative of the actual cost of the project when it takes place.

A complete opinion of probable costs for the upgrades needed to meet the target flow is provided in the Bath WTP Capacity Assessment document from JLR. The projects and associated costs listed below are items that are being recommended through the IMP prior to plant expansion.

Upgrade	Estimated Cost

Raw water intake structure assessment (Remedial)	$50,000
Chlorine Contact Tank and Clearwell Assessment (Growth + Remedial)	$50,000
Pressurized GAC system and UV Disinfection System (Growth + Remedial)	Capital - $8,250,000 OPC Total - $11,860,000
VFDs on pumps (Remedial)	$20,000 to $40,000 (x4 high lift pumps)

If the plant is expanded to 7,200 m^3/day the following process unit upgrades will be required.

Upgrade	Estimated Cost
Low lift pump upgrades	$650,000
High light pump upgrades	$1,000,000
Backwash pump upgrades	$200,000
Generator upgrades	$1,300,000
TOTAL	**$3,150,000**

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change/impacts/reduction of GHG emissions and an assessment of the potential for the project to adapt to climate conditions.

Construction and implementation of a pressurized GAC system and UV disinfection system would include installation of pressurized vessels and associated appurtenances and UV disinfection equipment within a constructed addition on the WTP building. This system would also require installation of a new pumping station or membrane permeate pumps at the membrane gravity filtration system upstream of the new GAC filters and UV disinfection equipment as well as additional piping and consideration of upgrades to existing membrane backwash pumps and settling tanks to accommodate GAC backwash cycles.
Climate conditions that will most likely impact the needs of the BWTP in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021).
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline I the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. Fore example it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms is projected to significantly increase (ICLEI, 2021).

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials with the general consensus of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.) and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high-density recycled plastic and composites, etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers, etc.
- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Increase in water temperature throughout the year may affect the efficacy of the GAC filters in their ability to remove taste and odours. Increases to the empty bed contact time may be required (Yuan, Huang, Nie, & Hofmann, 2020).
- Calculations for construction of conveyance and treatment infrastructure will consider potential increases in user demand as a result of increased temperatures and a decline in raw water quality (i.e., harmful algal blooms).

Linkages

Bath Water System Water Loss Technical Memorandum

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

J.L. Richards & Associates Limited. (2023). *Bath WTP Capacity Assessment.*

J.L. Richards & Associates Limited. (2023). *Bath WTP Taste and Odour Control Technology Review.*

Yuan, J., Huang, Y., Nie, Z., & Hofmann, R. (2020). *The effect of water temperature on the removal of 2-methylisoborneol and geosmin by preloaded granular activated carbon.*

Recommendations

The capacity of each process unit at Bath WTP was evaluated to determine if there are any capacity needs at the plant. Based on the evaluation with current growth projections, it was determined that upgrades to address taste and odour concerns and disinfection should be considered. It is recommended that three GAC filters are installed to address taste and odour concerns. To meet current and future disinfection requirements a UV disinfection system should be implemented.

The following recommendations have been made to improve efficiency and provide insight to staff before upgrades are needed in the future.

It is recommended that staff investigate the option to increase the minimum clearwell water level and minimum free chlorine residual to potentially delay the need for disinfection upgrades.

It is recommended that a raw water intake structure assessment is conducted to provide more insight into the current condition of the intake and what upgrades would be required to increase capacity.

It is recommended that VFD provision for the pumps be prioritized at the Bath WTP.

Staff should monitor flows from BWTP annually. When flows reach 80% of plant capacity the expansion process should be initiated.

IMP Technical Memorandum: Water Distribution System – Remedial Needs

Asset Class: Potable Water System

Objective: The objective of this technical memorandum is to outline the specific remedial distribution needs of Loyalist Township within the study period.

Background: The three main serviced communities of Amherstview, Bath, and Odessa each developed their potable water systems independently in the 1960s and early 1970s.

The three distribution systems gradually expanded with the growth of these communities. In the 2000s a trunk main was extended from Amherstview to the Taylor-Kidd Industrial Park. This main also services the rural subdivisions of Harewood and Brooklands, which flank Bath Road/Highway 33 west of County Road 6. In the 2000s a trunk main was constructed from Amherstview to Odessa along the County Road 6 corridor. Commencing in the 1980s and continuing to the early 2000s a program was established of encircling and reinforcing the community of Amherstview with a 400 mm diameter watermain. This project was finalized when new development east of County Road 6 was connected to the existing 400mm diameter main on County Road 6 at Kildare Avenue and Walden Pond Drive.

The Fairfield water system is serviced by the Fairfield Water Treatment Plant (FWTP) and serves the communities of Amherstview, Odessa, and the Bath Road/Highway 33 corridor to the Taylor-Kidd Industrial Park. The Fairfield system includes elevated storage towers in Amherstview and Odessa and a booster pump station with adjacent ground-based storage. The booster station separates the Odessa pressure zone from the Amherstview pressure zone.

There is an emergency connection of the Fairfield system to the City of Kingston system located at the intersection of Bath Road/Highway 33 with Coronation Boulevard.

The Bath water system is serviced by the Bath Water Treatment Plant (BWTP) and serves the community of Bath and the Correctional Services of Canada's (CSC) Millhaven and Bath Institutions.

Hydraulic modeling conducted by J.L. Richards and Associates Limited (JLR) (J.L. Richards & Associates Limited, March 9, 2020, with update on December 1, 2021) provides the basis of most of the technical content of this memo and is appended to the IMP report. Township staff provided direction in terms of expected timeframes for specific developments.

Assumptions

In the calculation of the water demand the following assumptions were made:

- To determine future demand expected residential and commercial areas of development were identified and classified based on the expected timeline of the development.
- Amherstview demand volumes equals Fairfield demand volume minus Odessa's demand volume.
- Average day demand equals the average monthly volume over three years.
- Maximum day demand was estimated by applying a peaking factor of 1.5 to the average day demand, based on Ministry of Environment, Conservation and Parks' (MECP) design guidelines for peaking flow factors (Ontario Ministry of the Environment, 2008).
- The modelling criteria used by JLR aligns with Ontario Building Code (OBC), and MECP guidelines.

Methodology

The Township engaged the services of J.L. Richards and Associates Limited (JLR) to update the existing hydraulic models. The models were last updated in 2014 and 2015 for the Bath and Fairfield systems respectively. For the 2020 model JLR integrated the Fairfield and Bath models into one single hydraulic model even though the Fairfield and Bath systems operate separately of each other. The 2020 review was in response to unprecedented residential development within the Township and the need to plan for the longer term within the scope of the IMP.

JLR utilizes Bentley's WaterCad® software platform. The stated objectives of the JLR 2020 modeling assignment included:

- Gather and review background information to update the water model to reflect physical changes to the distribution system, based on new development, watermain replacements and upgrades, water demands, and system operating parameters
- Carry out a model validation through a pressure and flow program
- Model the distribution system with expected future demands
- Summarize the model results under existing and future conditions for the following demand scenarios:
  - average day
  - maximum day
  - peak hour
  - maximum day plus fire flow
- Identify system deficiencies based on fire flow availability, system pressures, and head losses
- Assess water quality and identify deficiencies
- Identify required infrastructure upgrades to correct deficiencies and improve overall system efficiency for future conditions
- Evaluate interconnection of the two drinking water systems (Fairfield and Bath)

- Evaluate key water quality parameters:
    - trihalomethanes (THM) formulation
    - chlorine residual
    - water age

This evaluation is focusing on pieces of infrastructure that will require upgrades to address remedial issues that were identified through the hydraulic model.

Analysis

Existing Water Demand

JLR analyzed three years of flow data and updated the model accordingly for the Fairfield Water System (2016-2018) and Bath Water System (2015-2017). This data is summarized in the following tables:

Table 1 Amherstview Existing Water Demands

Amherstview – Total Treated Water (2016-2018)				
Average day demand	2440	m^3/d	28.24	L/s
Maximum day demand	3575	m^3/d	41.38	L/s
Peak hour demand	5363	m^3/d	62.07	L/s

Table 2 Odessa Existing Water Demands

Odessa – Total Treated Water (2016-2018)				
Average day demand	798	m^3/d	9.24	L/s
Maximum day demand	1191	m^3/d	13.78	L/s
Peak hour demand	1786	m^3/d	20.67	L/s

Table 3 Bath Existing Water Demands

Bath – Total Treated Water (2015-2017)				
Average day demand	1650	m^3/d	19.09	L/s
Maximum day demand	2654	m^3/d	30.72	L/s
Peak hour demand	3981	m^3/d	46.08	L/s

Future Water Demand

JLR used three future scenarios in their evaluation: near term (2024), mid term (2034), and long term (2044). Expected residential and commercial areas of development were identified with input from Township staff and classified based on the expected timeline of the development. The peak hour demand was estimated as 1.5 times the max day demand. The future average day water demands of each community are noted in the table below. These values are modified from Table 5 in the JLR report.

Table 4 Future Average Day Demands

Area	Near Term 2024 (m^3/d)	Mid Term 2034 (m^3/d)	Long Term 2044 (m^3/d)

Amherstview	2697	3216	3725
Odessa	1025	1313	1636
Bath	1782	1880	1890

Since the JLR study commenced, the Township requested that Hemson complete a population growth study (Hemson Consulting Ltd., 2019). After reviewing the most recent residential growth development and following input from the developer community in the Township, staff have developed a modified growth scenario as outlined in the projections for the treatment capacity of the Bath and Fairfield Water treatment plants found in this document.

Model Verification

Flow validation – JLR, assisted by SCG Flowmetrix, field-tested the model at various locations in the Fairfield system in April 2019. Model results were found to be close to the recorded field values.

Chlorine residual validation – The values predicted in the model for chlorine residual were found to be consistent with/slightly less than measured field values in the Fairfield Water System. The values of chlorine levels were found to be all lower in the field samples then the levels predicted in the Bath Water System model. This means that the models can be considered a slightly conservative comparator for water quality.

Since chlorine residual levels are linked to water age in the pipe system and to THM formation, the model has good correlation with these characteristics of water quality.

System Needs

JLR confirmed the physical operation parameters of the Township's two water systems and the current operational procedures when updating the hydraulic model.

From the results of the recent hydraulic modeling and input from Township's staff the following system needs have been summarized as follows:

Bath System: Modifications to the Mott Street Pressure-reducing Valve (PRV)

Fairfield System: County Road 6 Service and Valve Upgrades, Main Street – Odessa to Millhaven Road

Mott Street PRV

The Mott Street PRV was originally installed to create a local pressure zone for development in the vicinity of Mott Street. The existing PRV receives water directly from the transmission watermain that links the Bath Water Treatment Plant (WTP) to the Bath Elevated Storage Tank. The PRV and associated piping is in a small underground chamber, located at the Westbury Avenue/Mott Street intersection. As the community has grown with local interlinkages in the distribution system, the location and operating pressures of a PRV are restrictive and the unit is having difficulty meeting the expanding needs of the system. The unit needs to be replaced if the use of a PRV facility is required in the near term.

Pressure in the trunk main is higher than the two localized pressure zones in Bath. These zones moderate the system operating pressures and allow for a functional distribution system even as grades increased moving northward away from Lake Ontario. Development over the past two decades has consolidated the older sections of the Bath community, making it difficult to maintain the traditional pressure zones.

There are two alternatives to address the deficiencies of the existing PRV:

1. Replace the facility with a new station with increased capacity that is sized to meet the long-term community needs
2. Disconnect the existing Purdy Road PRV station from the transmission main and decommission the existing chamber; and construct new watermain connections to lower-pressure local distribution mains at Gildersleeve Boulevard and at Windemere Boulevard. Under this option a new PRV would be required at Windemere Boulevard. It would operate in conjunction with the Mott Street PRV, providing resiliency.

Both options were reviewed by staff and modelled by JLR. The second alternative is the recommended option, and with the balance of Gildersleeve Boulevard and a section of Windemere Boulevard being constructed and connected to the Purdy Road water main in 2023, the distribution system will have sufficient feed points to ensure sufficient capacity and pressure. The elevation of undeveloped lands increases to the north of Gildersleeve Avenue; therefore, as development moves north a new pressure zone will need to be established, such that local distribution mains are operated above minimum prescribed pressure levels.

The Windemere PRV is discussed further in the Water Systems Growth Technical Memorandum. *County Road 6 Silver and Valve Upgrades, Main Street – Odessa to Millhaven Road*

When the trunk watermain connecting the community of Amherstview to Odessa was constructed, County Road 6 had recently been resurfaced. Based on the preference of the County to minimize road cuts at the time, the existing properties on the west side of County Road 6 between Main Street and Shane Street were not connected to the new watermain and the existing main was kept in operation.

These services were flagged for replacement prior to County Road 6 being resurfaced again. In 2021 Loyalist Township replaced the water services between Shane Street and Millhaven Road. New water services north of Millhaven Road to properties on the west side of County Road 6 remain to be installed and the old section of main decommissioned. At a later date a main was extended north of the intersection adding to the complexity.

Operations staff have noted that the valving at the intersection of Main Street – Odessa and County Road 6 is difficult to operate due to the high traffic volumes and the location of the existing valves in the traffic. This is a key node for the distribution system. Original pipe location and pipe intersections were based on original main locations, and the trunk watermain from Amherstview was positioned intentionally to minimize road cuts. When the remedial servicing described above is completed, some of this main will require decommissioning.

A practical solution is to complete the remedial servicing and valve/piping modifications in the intersection prior to the resurfacing of the adjacent road surfaces. The road resurfacing is planned for the near term by the County of Lennox and Addington. It is expected that this project will be one of several sub-projects linked to the resurfacing of Main Street – Odessa.

Prior to the County's planned work on Main Street – Odessa, it is recommended that the valve and main connections be revised to meet operational and hydraulic efficiencies and the old main on County Road 6 be decommissioned.

Bath Transmission Main

The transmission main is an essential component of the Bath water distribution system.

As infill development occurs around the alignment of the main, there is an opportunity to replace the main in a relocated position that is coordinated with the new development. A section of transmission main was recently relocated with the extension of Gildersleeve easterly. It is recommended that this process of relocation continue as the existing main is approaching its useful service life rehabilitation of this main at the same time.

The transmission main was originally installed with a cathodic protection system which has failed in at least two locations, and possibly others. One known location is near the creek running through Centennial Park, and the other is adjacent to the sections where the main was relocated to Gildersleeve Boulevard. It is recommended that the cathodic protection system be repaired for those sections of transmission main that are not expected to be replaced or rehabilitated over the next few years.

The forcemain cathodic protection systems should be monitored regularly. If development along the Windemere Boulevard corridor does not progress as expected, consideration should be given to replacing any remaining sections of the original forcemain in accordance with the tangible capital asset management schedule.

Church Street

The original servicing of Bath included a 19mm service line feeding two homes on Church Street between Main Street – Bath and the lake shore, which is still in service.

The service line is insufficient in size to service two homes, and couplings in service lines are prone to leaking over time. This line cannot be flushed due to the size of the piping and lack of appropriate flushing hardware.

It is recommended that the service line be replaced as a medium- to high priority; and that when this work is undertaken, the Township evaluate the need for fire hydrants along the block, both for fire suppression and to facilitate system flushing. The roadway in this block requires resurfacing, so ideally the work could be coordinated.

Main Street – Odessa

Main Street – Odessa will undergo road reconstruction within the IMP study period. The details of this project are discussed in the Main Street – Odessa technical memorandum. As a part of this project the watermain along Main Street – Odessa will be replaced with a 300mm diameter main and extended to Shane Street. The replacement of the current main is considered remedial, however, the watermain oversizing and extension are growth costs.

System Dead-ends

The initial provision of municipal potable water in Odessa and Bath was a reaction to failing private systems. The pipe network installed at the time addressed the primary need of supplying safe drinking water to each household. Unfortunately, much of the original distribution piping would be considered below today's standards, both for efficient distribution that minimizes water age in the network and for good hydraulics for fire suppression. Older water age in the system is often associated with undesirable traits, such as higher levels of disinfection by-products and lower free chlorine residual levels.

While over the past few decades the Township has eliminated or reduced the extent of dead ends in the distribution system by adding new piping and creating looping, some areas remain that would benefit from improvements in this regard.

It would be useful to evaluate the most advantageous locations for additional looping within the community, and then work with local developers to address priority areas. It is recommended that the Township identify priority areas for watermain looping efforts, and coordinate with developers to place development such that as many dead ends as possible may be eliminated. Similarly, the Township should address any locations where dead ends result in moderate to high levels of maintenance and improvements via new adjacent development are not an option.

Water Hauler Facility

Water haulers fill at the booster pump station located at 243 County Road 6, south of the CN Rail crossing and adjacent to the ground-level water storage reservoir. Haulers appreciate the high-volume pumps located at this facility, which can substantially reduce waiting and fill times for the larger tankers. Most of the water hauled from this facility is consumed by individuals outside of the potable water service areas.

Operations staff have raised concerns regarding the road that provides access to the Fairfield water system's bulk water facility, as the access lane is close to the reservoir. Staff are concerned that a large truck could collide with the reservoir and damage the tank.

Consideration was given to relocating the facility; but after analyzing potential locations staff felt that moving the facility in the short term was impractical. As an alternative it is proposed that the tank be protected by a row of precast concrete Jersey barrier walls. It is recommended that this protective measure be initiated as soon as possible.

Water Loss

With reference to the separate technical memoranda on water loss in the Bath and Fairfield water systems, it is recommended that system water loss is an important problem that requires systematic direct attention. The high volume of losses results in less water being available for new development, and higher treatment costs based on more energy and treatment-related chemical use.

Taste and Odour

The Township's annual drinking water quality report for 2022 (Loyalist Township, 2023) notes that the Bath system has struggled with taste and odour control. Recent upgrades to the filtration process at the Bath WTP have improved the resiliency of the process and expanded the firm filtration capacity, but the modifications have not reduced the taste and odour complaints.

Staff have sought assistance from JLR on this topic, and their firm has analyzed the Bath Water Treatment Plant. It was determined that a combination of UV disinfection and pressurized GAC filters would help reduce disinfection and taste and odour concerns at Bath WTP (J.L. Richards & Associates Limited, 2023). Please refer to the Bath Water Treatment Plant Needs Assessment memorandum for a more detailed discussion of this topic.

Disinfection Process By-products

Trihalomethanes (THMs) and haloacetic acids (HAAs) are by-products of disinfection, formed when chlorine reacts with organic matter naturally present in water. The level of THMs and HAAs in treated water depends on numerous factors including total organic carbon, temperature, PH, chlorination dose, and residency time (water "age") in the distribution system.

The allowable levels of THMs and HAAs are regulated and monitored regularly. While observed concentrations in both the Fairfield and Bath systems are higher than desired, they are of particular concern in Bath.

Although higher THMs and HAAs usually appear in the distribution system, they are highly influenced by water quality and treatment plant processes. The proposed UV and GAC upgrades for Bath WTP will also help in reducing concerns with disinfection by-products.

Water Meter Age

The Township's inventory of water meters is aging rapidly when compared to the estimated useful life (EUL) of a meter. Loyalist Township staff tested 17 meters at Utilities Kingston's water meter testing facility. The test group were purposely selected from older meters aged 17 years or older. The results indicated that under low flow conditions, 90-95% of meters recorded numbers lower than actual consumption.

The Township's water meter data base yielded the following information on meter age as of December 31, 2021.

Table 5 Analysis of Current Water Meter Ages

	Water Meters – post-2010 EUL 15 years		Water Meters - pre-2010 EUL 25 years		Total Average of Age (Reporting Year)	Total Average of Service Life Remaining (Reporting Year)
	Average of Age (Reporting Year)	Average of Service Life Remaining (Reporting Year)	Average of Age (Reporting Year)	Average of Service Life Remaining (Reporting Year)		
Fairfield	7.79	7.21	21.21	3.79	13.30	5.81
Bath	7.61	7.39	24.18	0.82	17.90	3.31
Grand Total	**7.76**	**7.24**	**22.09**	**2.91**	**14.30**	**5.27**

Water meter age is expected to be one of the contributing factors in the total water system losses.

It is recommended that Loyalist commence a program to replace the meters that have met their expected useful service life. Consideration should be given to selecting metering technology that can react to low flow conditions often associated with plumbing issues and reduce data gathering costs.

Storage and Fire Suppression Capabilities – Bath Road/Highway 33 and Taylor-Kidd Industrial Park

In response to urgent remedial needs, in the late 1990s Loyalist Township was able to retire two poorly performing small water systems, Harewood and Brooklands, by extending a watermain along Bath Road/Highway 33 to service these communities and connecting the new main to existing piping. These mains were sized at 250mm Ø from County Road 6 to Edgewood Road, and at 200mm Ø from Edgewood Road to Bayview Drive. This sizing was felt to be adequate for these communities.

In response to new post-Walkerton water legislation, the local industries then known locally as Kosa, Bombardier, and Kingston Co-Gen negotiated an agreement with Loyalist Township for the extension of a municipal watermain to their facilities in the Taylor-Kidd Industrial Park, which took place in the late 2000s. Although the construction included the installation of fire hydrants, the agreements specifically note that the main had not been designed to support fire suppression, especially for the fire demand of the larger industries.

This system deficiency remains in place in 2023.

This arrangement was satisfactory for the local industries due to the presence of a major raw water pumping station on the former Kosa site. Through private agreements this facility continues to operate supplying raw water and water for fire suppression purposes to the existing (as of September 2023) industries in the Taylor-Kidd Industrial Park.

The likely municipal solution for this deficiency would be the construction of a combination of onsite fire water reservoirs and a standpipe or booster pump station to maintain local pressures.

After discussions with Loyalist Township Council there has been a decision that there are no plans within the IMP to improve the storage capacity situation in a manner that the Township can offer full fire suppression capabilities in the Industrial Park and along Bath Road/Highway 33 west of Parrott's Bay.

Financial

Mott Street PRV

Costs for a new 300mm PRV are approximately $25,000. Piping, chamber, and valving costs would be significantly higher. Sizing of the PRV should consider long-term fire demands which will increase as the service area grows.

County Road 6, Main Street – Odessa to Millhaven Road Service and Valve Upgrades

The cost to abandon the old watermain and change existing services to the new watermain is $89,578. The estimate assumes the work is undertaken in conjunction with County

Bath Transmission Main

Costs for this project should be treated similar to a life cycle replacement.

This approach limits the project to funding from water and sewer rates, or grant funding if available, except as noted below.

The transmission main is part of the infrastructure included in the provision of water service agreement with CSC. As such, CSC's contribution to this project is significant and proportional, as per the current service agreement. This contribution can be expected to be in the range of 40-50% of the total project expenses, based on current water use demand by the village and CSC respectively.

Church Street

Costs for the updating of this water line is estimated at $348,039. This estimate includes a new hydrant on Main Street – Bath, road reconstruction of the southern end of Church Street, and sidewalk replacement/upgrade to current standard.

Odessa Main Street

The remedial costs for this project are estimated at $5,031,000. The growth costs for oversizing and extending the watermain are estimated at $300,000. The total water related costs for Odessa Main Street are projected at $5,331,000.

System Dead-ends

Costs for this project should be treated in a similar fashion as a life cycle replacement. This approach limits the project to funding from water and sewer rates, or grant funding if available. However, if the looping can be tied into servicing construction required for new development, a direct contribution from or to the developer, as appropriate, can be made through the provisions of the subdivision agreement.

Water Haulers Facility

If precast barriers are deemed suitable for the protection of the ground-based reservoir, the supply and placement of barriers is in the range of $20,000-$30,000, not including any regrading of the road surface.

This expense is funded by water rates as the revenue from this facility goes into the general water funds.

Disinfection Process By-products and Taste and Odour

Township staff are in the process of developing a plant improvement plan that increases firm capacity of the plant, improves the levels of disinfection by-products in the distribution system, and addresses taste and odour issues. Refer to the BWTP Needs Assessment memorandum for more details.

Water Meter Replacements

Data indicates that many meters are over 20 years old, and that over half are incapable of the accurate low flow readings that meters with newer technology record. It is likely more efficient to plan for a major replacement program using experienced contractors to manage the whole process, like the recent program undertaken by Utilities Kingston, rather than try to address individual meter replacement in the traditional fashion. This will allow for bulk purchasing and delivery of meters, as well as focused meter replacement teams that don't conflict with other operational duties. Under this scenario, only meters that are not close to their end of estimated service life would be retained. Detailed budgets for this program have not been established.

This program will have to be funded by water and sewer rates. It is expected that the billed volume of water will increase as a whole with the installation of newer meters. The increase in sales will partially contribute towards the meter replacement program.

System Water Losses

In discussions with Hemson, the Township's financial advisors for evaluations of recent growth-related charges, it has been suggested that the Township consider a portion of the leak detection program expenses as a growth charge, as any system improvements will lead directly to the availability of additional capacity for new development. The balance of the program expenses would have to be paid for by the water rates or any available grant funding.

Climate Lens

Several aspects of Loyalist's Townships water distribution system require remedial action including replacement of water services and water mains, upgrading or replacement of PRVs and replacement of water meters and addressing taste and odour issues. These remedial activities should not be impacted by the conditions of climate change; however, improvements will generally increase efficiency, thereby mitigating the impacts of climate change through lowering energy consumption and GHG emissions.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Climate change requires extra hydraulic capacity. It is estimated that with an increase in temperature of between 2% and 6% by 2100, there will be an increase in demand of 14% to 45% (Roshani et al., 2022). Sizing of watermains should take this potential increase into consideration.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Alteration, upgrading or replacement of PRVs will decrease loss of unnecessary pressure downstream. Lowering pressures will decrease water consumption and decrease in wastewater generation. Decreasing water consumption results in a decrease in energy use, ultimately decreasing GHG emissions.

- Coordinating replacement of water services and mains to occur when road re-construction is scheduled will reduce excavation and use of road construction materials (asphalt and granular materials).

Linkages

Water Systems Growth Technical Memorandum

Water Storage Technical Memorandum

Fairfield Water System Water Loss Technical Memorandum

Bath Water System Water Loss Technical Memorandum

Bath Water Treatment Plant Needs Assessment Technical Memorandum

References

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

J.L. Richards & Associates Limited. (2023). *Bath WTP Taste and Odour Control Technology Review.*

J.L. Richards & Associates Limited. (March 9, 2020, with update on December 1, 2021). *Loyalist Township - Water Model Update.*

Loyalist Township. (2023). *2022 Drinking Water Quality Report.*

Ontario Ministry of the Environment. (2008). *Design Guidelines for Drinking-Water systems.*

Environmental Law & Policy Center (ELPC). 2019. An Assessment of the Impacts of Climate Change on the Great Lakes.

Conclusions

The following tasks are recommended:

High Priority

Mott Street PRV: address aging infrastructure, address pressure-related complaints from customers

County Road 6 Service and Valve Upgrades, Main Street – Odessa to Millhaven Road: Priority due to County paving schedule

Church Street: priority is due to coordinate the water main improvements within the expected timeframe to complete road surface restoration

Water hauler facility vehicle barrier protection

Disinfection process by-products and taste and odour concerns: Treatment plant improvements have the potential to provide positive impact to taste and odour conditions in the distribution system. Forward movement on this project is a priority because of the lengthy implementation timelines and the need to maintain capacity to match growth needs. It would be impractical to address one issue without addressing the other.

Main Street – Odessa: The watermain replacement should occur along with the road reconstruction project.

System dead-ends: Initiate communications with developers to expedite in-fill of vacant lands near community of Bath core (i.e., lands between County Road 7 and Westbury Avenue)

Medium Priority

Bath Transmission Main: Depending on location, various external factors affect priority status. If the Township proceeds with the Main Street – Bath reconstruction, that portion of the transmission main on Main Street – Bath would be high priority. If replacement or rehabilitation of sections of this main is deferred indefinitely, completing repairs to the cathodic system should be prioritized

Water meter replacements: An integral part of the water loss challenge

Low Priority

System dead-ends: Priority status is subject to maintaining acceptable levels of disinfection by-products and free chlorine residual in the distribution system. Messaging to developers to complete in-fill should be a high priority. Deferral of these linkages will result in higher maintenance costs.

IMP Technical Memorandum - Fairfield Water System Water Loss

Asset Class: Water

Objective: The purpose of this technical memorandum is to outline the benefits of reducing water loss in the Fairfield Water Distribution system, which services the communities of Amherstview and Odessa. The development and implementation of a water loss reduction strategy has the potential to not only increase the amount of available capacity at a plant, thereby delaying the need for costly plant expansions, but could also lower costs and limit the environmental impact of treating and distributing potable water.

Background

The Fairfield Water Treatment Plant (FWTP) draws water from Lake Ontario and has a rated capacity of 8,000 m^3/d. The population in the areas serviced by this plant is projected to increase by 30% between 2021 and 2046, meaning the demand for potable water will inevitably increase.

The Fairfield Water Distribution system is susceptible to water losses, with the 2021 Annual Drinking Water Report indicating that 34% of the water sent to the Fairfield distribution system in that year was non-revenue water. Non-revenue water is water that has been sent out to the distribution system but is unbilled, often referred to as water losses.

The total non-revenue water of 34% can be broken into the following categories: real loss, apparent loss, and unbilled authorized use, as shown in Figure 1.

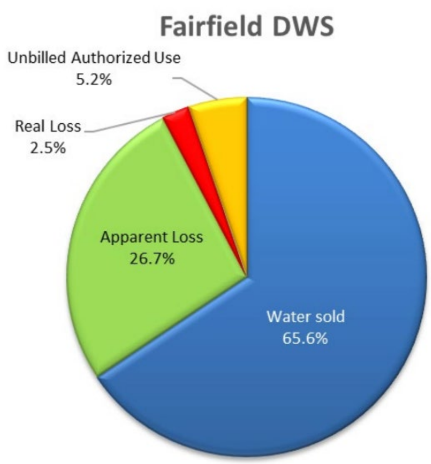


Figure 1 - Breakdown of Non-revenue water in the Fairfield drinking water system in 2021

These terms are defined as follows:

- Real loss is actual potable water being lost from the system, typically through leaks.

- Apparent loss is not truly water being lost, but instead a result of inaccurate metering or unauthorized use.
- Unbilled authorized use is water being used by municipal buildings including recreation centers, for hydrant flushing, or for firefighting.

It should be noted that these figures are estimates developed based on available data. As such, it is difficult to accurately differentiate between apparent loss and real loss.

Across Canada, water losses in distribution systems range from 7.5 to 21%, typically averaging 13%. The higher-than-average percentage of water loss in Amherstview and Odessa could suggest the presence of leaks in, or unauthorized connections to, the Fairfield distribution system. High rates of water loss in a system can lead to premature wear on equipment and higher chemical usage rates, which in turn can result in higher costs for the end user. Furthermore, as a municipality, Loyalist Township has a responsibility to ensure that an acceptable quantity and quality of water supply is available for future development, and that the approval or build-out of new connections does not exceed the design capacity of the water system. Reducing water losses in the distribution system will improve efficiency in the use of the FWTP's capacity, ensuring that future demand is met over the long term while delaying the need for costly plant expansion activities.

Assumptions

The following assumptions were made when developing these documents:

- The number of connections to the plant includes both residential dwellings as well as industrial, commercial, and institutional (ICI) accounts
- Connections are expressed in Equivalent Residential Units (ERUs)
- ICI growth is assumed to be proportional to population growth
- For the sake of maintaining consistency with the Uncommitted Reserve Capacity (UCRC) calculations developed each year, the methodology used to develop the figures presented in this technical memo are based on the MOE procedure D-5-1. Specifically:
    - Potable water needs are expressed in terms of maximum daily flow
    - The projected water demand for an ERU is based on the maximum daily flow value per ERU observed in the previous three years (between 2019 and 2021)

Methodology

Data Sources

Data used to develop the figures presented in these documents were obtained from the "Population and Dwelling Growth" and "Fairfield WTP Projections" technical memorandums included as part of the IMP, as well as the 2022 UCRC calculations for the FWTP and the 2021 ICI water account listing for Loyalist Township.

Flow per ERU

To perform the analysis on water loss from the distribution systems, flows were normalized on a per-ERU basis. This allowed for a direct comparison between the billed average daily flows at each connection and the plant flows needed to provide these connections with potable water. Table 1 presents the billed average daily water consumption per ERU in Amherstview and Odessa, as well as the calculated flow per ERU for the FWTP between 2019 and 2021.

Table 1. Billed and plant flows per ERU for Fairfield water distribution system

	Average Daily Flow per ERU – Billed (m^3/day/ERU)			**Average Daily Flow per ERU – Plant Flows (m^3/day/ERU)**		
Year	Amherstview	Odessa	Fairfield System	Amherstview	Odessa	Fairfield System
2019	0.402	0.403	0.402	0.612	2.035	0.791
2020	0.411	0.370	0.405	0.606	2.154	0.813
2021	0.403	0.377	0.399	0.459	1.656	0.632
Average	**0.405**	**0.383**	**0.402**	**0.559**	**1.948**	**0.745**

Table 1 shows that the plant flows values are higher than the billed flows, indicating that not all water being pumped from the plant is reaching the connections. There are several consequences in having a large difference between these values, including the loss of a significant amount of potable water in the distribution system, the plant operating at higher production than required, and less capacity being available for future allocation.

Percentage of Non-revenue Water

The volume of water leaving the plant can be compared to the volume of water billed to each connection, with the difference between these volumes indicating the amount of water lost in in the distribution system. These values can then be used to calculate the percentage of non-revenue water within the system by using the following equation.

$$\%\ Non\text{–}Revenue\ Water\ = \frac{(Plant\ Flows - Billed\ Flows)}{Plant\ Flows} \times 100\%$$

Table 2 below shows the percentage of non-revenue water for each area as well as for the Fairfield system as a whole.

Table 2. Percent of non-revenue water for each distribution system

Year	Amherstview	Odessa	Fairfield System
2019	34%	80%	49%
2020	32%	83%	50%
2021	12%	77%	37%
Average	**28%**	**80%**	**46%**

Note that the 2021 value for the Fairfield system is slightly different than the annual report. This is due to a small difference in data that is used for calculations.

The values in Table 2 indicate that the percent water loss in the Fairfield distribution system is significantly higher than the national average of 13%. The values for Odessa are particularly concerning, with an average of 80% of water being lost in the system over the last three years. It should however be noted that work conducted in 2020 and 2021 to fix leaks in the system have reduced the amount of water being lost in both Amherstview and Odessa, leading to lower water loss values in 2021 relative to 2019 and 2020. It is anticipated that these values will continue to decrease as additional sources of water loss are addressed.

Categories of Non-revenue Water

As outlined in the Background section of this document, non-revenue water can be broken down into three distinct categories: real loss, apparent loss, and unbilled authorized use. Estimates for each of these categories are typically included in the Annual Drinking Water Reports for the Fairfield Water system, with Table 3 below providing a summary of these values between 2019 and 2021.

Table 3 - Breakdown of unbilled authorized use, real loss, and apparent loss in the Fairfield Water System, expressed as a percentage of non-revenue water

Year	Unbilled authorized use	Real loss	Apparent loss
2019	19.8%	5.7%	74.5%
2020	11.5%	13.1%	75.4%
2021	15.1%	7.2%	77.7%
Average	15.5%	8.7%	75.9%

The table above indicates that, based on a 3-year average, 15.5% of the non-revenue water in the Fairfield Water System can be attributed to unbilled authorized use, 8.7% to real loss, and 75.9% as apparent loss.

Figure 2 below illustrates the amount of water that needs to be produced by FWTP each day to service one ERU, as well as how that water is lost or used between the plant and the final connection.

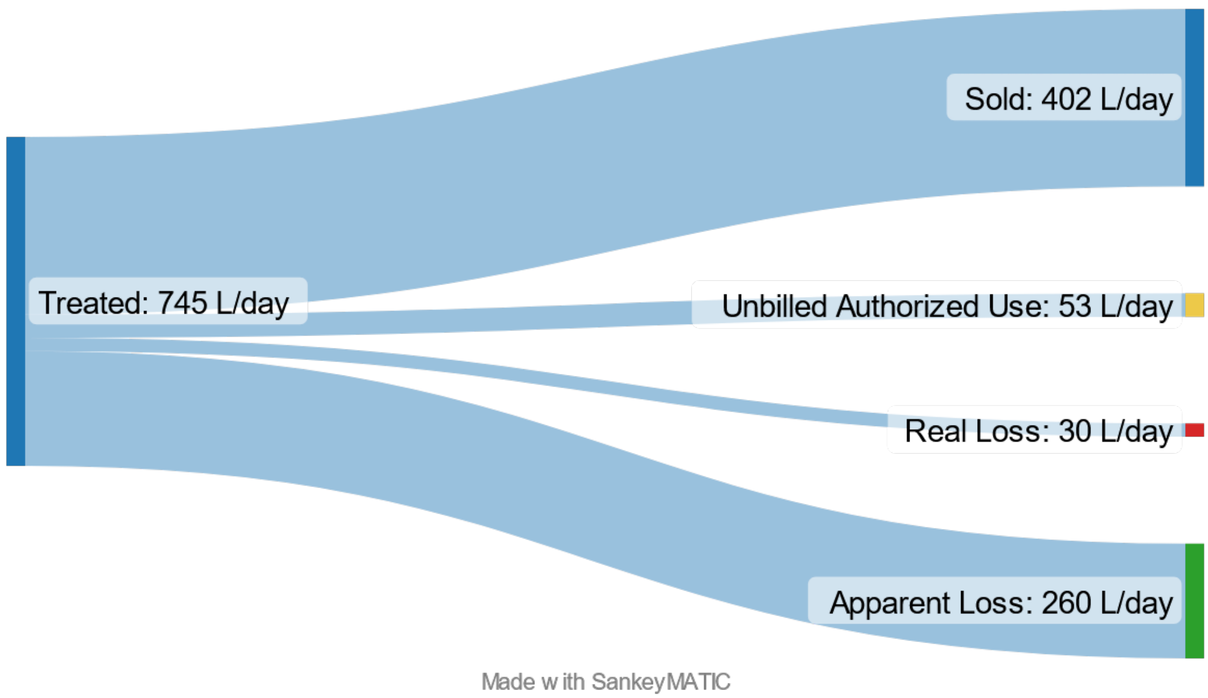


Figure 2 - Sankey Diagram Illustrating the amount of water required to service 1 ERU in the Fairfield Water System

Analysis

Reducing Water Loss in the System

Although some amount of non-revenue water is to be expected, such as through unbilled authorized use, reducing the amount of water losses in the distribution can lead to a number of beneficial impacts. These range from increasing the amount of available capacity for the system, to reducing the amount of energy associated with treating and distributing water to customers.

Non-revenue water attributed to unbilled authorized use serves important functions such as hydrant flushing, firefighting, and plant operations. As such, expecting a reduction in these figures is unrealistic, given that these activities are an important components of ensuring public safety and ensuring the quality of water produced and distributed in the system.

Similarly, the rate of real loss in the distribution system is typically attributed to events such as watermain breaks and can vary year to year. These incidents are unpredictable in nature and therefore hard to control; however, they could be minimized through proper asset management planning, such as the replacement of aging watermains. Although the Township is currently striving to replace aging infrastructure on a continuous and regular basis, it would be unrealistic to expect a significant reduction in real loss through the elimination of watermain breaks.

As such, focusing on reducing the apparent water loss in the system provides the best opportunity to reduce the plant flow per ERU of the Fairfield water system. It is important to note that, although watermain leaks are typically considered as real losses, they may be categorized as apparent losses until they are discovered.

The following is an analysis of the impacts of reducing the apparent loss in the Fairfield system over two different scenarios, relative to a business-as-usual (BAU) case.

Under the BAU scenario, volumes of sold water, unbilled authorized use, real loss, and apparent loss increase proportionally with the number of new connections to the Fairfield water system. This would increase the average daily plant flow for the Fairfield WTP from 3,851 m^3/day in 2021 to 5,292 m^3/day in 2046. These flows, broken down into their various components, are illustrated in Figure 3 below.

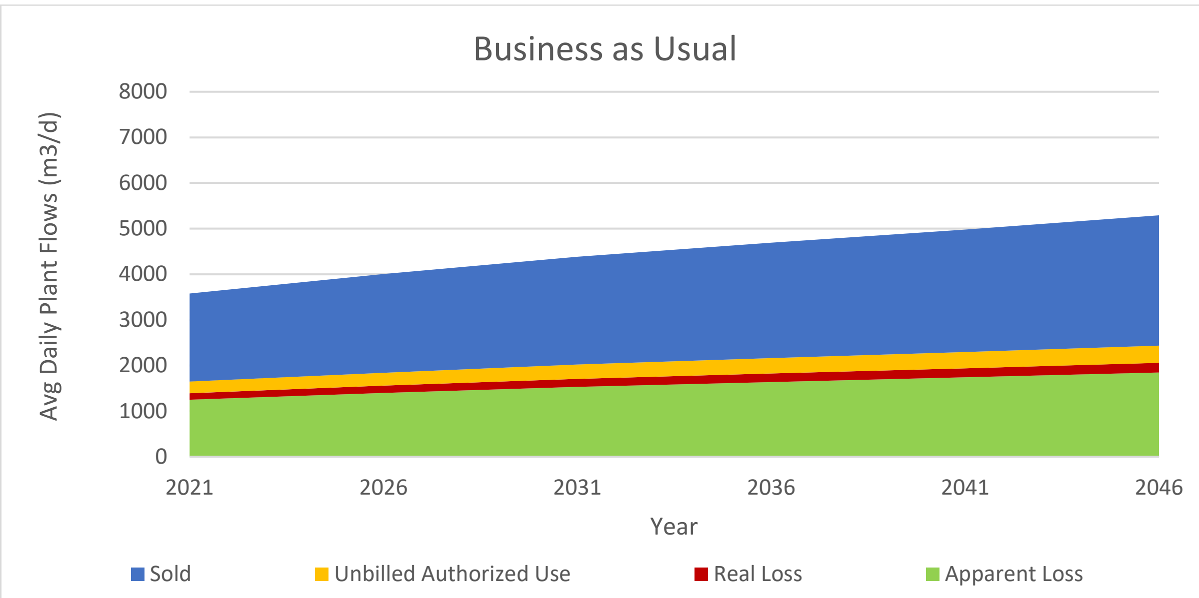


Figure 3 – Breakdown of average daily plant flows under the business as usual case

Scenario 1 examines the effects of maintaining the existing volume of apparent loss constant while volumes of sold water, unbilled authorized use, and real loss increased proportionally with growth. This scenario, which would result in a gradual decrease in the percentage of apparent loss, should be achievable since it is improbable that the factors which contribute to apparent loss will increase as the system expands. For example, unauthorized connections are unlikely to occur in new subdivisions. Under this scenario, the average daily plant flow for the FWTP would increase from 3,851 m^3/day in 2021 to 4,672 m^3/day in 2046, as illustrated in Figure 4 below.

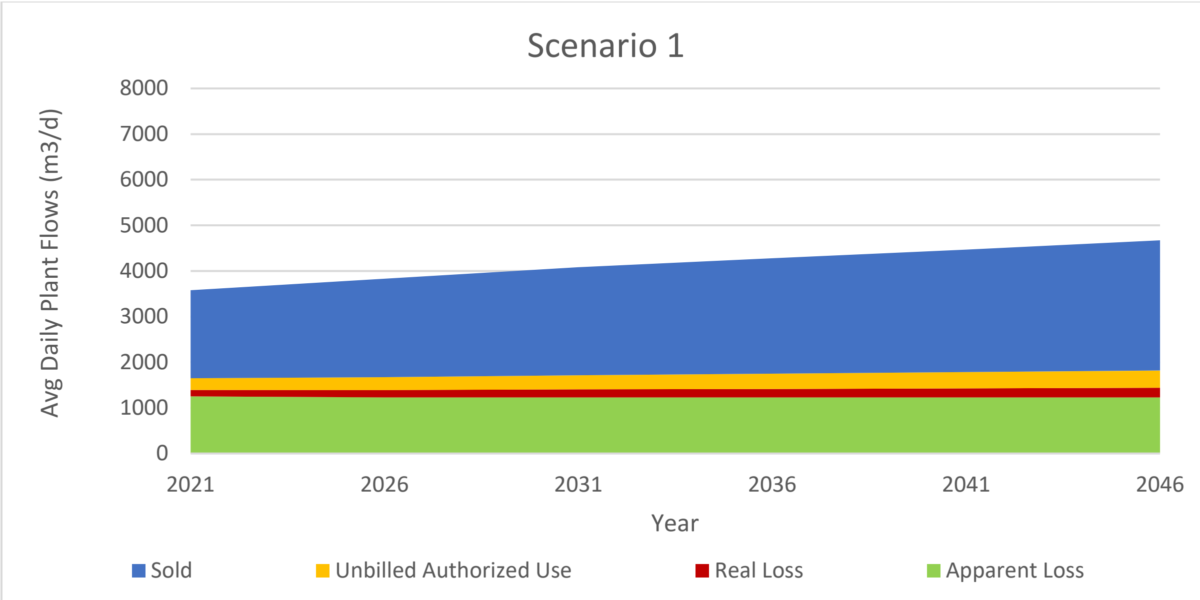


Figure 4 – Breakdown of average daily plant flows under Scenario 1

Finally, Scenario 2 examines the effects of gradually reducing the volume of apparent loss while volumes of sold water, unbilled authorized use, and real loss increase proportionally with growth. This scenario, which would result in a more pronounced decrease in the percentage of apparent loss compared to Scenario 1, would require concerted efforts to find and reduce the cause of water losses, such as through meter replacement programs or leak detection studies. Under this scenario, the average daily plant flow for the Fairfield WTP would only increase from 3,851 m^3/day in 2021 to 3,793 m^3/day in 2046, as illustrated in Figure 5 below.

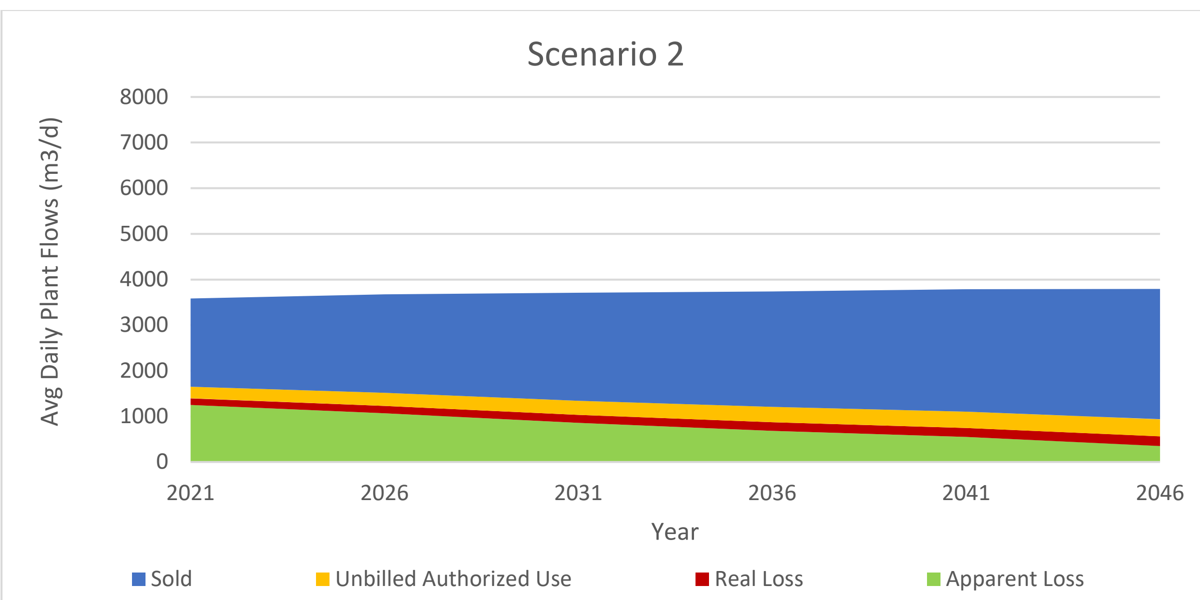


Figure 5 - Breakdown of average daily plant flows under Scenario 2

Impact on Maximum Day Flows and Plant Capacity

The scenarios presented above are expressed in average daily plant flows. However, water plant capacity calculations make use of maximum daily flow values, as opposed to average daily flow, to help determine the amount of available capacity in the system. As such, maximum daily flows from FWTP can also be calculated for the scenarios presented above.

Maximum daily flow per connection is one of several factors used to calculate the available capacity for a given water plant, with a reduction in per capita flows typically leading to an increase in available capacity.

A value known as the peaking factor, defined as the ratio between average daily flows and maximum daily flows, can be used to convert average daily flows to maximum daily flows. Available data indicates that the three-year average peaking factor for the Fairfield water system is 1.39. As such, target maximum daily flows per ERU under both scenarios can be calculated by multiplying the target average daily flow per ERU from Table 3 by the peaking factor, as per the equation below.

$$Target\ Max\ Daily\ Flow = Target\ Average\ Daily\ Flow\ \times Peaking\ Factor$$

Table 4 summarizes the projected average and maximum daily flows per ERU in 2046 under BAU conditions, as well as under both proposed scenarios.

Table 4. 2046 Projected Average and Maximum day flows per ERU for each scenario

	Average Daily Flow per ERU (m^3/day/ERU)	**Maximum Daily Flow per ERU (m^3/day/ERU)**
BAU	0.745	1.04
Scenario 1	0.668	0.91
Scenario 2	0.534	0.74

The values in Table 4, combined with the growth projections for Amherstview and Odessa, can be used to calculate the projected maximum daily flows for FWTP under both scenarios, as presented in Figure 6. These scenarios are compared to the projected plant flows under a BAU scenario, which assumes that no work will be done to identify and address water losses in the distribution system. These data are overlaid against a value of 6,400 m^3/day, 80% of the plant's rated capacity being the threshold at which plant expansion activities should begin. Under both presented scenarios, the projected maximum daily flow values remain below, or in one case, meet, the 80% threshold by 2046, as opposed to the BAU scenario, in which plant flows are projected to exceed 80% of the plant's capacity by 2033.

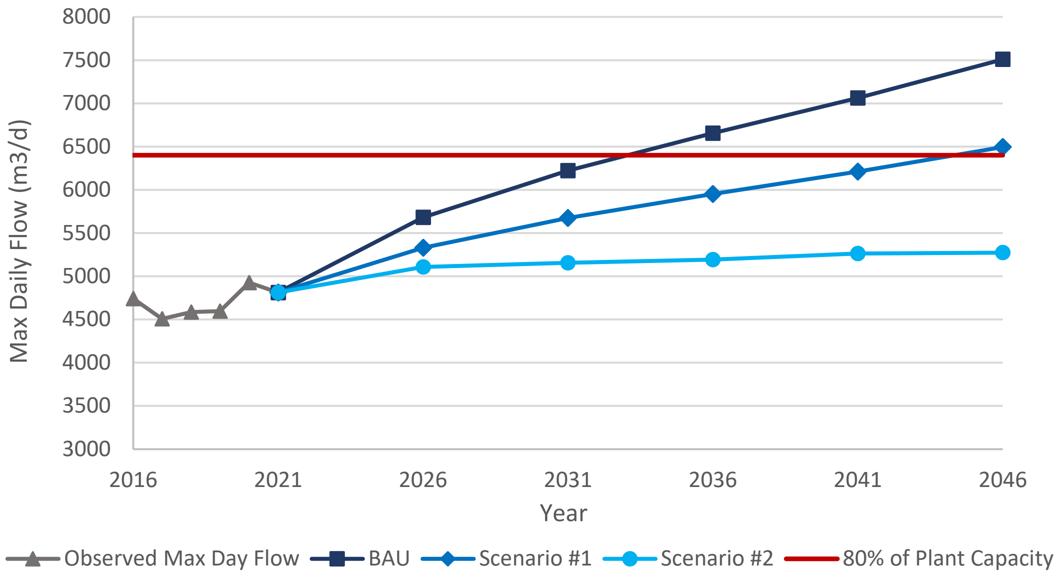


Figure 6- Projected maximum daily flow for each scenario. The horizontal red line represents 80% of the plant's 8,000 m^3/day rated capacity.

Finally, the projected maximum day flows can also be used to calculate the plant's projected available capacity under each proposed scenario. The available capacity is determined by subtracting the following flows from the plant capacity of 8,000 m^3: residential, ICI, purchased-but-unused ICI, and committed-but-unbuilt units. These flow values will vary significantly depending on the maximum flow per ERU value used in the calculations, resulting in substantial differences in projected available capacity over time.

Figure 7 and Table 5 below summarize the projected available capacity for each of the scenarios compared to the projected plant flows under a BAU scenario, in which capacity is approaching zero by 2046. Under both presented scenarios, the projected available capacity in 2046 increases significantly.

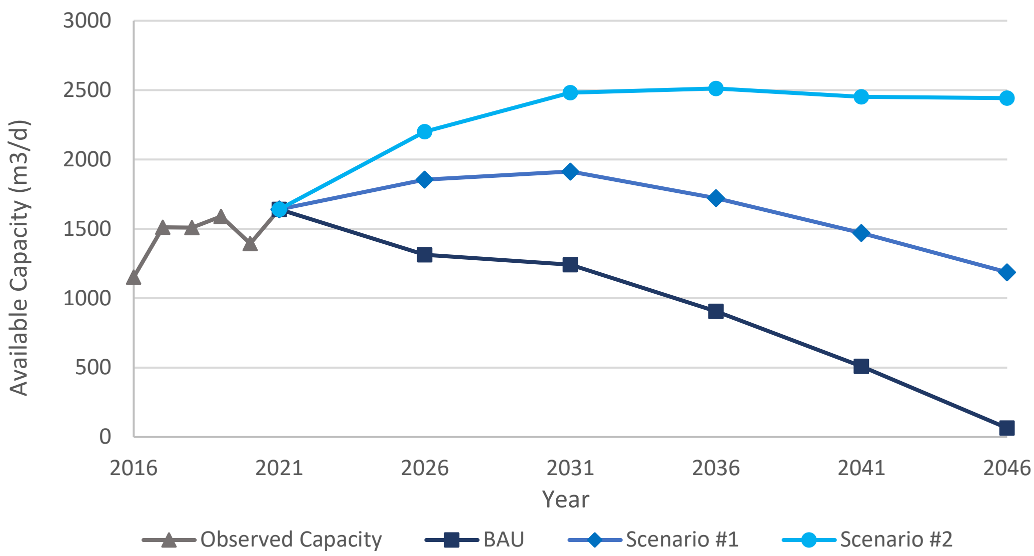


Figure 7- Available capacity at FWTP for each scenario

Table 5: Availably capacity at FWTP in 2046 for each water loss reduction scenario

Available Capacity in 2046 (m^3/d)		
Current	Scenario 1	Scenario 2
64	1,187	2,443

Limitations

The potable water demand forecasts presented in this Technical Memorandum are linked to projected population and dwelling growth for Loyalist Township over the course of the study period. These projections are based on the best-available information at this time and are subject to change based on any number of scenarios. Alterations to these projections would result in a change in available capacity for all water loss reduction scenarios.

Recommendations

Based on the analysis performed above, the implementation of a water loss reduction program (Federation of Canadian Municipalities & National Research Council, 2003) in the Fairfield distribution system is recommended. Reducing water loss could significantly increase the available capacity at the FWTP while reducing operating costs as well as costs to customers.

As previously discussed, there are two categories of non-revenue water which can be considered: apparent loss and real loss.

Apparent water loss can be due to water meter inaccuracies at customer buildings, accounting procedure errors, and unauthorized consumption. Performing an assessment of water meters and associated procedures associated with quantifying water usage at a connection would be a good first step in addressing apparent water loss.

Alternatively, a smart-metering program, similar to the one implemented in 2021 at the City of Cambridge, Ontario, could also be implemented in order to increase the accuracy of meter reading data. This would involve gradually installing, or transitioning to, smart meters at all locations serviced by a water connection. Smart meters use an advanced metering infrastructure (AMI) system that allows for remote meter reading, data analysis and alerts for possible leaks or problems (City of Cambridge, 2023). A web-based system which allows customers to track their daily water use could also be employed, in addition to presenting strategies which could save water and reduce utility bills. Finally, these meters could also make it easier to identify meter tampering/flow reversals and possible water theft, which could help the Township reduce the amount of unauthorized consumption.

In addition to upgrading individual water meters, a zone metering program could also be implemented to identify potential areas with high water loss rates by separating the system into distinct sections. Measurements collected would help determine if individual sections were using more water than anticipated based on the number of connections in the system, which could then be used to inform where efforts should be targeted for leak detection and repairs in the system. This would typically be accomplished through a type of acoustic analysis to accurately locate the leak within the identified zone of concern.

Finally, the Township may want to consider implementing an active leak detection program to locate new or hidden leaks by monitoring the distribution system. Several case studies conducted by municipalities throughout North America have demonstrated (City of Hamilton, 2022) (Morrow, 2017) that the programs such as these can lead to a reduction in non-revenue water. For example, the city of Cambridge, ON made use of the Echologics LeakFinder® ST system (Lalonde, 2019), and 57 local authorities in the State of New Jersey partnered with SUEZ and Aquarius Spectrum Systems (Aquarius Spectrum, n.d.) to address increasing rates of non-revenue water.

The implementation of one or several of the recommendations above could help reduce rates of apparent and real water loss in the Fairfield Water System over time, leading to lower fees for customers, lower operating costs, and the availability of additional plant capacity.

Approximately twenty years ago Loyalist had success in the Fairfield distribution system losses using ultrasonic testing on metallic pipe and nighttime pressure loss monitoring on areas with plastic mains. The entire water system was tested, and repairs were performed wherever required.

Climate Change Considerations

- An increase in temperatures and low amounts of precipitation during the summer months could result in an increase demand for potable water.
    - This would increase the per-capita potable demand from the Fairfield Water System, putting additional strain on the plant and reducing the amount of available capacity.
- Energy used to produce significant quantities of unaccounted potable water results in the unnecessary generation of GHG emissions. Reducing the per-capita water demand by identifying the sources of water loss, would result in a decrease in energy and GHG emissions associated with water treatment and distribution.

Linkages

Water Distribution Systems – Remedial Needs Technical Memorandum

Population and Dwelling Growth Technical Memorandum

References

Aquarius Spectrum. (n.d.). *Aquarius and SUEZ New Jersey Case Study*. Retrieved from AQS Systems: https://aqs-systems.com/case-studies/aquarius-and-suez-new-jersey-case-study/

City of Cambridge. (2023, January). *Smart Water Meters*. Retrieved from City of Cambridge: https://www.cambridge.ca/en/your-city/smart-water-meters.aspx

City of Hamilton. (2022, February 25). *Proactive detection of water leaks saves city half a million dollars last year*. Retrieved from City of Hamilton: https://www.hamilton.ca/city-council/news-notices/news-releases/proactive-detection-water-leaks-saves-city-half-million

Federation of Canadian Municipalities & National Research Council. (2003, March). Water Use and Loss in Water Distribution Systems.

Lalonde, A. (2019, December 9). *Charging ahead: The City of Cambridge adopts preventative water loss program*. Retrieved from Trenchless Technology: https://trenchlesstechnology.com/city-of-cambridge-ontario-adopts-preventative-water-loss-program/

Loyalist Township. (Annually, 2016-2021). *Uncommitted Reserve Capacity calculations.*

Morrow, K. (2017). *Active Leak Detection.* Utilities Kingston.

Conclusions

A program focused on reducing water loss in the Amherstview and Odessa water distribution system could significantly increase the available capacity at the FWTP.

Scenario #1 would increase the available capacity of the FWTP in 2046 from 64 m^3/d to 1,187 m^3/d.

Scenario #2 would increase the available capacity of the FWTP in 2046 from 64 m^3/d to 2,443 m^3/d.

Odessa seems to have the most issues in relation to water loss and would be a good area to focus the water loss reduction program.

Finding this additional capacity would allow more time before reaching 80% capacity, which would delay the need for plant expansion.

Reducing water loss would help Loyalist Township achieve Goal #24 of the Climate Action Plan.

IMP Technical Memorandum: Bath Water System Water Loss

Asset Class: Water

Objective: The purpose of this technical memorandum is to outline the benefits of reducing water loss in the Bath Water Distribution system, which services the community of Bath. The development and implementation of a water loss reduction strategy has the potential to not only increase the amount of available capacity at a plant, thereby delaying the need for costly plant expansions, but could also lower costs and limit the environmental impact of treating and distributing potable water.

Background

The Bath Water Treatment Plant (BWTP) draws water from Lake Ontario and supplies water to the village of Bath and indirectly to Correctional Services of Canada (CSC). For the purpose of this technical memorandum the flows allocated to CSC are not being considered. BWTP has a rated capacity of 3,328 m^3/d for the village alone. The population in the areas serviced by this plant is projected to increase by 40% between 2021 and 2046, meaning the demand for potable water will inevitably increase.

The Bath water distribution system is susceptible to water losses, with the values from the 2021 Annual Drinking Water Analysis indicating that 29% of the water sent to the village of Bath was non-revenue water. The total non-revenue water of 29% can be broken into the following categories: real loss, apparent loss, and unbilled authorized use, as shown in Figure 1.

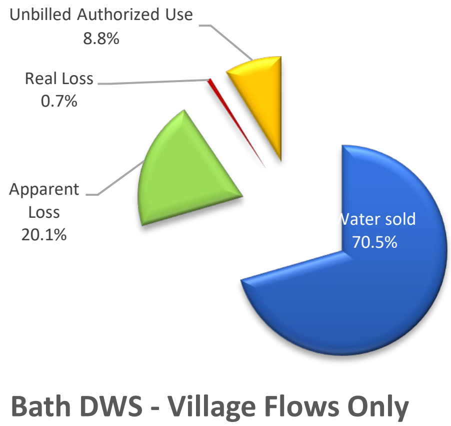


Figure 1 Non-revenue water in the village of Bath Drinking Water System, 2021

Real loss is actual potable water being lost from the system, typically through leaks.

Apparent loss is not truly water being lost, but instead a result of inaccurate metering or unauthorized use.

Unbilled authorized use (UAU) is water being used by municipal buildings, recreation centers, hydrant flushing or for firefighting.

Non-revenue water is water that has been sent out to the distribution system but that is not being billed, often referred to as water losses.

It should be noted that these figures are estimated and were developed based on available data. As such, it is difficult to definitively distinguish between apparent loss and real loss.

Across Canada, water losses in distribution systems range from 7.5 to 21%, typically averaging 13%. The higher-than-average percentage of water loss in Bath could suggest the presence of leaks in, or unauthorized connections to, the Bath distribution systems. High rates of water loss in a system can lead to premature wear on equipment, higher chemical usage rates, and increased energy charges, which in turn can result in higher costs for the end user. Furthermore, as a municipality, Loyalist Township has a responsibility to ensure that an acceptable quantity and quality of water supply is available for future development, and that the approval or buildout of new connections does not exceed the design capacity of the water system. Reducing water losses in the distribution system will free up capacity at the BWTP, ensuring that future demand is met over the long term while delaying the need for costly plant expansion activities.

Assumptions

The following assumptions were made when developing these documents:

- The number of connections to the plant includes both residential dwellings as well as industrial, commercial, and institutional (ICI) accounts
- Connections are expressed in Equivalent Residential Units (ERUs)
- ICI growth is assumed to be proportional to population growth
- For the sake of maintaining consistency with the Uncommitted Reserve Capacity (UCRC) calculations developed each year, the methodology used to develop the figures presented in this technical memo are based on the MOE procedure D-5-1. Specifically:
    - Potable water needs are expressed in terms of maximum daily flow
    - The projected water demand for an ERU is based on the maximum daily flow value per ERU observed in the previous three years (between 2019 and 2021)

Methodology

Flow per ERU

To perform the analysis on water loss from the distribution systems, flows were normalized on a per-ERU basis to allow for a direct comparison between the billed average daily flows at each connection and the plant flows needed to provide these connections with the potable water. Table 1 presents the billed average daily water consumption per ERU in Bath, as well as the calculated flow per ERU for the Bath WTP between 2019 and 2021.

Year	**Average Daily Flow per ERU – Billed (m^3/day/ERU)**	**Average Daily Flow per ERU – Plant Flows (m^3/day/ERU)**
2019	0.39	0.495
2020	0.405	0.480
2021	0.409	0.540
Average	**0.401**	**0.505**

Table 1 Billed and plant flows per ERU for Bath water distribution system

The table above shows that the plant flows values are higher than the billed flows, indicating that not all water being pumped from the plant is reaching the connections. There are several consequences in having a large difference between these values, including: a significant amount of potable water being lost in the distribution system, the plant operating at a higher level than required, and less capacity being available for future allocation.

Percentage of Non-Revenue Water

The volume of water leaving the plant can be compared to the volume of water billed to each connection, with the difference between these volumes indicating the amount of water lost in in the distribution system. These values can then be used to calculate the percentage of non-revenue water within the system by using the following equation.

$$\%\ Non\text{–}Revenue\ Water\ = \frac{(Plant\ Flows - Billed\ Flows)}{Plant\ Flows} \times 100\%$$

The following table shows the percentage of non-revenue water for the village of Bath.

Year	**% Non-Revenue Water**
2019	21%
2020	16%
2021	24%
Average	**21%**

Table 2 Percent of Non-Revenue Water for each distribution system

Note that the 2021 value is slightly different than the annual analysis. This is due to a small difference in the data used for calculations.

The values in Table 2 indicated that the percentage water loss in the Bath distribution system is moderately higher than the national average of 13%. There was a relatively significant increase between the amount of water loss in 2020 and 2021. Any known changes in the system in this timeframe should be considered when investigating where the water loss is occurring.

Categories of Non-Revenue Water

Estimates for each of the three categories of non-revenue water are typically included in the Annual Drinking Water Reports for the Bath Water system, with Table 3 below providing a summary of these values between 2019 and 2021.

Table 3 -

Year	Unbilled authorized use	Real loss	Apparent loss
2019	29.0%	2.0%	69.0%
2020	48.0%	0.0%	52.0%
2021	38.0%	0.0%	62.0%
Average	38.3%	0.7%	61.0%

Table 4 Breakdown of unbilled authorized use, real loss, and apparent loss in the Bath Water System, expressed as a percentage of non-revenue water

The table above indicates that, based on a three-year average, 38.3% of the non-revenue water in the Bath Water System can be attributed to unbilled authorized use, 0.7% to real loss, and 61.0% as apparent loss.

Figure 2 below illustrates the amount of water which needs to be produced by BWTP each day in order to service one ERU, as well as how that water is lost or used between the plant and the final connection.

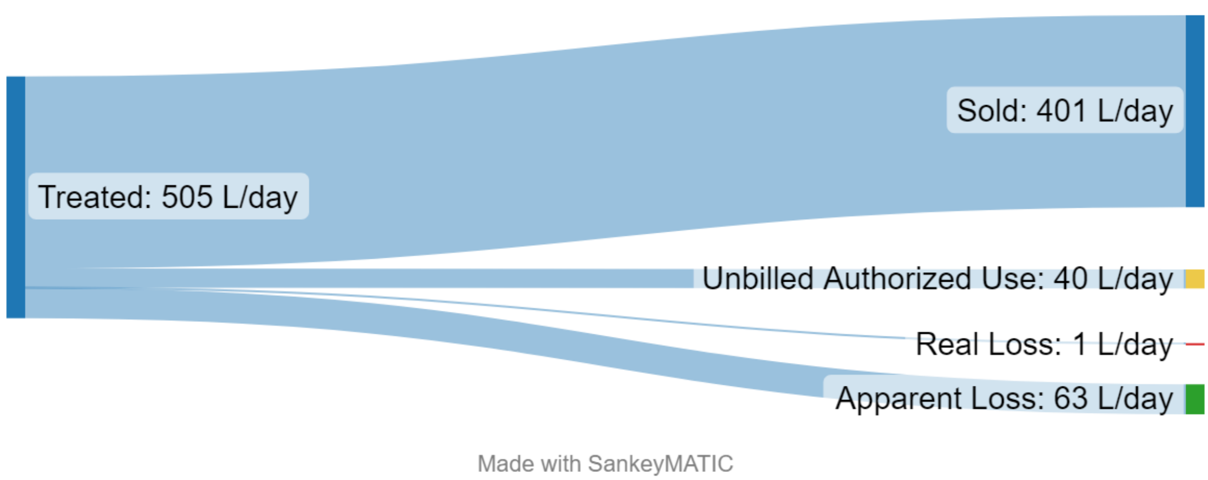


Figure 2- Sankey Diagram Illustrating the amount of water required to service 1 ERU in the Bath Water System

Analysis

Reducing Water Loss in System

Although some amount of non-revenue water is to be expected, such as through unbilled authorized use, reducing the amount of water losses in the distribution can lead to a number of beneficial impacts. These range from increasing the amount of available capacity for the system, to reducing the amount of energy associated with treating and distributing water to customers.

Non-revenue water attributed to unbilled authorized use serves important functions such as hydrant flushing, firefighting, and plant operations, which ensure water quality and public safety. As such, expecting any significant reduction in these figures is unrealistic.

Similarly, the rate of real losses in the distribution system are typically attributed to events such as watermain breaks and can vary year to year. These incidents are unpredictable in nature and therefore hard to control, however they could be minimized through proper asset management planning, such as the replacement of aging watermains. Although the Township strives to replace aging infrastructure on a continuous and regular basis, it would be unrealistic to expect a complete elimination of watermain breaks.

Therefore, focusing on reducing the apparent water loss in the system would provide the best opportunity to reduce the plant flow per ERU in the Bath Water System. It is important to note that, although watermain leaks are typically considered as real loss, they may be categorized as apparent loss until they are discovered.

To analyze the impacts of reducing apparent loss in the Bath system, two different scenarios are examined relative to a business-as-usual (BAU) case.

Under the BAU scenario, volumes of sold water, unbilled authorized use, real loss, and apparent loss increase proportionally with the number of new connections to the Bath Water System. This would increase the average daily plant flow for the Village of Bath from 734 m^3/day in 2021 to 1,517 m^3/day in 2046. These flows, broken down into their various components, are illustrated below.

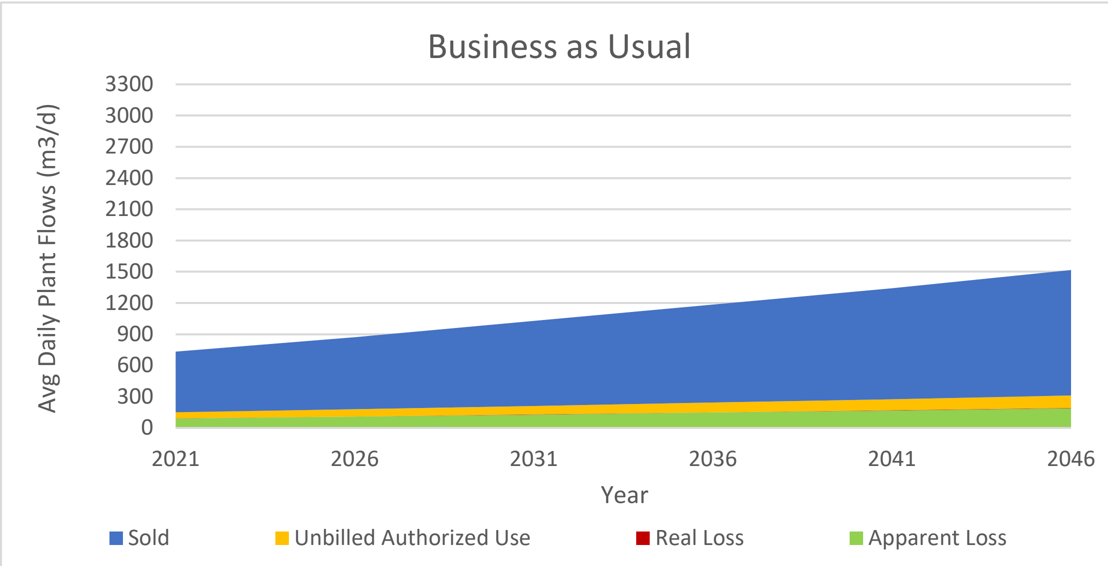


Figure 3 - Breakdown of average daily plant flows under the business-as-usual case

Scenario 1 examines the effects of maintaining the existing volume of apparent loss while volumes of sold water, UAU, and real loss increase proportionally with growth. This scenario, which would result in a gradual decrease in the percentage of apparent loss, should be achievable since it is improbable that the factors which contribute to this category will increase as the system expands. For example, unauthorized connections are unlikely to occur in new subdivisions. Under this scenario, the average daily plant flow for the Village of Bath would increase from 734 m^3/day in 2021 to 1,419 m^3/day in 2046, as illustrated below.

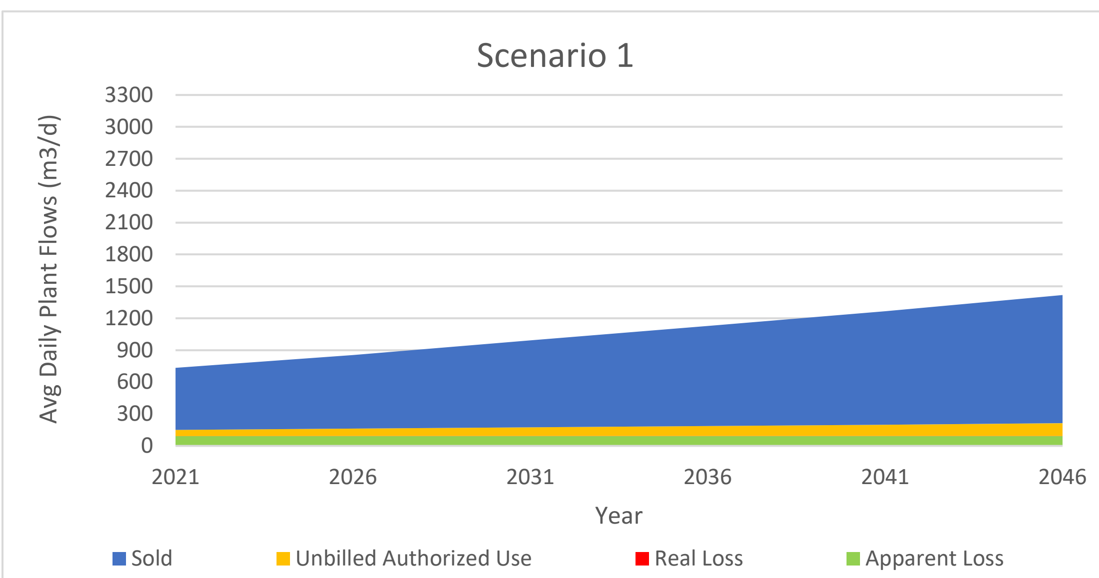


Figure 4 - Breakdown of average daily plant flows under Scenario 1

Scenario 2 examines the effects of gradually reducing the volume of apparent loss while volumes of sold water, UAU, and real loss increase proportionally with growth. To accomplish a similar decrease in the percentage of apparent loss as to Scenario 1 would require concerted efforts to find and reduce the cause of water losses, such as through meter replacement programs or leak detection studies. Under this scenario, the average daily plant flow for the village of Bath would increase from 734 m^3/day in 2021 to 1,357 m^3/day in 2046, as illustrated below.

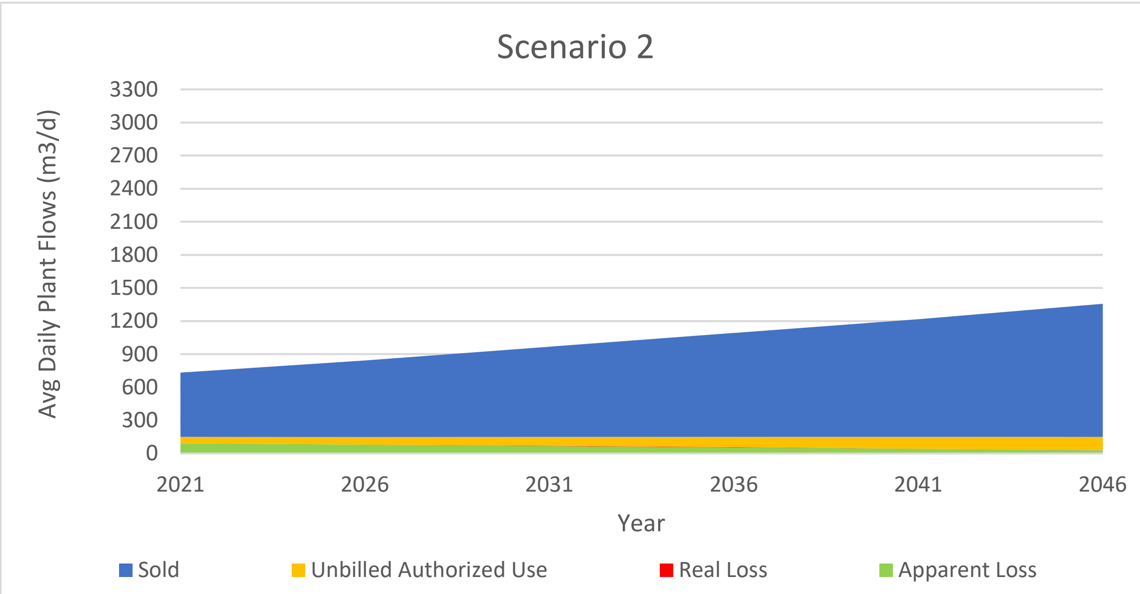


Figure 5 - Breakdown of average daily plant flows under Scenario 2

Impact on Maximum Day Flows and Plant Capacity

The scenarios presented above are expressed in average daily plant flows. However, water plant capacity calculations instead use maximum daily flow values to determine the amount of available capacity in the system. As such, maximum day flows from the Bath WTP can also be calculated for the scenarios presented above.

Maximum daily flow per connection is one of several factors used to calculate the available capacity for a given water plant, with a reduction in per capita flows typically leading to an increase in available capacity.

A value known as the peaking factor, defined as the ratio between average daily flows and maximum daily flows, can be used to convert average daily flows to maximum daily flows. Available data indicates that the three-year average peaking factor for the Bath water system is 1.95. As such, target maximum daily flows per ERU for the scenario can be calculated by multiplying the target average daily flow per ERU from Table 3 by the peaking factor, as per the equation below.

$$Target\ Max\ Daily\ Flow = Target\ Average\ Daily\ Flow\ \times Peaking\ Factor$$

The table below summarizes the projected average and maximum daily flows per ERU in 2046 under BAU conditions, as well as the proposed scenario.

	Average Daily Flow per ERU (m^3/day/ERU)	Maximum Daily Flow per ERU (m^3/day/ERU)
BAU	0.505	1.05
Scenario 1	0.472	0.92
Scenario 2	0.452	0.88

Table 5 2046 Projected Average and Maximum day flows per ERU for each scenario

These values combined with the growth projections for Bath can be used to calculate the projected maximum daily flows for the Bath WTP under both scenarios, as presented in Figure 7. These scenarios are compared to the projected plant flows under a BAU scenario, which assumes no effort made to identify and address water losses in the distribution system. These data are overlaid against a value of 2,662.4 m3/day, 80% of the plant's capacity which is typically the threshold at which plant expansion activities should begin.

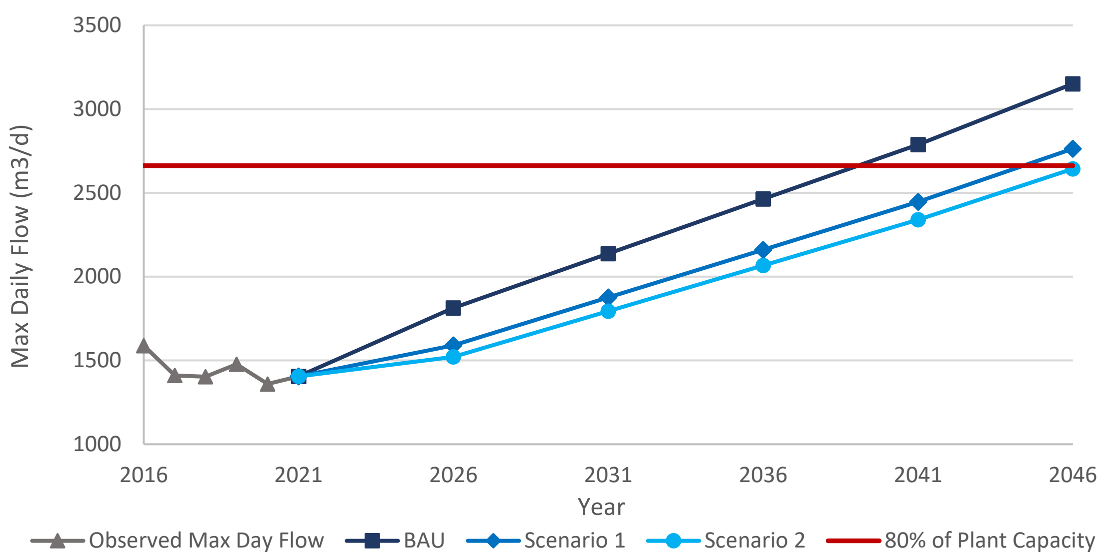


Figure 6: Projected maximum daily flow for each scenario. The horizontal red line represents 80% of the plant's 3,328 m^3/day rated capacity.

Under Scenario 1, the projected maximum daily flows exceed the 80% of capacity threshold by 2044, versus the BAU scenario in which plant flows are projected to exceed 80% of the plant's capacity by 2039. Under Scenario 2, projected maximum daily flows remain below 80% of capacity until 2046.

The projected maximum daily flows can also be used to calculate the plant's projected available capacity under the proposed scenario. The available capacity is determined by subtracting from the plant's rated capacity residential flows, ICI ERUs, purchased-but-unused ICI, and committed-but-unbuilt units. These flow values will vary significantly depending on the maximum flow per ERU value used as part of the calculations, resulting in substantial differences in projected available capacity over time.

Figure 8 and Table 6 below summarize the projected available capacity for each of the scenarios compared to the projected plant flows under a BAU scenario, in which capacity is approaching zero by 2036. Under both presented scenarios the projected available capacity in 2046 increases moderately.

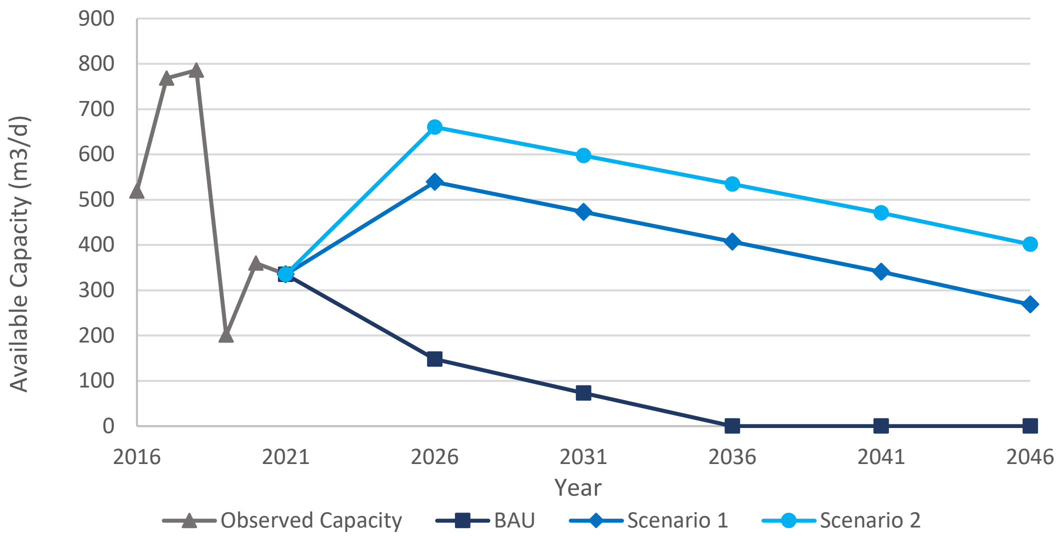


Figure 7 - Available capacity at BWTP for proposed scenario

Available Capacity in 2046 (m^3/d)		
Current	Scenario 1	Scenario 2
0	268	401

Table 6 Available capacity at BWTP in 2046 for each water loss reduction scenario

Limitations

The potable water demand forecasts presented are linked to projected population and dwelling growth for Loyalist Township over the course of the study period. These projections are based on the best-available information at the time of writing and are subject to change. Alterations to these projections would result in a change in available capacity for all water loss reduction scenarios.

Recommendations

Based on the analysis above, it would be beneficial to incorporate Bath into any water loss reduction program implemented in Loyalist Township. Although the increase in available capacity is moderate, this type of program would improve efficiency in the distribution system, giving the Township more time before expansion is required.

Apparent water loss can be due to water meter inaccuracies at customer buildings, accounting procedure errors, and unauthorized consumption. Performing an assessment of water meters and associated procedures associated with quantifying water usage at a connection would be a good first step in addressing apparent water loss.

Alternatively, a smart metering program, such as the one being implemented in the City of Cambridge (City of Cambridge, 2023), could be considered to increase the accuracy of meter reading data. This would involve gradually installing, or transitioning to, smart meters at all locations serviced by a water connection. Smart meters use advanced metering infrastructure (AMI) that allows for remote meter reading, data analysis, and alerts for possible leaks or problems. A web-based system which allows customers to track their daily water use could also be employed, in addition to presenting strategies which could save water and reduce utility bills. Finally, these meters could also make it easier to identify meter tampering/flow reversals and possible water theft, which could help the Township reduce the amount of unauthorized consumption.

In addition to upgrading individual water meters, a zone metering program could also be implemented to identify potential areas with high water loss rates by separating the system into distinct sections. Measurements collected would help determine if individual sections were using more water than anticipated based on the number of connections in the system, which could then be used to inform where efforts should be targeted for leak detection and repairs in the system. This would typically be accomplished through a type of acoustic analysis to accurately locate the leak within the identified zone of concern.

Finally, the Township may want to consider implementing an active leak detection program to locate new or hidden leaks by monitoring the distribution system. Several case studies conducted by municipalities across North America, such as the city of Hamilton, Ontario, have demonstrated that the programs such as these can lead to a reduction in non-revenue water (City of Cambridge, 2023). 57 local authorities in the State of New Jersey partnered with SUEZ and Aquarius Spectrum Systems to address increasing rates of non-revenue water (Aquarius Spectrum, n.d.). Loyalist has had similar successes in the past, using various leak detection devices on metal pipes and system pressure monitoring in areas with non-metallic pipes.

The implementation of one or several of the recommendations above could help reduce rates of apparent and real water loss in the Bath Water System over time, leading to improved operating costs and the availability of additional plant capacity.

Climate Change Considerations

An increase in temperatures and low amounts of precipitation during the summer months could result in an increase demand for potable water. This would increase the per-capita potable demand from the Bath Water System, putting additional strain on the plant and reducing the amount of available capacity.

Energy used to produce significant quantities of unaccounted potable water results in the unnecessary generation of GHG emissions. Reducing the per-capita water demand by identifying the sources of water loss, would result in a decrease in energy and GHG emissions associated with water treatment and distribution.

Linkages

- Population and Dwelling Growth Technical Memorandum
- Population and Dwelling Growth Technical Memorandum
- Bath WTP Projections Technical Memorandum

References

Aquarius Spectrum. (n.d.). *Aquarius and SUEZ New Jersey Case Study*. Retrieved from AQS Systems: https://aqs-systems.com/case-studies/aquarius-and-suez-new-jersey-case-study/

City of Cambridge. (2023, January). *Smart Water Meters*. Retrieved from City of Cambridge: https://www.cambridge.ca/en/your-city/smart-water-meters.aspx

City of Hamilton. (2022, February 25). *Proactive detection of water leaks saves city half a million dollars last year*. Retrieved from City of Hamilton: https://www.hamilton.ca/city-council/news-notices/news-releases/proactive-detection-water-leaks-saves-city-half-million

Loyalist Township. (2021). Commercial-Institutional Water Account Listing .

Loyalist Township. (Annually, 2016-2022). *Uncommitted Reserve Capacity calculations.*

Conclusions

- A program focused on reducing water loss in the Loyalist Township water distribution system would moderately increase the available capacity at the BWTP.
- Scenario 1 would increase the available capacity of BWTP in 2046 from 0 m^3/d to 268 m^3/d.

- Scenario 2 would increase the available capacity of BWTP in 2046 from 0 m^3/d to 401 m^3/d.
- Bath’s current rate of water loss is less significant than the Fairfield Water Distribution System, and therefore should not be the primary focus when deciding where to allocate resources for water loss reduction in Loyalist Township.
- Reducing water loss would help Loyalist Township achieve Goal #24 of the Climate Action Plan.

IMP Technical Memorandum: Amherstview Water Pollution Control Plant Needs Assessment

Asset Class: Sanitary Sewage

Objective: The objective of this technical memorandum is to provide an overview of the physical and process needs of the Amherstview Water Pollution Control Plant (AWPCP). A capacity assessment has identified where upgrades are needed to remedy treatment capacity issues, as well as providing options for upgrades that will be required to meet demand due to population growth. Opportunities to optimize current operations have also been investigated, with the aim of reducing energy demand at the plant.

Background

AWPCP services the communities Amherstview and Odessa, and the Loyalist East Business Park. The plant has a rated capacity of 6,400 m^3/d with a peak flow capacity of 16,000 m^3/day. Sanitary sewage received by the facility is treated through an extended aeration activated sludge process, and treated effluent is discharged into the Bayview Bog which outlets into Collins Creek near Westbrook.

The Population and Dwelling Growth technical memorandum projects a population increase of over 30% between 2021 and 2046, resulting in increased demand for sanitary sewage treatment. R.V. Anderson (RVA) conducted an assessment on the current plant capacity using a BioWin™ model (R.V. Anderson Associates Limited, 2023). In so doing, opportunities have been identified for remedial action that would address immediate issues with rated capacity at the plant. The assessment also used growth projections to outline options for plant upgrades to meet the projected capacity requirement associated with the anticipated population increase.

Assumptions

The following assumptions were made when developing these documents:

- Future flows at AWPCP were based on the growth projections that were provided through the AWPCP Projections memo included in the IMP.
- The model developed by RVA was based on sanitary sewage flow data from 2015 to 2021.

Methodology

To assist the Township in determining the needs at AWPCP, RVA conducted an assessment of current capacity at the plant. This assessment identifies where upgrades are needed to address current capacity issues, along with potential upgrades to meet future demand.

Township staff involved with water and sanitary sewage operations provided input with respect to plant deficiencies and operational needs in addition to the RVA assessment.

For simplicity a separate memorandum has been prepared that analyzes how and where the Township should both process and manage residual solids within the sewage treatment process in the future for both AWPCP and Bath Sewage Treatment Plant (BSTP).

Data Sources

The data used to develop the figures presented in these documents were obtained from the AWPCP Projections technical memorandum, as well as sanitary sewage flow data from 2015 to 2021.

BioWin™ Model

To assess the current operation conditions of the plant a BioWin™ Model was developed. BioWin™ is a software used for the simulation of biological sanitary sewage treatment plant design and analysis. The base model that was developed for AWPCP is shown in Figure 1.

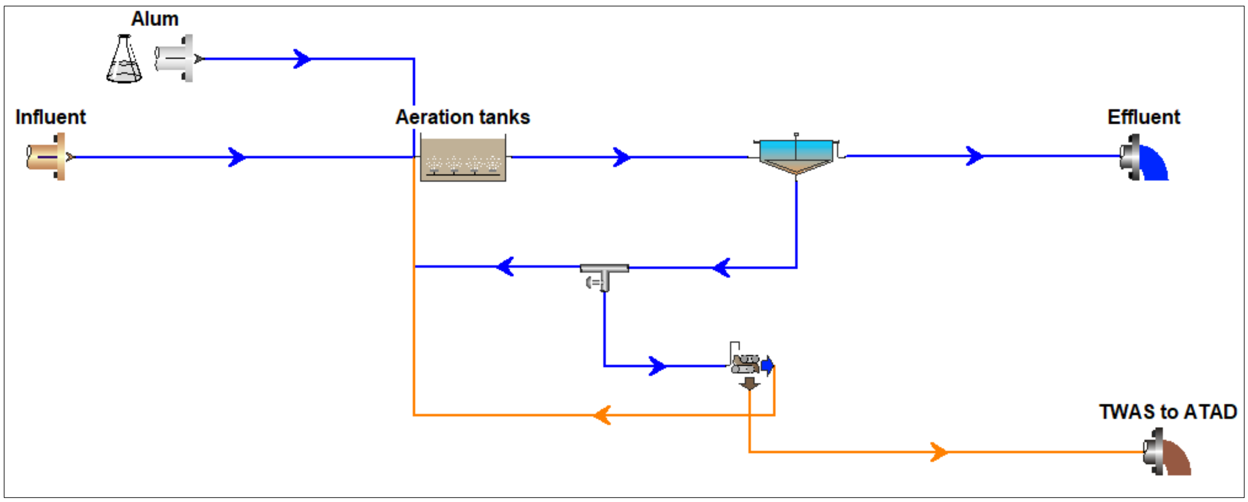


Figure 1. Base Model configuration for AWPCP

Sanitary sewage flow data from 2015 to 2021 was used along with this base model in order to conduct model calibration and validation. Once the model was validated, it was used to confirm that the results determined through the desktop assessment are accurate. The model was also used to assess the plant performance at anticipated future flows.

Desktop Assessment

Each process unit was evaluated through desktop analysis. This assessment was conducted based on guidelines from the Ontario Ministry of Environment, Conservation and Parks (MECP) and the Water Environment Federation (WEF).

Using the guidelines and historical data, the capacity of the following units was assessed:

- Headworks – screens
- Aeration tanks
- Oxygenation capacity
- Secondary clarifiers
- Sludge digester – ATAD
- Sludge digestion – aeration capacity
- Sludge thickening
- Disinfection

The desktop analysis and BioWin™ Model were examined to identify potential plant upgrade options. The recommended upgrades were provided while considering the required future plant capacity of 6,133 m^3/day for 2046.

Analysis

Figure 2 below illustrates the capacity for each process unit along with the required future capacity.

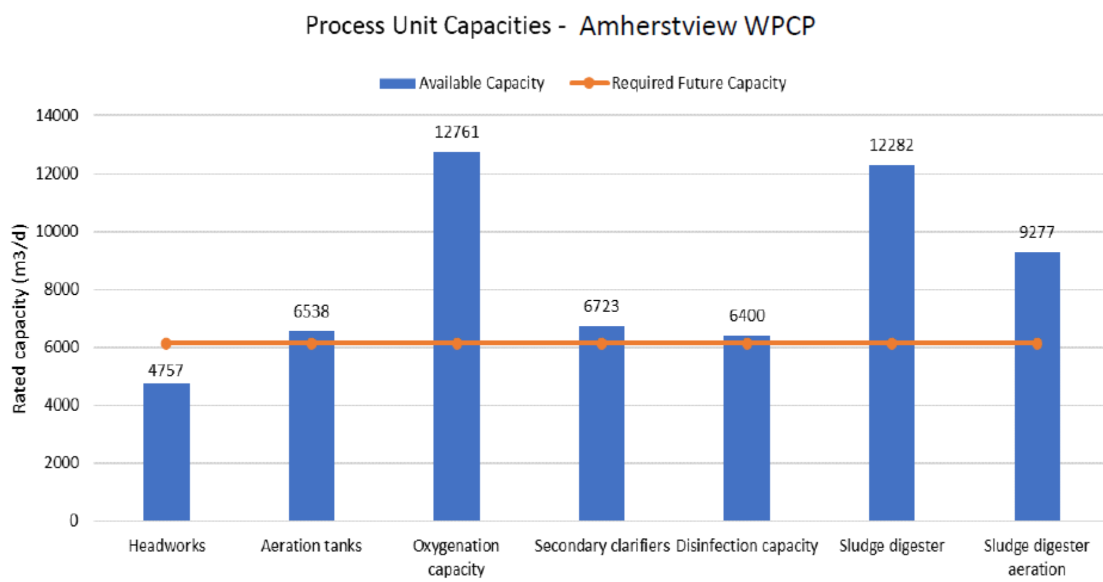


Figure 2. Process unit capacities at AWPCP

The capacity assessment indicated that the oxygenation, sludge digester, sludge digester aeration, and sludge thickening capacities would exceed the required future capacity and will not need upgrades.

The capacity of the aeration tanks and secondary clarifiers is only marginally higher than the projected required future capacity. These secondary treatment systems may need upgrades as growth continues and capacity approaches 6,000 m^3/day. The headworks capacity is lower than what the AWPCP is currently rated for. It was noted by RVA that this insufficiency was based on calculations using a peaking factor with no peak attenuation. There is potential for improved peak flow attenuation at the plant, as well as reduced inflow and infiltration (I&I) throughout the system which would reduce peak flows. Upgrades for these process units are outlined below.

The disinfection trends at AWPCP were also assessed. It was recognized that there have been a small number of exceedances with respect to E. coli in the summer months. These exceedances are also discussed in the Sanitary Sewage Regulatory technical memorandum. Utilities staff and MECP believe that the current infrequent exceedances have been caused by visiting wild birds near the outlet of the treatment wetland which acts as a polishing cell. In general, the disinfection provided by Cell 2 followed by Cell 1 (disinfection lagoons) has been adequate. MECP has advised that, provided interim process results are satisfactory, no changes would be required. It was noted by RVA that lagoon residence time impacts disinfection efficiency, suggesting that higher concentrations may be seen as flows increase. As the community grows and retention times are reduced, there may be a need to revisit this approach and thus the need for ongoing interim monitoring of E. coli populations. Ongoing monitoring will provide the Township with warning to when the polishing lagoon system needs to be supplemented. At that time, the disinfection upgrades described below may be options to consider.

Upgrade Options – Headworks and Secondary Treatment

The following options may be considered to address capacity limitations of the headworks and secondary treatment at AWPCP:

Option 1 – WPCP Expansion: This option provides for expansion of AWPCP through the addition of a secondary clarifier, headworks improvements including an upsized grinder, and potential upgrades to the inlet channel.

Option 2 – IFAS Retrofit: This option would see the addition of Integrated Fixed Film Activated Sludge (IFAS) modules in the aeration tank, headworks improvements including an upsized grinder, and potential upgrades to the inlet channel.

Option 3 – Peak Flow Equalization and Headworks Upgrade: This option would convert an existing lagoon into an equalization lagoon, connected with a wet well pumping station for discharging overflows into headworks. Headworks improvements would include upgrades to the mechanical fine screens, grit removal system, and any ancillary equipment as required.

Upgrade Option	Advantages	Disadvantages
Option 1	• Increased solids handling and hydraulic capacity during peak flows.	• Will result in more Return Activated Sludge (RAS) – ultimately requiring an increase in RAS pump capacity. • Cost: \$2.5 - \$3.0M • Sub-optimal use of existing assets. • Low return on investment during peak flows. • Significant construction will be required.

Option 2	• Secondary treatment will be able to treat higher flows, avoiding solids overloading to the secondary clarifier. • Moderate utilization of existing assets. • Cost: $300 - $500k • Minimal construction required.	• No increase in hydraulic capacity of the secondary clarifier – meaning the clarifier efficiency may be limited despite the IFAS retrofit.

Option 3	• Provides hydraulic capacity to all process units in the plant.
	• Upgraded headworks protects downstream processes and improves operation of the equalization facility.
	• Most optimal use of existing assets.
	• Eliminates need to upgrade secondary clarifier.
	• Peak flow equalization
	  ○ Cost: $300-$450k
	  ○ Minimal construction
		• Headworks upgrades
		  ○ Cost: $2.5-3.0M
		• Scheduled maintenance will be required for lagoon clean-up every 5 to 10 years.

Based on the evaluation above, RVA recommended Option 3 – Peak Flow Equalization and Headworks Upgrade. This recommendation is supported by Township staff and will be investigated further at the time upgrades are required. Along with this option, staff are working on a program to reduce I&I in the Loyalist East sanitary system.

In a separate assignment, RVA was requested to conduct a capacity assessment of the Lakeview Sewage Pumping Station (R.V. Anderson Associates Limited, 2023). This facility includes an older style bar screen, which is in poor condition and requires ongoing maintenance. In consultation with the consultant and operations staff, a decision has been made that in future Loyalist Township will focus its screening activity at the treatment plants. To compensate for this decision, future pump replacements will specify that the pumps are capable of handling trash often associated with sewage systems. Upgrading the headworks at the AWPCP will assist in the ability to provide manageable sanitary sewage efficiencies with lower maintenance requirements.

Upgrade Options – Disinfection

The following upgrades were presented as options to supplement disinfection from the lagoons if trending shows an increase in effluent E. coli levels.

Option 1 – Chlorination: Construct a chlorination building with a sodium hypochlorite tank and dosing system, used to supplement the natural disinfection in the lagoons.

Option 2 – UV Disinfection: Install a UV disinfection facility prior to the lagoons, which would be designed for full disinfection opposed to a supplementary role.

Upgrade Option	Advantages	Disadvantages
Option 1	• Utilizes the natural disinfection capabilities of the lagoons. • Cost: $200-$400k	• The effectiveness of disinfection and meeting non-detectable chlorine level at final discharge will need to be demonstrated for unconditional approval.
Option 2	• More robust than chlorination.	• Does no use the natural disinfection benefit of the polishing lagoon. • Cost: $0.7-$1.0M

Based on the evaluation above RVA recommended Option 1 – Chlorination. However, Township staff have identified concerns with using chlorination based on discussions with the MECP. The MECP, Fisheries Act, and WSER (Wastewater Systems Effluent Regulations) will require monitoring of dechlorination to avoid adverse impact on the environment, making the option of chlorination less desirable. With the polishing lagoons functioning well, there is no immediate need for additional disinfection. If required in the future, UV disinfection will be further investigated before implementation of supplementary disinfection. This task will be deferred subject to maintaining acceptable e-coli results from site monitoring program.

Energy Optimization and GHG Reduction

The blowers at AWPCP do not have variable frequency drives (VFDs) to regulate airflow. Without a VFD, a blower in operation is at 100%; however, only 39% of the air supply is required to meet demand. It was estimated that switching to a VFD could result in an annual energy saving of 410,625 kWh. It is recommended that this project be prioritized.

Biosolids Management and Storage

Biosolids produced by the ATAD at AWPCP are stored in a biosolids lagoon where they are periodically hauled away for land application. The moisture content of these biosolids is high, making hauling expensive. Options for improved biosolids storage to address this issue are provided in the technical memorandum Biosolids Management and Storage. This memo also considers the additional load at AWPCP that will be caused when hauling sludge from Bath Sewage Treatment Plant (BSTP).

Septage Receiving Station

The AWPCP is equipped with a septage receiving station that was designed to pump solids into the ATAD. Due to difficulty with use and lack of an effective method to reduce moisture content in the biosolids, the system is not currently economically viable. In addition to this, there are operational concerns regarding shock loadings on the plant and a high potential for contaminated sanitary sewage, making it difficult to meet final effluent limits. This system is not in use and was not considered in the RVA capacity assessment.

After reviewing current septage receiving rates charged by neighbouring municipalities, staff feel the AWPCP is not in a position to compete financially with these facilities. The economics of accepting septage at AWPCP may improve if sludge management systems are upgraded in the future. No improvements are planned for the septage receiving station at this time.

Final Effluent Monitoring Power Supply

Operations staff have reported that the power supply for the final effluent monitoring facility is not sufficiently stable to meet the needs of the Township. The system is energized by a solar panel and battery storage system which periodically has insufficient power for the continuous monitoring requirements. The facility is geographically isolated, meaning that a direct connection to the site's AC electrical supply has not been made, for reasons both technical and economical.

It is recommended that Loyalist Township engage the services of an electrical contractor familiar with alternative power supply to provide an upgrade to this facility.

Reduction in the Use of Potable Water

The Township's two sanitary sewage treatment plants are some of the municipality's largest users of both electrical energy and potable water. The primary use of potable water is for cleaning at various points of the process. Previous attempts to develop a long-term solution have been unsuccessful to date.

Operations staff continue to address this issue and the following tasks are underway at various stages:

- Restore existing process water treatment system for use in cold weather months when algae are less active;
- Replacement of water meters with the objective of improved accuracy.

Site Ecological Assessment and Archeology

GHD was retained to complete an Ecological and Natural Heritage Assessment at the AWPCP site (GHD, 2022). The report concluded that this site contains the presence of "species of special concern". The site is therefore designated as Significant Wildlife Habitat in the Provincial Policy Statement (Province of Ontario, 2020), which states in Section 2.1.5:

> "Development and site alteration shall not be permitted in:
>
> c) significant wildlife habitat."

There are also wetlands identified on the site. Wetlands are regulated by Cataraqui Conservation. Further consultation will be required if any development is planned within 30 meters of the identified wetlands. These ecological concerns will need to be considered before any upgrades are carried out at this site.

The AWPCP site was the location of major construction in the late 1990s and prior to that time the site used for sludge storage. Therefore, it is felt that there is limited possibility of encountering archeological heritage and no formal assessment has been undertaken at this time.

Future System Connection

When required, expansions at the Bath STP will be costly, and likely challenging with the proximity to surrounding houses. Staff have noted an opportunity to connect the Bath sanitary system to the Amherstview system. This would involve converting the current Bath STP to a pumping station and sending all sewage to AWPCP via a sanitary forcemain. Appropriate upgrades would be required at AWPCP to accommodate the additional flows from Bath. This project is beyond the scope of the IMP study. It is recommended that this option is investigated in more detail in a feasibility study.

Staff also recommend that, if conducting a study on system connection, Bayview Bog loading requirements should also be considered. MECP noted that the previous study undertaken through the last re-rating exercise could be used as a starting point. It is likely that as flows increase, the total phosphorus loading previously permitted would remain the same, meaning a reduction on a per litre basis. An updated Bayview Bog study is recommended along with the feasibility study to confirm what changes may be needed at the outlet of the plant.

Financial

The upgrades outlined in this document are initial recommendations. While further investigation and design will be required before implementation, the costs estimates provided below are based on these initial recommendations. They may not be representative of the actual cost of the project when it takes place.

Option 3: Peak Flow Equalization and Headworks Upgrade

This upgrade option is being considered as both remedial and growth. Upgrades to the headworks was identified as a potential remedial item, as the capacity is currently below the rated capacity of the plant. Headworks upgrades will also help to prevent rags and large debris from damaging downstream processes. Peak flow equalization is considered a growth item. As flows increase with growth, the ability to equalize flow will provide hydraulic capacity to all process units in the plant.

Upgrade	Estimated Cost
Flow Equalization System (growth)	$300 – 450k
Headworks Upgrade (remedial)	$2.5 – 3.0M

Total	**$2.8 – 3.5M**

Option 2: UV Disinfection

This upgrade option is considered a growth item. Additional disinfection capacity will not be required until flows increase significantly and there is a recognized need to reduce e. coli population in the final effluent.

Upgrade	Estimated Cost
UV Disinfection Facility	$0.7 – 1.0M

Energy Optimization: VFDs for Blowers

This project is considered a remedial item. The addition of VFDs will improve the efficiency of the blowers, and the initial investment will be offset by energy savings.

Upgrade	Estimated Cost
Blower VFDs (x3)	$70,000 (x3)

Effluent Monitoring – Electrical Upgrade

A preliminary estimate for an electrical upgrade to the final effluent monitoring facility is $25,000-$50,000 for a solar energy upgrade, or $100,000 if a connection to the site's electrical system is required.

Studies

The following studies have been recommended through the IMP and are considered growth items.

Study	Estimated Cost
Bayview Bog Study	$ 15,000
System Connection – Feasibility Study	$ 150,000

Future Plant Expansion

The projects discussed throughout this memorandum are to be conducted throughout the IMP study period to meet the flow requirements up to 2046. These projects do not involve changes to the plant's rated capacity. Plant expansion will need to be examined within the IMP study period. Current growth projections estimate that the plant will reach 80% capacity in 2033, at which point the process for plant expansion will be initiated. The increase in capacity will be based on updated growth projections in 2033. The extent of the plant expansion will be based around the updated Bayview Bog study and what capacity the bog can accommodate. If the results of past Bayview Bog study(s) do not change, and based on the capacity of other process units, the next plant expansion would likely be to 9200 m^3/day. The following processes would require upgrades for the plant to operate at 9200 m^3/day (excluding projects listed previously in this memo that are to be completed throughout the IMP).

- Aeration tanks
- Secondary clarifiers
- Disinfection (if not already addressed by that time)

When initiating this process staff should also consider the outcome of the Future System Connection study. If connecting the Bath and Loyalist East systems is favourable, the plant expansion will need to account for all flows from Bath.

Climate Lens

The climate lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts and/or reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the needs of AWPCP in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021)
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021).

Peak flow equalization and headworks upgrade would include conversion of a part of the existing lagoon into an equalization lagoon connected with a new wet well pumping station for discharging overflows into headworks.

- Increase in precipitation will result in potential increased loading of sewage treatment works and challenging conditions for estimation of treatment volumes.
- Increase in temperature during the summer months will result in increased evaporation of liquid stored in lagoons, a decrease in flow through the lagoons, an increase in algae growth and sludge from algae die-off, and may result in increased odours, increased concentrations of E. coli and changes in concentrations of other parameters.
- Increase in temperature throughout the year may result in an alternation of microorganisms in sanitary sewage lagoons ultimately potentially affecting the treatment efficacy.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials with the general aim of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020)
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers etc.
- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.
- Reducing the water content in biosolids to reduce the number of truck loads required for biosolids removal resulting in lower GHG emissions from transport.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Calculations for construction of conveyance and treatment infrastructure will consider potential increase in flows from inflow and infiltration resulting from increased annual precipitation.
- Consider alternatives or modifications to storage lagoons to prevent increased algae growth which will result in increased chlorine demand for disinfection when in use. Some options to prevent increased algae growth include baffling, shading, raking or screening, or inclusion of barley straw.

Linkages

Amherstview WPCP Projections Technical Memorandum

Sanitary Sewage Regulatory Issues Technical Memorandum

Biosolids Management and Storage Technical Memorandum

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

GHD. (2022). *Ecological and Natural Heritage Investigation, 50 Sir John Johnson Drive, 88 Main Street, 4326 Taylor-Kidd Boulevard, Loyalist Township, Ontario.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Province of Ontario. (2020, May 1). *Provincial Policy Statement, 2020.* Retrieved from Land use planning: https://www.ontario.ca/page/provincial-policy-statement-2020

R.V. Anderson Associates Limited. (2023). *Amherstview WPCP and Bath STP Wastewater Modelling and Capacity Assessment Report.*

R.V. Anderson Associates Limited. (2023). *Lakeview Sewage Pumping Station - Capacity Assessment.*

Recommendations

The capacity of each process unit at AWPCP was evaluated, and when combined with projected flows, used to conduct a needs assessment. It has been determined that the headworks system will likely be the first unit in need of upgrades to meet capacity. The recommended option is upgrades to the headworks' mechanical screens, along with the use of a peak flow equalization system.

It is also suggested that the disinfection process may need to be upgraded in the future. The timing and type of upgrade will depend on how the current polishing lagoons continue to function as flows increase.

The following projects are recommended for prioritization: peak flow equalization and headworks upgrades; upgrades to the final effluent monitoring facility power supply; and VFD provision for the blowers.

It is recommended that operations staff continue to seek process efficiencies to reduce the use of potable water at the AWPCP.

It is recommended that a feasibility study is conducted on the linkage of the Bath sanitary system to AWPCP. Along with this study, staff are also recommending that an updated study on Bayview Bog is conducted to determine what changes may be needed for the outlet of the plant.

Staff should monitor flows to AWPCP annually. When flows reach 80% of plant capacity the expansion process should be initiated.

IMP Technical Memorandum: Bath Sewage Treatment Plant Needs Assessment

Asset Class: Sanitary Sewage

Objective: The objective of this technical memorandum is to provide an overview of the physical and process needs of the Bath Sewage Treatment Plant (BSTP). A capacity assessment has identified where upgrades are needed to remedy treatment capacity issues, as well as providing options for upgrades that will be required to meet demand due to population growth. Opportunities to optimize current operations have also been investigated, with the aim of reducing energy demand at the plant.

Background

BSTP services the community of Bath as well as several Correctional Services of Canada (CSC) facilities. The plant has a rated capacity of 3,008 m^3/d with a peak flow capacity of 12,032 m^3/day and is described as a secondary treatment plant comprising of preliminary treatment, aeration, final clarification, and effluent disinfection, with treated effluent eventually being discharged into Lake Ontario. Existing agreements between the Township and CSC have allocated 909 m^3/day of sanitary sewage capacity to the facilities operated by the latter, leaving 2,099 m^3/day of capacity for Bath itself.

The Population and Dwelling Growth technical memorandum projects a population increase by over 40% in this area between 2021 and 2046, resulting in increased demand for sanitary sewage treatment. R.V. Anderson (RVA) conducted an assessment on the current plant capacity using a BioWin™ model (R.V. Anderson Associates Limited, 2023). In so doing, opportunities have been identified for remedial action that would address immediate issues with rated capacity at the plant. The assessment also used growth projections to outline options for plant upgrades to meet the projected capacity requirement associated with the anticipated population increase.

In recent years it has become increasing difficult to maintain compliance at this facility. Maintenance levels have been expanded on several processes throughout the treatment system to attempt to optimize the plant's function and maintain acceptable levels of suspended solids in the final effluent, with some success and with the assistance of process consultants. The additional effort results in higher operating costs.

Assumptions

The following assumptions were made when developing these documents:

- Future flows at BSTP were based on the growth projections that were provided through the BSTP Projections memo included in the IMP.
- The model developed by RVA was based on sanitary sewage flow data from 2015 to 2021.

Methodology

To assist the Township in determining the needs at BSTP, RVA conducted an assessment of current capacity at the plant. This assessment identifies where upgrades are needed to address current capacity issues, along with potential upgrades to meet future demand.

Township staff involved with water and sanitary sewage operations provided input with respect to plant deficiencies and operational needs in addition to the RVA assessment.

For simplicity a separate memorandum has been prepared that analyzes how and where the Township should both process and manage residual solids within the sewage treatment process in the future for both BSTP and Amherstview Water Pollution Control Plant (AWPCP).

Data Sources

The data used to develop the figures presented in these documents were obtained from the BSTP Projections memo included in the IMP, as well as sanitary sewage flow data from 2015 to 2021.

BioWin™ Model

To assess the current operation conditions of the plant a BioWin™ Model was developed. BioWin™ is a software used for the simulation of biological sanitary sewage treatment plant design and analysis. The base model that was developed for BSTP is shown in Figure 1.

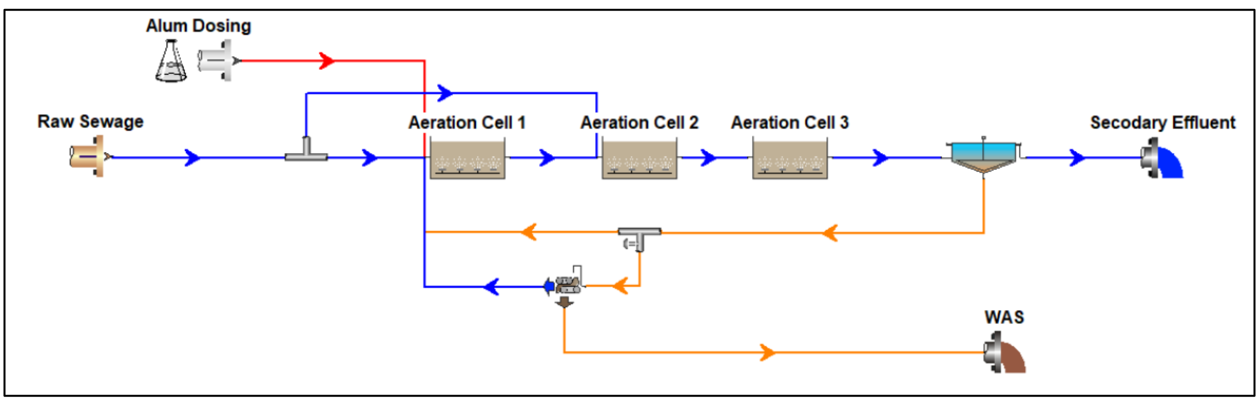


Figure 1. Base Model configuration for BSTP

Sanitary sewage flow data from 2015 to 2021 was used along with this base model in order to conduct model calibration and validation. Once the model was validated, it was used to confirm that the results determined through the desktop assessment are accurate. The model was also used to assess the plant performance at anticipated future flows.

Desktop Assessment

Each process unit was evaluated through desktop analysis. This assessment was conducted based on guidelines from the Ontario Ministry of Environment, Conservation and Parks (MECP) and the Water Environment Federation (WEF).

Using the guidelines and historical data, the capacity of the following units was assessed:

- Headworks – screens
- Aeration tanks
- Oxygenation capacity
- Secondary clarifiers
- Sludge digestion – aeration capacity
- Disinfection

The desktop analysis and BioWin™ Model were examined to identify potential plant upgrade options. The recommended upgrades were provided while considering the required future plant capacity of 2,623 m^3/day for 2046.

Analysis

Figure 2 below illustrates the capacity for each process unit along with the required future capacity.

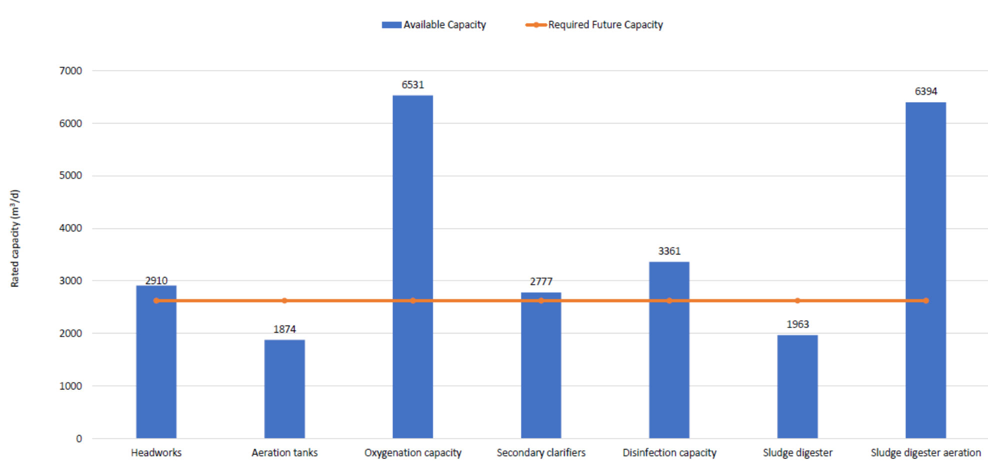


Figure 2. Process unit capacities at Bath STP

The capacity assessment indicated that the oxygenation, disinfection, and sludge digester aeration capacities would exceed the required future capacity and will not need upgrades.

The capacity of the headworks and secondary clarifiers is only marginally higher than the projected required future capacity. These systems may need upgrades as growth continues and flows approach the projected required capacity. The capacity of these units could be brought to par by lowering the peaking factor through the reduction of inflow and infiltration (I&I). An investigation into areas of high I&I is being conducted and should identify where remedial work is needed. Completion of this remedial work should delay the need for process unit upgrades.

The capacity of the aeration tanks is also only marginally above the projected required future capacity. The aeration capacity is dependent on the solids retention time (SRT) at which the plant operates. The MECP guidelines state that a nitrifying plant should have a SRT of 15 days. Under the current Environmental Compliance Approval (ECA), nitrification is not a requirement at STP, meaning that the SRT can be below 15 days. Operating at a SRT lower than 15 days provides sufficient aeration capacity at the plant. However, the assessment notes that any changes to the current ECA requirements could significantly alter the aeration capacity. Although changes to the ECA are not expected, Township staff have reviewed options for improving aeration capacity. RVA also noted that high levels of fats, oils, and grease (FOG) could be impacting the capacity of the aeration tanks and clarifier. Reduced FOG levels would improve sludge settleability and increase secondary treatment capacity.

The assessment determined that the sludge digestor would not meet the required future capacity and upgrades or operational changes will be required.

The constraints on the plant noted in the capacity assessment may contribute to the difficulties Utilities operators have had when operating BSTP, leading to increased maintenance efforts to remain in compliance.

Upgrade options to address the capacity concerns outlined above are presented in the following sections.

Upgrade Options – Secondary Treatment (Liquid Train)

The following upgrades are options to address/prevent potential capacity limitations of the aeration tanks at BSTP.

Option 1 – Operation Optimization: Operate at a SRT of 10 days and increase efforts to reduce FOG discharges from CSC and institutional, commercial, and industrial (ICI) users.

Option 2 – Aeration Tank Expansion: Addition of aeration cell with a volume of 585 m^3.

Option 3 – IFAS Retrofit: Addition of integrated fixed film activated sludge (IFAS) modules within the existing aeration tanks.

Option 4 – Enhanced Clarification: Addition of cationic polymer prior to the secondary clarifier during wet weather.

Option 5 – Tertiary Filtration: Addition of cloth media or granular tertiary filtration system to be operated during wet weather.

Upgrade Option	Advantages	Disadvantages

Option 1	• No need for capital upgrades • Improved effluent quality can be achieved through reducing FOGs • Provides additional capacity to the secondary treatment system	• Option may no longer suffice if effluent ammonia requirements are put in place
Option 2	• Increases capacity and redundancy for existing bioreactors. • Reduces loading on secondary clarifier.	• Proximity of residential households does not allow for adequate setback when expanding. • Cost: $750k - $1.0M
Option 3	• Increases capacity with minimal construction. • Reduces loading on secondary clarifier. • Cost: $200 - $250k	• Additional operation and maintenance requirements.
Option 4	• Increases secondary clarifier capacity during wet weather conditions. • Cost: $200 - $250k	• Additional operation and maintenance requirements. • Method has been reported to be challenging to operate and optimize. • High operational and life cycle costs.
Option 5	• Provides required additional capacity to secondary system. • Ensures best effluent quality.	• Does not add redundancy to the existing aeration tanks. • Additional operation and maintenance requirements. • Significant life cycle cost. • Cost: $1.0M - $1.5M

Based on this evaluation, RVA recommend Option 1, operation optimization. This recommendation aligns with current efforts of operations staff. As outlined above, this option will only remain applicable if there are no changes to the ECA. Staff currently monitor effluent levels carefully to determine how operations should be adjusted. This level of monitoring will be continued to ensure that the plant operation is optimized. Staff are also working towards improved monitoring of the flows and loadings coming from CSC. As presented by RVA, reducing the FOG levels entering the plant will improve settleability, and provide additional capacity to the secondary treatment units.

Upgrade Options – Sludge Digestion (Solids Train)

The following options were presented to address the capacity limitations with sludge digestion at Bath STP.

Option 1 – Repurpose small clarifier as digester: Remove the clarifier mechanism and retrofit an aeration system in the smaller clarifier.

Option 2 – Haul excess sludge to Amherstview WPCP: Haul excess sludge to Amherstview WPCP where additional digestion capacity is available.

Upgrade Option	Advantages	Disadvantages
Option 1	• Makes up for the SRT deficiency within the existing digester. • Increases sludge digestion capacity.	• Reduces liquid train capacity. • Removes redundancy for secondary clarification.
Option 2	• Utilizes available digestion capacity at Amherstview WPCP. • Avoids large construction projects.	• Estimated that hauling will be required 3 times a week.

Based on the evaluation above RVA recommends Option 2, haul excess sludge to Amherstview WPCP. Township staff requested further information on this option so that it could be trialed in the future. Details of this option are provided in the Biosolids Management and Storage technical memorandum.

Energy Optimization and GHG Reduction

The blowers at BSTP do not have variable frequency drives (VFDs) to regulate airflow. Without a VFD, a blower in operation is at 100%; however, only 34% of the air supply is required to meet demand. It was estimated that switching to a VFD could result in an annual energy saving of 197,100 kWh.

Reduction in the Use of Potable Water

The Township's two sanitary sewage treatment plants are some of the municipality's largest users of both electrical energy and potable water. The primary use of potable water is for cleaning at various points of the process. Previous attempts to develop a long-term solution have been unsuccessful to date.

Operations staff continue to address this issue and the following tasks are underway at various stages:

- Look at options available for implementing a process water system, possibly from clarifier effluent, to clean headworks augers; or, if the plant eventually adds a tertiary filter, the effluent from this filter could be used for process water
- Replacement of water meters with the objective of improved accuracy.

Flow Meter – CSC Inlet Control

Since the last plant upgrade a decade ago, the flow meter that measures the flow from the CSC properties has not functioned properly. Staff have trialled alternative meters to no avail. The issue relates to the poor hydraulics associated with the outlet, headworks and inlet well, and minimum elevation difference available to obtain suitable flow characteristics necessary for optimum meter operation.

Poor meter readings result in the municipality having difficulty accurately measuring CSC flows and not being able to accurately record CSC flows on a continual basis. This means that specific high flow events can be missed in the data summaries, making issues assessment difficult. Alternatively, Loyalist uses water demand data to assist in assessing sewage flow. Theoretically this makes sense, but when dealing with a large, complicated site like the Millhaven and Bath Institutions the results can be varied.

Staff are working towards a solution to more accurately record flows coming from CSC. Along with improved flow measurements staff are also recommending increased sampling of flows from CSC so that the impact of high FOG levels and toxic loadings can be more closely monitored.

Biosolids Management and Storage

Biosolids produced by the ATAD at AWPCP are stored in a biosolids lagoon where they are periodically hauled away for land application. The moisture content of these biosolids is high, making hauling expensive. Options for improved biosolids storage to address this issue are provided in the Biosolids Management and Storage Technical Memorandum. This memo also considers the additional load at AWPCP that will be caused when hauling sludge from BSTP.

Site Ecological Assessment and Archeology

GHD was retained to complete an ecological and natural heritage assessment of BSTP and 88 Main Street – Bath, the adjacent property also owned by the Township (GHD, 2022). The report concluded that these sites contained no significant natural features, significant wildlife habitat, or species at risk. Based on this conclusion, there are no ecological concerns at BSTP

The site of BSTP was the location of major construction in the last decade. Based on this information it is felt that there is limited possibility of encountering archeological heritage and no formal assessment has been undertaken at this time.

Future System Connection

When required, expansions at the BSTP will be costly, and likely challenging with the proximity to surrounding houses. Staff have noted an opportunity to connect the Bath sanitary system to the Amherstview system. This would involve converting the current BSTP to a pumping station and sending all sewage to Amherstview WPCP via a sanitary forcemain. Appropriate upgrades would be required at Amherstview WPCP to accommodate the additional flows from Bath. This project is beyond the scope of the IMP study. It is recommended that this option is investigated in more detail in a feasibility study.

Financial

The upgrades outlined in this document are initial recommendations. Further investigation and design will take place before implementation.

An investigation into identifying areas of high I&I is being conducted. Depending on the results of this investigation, remedial work may need to be done to reduce the amount of I&I. The cost of this remedial work will be determined through further study. The I&I investigation is further discussed in the Collection Systems Technical Memorandum.

An option to remedy flow metering from CSC is currently being trialed. If the trial is unsuccessful a more in-depth project may be required, with costs to be determined

A net preset value (NPV) analysis was conducted by RVA regarding options for hauling sludge from Bath STP to Amherstview WPCP, and is presented in the Biosolids Management and Storage technical memorandum.

Energy Optimization: VFDs for Blowers

This project is considered a remedial item. The addition of VFDs will improve the efficiency of the blowers.

Upgrade	Estimated Cost
Blower VFDs	$30,000 (x3)

Future Plant Expansion

The projects discussed throughout this memorandum are to be conducted throughout the IMP study period to meet the flow requirements up to 2046. These projects do not involve changes to the plant's rated capacity. Plant expansion may need to be considered within the IMP study period. Current growth projections estimate that the plant will reach 80% capacity in 2045, at which point the process for plant expansion will be initiated. The increase in capacity will be based on updated growth projections in 2045. It is likely that all process units will require upgrades at this time. Staff will have to consider the outcome of the Future System Connection study prior to the plant reaching 80% capacity, to determine if system connection is more favourable than expanding the plant.

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the needs of BSTP in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021).
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).

- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021).

Recommended upgrades to the BSTP included the following:

- The recommended upgrade option for the sludge digestion (solids train) at the BSTP includes hauling excess sludge to Amherstview WPCP.
- Future operations will include the investigation of recycling water for process and/or cleaning use within the plant, to reduce the use of potable water.
- As recommended, consideration of implementation of VFDs on blowers for energy optimization for future operations.
- Program to reduce I&I.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Decreasing the use of potable water will result in the decrease of demand from the water treatment plant ultimately reducing energy use and GHG emissions.
- Implementing VFDs on blowers will reduce energy consumption ultimately reducing GHG emissions.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- The recommended upgrades should not need to be adapted to the impacts of climate change.

Linkages

Bath STP Projections Technical Memorandum

Sanitary Sewage Regulatory Issues Technical Memorandum

Biosolids Management and Storage Technical Memorandum

References

GHD. (2022). *Ecological and Natural Heritage Investigation, 50 Sir John Johnson Drive, 88 Main Street, 4326 Taylor-Kidd Boulevard, Loyalist Township, Ontario.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

R.V. Anderson Associates Limited. (2023). *Amherstview WPCP and Bath STP Wastewater Modelling and Capacity Assessment Report.*

Conclusions

The capacity of each process unit at Bath STP was evaluated, and when combined with projected flows, used to conduct a needs assessment. It has been determined that sludge digestion is a limiting factor in sanitary sewage treatment at Bath STP. To address this limitation, it has been recommended to undertake a trial of hauling sludge from BSTP to Amherstview WPCP. This recommendation is detailed further in the Biosolids Management and Storage technical memorandum.

It is also determined that upgrades to the headworks and secondary clarifiers could be delayed by reducing I&I. It is recommended that after completion of the I&I investigation, remedial work is conducted to reduce the amount of I&I in the system.

To delay the need for aeration upgrades, it is recommended that staff continue to monitor the effluent carefully and operate with a lower SRT. To further reduce capacity limitations at the plant, it is also recommended that staff discuss reducing FOG levels coming from CSC and implement more accurate CSC flow metering.

Staff should monitor flows to BSTP annually. When flows reach 80% of plant capacity the expansion process should be initiated.

IMP Technical Memorandum: Collection System Needs Assessment

Asset Class: Sanitary

Objective: The objective of this technical memo is to outline the specific collection system needs of Loyalist Township within the study period.

Background

During the late 1960s and early 1970s the three main serviced communities of Amherstview, Bath, and Odessa each developed their own sanitary collection systems. These three collection systems have gradually expanded with the growth of the urban centers. In 2009 the Bridge Street pumping station and Odessa-Amherstview Sewage Forcemain were commissioned. This allowed for the connection of the Odessa and Amherstview collection systems, resulting in all sewage from Odessa was sent to the Amherstview Water Pollution Control Plant (WPCP). Sewage in Bath is collected and then treated at the Bath Sewage Treatment Plant (STP).

The Amherstview WPCP and associated pumping stations and collection system makes up the Loyalist East sanitary system. This system services Odessa, Amherstview, and the Loyalist East Business Park. The four sewage pumping stations (SPS) in this system are the Lakeview SPS, Islandview SPS, Bridge St. SPS, and Taylor Kidd SPS.

The Bath sanitary system is serviced by the Bath STP and serves the community of Bath and Correctional Service of Canada's (CSC) Millhaven and Bath Institutions. This system also consists of four pumping stations, Bath SPS #1, #2, #3, and #4.

Most sanitary collection system infrastructure (sewer manholes and sewer mains) in the Township is approximately 30 years old or older, meaning it could have up to 50 years of service life remaining. If issues are identified in the system, they are repaired by operations staff. If no immediate repairs are required, then staff aim to time replacement of collection system infrastructure with other reconstruction in the area.

Methodology

The individual Sanitary Sewer Design (SSD) check sheets were placed into single spreadsheets established for the individual pump stations. The new summary of the SSD check sheets were used by staff to highlight potential areas of concern in the sanitary collection system. These sheets model the full flow velocity, actual velocity, and used capacity of each section of sewer. The following criteria were used to determine if a section of sewer needed to be flagged for review:

1. Full flow velocity is greater than the maximum peak flow velocity of 3.0 m/s
    - This is commonly referred to as the scouring velocity and represents an increased rate of wear on the Townships infrastructure.
2. The actual velocity is less than the minimum average flow velocity of 0.6 m/s

   - This is commonly referred to as the cleansing velocity and represents minimum flows required to prevent build-up within the sewer. As noted below, this is not commonly observed as an issue within the Township.
3. The “Percent Full” value if over 80%
   - This represents a further conservative estimate to prevent surcharging of the sewers by limiting the sewer capacity to this point.

It was noted by staff that based on the SSD model, Criteria 2 is true for many sections of sewer in the Township; generally, though, there are no issues noted by operations staff. All sections of sewer that have been flagged were reviewed by staff to determine if the issues predicted by the model were seen in practice. If the issues were confirmed, remedial projects would be proposed.

In addition to the SSD model, actual flows at the pumping stations and treatment plants were monitored to identify if there are any issues with inflow and infiltration (I&I).

Assumptions

Staff updated existing Sanitary Sewer Design (SSD) check sheets to determine if any sections of sewer were close to capacity or if any flow velocities were of concern. The SSD sheets use the following assumptions:

- Average daily flow per person = 350 L/day/capita
- Extraneous flow = 0.26 L/s/ha
- Commercial area average flow = 28 m^3/d/ha
- People per residential unit = 2.5
- People per apartment unit = 2.3

It should be noted that these assumptions for the model are considered conservative.

Analysis

Loyalist East Sanitary System

Lakeview SPS Catchment Area
The following sections of sanitary sewer were flagged through the SSD model, based on the criteria outlined above:

Location			Reason for review
Street Name	From MH	To MH	
Kidd Dr.	1069	1073	Full flow velocity = 3.78 m/s
Littlefield Rd.	1109	1108	Full flow velocity = 6.06 m/s
Westran Rd.	1127	1124	Full flow velocity = 3.91 m/s
Cambridge Cr. Easement	1093	1318	Full flow velocity = 3.43 m/s
Cambridge Cr. Easement	1318	1319	Full flow velocity = 6.10 m/s
Lakeview Park Easement	1316	1317	Full flow velocity = 4.08 m/s

In addition to the items listed in the table, 183 sections of sewer were noted through the model for having a minimum average flow velocity below 0.6 m/s.

Bridge Street SPS Catchment Area
The following sections of sanitary sewer were flagged through the SSD model, based on the criteria outlined above:

Location			Reason for review
Street Name	From MH	To MH	
Factory Street Easement	1893	1882	Percent full = 99.94%
Factory Street Easement	1882	1883	Percent Full = 101.71%

It is noted that staff are not aware of any issues with these sewers surcharging, flooding of resident basements, or flooding to grade. As such, no immediate action is required; however, this will require that for any new development flowing through, these sewers will need to be upsized accordingly.

In addition to the items listed in the table, 89 sections of sewer were noted through the model for having a minimum average flow velocity below 0.6 m/s.

Islandview SPS Catchment Area
In the Islandview SPS catchment area 11 sections of sewer were noted through the model for having a minimum average flow velocity below 0.6 m/s.

Taylor Kidd SPS Catchment Area
In the Taylor Kidd SPS catchment area 6 sections of sewer were noted through the model for having a minimum average flow velocity below 0.6 m/s.

All items noted through the SSD model for the Loyalist East system were reviewed with operations staff. Based on their review it was determined that there are no collection system infrastructure upgrades to be recommended through the IMP. Collection system upgrades will be completed through the Asset Management Plan and along with reconstruction projects.

Bath Sanitary System

Bath SPS #1 Catchment Area
In the Bath SPS #1 catchment area 70 sections of sewer were noted through the model for having a minimum average flow velocity below 0.6 m/s.

Bath SPS #2 Catchment Area
In the Bath SPS #2 catchment area 17 sections of sewer were noted through the model for having a minimum average flow velocity below 0.6 m/s.

Bath SPS #3 Catchment Area

In the Bath SPS #2 catchment area 6 sections of sewer were noted through the model for having a minimum average flow velocity below 0.6 m/s.

Bath SPS #4 Catchment Area
In the Bath SPS #4 catchment area 25 sections of sewer were noted through the model for having a minimum average flow velocity below 0.6 m/s.

All items noted through the SSD model for the Bath system were reviewed with operations staff. Based on their review it was determined that there are no collection system infrastructure upgrades to be recommended through the IMP. Collection system upgrades will be completed through the Asset Management Plan and along with reconstruction projects.

Inflow and Infiltration

Inflow and infiltration (I&I) refers to stormwater and groundwater entering the sanitary sewer system. I&I creates more demand on the collection system, pumping stations, and sanitary treatment plants. This increase in demand results in less available capacity for new connections to the system.

As expressed in the sewage system annual reports, both sanitary systems in the Township experience high levels of I&I. The annual reports note that peak flows at the pumping stations occur during heavy precipitation events, which is an indicator of significant I&I.

The treatment plant needs assessment memos highlight that reduction of I&I can decrease demand on the plant and potentially delay the need for costly upgrades. It is recommended that staff continue working towards the following solutions to reduce I&I:

1. Develop a wet weather sanitary model (as required in the CLI-ECA)
2. Continue program to identify areas of high I&I
3. In known areas of concern, work on manhole and lateral repairs
4. Continue capital investment for replacement of aging infrastructure

Development of a wet weather sanitary model is a requirement as a part of the CLI-ECA. Staff plan to start development of this model next year. In addition, this model can be used to help staff identify areas that experience high levels of I&I.

As items 1 and 2 on this list are completed, staff will be able to pinpoint areas of concern and focus repair/replacement efforts on those locations. Currently staff complete spot repairs as they are identified, but this is a reactive rather than proactive approach. When possible, staff should target capital replacement of sanitary infrastructure as reconstruction is occurring in an area. Completion of the model and I&I program will support staff in developing a proactive capital replacement strategy that can reduce I&I.

Administrative Improvements

In addition to the improvements outlined above, it is recommended that the following administrative improvements are investigated:

- Add requirements to the Sewer Use and Sewage Works by-laws to ensure that harmful materials (i.e., plastics) are not discharged to the sewer
- Develop oil removal program/strategy for residents
- Consider the following items in the development guidelines once they are completed:
    - Maintain I&I requirement
    - Installation of sewer cleanouts at property line
    - Installation of backflow preventers in new developments on private properties to prevent basement flooding

Remedial Considerations

Staff have tracked sewer related concerns by street, with specific notes for each issue. For example, it has been noted by staff that there are joint sanitary services along Bath Road/Highway 33 that should be individualized when the highway is reconstructed.

It is recommended that these records are referenced when determining the scope of any reconstruction project, to ensure it addresses any deficiencies.

Future Development

As development continues in the Township the collection system will expand. All projects that result from new development are discussed in more detail in the Sanitary Future Development technical memorandum.

Financial

The only collection systems project expected to require financial involvement from the Township is the development of a wet weather sanitary model. It is estimated that this project will cost $250,000.

Operation budgets should have sufficient resources to maintain I&I monitoring and to have all leaks repaired expediently. Reduction of I&I will preserve and perhaps enhance available capacity for further growth.

In the case of a new development that feeds to the sewers in the Factory Street easement, this section of sewer will need to be upsized accordingly. The financial involvement of the Township will need to be determined if this situation arises.

Climate Lens

The climate lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate change conditions.

Climate conditions that will most likely impact the needs of the sanitary collection system include the following:

- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021)
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021).

Recommended projects related to collection systems include the following:

- Develop wet weather sanitary model
- Continue I&I reduction program
- Additional parameters in the Sewer Use and Sewage Works by-laws
- Develop oil removal program/strategy for residents
- Additional considerations in development guidelines

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Changes to Township sanitary-related by-laws and development guidelines will protect the sanitary system from items that make treatment more difficult. This will decrease the demand on the sewage treatment plant, ultimately reducing energy use and GHG emissions.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- The development of a wet weather sanitary model and I&I reduction program will reduce inflow and infiltration throughout the collection system, making it more resilient against the increased frequency and intensity of rainfall events.

Linkages

Sanitary Future Development Technical Memorandum

Amherstview WPCP Needs Assessment Technical Memorandum

Bath STP Needs Assessment Technical Memorandum

References

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Conclusion

Both sanitary collection systems in the Township have been reviewed to determine if any projects need to be identified through the IMP. Based on discussions with Utilities staff it was determined that sanitary sewer infrastructure upgrades/repairs will be completed through the Asset Management Plan. I&I reduction has been identified as a priority through the IMP. The development of a sanitary wet weather model and continuation of an I&I reduction program are recommended through the IMP.

Along with these I&I related programs it is also recommended that the following administrative improvements are undertaken.

- Addition of parameters to the Sewer Use and Sewage Works By-laws to ensure harmful materials (i.e., plastics) are not discharged to the sewer
- Update the balance of the Sewer use By-law to reflect current best practices
- Develop oil removal program/strategy for residents
- Consider the following items in the Development Guidelines
    - Maintain an I&I requirement
    - Installation of sewer cleanouts at property line
    - Installation of backflow preventers in new developments on private properties to prevent basement flooding

Depending on how development proceeds in Odessa, the sewer mains along the Factory Street easement may need to be upsized.

IMP Technical Memorandum: Capacity Assessment of Islandview Sewage Pumping Station

Asset Class: Sanitary

Objective: The objective of this technical memorandum is to provide an overview of the capacity assessment of Islandview Sewage Pumping Station (SPS).

Background

The aim of this SPS evaluation is to assess the current hydraulic capacity of the station. The areas contributing to the Islandview SPS will be analyzed in their “as is” state.

During the late 1960’s and early 1970’s, the developer of Amherstview installed a sewage collection system and pump stations to the initial treatment facility. The Islandview SPS at Islandview Park, located on the south side of Bath Road, was constructed in 1970 and currently receives flows from the east end of Amherstview. Sewage from this pump station is then conveyed west, where it flows in the existing sanitary system just west of Sherwood Avenue, ultimately discharging into the Lakeview SPS. This pumping station provides sanitary pumping capacity to an of approximately 54 hectares.

The original pumping station was replaced by the current Islandview SPS in 1998. The updated station includes:

- A new wet well,
- Two solids handling, non-clog pumps, each rated at 48 L/s against a total dynamic head of 20 m,
- Updated control panel, air vents, access ladder, ultrasonic transducers, and float switches including high level alarm, and
- New discharge piping.

Replacement of the control panel occurred in 2017. One pump was also rebuilt in 2017 after it was damaged by a cable drawn into the pump.

Upgrades to the PLC including installation of new controllers with water pilot pressure transducers, and a backup high-level float occurred in 2019.

This station does not have a flow meter and as a result, the only method of estimating sewage flows is to use the meter that measures pump operating time. This is the largest pump station in the system without flow metering and should be the highest priority for a flow meter installation.

The population of Amherstview is expected to grow by 53% within the study period covered by the IMP. It is likely that with development and population growth, the demand on the Islandview Pumping Station (SPS) will increase.

Assumptions

The following assumptions were made when developing this document:

- Capacity assessment was based on flow data from 2018-2020 and design capacity of the pumping station.

Methodology

To assist the Township in determining the remaining capacity and potential needs of the Islandview SPS required to meet projected growth, Township staff assessed the current capacity of the pumping station to determine where upgrades are needed to address current capacity issues, along with potential upgrades to meet future demand.

Township staff involved with water and sanitary sewage operations provided input with respect to pumping station deficiencies and operational needs.

Analysis

Hydraulic Assessment

Islandview SPS can be described as follows:

- pumping station capacity is 45.7 L/s,
- 2 solids handling, non-clog pumps (1 duty, 1 standby) – all pumps rated for 48 L/s against a total dynamic head of 20 m,
- wet well with a volume of approximately 69 m^3 (3.6 m diameter, 6.8 m deep wet well),
- connected to a 200 mm forcemain that discharges to a 400 mm gravity sewer terminating at Lakeview Pumping Station.

According to information provided by Utilities operators, the pump station has operated as intended since its reconstruction in 1998.

Design Capacity

An assessment of flows contributing to the Islandview SPS has been undertaken by reviewing historical flow data collected between 2018 and 2020. The data has been summarized using monthly flow data and has been calculated monthly flow (m^3) and flow per capita per day (L/cap/day).

Remaining Capacity

The remaining capacity of the Islandview SPS was calculated by subtracting the estimated current peak flows from its total capacity. It should be noted that for existing connections the extraneous flow value was set to zero since extraneous flows are accounted for in the flow per capita value. Estimated current peak flows were calculated using the following formula:

$$Q = \frac{PqM}{86.4} + lA$$

where:

- Q = estimated peak flow (L/s)
- P = population (thousands) = 1.7204 cap
- q = flow per capita = 308 L/cap/day
- M = Peaking factor = 3.6
- I = unit of peak extraneous flow = 0.14 L/ha/sec
- A = contributing area = 54.04 ha

The peaking factor (M) was calculated using the following formula:

$$M = 1 + \frac{15}{4 + P^{0.5}}$$

Based on this information, the current peak flow value can be calculated to be 22.81 L/s, leaving 22.89 L/s (or 50%) of remaining capacity for Islandview SPS.

Mechanical, Electrical, and Instrumentation Assessment

The following mechanical and electrical components and instrumentation exists at the pumping station:

- all necessary appurtenances, controls, and alarms,
- connected to 250 kWh diesel generator at Fairfield Water Treatment Plant (on-site),
- control panel, air vents, level transmitter, float switches including alarm,
- discharge piping, and
- SCADA integration.

The mechanical, electrical and instrumentation components of the pumping station were not assessed as part of this investigation. Based on information provided by the operators, other than some maintenance to electrical controls and a rebuild of one pump, all equipment is functioning according to operational requirements of the pumping station.

Growth Expectations for Catchment Area

There is expected to be minimal growth within the catchment area of Islandview SPS.

This growth can be classified into 3 distinct categories. Most of the catchment area is developed as single-family homes. There are approximately 43 approved residential lots to be developed on Westfield Drive and Kilimanjaro Drive, representing an area of approximately 3 hectares. It is estimated that this development will result in a flow of 2.17 L/s. There is also some potential for intensification in the existing catchment area. A 15% increase in flows is considered for this infill, which is equivalent to approximately 3.35 L/s. The original design assumptions allowed for the potential of some of the homes along the Coronation Boulevard corridor to be eventually serviced by this pump station, as homes on Coronation Boulevard have private septic systems that eventually may have to be replaced. If 16 units on Coronation Boulevard were to connect to the system, that would result in a 1.13 L/s increase in flow.

Based on this analysis, and using the same calculations described above, the overall increase in flows expected for this catchment area is 6.65 L/s.

Summary of Remaining Capacity

Analysis completed earlier indicates that for this station approximately 50% of the pumping station's original capacity, approximately 22.89 L/s, remains available. After considering the expected growth discussed above, approximately 36% of the original capacity will be remaining, which is equivalent to 16.24 L/s. Based on this analysis there is no need to plan for increased pump capacity at this location.

Upgrade Requirements or Options

This station does not have a flow meter, and as a result the only method of estimating sewage flows is to measure pump operating time. This is the largest pump station in the system without flow metering, and should be the highest priority for a flow meter installation.

Financial

Upgrade	Estimated Cost
Installation of Flow Meter	$15-20k

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the future upgrades of sewage pumping stations in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). Increase in temperatures will result in increase water usage and wastewater generation.

- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021). Wetter weather will result in an increase in infiltration within the sanitary system.
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). Extreme events will result in an increase in infiltration within the sanitary system.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials, with the overall goal of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined, including granular materials, and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers etc.
- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Calculations for construction of conveyance and treatment infrastructure will consider potential increase in flows from inflow and infiltration as a result of increased annual precipitation.

Linkages

n/a

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Conclusions

Minimal development is expected within the catchment area of Islandview SPS and what growth is anticipated will be less than the station’s remaining capacity. Staff do not anticipate that the station will require capacity-related upgrades within the term of the IMP. Installation a flow meter may be considered to enhance service delivery of the SPS for the future.

IMP Technical Memorandum: Capacity Assessment of Bridge Street Sewage Pumping Station

Asset Class: Sanitary Sewage

Objective: The objective of this technical memorandum is to provide an overview of the capacity assessment of Bridge Street Sewage Pumping Station (SPS).

Background

During the 1970s the community of Odessa implemented a sewage collection system. In 2008 Loyalist Township constructed the current Bridge Street SPS at the south end of Bridge Street, to replace the original SPS built in 1975. Bridge Street SPS receives sanitary flows from the entire serviced area of Odessa, and conveys them south by a forcemain along County Road 6 and Taylor-Kidd Boulevard, to the Amherstview Water Pollution Control Plant (WPCP). Bridge Street SPS provides sanitary pumping capacity to an area of approximately 23.59 ha.

One pump was rebuilt in January 2019. The repair was required due to a partially severed cable that resulted in a leak. The level sensor has also been upgraded from an ultrasonic sensor to a pressure sensor.

The population of Odessa is expected to grow by 53% within the study period covered by the IMP. It is likely that with development and population growth, the demand on the Bridge Steet Sewage Pumping Station (SPS) will increase.

The aim of this SPS evaluation is to assess the current hydraulic capacity of the station. The areas contributing to the Bridge Street SPS will be analyzed in their “as is” state.

Assumptions

The following assumptions were made when developing this document:

- Capacity assessment was based on flow data from 2019-2021 and design capacity of the pumping station.

Methodology

To assist the Township in determining the remaining capacity and potential needs of the Bridge Street SPS required to meet projected growth, Township staff assessed current the capacity at the pumping station. This assessment determined where upgrades are needed to address current capacity issues, along with potential upgrades to meet future demand.

Township staff involved with water and sanitary sewage operations provided input with respect to pumping station deficiencies and operational needs.

Analysis

Hydraulic Assessment

Bridge Street SPS can be described as follows:

- Pumping station with a rated capacity of 165 L/s,
- 3 solids handling, non-clog pumps (2 duty, 1 standby), all rated for 83.8 L/s against a total dynamic head of 16.9 m,
- Wet well with a volume of 83.4 m^3 (3.10 m x 4.27 m x 6.30 m),
- Connected to a 450 mm sanitary forcemain;
- Discharges to AWPCP.

According to information provided by utility operators, the pump station has operated as intended since its construction in 2008.

Design Capacity

Flows contributing to Bridge Street SPS were assessed by reviewing past (2019-2021) flow data from the Bridge Street SPS as recorded at the Amherstview WPCP, based on the initial pumping station design factor of 165 L/s.

Remaining Capacity

The remaining capacity of Bridge Street SPS was calculated by subtracting the estimated current peak flows from its total capacity. It should be noted that for existing connections the extraneous flow value was set to zero since extraneous flows are accounted for in the flow per capita value. Estimated current peak flows were calculated using the following formula:

$$Q = \frac{PqM}{86.4} + lA$$

where:

- Q = estimated peak flow (L/s)
- P = population (thousands) = 2.254 cap
- q = flow per capita = 676 L/cap/day
- M = Peaking factor = 4.42
- I = unit of peak extraneous flow = 0.14 L/ha/sec
- A= contributing area = 37.94 ha

The peaking factor (M) was calculated using the following formula:

$$M = \frac{\text{maximum } day\ flow}{average\ day\ flow}$$

The maximum value from the 2019-2021 calculated peaking values was used.

Based on this information, the current peak flow value can be calculated to be 52.40 L/s, leaving 112.20 L/s (or 68%) of remaining capacity for Bridge Steet SPS.

Mechanical, Electrical, and Instrumentation Assessment

The following mechanical and electrical components and instrumentation exist at the pumping station:

- all necessary appurtenances, controls, and alarms,
- 225 kWh diesel standby generator,
- magnetic discharge flow meter, control panel, air vents, level transmitter, float switches including alarm,
- discharge piping, by-pass connection of the wet well,
- SCADA integration,
- odour control units installed on the air-release valves of the forcemain.

The mechanical, electrical and instrumentation components of the pumping station were not assessed as part of this investigation. Based on information provided by the operators, other than some maintenance to electrical controls, all equipment is functioning according to operational requirements of the pumping station.

Growth Expectations for Catchment Area

There is expected to be significant growth within the catchment area of Bridge Street SPS. Staff have estimated the timing of developments to demonstrate when additional capacity may be needed at this pump station. It should be noted that some of these developments are in very early planning phases and therefore may not proceed as estimated.

Short Term – Next 5 Years

Most of the catchment area is developed as single-family homes. 321 committed-but-unbuilt units are projected to be built out in the next 5 years from the Babcock Mills and 315 Main Street – Odessa developments. The total flow from these developments is projected to be 29.93 L/s, which will leave 82.26 L/s or 50% as remaining capacity at the pump station.

Medium Term – 10 to 15 Years

In addition to the short-term development, 600 future units are projected to be built in the next 15 years as a part of the Fields of Loyalist development. The total flow from this development is projected to be 56.06 L/s.

A development along Shane Street is in the early stages of planning. This development is projected to have 736 units in the first parcel, which will be equivalent to 66.41 L/s.

There is also some potential for intensification in the catchment area. A 15% increase in flows is considered for this infill, which is equivalent to approximately 7.86 L/s.

When considering all the above units to be connected to the system, the pump station will have a deficit in capacity. The current capacity will be surpassed by 48.06 L/s or 29%. This indicates that pump upsizing will need to occur in 10 to 15 years.

Long Term – 20 to 35 Years

Staff are expecting that the Fields of Loyalist and Shane Street developments mentioned above will continue to grow into the long term.

It is projected that the lands west of the current Fields of Loyalist development will house approximately 657 units, resulting in a flow of 61.38 L/s.

The Neighbourhood Plan for the Shane Street subdivision estimates that 1,924 units could be constructed on the remaining parcels along Shane St. (parcels 2-5). The total flow from these additional units is estimated to be 173.36 L/s.

When considering the above units, the current capacity will be surpassed by 282.80 L/s or 172%. It is not expected that all these units will be constructed within the timeframe of the IMP; however, this large increase in flow should be noted by staff. These flows will need to be evaluated in more detail in 10 to 15 years, when it is projected the pumping station's capacity will need upgrades.

Upgrade Requirements or Options

There are no required upgrades for this station at this time. Based on the high-level analysis provided in this report, the SPS will be approaching its capacity in approximately 10 to 15 years. The equipment at Bridge Street is marked for replacement through the Township's asset management plan in 16 years. Staff should keep these timeframes under consideration so that the pumps can be appropriately upsized if required.

When considering all the potential development in the Odessa catchment area, the SPS will need to be upgraded to meet a capacity of 450 L/s. It is recommended that a more detailed analysis of the pump station is conducted as capacity is approached. This analysis will provide more insight as to what specific upgrades will be required to meet the desired capacity. At that time staff will also have more concrete numbers for long term development and will therefore be able to confirm what capacity the station needs to be able to pump. It should be noted that this assessment should include review of the forcemain that takes flows from Bridge Street to the Amherstview WPCP.

Financial

To upgrade the pump station capacity to 450 L/s is estimated to cost $4,500,000. This is a high-level estimate, and the station will need to be assessed in more detail prior to upgrades to confirm the scope of work required.

It is recommended that a detailed assessment of Bridge Street SPS is conducted in approximately 10 years. It is estimated that this study will cost $20,000.

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the future upgrades of sewage pumping stations in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). Increase in temperatures will result in increase water usage and wastewater generation.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021). Wetter weather will result in an increase in infiltration within the sanitary system.
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). Extreme events will result in an increase in infiltration within the sanitary system.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials with the general aim of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers etc.

- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Calculations for construction of conveyance and treatment infrastructure will consider potential increase in flows from inflow and infiltration due to increased annual precipitation.

Linkages

n/a

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Conclusions

Given Bridge Street SPS's location relative to available development lands, it is likely that there will be many new connections in the medium to long term, leading to the need to upsize the station within IMP study period. It is recommended that a detailed assessment of the station is conducted as capacity is approached (±10 years) to confirm what upgrades will be required.

IMP Technical Memorandum: Capacity Assessment of Taylor-Kidd Sewage Pumping Station

Asset Class: Sanitary

Objective: The objective of this technical memorandum is to provide an overview of the capacity assessment of the Taylor-Kidd Sewage Pumping Station (SPS).

Background

Constructed in 2008, the Taylor-Kidd SPS is located at the northeast intersection of County Roads 6 & 23 (Taylor-Kidd Boulevard) in Amherstview and receives sanitary sewage from the Loyalist East business park. Sanitary sewage is pumped east from the pumping station to the Amherstview Water Pollution Control Plant (WPCP) on Taylor-Kidd Boulevard.

According to the Environmental Compliance Approval (ECA), the firm capacity of the station is approximately 7,430 m^3/day (86 L/s) and consists of three pumps (2 duty and 1 standby) and associated appurtenances. The ECA indicates that each pump is rated at 51.9 L/s against a total dynamic head (TDH) of 26.5 m; however, the Township's consultant identified a discrepancy in this information during their field work, and reports that the pumps are rated for 22.5 m TDH at 52 L/s.

Methodology

R.V. Anderson Associates Limited (RVA) were retained by Loyalist Township to undertake a capacity evaluation of the Taylor-Kidd SPS to identify potential capacity restrictions and upgrade options for meeting the future sanitary sewage servicing needs.

To assist the Township in determining the needs at the Taylor-Kidd SPS, RVA's assessment identified where upgrades are needed to address current capacity issues, along with potential upgrades to meet future demand.

The Township also assessed remaining capacity of the station in its current state to meet proposed growth based on current connections to the sanitary system.

Data Sources

The data used to determine the capacity of the pumping station included:

- Historic flow data from 2019-2021
- Odessa & Loyalist East Sewage Pumping Stations contract No. 2007-09 As-Builts by The Thompson Rosemount Group Inc. (2009)
- Odessa & Loyalist East Forcemain Contract No. 2007-07 As-Builts by the Thompson Rosemount Group Inc. (2008)
- Amherstview WPCP Upgrades IFC Drawings by the Thompson Rosemount Group (2008)

- Lakeview SPS Record Drawings by Gore & Storrie Limited (1989)
- Design Brief – Odessa and Loyalist East Sewage Pumping Stations by The Thompson Rosemount Group Inc. (2007)
- Sewage Treatment Plants – Annual Report 2020 (Corporation of Loyalist Township, 2021)

Capacity Assessment

The capacity assessment conducted by RVA included a hydraulic capacity assessment of existing components of the pumping station as well as establishing a list of capacity expansion options based on potential future servicing needs.

The theoretical maximum capacity of Taylor-Kidd SPS is 86 L/s, and the station is currently operating with a peak flow rate of 52-52.5 L/s, which represents 61% of the expected flow rate to be generated by the pumps based on the ECA, based on draw-down testing by RVA during the capacity evaluation. Based on RVA's review of the pumping station and forcemain system curve, the TDH required for two pumps to achieve a combined flow of 86 L/s is approximately 39 m whereas the existing pumps produce a head of only 26.5 m. Based on RVA's review, possible reasons for the decreased capacity include:

- According to the design basis for the station, the discharge elevation of the forcemain was intended to be an open discharge at an elevation of 102.6 m however based on the current WPCP design, the forcemain flows pump up to the top water level of the headworks, which is above grade, contributing an approximate 35% increase in the static head to overcome while pumping (equivalent to an increase in a combined 22% TDH)
- The 2008 Amherstview WPCP Upgrades added some valve chambers including valves, fittings, and bends, which may not have been known at the time of design for the TKPS pump selection. It is possible the number of fittings and bends along the main forcemain, combined with friction losses through the new chambers, were not known in the original design basis.
- The ECA lists pumps rated for TDH of 26.5 m against a flow rate of 51.9 L/s. RVA received documentation from the original pump equipment manufacturer (Flygt), that indicated the pumps installed are rated for 22.5 m TDH at 52 L/s.
- The draw down test may have been impacted by incoming flows from Odessa PS occurring at the same time as the draw down testing.

Based on the review of existing system curve and pump curves, the maximum achievable capacity for the pumping station appears to be closer to 55-56 L/s at 29 m TDH. The pumps appear to need to work harder to pump to a higher elevation and the pumps are undersized compared to what is listed on the ECA. Given this information, it is unlikely the full 86 L/s flow capacity would be achievable with the current station configuration. However, the station is only operating at less than 1% capacity, therefore there remains significant build-out capacity available over current flows into the station.

Table 1 Pump capacity test

Test Description	Measured Flow (L/S)
Pump #2 + Pump #3 at 100% speed	52-52.5

Historic monthly flow data from 2019-2021 indicates that there are no discernable average daily flow trends. The annual average daily flow trending is mostly flat ranging from 0.07 L/s to 0.25 L/s which represents approximately 1% of the measured firm capacity of the station.

The capacity of individual components of the station were reviewed to assess their ability to accommodate increased flow through the station and are summarized in the table below.

Table 2 Maximum capacity by component

Station Component	Max Capacity (Firm Station Capacity)
Inlet Sewer – EXMH11 to MH-12	129 L/s
Inlet Sewer MH-12 to PS	210 L/s
Wet Well	120 L/s (without using VFD modulate level, based on 10-minute pump cycling time)
Pumps	2 pumps running in parallel achieves 52 L/s (draw down test), estimated maximum capacity based on pump curve is 56 L/s
Discharge piping	70 L/s through common header at standard flow velocities
Force main	130 L/s maximum
Transformer capacity	400 A, 600 V, 3 ph., 4 wire
Standby generator	125 kW

Capacity Assessment of Future Scenarios

Anticipated station upgrades to accommodate the current rated capacity of the Taylor-Kidd pumping station is summarized in the tables below.

Table 3 Process upgrades summary

Scenario	Inlet Sewers	Wet well	Pumps	Pump discharge piping	Pressure relief valve	Force main
Scenario 1 – Upgrade Capacity to 86 L/s.	No upgrade required.	No upgrade required.	Three (3) new pumps (43 L/s each at 39m TDH) on VFD.	Common header section of 150 mm be increased to 300 mm diameter.	No upgrade required unless identified by future transient analysis.	No upgrade required.

Table 4 Electrical upgrades summary

Scenario	Existing Utility	Power Distribution Equipment	Standby Generator	Pump Starter	Service Cables	Controls
Existing condition – 3 x 30 hp pumps (2 duty + 1 standby)	No upgrade required.	Existing Pump control panel 600V, 3 ph. Pump feeder cables 3#8AWG U/G	No upgrade required.	No upgrade required	No upgrade required.	Level sensor
Scenario 1 – Upgrade Capacity to 86 L/s	No upgrade required.	Replacement of pump control panel required. Replacement of pump feeder cables required.	No upgrade required	New VFDs required.	No upgrade required.	Level Sensor

It should be noted that the upgrades outlined in this document are initial recommendations, and that further investigation and design work will be required before

Remaining Capacity

The remaining capacity of Taylor-Kidd SPS was calculated by subtracting the estimated current peak flows from its total capacity.

Estimated current inlet flows from the business park were calculated based on the following parameters:

- Commercial area = 8.64 ha
- Commercial area average flow = 28 m^3/ha/d
- Extraneous flow = 0.26 L/s/ha

Based on this information, the current commercial inlet flow is estimated at 5.05 L/s.

Actual flows based on historical pump station data from 2018-2020 ranged from 0.53 to 6.72 L/s with an average of 1.43 L/s.

The calculated maximum capacity of Taylor-Kidd SPS was determined to be 52 L/s based on draw down testing completed by RVA in 2022. Based on historical data and estimated data for commercial development characteristics, flows between 0.53 (lowest recorded flow) and 6.72 L/s (maximum recorded) are pumped through the station, leaving 45.28 and 51.47 L/s (or between 87 and 99%) of remaining capacity for Taylor-Kidd SPS.

Growth Expectations for Catchment Area

There is expected to be significant growth within the expanded catchment area of Taylor-Kidd SPS. Staff have estimated the timing of developments to demonstrate when additional capacity may be needed at this pump station. It should be noted that some of these developments are in very early planning phases and therefore may not proceed as estimated.

Within IMP Study Period

Most of the catchment area will be developed as single-family homes. 274 units in the Lakeside Ponds subdivision will be/have been constructed and will send flows to the Taylor-Kidd SPS. The total flow from this development is projected to be 13.34 L/s.

The majority of the Amherstview West development will also send flows to the Taylor-Kidd SPS. The first phase of this development is projected to be completed by the end of the IMP study period and will consist of 1,000 units. Residential and commercial flow from development in this area is projected to be 42.81 L/s.

The total flow from new development within the IMP study period is projected to be 56.16 L/s, which will put this station at a deficit for capacity by 16%, or 8.44 L/s.

Post IMP Study Period

Building out the rest of the Amherstview West Secondary Plan lands is estimated to result in an additional 1,526 residential units and 1.85 ha of commercial lands. The flows associated with this growth are projected to be an additional 74.04 L/s. This development is expected to occur beyond the IMP study period, however, when the pumps are next replaced (in ~20 years) the upgrades will need to consider this growth.

When considering all development, within the IMP and post IMP, the increase in flows will be approximately 135.24 L/s, which will put the station at a deficit of 160% or 135.24 L/s. These flows will need to be evaluated in more detail in 20 to 25 years, when it is projected the pumping station's capacity will need upgrades.

Upgrade Requirements

There are no required upgrades for this station at this time. Based on the high-level analysis provided in this report, the SPS will be approaching its capacity in approximately 20 to 25 years. The equipment at Taylor-Kidd is marked for replacement through the Township's asset management plan in 20 years. Staff should keep these timeframes under consideration so that the pumps can be appropriately upsized at the time of replacement, if required.

When considering all the potential development in the Taylor-Kidd SPS catchment area, the pumping station will need to be upgraded to meet a capacity of 135.24 L/s. It is recommended that further analysis is conducted as capacity is approached, or as the pumps approach end-of-life in terms of asset replacement. This analysis will provide more insight as to what specific upgrades will be required to meet the desired capacity. At that time staff will also have more concrete numbers for long-term development and will therefore be able to confirm required capacity. It should be noted that this assessment and station upgrades should include review of the inlet sewer, wet well, discharge piping, and forcemain.

Financial

The upgrades outlined in this document from RVA are initial recommendations that do not consider full build-out of the Amherstview West Secondary Plan. Further investigation and design will take place before implementation. The costs presented below are estimates based on these initial recommendations, but may not capture the actual cost of the project when it takes place.

The cost presented by RVA to upgrade the pump station to 86 L/s is $1.4 million. However, as shown in the analysis above, when the pump station is next upgraded, it will need to accommodate flows closer to 135.24 L/s. Upgrading to this capacity will involve pump upgrades along with potential changes to the inlet sewer, wet well, discharge piping, and forcemain. The exact cost for these additional upgrades will need to be determined closer to the design phase. An initial estimate of $3.0 million will be used as a placeholder for this project.

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of GHG emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the future upgrades of sewage pumping stations in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). Increase in temperatures will result in increase water usage and sanitary sewage generation.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021). Wetter weather will result in an increase in infiltration within the sanitary system.
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). Extreme events will result in an increase in infiltration within the sanitary system.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials with the general consensus of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers etc.

- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Calculations for construction of conveyance and treatment infrastructure will consider potential increase in flows from inflow and infiltration as a result of increased annual precipitation.

Linkages

N/A

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

Corporation of Loyalist Township. (2021). *Sewage Treatment Plants - Annual Report 2020.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

R.V. Anderson Associates Limited. (2023). *Taylor Kidd (Loyalist East Business Park) Sewage Pumping Station - Capacity Assessment.*

Conclusion

Given Taylor-Kidd SPS's location relative to available development lands, it is likely that there will be many new connections in the medium to long term, leading to the need to upsize the station within the IMP study period. It is recommended development in this area is tracked carefully to determine if the station will need to be upsized prior to asset replacement that is scheduled for around 2043. When required, the pump station should be upgraded to accommodate future flows from new developments.

IMP Technical Memorandum: Capacity Assessment of Lakeview Sewage Pumping Station

Asset Class: Sanitary

Objective

The objective of this technical memorandum is to provide a capacity assessment of Lakeview Sewage Pumping Station (SPS).

Background

Constructed in 1990, Lakeview SPS receives sanitary sewage from Amherstview properties north of Bath Road/Highway 33 from Westfield Drive and Park Crescent west to County Road 6, and north to Golf Course Road. Sanitary sewage is pumped north from the pumping station to the Amherstview Water Pollution Control Plan (AWPCP) located on Taylor-Kidd Boulevard.

According to the environmental compliance approval (ECA), the firm capacity of Lakeview SPS is approximately 20,736-21,600 m^3/day (240-250 L/s). The pumping station consists of three pumps and associated appurtenances. The pumps are rated at 135 L/s against a total dynamic head (TDH) of 43.5 m.

In May 2023 Pump #2 at Lakeview SPS failed, which has initiated the process of upgrading this pump. The calculations and analysis shown in this report were conducted based on Pump #2 operating as it was prior to failure. The plan for upgrading Pump #2 will be discussed at the end of this report.

Methodology

R.V Anderson Associates Limited (RVA) were retained by Loyalist Township to undertake a capacity evaluation of Lakeview SPS and to identify potential capacity restrictions and upgrade options for meeting the future sanitary sewage servicing needs (R.V. Anderson Associates Limited, 2023).

To assist the Township in determining the needs at Lakeview SPS, RVA assessed current capacity, and identified where upgrades are needed to address current capacity issues and meet future demand.

The Township also assessed remaining capacity of the station in its current state to meet proposed growth based on committed connections to the sanitary system.

Capacity Assessment

The capacity assessment conducted by RVA included a hydraulic capacity assessment of existing components of the pumping station, as well as establishing a list of capacity expansion options based on potential future servicing needs. The consultant used historic flow data from 2011-2020.

The theoretical maximum capacity of Lakeview SPS is 240-250 L/s. The station is currently operating with a peak flow rate of 230 L/s based on draw down testing conducted during the capacity evaluation. Historic monthly flow data from 2019-2021 indicates that there are no discernable average daily flow trends. Daily peak flows are likely affected by inflow and infiltration as they do not appear to correlate with average daily flow. The annual average daily flow trending is mostly flat, ranging from approximately 30 L/s to 50 L/s which represents approximately 13%-22% of the measured firm capacity of the station. Below is a summary of the pump capacity field test:

Table 1 Pump capacity test

Test Description	Measured Flow (L/s)
1 Pump at 100% speed	136-146
2 Pumps at 100% speed	230

Individual station components were reviewed to assess their ability to accommodate increased flow through the station and are summarized in the table below.

Table 2 Summary of maximum capacity by component

Station Component	Max Capacity (Firm Station Capacity)
Inlet sewer	1185 L/s
Bar screen	Up to 350 L/s, decreased performance beyond 266 L/s
Wet well	Recommended peak 428 L/s, maximum 340 L/s
Suction piping (pump inlet)	Recommended peak 282 L/s, maximum 340 L/s
Pumps	2 large pumps 230 L/s based on pump capacity test
Discharge piping	321 L/s (as-is), 385 L/S with minor modifications
Force main	325 L/s recommended, 350 L/s maximum pending further investigation
Transformer capacity	Can accommodate 3 x 150 hp pumps, equivalent to 300 L/s for certain pump types
Pump starter (VFDs)	One of three VFDs requires upgrade for 150 hp pumps, equivalent to 300 L/s on certain pumps
Standby generator (proposed 350 kw)	3 x 200 hp pumps, flows up to 350 L/s, depending on pump types

Capacity Assessment of Future Scenarios

To determine the impact of increased flows at Lakeview SPS, three separate flow scenarios and the upgrades required to accommodate them have been evaluated. The station components outlined in Table 2, as well as various electrical components, are evaluated against peak flows of 300, 350 and 400 L/s. Upgrades to accommodate the flows in each of these scenarios are summarized below.

Table 3 Process upgrades summary

Scenario	Inlet Sewers	Bar Screen	Wet well	Pumps	Pump suction piping	Pump discharge piping	Pressure relief valve	Force main
Scenario 1 – Upgrade capacity to 300 L/s	No upgrade required	Decreased performance at peak flows	No upgrade required	Three new pumps (150 L/s each at 53.3 m TDH) on VFD	Short pipe section may need to be replaced to match selected pumps inlet size	Short pipe section may need to be replaced to match selected pumps discharge size	Not required unless indicated by future transient analysis	No upgrade required
Scenario 2 – Upgrade capacity to 350 L/s	No upgrade required	Decreased screening performance at peak flows	No upgrade required.	Three new pumps (175 L/s each at 58.9 m TDH) on VFD	Short pipe section may need be replaced to match selected pumps inlet size	Short pipe section may need to be replaced to match selected pumps discharge size. Pump 2 vertical discharge to be considered to increase to 250 diameter	Likely identified to be required by future transient analysis	Install pressure transmitter to monitor pressure for design basis above 325 L/s
Scenario 3 – Upgrade capacity to 400 L/s	No upgrade required	Notable decreased screening performance at peak flows, possible modifications required for new screen additions	No upgrade required	Three (3) new pumps (200 L/s each at 65.2 m TDH) on VFD	Short pipe section may need be replaced to match selected pumps inlet size. Flow Velocities will be higher than recommended and may cause issues with some pump types.	Short pipe section may need to be replaced to match selected pumps discharge size. Pump 2 vertical discharge to be considered to increase to 250 diameter	New larger valve recommended	Exceeds recommended operating pressure

Pump expansion option scenarios consider vertical shaft driven pump (FlowServe – Option A) and dry pit submersible (Flygt – Option B).

Table 4 Electrical upgrades summary

Scenario	Existing Utility/Transformer Upgrade	Existing Power Distribution	Standby Generator	Pump Starter	Service Cables
Scenario 1A – Upgrade capacity to 300 L/s, 3 pumps at 150 hp (2 duty + 1 standby)	No upgrade required	No upgrade required	Ongoing 350 kW upgrade is sufficient	One VFD 75 kW rated to be changed	No upgrade required
Scenario 1B – Upgrade capacity to 300 L/s, 3 pumps at 185 hp (2 duty + 1 standby)	Upgrade existing transformer to 500KVA	Replace existing service entrance switchboard with 800A	Ongoing 350 kW upgrade is sufficient. Stagger pump starts when operating on generator.	Replace all three VFDs	New service cables
Scenario 2A – Upgrade capacity to 350 L/s, 3 pumps at 200 hp (2 duty + 1 standby)	Upgrade existing transformer to 500KVA	Replace existing service entrance switchboard with 800A	Ongoing 350 kW upgrade is sufficient. Stagger pump starts when operating on generator.	Replace all three VFDs	New service cables
Scenario 2B – Upgrade capacity to 350 L/s, 3 pumps at 250 hp (2 duty + 1 standby)	Upgrade existing transformer to 750KVA	Replace existing service entrance switchboard with 1000A	Replace with 600 kW generator	Replace all three VFDs	New service cables
Scenario 3A – Upgrade capacity to 400 L/s, 3 pumps at 250 hp (2 duty + 1 standby)	Upgrade existing transformer to 750KVA	Replace existing service entrance switchboard with 1000A	Replace with 600 kW generator	Replace all three VFDs	New service cables
Scenario 3B – Upgrade capacity to 400 L/s, 3 pumps at 335 hp (2 duty + 1 standby)	Upgrade existing transformer to 1000KVA	Replace existing service entrance switchboard with 1200A	Replace with 750 kW generator	Replace all three VFDs	New service cables

It should be noted that the upgrades outlined above were RVA's initial recommendations. Since they were made, Pump #2 has failed; therefore, RVA was again retained to review options and provide a recommended pump size and staging so that the emergency pump upgrades would also meet future requirements for the SPS (R.V. Anderson Associates Limited, 2023). The proposed emergency upgrades vary slightly from the original upgrades proposed above. The revised upgrade options are listed below and discussed in detail in Lakeview Sewage Pumping Station Pump #2 Replacement Options report.

Table 5 Pump 2 replacement options following 2023 failure

Option	SPS Flow (L/s)	Pumps (HP)	Efficiency (%)	Head Loss (m)
#1	272.1	3 x 140	75.9	48.8
#2A	280.5	3 x 160	66.4	49.5
#2B	283.3	3 x 160	67	49.7
#3	310.0	3 x 185	69.5	52.1

The above upgrades were considered by staff and RVA along with review of the remaining capacity to determine the best path forward in upgrading Lakeview SPS.

Remaining Capacity

The remaining capacity of Lakeview SPS was calculated by subtracting the estimated current peak flows from its total capacity. It should be noted that for existing connections the extraneous flow value was set to zero since extraneous flows are accounted for in the flow per capita value. Estimated current peak flows were calculated using the following formula:

$$Q = \frac{PqM}{86.4} + lA$$

where:

- Q = estimated peak flow (L/s)
- P = population (thousands) = 8.97 cap
- q = flow per capita = 346 L/cap/day
- M = Peaking factor = 2.95
- I = unit of peak extraneous flow = 0.35 L/ha/sec
- A = contributing area = 184 ha

The peaking factor (M) was calculated using the following formula:

$$M = 1 + \frac{15}{4 + P^{0.5}}$$

Based on this information and the consideration for commercial flows, the current peak flow value can be calculated to be 110.5 L/s, leaving 120 L/s (or 52%) of remaining capacity for Lakeview SPS.

Growth Expectations for Catchment Area

There is expected to be significant growth within the catchment area of Lakeview SPS.

This growth can be classified into 2 distinct categories, being typical development and infill. Most of the catchment area is developed as single-family homes. The breakdown of flows per residential development is shown in the table below.

Table 6 Projected flows from upcoming development areas

Development	Projected flows (L/s)
Lakeside Ponds	23.5
Block F	4.5
Loyalist Shores	4.28
Brookland Square	1.24
Lakeside Phase 8	1.69
Secondary Plan	15

In addition to these flows, there will also be an increase in extraneous flows that is associated with this growth, estimated using an area of 38 ha and resulting in a flow of 5.3 L/s. In total these developments will result in and additional 55.5 L/s of increased flows to Lakeview SPS.

There is also some potential for intensification in the existing catchment area. A 15% increase in flows is considered for this infill, which is equivalent to approximately 15.9 L/s.

Since Islandview SPS pumps to Lakeview SPS, consideration need to be given to growth in the Islandview catchment area. It is estimate that growth in this area due to development and infilling will result in an additional 5.5 L/s.

Based on this analysis, and using the same calculations described above, the overall increase in flows expected for this catchment area is 76.9 L/s.

Summary of Remaining Capacity

Analysis completed earlier indicates that for this station approximately 52% of the pumping station's original capacity, approximately 120 L/s, remains available. After considering the expected growth discussed above, approximately 19% of the original capacity will be remaining, which is equivalent to 42.6 L/s. Although sufficient capacity remains, one pump at this station recently failed, which initiated the process of conducting upgrades. Further details on the pump upgrades will be provided below.

NFPA 820 Required Improvements

The facility was reviewed for compliance with the National Fire Association Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820). It was noted during the site investigation that the dry well is directly connected to the main floor electrical room via the access hatches. According to NFPA 820, the electrical room area either requires continuous ventilation at 6 air changes per hour; or physical separation of the spaces so that combustible gases from the dry well cannot migrate into the electrical room; or have all equipment within the space be rated for Class 1, Division 2 (it is noted by RVA that this third option is not feasible for the main electrical and control equipment in the pumping station).

Current Pump Upgrades

Lakeview SPS has three pumps, each with a capacity of 135 L/s. In May 2023, Pump #2 failed entirely. While the remaining two pumps are functioning, a third pump is required to maintain redundancy. Staff are in the process of replacing this pump with the support of RVA. After an evaluation of the current system, it was determined that a like-for-like replacement would be the preferred option to replace Pump #2. The current plan is to install and commission the new pump in 2024, which will not alter the rated capacity of the station. In 2025 and 2026 the plan is to conduct facility classification compliance upgrades so that Pump #1 and #3 can be upsized, following which the upgraded pumps, as dictated by growth, would be installed and commissioned. This plan aligns closely with Option #3 provided by RVA, with slight variations due to the current equipment at the station.

It has been proposed that the bar screen at Lakeview SPS eventually be decommissioned. Prior to removal of the screen, the headworks at AWPCP will need to be upgraded to remove rags and other larger items. Staff will need to consider the timing of the headworks upgrades before making changes to the screen at Lakeview SPS. In preparation for removal of the screen, upgraded pumps will need to have the ability to handle oversized material.

Financial

The costs associated with the current plan for station upgrades will be split into three stages.

Table 7 Estimated costs by stage

Stage	Description	Cost
Stage 1	Design and Construction requirements for replacement of Pump #2.	$905,000
Stage 2	Facility classification compliance upgrades.	$600,000
Stage 3	Install and commission Pump #1 and #3.	$2,300,000

It is expected that Stage 1 will be completed in 2024, following by Stage 2 in 2025 and 2026. Stage 3 will be dependent on growth in the catchment area.

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the future upgrades of sewage pumping stations in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). Increase in temperatures will result in increase water usage and sanitary sewage generation.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021). Wetter weather will result in an increase in infiltration within the sanitary system.
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). Extreme events will result in an increase in infiltration within the sanitary system.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials with the overall goal of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. “Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050” (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers etc.
- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Calculations for construction of conveyance and treatment infrastructure will consider potential increase in flows from inflow and infiltration due to increased annual precipitation.

Linkages

Capacity Assessment of Islandview SPS Technical Memorandum

Amherstview WPCP Needs Assessment Technical Memorandum

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

R.V. Anderson Associates Limited. (2023). *Lakeview Sewage Pumping Station - Capacity Assessment.*

R.V. Anderson Associates Limited. (2023). *Lakeview SPS Pump 2 Replacement Options Technical Memo.*

Conclusion

It is recommended that Lakeview SPS is upgraded using the approach outlined in this report and in alignment with the recommendations made by RVA. When upgrading pumps at this station it is important to consider the ability to handle oversized materials.

IMP Technical Memorandum: Capacity Assessment of Bath Sewage Pumping Station #1

Asset Class: Sanitary

Objective: The objective of this technical memorandum is to provide an overview of the capacity assessment of Bath Sewage Pumping Station (SPS) #1.

Background

During the late 1960s-early 1970s the then-Village of Bath installed a sewage collection system and treatment plant. Constructed in 1975, SPS #1 receives wastewater from the village of Bath from properties along Main Street between Birch Avenue and Country Club Drive, and properties north of Main Street – Bath within the Loyalist Estates subdivision in the northwest and Houghton Park subdivision in the northeast. Wastewater is pumped north from the pumping station to the Bath Sewage Treatment Plant (STP) located on Sir John Johnson Drive.

According to the ECA, the firm capacity SPS #1 is approximately 3,975 m^3/day (45 L/s). The pumping station consists of three pumps and associated appurtenances. Two pumps are rated at 30 L/s against a total dynamic head (TDH) of 20 m and one pump is rated for 15 L/S against a TDH of 20 m.

Assumptions

The following assumptions were made when developing this document:

- Capacity assessment was based on flow data from 2019-2021 and pump capacity field tests.

Methodology

R.V. Anderson Associates Limited (RVA) were retained by Loyalist Township to undertake a capacity evaluation of SPS #1 (R.V. Anderson Associates Limited, 2023), to identify current operation capacity, potential capacity restrictions, and upgrade options for meeting the future sanitary sewage servicing demand.

The Township also assessed remaining capacity of the station in its current state to meet proposed growth based on current and committed connections to the sanitary system.

Data Sources

The data used to determine the capacity of the pumping station included:

- historic flow data from 2019-2021
- Bath SPS #1 As-Builts (1974)
- Bath SPS #1 Upgrade As-Builts (2005)
- Bath STP Annual Report 2020

Analysis

Capacity Assessment

The capacity assessment conducted by RVA included a hydraulic capacity assessment of existing components of the pumping station as well as establishing a list of capacity expansion options based on potential future servicing needs.

The theoretical maximum capacity of SPS #1 is 45L/s and the station is currently operating with a peak flow rate of 40-43L/s based on draw down testing conducted during the capacity evaluation. Historic monthly flow data from 2019-2021 indicates that there are no discernable average daily flow trends. Below is a summary of the pump capacity field test:

Table 1 Pump Capacity Test

Test Description	Measured Flow (L/S)
Pump # 1 Only at 100% speed	25-26.5
Pump #2 Only at 100% speed	21-21.8
Pump #1 + Pump #2 at 100% speed	40.9-43.7

The capacity of individual components of the station were reviewed to assess their ability to accommodate increased flow through the station and are summarized in the table below.

Table 2 Summary of Maximum Capacity by Component

Station Component	**Max Capacity (Firm Station Capacity)**
Inlet Sewer	148 L/s
Bar Screen	Up to 190 L/s, decreased performance beyond 140 L/s
Wet Well	Limitations on pump start frequency at 130 L/s, Peak 240 L/s if using VFD
Suction piping (wet well)	Recommended Peak 282 L.s, Maximum 340 L/s
Suction piping (dry well)	Recommended Peak 125 L/s, Maximum 150 L/s
Pumps	2 large pumps are required to achieve 44L/s, theoretically 1 large 30 L/s and 1 small 15 L/s pump should achieve 45 L/s
Discharge piping	140 L/s (as-is)
Force main	210 L/s maximum
Transformer capacity	No upgrades required based on proposed upgrade scenarios
Pump Starter (VFD)	New VFDs required for large pump capacity expansions (> 100 hp)
Standby Generator (proposed 100 kw)	3 x 50 hp pumps, flows up to 140 L/s, new generator required for 210 L/s

Capacity Assessment of Future Scenarios

In order to determine the impact of increased flows at Bath Pump Station #1, three separate flow scenarios, along with the upgrades required to accommodate them, were evaluated. The station components outlined in Table 2, as well as various electrical components, were evaluated against peak flows of 60, 140, and 210 L/s. Upgrades to accommodate the flows in each of these scenarios are summarized in Tables 3 and 4 below.

Table 3 Process Upgrades Summary Chart

Component	**Scenario 1** Upgrade capacity to 60 L/s	**Scenario 2** Upgrade capacity to 140 L/s	**Scenario 3** Upgrade capacity to 210 L/s
Inlet sewers	Capacity sufficient	Total capacity sufficient, however verification of inlet distribution (flows from north or south) would need to be confirmed	New inlet sewer may be required, dependent on where flows are generated from
Bar screen	No upgrade required	No upgrade required	Decrease in screening performance at peak flows
Wet well	No upgrade required	Divided well should be considered. Wet well level setpoints need adjustment	Divided well should be considered. VFD required for level control
Pumps	One (1) new pump (30 L/s at 20m TDH)	Three (3) new pumps (70 L/s each at 27m TDH)	Three (3) new pumps (105 L/s each at 37m TDH) on VFD
Pump suction piping	No upgrade required	Short pipe section may be replaced to match selected pumps' inlet size	Short pipe section may be replaced to match selected pumps' inlet size
Pump discharge piping	No upgrade required	No upgrade required	Individual discharge piping size to be increased to 200mm and common discharge header size to be increased to 350mm
Pressure relief valve	No upgrade required	Not required unless identified by future transient analysis	Not required unless identified by future transient analysis
Forcemain	No upgrade required	No upgrade required	Not upgrade required

Table 4 Electrical Upgrades Summary Chart

Component	**Scenario 1** Upgrade capacity to 60 L/s	**Scenario 2** Upgrade capacity to 140 L/s	**Scenario 3** Upgrade capacity to 210 L/s
Existing utility/transformer upgrade	No upgrade required	No upgrade required	No upgrade required
Existing power distribution	No upgrade required	No upgrade required	No upgrade required
Standby generator	No upgrade required	No upgrade required	New 250 kW generator required
Pump starter	No upgrade required	Three (3) x 50 hp new VFD	No upgrade required
Service cables	No upgrade required	Three (3) x 100 hp new VFD	No upgrade required

It should be noted that the upgrades outlined in this document are initial recommendations, and that further investigation and design work will be required before implementation.

Remaining Capacity

The remaining capacity of SPS #1 was calculated by subtracting the estimated current peak flows from its total capacity. It should be noted that for existing connections the extraneous flow value was set to zero since extraneous flows are accounted for in the flow per capita value. Estimated current peak flows were calculated using the following formula:

$$Q = \frac{PqM}{86.4} + lA$$

where:

- Q = estimated peak flow (L/s)
- P = population (thousands) = 0.153 cap
- q = flow per capita = 323 L/cap/day
- M = Peaking factor = 3.7
- I = unit of peak extraneous flow = 0.14 L/ha/sec
- A = contributing area = 66.69 ha

The peaking factor (M) was calculated using the following formula:

$$M = 1 + \frac{15}{4 + P^{0.5}}$$

Based on this information, the current peak flow value is calculated to be 21.01 L/s, leaving 18.99 L/s (or 47%) of remaining capacity for Bath SPS #1.

Growth Expectations

There is expected to be significant growth within the catchment area of SPS #1.

This growth can be classified into two distinct categories. Most of the catchment area is developed as single-family homes. 585 committed-but-unbuilt units are projected to be built out in the next 10 years. In addition to this, there are 800 projected future units. The total flow from future development is projected to be 61.94 L/s for residential flows and 0.05 L/s for commercial flows. There is also some potential for intensification in the catchment area. A 15% increase in flows is considered for this infill, which is equivalent to approximately 3.15 L/s.

Bath SPS #1 also receives flows from SPS #2 and pumps it to the treatment plant. Due to this, future committed units from the SPS #2 catchment area will also need to be accounted for in the SPS #1 capacity calculations. It is projected that the additional flow from SPS #2 will be 1.05 L/s.

Subsequently, the overall increase in flows anticipated for this catchment area is 66.19 L/s.

Summary of Remaining Capacity

Analysis indicates that approximately 47% of the pumping station’s original capacity, approximately 18.99 L/s, remains. After considering anticipated growth, the remaining capacity will be -118 %, meaning there will be a requirement for significant increase in capacity. The pump station will need to be increased by an additional 47.14 L/s. The future pump station capacity will need to be able to service 87.19 L/s.

Capacity Upgrade Requirements

Based on the capacity analysis, the pumping capacity will need to be increased for SPS #1 as development continues. Two situations would initiate pump replacement, either the ongoing reduction in remaining capacity, signalling the need for upgrades; or when the pumps are planned for replacement through asset management.

The Township’s asset manager outlined that the pumps at this station will be due for replacement in 2031. It is recommended that staff continue to track development and increased flows at this station to determine if the need for increased capacity will result in pump upgrades prior to 2031. When upgrades are planned for this pumping station, the target pumping capacity should be between 90 to 100 L/s. This pumping requirement is between the values in Scenario 1 and Scenario 2 presented by RVA. Scenario 1 (60 L/s) will not provide sufficient capacity and will not be considered. Scenario 2 (140 L/s) provides significantly more capacity than what is required for future development. Scenario 2 will be used as a financial placeholder as a recommended project; however, it is recommended that staff evaluate the pumping needs at the time of replacement and consider more appropriately-sized pumps for the true needs of the station.

NFPA 820 Required Improvements

The facility was reviewed for compliance with the National Fire Association Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820). It was noted during the site investigation that the dry well is directly connected to the main floor electrical room via the access hatches. According to NFPA 820, the electrical room area would require either continuous ventilation at 6 air changes per hour, or physically separate the space so that combustible gases from the dry well could not migrate into the electrical room or have all equipment within the space be rated for Class 1, Division 2 (it was noted by RVA that this option is not feasible for the main electrical and control equipment in the pumping station).

Financial

The costs associated with the implementation of scenarios 1, 2, and 3 are presented in Table 5 below. It should be noted that these are preliminary estimates based on 2023 figures. Updated budget numbers will need to be developed as part of the design process should the Township elect to move forward with any of the three scenarios described in these documents.

Table 5 Financial Estimate

Scenario	Description	Budget Cost	NFPA 820 Retrofit	Project Sum Allowance
1	60 L/s	$128,000	$100,000	$228,000
2	140 L/s	$1,097,000	$100,000	$1,197,000
3	210 L/s	$2,230,000	$100,000	$2,330,000

As discussed above Scenario 2 is being recommended through the IMP, however, at the time of the project the pump size should be revaluated to ensure it matches the requirements of the station.

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the future upgrades of sewage pumping stations in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). Increase in temperatures will result in increase water usage and wastewater generation.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021). Wetter weather will result in an increase in infiltration within the sanitary system.
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). Extreme events will result in an increase in infiltration within the sanitary system.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials, with the overall goal of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined, including granular materials, and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers etc.
- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Calculations for construction of conveyance and treatment infrastructure will consider potential increase in flows from inflow and infiltration as a result of increased annual precipitation.

Linkages

Capacity Assessment of Bath SPS #1 Technical Memo

Capacity Assessment of Bath SPS #3 Technical Memo

Capacity Assessment of Bath SPS #4 Technical Memo

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

R.V. Anderson Associates Limited. (2023). *Bath Sewage Pumping Station #1 Capacity Assessment.*

Conclusions

Significant development is expected within the catchment area of SPS #1. This growth surpasses the remaining pumping capacity, therefore upgrades to the capacity of the station will be required. It is recommended that staff plan for Scenario 2 presented by RVA, and at the time of replacement, conduct a more in-depth analysis of pumping requirements. When this project is conducted, the NFPA 820 requirements should also be considered.

IMP Technical Memorandum: Capacity Assessment of Bath Sewage Pumping Station #2

Asset Class: Sanitary

Objective: The objective of this technical memorandum is to provide an overview of the capacity assessment of Bath Sewage Pumping Station (SPS) #2.

Background

The population in the village of Bath is expected to grow by 41% over the duration of the study period covered by the IMP. Depending on the location of development and population growth, the demand on Sewage Pumping Station (SPS) #2 may increase.

The aim of this SPS evaluation is to assess the current hydraulic capacity of the station. The areas contributing to SPS #2 will be analyzed in their “as is” state. The SPS will also be analyzed using growth projections to determine if the station has the required available capacity for the future.

During the late 1960s-early 1970s the then-Village of Bath installed a sewage collection system and treatment plant. SPS #2, which currently receives flows from west of Factory Lane and south of Hawley Court, was constructed in the west end of the Village in 1976. Sewage from this pumping station is conveyed east to the west section of the SPS #1 servicing area. This pumping station provides sanitary pumping capacity to an area of approximately 9.87 ha. The current contributing area to SPS #2 is outlined in Appendix A of this report.

The pumping station underwent upgrades in 2011 which consisted of replacing the original pumps with new pumps of the same size. Pump 2 was subsequently replaced on January 19, 2022, with the same size of pump.

Assumptions

The following assumption was made when developing this document:

- Capacity assessment is based on flow data from 2018-2020 and the design capacity of the pumping station.

Methodology

To assist the Township in determining the remaining capacity and potential needs of the Bath SPS #2 required to meet projected growth, Township staff assessed the current capacity at the pumping station. This assessment determined where upgrades are needed to address current capacity issues, along with potential upgrades to meet future demand.

Township staff involved with water and sanitary sewage operations provided input with respect to pumping station deficiencies and operational needs.

Analysis

Hydraulic Assessment

SPS #2 can be described as follows:

- Pumping station with a rated capacity of 6.4 L/s, consisting of a pump chamber and an above-grade control panel.
- Sewage enters through a 200 mm diameter gravity sewer into a wet well with a volume of approximately 4.7 m^3.
- Sewage is pumped using a submersible two-pump system; the two APS pumps (model XFP100) are in parallel with a check valve and gate valve located on the discharge side of each pump. Each of the two pumps (1 duty, 1 standby) are rated for 6.4 L/s (553 m^3/d) against a total dynamic head of 13.1 m.
- The station discharges through the 100 mm diameter forcemain which connects to a 250 mm gravity sewer at Manhole #24, approximately 425 m east of the station on Main Street – Bath.
- The station does not have an overflow outlet. If overflow occurs, the sewage will back up within the collection system and potentially into dwellings.

An assessment report was completed for Bath SPS #2 and #3 in 1999 (Cumming Cockburn Limited, 1999). Pump testing at SPS #2 in December 1998 indicated that pump performance had declined by approximately 60% and indicated that the station could not achieve a capacity rating sufficient to meet peak inflow, which at that time was estimated to be 267.04 L/min.

In 2011 the pumping station underwent upgrades which included the replacement of the existing pumps with new pumps of the same size. Draw down tests were not completed during commissioning of the new pumps; however, the curves from the pump performance testing indicated that at 102 USGPM (6.4 L/s) the head is approximately 43 feet (13.1 m), which is greater than the rating of the initial pumps installed (39 feet or 11.9 m).

A draw down test completed in the fall of 2021 indicated that the pumps have a capacity to pump at 6.3 L/s.

Design Capacity

An assessment of flows contributing to Bath SPS #2 has been undertaken by reviewing past historical data spanning from 2018 to 2020. Appendix G contains a table of pump run times for Bath SPS #2 between January 2018 and December 2020. As the number of pump cycles relating to run time is not known, volume pumped (liters) has been calculated as pump run time (minutes) x calculated pumping station capacity (6.3 L/s).

Remaining Capacity

The remaining capacity of Bath SPS #2 was calculated by subtracting the estimated current peak flows from its total capacity. It should be noted that for existing connections the extraneous flow value was set to zero, since extraneous flows are accounted for in the flow per capita value. Estimated current peak flows were calculated using the following formula:

$$Q = \frac{PqM}{86.4} + lA$$

where:

- Q = estimated peak flow (L/s)
- P = population (thousands) = 0.138 cap
- q = flow per capita = 294 L/cap/day
- M = Peaking factor = 4.2
- I = unit of peak extraneous flow = 0.14 L/ha/sec
- A=contributing area = 9.87 ha

The peaking factor (M) was calculated using the following formula:

$$M = 1 + \frac{15}{4 + P^{0.5}}$$

Based on this information, the current peak flow value can be calculated to be 1.97 L/s, leaving 4.33 L/s (or 69%) of remaining capacity for Bath SPS #2.

Appendix E contains a table summarizing the capacity calculation of Bath SPS #2.

Mechanical, Electrical, and Instrumentation Assessment

The following mechanical and electrical components and instrumentation exist at the pumping station:

- All necessary appurtenances, controls, and alarms.
- Portable standby generator connection – quick connect.
- Above-grade control panel, gate valves, MCC, wet well level indicator, PLC, and hard-wired floats.
- Vent pipes, gas detector, alarms, by-pass connection of the wet well.

The mechanical, electrical and instrumentation components of the pumping station were not assessed as part of this investigation. Based on information provided by the operators, all equipment is functioning according to operational requirements of the pumping station.

Growth Expectations for Catchment Area

There is expected to be moderate growth within the catchment area of SPS #2.

This growth can be classified into 2 distinct categories. Most of the catchment area is developed as single-family homes. There is a proposed development slated for the corner of Main Street – Bath and Country Club Drive (Part 2, RP3560) with an area of 1.283 ha and an estimated population of 60 persons. Using the Township's sanitary model, it is estimated that this development will result in a flow of 1.05 L/s. There is also some potential for intensification along the desired waterfront properties. A 15% increase in flows is considered for this infill, which is equivalent to approximately 0.3 L/s.

Based on this analysis, and using the same calculations described above, the overall increase in flows expected for this catchment area is 1.55 L/s.

Summary of Remaining Capacity

Analysis completed earlier indicates that approximately 69% of the pumping station's original capacity, or 4.33 L/s, is available. Should the expected growth discussed above come to fruition, approximately 47% of the original capacity will remain, equivalent to 2.99 L/s. Based on this analysis there is no need to plan for increased pump capacity at this location.

Upgrade Requirements or Options

- The station does not have a standby generator. In the event of a power outage, a portable generator is used. Depending on growth rates, installation of a standby generator may be considered.
- Current pump rates and volumes are estimated based on pump run times. Installation of a totalized flow meter may be considered in the future to improve accuracy of data collection and calculation of flow rates, and to assist with planning of future equipment upgrades and maintenance.

Financial

Upgrade	Estimated Cost
Installation of Standby Generator	$200-300k
Installation of Flow Meter	$15-20k
TOTAL	**$215 – 320k**

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the future upgrades of sewage pumping stations in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). Increase in temperatures will result in increase water usage and wastewater generation.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021). Wetter weather will result in an increase in infiltration within the sanitary system.
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). Extreme events will result in an increase in infiltration within the sanitary system.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials, with the overall goal of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined, including granular materials, and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world’s largest contributor to embodied carbon in the built environment. “Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050” (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers etc.
- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Calculations for construction of conveyance and treatment infrastructure will consider potential increase in flows from inflow and infiltration as a result of increased annual precipitation.

Linkages

Capacity Assessment of Bath SPS #1 Technical Memo

Capacity Assessment of Bath SPS #3 Technical Memo

Capacity Assessment of Bath SPS #4 Technical Memo

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

Cumming Cockburn Limited. (1999). *Assessment of Bath Pumping Stations 2 and 3.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Conclusions

While moderate development is expected within the catchment area of Bath SPS #2, anticipated growth is less than the remaining capacity; therefore, staff do not anticipate that growth-related upgrades will be required within the horizon of the IMP. Installation of an emergency generator and a flow meter may be considered to enhance service delivery of the SPS for the future.

IMP Technical Memorandum: Capacity Assessment of Bath Sewage Pumping Station #3

Asset Class: Sanitary Sewage

Objective: The objective of this technical memorandum is to provide an overview of the capacity assessment of Bath Sewage Pumping Station (SPS) #3.

Background

The population in the village of Bath is expected to grow by 41% over the 25-year study period covered by the IMP. Depending on the location of development and population growth, the demand on SPS #3 may increase.

The aim of this SPS evaluation is to assess the current hydraulic capacity of the station. The areas contributing to SPS #3 will be analyzed in their “as is” state. The SPS will also be analyzed using growth projections to determine if the station has the required available capacity for the future.

During the late 1960s and early 1970s the then-Village of Bath installed a sewage collection system and treatment plant. SPS #3 in the east end of Bath was constructed in 1976. The station receives flows from east of Somerset Drive and approximately 200 m east of Sir John Johnson Drive, then conveys flows northerly to the Bath Sewage Treatment Plant. This pumping station provides sanitary pumping capacity to an area of approximately 16.13 ha.

The pumping station underwent upgrades in 2011 which consisted of replacing the original pumps with new pumps of the same size. A human-machine interface (HMI) was installed at the station in February of 2015. The soft start for pump 2 was replaced in January of 2019.

Assumptions

The following assumptions have been made when developing this document:

- Capacity assessment is based on flow data from 2018-2020 and the design capacity of the pumping station.

Methodology

To determine the remaining capacity and potential needs of Bath SPS #3 required to meet projected growth, Township staff assessed current the capacity at the pumping station. This assessment determined where upgrades are needed to address current capacity issues, along with potential upgrades to meet future demand.

Township staff involved with water and sanitary sewage operations provided input with respect to pumping station deficiencies and operational needs.

Analysis

Hydraulic Assessment

Bath SPS #3 can be described as follows:

- Pumping station with a rated capacity of 13.88 L/s consisting of a pump chamber and an above grade control panel.
- Sewage enters through a 200 mm diameter gravity sewer into a 2.4 m diameter wet well.
- Sewage is pumped using a submersible two-pump system; the two APS pumps (model XFP100) are in parallel with a check valve and gate valve located on the discharge side of each pump. Each of the two pumps (1 duty, 1 standby) are rated for 13.88 L/s (1200 m^3/d) against a total dynamic head of 15.8 m.
- The station discharges through the 150 mm diameter force main which connects to a 600 mm gravity sewer at Manhole #5350, approximately 245 m north of the station on Main Street.
- Overflow discharges to the storm sewer outlet and further to Lake Ontario via an existing watercourse.

An assessment report was completed for Bath SPS #2 and #3 in 1999 (Cumming Cockburn Limited, 1999). This assessment was then updated in 2012 (D.R. Barker & Associates Ltd., 2012), at which time drawdown tests were performed by Loyalist Township on the newly installed pumps. The 2012 tests determined that the capacity was 828 L/min (13.8 L/Sec). Another assessment report was conducted for the station in 2018 (D.R. Barker & Associates Ltd., 2018). Pump testing was not conducted in 2018, but Township staff confirmed the pumping capacity of 13.8 L/s was appropriate for the study.

Design Capacity

An assessment of flows contributing to Bath SPS #3 has been undertaken by reviewing past historical data spanning from 2018 to 2020. As the number of pump cycles relating to run time is not known, volume pumped (liters) has been calculated as pump run time (minutes) x calculated pumping station capacity (13.8 L/s).

Remaining Capacity

The remaining capacity of Bath SPS #3 was calculated by subtracting the estimated current peak flows from its total capacity. It should be noted that for existing connections the extraneous flow value was set to zero since extraneous flows are accounted for in the flow per capita value. Estimated current peak flows were calculated using the following formula:

$$Q = \frac{PqM}{86.4} + lA$$

where:

- Q = estimated peak flow (L/s)
- P = population (thousands) = 0.286 cap
- q = flow per capita = 391 L/cap/day
- M = Peaking factor = 4.3
- I = unit of peak extraneous flow = 0.14 L/ha/sec
- A = contributing area = 16.13 ha

The peaking factor (M) was calculated using the following formula:

$$M = 1 + \frac{15}{4 + P^{0.5}}$$

Based on this information, the current peak flow value from residential and commercial connections can be calculated to be 2.91 L/s, leaving 10.89 L/s, or 79%, of remaining capacity for SPS #3.

Mechanical, Electrical, and Instrumentation Assessment

The following mechanical and electrical components and instrumentation exist at the pumping station:

- All necessary appurtenances, controls, and alarms.
- Portable standby generator connection – quick connect.
- Above grade control panel, gate valves, MCC, wet well level indicator, PLC and hard-wired floats.
- Vent pipes, gas detector, alarms, by-pass connection of the wet well.

The mechanical, electrical and instrumentation components of the pumping station were not assessed as part of this investigation. Based on information provided by the operators, all equipment is functioning according to operational requirements of the pumping station.

Growth Expectations for Catchment Area

There is expected to be measurable growth withing the catchment area of SPS #3.

This growth can be classified into 2 distinct categories. Most of the catchment area is developed as single-family homes. There is a proposed development slated for the corner of Bath Main St and Sir John Johnson Drive. The development will be a combination of townhomes and an apartment, covering an area of approximately 3.10 ha and having an estimated population of 190 persons. This is equivalent to an estimated flow value of 4.07 L/s. A portion of the Aura by the Lake development will also be serviced by SPS #3. This development will have an area of 1.21 ha and estimated population of 40 persons. This is estimated to result in a flow value of 0.91 L/s. There is some potential for intensification along the desired waterfront property (approximately 1.7 ha) southeast of Sir John Johnson Drive. A 15% increase in flows is considered for this infill, which is equivalent to approximately 0.2 L/s.

Based on this analysis, and using the same calculations described above, the overall increase in flows expected for this catchment area is 5.18 L/s.

Summary of Remaining Capacity

Analysis indicates that approximately 79% of the pumping station's original capacity, approximately 10.89 L/s, remains available. After considering the expected growth discussed above, approximately 41% of the original capacity will be remaining, which is equivalent to 5.70 L/s. Subsequently, there is no illustrated need to plan to increase the capacity of this station.

Upgrade Requirements or Options

The station does not have a standby generator. In the event of a power outage, a portable generator is used. Depending on growth rates, installation of a standby generator may be considered.

At this time, pump rates and volumes are estimated based on pump run times. Installation of a totalized flow meter may be considered in the future to improve accuracy of data collection and calculation of flow rates, and to assist with planning for future equipment upgrades and maintenance.

Financial

Upgrade	Estimated Cost
Installation of Standby Generator	$200-300k
Installation of Flow Meter	$15-20k
TOTAL	**$215 – 320k**

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the future upgrades of sewage pumping stations in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). Increase in temperatures will result in increase water usage and wastewater generation.

- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021). Wetter weather will result in an increase in infiltration within the sanitary system.
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). Extreme events will result in an increase in infiltration within the sanitary system.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials with the overall goal of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers etc.
- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Calculations for construction of conveyance and treatment infrastructure will consider potential increase in flows from inflow and infiltration as a result of increased annual precipitation.

Linkages

Capacity Assessment of Bath SPS #1

Capacity Assessment of Bath SPS #2

Capacity Assessment of Bath SPS #4

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

Cumming Cockburn Limited. (1999). *Assessment of Bath Pumping Stations 2 and 3.*

D.R. Barker & Associates Ltd. (2012). *Bath SPS #3 Assessment.*

D.R. Barker & Associates Ltd. (2018). *Assessment of Bath Pumping Station #3.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Conclusions

While measurable development is expected within the catchment area of SPS #3, the anticipated growth is not expected to approach the capacity of the station and therefore staff do not anticipate that capacity-related upgrades will be required within the 25-year term of the IMP. Installation of an emergency generator and a flow meter may be considered to enhance service delivery of the SPS for the future.

IMP Technical Memorandum: Capacity Assessment of Bath Sewage Pumping Station #4

Asset Class: Sanitary

Objective

The objective of this technical memorandum is to provide an overview of the capacity assessment of Bath Sewage Pumping Station (SPS) #4.

Background

The population in the village of Bath is expected to grow by 41% over the 25-year study period covered by the IMP. Depending on the location of development and population growth, the demand on SPS #4 may increase.

The aim of this SPS evaluation is to assess the current hydraulic capacity of the station. The areas contributing to SPS #4 will be analyzed in their "as is" state. The SPS will also be analyzed using growth projections to determine if the station has the required available capacity for the future.

During the late 1960s and early 1970s the then-Village of Bath installed a sewage collection system and treatment plant. SPS #4 in Heritage Park in Bath was constructed in 1989. The station receives flows from south of Main Street – Bath, east of Manor Road and west of Windermere Boulevard, then conveys flows northerly to the intersection of Somerset Drive and Westbury Avenue, then to the Bath Sewage Treatment Plant via the Windermere Boulevard and Purdy Road forcemains. This pumping station provides sanitary pumping capacity to an area of approximately 16.52 ha.

The pumping station was re-constructed in 2010 to replace the existing components of the pumping station that had reached the end of its service life and to accommodate a projected increase in flow to the station. This project included:

- Construction of a new wet well.
- Installation of three submersible sewage pumps, each with a capacity of 6.5 L/s against a total dynamic head (TDH) of 36 m.
- Installation of updated electrical and electronic control systems including a hydrostatic level transmitter with an adjustable float system.
- Installation of replacement of discharge piping, ventilation system, valves, by-pass chamber, and overflow pipe.
- Installation of a standby natural gas generator.

Assumptions

The following assumptions were made when developing this document:

- Capacity assessment was based on flow data from 2018-2020 and design capacity of the pumping station.

Methodology

To assist the Township in determining the remaining capacity and potential needs of the Bath SPS#4 required to meet projected growth, Township staff assessed current the capacity at the pumping station. This assessment determined where upgrades are needed to address current capacity issues, along with potential upgrades to meet future demand.

Township staff involved with water and sanitary sewage operations provided input with respect to pumping station deficiencies and operational needs.

Analysis

Hydraulic Assessment

Bath SPS #4 can be described as follows:

- Pumping station with a rated capacity of 13.1 L/s (1,132 m^3/d) consisting of a 1.8 m diameter receiving chamber, a 3.6 m diameter wet well, and an above grade control panel.
- Sewage enters the wet well through a 250 mm diameter gravity sewer after passing through the receiving chamber.
- Sewage is pumped from the wet well using a submersible three-pump system; the three Flygt centrifugal grinder pumps (model NP3127.090) are in parallel with a check valve and gate valve located on the discharge side of each pump. The three pumps (2 duty, 1 standby) are each rated for 6.5 L/s (562 m^3/d) against a total dynamic head of 36 m.
- The pumping station discharges through the 100 mm diameter forcemain which connects to a 600 mm gravity sewer at Manhole #5357, approximately 510 m north of the station at the east terminus of Westbury Avenue.
- During periods of excessive flows, sewage discharges from the receiving chamber through the 200 mm overflow outlet into the 675 mm storm sewer discharging into the lake.
- A by-pass chamber exists on Bayshore Drive for use to divert sewage from entering the pump station when necessary (i.e., during maintenance activities).

According to information provided by Utilities operators, the pump station has operated as intended since its reconstruction in 2010, and no upgrades or pump replacements have occurred since that time.

Design Capacity

An assessment of flows contributing to Bath SPS #4 has been undertaken by reviewing past historical data spanning from 2018 to 2020. As the number of pump cycles relating to run time is not known, volume pumped (liters) has been calculated as pump run time (minutes) x calculated pumping station capacity (6.55 L/s).

Remaining Capacity

The remaining capacity of Bath SPS #4 was calculated by subtracting the estimated current peak flows from its total capacity. It should be noted that for existing connections the extraneous flow value was set to zero since extraneous flows are accounted for in the flow per capita value. Estimated current peak flows were calculated using the following formula:

$$Q = \frac{PqM}{86.4} + lA$$

where:

- Q = estimated peak flow (L/s)
- P = population (thousands) = 0.4002 cap
- q = flow per capita = 323 L/cap/day
- M = Peaking factor = 4.0
- I = unit of peak extraneous flow = 0.14 l/ha/sec
- A = contributing area = 16.52 ha

The peaking factor (M) was calculated using the following formula:

$$M = 1 + \frac{15}{4 + P^{0.5}}$$

Based on this information, the current peak flow value can be calculated to be 3.01 L/s, leaving 10.09 L/s, or 77%, of remaining capacity for SPS #4.

Appendix D contains a table summarizing the capacity calculation of Bath SPS #4.

Mechanical, Electrical, and Instrumentation Assessment

The following mechanical and electrical components and instrumentation exists at the pumping station:

- All necessary appurtenances, controls, and alarms.
- Above grade control panel, gate valves, MCC, wet well level indicator, PLC, and hard-wired floats.
- Vent pipes, gas detector, alarms, by-pass connection of the wet well.

The mechanical, electrical and instrumentation components of the pumping station were not assessed as part of this investigation. Based on information provided by the operators, all equipment is functioning according to operational requirements of the pumping station.

Growth Expectations for Catchment Area

Given its location relative to available development lands, significant growth is not expected in this catchment area. There is some potential for intensification throughout the subdivision. A 15% increase in flows is considered for this infill, which is equivalent to approximately 0.45 L/s.

Summary of Remaining Capacity

Analysis indicates that approximately 77% of the pumping station's original capacity, approximately 10.09 L/s, remains available. After considering the minimal infill growth discussed above, approximately 74% of the original capacity will be remaining, which is equivalent to 9.63 L/s. Subsequently, there is no illustrated need to plan to increase the capacity of this station.

Upgrade Requirements or Options

At this time pump rates and volumes are estimated based on pump run times. Installation of a totalized flow meter may be considered in the future to improve accuracy of data collection and calculation of flow rates, and to assist with planning for future equipment upgrades and maintenance.

Financial

Upgrade	Estimated Cost
Installation of Flow Meter	$15-20k

Climate Lens

- The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.
- Climate conditions that will most likely impact the future upgrades of sewage pumping stations in Loyalist Township include the following:
- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). Increase in temperatures will result in increase water usage and wastewater generation.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021). Wetter weather will result in an increase in infiltration within the sanitary system.

- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). Extreme events will result in an increase in infiltration within the sanitary system.
- Climate Change Mitigation
- How will these projects assist in mitigating the impacts of climate change?
- Following best management practices regarding the management of excess soil materials with the overall goal of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Employ energy efficient mechanisms such as variable frequency drives (VFDs) on pumps, blowers etc.
- Consider the use of renewable energy sources (such as solar or wind) to supplement electricity usage.
- Climate Change Adaptation
- How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?
- Calculations for construction of conveyance and treatment infrastructure will consider potential increase in flows from inflow and infiltration as a result of increased annual precipitation.

Linkages

Capacity Assessment of Bath SPS #1

Capacity Assessment of Bath SPS #2

Capacity Assessment of Bath SPS #3

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Conclusions

As no further development is expected within the catchment area of SPS #4, staff do not anticipate that capacity-related upgrades will be required within the 25-year term of the IMP. Installation of a flow meter may be considered to enhance service delivery of the SPS for the future.

IMP Technical Memorandum: Minor Stormwater System

Asset Class: Stormwater

Objective: The purpose of this technical memorandum is to present an overview of the examined minor stormwater system and identify potential shortcomings within the Township's minor stormwater system for the period of the IMP. Developing an understanding of the operational and functional requirements will help ensure that any required upgrades are implemented to help minimize the risk of significant property damage and environmental degradation.

Background

Stormwater management deals with the implications of surface water runoff generated from precipitation, primarily from active sources like rainfall or snowfall, but also from snowmelt. As changes to land use alters the surface features of the Township, the nature of runoff changes. It is the goal of stormwater management to ensure that these development changes minimize the effects of the change in runoff on the natural environment, as well as the risk to the people and property using the development.

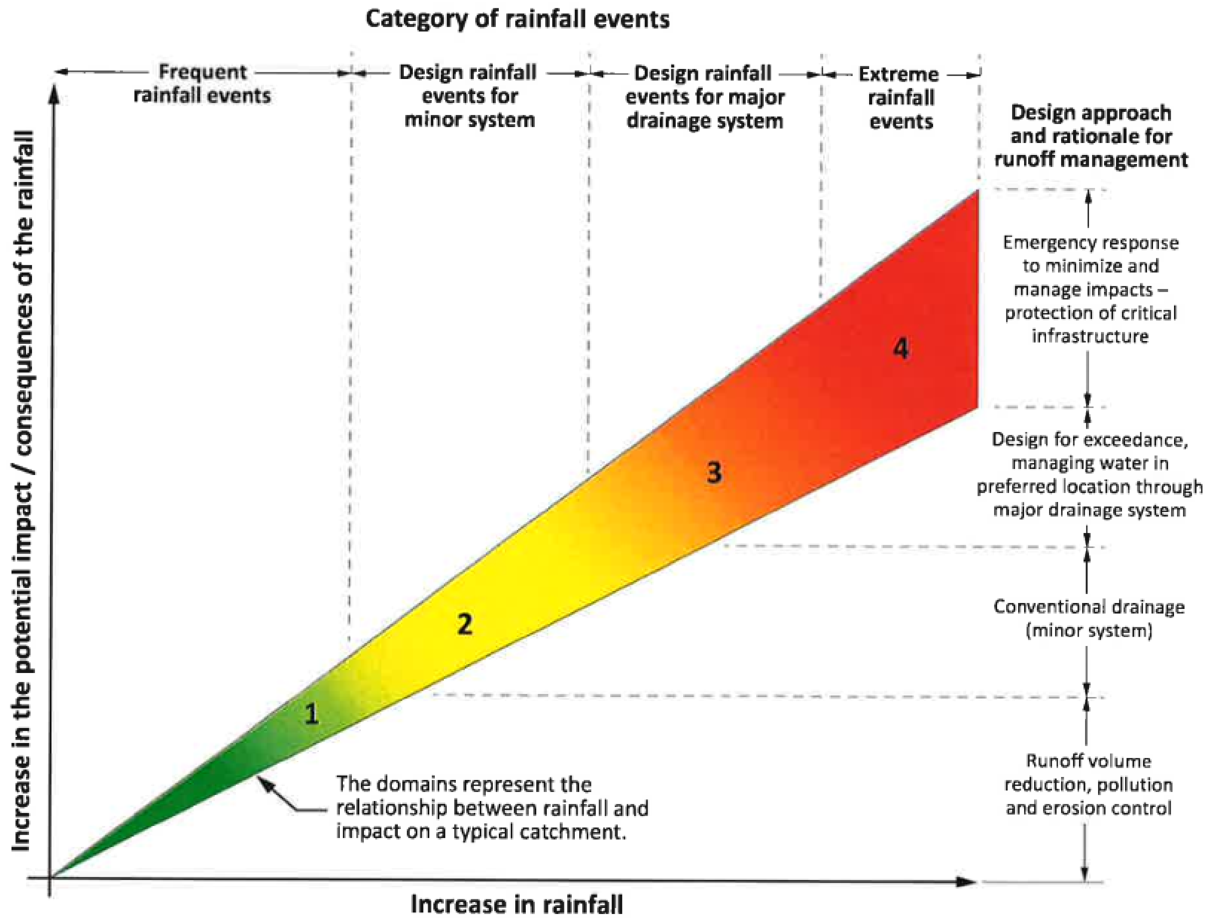
Most of Loyalist Township has similar surficial geology consisting of a thin soil veneer over limestone bedrock. A typical total soil depth throughout the Township is 0.5 m. The limestone is often fractured in its upper most layers but quickly transitions to a relatively impermeable mass, often within 1.0-2.0 metres below the surface. This combination of soil and rock results in a generally low ability for surface water to infiltrate into the ground, typically much lower than would occur in other areas with deeper soil. Occasionally the local surface limestone is classified as karst. Karstic characteristics include open cracks, small caves, and springs; and have been known to occasionally develop into complex, localized urban drainage problems.

With Loyalist Township adjacent to Lake Ontario, much of the Township's drainage system including Amherst Island drains directly into the Lake. An exception is the community of Odessa, draining into Millhaven Creek and the Wilton Creek watershed, both of which drain into Lake Ontario. Amherst Island is served by the Miller Drain which drains much of the central and southwestern portion of the Island and eventually into Lake Ontario.

Apart from some historical municipal drains, municipally owned stormwater systems are limited to urbanized areas.

For the purposes of this report roadside drainage and cross culverts that serve natural drainage courses have not been included in this report. These features are normally considered as part of the total rural road infrastructure.

The four rainfall event types are: frequent, minor storm, major storm, and extreme. The rainfall event types in Figure 1 generally represent the effect as rainfall increases in intensity and/or amount, elevating the short-term risk to lives, property, and infrastructure, both natural and constructed (CSA Group, 2019).



Note: *Adapted from CIRIA (2014).*

Figure 1 Types of Rainfall Events

In general terms, the minor stormwater system addresses frequent and minor storm events with the focus on soil erosion and the water quality of the released runoff. The objective is to minimize both pollutants and suspended solids from impacting the receiving body of water such as lake Ontario. The major system addresses major storms and extreme rainfall through management of flood risk. This memorandum addresses the minor stormwater system.

Minor Storm Design Events

The minor system handles surface runoff and local infiltration. However, it is not cost-effective to try to build a minor system with the capacity to handle all potential runoff including the largest storm event, so the minor system of stormwater ditches and pipes are sized to be large enough so that the vast majority of precipitation events do not travel overland, but not so large as to be financially crippling. Most jurisdiction agencies design a minor system to handle a design storm between a 1:2 year event up to a 1:10 year event. The majority of minor systems in Loyalist Township are designed for a 1:5 year event. Some older portions of the Township are designed for a 1:2 year design event.

Many of the oldest urban areas of the Township in the communities of Bath and Odessa were developed without neighbourhood drainage in mind. Drainage was focused on keeping main thoroughfares passable and buildings free of standing water. Concepts such as 1:2 year design event did not exist in these communities prior to the 1950s, aside from the County Road 2 and Highway 33 corridors where drainage for the highways was more advanced.

Storm events with intensities up to the selected design storm guideline will be handled by the minor storm system. In a fully urbanized road cross-section (curb and gutter), the water from the road and adjacent properties will be carried in the gutters or roadside ditches to catch basins or ditch inlets, where the water will flow in pipes to the stormwater system's outlet. This is intended to keep the roads and sidewalks clear of standing water.

The release of stormwater is controlled with the goal of ensuring the peak runoff rate for any given design storm up to the design limit of the system is limited to the pre-development discharge rate. It is typical for stormwater system designers to assume the pre-development conditions are what the location would be like in its natural state prior to any historical human impacts. Normally, a method of temporarily holding the surplus water is used to delay the release until the peak of the storm has passed. This is often achieved by constructing stormwater detention ponds. Although an increase in a minor storm event does not necessarily represent the flood risk of a major storm, soil erosion, scour, and other negative effects from smaller-but-more-frequent releases can have long-term effects on both infrastructure and downstream properties.

Water Quality Storm Events

One of the primary functions of the minor stormwater system is to ensure that the stormwater collected will not negatively affect the downstream receiver. Stormwater treatment size is based on a water quality storm event that is larger than 90% of the stormwater events in a year. For Loyalist Township, that is a precipitation event of 25-26 mm. Water quality targets are currently defined by a theoretical reduction of post-development suspended solids to a percentage reduction based on the sensitivity of the receiver which may require low, normal, or enhanced levels of treatment. More specific water quality parameters based on temperature, salinity, clarity, and concentrations of contaminants like oils, phosphorous, and others can be added to the list of discharge limitations by the agency having jurisdiction, as identified in the permit for the system.

It is required that the minor system treat the collected stormwater to meet these criteria prior to release.

During a major storm event, the minor storm system will still operate to remove most contaminants up to the capacity of the minor system.

Drainage Events

90% of annual rain events are lower than the water quality design limit. These are the most common events, and most pass without any concern. The runoff is generally small in quantity due to the natural surface retention of all surfaces – the small natural indents and surface irregularities that hold a considerable amount of these common events. Any runoff that does occur is directed through surface grading toward the minor system for treatment and release.

The minor stormwater system generally serves the urban areas of the Township. In rural areas, roadside ditches and culverts that exist only for roadways are specifically excluded as part of the storm sewer system. The semi-urban neighbourhoods of the Township without curb and gutter are served by roadside ditches and driveway culverts, both of which are part of the minor system, even though they are not fully piped systems.

Assumptions

The following assumptions were made for this memorandum:

- Individual site stormwater systems are not included
- Municipal drain systems are not included in the minor storm systems. A summary of municipal drains within Loyalist Township is included in the Stormwater Major System technical memorandum
- Flooding and flood risk areas associated with coastal erosion (e.g., south shore of Amherst Island) are not included
- Drainage systems that exist due to a roadway redirecting surface water flow are not included
- Natural and constructed infrastructure within the boundaries of natural watercourses (bridges, dams, etc.) are not included.

Methodology

Stormwater management, particularly for major and extreme events, is a risk-management endeavour. Stormwater inputs are not particularly predictable, and the resultant flows are not measured. While statistical methods and regional rainfall records have increased confidence in designed features, the reality is that storms are difficult to predict. The best practice is risk management coupled with resilient design.

This report is based on quantitative discussions concerning minor stormwater features and the end-of-pipe quality control measures, based on geographic location, existing ground surface topology, local site conditions, review of design documentation, and maintenance records.

Although covered under by the Drainage Act as opposed to the Ontario Water Resources Act this memorandum will examine the status of municipal drains within Loyalist Township.

Analysis

Geography

From a minor storm perspective, Loyalist Township is a study in contrasts. While its largest urban centres were formed alongside natural water features (Lake Ontario, Bath and Millhaven Creeks), the land in general tends to be relatively flat. When land is developed, the requirement for gravity linear infrastructure to achieve a minimum amount of fall means the careful utilization of cut and fill to maintain minimum pipe and gutter grades. Additionally, the historical nature of development resulted in the oldest settlements to be crowded near the water edge, which presents difficulty in retrofitting stormwater drainage and treatment into these areas.

The areas of greatest concern are adjacent to the watercourses that drain the interior of the Township to their major outlets. The lands here tend be broader, rising slowly from the slow, shallow creeks, with wetlands, marshes, and other poorly draining areas. Fortunately, development adjacent to these areas was avoided during initial rural settlements, and eventually restricted with acknowledgement of the inherent flood risk and environmental sensitivity of these areas. There are existing areas of development that under current policy and regulation would not be permitted.

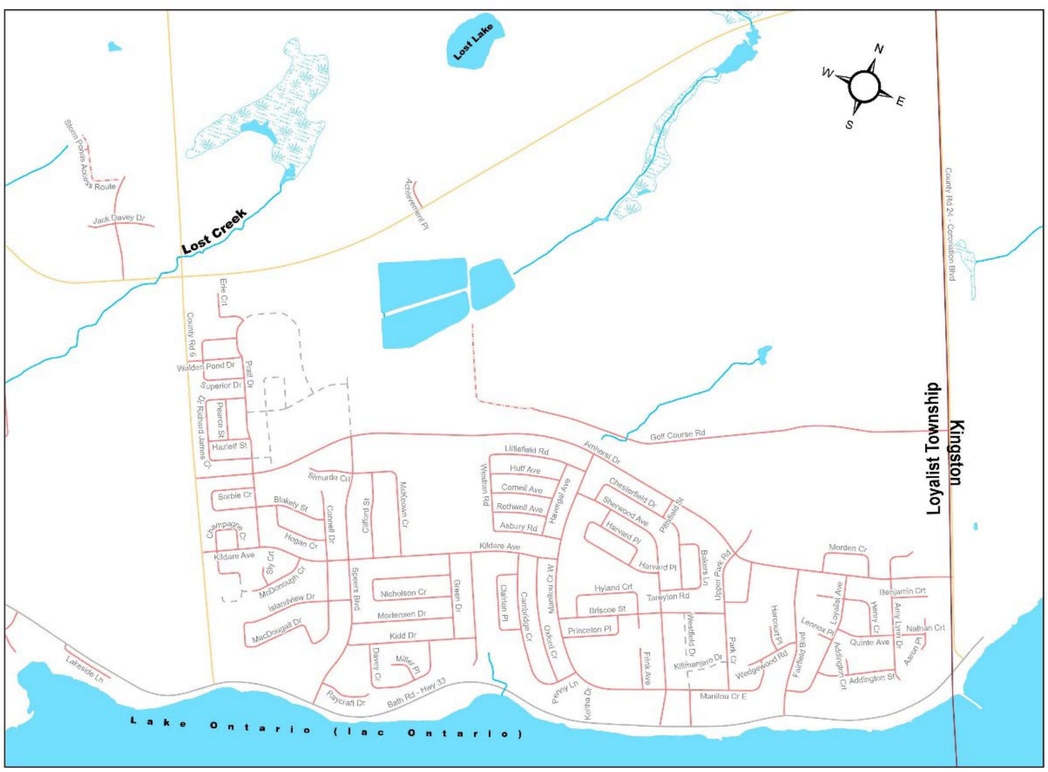


Figure 2 Amherstview natural watercourses

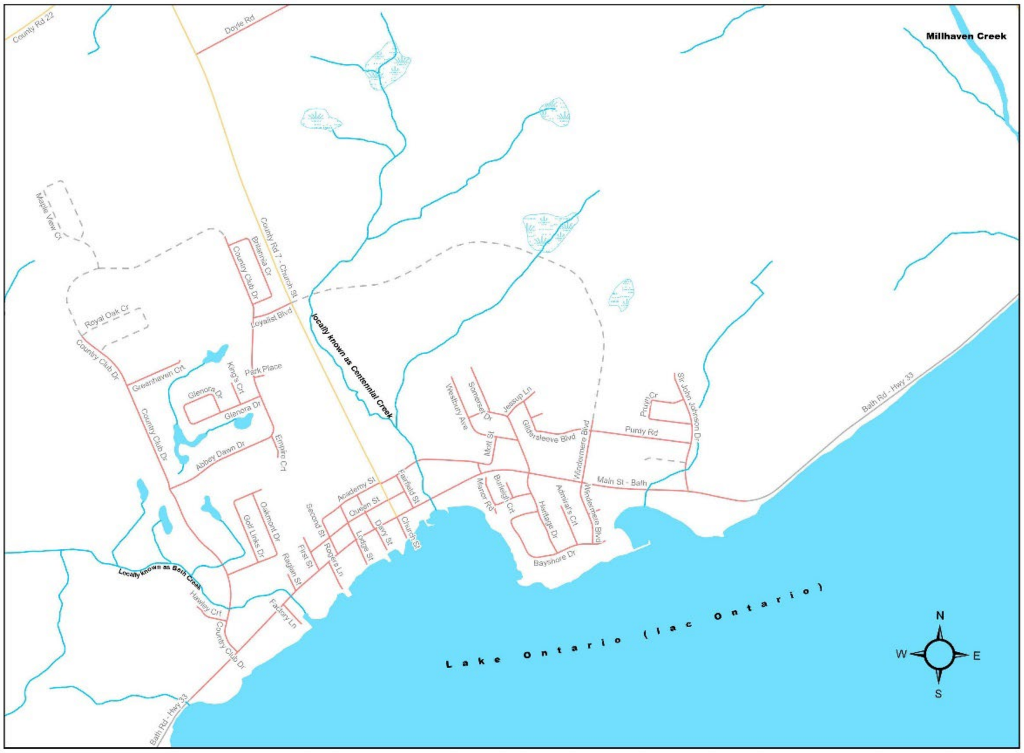


Figure 3 Bath natural watercourses

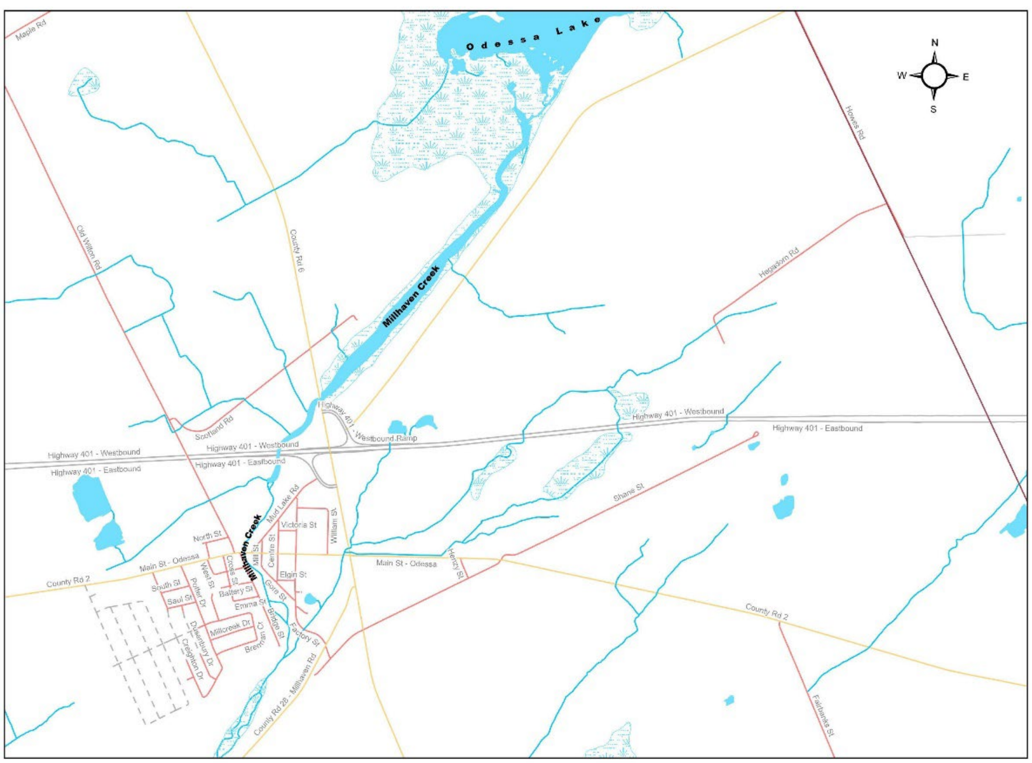


Figure 4 Odessa natural watercourses

Minor System – Interception

The Ministry of Environment, Conservation and Parks' (MECP) stormwater guidelines require the consideration of systems for the interception of runoff from properties prior to becoming runoff to be collected by the minor system. The intent of these features is to mimic the water balance by reducing the runoff at or near the source to pre-development conditions through infiltration, groundwater recharge, and evapotranspiration by plants. These low-impact development features include concepts like rainwater harvesting, rain gardens, infiltration trenches, bioswales, and permeable pavement.

Due to the Township's karst limestone bedrock, shallow overburden soils, and extensive areas of flat lands, high groundwater levels (seasonal or otherwise) are a persistent feature that limit the use of infiltration methods for runoff interception.

The use of low-impact features in Loyalist to date have been limited to use on larger private sites, and to a minor extent on municipal rights-of-way, as opposed to intentional incorporation in residential development stormwater designs.

Concerns

Due to the long term development pace in Loyalist Township, most of the communities were constructed or approved prior to the regulatory focus change and the introduction of innovative technologies and methodologies. As such, low-impact development practices to intercept runoff have not been implemented within the Township's minor system to date.

Opportunities

Potential usage of these technologies will be reviewed on a case-by-case basis as part of all new development. When roads are scheduled for rehabilitation, the Township will examine the appropriateness to install infrastructure that benefits stormwater quality and quantity control. It is recommended that this practice be continued

Minor System – Collection

The minor system begins with collection of local runoff. In urban sections, runoff from properties is collected by curb and gutter to catch basins or ditch inlets. It is then piped, with the pipes increasing in size heading downstream until discharged. In semi-urban sections, the local ditches lead eventually to ditch inlets or major channels before being discharged. Culverts that cross under roads to allow the flow to proceed downstream are part of the minor system, as are driveway culverts in these local ditches.

Concerns

In areas like the oldest portions of Bath and Odessa, historical development was somewhat haphazard, with stormwater management not considered a priority when creating streets and houses. It is within these development areas, albeit not exclusively, that most shortfalls in stormwater collection are found. These shortcomings become opportunities in areas of brownfield development and infill.

Over the last 30 years the Township has focused on improvements to areas underserved by stormwater management. Projects were protected on a priority basis based on the potential for flood damage.

The Township often receives requests for storm sewer installation in urban areas now serviced by roadside ditches. In most cases these requests are denied on the basis that:

- A grass swale is more effective for capturing suspended solids and maintaining a higher level of water quality than an underground sewer system.
- An urban ditch is very resilient in handling high flows, as the structure allows for a large storage capacity of runoff during major storm events, thereby reducing property damage.
- Occasionally it is recommended that, for the replacement of a ditch with an underground storm pipe, there will be a need no size the pipe for the 100-year storm. This is much more expensive then simply replacing an existing pipe.
- Installation of roadside curb and gutter may impact lot grading, possibly necessitating the need for additional inlets on or near the property line.

Opportunities

Loyalist staff assembled relevant documentation regarding outstanding storm drainage concerns and have developed a list of locations which require alteration/improvements. It is recommended that these upgrades be coordinated with other projects in the area. In locations where road rehabilitation is not expected in the short term smaller projects may need to be prioritized.

This listing consists primarily of concerns based on water quantity as opposed to water quality and are considered localized issues.

Amherstview

Harvard Place and Dinosaur Park: Prior to re-ditching, the area's outlets couldn't keep up to the largest storms. Driveway culverts were replaced and ditching redone in approximately 2010. Hyland Court had storm sewers installed in 2017, which improved drainage on the south side of area. The drains in the park need to be kept working. The Township will look at extending underground storm leads into the area to provide additional relief and will maintain the ditches for storage as well.

Parkside Subdivision Stormwater Management Facility: A complaint was described above regarding vegetation in the swale, with the resident asking to have the outfall piped instead of conveyed by open channel. After review, staff feel that the outlet offers good resilience and recommended to retain swale as is.

The outlet just east of 4423 Bath Road ("The Moorings" condominium): A drainage concern was identified at what appears to be an informal outlet from Addington Street south to Bath Road/Highway 33. This is an overland flow route. The Township needs to confirm easement rights and/or ownership of this overland flow route. Outlets to Lake

Ontario beside 4419 Bath Road/Highway 33. A review of the easement summary maintained by the Township indicates other locations where easements may not be registered in favour of the Township. It is recommended that the Township review all overland flow routes and storm piping that extend beyond road allowances and confirm the status of easements/ownership. Where easement rights or ownership are not in place then an effort should be made to obtain operational and maintenance rights of the storm system.

84 Mortensen Swale: A rear yard swale from Speers Boulevard empties onto Mortensen Street, east of civic 84. In the winter this causes ice build-up on the street. Staff recommend intercepting this flow with a catch basin and extending piping to the storm system.

Lakeview Park storm outlet: Staff recommending reserving some land for an enhanced storm outlet to improve stormwater quality.

Willie Pratt Park, 177 Upper Park Road: Drainage from north to south and along adjacent properties remains an issue. Staff recommend a drainage evaluation. Existing outlets connect to the Amherst drive storm system.

2 Quinte Avenue: The portion of the yard facing Loyalist Boulevard needs to be assessed to improve outlet to street drainage. Options may include the installation of a yard basin or diversion to the Quinte Avenue swale.

Bath

The general approach of the IMP will be to retain grass swales as much as possible for public rights-of-way that outlet at the lakeshore. Storm sewers are to be considered only when upstream requirements dictate this approach.

Church Street south of Main Street – Bath: Ditches have not been maintained; the outlet to the lake is blocked. Evaluation is needed to develop a functional drainage strategy for this section of the street.

Lodge Street south of Main Street – Bath: The depth and steepness of the ditch on the southeast corner of this intersection poses a safety concern. The outlet on this corner drains the piecemeal storm system coming from upstream inlets at Queen Street and Second Street. Lodge Street has inadequate shoulders due to ditch.

Stormwater entering the area around the Queen Street/Second Street intersection drains south on Second Street to inlets located midblock where there is a localized sag in the street elevation. The two inlets drain easterly, under a privately owned building through piping, and daylight into an open swale behind the post office. The Township does not have any information on the characteristics or condition of the pipe used on private property. There is no easement in place for this pipe. The swale then swings southeasterly across the former Bath firehall site, and stormwater flows south within the Lodge Street roadside gutter(s) toward Main Street – Bath. There is one inlet on the north side of Main Street that carries the stormwater under Main Street – Bath to the ditch running between Main Street – Bath and Lake Ontario.

If the two Second Street inlets were unable to handle all the stormwater they received, there would likely be some flood damage to adjacent properties once the small road storage volume was fully used.

Coiled steel pipe (CSP) is popular for storm drainage. The life span of CSPs can be significantly reduced when exposed to winter road salt. Structural grades vary significantly for CSPs and a pipe with a higher strength rating due to thicker steel may better resist the effects of road salt.

The ideal solution for Second Street involves improving this system from Queen Street to a new Lodge Street outlet, with a new storm sewer starting at the Queen Street and Second Street intersection, constructed sufficiently deep to pick up catch basins that drain under the private property (408 Main Street – Bath) and extending easterly along Queen Street to Lodge Street. From Lodge Street the piping would flow southerly until a suitable storm sewer outlet elevation is achieved, likely at or near the shore of Lake Ontario. An alternative route is to construct the storm sewer through the Township's property on Lodge Street and pick up the low spot behind the Post Office. This outlet is expected to require an OGS unit.

Factory Lane: Recommend re-establishing a proper ditch outlet at the shore of lake Ontario, at a location that has municipal control. The existing road allowance is not maintained, but it extends to the lake. This location will require an OGS unit or alternative form of treatment.

Raglan Street at the Queen Street right-of-way: This low spot collects water from west of First Street and north of Queen Street, as well as potentially runoff from the undeveloped Township-owned lands behind the Bath Fire Station. There is a need to pick up the drainage that collects at the north end of Raglan, and convey it westerly towards Bath Creek, or northerly to the new system on Oakmont Drive. Raglan Street doesn't have a formal outlet: water runs across the front lawn of 458 Main Street – Bath, with no easements in place. It's difficult to fix Raglan Street as a shared pedestrian route without addressing drainage. If a comprehensive drainage strategy could be developed in coordinated with Kaitlin Corporation, the Loyalist Estates developer, staff could examine using the Loyalist Estates Phase 4 outlet.

Loyalist Estates Stormwater Management Facilities: Regulatory issues related to these facilities must be assessed, as they receive municipal stormwater. Legal agreements are in place, but new MECP regulations may contradict some elements of these agreements.

155 Main Street – Bath culvert outlet: This is a major stormwater outlet for which there no easement in favour of the Township. The condition of the outlet is deteriorating. A pipe on private property is in poor condition and adjacent to a steep bank. The catchment area extends northeasterly and includes the southwest corner of the Correctional

Services of Canada's large property. It is recommended that the Township negotiate with the owners of 153 Main Street – Bath for easement rights, to allow us to maintain the outlet. The inlet on north side of Main Street – Bath requires slope improvements, erosion control, and sidewalk protection. Once an easement is established the Township can develop plans to rehabilitate the outlet and look at options to enhance stormwater treatment at the outlet.

Odessa

Apart from Factory Street, all side streets entering Main Street – Odessa have drainage deficiencies. The Main Street – Odessa technical memorandum examines these in detail.

The oldest section of the Odessa West neighbourhood, comprised of Emma, Bridge, Cross, Battery, and South (East) Streets: This area is currently undergoing construction to rehabilitate infrastructure, including drainage improvements.

Potter Drive, South Street West, and Creighton Drive: Improvements are proposed, to be constructed concurrent with the proposed upgrade of the intersection of Potter Drive and Main Street – Odessa.

There is also a need to address an issue with the outlet of the County's Main ditches at the southwest quadrant of the Creighton Drive-Main Street – Odessa intersection. The current ditch system relies on a poorly draining, overland shallow swale across private property which experiences some occasional side and rear yard ponding. In the long term a major storm outlet can be included in the planned development. An alternative solution is to construct a suitable conveyance to newer the stormwater drainage system near South Street-Creighton Drive intersection.

The Potter Drive project will also address drainage concerns for lots on north side of South Street, west of Potter, by improving the existing stormwater outlet by directing stormwater into the Potter Drive storm sewer constructed in 2013.

Neighbourhood of Centre, Gore, and Elgin Streets: The area is prone to minor flooding, especially during ice jam events on Millhaven Creek. There is insufficient fall at the outlet, and at times the existing system backflows into and out the tops of the catch basins closer to Main Street – Odessa.

West Street: Drainage must be extensively reviewed on the extent of the street. There is a need to pick up drainage from the new park access area, the park, and the proposed southeast exit from the fire station. There is a low area, between the Odessa Fire and the Pop-In Convenience Store, that doesn't drain.

General area bounded by Factory Street on the east and Millhaven Creek on the west, both north and south of Main Street – Odessa: Consider developing an overall drainage plan. There is the potential for a new north-south sewer. This evaluation is a priority and should be completed prior to rehabilitating any more streets in this area to the south of Main Street – Odessa.

William Street: Drainage is poor along the William Street right-of-way due to flat topography. There is a small section of storm sewer extending north from Main Street – Odessa. There is vacant land, expected to be developed shortly, that currently appears to be functioning as an informal stormwater reservoir. If the area is developed an increase in localized drainage can be expected. The area could benefit with a system designed to address the full length of William Street.

Old Wilton Road: Properties on the west side of the street south of Highway 401 that back onto the school property, are sometimes affected by drainage issues. The swale between the Township's recreation property and the site of the former water treatment plant should be cleaned out to improve drainage.

Main Street – Odessa ditches east of County Road 6: These ditches are part of the County's roadside ditches. On both sides of the road they are prone to seasonal blockages, requiring monitoring and maintenance between Shane Street and County Road 6. Consideration should be made to improve this system

This area would benefit from a collective approach involving the County, Loyalist Township, and the owner of lands south of Shane Street.

Mill Street: Recommend cleaning out the swale in the easement south of the former Township roads garage, behind Main Street – Odessa properties.

Drainage Hot Spots

Amherst Drive cross culvert, near 18 Amherst Drive: There is a concern that if the cross culvert becomes blocked, the only flow option is the overland route. Based on design grades, flows would likely be diverted easterly on Amherst Drive to Coronation Boulevard, as the curbs would contain the water and the existing overland outlet sewer inlet elevation in Parkside storm system may be too high to take water. There is a concern that the older Coronation Boulevard west side ditching system may not have sufficient capacity for this situation. The system is complicated, as it appears that many Coronation Boulevard properties have side yard swales that flow west to the rear property line and into the Parkside stormwater facility via three ditch inlets located along the rear property line. It is recommended that elevations be confirmed in this area and prepare necessary action plan.

Penny Lane: If heavy flows bypass the Manitou Crescent West catch basins, the stormwater flows along the curb line and down the private driveway of Penny Lane. Adding a gutter across the entrance would help to divert flows to two CBs immediately downstream of the Penny Lane driveway. It is suspected that this route is a major flow route, and if not protected by easements, the Township should attempt to obtain easement rights to maintain the storm system outlets.

There are two low catch basins between the Keitha Drive apartments and Penny Lane that could drain the area but would not be able to accept full major flow without major ponding. Casual observation suggests that the Penny Lane entrance is not dipped sufficiently to divert all flow to the catch basins which would assist in draining the private property. The property owner could participate in an improvement.

Use of lidar imagery would be beneficial in an analysis of the Amherst Drive/Coronation Boulevard and Keitha Drive/Penny Lane areas to develop flood prevention plans.

An alternate outlet for major flows may be through the yard of 4539 Bath Road. Bath Road is higher than the adjacent yards. The new swale and catch basins belong to the Ministry of Transportation.

Minor System – Treatment Systems

Stormwater treatment comes in many forms. In urban sections, the catch basins contain a sump that will intercept the sand and grit that accompanies stormwater flow. In semi-urban sections, the roadside ditches will trap the same sand and grit in the grass bottom. Smaller suspended particulate and dissolved contaminants are carried by the minor system downstream to the end of pipe.

Treatment of the collected stormwater was originally not seen as important as it is now. In older areas of the Township, collected stormwater has been discharged into Lake Ontario or the large creeks without treatment. Following updates in regulations, stormwater treatment features have been added to modern developments. There remain in all areas of the Township, areas of stormwater collection that are without stormwater treatment beyond the minor benefits gained by roadside ditches and catch basins.

Source Water Protection

Source water protection is part of the multi-barrier approach to ensure safe, clean drinking water by protecting sources of municipal drinking water. The municipality maintains potable water intakes in the communities of Bath and Amherstview. Water movements within Lake Ontario have been evaluated and the potential for impacts from human activities through the establishment of inlet protection zones (IPZ). Many of the untreated stormwater outlets noted in this memorandum are within the IPZ associated with the potable water treatment plants in Amherstview and Bath.

Erosion caused by stormwater flows creates small suspended solid particles (TSS) which can visibly impact and harm natural ecosystems. TSS pose additional problems at the Bath Water Treatment Plant, where the relatively shallow intake structure is frequently impacted by raw lake water with very high TSS. The sources of the TSS are suspected to be primarily caused by soil erosion along two creeks in the village during large flow events and from suspended particles stirred up by lake turnover events combined with onshore wave action.

Source water protection is discussed in more detail in the Source Water Protection Technical Memorandum.

The 2003 Stormwater Management Planning and Design Manual (Province of Ontario, 2003) outlines three different levels of protection that may be acceptable depending on the receiver. These levels are differentiated using a long-term average (at least 10 years) of suspended solids removal:

- Enhanced – removal of 80% of suspended solids
- Normal – removal of 70% of suspended solids
- Basic – removal of 60% of suspended solids

The manual provides more detail as to which level of protection is required for different receivers, but also notes that the selected level should be determined based on site-specific conditions. Ideally, the level of protection should be selected to maintain or enhance the aquatic habitat.

Depending on the year of construction, existing stormwater infrastructure in the Township would have been designed using the levels of protection described above. Moving forward, the level of protection requirements will change with the implementation of the Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA). The new requirements use the same three levels of TSS removal: enhanced (80% removal), normal (70% removal), and basic (60% removal). However, the percentage of suspended solids removal is no longer based on a long-term average, instead, the level of control needs to be achieved for a 90th percentile storm event. This is a significant change to the level of suspended solids being removed and will need to be considered when implementing retrofits to improve treatment.

Where implemented, end-of-pipe treatment systems are typically stormwater management ponds or in-line oil/grit separator (OGS) units. Stormwater wet ponds have two primary functions, being quantity control and water quality control. For minor storm events, the stormwater pond detains peak flow and stores the runoff for gradual and controlled discharge, with the peak flow rate from the pond less than or equal to the calculated pre-development flow rate. In some instances, the permitted peak flow rate is further limited by the capacity of downstream major stormwater infrastructure. The large water volume within the pond and the permanent pool of water allow the suspended sediments to settle, with some biological processes helping reduce the dissolved contaminants. The outfall slowly releases the minor storm event flow. The pond is sized according to provincial design standards based on the desired water quality level and the catchment area of the served minor collection system. The primary criteria for water quality control are the location and shape of the sediment forebay, the volume and depth of the permanent pool, and the capacity of the water quality outlet. There are several variations of stormwater ponds (wet pond, wetland pond, or hybrid-wetland pond) and these have been demonstrated to be the most effective at treating typical stormwater runoff, being able to treat the runoff from a minor system to achieve the 70-80% sediment removal standard for release (normal to enhanced levels).

OGS units are typically implemented as part of a treatment train of two or more alternate treatment processes, as on their own they are often insufficient for reducing stormwater sediment loads by the 70-90% requirement for a minor system. OGS sizing calculations have historically been completed to demonstrate an 60%-70%-80% annual TSS removal rate; however as noted above the new CLI-ECA requires a 60%-70%-80% TSS removal rate based on the 90th percentile storm. The change results in adjusting the flow calculations through an OGS to output the required TSS removal rate. Generally, as the flow through an OGS increases, its efficacy at removing TSS and other pollutants is reduced. However, it remains effective for removing oil and grease from stormwater. As OGS units take up less room than a traditional wet pond and can be easily incorporated into an urban environment, they are often used to retrofit existing systems without any treatment options as a primary method of improving water quality as much as is practical. Additionally, OGS remain a suitable solution for small catchment areas where the anticipated flow is not large.

As part of a treatment train, with either a dry pond, bioswale, or enhanced swale to provide additional suspended sediment removal, the OGS can help the minor system achieve the 70-80% sediment removal standard for release, achieving normal to enhanced levels.

The treatment systems that have been constructed in the minor systems remain in compliance with their original ECA requirements. Monitoring of the performance of those systems will be part of the ongoing monitoring program the Township will be implementing throughout the system as part of the CLI-ECA.

Concerns

Treatment shortcomings in the Loyalist Township stormwater systems consist of older developed areas constructed without treatment systems in place, and older systems with partial treatment.

Generally, the OGS and stormwater ponds have been designed and constructed as per their approval conditions. When combined with regular monitoring to ensure they remain functional, theses methods of treatment are expected to meet the required performance levels. In accordance with the new CLI-ECA program being implemented by MECP, the Township will begin to monitor the performance of its stormwater treatment systems.

Therefore, the opportunities identified below will be based on the treatment available for those systems, as well as identifying those that have space for wet pond, OGS, or other treatment systems.

Significant space is required for a wet pond system, and this is the primary obstacle for their use in a retrofit situation. OGS units have a hard upper limit in treatment capacity due to spatial constraints. Therefore, treatment options that are both simple and effective are limited. Timing for any potential upgrade in water quality treatment will likely come about through urban renewal of the oldest sewer catchments, in addition to future regulatory changes requiring storm system owners to decrease pollutant loads on the natural environment.

Priority within this group (excluding the priority considerations between this group and other group of priorities within the overall stormwater system) is difficult, as the cost associated with retrofitting stormwater treatment is substantial even for small catchments, and can become unattainable for large catchments. Therefore, opportunities are presented sorted by catchment size for those minor systems without end-of-pipe treatment, then by areas of partial treatment.

After reviewing all known deficiencies and potential liabilities related to stormwater, it is recommended that higher priority be provided to those projects that have potential impacts to public safety and/or significant property damage.

Opportunities

Upgrades for stormwater treatment for portions of the minor system will be of lower priority in comparison to addressing deficiencies in the collection system itself. However, each improvement to the existing stormwater system will need to at least consider the opportunity to ensure stormwater quality is addressed.

As catchment area is the most significant indicator of the magnitude of a stormwater treatment opportunity, the list of catchments with no or minimal end-of-pipe treatment is sorted by catchment area. The most significant catchment areas are detailed.

Amherstview

Catchment description	Area (ha)	End-of-pipe control
Manitou West, north plus	110	Quantity – none Quality – catch basin
Islandview Park outfall	47.17	Quantity – none Quality – catch basin
Manitou West, south	10	Quantity – none Quality – catch basin, ditches
Penny Lane outfall	8.15	Quantity – none Quality – catch basin
Sherwood Avenue	4.51	Quantity – none Quality – catch basin

Lakeview Park Outlet

The outlets into Lakeview Park drain under Highway 33 to Lake Ontario. Lakeside Park was originally a poorly draining low area which was filled over time. There is sufficient area in the park to warrant a full examination of the possibility of constructing a wet pond for the purpose of providing stormwater quality control, but there is no need to provide quantity control, as the receiving body is Lake Ontario. The catchment area that drains to this park is approximately 110 ha, representing approximately 50% of the total untreated stormwater for Amherstview.

Islandview Park Outlet

The outlet drains under Highway 33 to Lake Ontario. The catchment area draining to this park is approximately 47 ha, representing approximately 25% of the total untreated stormwater for Amherstview. There is insufficient area in the vicinity of the outlet to construct a wet pond, and the catchment area is far too large for an end-of-pipe OGS. Underground storage of the water for such a large catchment, to be released slowly through a maximally sized OGS, would be enormous. There is no available land in the area to support such a structure.

Bath

Catchment description	Area (ha)	End-of-pipe control
Lower Windermere	33.4	Quantity – none Quality – OGS, enhanced swale
Davey Street	6	Quantity – none Quality – catch basin
Main Street – Bath at Centennial Park	5.35	Quantity – none Quality – catch basin
Heritage Park	5	Quantity – none Quality – catch basin
Manor Road-Burleigh Court	4	Quantity – none Quality – catch basin
Main Street – Bath west of Factory Lane	4	Quantity – none Quality – catch basin
Lodge Street	3	Quantity – none Quality – catch basin
Main Street – Bath west of Rogers Lane	3	Quantity – none Quality – catch basin

Heritage Park Outlet

The outlet discharges Lake Ontario. The catchment area that drains to this park is approximately 5 ha, representing approximately one-sixth of the total untreated stormwater for Bath. There is sufficient area in the park to warrant a full examination of the possibility of constructing a wet pond for the purpose of providing stormwater quality control, but there is no need to provide quantity control, as the receiving body is Lake Ontario. There is a sewage pumping station in Heritage Park itself that may restrict the available surface area for a wet pond. An OGS could also be considered, though this would represent a lower level of quality treatment.

Main Street – Bath at Centennial Park Outlets

The outlets discharge to Centennial Creek which immediately discharges to Lake Ontario. The catchment area that drains to this park is approximately 5 ha, representing approximately one-sixth of the total untreated stormwater for Bath. Historic high groundwater, consistent with adjacent lake surface elevations, may present a challenge to the use of one or two OGS units (two may be required as the catchment drains via two outlets on opposite sides of the creek).

There is insufficient space for a treatment train approach, so the addition of one or more OGS would represent an improvement rather than full compliance.

Manor Road-Burleigh Court Outlet

The outlet discharges into Lake Ontario. The catchment area is approximately 4 ha. An OGS could be considered. There is insufficient space for other elements that would constitute a treatment train, so this would result in an improvement to water quality rather than a fully compliant stormwater solution.

Odessa

Catchment description	Area (ha)	End-of-pipe control
Main Street – Odessa, west of Millhaven Creek	4.5	Quantity – none Quality – catch basin
Factory Street, between Main Street – Odessa and Millhaven Creek	4.3	Quantity – none Quality – catch basin
Factory Street, north of Main Street – Odessa	3.5	Quantity – none Quality – catch basin
Factory Street, between Millhaven Creek and Millhaven Road	3	Quantity – none Quality – catch basin
Old Wilton Road, south of Highway 401	3	Quantity – none Quality – catch basin
Mill Street	2.5	Quantity – none Quality – catch basin
Gore Street	1	Quantity – none Quality – catch basin

Factory Street (north of Main Street – Odessa)

The outlet discharges to the County of Lennox and Addington-owned storm sewer system on Main Street – Odessa, which discharges to a tributary to Millhaven Creek. The catchment area that drains to the sewer is approximately 3.5 ha. Should the County look to install an OGS for an upgrade to stormwater treatment of this portion of Main Street – Odessa, they would likely request partial funding from the Township for the area draining into their storm system. Additionally, modifications of this piping to address drainage concerns in the vicinity of Victoria Street and Mud Lake Road will likely increase the drainage area.

Factory Street (Main Street – Odessa south to Millhaven Creek)

The outlet discharges to the tributary of Millhaven Creek just upstream of Millhaven Creek without treatment. The catchment area is approximately 4.3 ha. The invert of this creek is in the Millhaven Creek floodplain. There is insufficient space for a treatment train, so this would only result in a treatment upgrade and not full compliance. This roadway was recently repaved, so modifications of the drainage system (beyond an OGS installation) within the horizon of the IMP is unlikely.

Factory Street (between Millhaven Creek and Millhaven Road)

The outlet discharges to the tributary to Millhaven Creek just upstream of Millhaven Creek without treatment. The invert of this creek is in the Millhaven Creek floodplain. The catchment area that drains to this park is approximately 3 ha. An OGS could be installed at the lower end. There is insufficient space for a treatment train, so this would only result in a treatment upgrade and not full compliance.

Main Street - Odessa, west side of Millhaven Creek

The outlet discharges to Millhaven Creek without treatment. The catchment area is approximately 4.5 ha and is primarily County of Lennox & Addington-owned storm sewer, apart from Durham Street. Should the County look to install an OGS to upgrade stormwater treatment of this portion of Main Street - Odessa, they would likely request partial funding from the Township for the area draining into their storm system. An alternative could be to place an OGS on the pipe leading to the County's storm system, but this would likely be inefficient as it would result in 2 OGS units on the same run.

There is insufficient space for a treatment train approach, so the addition of an OGS would result in an improvement, rather than full compliance.

Nicholson Point

Nicholson Point is an area of residential development on the waterfront side of Nicholson Point Road, a rural road adjacent to Lake Ontario. The lands on the interior side of Nicholson Point Road that drain toward Lake Ontario are controlled by a Trust that restricts development on this land. As such, the land retains its undeveloped nature, although the natural forest canopy and undergrowth will slowly change over time. Maintenance of the health of the wooded area is a responsibility of the Trust.

Drainage of the area follows surface contours and ephemeral channels to the roadway. Currently, there are only a few cross culverts under this road located where the natural low points in the topography. The existing flow paths from the road to the Lake are limited and many are undersized for major events.

Properties in this area have slowly and independently transitioned from small seasonal cottages to large homes. In many cases the provision of drainage across/through the lots have been neglected by the owners.

Due to the nature and history of the development of this area, sufficient stormwater infrastructure does not exist, nor do land reserves for such infrastructure. The ideal solution is for several property owners on the exterior side to come forward and work with the Township on a solution that provides an outlet to the lake.

The controlled nature of the conservation lands draining toward this area reduces the flood risk by limiting the potential volume of storm runoff.

Should sufficient land reserves or easements become available, the Township could consider the installation of larger cross culverts and channels designed for the major storm condition to guide drainage and major storm flow to Lake Ontario.

Limitations

The minor flow system discussion above is limited to those areas within the developed portions of Loyalist Township, and focuses on those areas of poor drainage (collection) and poor water quality control.

Climate Change Considerations

Climate change impacts on stormwater management has been specifically addressed in a separate technical memorandum included as part of the IMP.

In general terms, climate change will increase the frequency of major and extreme events; but these largely impact the major system's function and capacity. It is expected that there will be little effect on the minor system's ability to collect stormwater for minor storms. The ability of existing facilities to treat stormwater quality will be negatively impacted, as the magnitude of the 90% level of treatment will likely rise slightly. Existing OGS units will have their overall efficiency reduced, but meaningful changes are not expected to be measurable for the horizon of this IMP.

Linkages

Major Stormwater Technical Memorandum

Source Water Protection Technical Memorandum

References

CSA Group. (2019). *CSA W204:19 Flood resilient design of new residential communities.*

Province of Ontario. (2003). *Stormwater Management Planning and Design Manual.*

Conclusions

Stormwater catchments within the Township were reviewed, identifying locations and the corresponding state of stormwater management for minor stormwater collection and water quality treatment of the effluent.

Based on these examinations, the existing minor storm management features generally remain viable. Obvious exceptions are found in the oldest settlement areas, primarily

Odessa and Bath, as the original development did not provide adequate drainage and stormwater collection and treatment. Where it does exist, adequate levels of service for treatment are provided based on the standards in place when the systems were constructed. However, as new regulations for retrofit and replacement of minor systems are implemented, modern stormwater quality improvements must be considered both in Township-owned minor systems or minor systems that receive our stormwater.

The potential for adding minor stormwater collection and treatment for those catchments within the Township that were developed prior to the current stormwater quality and quantity guidelines is limited by site constraints and will need to be examined on a case-by-case basis when street rehabilitation efforts are undertaken. In many cases these evaluations will be more effective if a catchment or sub-catchment area wide analysis is completed in advance. This approach will result in a systematic approach that can be extended over time when conditions are appropriate.

Recommendations

It is recommended that higher priority be provided to those projects that have potential impacts to public safety and/or significant property damage.

It is recommended that the scope of each Township road and facility rehabilitation project include a review of the existing stormwater system, with a view to upgrading the stormwater system to meet current MECP quality and quantity control requirements, subject to financial feasibility when upgrades are not mandatory.

It is recommended that the Township review all overland flow routes and storm piping that extend beyond road allowances and confirm the status of ownership and/or easements. Where easement rights or ownership are not in place, an effort should be made to obtain operational and maintenance rights of the storm system.

It is recommended that a work plan[1] be established to address the known drainage deficiencies/concerns listed in this memorandum and summarized as follows:

1. Harvard Place and Dinosaur Park drainage improvements
2. Mortensen Drive swale inlet and sewer extension at civic address 84
3. Willie Pratt Park drainage improvements
4. 2 Quinte Avenue local drainage improvement, boulevard drainage
5. Church Street south of Main Street – Bath drainage rehabilitation
6. Lodge Street, including improvements to Second Street at Queen Street
7. Factory Lane outlet improvements
8. Raglan Street drainage improvements
9. 155 Main Street – Bath drainage easement and outlet improvements
10. Odessa Drainage Study, Factory Street to Millhaven Creek

[1] The scope of the list of projects varies from small to relatively large projects.

11. Main Street – Odessa inlet improvements, opportunities to drain side streets, possible outlets for other project areas, ditch improvements east of County Road 6
12. Potter Drive, South Street, Creighton Drive improvements
13. Centre Street, Gore Street, Elgin Street drainage improvements, possibly tied to project 10 in this list
14. West Street drainage improvements
15. William Street
16. Battery Street, Bridge Street, Emma Street, Cross Street rehabilitation (note: this project is underway, slated for completion in 2024)
17. Mill Street swale improvements south of former roads garage
18. Evaluation of major storm outlet at cross culvert near 18 Amherst Drive
19. Evaluation of Penny Lane entrance major storm concern
20. Evaluation of Keitha Drive major storm concern

IMP Technical Memorandum: Major Stormwater System

Asset Class: Stormwater

Objective: The purpose of this technical memorandum is to present an overview of the examined major stormwater system and identify potential shortcomings within the Township's major stormwater system, for the horizon of the IMP. Understanding the operational and functional requirements of the system will help ensure that any required upgrades are implemented to help minimize potential risks of both significant property damage and loss of life.

Background

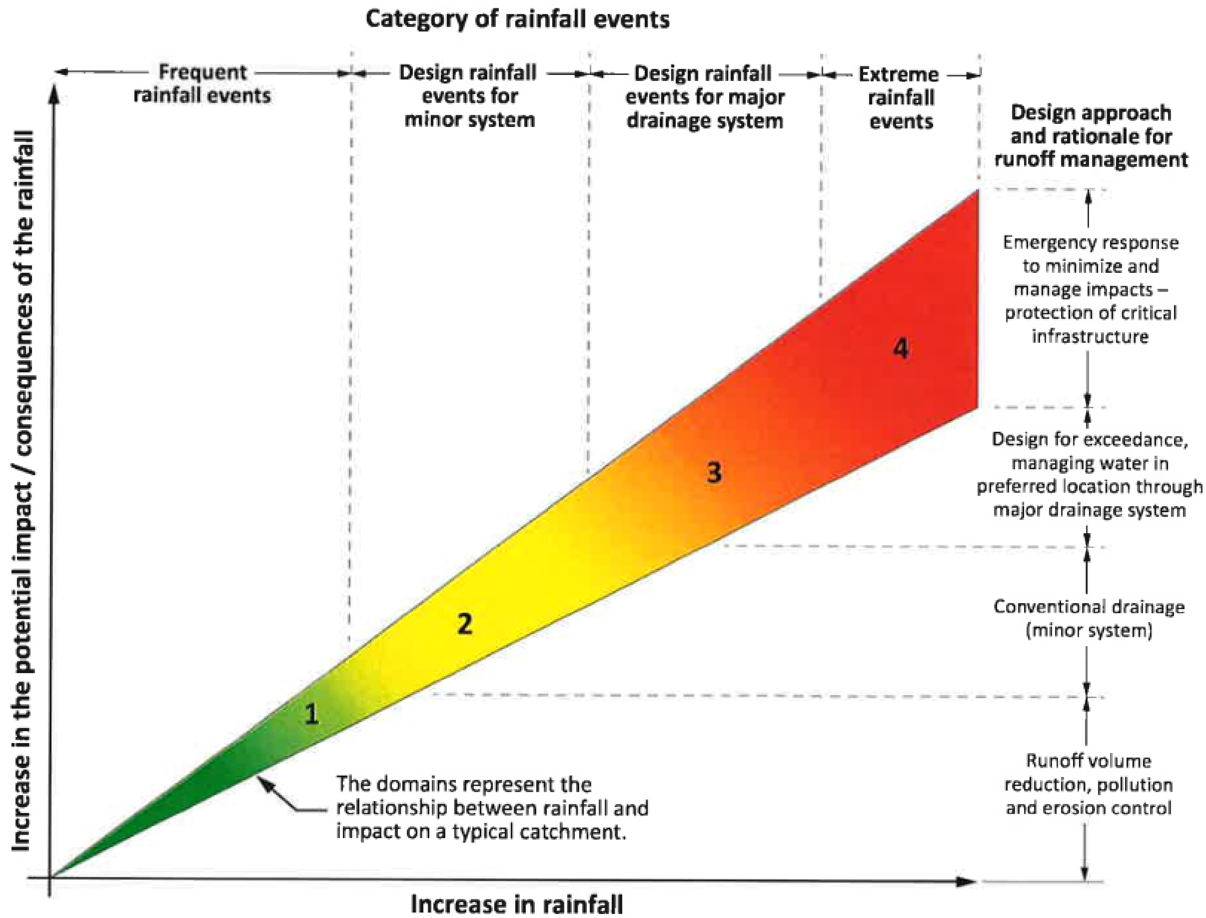
Stormwater management deals with the implications of surface water runoff generated from precipitation, primarily from active sources like rainfall or snowfall, but also from snowmelt. As changes to land use alter the surface features of the Township, the nature of runoff changes. It is the goal of stormwater management to ensure that these development changes minimize the effects of the change in runoff on the natural environment and minimize the risk to life and property.

As shown in Figure 1 Types of Rainfall Events, taken from CSA W204:19 (CSA Group, 2019), a recent flood resiliency design standard, the four rainfall event types are:

- Frequent
- Minor storm
- Major storm
- Extreme

They generally represent greater rainfall intensities as well as greater rainfall amounts and present increasing short-term risk to lives, private property, and infrastructure (natural and constructed).

In general terms, the minor stormwater system addresses frequent and minor storm events, focusing on soil erosion and the water quality of the released runoff; while the major system addresses major storms and extreme rainfall through management of flood risk. This memorandum addresses the major stormwater system, as well as including information on the Township's municipal drains.



Note: *Adapted from CIRIA (2014).*

Figure 1 Types of Rainfall Events

Major Storm Events

A major storm event is a significant rainfall event between the design limit of the minor storm and the one-in-100-year storm event. The major storm exceeds the capacity of the minor stormwater system and therefore drains primarily overland across the catchment area toward the outlet. For flood management, a major flow route is designed into land development to ensure that all building openings remain safely above the one-in-100-year design flood elevations, that maximum depths of water ponding are limited, and that the major storm is contained within public land as much as possible. The road right-of-way is the primary component of the major storm route, with ditches and channels used where necessary. In some isolated instances, the major storm is piped.

A general design requirement for major system design is that peak flows released during the design major storm event must match the theoretical pre-development flows during the same design storm event. This is to ensure that downstream natural and constructed infrastructure and landowners are not negatively affected. The current upper limit for design peak flow control is the one-in-100-year storm event. This design requirement generally does not apply where the receiving waterbody is so large in comparison to the drainage area that the receiving body would remain unaffected by the changes in surface runoff of the drainage area. This is typical for drainage areas that drain directly to Lake Ontario without entering a natural drainage channel first.

A critical feature of the storage and release systems is that the system must safely operate should the primary outlet become blocked. Typically, this is ensured through the requirement of freeboard for the storage structure above the one-in-100-year maximum fill level, and an emergency outlet which only functions once the fill level is exceeded.

Road cross culverts in urban areas are part of the major storm system. For local roads, cross culverts are typically designed for much more frequent storms than the one-in-100-year event. They are usually sized for the one-in-20-year to the one-in-50-year events, depending on the importance of the roadway, i.e., collectors and arterial roadways. If the storm event runoff exceeds the cross culvert capacity, the runoff that cannot be passed by the culvert will find the most hydraulically-convenient pathway, including over the surface of the road.

Extreme Storm Events

An extreme storm event is a massive storm event that exceeds the one-in-100-year storm event. Generally, no typical municipal infrastructure is specifically designed for these extreme conditions, as there is no upper limit to an extreme storm event. However, the design of the major system has requirements in place to help withstand extreme events while still minimizing risk to health and property. This feature is known as resilience, and it is important as the Township considers the risks associated with climate change. As previously discussed, stormwater management facilities are designed with overflows to safely release runoff beyond the one-in-100-year design limit. Major flow routes are designed primarily as open channel flow, meaning that flow greater than the one-in-100-year design flow can be accommodated but with higher flow depths and velocities. It is a design philosophy goal that extreme storm events should pass through the Township with limited damage to natural and constructed infrastructure.

Recently, the Township has been requiring that stormwater facilities size their emergency outflows and downstream outlet channels to accommodate a peak flow 20% larger than the one-in-100-year flow. These accommodation costs are marginal when included in initial construction of the facilities.

There is no design requirement to match pre-development and post-development flow rate for extreme storm events. However, the major storm system will still need to function during these events and will help minimize damage and help reduce risk of catastrophic loss. All major storm routes should include a resilient outlet. This might be a road right-of-way, additional clear natural space adjacent to a waterway, or simply an oversized outlet swale.

The major stormwater system generally serves the urban areas of the Township.

Assumptions

The following assumptions were made for this memorandum:

- Individual site stormwater systems are not included
- Municipal drain systems are discussed in this memorandum as they assist with Township drainage but not included in infrastructure discussion
- Flooding and flood risk areas associated with coastal erosion (e.g., the south shore of Amherst Island) are not included
- Drainage systems that exist due to a roadway redirecting surface water flow, typically encountered in rural areas are not included
- Natural and constructed infrastructure within the boundaries of natural watercourses (bridges, dams, etc.) are not included, with the exception of the dams along Millhaven Creek

Methodology

Stormwater management, particularly for major and extreme events, is a risk management endeavour. Stormwater inputs are not particularly predictable, and the resultant flows are not measured. While statistical methods and regional rainfall records have increased confidence in designed features, the reality is that floods are hard to predict, and the best practice is risk management coupled with resilient design.

This report is based on quantitative discussions concerning major stormwater features of overland flow routes and end-of-pipe flood control measures, based on geographic location, existing ground surface topology, local site conditions, review of design documentation, and maintenance records.

This memorandum will briefly discuss stormwater policies that have broad impacts.

Analysis

Geography

From a major and extreme storm perspective, Loyalist Township is fortunate. While its urban centres were formed alongside natural water features (Lake Ontario, Bath and Millhaven Creeks), the topography has made flood risk lower than in other municipalities. Most of the Township lands adjacent to Lake Ontario rise quickly above historical flood levels, keeping initial settlements away from flood-risk lands. Much of the Township resides on relatively shallow soils over shallow bedrock, which encourages existing watercourses to be stable in their courses without meanders and large alluvial floodplains.

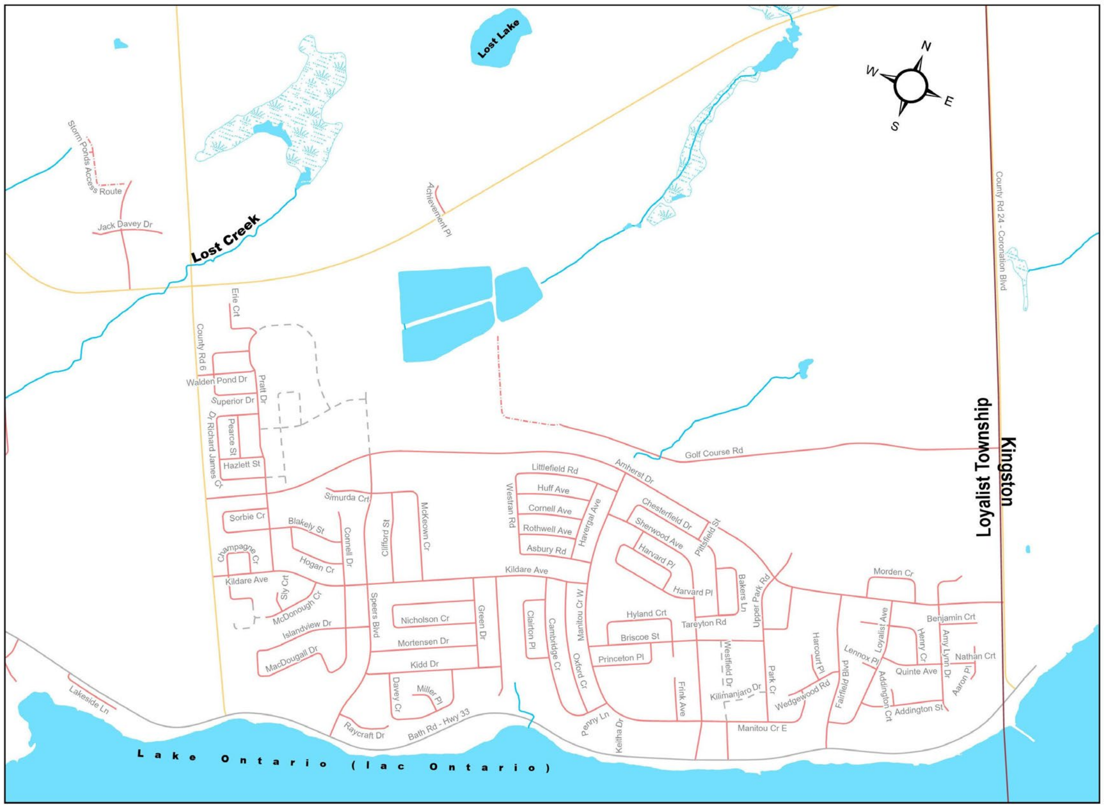


Figure 2 Amherstview natural watercourses

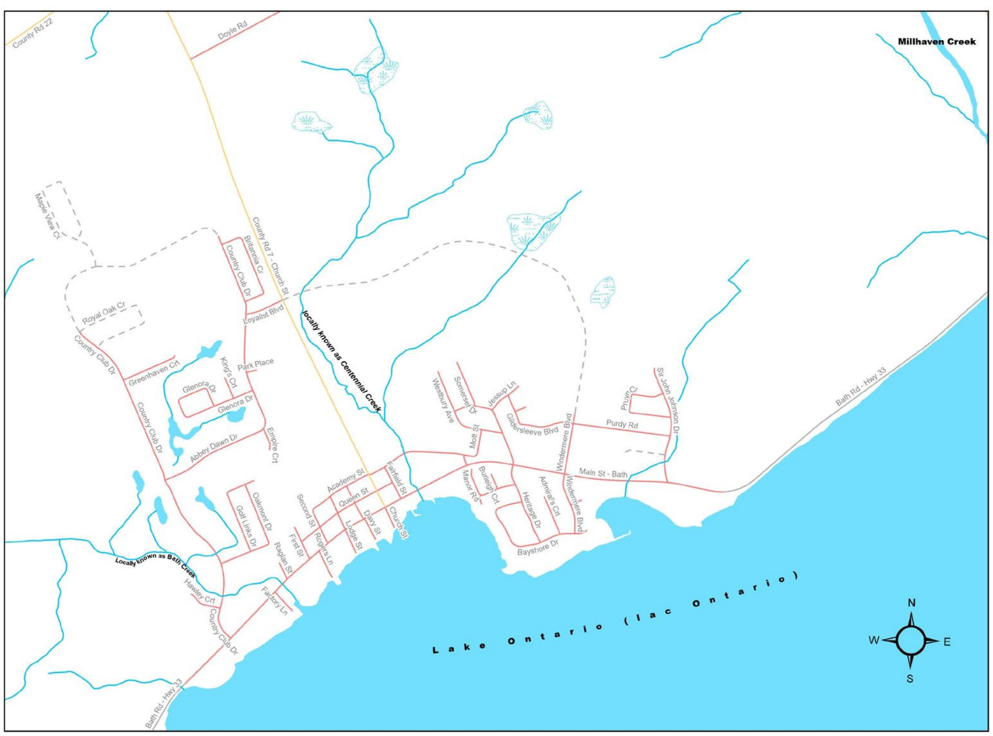


Figure 3 Bath natural watercourses

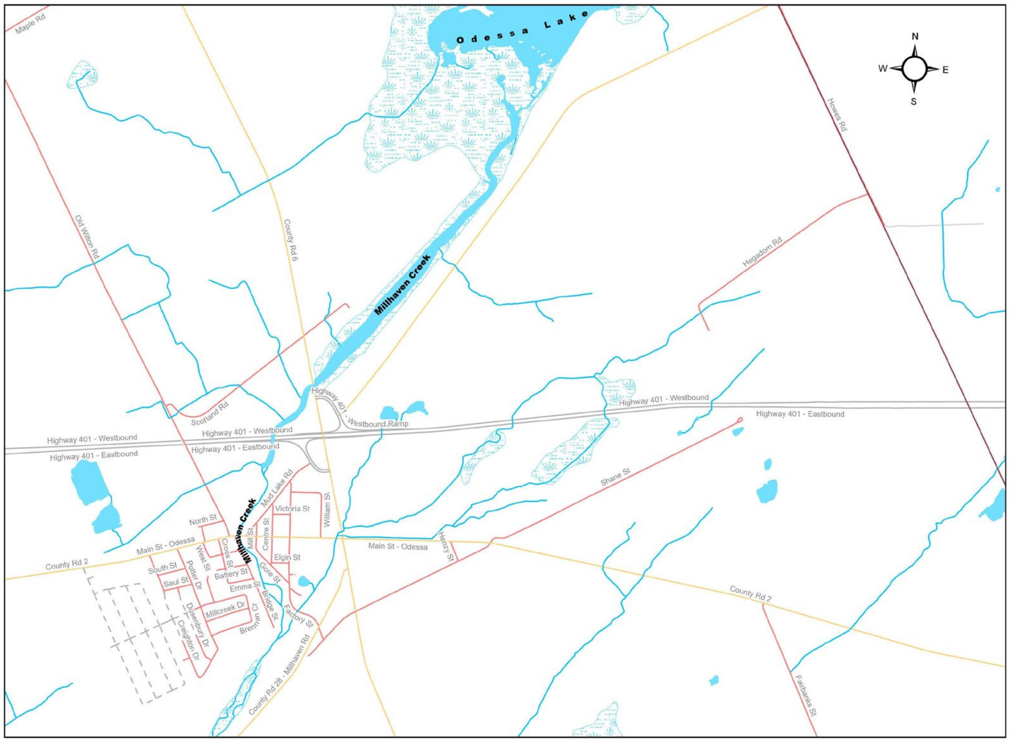


Figure 4 Odessa natural watercourses

The areas of greatest concerns are those that are adjacent to the watercourses that drain the interior of the Township to their major outlets. The lands here tend be broader, rising slowly from the slow, shallow creeks, with wetlands, marshes, and other poorly draining areas. Fortunately, development adjacent to these much of these areas was avoided during initial rural settlements and eventually restricted with acknowledgement of the inherent flood risk and environmental sensitivity of these areas. An exception is some of the historic development along Millhaven Creek between Odessa and County Road 4. There are existing developed areas that would not be permitted under current policy and regulations.

Stormwater Management Ponds

Stormwater management ponds (SWMP) have two primary functions: major and minor flow quantity control, and water quality control. In major storm events, the stormwater pond retains peak flow and stores the runoff for gradual and controlled discharge, with the peak flow rate from the pond less than or equal to the calculated pre-development flow rate. In some instances, the permitted peak flow rate is further limited by the capacity of downstream major stormwater infrastructure. These restrictions are placed on the designers of the stormwater system to minimize negative downstream effects, especially flooding. The pond is sized according to provincial design standards, which have evolved over time.

Under extreme flow conditions, these ponds will be full – the controlling outlet restricting the flow to some degree (more than the one-in-100-year design flow rate, but not the full uncontrolled extreme flow rate) – but the separate overflow channel will be carrying the additional flow that the major flow outlet cannot. As there is no upper limit to an extreme event, there is no known maximum flow rate for which to design. Typical design requirements for the emergency outlet are to carry the entire one-in-100-year design controlled rate, which helps ensure that the behaviour of the pond structure is predicable under an extreme event. A one-in-200-year storm event in Loyalist Township is approximately 25% larger than the design one-in-100-year storm event, so designing the overflow outlet for 100% of the one-in-100-year storm event gives a broad safety margin. For the outlet channel, which typically carries discharge from the normal flow outlet and the overflow outlet, historical design practice was to design the outlet channel for the one-in-100-year flow plus a freeboard allowance (vertical distance from the design water level to the top of the channel) to cover extreme events. More recently, the Township has asked that the overflow and outlet channel be designed for 125% of the one-in-100-year flow rate, as a recognition of the expected effects of climate change on extreme rainfall events.

Concerns

With respect to existing stormwater maintenance ponds, there are no significant flood control issues noted in the maintenance records that raise concern for major storm components, except as noted below. Review of available design documentation and MECP approvals show that the design criteria for the facilities remain compatible with current guidelines for flood control measures with respect to major storms. However, this does not mean there are no concerns regarding the ponds themselves, as stormwater management ponds also serve an important water quality function. These functions and points of concern are discussed in the separate minor stormwater system technical memorandum.

For extreme events, i.e., rainfall events exceeding the one-in-100-year rainfall, the concern will be for the pond inlet channels and the overflows and channels from the stormwater ponds to the overland flow routes/outlets. In addition to the rare storm events beyond the one-in-100-year storm event, climate change will increase the strength of the one-in-100-year storm, possibly to as much the equivalent to the 1 one-in-200-year storm event currently. This represents an estimated 25% increase in peak flow. A storm pond will perform as expected up to the 1:100 storm event. As additional flow enters the pond in excess of the 1:100 flow rate limit, the pond overflows will release that amount without flow rate control. The result of this extreme event will be a flow rate increase, but less than the 25% increase in rainfall.

In a simplified numerical example, if the pre-development flow limit for the one-in-100-year storm is 100 L/s and the estimated unrestricted post-development peak flow rate was 150 L/s, the storm pond would control the peak release to match the pre-development flow of 100 L/s. A 25% increase in peak rainfall would in this case likely lead to a pre-development flow rate of 125 L/s and an unrestricted flow peak rate of 185 L/s. The pond will continue to control the first 150 L/s down to 100 L/s, but 35 L/s will likely overflow from the pond. Thus a 25% rainfall increase would result in 135 L/s post-development flow in comparison to a 125 L/s expected pre-development flow, an increase of 8%.

Opportunities

There are a multitude of existing developed catchments with the Township that do not have flood control features. They vary in size from a single lot to tens of hectares. There are primarily two reasons why these areas were not developed with flood protection: they drain directly to Lake Ontario, or they were developed prior to provincial regulations on flood control measures. Those areas that discharge to Lake Ontario have not required quantity control, as the lake will be unaffected in the changes in peak discharge from these areas which constitute a tiny portion of the Lake's total catchment area. For those areas that currently drain to water courses like Millhaven Creek or Bath Creek and do not have flood control features to ensure pre- and post-development peak flow is controlled, it may be possible to implement some measure of flood control. In these previously developed areas, it is typically difficult to locate sufficient space to permit the construction of a stormwater pond, due to lack of available open land, insufficient elevation between the development and the high-water level of the receiving watercourse, or other site constraints.

Table 1 Largest developed catchment areas in Loyalist Township discharging to water bodies other than Lake Ontario

Watershed description	Receiver	Land use	Outlet diameter (mm)	Catchment area (ha)
Speers Boulevard outfall	MTO, Highway 33	urban	1200	56.57
Parkside stormwater management pond	MTO, Highway 33	urban	900	33.4
Penny Lane outfall	MTO, Highway 33	urban	600	8.15
Jordyn's Landing outfall	MTO, Highway 33	urban	450	5.11
Lakeside Phase 3 Stage 5	MTO, Highway 33	urban	300	5
Lakeside Phase 3 Stage 5	MTO, Highway 33	urban	300	5
Lakeside stormwater management pond	MTO, Highway 33	urban	900	5
Sherwood Avenue	MTO, Highway 33	urban	500	4.51
Main Street – Odessa west of creek	Millhaven Creek via County outlet	urban	675	4.5
Factory Street	Millhaven Creek tributary	semi-urban	525	4.3

Major Flow Routes

Major flow routes are the overland pathways that the major or extreme storm will travel to get to the outlet. By far the most common intentional route is a road network. Most houses and buildings are constructed above the roadway, with either storm sewers below the road or ditches along either side as the minor system. When the minor system overflows during a major or extreme event, the ditches flood and catchbasins can’t accept any more water. The additional flow will travel over the roadway, following the designed route to the outlet. An open channel can take the overland flow, should the design be to move this flow off the roadway due to a steep downhill road section, a significant intersection or other geometric road issue; or simply to move the overland flow from the road network to an open channel, leading to the stormwater management pond for detention storage.

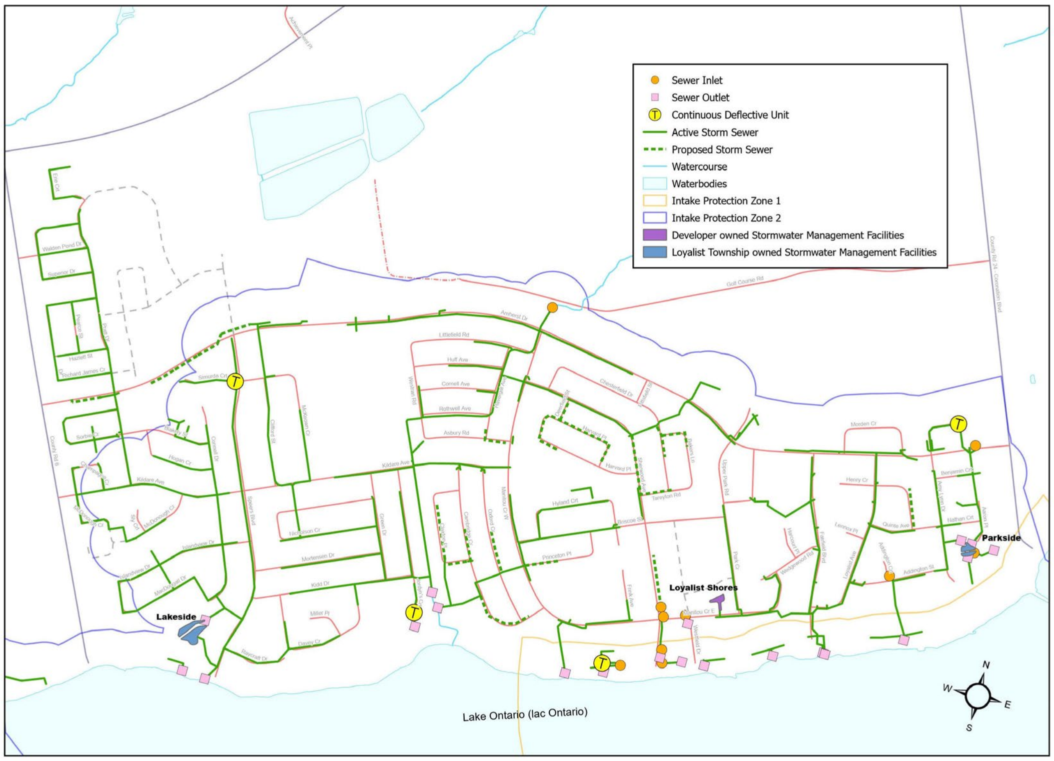


Figure 5 Amherstview sewer outlets

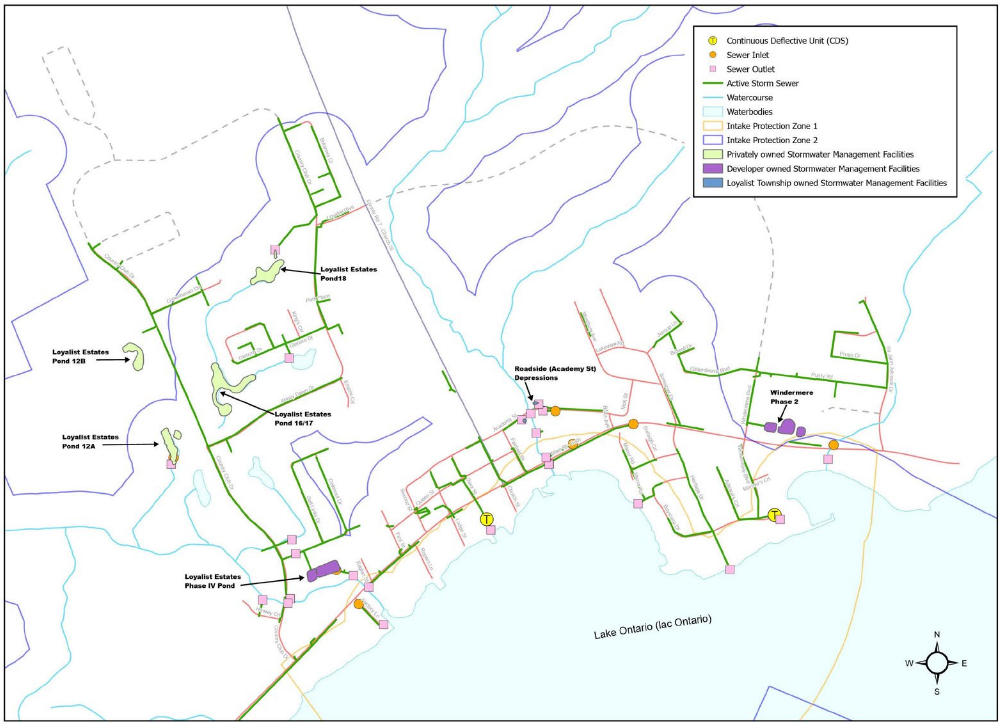


Figure 6 Bath sewer outlets

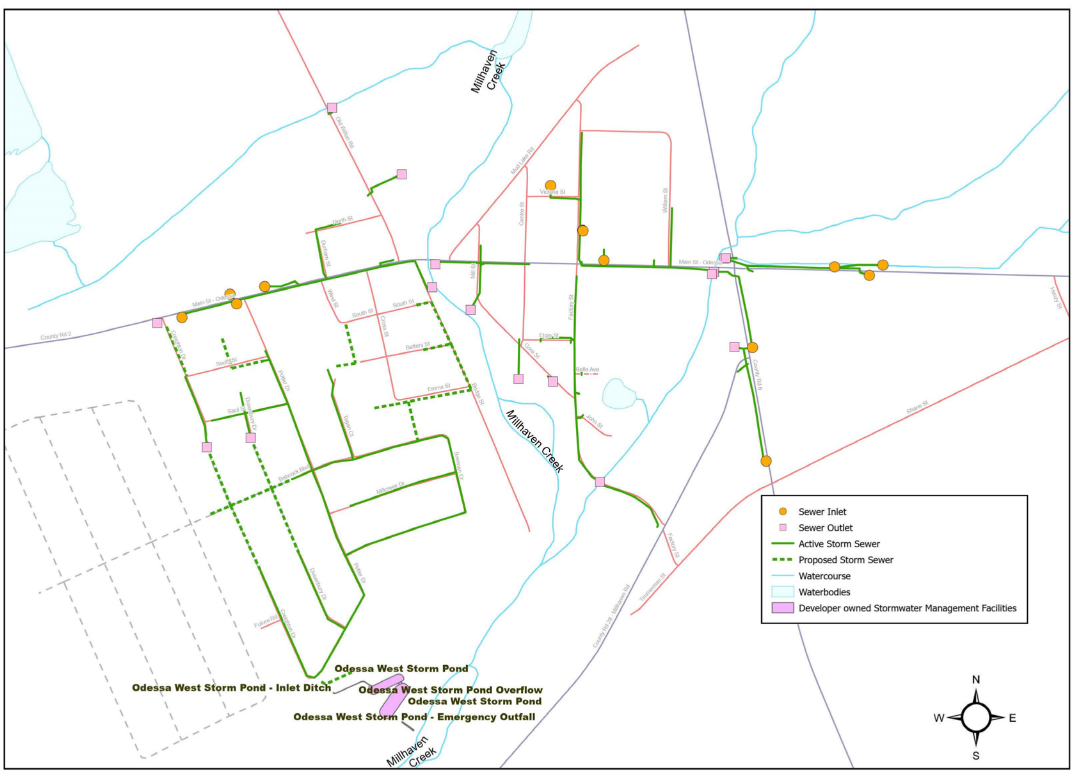


Figure 7 Odessa storm outlets

Concerns

Individual major flow routes are nominally discussed in individual development documentation, primarily addressed in individual stormwater management reports. The following are major storm routes/portions of same that warrant discussion and, potentially, measures to address:

Outlet from Parkside Subdivision Stormwater Management Facility

Concerns regarding this outlet were submitted by M. Latham of 294 Coronation Boulevard, Amherstview, asking that this major storm outlet be converted from an open channel to a closed culvert, due to negative effects associated with the vegetation in the open channel.

The portion of the major flow channel in question is an 80m open channel that extends from the stormwater management facility via the downstream end of the 900mm outfall pipe, to Coronation Boulevard in a dedicated easement. The roadside ditch of Coronation Boulevard continues south toward Bath Road/Highway 33 where it joins the roadside drainage system on the north side of Bath Road/Highway 33, which includes a storm sewer system; then passes below the highway before discharging into Lake Ontario.

Figure 8 Open channel drainage behind 294 Coronation Boulevard, Amherstview, looking south

There are several factors involved in this location:

- The open channel initially collects the discharge from the SWMP from the existing (900 mm) outfall pipe and emergency overflow from the pond, as well as the overland flow collected along the east side of the Parkside subdivision (rear side of lots along west side of Coronation Boulevard) that does not flow into the stormwater management pond
- After the channel joins Coronation Boulevard, the total flow also includes waterflow draining in open ditches alongside Coronation Boulevard
- There is communication infrastructure including a Bell pedestal that intersects the existing channel just prior to discharging into the Coronation Boulevard ditch. This infrastructure is just below the invert of the existing channel.
- Land immediately adjacent on the south side of the channel leading to Coronation Boulevard is privately owned.

Possible responses to this major storm route include, but are not limited to:

- Do nothing
- Extend the outfall storm sewer all the way to Coronation Boulevard
- Further extend the storm sewer to the Bath Road/Highway 33 roadside ditch
- Review and potentially increase the level of maintenance of the vegetation in the outflow channel leading to Coronation Boulevard.

The “do nothing” option fails to address the concern.

Extending the existing outflow to Coronation Boulevard does not address the additional flow captured from the east side of the Parkside Subdivision. An inlet structure at the same invert at the location of the existing outflow would need to be constructed as part of this option. This sewer extension would need to remain at the same invert elevation as the existing channel due to the communication infrastructure at the Coronation Boulevard end, unless that private infrastructure is relocated. Otherwise, a significant amount of bedrock would need to be removed to lower the pipe. Depending on the distance it is lowered, backfill would be required to cover the sewer, resulting in a linear berm over the sewer. Finally, the sewer extension would need to be larger than the existing pipe outfall, as the channel drains more than just the facility outfall. This channel drains the major flow from the entire subdivision; therefore, it would need to be able to accommodate extreme storms in excess of the one-in-100-year storm design of the stormwater management pond. Open channels can fill deeper than normal to accommodate this flow and significantly increase their capacity with a minor increase in depth. A sewer is a closed pipe and as such its capacity has an upper limit. Open channels are preferred for major flow routes.

The bypass for the Bath Road/Highway 33 storm system is to overflow the highway itself. While the new storm system at Bath Road/Highway 33 has a significant capacity, there is always the possibility of an overflow either due to severe flow or pipe blockage. Therefore, a bypass is required.

Should a sewer extension be used, any major flow that surpasses the capacity of the sewer extension would need an overland flow route to Coronation Boulevard. After the installation of a new sewer extension to Coronation Boulevard is complete, an overland flow route to Coronation Boulevard is still required. If the sewer extension is not lowered sufficiently, the covering backfill berm would be the south side of the overland flow route which exist to the north of the existing easement, requiring an expansion of the easement itself to the north.

The extension of the outfall sewer to Coronation Boulevard is a substantial capital infrastructure project, with an associated substantial cost, that would result in very limited benefit.

The problem as stated does not appear related to the portion of the major flow route along Coronation Boulevard. As such, extending a sewer in this section would be unnecessary.

Reviewing and potentially increasing maintenance of the channel vegetation appears to be the best way to directly address the effects of that vegetation, without the significant expense of a major infrastructure initiative requiring substantial relocation and design of private communications assets.

It is recommended that the Township not install any new underground outlet sewer for the Parkside outlet at this location, and to review the level of maintenance with respect to vegetation growth along the banks.

Outlet from Purdy Road Storm Sewer

The storm sewer at Purdy Road is an oversized storm sewer designed to be the underground storage necessary to manage the post-development flow to pre-development flow rates. Storm sewer systems are normally designed to pass the minor storm flows, but for this development, the storm sewer outlet was sized to match pre-development flow rates and the oversized storm sewer was designed store the excess flow until it could be released without increasing the peak flow rate. However, this system was designed with the one-in-100-year peak flow as its design condition, so extreme events or a pipe blockage would cause this system to overflow. The overland flow route crosses Purdy Road in a location where there is known to be a sag in the vertical alignment of the road, near civic numbers 133 and 135 Purdy Road, approximately one half-block west of Sir John Johnson Drive.

This represents a potential risk for the local residents. Although many major storm paths cross municipal streets, the concern highlighted here is that the flow path is close to residential properties. It is recommended that the Township continue to monitor the surface features of this overland flow route to help ensure it continues to be unobstructed. More modern design approaches avoid this problem through the placement of major flow crossings with downstream public walkways, parks, or other open areas with good access to ensure the major flow can move downstream efficiently. Ideally the municipality would negotiate easement rights for this outlet and modify the outlet as necessary, so that it is perpetually able to perform as a major outlet overflow should the need arise.

It is recommended that the Township negotiate storm water easement rights with applicable landowners of the Purdy Road major overland flow outlet.

In the meantime, recent modifications to Purdy Road in the 2022 construction of Aura By The Lake Phase 1 has reduced the catchment area size on the west side by introducing a new storm sewer system.

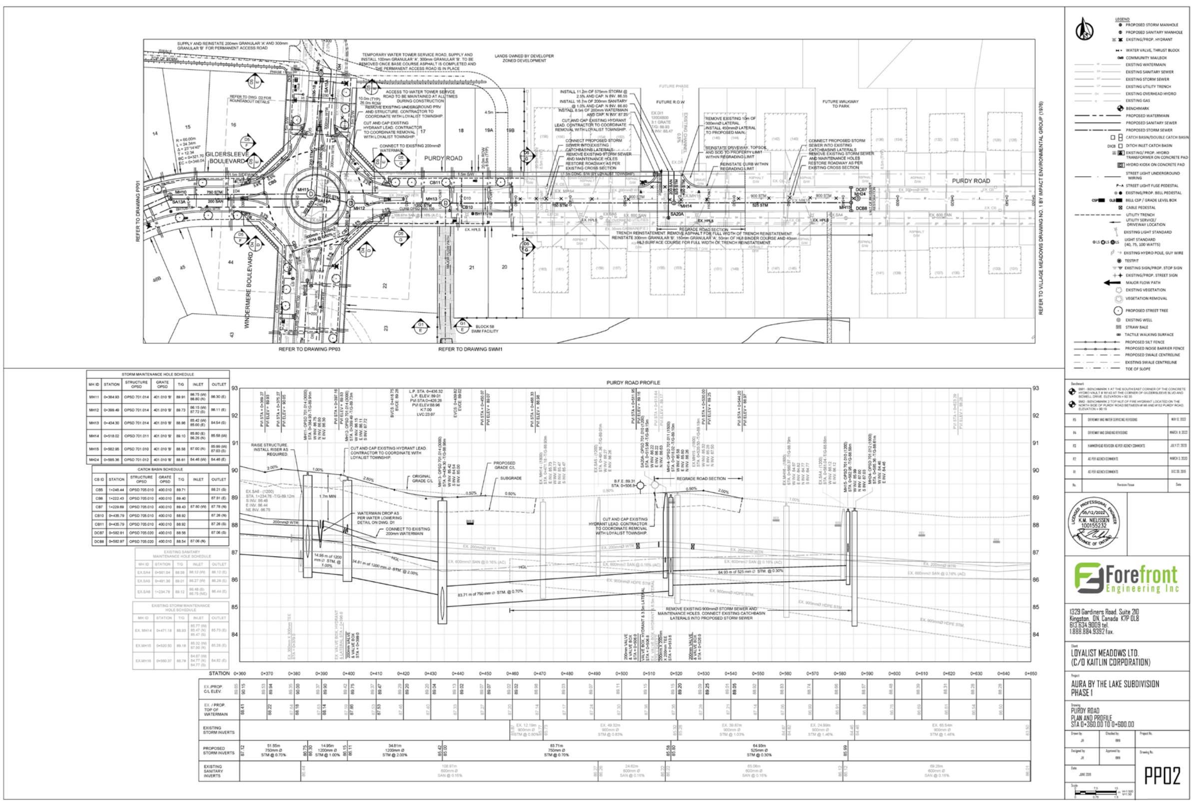


Figure 9 Aura by the Lake Phase 1 Plan & Profile

While not eliminating the potential for flooding in an extreme event, this modification does reduce the potential for flooding. When finalizing grading for future phases of Aura By The Lake, north of Purdy Road and west of Briscoe Park, final lot grading should continue to reduce the catchment area of the existing outlet swale.

Lack of Stormwater Treatment – Central Amherstview

All underground storm systems constructed prior to the mid 1990s are deficient with respect to the level of storm water treatment provided. The largest area in this category is a portion of Amherstview roughly defined as the area east of Speers Boulevard and west of Sherwood Avenue. The catchment area also includes runoff from lands north of the Canadian National Railway right-of-way. The catchment area outlets through a large storm sewer in Lakeview Park near the sewage pumping station. This system was constructed in 1974, prior to the implementation of stormwater quality criteria for storm systems. As such, there is no opportunity within this system to treat storm water, apart from the passage of stormwater through grass swales in neighborhoods where swales exist. The only opportunity for large-scale treatment of this catchment area would be to develop a stormwater treatment facility at this site. The area immediately adjacent to Bath Road/Highway 33 was formerly a natural wetland, filled in during the development stages of the community. This location is ideal for the eventual development of a treatment facility that would facilitate sedimentation.

Under current regulations, quality control is not a factor for this outfall. The site may not be large enough to fully benefit from a properly sized stormwater management facility, but it is large enough to accomplish a higher level of treatment at a reasonable cost compared to other alternatives. Therefore, it is recommended that the area within Lakeview Park south of the sewage pump station, be reserved as open space for the future development of a stormwater management facility.

Nicholson Point

Nicholson Point is an area of residential development on the waterfront side of a rural road, adjacent to Lake Ontario. The land on the interior side of the rural road is controlled by a trust that prevents development. As such, this land retains its undeveloped nature, although the natural forest canopy and undergrowth will slowly change over time. Maintenance of the health of this wooded area is a responsibility of the trust.

Drainage of the undeveloped area follows surface contours and ephemeral channels away from the interior and toward the roadway. Currently, there are no cross culverts under Nicholson Point Road. Consequently, during major and extreme storm events the resulting ponding on the upper side eventually overflows the roadway to find a path(s) to Lake Ontario. There are no established major flow paths from the road to the Lake.

Due to the nature and history of the development of this area, sufficient stormwater infrastructure, or the land reserves for such infrastructure, do not exist.

The controlled nature of the lands draining toward this area reduces the flood risk by limiting the potential volume of storm runoff.

Should sufficient land reserves or easements become available, the Township could consider the installation of cross-culverts and major storm channels to guide drainage and major storm flow channels directly to Lake Ontario.

It is recommended that the Township maintain a standing offer to cooperatively work with individual(s) who can provide hydraulically suitable stormwater outlets for the Nicholson Point area.

Limitations

The major flow system focuses on those areas within the developed portions of Loyalist Township, specifically recognizing areas of concentrated stormwater flow that represents a flooding risk.

Millhaven Creek Flooding Issues, Highway 401 to County Road 4

Millhaven Creek has a basin size of approximately 179 km^2. Most of the basin area is upstream of Odessa. For the section of the creek in this discussion, the creek bed is a relatively flat limestone bedrock plain. Downstream of Odessa, the creek is flanked by historical housing, some close to the creek.

There is a flow control dam located just north of Highway 401, and a small, currently uncontrolled waterfall and dam located at the Babcock Mill site within Odessa. A dam previously controlling flow adjacent to the Mill site was deemed unsafe and has not been operated for several years.

Downstream from the waterfalls the creek is prone to flooding, primarily due to ice jams and blockages caused by vegetation, particularly during high flow events.

Major flow in the creek responds on a schedule dictated by the whole Millhaven Creek basin, and as such, usually differs from when a major storm impacts the immediate area surrounding Odessa.

Older flood mapping completed by Cataraqui Conservation indicates that the one-in-100-year flood corridor includes much of the Bridge Street corridor.

In the section of Millhaven Creek between Main Street – Odessa and the former Babcock Mill Dam, the creek has experienced flooding on numerous occasions that has affected property and infrastructure.

This section of the creek experiences localized ice jams which are suspected to be more restrictive due to the build-up of frazil ice. Frazil ice forms under specific conditions that exist in this shallow section of Millhaven Creek when extremely cold air conditions are prevalent.

Limitations on Frazil Ice Project Implementation

The Township has previously looked at solutions for this problem but there are few examples where projects have been initiated to address similar concerns.

The situation is complicated by the limited depth of water that can be safely maintained in this section of the creek, as well as heritage aspects of the Babcock Mill site and dam.

Properties adjacent to this section of Millhaven Creek require flood proofing. This is a complicated option, as the properties themselves are within the floodplain; as such permanent elevation changes for many features are not allowed due to floodplain regulations.

It is recommended that Loyalist Township continue to look for solutions that would minimize flooding events along the stretch of Millhaven Creek between Main Street – Odessa and Babcock Mill and make efficient use of public investment.

Millhaven Creek Dams

There are three dams along Millhaven Creek in Loyalist Township, each located in the Odessa community:

- Wilton Road Dam, on the east side of the bridge crossing the Creek at County Road 6
- Potter's Dam, immediately north of Main Street – Odessa
- Babcock Mill Dam, adjacent to Babcock Mill immediately upstream of the waterfalls

These dams artificially control the flow of the Creek, both to provide an historic source of water power and to maintain a steady flow of water through the community of Odessa. All the dams were designed to retain minor increases in water levels and were restricted in that function by the relatively flat topography in the vicinity of Odessa. Over time the distinct purpose for each has evolved, and their respective condition varies significantly.

The Wilton Road Dam is a relatively modern reinforced concrete structure constructed in the 1960s. The presence of this dam creates Mud Lake. In prior years the Wilton Road dam provided adequate supply for the original Odessa water treatment plant and adequate dilution for the former Odessa sewage treatment facility, neither of which operate any longer. Beyond aesthetics, the dam's remaining function is flow moderation in the downstream reaches of Millhaven Creek.

While the Wilton Road Dam is owned by Cataraqui Conservation, by agreement Loyalist Township partially funds operations and maintenance costs. Water levels are controlled by the conservation authority based on hydraulic forecasts and conditions.

Cataraqui Conservation commissioned a safety evaluation of the Wilton Road Dam (D.M. Wills Associates Limited, 2023). Results from this study have identified the need to address several safety deficiencies:

- Catwalk access safety concerns
- Cattail mat accumulation
- Public and operator safety
- North deck access
- Sluiceway gate design safety concerns

The consultant has advised that their recommended solutions to resolve these concerns come at a cost of approximately $533,700, with an additional $85,000 in suggested measures should the recommended prevention measures for cattail mat accumulation prove ineffective.

The Babcock Mill and Potter's Dams are owned by the Township.

Potter's Dam was a small control structure, and the structure has decomposed such that only a small portion of its foundation is recognizable. The dam has not retained a head of water for a few decades. While restoration of this structure would have a potential aesthetic benefit, it could also potentially mitigate benefit the frazil ice issue noted above by facilitating ice cover immediately upstream of the primary area where frazil ice formation is observed.

Specific replacement of this structure is not being recommended with the IMP.

Babcock Mill Dam consists of three distinct components. Some of the area is covered by a historical cultural designation which may restrain the options available for future site improvements including the existing dam.

The primary component is a reinforced concrete dam that no longer operates, and all stop logs have been removed for safety purposes. Upstream of the control dam are earthen dykes. On the east side of the dam the shoreline is configured to allow for the inlet works for the Babcock Mill while the west side resembles a typical natural stream bank. Earthworks line both sides of Millhaven Creek upstream from the control structure and are an extension of the dam structure. The earthworks are in poor condition and worthy of further structural assessment should the dam ever constrain a head of water again.

The Township commissioned an environmental assessment of the dam (G.D. Jewell Engineering Inc and WaterPlan Associates, 2011). The report suggested that under draft guidelines of the day, the dam would be classified as Low Hazard because expected damage downstream of the dam would be minimal were the dam's control to fail. Under this classification it is generally difficult to obtain funding from upper levels of government for a project to rehabilitate a dam.

After assessing the alternatives, the EA recommended that the control structure be fully decommissioned and removed. This EA is over ten years old and should be updated, especially since the cultural designation has been assigned to some components of the site. Other factors used in the evaluation may also have changed over time.

With the progress of time the Babcock Mill Dam becomes increasingly unsafe. Removal or stabilization of this structure must consider any heritage requirements, as well as impact on frazil ice formation immediately upstream of the structure.

Major Flow Hot Spots

The Township has experienced flooding of municipal road rights-of-way on frequent occasions at the locations listed below. These locations require monitoring, specialized maintenance procedures, and occasional road closures and/or appropriate signage based on conditions. Major alterations beyond life cycle replacements are not being planned at any of these locations:

- Emerald Forty-Foot Road, between Second and Third Concession Roads
- Peters Road, in the vicinity of the 90-degree bend, Lots 32 and 33
- Lucas Road, in the vicinity of Millhaven Creek. Lucas Road's profile must be kept sufficiently low immediately west of the bridge to maintain a major flow bypass of the bridge site, especially during periods of ice jam
- Bridge Street, from South Street southerly to below Babcock Mill Dam. With the dam's stop logs removed, this area is now primarily a flooding concern under certain ice conditions
- Parrott's Bay Lane, adjacent to civic address 171. Ensure minimum cover over culverts adjacent to this property to allow for major storm flow from Lost Creek. Culverts at this location were twinned in last few years. Higher flows in Lost Creek may have been influenced by beaver dams east of Lost Lake; these were removed in approximately 2019.

Municipal Drains

Municipal drains are created under the authority of the Drainage Act (Province of Ontario, 1990) and are not subject to Municipal Class EA requirements. The topic has been included here to complete the discussion on drainage infrastructure within the Township. For clarification the Township is only a minor landowner with respect to the ownership of the various municipal drains. Ownership is generally shared amongst the landowners that benefit from the drain.

Although the general objective of a municipal drain is the same as a storm sewer system, their implementation and funding is significantly different. A municipal drain is designed to move water in a safe manner across multiple properties. A municipality must sanction the implementation of the drain by municipal by-law. The municipality administers the construction of the system, future maintenance, and repairs. Costs for the drain may be recovered from those landowners benefiting from the drain. Although popular in agricultural areas such as southwestern Ontario, a municipal drain is sometimes considered a drainage tool of last resort in more developed locations.

Loyalist Township has four municipal drains on file.

The Hawley-Creighton and Charters Municipal Drains are in the southwest portion of the Township north of Bath. These drains have not been recently inspected and their general condition is unknown. The Charters Municipal Drain extends into the Town of Greater Napanee so any physical or administrative effort on this drain must be completed in conjunction with the Town, in accordance with Drainage Act requirements.

The Miller Drain is located on Amherst Island and services the south-central portion of the Island. The drain was last inspected around the year 2000. The drain continues to perform an important role near the active farmlands near the central portion of the Island, primarily west of Stella Forty-Foot Road.

The Edgewood Drain was constructed in 2018. It conveys surface water from the southeastern portion of the Amherstview West Secondary Plan area, being the lands bounded by Bath Road/Highway 33, County Road 6, Taylor-Kidd Boulevard/County Road 23, and Parrott’s Bay, through a new storm sewer under Edgewood Road to the outlet structure.

There is some concern of municipal liability where the drains have not been formally abandoned in accordance with the Drainage Act and damage occurs to private property because of insufficient maintenance. Sections 79-84 of the Drainage Act discusses these topics in detail. The Act is very prescriptive and should be consulted closely. Inspections of the drains are recommended. Based on no public involvement in at least three decades it is recommended that the Hawley-Creighton and Charters drains be reviewed for potential abandonment.

Operations staff have reported problems with the inlet structure of the Edgewood Drain.

The grates appear to be occasionally blocked by debris leading to local flooding upstream of the cross-culvert. Minor modifications to the inlet grates have been made, allowing for larger sticks and debris to enter the storm system than when the grates were first installed.

It is recommended that this location be monitored regularly and assessed for any further modifications. The balance of the Edgewood municipal drain is performing well.

It is recommended that, in in accordance with the Drainage Act:

- The Miller, Hawley-Creighton, and Charters municipal drains be inspected as soon as possible
- That Loyalist Township explore the possibility of abandoning the Hawley-Creighton and Charters Municipal Drains
- That operations staff address the inlet problems at Edgewood Drain as soon as possible.

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the major stormwater system in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). More frequent heatwaves and shorter winter ice road season due to warming may result in softening and rutting of roads (Swanson, Murphy, Temmer, & Scaletta, July 2021).
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and overland flow.

In general terms, climate change will increase the frequency of major and extreme events, but due to the natural landform of the Township and the of the inherent design safety built-in to major storm systems, the increase in risk of flood-related damage is within the Township is manageable.

Assessment of Alternatives

Stormwater infrastructure is essential to the functionality of the Township especially in the urban areas where land development constrains. The conditions of many of these proposed projects are controlled by government standards and regulations, limiting the opportunities to consider alternative approaches for implementation. However, industry standards and protocols have evolved to include best management practices with regards to the sourcing, use, and management of materials during construction projects in general. In addition to regulatory constraints are physical constraints including elevations, offsets to adjacent property boundaries, and the presence of underground utilities.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials with the general aim of reusing materials on-site when possible.
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternatives (low-carbon concrete, cross-laminated timber, alternative steel technologies, high density recycled plastic and composites etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020).

- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Implement storage solutions to capture excessive stormwater for onsite use as an alternative to using treated water (Rutgers University, n.d.)

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Increase drainage capacity (when possible) and the frequency of culvert debris clearing (IISD, 2021).
- Increase the use of permeable or semi-permeable pavements in urban areas to better manage more intense storms (IISD, 2021).
- Increase culvert capacities to manage increased precipitation and prevent washouts (IISD, 2021).
- Consider the potential of increased water levels in roadside ditches when regrading and adjusting road elevations.
- Use geotextiles to improve stability and reduce settlement of roadways (IISD, 2021).
- At the planning phase, account for space required for increased road right of ways, ditches, and channels to accommodate increased stormwater run-off.
- Increase/improve natural infrastructure such as vegetative buffers to mitigate ditch and channel erosion caused by major and extreme storm events.

Financial

Stormwater Quality Improvements

New developments have included stormwater treatment for the past few decades. Older areas require remedial improvements to meet provincial guidelines. It is recommended that as municipal roads and facilities streets are reconstructed, these locations be upgraded for improved stormwater treatment. This provision will add incremental costs for most projects, with actual costs based on detailed design.

These projects are not likely eligible for DC funding.

Millhaven Dam Infrastructure

Recent Loyalist Township capital budgets have not included budgets for dam improvements, and the structures are not currently included in the Township’s asset management program. This is likely because Cataraqui Conservation has administered the operations and maintenance of the dam.

These projects are not likely eligible for DC funding and due to the low risk safety evaluation are low priorities for provincial funding.

In 2022-23 the Cataraqui Conservation commissioned a safety study of the Wilton Road Dam, to which Loyalist Township contributed financially as the beneficiary of the control structure. Results from this study have identified the need to address several safety deficiencies:

- Catwalk access safety concerns
- Cattail mat accumulation
- Public and operator safety
- North deck access
- Sluiceway gate design safety concerns

The consultant has advised that their recommended solutions to resolve these concerns come at a cost of approximately $533,700, with an additional $85,000 in suggested measures should the recommended prevention measures for cattail mat accumulation prove ineffective. This also provides a foundation for future capital maintenance projects at the dam.

Lakeview Park Stormwater Treatment Facility

This improvement will provide improvements to the effluent quality of stormwater contributed by the major portion of the older development area of central Amherstview. Included in the catchment area is an undeveloped area in the vicinity of Speers Boulevard and north of Amherst Drive. The undeveloped locations may potentially be eligible for DC contributions for this project.

Further analysis of funding options is recommended, once detailed design for this area is complete.

Linkages

Stormwater Minor System Technical Memorandum

Stormwater Regulatory Issues Technical Memorandum

Stormwater New Technology Technical Memorandum

Stormwater Future Development Technical Memorandum

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

CSA Group. (2019). *CSA W204:19 Flood resilient design of new residential communities.*

D.M. Wills Associates Limited. (2023). *Wilton Road Dam Safety Study.*

G.D. Jewell Engineering Inc and WaterPlan Associates. (2011). *Class Environmental Assessment under the Municipal Class EA, Schedule B Project: Babcock Mill Dam, Millhaven Creek Watershed.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Province of Ontario. (1990). *The Drainage Act, R.S.O. 1990, c. D.17.* Retrieved from https://www.ontario.ca/laws/statute/90d17

Rutgers University. (n.d.). *On-site Alternative Water Reuse*. Retrieved from NJ Green Building Manual: https://greenmanual.rutgers.edu/ec-on-site-alternative-water-reuse/

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (July 2021). *Advancing the Climate Resilience of Canadian Infrastructure: A review of literature to inform the way forward.* International Institute for Sustainable Development.

Conclusions

Stormwater catchments with the Township have been reviewed to identify locations and the corresponding state of stormwater management for major stormwater control, including the general design of existing flood control features.

The major storm management features in the Township remain viable, providing adequate levels of flood control. This does not imply that the Township is fully protected from all potential flood events; rather, that the stormwater features already in place will provide the level of protection for which they were designed.

For those catchments in the Township that were developed prior to the guidelines for flood control design, adding major stormwater management facilities may be challenging due to site constraints. These will need to be examined on a case-by-case basis when major street reconstruction efforts are undertaken.

Recommendations

The following actions are recommended:

1. That as municipal Township streets and facilities are reconstructed, they benefit from improved stormwater treatment.
2. That the Township maintain a standing offer to cooperatively work with property owner(s) who can provide hydraulically suitable stormwater outlets for the Nicholson Point area.
3. That the Township continue to look for solutions that would minimize flooding events along the stretch of Millhaven Creek between Main Street – Odessa and Babcock Mill.

4. That the Township consider removal or stabilization of the Babcock Mill Dam, considering any heritage requirements as well as impacts to frazil ice conditions immediately upstream of the dam.
5. That the Township update the Environmental Assessment of the Babcock Mill Dam on Millhaven Creek, Odessa.
6. That the Township continue to monitor the effectiveness of 2023 modifications to the Edgewood municipal dam’s inlet grates on the north side of Bath Road/Highway 33.
7. That the Miller, Hawley-Creighton, and Charters Municipal Drains be inspected as soon as possible.
8. That Loyalist Township explore the abandonment of the Hawley-Creighton and Charters Municipal Drains.
9. That the area of Lakeview Park south of the sewage pumping station be reserved as open space for the future development of a stormwater management facility.
10. That further analysis of funding options for the proposed Lakeview Park stormwater management facility be completed once detailed design is complete in this area.
11. That funding be examined to fund the necessary safety deficiency corrections at the Wilton Road Dam.
12. That the Township’s Tangible Capital Asset Management Plan be expanded to include the Township’s Millhaven Creek dam assets.

IMP Technical Memorandum: Remedial Roads Concerns

Asset Class: Roads

Objective

The objective of this memorandum is to identify remedial road segments which are recommended for improvements due to problems associated with the roadway. Operations and policy updates that would improve road administration, operations, and general road conditions are also discussed.

Background

Section 44(1) of the *Municipal Act* states, “The municipality that has jurisdiction over a highway or bridge shall keep it in a state of repair that is a reasonable in the circumstances, including the character and location of the highway or bridge.” (Government of Ontario, S.O. 2001, c.25) This clause clarifies that the municipality is legally responsible to maintain the roads in a safe condition.

The Infrastructure Masterplan separates lifecycle replacement projects from improvements. Lifecycle replacements projects are identified through the Township’s tangible capital asset management plan.

On of the IMP’s themes is remedial action on existing issues, and this report is a summary of remedial transportation issues that have been identified.

At the outset of the IMP there was an internal discussion on the overall scope of the IMP. In 2020 the departmental management team envisioned a priority project that would review the condition of rural roads and develop a road resurfacing policy. The basis for this developing project was primarily due to:

- Complaints arising from residents regarding periods when gravel-surfaced roads experience either dusty or bumpy conditions, beyond the tolerance of local road users
- The inconsistent administration and promotion of a long-term rural road strategy
- Reduction in rural road improvements budgets in the past due to other priorities

The ensuing project has been named the Rural Road Improvement Plan and is expected to be presented to Loyalist Township Council in 2024 for their initial review.

With the establishment of the Rural Road Improvement Plan, it was decided that the IMP’s scope would not include improvements to rural road surfaces or rural road drainage. This decision reduces the scope of the IMP significantly.

The conditions of most of the older roads within the Township exhibit the same characteristics that they have for the past several decades. These roads reflect the former communities that existed when the roads were first established and improved.

Prior to amalgamation in January 1998, the former Townships of Ernestown and Amherst Island and the former Village of Bath all had varying priorities and financial and technical resources. With varying historical growth rates, the pre-amalgamation road systems each had their own characteristics.

The typical road allowance width for older communities was forty feet (12.191 metres). Most roads established under the original Crown surveys and road allowances surveyed on Amherst Island were laid out using this width. Many of the current rural Township roads retain the forty-foot width. Within the older communities of Odessa and Bath, road segments were developed at varying standards with forty feet being a common width.

Modern subdivision development commencing in approximately the 1960s included wider residential streets with a typical right-of-way width of sixty-six feet (20.116 metres). This standard remains in place for local streets.

Due to the complexity of the remedial and growth-related issues along these road segments, separate technical memoranda have been completed for Main Street – Bath and Main Street – Odessa, respectively.

An unusual factor associated with Amherst Island is the fact that until quite recently, the Island had been serviced by a side-loading ferry. The side-loader meant that the length of vehicles traveling to the Island was restricted to the maximum length able to load on the ferry. Many of the modern tractor trailers, which routinely carry longer loads everywhere else, were too long for the side-loading constraints.

Amherst Island with its rustic rural road network had no reason to manage the movements of longer vehicles. With the completion of the recent dock reconstruction, which converted the docks to allow for end loading of the ferry, long vehicles can now access the Island. Many of the intersections in the Island road network do not have the alignment to allow these vehicles to maneuver safely and efficiently.

Assumptions

It is assumed that the Township's Rural Road Improvement Project will be established in 2023, and this program is designed to complement the IMP. The project includes recommendations for the requirements for a road surface to be improved.

It is assumed that the Township will continue to review and update its transit program due to a variety of pressures, and that transit-related improvements will be independent of the IMP.

Methodology

This memorandum is a review of outstanding remedial issues, the list having been developed primarily from staff observations and experience. It is divided into two segments. The first segment is a listing of roads with remedial issues. The second segment is a listing of operational and administrative programs that are recommended to support the roads system.

Analysis

General

The sixty-six-foot right-of-way width provided by modern local roads allows for proper drainage works and other utilities to be constructed within the road allowance as well as room for parking if required. The older roads with forty-foot-wide road allowances are constrained and improvements are difficult and hence the Township has instituted policies for road widenings. With Loyalist Township being one of the earliest areas to develop in eastern Ontario, many of the roads were developed using the former forty-foot standard.

In the older urban areas, attempts at updating the neighbourhoods for the inclusion of sidewalks and improved storm drainage are often impeded, as there simply isn’t sufficient room to improve the infrastructure toward current standards.

Modern mandatory requirements for stormwater quantity and quality control make the retrofitting of roadside ditches and swales with underground sewers a difficult and usually a more expensive alternative. The traditional grass lined ditches are typically both more resilient for handling storm volumes and environmentally more suited to handling stormwater than underground sewer systems, where downstream treatment facilities are not feasible.

Remedial Projects

Intersection of Front Road and Stella Forty-Foot Road, Stella: Intersection improvements designed to address turning constraints currently applicable for large vehicles and pedestrian safety. This project is currently in detailed design stage with tendering expected in near term.

Front Road, Stella: Project to address lack of sidewalks, failing road surface, and remedial drainage issues. This project is currently in detailed design stage with tendering expected in near term.

Amherst Island Shore Road Protection: Many of Amherst Island’s roads are located immediately adjacent to Lake Ontario and are prone to flooding and dangerous wave action when Lake Ontario water levels are at their highest levels. In an effort to stabilize the road base and side slopes, the Township has commenced the Amherst Island Shore Road protection project. It is clear that higher Lake Ontario water levels like the recorded maximums experienced over the summers of 2017 and 2019, combined with heavy storm action, can profoundly deteriorate the exposed shoreline along South Shore Road.

Figure 1 Shoreline protection project, South Shore Road - January 2023

Phase One, considered the highest priority areas on the Island, was completed in 2023. Attached is a map showing the shoreline sections that underwent revetment. These locations experienced dangerous road conditions and/or shoreline erosion during the periods of high water levels on Lake Ontario in 2017 and 2019.

Phase Two consists of three general locations, being Front Road near the hamlet of Emerald (Figure 2), Third Concession Road near Emerald Forty-Foot Road (Figure 3), and the easterly end of South Shore Road (Figure 4).

Figure 2 Front Road, approximately 700m each side of Emerald Forty-Foot Road

Figure 3 Third Concession Road east of Emerald Forty-Foot Road

Figure 4 South Shore Road from 3500 south Shore Road to Lower Forty-Foot Road

This work will commence once funding has been confirmed. These locations have been chosen based on the report prepared by W.F. Baird & Associates (W.F. Baird & Associates Coastal Engineers Ltd., March 31, 2023) on behalf of Loyalist Township in 2022.

Depending on the location of the proposed slope protection, Loyalist Township may need to acquire property for road widening purposes. Where shore wells are already established, the Township will work with adjacent residents to ensure well operation is maintained during the project. Baird has noted that the map indicates areas of general concern, but within these sections are variations in the priority for slope stabilization and the best approach to maintain the safety of the road. At the time of writing this memorandum, Baird is completing their report and it is expected that individual locations will be prioritized for slope restoration, with site-specific recommendations. The Township previously completed an environmental assessment for South Shore Road, which considered a major relocation of the road as one of the alternatives to solve shoreline erosion concerns. The preferred alternative was a minor realignment of the road and guardrail installation for a major portion of the exposed shoreline. Other locations required enhanced solutions which consisted of armour stone-covered reconstructed slopes.

West Street, Odessa: It is proposed to realign West Street at Main Street – Odessa with Durham Street to the north. Along with a new sidewalk, this project will facilitate an improved pedestrian experience at this crossing, which is the location of a school crosswalk serving Ernestown Secondary School and Odessa Public School. Drainage improvements are also included in this project. The project is expected to be completed in conjunction with improvements to Main Street – Odessa, coordinated by the County of Lennox and Addington which includes upgrades to the Potter Street intersection. This project is considered a high priority to address both pedestrian safety concerns and to match recommendations of the Traffic Impact Study contained in the Odessa West Neighbourhood Plan (AECOM, 2011).

Bridge Street-Cross Street-South Street East-Emma Street, Odessa, improvements: This project is in the first year of a multi-year reconstruction project, with construction expected to be completed in 2024. Initially the designers were asked to try to include sidewalks in the design in some areas. Unfortunately, the narrow streets and tight grades could not accommodate these improvements easily. A one-way street system was evaluated, which would have allowed for more space for pedestrians; but these scenarios predicated undesired traffic concentrations and movements at some locations. The road network was intentionally not connected to the newer development to the west, and as such, traffic volumes in the study area remain low.

The final design includes a trunk storm sewer on Bridge Street, with an extension along Battery Street to Cross Street and another branch along Emma Street.

Township Bridges

Wing Road Bridge replacement: The Wing Road crossing of Millhaven Creek consists of two structures. The northerly structure is a precast concrete arch culvert, and the south structure is an oval coiled steel culvert with an open bottom. The south structure is very near Millhaven Road and there is little space for queuing between Millhaven Road and the current one-lane structures. The road narrows to a width supporting only one lane across the two structures, a length of approximately 60 metres.

Recent formal Ontario Structure Inspection Manual (OSIM) (Ontario Ministry of Transportation, 2008) inspections have noted declining conditions of the Wing Road culvert section at Millhaven Creek, and the structure was recently noted for replacement.

As traffic volumes increase on Millhaven Road, it is more difficult for traffic to turn from Millhaven Road onto the single structures, especially if an oncoming vehicle is met on the structure and particularly if the turning vehicle is a truck or bus. To address this safety concern, staff are recommending that the current single-lane steel culvert be replaced with a two-lane structure.

The Township employed the engineering firm GHD to complete an ecological assessment of the site (GHD, February 14, 2023). The subsequent report notes that the site had potential for species-at-risk habitat, but no such habitat was found on the site. GHD recommends that the Township work closely with CRCA when detailed work is in the planning stages for the bridge replacement.

The Township employed the engineering firm WSP to review the archeological resources at the site (WSP, February 2, 2023). The subsequent report notes that while the Stage I assessment indicated the potential for archaeological heritage in the vicinity of the bridge, the Stage II field work did not yield any archaeological sites or artifacts and no additional archaeological assessments were warranted for this site. A representative from the Métis Nation of Ontario participated in the archaeological field work.

The structure will be constructed in the same general location, but the Township will shift the centreline of the road upstream to allow for the existing road expansion to two lanes. The Township has previously acquired sufficient property to accommodate the road relocation.

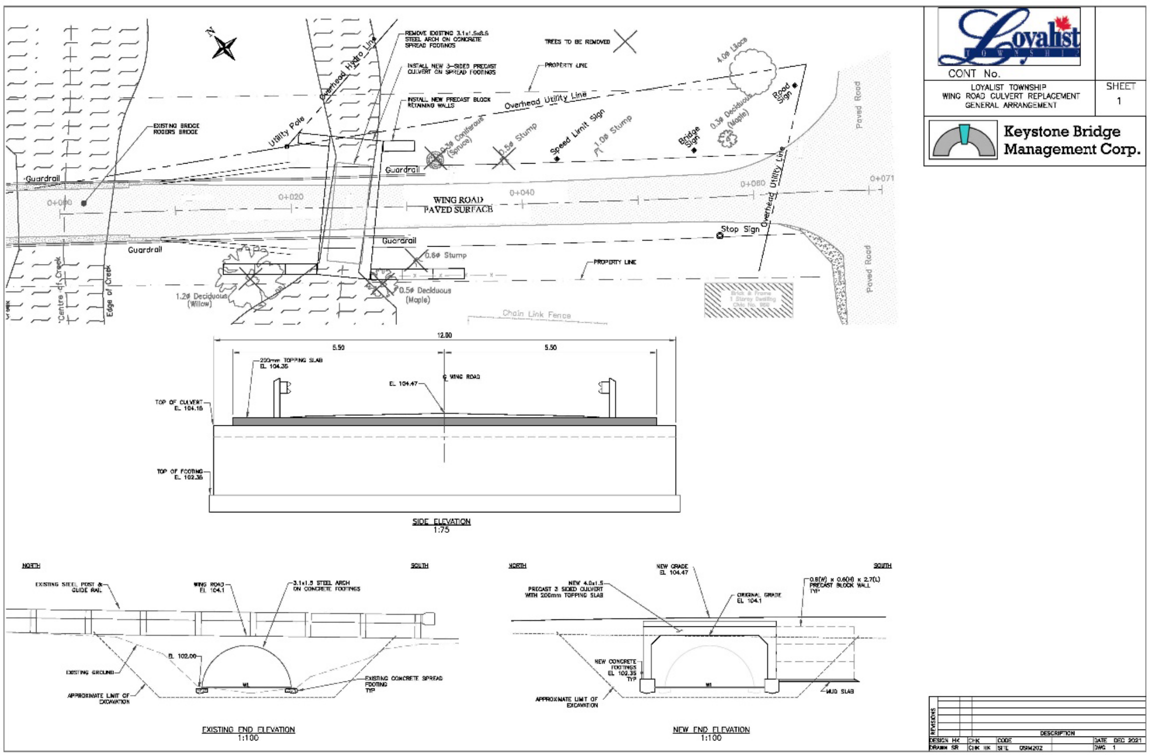


Figure 5 Wing Road Bridge replacement design

Bridge railing deficiencies, multiple sites: In 2022 Loyalist Township utilized the service of Keystone Bridge Management Corporation (Keystone) for the biannual OSIM bridge inspections.

Railing systems utilized on bridge approaches and on the structures themselves are updated periodically as safety design develops. With structures designed to last for several decades, it is not unusual for bridge railing systems become to become outmoded. Several structures have been noted by Keystone as requiring railing upgrades due to updated standards. This list does not include railing systems which have been noted for upgrades due to life cycle replacement, or those that have been damaged but are still compliant with current design standards. Please refer to the Keystone report (Keystone Bridge Management Corp., 2022) for further details.

- Amey's Bridge, Doyle Road – see Note 1
- Manore Bridge, Brandon Road – see Note 1
- Violet Bridge, Violet Road – see Note 2
- Wilton Bridge, Simmons Road – see Note 2
- Stella Forty-Foot Road Culvert, Stella Forty-Foot Road – see Note 3
- Townline Road Culvert, Townline Road (north leg at Switzerville Road intersection) – see Note 3

Note 1: Deficient railing components to be replaced concurrent with upcoming major rehabilitation.

Note 2: These repairs are a combination of life cycle replacement and changes to railing standards which will be addressed exclusive of a bridge rehabilitation scenario

Note 3: Keystone has recommended that these structures be confirmed for warrant status re: need for guardrail and if railing required then prioritized accordingly.

Township bridges: The Keystone inspection report indicated the need for some bridges to be rehabilitated in the near future, but all improvements to these structures, with the exception of the Wing Road Culvert, would be treated as lifecycle replacements.

Keystone noted that the structures listed below were expected to be replaced within the planning period of the IMP. Based on expected traffic volumes and development patterns, it is expected that these replacements would be treated as lifecycle replacements. In the Highway Traffic Act (Government of Ontario) a bridge is defined as having a span of 3.0 metres or more, and thus the culverts listed below are defined as bridges. This has additional meaning as, under the current requirements of the MCEA, all these sites would have to be screened for the need for potential cultural and archaeological heritage due to the age of the existing structures.

The following structures are listed for replacement:

- Simmons Road Twin Culverts, Simmons Road at Thorpe Road
- Third Concession Road Culvert, Third Concession Road at municipal drain
- Townline Road Culvert, Townline Road (north leg at Switzerville Road intersection)

Localized drainage repair program: One of the primary reasons for road failure is that too much moisture permeates the roadbed. Good road maintenance includes regrading and repairs to ensure water drains quickly from the road surface. Loyalist staff are currently developing a priority list for localized drainage projects, with the objective of improving local drainage problems experienced by the road structure. Depending on the type of problem and the road surroundings, improvements may include construction of local curb and gutter, road regrading, outlet swales, or catch basins and underground piping.

These projects will typically be initiated on rural roads and will not normally require property acquisition or obstruct existing access to private driveways. These projects can normally be expected to be scheduled shortly before resurfacing operations.

Major drainage improvements: The stormwater management sections of the IMP will highlight various remedial drainage projects and areas under consideration within the Township. It is expected that where remedial drainage infrastructure is constructed, the road restoration component of the project will be treated as a lifecycle expense.

Intersection signage: Loyalist Township currently does not have any internal policies related to warrants for intersections without signage, yield signs, or stop signs. The Township has not undertaken a comprehensive review of intersection controls in over three decades. A review of signage indicates a variety of approaches on the current use of intersection signage, with a lack of consistency throughout.

The Ontario Traffic Manual is a guideline for road administration written by MTO and is designed to be consistent with the Ontario Highway Traffic Act. Book 5 (Ontario Ministry of Transportation, 2021) of this manual includes suggested guidelines for appropriate use of various types of intersection signage and explains analyses of technical warrants for each type of signage.

In preparing the IMP and through discussions with Township operation's staff, it has become apparent that Loyalist's standards for signage should be reviewed. The scope of the review should include both the appropriateness of individual signage for the location and consistency.

For lower volume roads the hierarchy of intersection controls is:

- Uncontrolled (no signage)
- Stop signs (single or opposing roads at intersections)
- Yield signs
- Four-way stop sign control

The OTM is clear that stop signs should never be used explicitly for speed control and/or pedestrian safety.

The type of intersection control employed should be determined by traffic volumes and speed, sight line visibility, and accident rates.

Most intersections under Loyalist's control as road authority are signed with stop signs. Recent examination of the road network reveals stop signs on some very low volume roads while other roads with moderate volumes have no signage. An example of signage on a low volume road is the intersection of Gift Road and Simmons Road;

conversely, the intersection of Havergal Avenue and Asbury Road has no signage controls.

Variations from the above are listed below.

Table 1 Intersections with yield signs

Street	Intersecting street
Townline Road (south leg)	McIntyre Road
Violet Road	Sharpe Road
Big Creek Road	Fralick Road
Switzerville Road	Newburgh Road
Maple Road	Old Wilton Road
Thorpe Road	Fred Brown Road
South Shore Road	Stella Forty-Foot Road
McDonald’s Lane	Front Road
Second Concession Road	Easterly approach to Art McGinn Road
Emerald Forty-Foot Road	Front Road
Brandon Road	Sharpe Road

Table 2 Intersections with no signage

Street	Intersecting street
Switzerville Road	West boundary road – south leg
Switzerville Road	West boundary road – north leg
Newburgh Road (south leg)	Switzerville Road
Rutherford Road	Simmons Road
McConnell Road	Empey Road
Hegadorn Road	Howes Road
Caton Road (east leg)	Fairbanks Street
Creekside Drive (west leg)	Sharpe Road
Creekside Drive (east leg)	Sharpe Road
Morven Crescent (west leg)	Sharpe Road
Morven Crescent (east leg)	Sharpe Road
Fralick Road	Withers Road
Absalom Road	Absalom Road (north leg)
Compton Court	Edgewood Road
Harrow Court	Brooklands Park Drive
Bayview Drive (east leg)	Parrott’s Bay Lane
Dump Road/Kerr Point Road	Front Road
Back Beach Road	Art McGinn Road
Emerald Forty-Foot Road	Third Concession Road
Raglan Street	Main Street – Bath
Havergal Avenue	Asbury Road
Rothwell Avenue	Westran Road
Cornell Avenue	Westran Road
Huff Avenue	Westran Road

Clairton Place (east leg)	Cambridge Crescent
Clairton Place (west leg)	Cambridge Crescent
Belle Avenue	Factory Street
Durham Street	North Street*
Henzy Street	Shane Street
Addington Crescent	Addington Place
Henry Crescent	Quinte Avenue
Bakers Lane	Chesterfield Drive

*An argument may be made that this is not an intersection; however, it is also adjacent to schools.

Note: The listing of intersections is current as of May 2023.

It is expected that this project will be undertaken in two stages. The first stage will be to evaluate all intersections for appropriate based on industry standards and local preferences when options on signage are acceptable. The second stage will be a systematic update of signage in the field and corresponding amendments to related by-laws. Discussions with operations and development staff have highlighted that regular updates to the stop sign by-law have not been completed. It is recommended that adequate resources be applied to creating a workflow plan for both operations and development administration staff to maintain the stop sign by-law data and similar documentation.

Amherst Island road system speed limits: Amherst Island's road system is unique in many ways, with one being that many sections of road retain the historic forty-foot (12.2m) width and have a gravel surface. Currently the only hard surface road is Front Road. Some roads are impacted by a variety of encroachments. Some of these encroachments are formidable in size and/or mass and could cause significant damage if involved in a vehicle collision.

Figure 6 Front Road at Emerald Forty-Foot Road, Amherst Island – April 2023

Ideally the road allowances would over time be widened to accommodate a wider driving surface and full shoulders, as well as drainage ditches and, in some locations, sidewalks. Efforts in this regard have at times been impeded by individuals who wish to retain the Island as noted in the Township's Official Plan, Schedule I. The road system has the potential for increased use by pedestrian and cyclists. The municipality has the responsibility to maintain a safe road system for all users.

Road safety is best achieved by a combination of road improvements (appropriate surface type for expected traffic conditions) and appropriate vehicle speeds.

Most roads on Amherst Island are not posted with maximum speed signs. As such, they fall under the default Ontario regulation speeds of 80 km/hr in rural areas or 50 km/hr in urban areas.

Minimum Maintenance Standards (Government of Ontario) for roads are defined in O.Reg. 239/02, under the authority of the *Municipal Act* (Government of Ontario). The expected maintenance requirements for each road class are listed in the table below. The classification of a particular road is a function of the traffic speed limit and the traffic volume of that road. Lower speeds and lower volumes result in a lower classification.

Table 3 Road classification under MMS

Column 1 Average Daily Traffic (number of motor vehicles)	Column 2 91 - 100 km/h speed limit	Column 3 81 - 90 km/h speed limit	Column 4 71 - 80 km/h speed limit	Column 5 61 - 70 km/h speed limit	Column 6 51 - 60 km/h speed limit	Column 7 41 - 50 km/h speed limit	Column 8 1 - 40 km/h speed limit
53,000 or more	1	1	1	1	1	1	1
23,000 - 52,999	1	1	1	2	2	2	2
15,000 - 22,999	1	1	2	2	2	3	3
12,000 - 14,999	1	1	2	2	2	3	3
10,000 - 11,999	1	1	2	2	3	3	3
8,000 - 9,999	1	1	2	3	3	3	3
6,000 - 7,999	1	2	2	3	3	4	4
5,000 - 5,999	1	2	2	3	3	4	4
4,000 - 4,999	1	2	3	3	3	4	4
3,000 - 3,999	1	2	3	3	3	4	4
2,000 - 2,999	1	2	3	3	4	5	5
1,000 - 1,999	1	3	3	3	4	5	5
500 - 999	1	3	4	4	4	5	5
200 - 499	1	3	4	4	5	5	6
50 - 199	1	3	4	5	5	6	6
0 - 49	1	3	6	6	6	6	6

Vehicle volumes in a rural area are typically dependent on the size of the local population who utilize that section of road network, and thus are relatively stable values.

A reduction in posted speed on a section of road could possibly reduce the classification of the road.

Current Amherst Island roads classifications range from Class 4 to Class 6.

Figure 7 Amherst Island roads classifications

Roads with significant curvature, encroachments, and other safety concerns are subjects for reduced speed considerations. A full evaluation has never been undertaken for the Amherst Island system. An evaluation is being recommended for the Island roads system.

The rationale for the timing of this evaluation is the recent implementation of the end-loading docks and impending commissioning of the larger ferry. Access to Amherst Island will become easier and more tourist traffic is expected. These individuals will have less familiarity with local roads, and they will be accustomed to local speed signage when there are fewer apparent dangers.

If after the evaluation of the Island roads system it is felt that some roads should have reduced speed zones posted, then along with the legal requirements for posting lower speeds it is recommended that any changes in posted speed be accompanied by an education program focusing on local road users.

Sidewalks

The Township’s roads were reviewed with respect to the level of service for sidewalks.

Current standards don’t require sidewalks on low-volume, dead-end streets. When reviewing the sidewalk network, it was noted that several streets are not serviced with sidewalks, and in some cases the sidewalks don’t meet the current standard with of 1.5 metres or have other inadequacies.

The results of the detailed review are detailed in the Active Transportation technical memorandum.

Remedial road allowance administrative improvements: There are several administrative tasks which, due to past unavailability of staff resources and the inability to access some historical information, remain outstanding.

The following items are suggested to be prioritized to both reduce municipal liability and increase public safety.

Encroachment Permits

There is a need to review and update the existing encroachment by-law, especially those sections referring to time limitations on permits. Efforts to date to complete an inventory of water line and electrical service encroachments on Amherst Island have had limited success. Those encroachments which have been recently documented (approximately within the past decade) have been appropriately captured in the Township’s GIS, but this program needs to be expanded for all existing encroachment documentation. Conversion of this file to a full GIS layer with supporting documentation is recommended.

Unmaintained road allowances: These allowances have been demonstrated to have high level of liability risk. It is recommended that all road allowances be reviewed, and that those allowances that are classified to be unmaintained, be closed by Township by-law. Once closed, these allowances can be signed accordingly to reduce level of liability by removing public right of passage. In many cases where allowances are closed there will be a need to have separate agreements that authorize adjacent landowners access to their lands, especially where agricultural practices are maintained. There is also a possibility that some rights-of-way may have some economic value if sold. The following example is one such location where the Township's liability can be reduced, and the value of a serviced residential lot be gained through sale:

With development nearing completion along Potter Street, there is an unimproved portion of South Street running east of Potter Street, with the parcel of land being identified as Plan 29R-107377, Part 5. This former right-of-way should be reviewed for future needs and the unmaintained road section closed. One option may be to sever off the Potter Street frontage to create a residential lot.

Road widening inventory: The current system for storing and retrieving road widening information is antiquated and non-functional. Staff are unable to quickly find important information. Loading these files into a GIS format should be prioritized accordingly. It is recommended that prioritization be established for the establishment of a Township maintained road widening register that is easily accessible that maintains both legal survey and other relevant GIS data and related agreements

Formal road classification: The *Municipal Act* includes a chart that defines a road classification based on traffic volumes and posted speeds. The municipality's liability is reduced if the classification of maintained roads is approved by Council. This has never been undertaken by Loyalist Township, due to the volume of historic data to review regarding the legal status of certain unmaintained roads, as well as a lack of traffic count data. Efforts have been made to eliminate the data gap, and it is believed that Loyalist is now in a position to present an accurate list of roads classifications for Council's formal endorsement. With the continual and rapid growth within the Township this is a process that should be repeated on a continual basis.

Half-load restrictions: Most of the Township's non-subdivision roads were constructed to local standards suitable for the lightweight vehicles that were common before the 1950s. Many of these roads are loose-top gravel surface which allows for the penetration of rainwater and often the whole road structure is poorly drained. Moisture in the roadbed weakens a road, leaving it highly susceptible to seasonal/freeze thaw deterioration. These roads are currently experiencing both a greater number of vehicles and heavier vehicles than in the past. Heavy loads applied to the roadbed when it is soft can reduce the functional lifespan of the asset requiring increased expenditures to restore to an acceptable level of service.

The impact of the transitioning warming climate is such that the historical period when roads were most impacted of March 1 to April 30 is generally no longer practical. This was demonstrated in 2023, when the conditions for the application of load restrictions were present in mid-February.

Loyalist Township maintains a by-law to designate dates for a reduced load period for commercial vehicles or trailers on municipal highways (The Corporation of Loyalist Township, 2003). The period of load restrictions is March 1 to April 30. Part III, clause 1(i) allows for the Director of Engineering Services[1] to allow for individual exemptions upon written request but the by-law doesn't allow for the appropriate staff person(s) to adjust the restrictive period to match prevailing weather conditions.

It is recommended that the reduced loads by-law be updated, and that the updates include the evolving warming climate conditions and the revised organizational structure of Loyalist Township.

Financial

Projects in the detailed design stage have been included in Loyalist Township's current capital budget program and are not repeated in this list.

Table 4 Financial estimates for recommended projects

Location	Estimated cost	Date required
Amherst Island shore roads protection phase 2		2024
Wing Road culvert replacement	$236,000	2024
Bridge railing deficiencies (4-6 locations)	$40,000 each	TBD
Intersection signage	TBD	TBD
Amherst Island speed limits	TBC	TBD

Climate Lens

The Climate Lens process was developed by Infrastructure Canada to help address the climate change impacts and GHG emissions associated with infrastructure projects in Canada. By incorporating climate considerations during the planning and design of infrastructure projects, the Climate Lens is intended to help assess the potential impacts of projects, influence the design process, and inform funding decisions (WSP, 2020). This effort is an essential part of the federal and regional governments strategy to achieve Canada's 2030 GHG reduction target of 30% below 2005 levels, as documented in the Pan-Canadian Framework for Clean Growth and Climate Change (Environment and Climate Change Canada, 2016).

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of GHG emissions, and an assessment of the potential for the project to adapt to climate conditions.

[1] An obsolete role following organizational restructuring. The current position would now be the Director of Community and Customer Services or the Public Works Manager.

Climate conditions that will most likely impact remedial transportation projects in Loyalist Township include the following:

- Mean temperatures are projected to increase annually, and in every season (ICLEI, 2021). More frequent heatwaves and shorter winter ice road season due to warming may result in softening and rutting of roads (Swanson, Murphy, Temmer, & Scaletta, 2021)
- The number of days expected to reach above 30 degrees is expected to increase, while the number of days below -15 degrees is expected to decrease in the next 30 years (ICLEI, 2021)
- A decrease in the number of cold days, the number of icing and frost days and in the average number of freeze-thaw days. Per the 2021 ICLEI report, it is important to know how winters will change in the future because cold weather temperatures among other things “define how we design our buildings, vehicles, and shape our transportation and energy use”. On average, slightly less freeze-thaw cycles are projected for Loyalist Township in the next 30 years. Roads may not have to be built to sustain as many freeze-thaw cycles.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and overland flow.
- A decrease in the duration of ice cover of Lake Ontario (ICLEI, 2021) resulting in periods of increased open water conditions, will result in increased wave action and subsequent potential increased shoreline erosion during weather events.

Assessment of Alternatives

Remedial work to transportation infrastructure is essential to the functionality of the Township. The conditions of many of these proposed projects are controlled by government standards and regulations, limiting the opportunities to consider alternative approaches for implementation. However, industry standards and protocols have evolved to include best management practices with regards to the sourcing, use and management of materials during construction projects in general. In addition to regulatory constraints there are also physical constrains such as elevations, offsets to adjacent property lines, and the location of underground utilities.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials with the general consensus of reusing materials on-site when possible

- Following best management practices regarding the use of new materials such as materials that are mined including granular materials, and using recycled materials when possible
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternative materials (low-carbon concrete, high-density recycled plastic, cross-laminated timber, alternative steel technologies, etc.) and designs (open bottom modular culverts, prefabricated/composite bridges, etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Consider using roundabouts instead of 4-way stop at intersections to mitigate additional GHG emissions from idling vehicles (City of Fredericton, n.d.)).

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Increase culvert capacities to manage increased precipitation and prevent washouts (Swanson, Murphy, Temmer, & Scaletta, 2021)
- Use heat-tolerant pavement mixtures to reduce pavement softening, rutting and bleeding (Swanson, Murphy, Temmer, & Scaletta, 2021)
- Consider the potential of increased water levels in roadside ditches when regrading and adjusting road elevations
- Use geotextiles to improve stability and reduce settlement of roadways (Swanson, Murphy, Temmer, & Scaletta, 2021)
- Use hedgerows to protect roadways from snow accumulation and wind gusts (Swanson, Murphy, Temmer, & Scaletta, 2021)
- Increase/improve natural infrastructure such as riparian buffers to mitigate shoreline erosion (Swanson, Murphy, Temmer, & Scaletta, 2021)

Linkages

Traffic calming and active transportation have been addressed in separate technical memoranda and are very much related to the remedial transportation topic.

Although the road infrastructure may be adequate, there are some locations in the older residential communities where there are remedial drainage concerns. To address drainage concerns, the Township may need to reconstruct the road concurrent to the drainage project. The technical memorandum Major Stormwater System lists these locations.

Two other technical memoranda in the IMP, being Main Street – Odessa and Main Street – Bath, highlight many deficiencies associated with the respective road segments and should be read in conjunction with this memorandum. These memoranda also capture remedial drainage concerns.

A detailed analysis of the Township's sidewalk system can be found in the Active Transportation technical memorandum. This document includes a listing where sidewalks are deficient for a variety of reasons or were simply not included in the original development, and recommended strategies to address the level of service discrepancies. It is expected that many of the locations listed for new sidewalks would be addressed concurrent with other remedial road and utility rehabilitation. A few existing streets and unmaintained rural corridors have been identified for potential improvement with the establishment of multi-use paths or bicycle routes. The establishment of these routes will have some impact on the local roads. An evaluation of an appropriate design will be the next step in this process.

It is expected that traffic calming measures will be implemented on selected higher volume streets within the urban area which will result in some localized modifications

There are numerous strategies that can be applied to improve traffic calming. Further evaluation on this topic is recommended for many of the higher volume (collector) roads within the urban communities within the Township.

References

AECOM. (2011, June). Odessa West Neighbourhood Plan.

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

City of Fredericton. (n.d.). *Roundabouts*. Retrieved from City of Fredericton: https://www.fredericton.ca/en/roads-parking/roundabouts

Environment and Climate Change Canada. (2016). Pan-Canadian Framework on Clean Growth and Climate Change : Canada's plan to address climate change and grow the economy.

GHD. (February 14, 2023). *Ecological Characterization Assessment Wing Road Bridge.*

Government of Ontario. (n.d.). Highway Traffic Act, R.S.O. 1990, c. H.8.

Government of Ontario. (n.d.). Municipal Act, 2001, S.O. 2001, c. 25.

Government of Ontario. (n.d.). O. Reg. 239/02: Minimum Maintenance Standards for Municipal Highways.

Government of Ontario. (S.O. 2001, c.25). Municipal Act, Section 44(1).

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Keystone Bridge Management Corp. (2022). *2022 Bridge & Large Culvert Biennial Inspections Loyalist Township.*

Ontario Ministry of Transportation. (2008). Ontario Structure Inspection Manual (OSIM). St. Catharines, ON.

Ontario Ministry of Transportation. (2021). *Ontario Traffic Manual Book 5 - Regulatory Signs.*

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (2021). *Advancing the Climate Resilience of Canadian Infrastructure.* International Institute for Sustainable Development - IISD.

The Corporation of Loyalist Township. (2003, February 10). By-law 2003-12 - A By-law to Designate Dates for a Reduced Load Period for commercial vehicles or trailers on Municipal Highways.

W.F. Baird & Associates Coastal Engineers Ltd. (March 31, 2023). *Amherst Island Shoreline Conceptual and Preliminary Design.*

WSP. (2020). *Bracebridge Community Multi-Use Complex, Draft Climate Lens Assessment – Climate Change Resilience, Bracebridge, Ontario.*

WSP. (February 2, 2023). *Stage 1-2 Archaeological Assessment Wing Road Culvert Replacement.*

Conclusions

It is recommended that Loyalist Township complete a comprehensive review of the use of signage for intersection controls. This review will look at the consistency of signage use and recommend strategies to ensure compliance with Highway Traffic Act requirements, to maintain a safe roads system, and to develop associated policies and updates to by-laws where warranted.

It is recommended that, in addition to the lifecycle replacement program for bridge railings and guardrails, additional funds be provided in the capital budget for improvements to bridge railing systems based on the noted deficiencies in this memorandum.

It is recommended that the Township review the appropriate speed limits for the Amherst Island road system and amend the posted speeds on Island roads based on the recommendations of the posted speed assessment.

It is recommended that the Township prioritize resources to address the tasks required to complete the remedial administrative items: encroachments, unmaintained road liability and road classifications.

It is recommended that adequate resources be applied to creating a workflow plan for both operations and development administration staff to utilize to maintain the stop sign bylaw data and similar documentation.

It is recommended that prioritization be established for the establishment of a Township maintained road widening register that is easily accessible that maintains both legal survey and other relevant GIS data and related agreements.

It is recommended that By-law 2003-12 (Designate Dates for a Reduced Load Period for commercial vehicles or trailers on Municipal Highways) be updated, and the updates include the evolving warming climate conditions and the revised organizational structure of Loyalist Township.

IMP Technical Memorandum: Main Street – Bath Road Issues

Asset Class: Roads

Objective: The objective of this report is to document the remedial issues associated with Main Street – Bath. Since Main Street – Bath is experiencing growth impacts, especially in the east end of the community, the growth impacts affecting this corridor have been included in this memorandum.

Background

Main Street – Bath is owned and maintained by Loyalist Township. Loyalist Township has a Connecting Link agreement with the Province. As Main Street – Bath connects two sections of Highway 33, this roadway is eligible for the Connecting Link program. The Connecting Link program provides provincial subsidy for eligible capital projects through an application process administered by the Ontario Ministry of Transportation (MTO). The Connecting Link agreement applies to that portion of road between the former Village of Bath corporate limits. From Loyalist's perspective the MTO funding program is awkward to work with, as available funding seldom matches the timing of physical needs of the Township.

This section of road has a relatively high volume of large trucks, due in part to being a provincial highway and in part to the Lafarge Holcium cement plant, located just west of the community. MTO pre-COVID traffic data indicated an AADT of approximately 7,000 trips per day at the east end of the Connecting Link.

In 2000 the road surface was replaced from the Connecting Link west limit easterly to Centennial Park, approximately 70 metres east of Fairfield Street. The scope of the project included road base repairs at isolated locations where the base had failed, complete removal of old asphalt, and asphalt resurfacing. This section of Main Street – Bath has a two lane urban cross-section, with occasional locations where the pavement width is wider than a standard two lane road. In the commercial sections there is parallel parking in some areas, and some of the side street intersections have bullnoses that separate some of the parking spaces from the through traffic. Sidewalks are constructed of standard concrete slabs and there is a moderate use of precast concrete pavements, most of which requires refurbishing. Portions of the precast pavement have settled and require regular maintenance.

Underground municipal infrastructure was evaluated prior to the 2020 west end resurfacing project and a decision was made not to replace underground piping as part of the overall project, with one exception: a small shallow stormwater system was replaced including catch basins at Fairfield Street and an outlet to the creek east of the Bath Water Treatment Plant. The balance of the storm, water, and sanitary underground infrastructure within the project area was deemed to have sufficient service life remaining at the time of this project, but will likely need some major attention when the road is resurfaced the next time.

The concrete culvert that services the intermittent creek flowing through Centennial Park consists of an older two lane central section and extensions on each end. The age of the culvert is unknown, but in an inspection by WSP in 2020, but the structure was found to be in good condition and minor repairs were completed concurrent with the resurfacing project.

There is a sidewalk on the north side of the street the full length of the Connecting Link section.

Informal continuous bicycle lanes have been painted on the paved road shoulders in the west end, but the lanes do not meet current standards for a bicycle lane and are not signed or considered as bicycle lanes.

Sidewalks on the south side of Main Street – Bath are limited to segments between Davy Street and Fairfield Street, and between Heritage Drive and Windemere Boulevard. The lack of continuous sidewalks on the south side is considered a major deficiency of this road based on traffic volumes. The two public surveys issued during the IMP indicate public support for improved sidewalks for the right-of-way. Sidewalks on both sides of the roadway are recommended, subject to any improvements recommended for a waterfront trail.

East of Fairfield Street, Main Street – Bath has a variable cross-section. Most of the roadway between Fairfield Street and the eastern limit of the community can be defined as a semi-urban or rural cross-section. The road has a continuous, partially paved shoulder, and some areas have more recently been upgraded with curb and gutter. On the south side of the road are numerous locations with steep side slopes, both up and down, immediately beside the paved shoulder, making pedestrian movements difficult. This section of road was repaved in approximately 2000 and will soon require extensive revitalization. Some of the underground piping in this area has been replaced, but most of the water and sewer mains and service laterals are approaching their recommended service life based on Loyalist Township's asset management plan. Most of the drainage in this area is accommodated by open ditches with minimum quality and quantity controls. This section of roadway is experiencing development pressure, with all adjacent lands expected to be fully developed within the next decade.

The Main Street – Bath intersection with County Road 7, also known locally as Church Street, is a signalized intersection. This intersection is physically constrained by historic development, and future expansion of turning lanes would be difficult without significant property acquisition and demolition of existing buildings. There are no other controlled intersections or pedestrian crossings within all of the Main Street – Bath corridor.

During a recent watermain replacement project contaminated soil was encountered near the intersection of Main Street – Bath and Church Street. The contaminated soil contained hydrocarbons, but the source of contamination remains unknown. All excavated contaminated soil and groundwater was removed from the site and disposed of according to Ministry of Environment, Conservation, and Parks (MECP) requirements. No attempt was made to remove contaminated material beyond the excavation required for the watermain work. The contaminated soil was encountered during a relatively wet year and the following year crews did not encounter contaminated groundwater when the watermain replacement was extended easterly from the intersection.

Traffic calming along Main Street – Bath is desired by many Bath residents, as well as improved pedestrian crossing opportunities between Church Street and Lodge Street and throughout the east end of Bath. Traffic calming concerns for this section of road were well documented in the Township’s survey results.

Assumptions

With all the undeveloped lands immediately north of Main Street – Bath and east of Somerset Drive having received draft plan approvals, it is expected that the east end of Main Street – Bath will be fully developed within the next decade.

It is expected that the Loyalist Estates development will be reach full build-out during the IMP study period. The same developer now owns land east of County Road 7, and there is a possibility that some of these lands will be developed within the IMP study period.

It is assumed that Loyalist Township will initiate both planning and limited construction on a waterfront trail and that Main Street – Bath can be expected to accommodate a portion of this trail within the IMP study period.

It is assumed that Highway 33 will reach vehicle capacity within the IMP planning period. The County of Lennox and Addington has indicated that work to extend County Road 23 (Taylor-Kidd Boulevard) west of County Road 4, will commence near the middle of the 25 year IMP planning period. This road improvement will offer some relief for Highway 33 traffic volumes and Bath commuters in particular.

Loyalist Township staff are in the planning stages of a Waterfront Masterplan process. This plan’s objectives include improving access to the many waterfront attributes within Loyalist. It is envisioned that the masterplan would include the development of a waterfront trail element. This report envisions the proposed waterfront trail to be separated from traffic either by space or a physical barrier consistent with Ontario Traffic Manual Book 18 (Ontario Ministry of Transportation, 2021). This report also anticipates that construction of the waterfront trail is likely in the latter stages of the IMP planning period. To accommodate a future trail it is recommended that the Main Street – Bath right-of-way from the former east Village limit to Centennial Park be modified to suit future trail enhancements during the next rehabilitation project or sidewalks on both sides of the roads.

Methodology

This section of road is being provided additional attention in the IMP, as a number of infrastructure improvements (non-life cycle replacements) are expected over the term of the Masterplan. These improvements are being planned in a coordinated fashion such that aging infrastructure within the corridor can be replaced in a cost efficient manner.

The information presented in this memorandum is a summary of information from many sources, including structure inspection reports, asset management records, OPP accident data, the results of IMP surveys on active transportation and traffic calming, various servicing reports related to adjacent development and development in the entire Bath community, various evaluations of the Windemere intersection, and a review for pedestrian crossings (GHD, 2022). The 1990s era Master Transportation Plan completed for the Village of Bath was recently updated by the prime Developers currently operating in Bath. Loyalist Township engaged GHD to review the recent Traffic Impact Study submissions and to complete a detailed review of development impacts expected along Main Street – Bath within the study period of the IMP.

During the early stages of the IMP the Township indicated a preference for a roundabout to be constructed at the intersection of Main Street – Bath and Windermere Boulevard. Staff asked GHD to review roundabout designs relative to long and wide loads on marine lowboy trailers, representative of some of the larger loads hauled by the Loyalist Cove Marina. These vehicles require larger turning radii and have less clearances, vertical and horizontal than most vehicles.

After reviewing initial results of the active transportation component of the IMP, GHD was asked to review the appropriate locations for pedestrian crossings on Main Street – Bath east of Centennial Creek.

Technical details have not been included in this memorandum but can be found in the appended engineering reports noted in the reference section.

Analysis

Main Street – Bath, Church Street westerly to Finkle's Shore Park

No major road work is anticipated west of Church Street until the end of the study period at the earliest. At that time full replacement of underground water and sewer infrastructure should be considered prior to any major resurfacing projects.

As the Township addresses local remedial drainage issues in the older areas of Bath, there may be a need for localized storm sewer placement within the right-of-way. Most of these would be relatively simple transverse installations, similar to the recent Davy Street rehabilitation. The stormwater review indicated that improvements in the vicinity of Lodge Street should be prioritized.

The Bath Creek Bridge was rehabilitated in 2015. This rehabilitation was limited to repairs inside the vault of the culvert-style structure, and no attempt was made to expose the upper surface of the concrete deck. The railing adjacent to this structure was not designed as an engineered railing to meet bridge design codes. The steel railings are not integrated with the bridge and are slightly offset from the travelled road. An assessment report from April 2015 (MMM Group Limited, 2015) recommends that this shoulder railing should be replaced with a steel beam guiderail and channel railing system. Ontario Structure Inspection Manual (OSIM) data reports that the original portion of this structure was constructed in 1940. The original structure was later extended on each end, date unknown. Main Street – Bath crosses Bath Creek over an older style concrete bridge. The bridge has a natural gas main and a watermain are buried adjacent to the north side of the structure and railings. The combination of wide right of way, and low posted speed and roadside curbs make the need for traffic rail a bit of an anomaly when compared to typical bridge design standards. Due to the depth of the structure to the creek a railing is required for the safety of pedestrians.

Based on Keystone's 2022 OSIM inspection report (Keystone Bridge Management Corp., 2022), the expected remaining service life of the Bath Creek structure is 35 years, which is outside the term of the IMP. Prior to the next resurfacing of the west end of Main Street – Bath, it may make financial sense to replace this structure. This decision would be based on the condition of Bath Creek Bridge at that time and the timing of the next resurfacing; or sooner, if future OSIM inspections indicate a need for rehabilitation or replacement. It is noted that during the most recent structure rehabilitation and the road resurfacing project the upper deck of this structure, which is buried under the road base was not inspected or tested and is not likely waterproofed.

The pre-cast sidewalk and boulevard pavement found in the central area of Bath will need to be refurbished or replaced. Consideration should be made to defer replacement of this surface until the scope of the waterfront trail is defined. Potential improvements of the sidewalks through the Bath community should consider the long-term active transportation objectives of this corridor and the provision of vehicle parking for the commercial area.

Main Street – Bath, Centennial Park easterly to former Village eastern limit

It is expected that the road surface between Centennial Park and the eastern limit of the former Village will be upgraded early in the IMP term, with drainage improvements included in the project scope. These expenses are eligible Connecting Link expenses, subject to grant approval. It is recommended that as the various stages of the work progress, the underground water and sanitary infrastructure be replaced concurrently, and active transportation infrastructure upgraded.

GHD also has evaluated the section of Main Street – Bath from Fairfield Street easterly to Heritage Drive and recommended a pedestrian crossing at Manor Road to Bulch Avenue.

This location provides access to the north via Academy Street, while Manor Road allows access to the waterside Heritage and Edgewater communities. The vertical and horizontal alignments of Main Street – Bath in this area limit locations for crossings due to limited sightlines. This is another factor in favour of the Manor Road location.

Locations of local pedestrian traffic generators and potential crossing points evaluated by GHD are illustrated below.

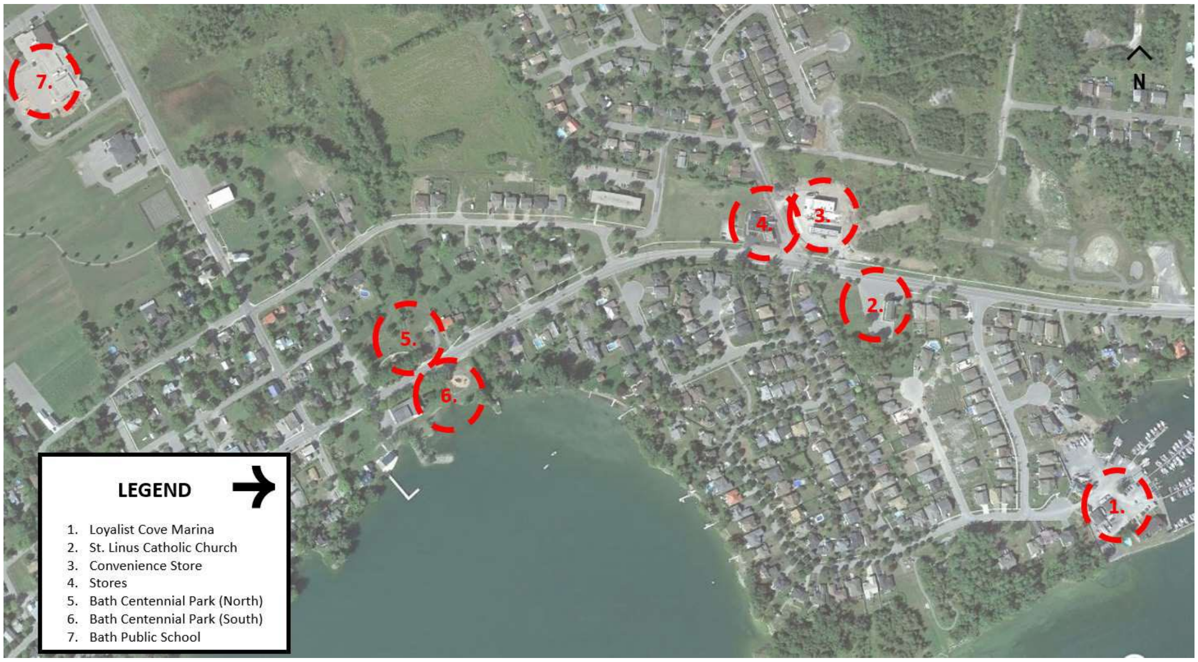


Figure 1 Pedestrian Generators and Destinations in Bath. Source: GHD

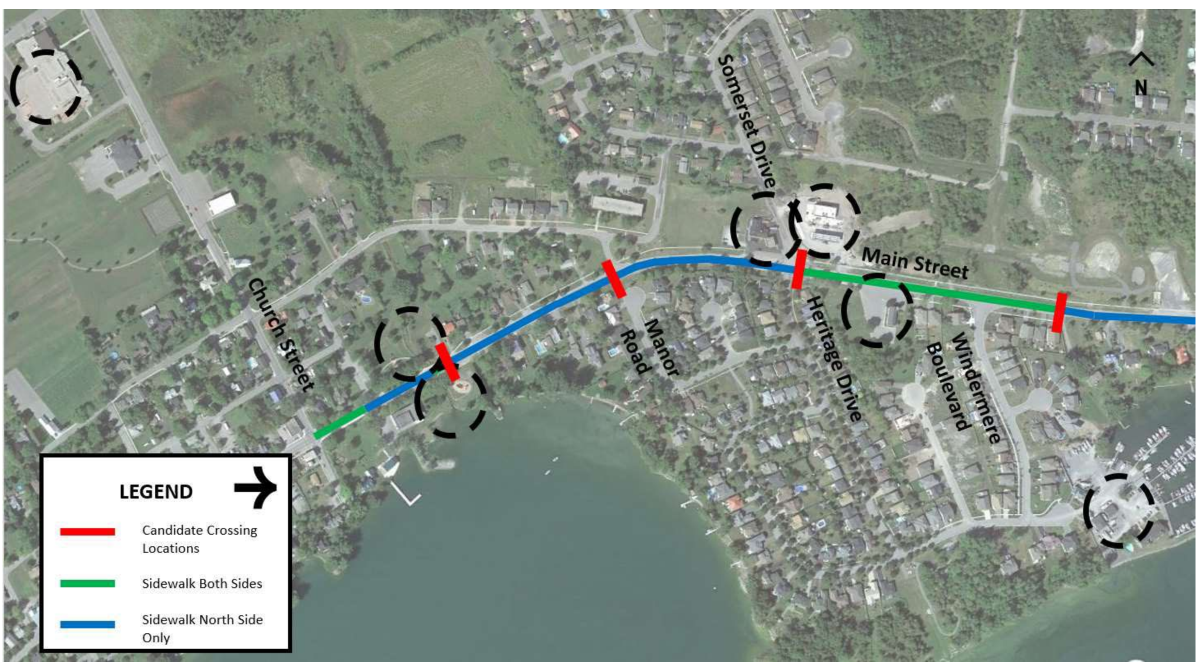


Figure 2 Candidate pedestrian crossing locations. Source: GHD

Other pedestrian crossings of Main Street – Bath will be required between Bulch Avenue and Windemere Boulevard. The overall road design will need to meet the requirements of Ontario Traffic Manual Book 15 (Ontario Ministry of Transportation, 2016) when considering additional pedestrian crossings. Book 15 primarily considers sightline distances and distances between crossings as criteria for evaluating new crossings.

The level of development within the Heritage and Edgewater subdivision requires sidewalk linkages both towards the west and easterly to Sir John Johnson Drive at a minimum, and preferably east to the former Village boundary.

Ideally new pedestrian facilities would be implemented to meet the needs of the proposed waterfront trail, but the timelines for planning the waterfront trail may not suit this schedule due to deteriorating pavement conditions.

When the eastern section of the Connecting Link is re-evaluated during the design stage, attempts should be made to ensure an adequate corridor is created for active transportation infrastructure, whether or not that infrastructure is completed concurrent with the road rehabilitation. This may mean more storm sewers replacing existing open ditch drainage in the right-of-way. This process would likely mean levelling off the south boulevard, to approximately the same elevation as the shoulder. The existing boulevard grades drop or rise suddenly adjacent to the edge of the gravel shoulder.

At the time of writing this memorandum Loyalist Township has received Connecting Link funding for the design of the eastern section of Bath Main Street. An engineering consultant team has been hired and is reviewing all of the background material prior to developing a design for the right of way. This project is a Schedule A project and as a result the project is classified as exempt from further Municipal Class Environmental Assessment processes. As per past practice for projects of this significance, Loyalist Township will engage the public once initial designs are available for public and agency practice.

Windemere Intersection Improvements

For a couple of decades various Traffic Impact Studies (TIS) for the community of Bath have indicated the need of a new collector road, Windermere Boulevard, that would extend from County Road 7 south easterly to Main Street – Bath as the east side of Bath continued to develop.

Windemere Boulevard has been noted in several versions of the Township's Official Plan as a future collector road based on the 1990s TIS. Development in the area did not proceed as quickly as originally expected, but recently new ownership has accelerated development.

The most recent traffic impact study (GHD, 2021) indicates that the intersection of Main Street – Bath and Windermere Boulevard meets warrants for a controlled intersection with the development of Aura by the Lake Phase 1, which has now been serviced.

GHD also noted that they expect that Highway 33 will reach capacity within the next 25 years, with actual timing based on the expected completion of an extension of County Road 23 (Taylor-Kidd Boulevard) to County Road 7.

As part of the Aura by the Lake Phase 1 subdivision approval process, Loyalist Township obtained additional lands adjacent to the existing subdivision suitable for a typically sized, mid speed range urban roundabout.

With the traffic volumes projected in GHD's evaluation, there are only two options for a controlled intersection that satisfactorily meet the needs of Loyalist Township; installation of traffic signals, or construction of a roundabout.

An initial preference for a roundabout at this location was presented in some of the early public information material for the IMP and the project was presented to MTO for comments. This preference is supported by GHD's recommendations which in turn are based on both the need and desire to have increased traffic calming measures introduced to Main Street – Bath. MTO has subsequently documented their requirements to the Township's engineering consultant, who has been contracted to develop a design for the Main Street – Bath right-of-way east of Centennial Park. MTO has some limited jurisdiction on the improvements under the terms of the Connecting Link agreement.

Loyalist Cove Marina complements their traditional shore-based marina operations with off-site boat storage. The largest boats require a specialized marine trailer unit, which is both longer and wider than traditional tractor trailers. This trailer also operates with a low vertical clearance from the road surface.

Figure 3 Tractor low-boy semi-trailer. Source: GHD

After consulting with Marina staff regarding their unique needs, the Township engaged GHD to examine this concern specifically. GHD provided a report with several specific recommendations to be followed should the Township proceed with a roundabout at this location based on frequent use by Loyalist Cove's larger hauling vehicle. These design considerations are summarized as follows:

- Increased size of truck aprons at turning areas
- Low mountable curb heights
- Relatively flat grades through intersection
- Large turning radii.

GHD based their design on a marine trailer unit similar to the one pictured above, noting that a lower design speed for the roundabout would be beneficial. Loyalist Cove Marina representatives also expressed concern for the potential for increased tire wear and longer turning movements for their largest loads.

The primary benefits of a roundabout are:

- The safety aspect related to their ability to reduce serious vehicle accidents
- The ability of roundabouts to consistently slow down the speed of through traffic
- Offers the highest level of service based on traffic projections, (no delays due to full stop requirement)

The benefits of a signalized intersection option are:

- Lower construction and lifecycle costs versus the expected costs of a roundabout
- Easier to accommodate large vehicles
- The footprint of the intersection, which are primarily paved surfaces, will be reduced
- MTO is more familiar with the expected impacts of a signalized intersection and this option is likely to receive agency acceptance faster

One of the main drawbacks of the signalized intersection option is that the green signal will be prioritized for the heavier through traffic on Main Street – Bath. During a long green signal, vehicle speeds will be less likely to be reduced except during peak commuter times when traffic is queued at the signal.

In terms of minimizing overall traffic delays, GHD's analysis indicated the highest level of service for the roundabout option. There would be a minor reduction in the level of service if traffic signals were installed and Taylor-Kidd Boulevard was extended, as contrasts with the roundabout option. The drop in service level would be greater if Taylor-Kidd Boulevard was not extended and signals were installed as opposed to the roundabout option.

This project is proceeding through the design stage as a Schedule A+ (exempt) project based on the Municipal Class Environmental Assessment (MCEA) requirements as amended in 2023 (Municipal Engineers Association, 2023).

The Township's current design consultants will be reviewing all feedback from the public and agencies, and will develop an intersection design that best suits the Township's needs with input from MTO and Lennox and Addington County.

Financial

The Connecting Link agreement allows for 90% subsidy from the Province for eligible expenses. Funding is based on grant approval from the Ministry of Transportation, and as such, the timing of funding is unpredictable. Eligible expenses include drainage and road surface features, grading, curb and gutter, and work on structures, etc. Sidewalks are not eligible expenses for this funding.

Any rehabilitation or eventual replacement of the Bath Creek Bridge would be an eligible expense under the grant program, if approved by MTO for funding. This work is not currently expected within the IMP study period.

The Township has received funding for the design of a major rehabilitation project for the portion of Main Street – Bath east of Centennial Park which extends into 2024. The Township should continue to apply to each intake of the Connecting Link program for the construction phase(s) of this project.

Due to the length and complexity of this project it is quite likely that construction will be completed over multiple construction seasons.

All underground water and sanitary sewer infrastructure upgrades would be the financial responsibility of the Township unless specific elements are covered within the eligible projects to be funded from impost fees. Decisions to increase main sizes will be made based on the results of hydraulic modelling.

It is expected that storm sewer infrastructure placed in the Main Street – Bath right-of-way should be eligible for Connecting Link funding.

The Windemere Boulevard intersection improvements are eligible expenses for Connecting Link funding, less any portion attributable to local growth. Loyalist Township's Development Charges (DC) by-law (Corporation of Loyalist Township, 2021) includes funding for this intersection. As such most of this project will be almost fully funded without the need of direct (general rate) funding from Loyalist Township. GHD has estimated that the costs of the signalized intersection is approximately $600,000 and the cost of a roundabout is approximately $1,600,000. It is noted that the cost estimate for signals does not include an allowance to address traffic calming. To be fully comparable, a traffic calming strategy in an alternate location compatible with a signalized intersection should be included in any cost analysis.

Funding of pedestrian crossings servicing the moderately new Heritage and Edgewood developments and expanding Aura of the Lake development should be evaluated as a DC-applicable project.

The Township should seek external funding opportunities for the Waterfront Trail network; alternatively, the project could be funded internally.

Actual costs for the various IMP related projects will be included in specific IMP technical memoranda on that topic. Please refer to the Transportation Growth and Active Transportation technical memoranda for specific details.

Climate Lens

Proposed work as part of Main Street – Bath includes modifications to the Windemere Boulevard intersection; reconstruction and repaving of sections of Main Street – Bath; improvements to the stormwater system and drainage; construction of sidewalks; and a pedestrian crossing.

Climate conditions that will most likely impact remedial transportation projects in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). More frequent heatwaves and shorter winter ice road seasons due to warming may result in softening and rutting of roads (Swanson D. , Murphy, Temmer, & Scaletta, 2021).
- The number of days expected to reach above 30 degrees is expected to increase, while the number of days below -15 degrees is expected to decrease in the next 30 years (ICLEI, 2021).
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and overland flow.
- Increased overland flow of stormwater from roadways into surface water bodies such as Millhaven Creek increases loading of sediment and other pollutants.

Climate Change Mitigation

How can these projects assist in mitigating the impacts of climate change?

- Follow best management practices regarding the management of excess soil materials with the goal of reusing materials on-site when possible
- Follow best management practices regarding the use of new materials such as materials that are mined including granular materials, using recycled materials when possible
- Reduce the use of materials that are high in embodied carbon (e.g., concrete, steel, aluminum) and use alternative materials (e.g., low-carbon concrete, high-density recycled plastic, cross-laminated timber, alternative steel technologies)

and designs (e.g., open-bottom modular culverts, prefabricated/composite bridges) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050. (CarbonCure, 2020)

- Source materials as local as possible to reduce the amount of greenhouse gas (GHG) emissions created by transport
- Consider using roundabouts instead of traffic signals at the Windemere intersection to mitigate additional GHG emissions from idling vehicles (City of Fredericton, n.d.)
- Increase riparian buffers along surface water bodies and creeks to protect waterways from pollution associated with overland flow

Climate Change Adaptation

How can these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Increase culvert capacities to manage increased precipitation and prevent washouts (Swanson D. , Murphy, Temmer, & Scaletta, July 2021)
- Increase storm and sanitary sewer capacities to manage increased precipitation and inflow and infiltration
- Use heat-tolerant pavement mixtures to reduce pavement softening, rutting, and bleeding (Swanson D. , Murphy, Temmer, & Scaletta, July 2021)
- Consider the potential of increased water levels in roadside ditches when regrading and adjusting road elevations
- Consider increasing the number of impermeable surfaces in future development to decrease the amount of overland flow during storms
- Consider the slope of paved surfaces to direct overland flow away from residences and towards drainage ditches and storm sewers

Linkages

Transportation Future Development Technical Memorandum

Active Transportation Technical Memorandum

Stormwater Minor System Technical Memorandum

The primary project(s) for Main Street – Bath are the reconstruction of the eastern portion of the Connecting Link from Centennial Park easterly. This section includes the Windemere Boulevard intersection as well as urbanization of the right-of-way. Both elements are growth related.

The active transportation section of the IMP has noted the objectives for this corridor Including the proposed Waterfront Trail improvements, the need for improved pedestrian crossings, and sidewalk facilities along the corridor.

The stormwater evaluation notes a few projects that will have a minor impact, particularly during construction of Main Street – Bath.

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

City of Fredericton. (n.d.). *Roundabouts*. Retrieved from City of Fredericton: https://www.fredericton.ca/en/roads-parking/roundabouts

Corporation of Loyalist Township. (2021, October 25). *By-law 2021-066 - A by-law to establish development charges for the Corporation of Loyalist Township*. Retrieved from Corporation of Loyalist Township: https://loyalist.civicweb.net/filepro/documents/?preview=160286

GHD. (2021). *Review of Development Impacts in Bath.*

GHD. (2022, July 12). *Main Street Pedestrian Facilities and Somerset Drive Improvements.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Keystone Bridge Management Corp. (2022). *2022 Bridge & Large Culvert Biennial Inspections Loyalist Township.*

MMM Group Limited. (2015). *Existing Guiderail Report - Main Street Culvert.*

Municipal Engineers Association. (2023). Appendix 1 - Project Schedules. In M. E. Association, *Municipal Class Environmental Assessment.*

Ontario Ministry of Transportation. (2016). *Ontario Traffic Manual Book 15, Pedestrian Crossing Treatments.*

Ontario Ministry of Transportation. (2021, August). *Ontario Traffic Manual Book 18 - Cycling Facilities.* Retrieved from Ontario Ministry of Transportation.

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (2021). *Advancing the Climate Resilience of Canadian Infrastructure.* International Institute for Sustainable Development - IISD.

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (July 2021). *Advancing the Climate Resilience of Canadian Infrastructure: A review of literature to inform the way forward.* International Institute for Sustainable Development.

Conclusions

This report has been prepared primarily to tie together the many infrastructure elements noted in developing the IMP, so the Township can develop an effective strategy for improvements along the Main Street – Bath corridor.

Priorities for this corridor include the following:

- Intersection improvements at Windemere Boulevard
- Sidewalks on the south side of Main Street – Bath
- Drainage improvements
- Pavement restoration, east end
- Pedestrian crossings at Manor Road, Somerset/Windemere area, and downtown core

It is recommended that the Main Street – Bath right-of-way, from the former east Village limit to Centennial Park, be modified to suit future trail enhancements during the next rehabilitation project.

It is recommended that Loyalist Township apply for Connecting Link funding at each opportunity throughout the construction phase of the east end of the Main Street – Bath project.

It is recommended that all buried municipal infrastructure be replaced concurrent with the phasing of the road rehabilitation, according to the replacement schedule within the Township’s asset management plan.

IMP Technical Memorandum: Main Street – Odessa Remedial Roads Needs

Asset Class: Roads and Stormwater

Objective: The purpose of this technical memo is to provide an overview of the infrastructure needs within and immediately adjacent to this corridor.

Background: Prior to the mid 1990s, Main Street – Odessa was under the authority of MTO and known as King's Highway 2. The road was downloaded to the County of Lennox and Addington ("the County") and is now known also as County Road 2, with the County administering of the right-of-way. MTO was responsible for the current road design, apart from the County Road 6 intersection which was upgraded in the early 2000s by the County.

The right-of-way includes trunk water, sanitary, and storm trunk mains, as well as overhead utilities and buried natural gas lines. The water and sanitary systems belong to Loyalist Township while the storm system is the responsibility of the County.

There are a variety of cross-sections along the urban sections. At the two extremities of the community boundaries, the highway has a typical rural cross-section. This cross-section transitions to an urban section with paved boulevards and sidewalks on each side. The boulevards allow for some parking.

There are inconsistencies in sidewalk standards along much of the route. There are drainage concerns at almost every intersection. The current design has minimal allowance for bicycles. School crossings are inadequate, especially when considering the recent development in the west end of the community.

The County has indicated that this section of County Road 2 is slated for reconstruction, and preliminary planning is underway. Loyalist staff met with County officials and reviewed the known deficiencies within and adjacent to the right-of-way. Minutes from this meeting represent a comprehensive needs assessment of the corridor.

Subsequently it has been decided that as part of the County project, Loyalist will replace all waterworks within the right-of-way, and the Township will advise at a later date the level of replacement/rehabilitation of the Township's sanitary system.

The Potter Street intersection, representing a road segment from Creighton Drive to West Street, has been prioritized as the initial phase of the project.

Assumptions

At the time of writing this memorandum it is assumed that development will continue in the west end of Odessa, with the completion of the Odessa West neighborhood (comprising the Babcock Mills and Millcreek developments) and the proposed Fields of Loyalist development. Development is also expected on the triangular shaped piece of land bounded by County Road 2, Henzy Street, and Shane Street.

It is assumed that traffic volumes on this road will continue at a rate that surpasses the regional population growth rate of approximately 1% per year.

It is assumed that the County will complete reconstruction of Main Street – Odessa (the urban portion of County Road 2) within the next decade with the project currently planned to be completed in phases.

Methodology

A full review of the needs of the corridor are detailed in the meeting minutes from July 8, 2021, which are attached as Appendix A to this memorandum (Loyalist Township, 2021).

The County will manage the primary project. Loyalist will contribute to those components of the project owned by the Township. All work within a phase is expected to be completed concurrently, regardless of which agency owns/administers the asset.

Loyalist staff will continue to meet with County staff to develop a work plan.

As of May 2023, the overall phasing has been outlined as follows:

- Phase 1, Potter Street to West Street/Durham Street. Includes realignment of West/Durham intersection and new rear entrance to firehall
- Phase 2, Potter Street to west community limit
- Phase 3, balance of Main Street - Odessa to east community limit

Phase 1 design is underway in 2023, with construction planned for 2024-2025. Construction for phases 2 and 3 is currently scheduled to begin in 2026 and expected to extend over multiple seasons due to the inclusion of underground utility revitalization.

As each phase is completed, it is expected that Loyalist will address all remedial issues within and adjacent to the corridor. The schedule is subject to change and will be administered by the County of Lennox and Addington.

Analysis

Every intersection requires some measure of drainage improvements, ranging from additional catchbasins to realignments of side street gradients to facilitate drainage.

There is the potential that the Township's remedial drainage needs may trigger a need to upgrade the County's storm sewer system.

The current urban cross section with sporadic on-street parking does not facilitate cycling activities; however, the on-street parking is desired by the owners of commercial operations fronting on Main Street – Odessa. It is hoped that the Township's requirements for arterial roads to have sidewalk on each side of the road can be supported for the whole project; and where possible, one of the sidewalks may be improved to the status of a multi-use pathway. This is a lofty goal when considering the varying priorities for Main Street – Odessa and the property constraints on the corridor.

Many residents have requested traffic calming measures. However, two Emergency Detour Routes (EDR) from Highway 401 utilize the entire length of Main Street – Odessa and the bordering sections of County Road 2. The EDR is frequently activated when incidents cause the closure of Highway 401, leading to extreme traffic volumes through Odessa.

Financial

A broad conceptual project scope has been established in advance of the design process, to estimate the Township's share of the project budget. The estimated budget will need to be revisited following design. The Township's overall construction costs would be funded over three or more capital budget years, anticipated to be approximately 2024-2026.

The conceptual project scope includes one 1.5m sidewalk on the north side along the full length of Main Street – Odessa, as well as one 3m multi-use pathway on the southside throughout the full extent which would preclude any parking on the south side of the street. The overall project cost is estimated to be $19,462.708. The County's financial responsibility includes the road and stormwater systems within the right-of-way; and the Township's responsibility is the water and sanitary systems, sidewalks, and the stormwater systems on adjacent roads that contribute to the County's stormwater infrastructure.

Climate Lens

Proposed work as part of Main Street – Odessa includes modifications to major intersections to include traffic signals, reconstruction, and repaving of sections of County Road 2 and County Road 6, improvements to the stormwater system including modifications to curbs and gutters and ditches, and expansion of urbanization of Main Street – Odessa including construction of sidewalks.

The extent of Main Street – Odessa is generally flat, with shallow soils on top of impermeable limestone, often resulting in flooding of Main Street – Odessa and adjacent streets. Increased overland flow as a result of increased intensity and duration of precipitation will likely result in increased inflow and infiltration of storm sewers. Given the shallow soil conditions, permeable pavement and other low impact development (LID) options are not feasible in the Odessa area.

Climate conditions that will most likely impact remedial transportation projects in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021). More frequent heatwaves and shorter winter ice road seasons due to warming may result in softening and rutting of roads (Swanson D. , Murphy, Temmer, & Scaletta, 2021)

- The number of days expected to reach above 30 degrees is expected to increase, while the number of days below -15 degrees is expected to decrease in the next 30 years (ICLEI, 2021).
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and overland flow.
- Increased overland flow of stormwater from roadways into surface water bodies such as Millhaven Creek increases loading of sediment and other pollutants.

Climate Change Mitigation

How can these projects assist in mitigating the impacts of climate change?

- Follow best management practices regarding the management of excess soil materials with the goal of reusing materials on-site when possible
- Follow best management practices regarding the use of new materials such as materials that are mined including granular materials, using recycled materials when possible
- Reduce the use of materials that are high in embodied carbon (e.g., concrete, steel, aluminum) and use alternative materials (e.g., low-carbon concrete, high-density recycled plastic, cross-laminated timber, alternative steel technologies) and designs (e.g., open-bottom modular culverts, prefabricated/composite bridges) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050. (CarbonCure, 2020)
- Source materials as local as possible to reduce the amount of GHG emissions created by transport
- Consider using roundabouts instead of 4-way stop at intersections to mitigate additional GHG emissions from idling vehicles (City of Fredericton, n.d.))
- Increase riparian buffers along surface water bodies and creeks to protect waterways from pollution associated with overland flow

Climate Change Adaptation

How can these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Increase culvert capacities to manage increased precipitation and prevent washouts (Swanson D. , Murphy, Temmer, & Scaletta, July 2021)

- Increase storm and sanitary sewer capacities to manage increased precipitation and inflow and infiltration
- Use heat-tolerant pavement mixtures to reduce pavement softening, rutting, and bleeding (Swanson D. , Murphy, Temmer, & Scaletta, July 2021)
- Consider the potential of increased water levels in roadside ditches when regrading and adjusting road elevations.
- Consider increasing the number of impermeable surfaces in future development to decrease the amount of overland flow during storms
- Consider the slope of paved surfaces to direct overland flow away from residences and towards drainage ditches and storm sewers

Linkages

Remedial Transportation Topics Technical Memorandum
Active Transportation Technical Memorandum

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

City of Fredericton. (n.d.). *Roundabouts*. Retrieved from City of Fredericton: https://www.fredericton.ca/en/roads-parking/roundabouts

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Loyalist Township. (2021, July 8). Odessa - Main Street IMP Discussion.

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (July 2021). *Advancing the Climate Resilience of Canadian Infrastructure: A review of literature to inform the way forward.* International Institute for Sustainable Development.

Attachments

Attachment “A”: Odessa – Main Street IMP Discussion Minutes

Conclusions

The County’s need to rehabilitate the Main Street – Odessa road surface provides an opportunity to update active transportation infrastructure and underground works. Main Street – Odessa is a vital key link for local transportation due to the physical local constraints created by Highway 401 and Millhaven Creek.

1. That Loyalist Township address the remedial stormwater concerns within and adjacent to the Main Street – Odessa corridor.
2. That Loyalist Township and the County of Lennox and Addington upgrade the Potter Street intersection in accordance with the needs outlined in the Odessa West Neighbourhood Study.
3. That the Township work closely with the County of Lennox and Addington to improve active transportation through the community of Odessa.
4. That Loyalist Township undertake life cycle replacement of underground water and sanitary infrastructure during the County's road reconstruction project.

Attachment “A”

Review of Main Street - Odessa IMP Discussion – Minutes

Date: Thursday, July 8, 2021 via Microsoft Teams

N.B. This meeting is being referred to internally as IMP weekly Meeting No. 50.

Comments not verbatim. These minutes were reorganized on January 18, 2022, after receiving initial comments, with items of concern listed from west to east. Individual sub-issues have been identified.

Attendees:

Dave Thompson
Jenna Campbell
Joe Gratton
Alex Scott
Lorie McFarland
Richard Cox
Cory Grant
Brad Nieman
Sarah Doherty
Jim Klaver
Chris Wagar
James Feeney

Regrets:

Sheila Buck
MJ Merritt
Meaghan Davey
Fred Stephenson

Minutes:

Laurissa Tassielli, Katie Amey, David Thompson

Jim provided a high-level overview of the current County budget.

In 2022, the County intends to initiate the County Road 2 and Potter Drive subdivision improvements (includes Creighton modification when referring to Potter) consistent with intent of Odessa west neighbourhood plan. The proposal is to realign the school entrance with Potter Drive, installation of traffic signals at that intersection. This design is underway.

The County currently has the County Road 2/Main Street – Odessa and County Road 6 reconstruction from Highway 401 southerly to Millhaven Road scheduled for 2025.

In addition to the paving through Odessa the County is planning the repaving of County Road 2 from County Road 4 to the west limits of Odessa in 6-10 years.
Chris noted that for the larger project the County is flexible both in project scope and timing and will accommodate the Township's needs.

Jim advised that the current County scope includes improvements to the storm system, curb and gutter, and asphalt resurfacing and some intersection upgrades.

Jim advised that the Main Street – Odessa project limits would be from the west limit of serviced residential area easterly to approximately 200 metres east of Shane Street.

Dave noted that the purpose of this meeting was to discuss various infrastructure concerns that the Township was experiencing with Main Street so that project planning could be completed with an understanding of the Township's scope of work. The timing of this project would present an opportunity for the Township to address some of the life cycle replacement of some of its assets in a cost-efficient manner and to update the road cross-sections to meet the needs of a growing and active community. The result would be a list of projects for consideration within the full scope of the project when the Main Street – Odessa project enters the design stage.

Dave noted the objective of today's meeting is also to identify which level of government would bear financial responsibility for the various improvements.

Chris provided a high-level overview of the cost sharing policy for these types of projects. Chris noted that paving and Main Street – Odessa-related storm sewer improvements would be the County's responsibility, as well as sidewalks if they are impacted by the construction. Areas that need to have sidewalks added would be Township responsibility. If there is not a sidewalk grade adjustment caused by highway reconstruction, then new sidewalk reconstruction would be a Township responsibility. In Odessa the sidewalks are elevated above the road, so that would be Township responsibility if the sidewalks were extended in similar fashion, but any that are flush with the road surface would be County responsibility if modifications were required.

Richard asked who is responsible for sidewalk costs if the road grade is lowered. Chris responded that if the road grade is lowered, then there is less impact to the sidewalks, so it is still a Township responsibility. Mountable curbs would be County responsibility as well as paved roads.

The County will perform full-depth excavation at its expense. This will result in potential savings should the Township consider replacement of its existing potable water and sanitary sewer infrastructure or if additional Township storm sewers are installed. Should these activities be included in the scope, the Township will need to consider the scheduling of this type of project and the overall impact on County project costs.

Chris noted that the schedule is very flexible at this stage, and the Township could decide to do any underground work in advance of the County resurfacing operations, or the construction scopes could be completed concurrently with potential multi-year phasing of the overall project.

Dave summarized these discussions and stressed the importance of evaluating the condition of the underground systems and advising the County soon of the scope of the Township's planned work.

Brad questioned the Township's responsibility as to when water and sewer underground work should be completed at these locations. After some discussion it was agreed that the Township should set its general objectives for the scope of water and sewer within the right-of-way as part of the IMP project in the fall of 2021/spring 2022. Where detailed investigation by sampling, flushing/CC video, etc., is required, this activity should ideally be budgeted for and completed in 2022 so that the project(s) is ready for detailed design in 2023. The decision to upgrade or replace main piping is an internal decision of Loyalist Township. If the mains are replaced or relined then consideration for replacement of services will be required.

Brad also asked whether the manholes could be done with the Main Street reconstruction, rather than separately. The County will be responsible for resetting the tops of any manholes as part of the roadway reconstruction. If there is structural work below the asphalt grade, that repair would be the Township's responsibility. This work can be scheduled anytime that makes the most sense, but definitely ahead of final paving.

Jenna noted that past reconstruction projects in Odessa have resulted in sudden watermain failures and a concern of losing use of the storage tower. The original watermain is series pipe and can be prone to longitudinal failures in the pipe wall which require immediate response, due to the short time involved in losing pressure in the system.

There was a broad discussion on scheduling scenarios should the Township wish to complete water and sewer upgrades.

Chris responded that the final project staging will depend on the scope of the work that needs to be done. The County's scope of curb and gutter repair, storm sewer upgrades, and resurfacing could likely be planned to be fully completed in one year, but if it's planned to do water and sanitary as well, the project could be phased over 2-3 years.

Joe commented that in his opinion, there is limited financial benefit to relining watermains if the pipe can be excavated, especially when servicing is to be addressed. He feels that it would be better to extend the project timeline and do all the work concurrently on a phase-by-phase basis.

(Post meeting comment: The Township intends to replace or reline all waterworks within the Main Street – Odessa corridor as part of the overall project with detailed scheduling to be determined later. The Township will investigate the condition of the sanitary system and develop a repair/replacement program to be performed concurrently with the water main replacement.)

There was a lengthy discussion on what the future cross-section on Main Street – Odessa would look like.

Chris noted that if the Township would like improvements, the County is open to consider options. Jim noted that on similar projects in Napanee, items such as pedestrian crossings, accessible parking, decorative light fixtures, matching benches, bike racks, planters, etc., would be considered. Jim suggested downtown Napanee as one design option, and the Township should look at others.
It was noted that there are no formal crossings of Main Street – Odessa currently, and uncontrolled crossings on Main Street – Odessa are challenging.

Chris commented that there would need to be a discussion with the Township regarding curbs. He suggested that the County could move the curb face back adjacent to the sidewalk edge, or on the actual gutter line/drainage point. He suggested the Township discuss this with the Town of Greater Napanee and see how that's working for them with their design.

With respect to the discussion of parking bays with curbs along Main Street – Odessa, Alex noted that when preparing the detailed design, there is a need to consider the Township's snow clearing operations, and the complications parking stalls will pose for this.

Alex raised a concern regarding the elevation works in Main Street – Odessa, that there may be some grade challenges doing curbs. The road is quite a bit lower than the sidewalks. Also, wider asphalt will increase traffic speed on Main Street – Odessa.

Lorie asked how it would work to have wider sidewalks, higher curbs, and parking on street. Chris responded that this is one of several possible options, and similar to work completed in Napanee, but it's more of a Township decision of what Loyalist Township would prefer.

Lorie noted that increasing speed with bikes not having their own lane is not a great idea. She asked whether the County is looking into grants geared toward active/passive transportation. Chris responded that the County has not received these types of grants in the past, but he will look again as the project gets closer. As of now the grant programs that he is familiar with don't extend beyond the 2023 year.

Jenna asked whether any consideration might be given to adding active transportation, such as wider bike lanes, or separate active transportation on one side of the road instead of sidewalks. Chris responded that there are no plans that he is aware of. Cycling lanes are also not recommended in urban areas, as there is a minimum width recommended for a proper bike lane. There is also not a high demand for cyclists.

Joe asked if the County would consider eliminate parking on one side and do a bike lane on the another. Jim advised that businesses want as many parking spaces as available for Odessa. In Napanee there is accessible parking in the easiest-to-access locations, such as the far side of the intersection, with a curb radius letdown that’s extended for the parking space in the first stall, in order to easily get out and in curb.

One suggestion for traffic calming was to install a continuous painted line for the parking stalls, or a painted “T” to mark the end of the stalls to give an impression of narrowing of lanes to help with the speed if there are no cars parked. Kingston and Belleville did concrete parking stalls which is another option. It was noted that functionality, speed, and design/appearance need to be kept in mind for this.

Dave noted that as part of the Township’s Infrastructure Masterplan, the Township is assessing the community desire for increasing the active transportation infrastructure within the Township.

Jenna noted that community feedback on desired traffic calming features here should be undertaken, as well as what the public is looking for on Main Street – Odessa. The Township can help with public outreach.

Lorie and Jenna suggested that it would be beneficial for the County to put a business committee together to gain local feedback for the project. If they are a part of the solution, then we have their support going through this.
(Post meeting update from MJ Merritt September 2021: “Stephen Paul and I discussed the comments with regards to potential cross sections for Main St. He explained that in an earlier County EcDev meeting, Main Street – Odessa business owners expressed interest in meeting to discuss business improvements/BIA opportunities. I suggested that Jenna attend that meeting with Bohdan and I to discuss potential cross section improvements and we all agreed this would be a good idea.” MJ noted meeting planned for September.)

The meeting then started to focus on specific issues generally moving from the west limits of Odessa easterly to the east limits. The minutes of the meeting have been slightly re-arranged to reflect the west to east discussion. To assist in referencing minutes, the cross-sections of Main Street – Odessa have been noted. Estimate of widths is from a review of Google maps imagery and should not be relied upon.

Alex noted that a roundabout is more challenging in the urban area, and a traffic signal would be better for pedestrians and children going to school with a more controlled intersection. He suggested that it might make sense to install a roundabout at the location of the future west collector to the undeveloped (former Poulus) lands, as shown as per the Odessa West Neighbourhood Plan to achieve traffic calming for vehicles approaching Odessa.

Cross-section: West limit to entrance of 15 Main Street – Odessa townhouse complex. Rural section with partially (approximately 1.0m wide) paved shoulders, posted speed 60 km/h.

Cross-section: East side of entrance to 15 Main Street – Odessa easterly to Creighton Drive. North side is a rural section with partially (approximately 1.0m wide) paved shoulders. South side has sidewalk with barrier face and paved shoulder (approximately 1.0 m wide) with catchbasins at gutter line.

The County plans to upgrade the Creighton Drive and Potter Drive intersections in 2022 as one project. Access to Creighton Drive will be modified to a "right turn into and a right turn from" as per the Odessa West Neighbourhood plan. This work is funded by the County.

Loyalist identified that it plans to upgrade Creighton Drive from South Street north to Main Street to meet the traffic needs as identified in the Odessa West report and to address remedial stormwater issues. This work will be completed concurrently with the County project.

The Township alerted County attendees of the drainage complaints received from a resident on the southwest quadrant of the intersection who receives stormwater runoff from the south side of the road. Alex suggested that the drainage path is very flat and as such doesn't get cleaned out and is not maintained.

Chris and Jim offered their comments that for Creighton Drive, most of the water originates from the school yards and County road right-of-way, which is an existing condition. A block should have been obtained prior to the lot creation but it wasn't done; relatively major flow is coming through private lands, and yards aren't set up for handling this. The County's thought is to leave this as is, because if the area is urbanized, it is doubtful it would be changed. There is no ability to extend the County storm sewer and the bigger issue is lack of clean out, coming from complaints from residents.

Dave agreed that the problem is the homeowners' issue, but the problem isn't going to go away. Negotiations may be required to facilitate a swale cleanout on private (former

Poulos) lands to relieve some of the current problems faced by residents on west side of Creighton Drive.

Cross-section: Creighton Drive easterly to Potter Drive. North side is a rural section with partially (approximately 1.5 m wide) paved shoulders. South side has sidewalk with barrier face and paved shoulder approximately 1.0 m wide) with catchbasins at gutter line. Eastbound speed reduces to 50 km/h immediately west of the Creighton Drive intersection. Sidewalk width looks less than 1.5m. The existing entrance to Ernestown Secondary School has curbed radii and sidewalk. The shoulder is paved full width once curbs start. The school entrance is just west of Potter Drive.

The County is going to upgrade Potter intersection in 2022 ahead of the balance of Main Street – Odessa. The County is relocating the high school entrance to align with the Potter Street improvements. A roundabout and a signalized intersection were being considered, but the County is currently leaning towards signalization, as the roundabout's ability to manage high pedestrian movements is limited. This work is funded by the County. Loyalist will be upgrading Potter Drive from South Street to Main Street – Odessa to collector requirements, as per the Odessa West Neighbourhood Plan, to match the new intersection alignment concurrent with the County's project.

Cross-section: Potter Drive to West Street/Durham Street intersection. North and south sides have a rolled faced curb and gutter at edge of pavement with a 0.75 m paved strip between sidewalk and curb with catchbasins at gutter line.

The Township and County discussed the need to reconstruct all sidewalks at commercial entrances where the sidewalk is currently stopped at the edge of the entrance. These sidewalks don't meet current Township requirements; specifically, the entrances in this section are the Pop-In convenience store, the firehall, and school entrances. Sidewalks will need to be established and built to commercial entrance specifications.

The Township alerted County attendees for the need to improve drainage between the firehall and Pop-In properties. It was suggested that a permanent feature be added so that traffic cannot move from property to property at this location. Chris noted that the entrances to the Pop-In do not comply with County policy and that they will work with the Pop-In to improve the situation.

Dave noted that drainage around West Street intersection is poor and should be closely looked at during design stage.

Dave asked if there should be any changes to the fire station's entrance, and whether the existing fire hydrant suits the Township's needs. James responded that the existing fire hydrant does suit their needs currently. They will look at the entrance details more in-depth and provide a definitive answer at a later date.

Chris noted that the Township currently employs a crossing guard at West Street. He suggested that the Township review this situation once the Potter Drive upgrade is completed.

Cross-section: West Street/Durham Street intersection easterly to Cross Street. North and south sides have a rolled faced curb and gutter at edge of pavement with catchbasins at gutter line. North boulevard is typically 3.0m wide and paved with sidewalk at property line. South boulevard is primarily 3.0m wide, but narrowing at intersections and paved with sidewalk typically at property line.

Joe commented on the narrow alignment of Cross Street and the inability to extend a sidewalk onto Cross Street. Joe also noted the difficulty in drainage as there is currently a non-draining area adjacent to the corner properties on Cross Street. He noted that the Township is currently in a design stage for Cross Street upgrades and recommended that Loyalist and the County work together on new vertical alignments for Cross Street to eliminate the drainage issue. Joe noted that the Township is planning to bring the storm sewer up South Street to the intersection of Cross Street. It would be good to have another catchbasin there draining into Main Street – Odessa as part of the Township project, just need to make sure the capacity is there to take the additional flow. It's hard to make grade changes on the road because all the properties are so close. There is a sub drain here but nowhere to outlet the subdrain right now. We need to have a conversation on how to coordinate this work.

Cross-section: Cross Street intersection easterly to Old Wilton Road. North and south sides have a rolled faced curb and gutter at edge of pavement with catchbasins at gutter line. North boulevard is typically 3.0m wide and paved with sidewalk at property line. South boulevard is primarily 3.0m wide but narrowing at intersections and paved with sidewalk typically at property line.

Cross-section: Old Wilton Road to Mud Lake Road. North side rolled faced curb and gutter, except on Millhaven Creek structure where there is a vertical sidewalk face at edge of pavement. Typically sidewalk is adjacent to curb and much of north side has a railing. Due to pavement super-elevation, there are no catchbasins. South side is the same as the north side from Bridge Street to Mud Lake Road. West of Bridge Street, the paved should gradually widens approaching Old Wilton Road. There is one catchbasin west of Bridge Street and three deck drains on the bridge.

There was a general discussion about the structure on the southeast quadrant of the Bridge Street intersection. The Township noted the extremely sub-standard road width of Bridge Street near Main Street – Odessa.

Jenna noted the desire of Loyalist, as per the Official Plan, to develop a trail system along Millhaven Creek. The narrow right-of-way at this location makes this problematic. Jenna noted that Bridge Street (along with Cross, West, and Battery Streets) is also currently in design stage and the County should satisfy itself that the existing county storm outlet from Main Street – Odessa to Millhaven Creek is sufficient.

Dave asked Chris about the condition of the bridge over Millhaven Creek. Chris responded that the County will do a survey to see anything needs to be done on the actual bridge, but as of now it doesn't look like anything needs to be done other than an asphalt surface in the next 10 years.

There was a brief discussion regarding the new MECP requirements for linear storm sewer systems and the impact this may have on County and local storm systems within Loyalist Township. Jenna noted that we will need to have a conversation about when drainage goes from the Township to the County, and back and forth, on how this responsibility will change with the new linear ECA framework that the Ministry is implementing.

Cross-section: Mud Lake Road to County Road 6. North and south sides similar, rolled faced curb and gutter at edge of pavement with catchbasins in gutter line. Typically a 3.0m wide paved boulevard used as parking space and sidewalk is at property line. Boulevard tapers to almost 0m width approaching each intersection over a distance of 30m.

Alex raised the concern that the north sidewalk is discontinued at the west side of a commercial entrance. There is no sidewalk across the frontage of O'Neil's Garage and easterly to the County Road 6 intersection. Current arrangement in front of garage forces pedestrians into traffic.

There was a general discussion on drainage of the side streets in the section from Mud Lake Road to County Road 6. Except for Factory Street which has its own storm sewers, all the side streets are in need of drainage improvements. The general lay of the land is flat. Roads coming from the north of Main Street – Odessa generally have flat surface flow towards Main Street – Odessa and would benefit from northerly extensions of the storm water systems. Storm water in the vicinity of streets south of Main Street – Odessa generally flows south and there are some small shallow systems in place.

Future changes in grading should attempt to minimize surface flows going south.

(Post meeting comment: As an example of the drainage concerns noted in the preceding comment, Dave notes that in previous evaluations of William Street,

the only way that drainage can be achieved at the northern end at the corner is to install a ditch or storm sewer to Main Street – Odessa. There are currently undeveloped lots in this area that informally act as local stormwater management facilities. When these lots are developed, the need for street drainage can be expected to increase substantially.)

Dave suggested that all radii should have inlets to assist with the drainage of side streets and to prevent surface flows from leaving the right of way and flowing southerly.

Cross-section: The County Road 6 intersection consists of single north and south bound lanes, a south bound right turn lane and a northbound left turn lane. Anecdotally, the queuing lanes look sub-standard in size. There is a house in the southwest quadrant which is currently restricting the installation of a proper right hand turn lane. All radii have rolled faced curb and gutter. There are currently no sidewalks at this intersection or on County Road 6 apart from the sidewalk that extends from Factory Street to County Road 6 on the south side of Main Street.

Jim mentioned that the County will be resurfacing County Road 6 in 2021 commencing at Millhaven Road and heading south. The balance of County Road 6 northerly to the 401 off-ramps will likely be completed as part of the Main Street – Odessa program.

Chris noted that the County will be re-evaluating this intersection and a roundabout at this location is one of the options. He noted that the tight right and left turns here as well need to be dealt with. The County will reach out to Vanessa Skelton, GHD, to come up with a review of this intersection to include our discussions.

Dave commented that the intersection will require some major water and sanitary update work.

Joe noted that he has started to work on some of the water and sewer servicing issues at the intersection of Main Street – Odessa and County Road 6. He noted that the reconfiguration of the water pipes for better hydraulic flow, decommissioning of older redundant piping, and relocation of valves to avoid traffic interference during valve operation are being considered. Joe also noted that the services for the houses on the west side of County Road 6 south to Millhaven Road, are switching from the old original main to the newer trunk main on County Road 6. All of this work needs to be completed prior to resurfacing the intersection and County Road 6.

Dave noted that he has been informed that MTO plans to close off the connection to the south leg of Mud Lake Road from the Highway 401 EBL on and offramps. This project is in the early planning stages. Closure of this connection will result in increased turning movements at the Main Street – Odessa intersection with County Road 6. Intersection reviews should keep this in mind.

Dave asked if the Emergency Services have capability of controlling new intersections, and whether this is something the Emergency Services Department could provide direction on. James responded that Emergency Services does not have a control mechanism, so it wouldn't be an issue. The Emergency Services Department like to be involved with future discussions regarding this intersection design.

Cross-section: County Road 6 to 210 Main Street – Odessa (entrance to Odessa Fairgrounds). Rolled faced curb and gutter on both sides of road, catchbasins at gutter line. North side has 0.5 m paved maintenance strip, south side has 0.5 m paved boulevard and then a sidewalk of sub-standard width. At County Road 6 the sidewalk narrows to nothing east of the intersection.

Cross-section: 210 Main Street – Odessa to west side of 263 Main Street – Odessa (entrance to Loyalist Township municipal office). Rolled faced curb and gutter on both sides of road, catchbasins at gutter line. North side has 0.5 m paved maintenance strip, south side has 0.5 m paved maintenance strip behind curb and a wide grass boulevard and then a sidewalk of substandard width. Shallow storm sewer on north side at approximately the former ditch line. Curbs stop at civic 247 Main Street – Odessa and road is rural section from that point east.

Dave noted that the Loyalist office should have the sidewalk constructed to commercial entrance requirements and the sidewalk should be extended across the entrance. Drainage from the northeast corner of parking lots needs an outlet. The grade at entrance is difficult for sightlines when exiting the parking lot. There is a need to confirm that the vertical alignment of the entrance is appropriate for traffic volumes, speeds, and grades on County Road 2.

Alex noted that the ditch inlet grates ahead of the storm sewers are difficult to maintain.

Dave noted that the ditch system along the east end of Main Street – Odessa is insufficient, and the new design needs to address this. Dave suggested a storm sewer extension would be beneficial.

There was a general discussion on drainage in this area. The ditches around the office and easterly to Henzy Street run full during spring run-off on south side, as does the north side ditch. The County was asked about improvements, and whether they would consider extending the north side sewer that outlets at County Road 6 and runs easterly, thereby making it a proper sewer. Chris responded that they wouldn't look at extending the pipe system; however, they could change the inlet and replace it if it's a significant maintenance issue.

Cross-section: 263 Main Street – Odessa to east side of the western entrance to 295 Main Street – Odessa (entrance to seniors' apartments). Shoulders are paved approximately 1.0m wide and the balance is gravel. Ditches on both sides, sidewalk on south side.

Cross-section: 295 Main Street - Odessa western entrance to east of Shane Street. Shoulders are paved approximately 1.0m wide and the balance is gravel. Ditches both side, curb and gutter, rolled faced curbs at Shane Street intersection radii.

Dave asked Township development staff about timing on the potential development at 315 Main Street – Odessa. Is the developer responsible for the Henzy Street upgrades, or is that the Township's obligation? Cory advised that the development is on its way with draft plan approval, so it could proceed as early as 2023. The financial obligations are to be negotiated. The developer must put sewer and water partially up Henzy Street to the new development entrance.

Dave noted that the Township will wish for the sidewalk to be extended to Henzy Street and the new development at 315 Main Street – Odessa. There is already a serious drainage issue on record for the house west of Henzy Street (311 Main Street – Odessa). Ditches will need to be modified here to accommodate sidewalk placement. Chris suggested the County could extend the urbanization of Odessa east on the south side, placing a sidewalk there through Henzy Street to Main Street – Odessa.

Brad noted that he would like to see the entrance to the Odessa Water Tower paved. Dave noted that the drainage from the tower site into the ditch is poor causing water to back up into the tower base itself, because the ditch is blocked with ice and snow and doesn't function.

There was a general discussion on the Shane Street intersection and future resurfacing of Shane Street. Jenna noted that the north side of Shane Street will be urbanized to accommodate the new development. Dave suggested that the Township consider a surface upgrade for the balance of Shane Street to County Road 6. Chris noted that paving prices are always better with bigger volumes for the contractor.

Dave noted that there will need to be good three-way communication as the plans and development agreement requirements are finalized for 315 Main Street – Odessa between Loyalist development staff, engineering staff, and the County's Infrastructure Services team.

(Post meeting comment: With urban development along the Shane Street corridor a distinct possibility for the near and mid-term of the IMP study, consideration should be given to improving both the surface and cross-section to urban requirements. Consideration of the alignment of the Shane Street intersection

should be included in the County's Main Street – Odessa program, including the possibility of using the Henzy corridor as an alternative and converting Shane Street into a "local" street, closing the current intersection. I think that Henzy Street and most of Shane Street are 40-foot rights-of-way, so widenings would be required.)

IMP Technical Memorandum: Traffic Calming Initiative

Asset Class: Transportation

Objective: To establish a framework for transparent technical evaluations of locations of traffic calming concerns within Loyalist Township.

Background

Loyalist Township has a responsibility to maintain safe roads for all types of users, including cars, public transit, bicycles, and pedestrians, agriculture and industry vehicles, and road maintenance equipment.

There may be situations where people using the street don't feel safe because basic traffic rules are not being observed by all drivers. In these cases, traffic calming solutions may be required to restore public confidence for using the road right-of-way (ROW).

As the community expands and traffic volumes increase, there appears to be an increase in the number of complaints raised by residents concerning traffic calming. More traffic means less time when a road is clear for safe crossing or for an intersection to be free for turning movements.

The issue is not a strictly local concern. The Canadian Institute of Transportation Engineers (CITE) and the Transportation Association of Canada (TAC) partnered in 2018 to release the second edition of their traffic calming guide (TAC & CITE, 2018). Likewise, many municipalities are updating their traffic calming policies (City of Kingston), (City of Hamilton).

Loyalist Township is the road authority for Township-owned roads and has no jurisdiction over the Ministry of Transportation's ("MTO") Highway 401 and Highway 33 (Bath Road), except within the former Village of Bath; or over the County of Lennox and Addington's ("the County") network of county roads within Loyalist Township.

Loyalist Township has an existing traffic calming policy developed in 2009. With the increased public focus on traffic calming and substantial increases in traffic volumes on Loyalist Township's urban collector and arterial roads, it is recommended that an update to this policy be undertaken in the near future.

Assumptions

An important clarification regarding the intersection of Township roads with other road jurisdictions is prudent for this memorandum. The results of a traffic calming survey conducted in fall 2021 by Loyalist Township (Corporation of Loyalist Township, 2021), were provided to appropriate authorities at MTO and the County with an alert statement that many of the comments were reflective of roads and intersections under their authority. Township staff are aware of these concerns and will be following up with these road authorities periodically. This memorandum focuses only on those roads and intersections under the Township's authority. As background to this issue, when a

Township road intersects with a road of a higher road authority (i.e., County or MTO), the higher road authority is responsible for the intersection.

Generic references to roads, streets, or road rights-of-way within this report refer to the whole public thoroughfare including boulevards, sidewalks, and driving surfaces.

Methodology

The Township is proposing a multi-step approach to the initiative.

The Township has obtained from the Ontario Provincial Police (OPP), a list of motor vehicle accident records for all Township roads for the period 2002-2015. The Township has access to current OPP enforcement officers and their current practices.

The Township maintains a listing of historical complaints concerning potential traffic calming needs.

As part of the IMP process, the Township issued an online survey regarding traffic calming issues in the fall of 2021 and received a total of 375 responses. The survey was designed to qualify the types of concerns residents have and to identify the locations of most concern within the Township were raised. The results have been summarized and appear in the appendix of this memorandum.

The information above was reviewed to develop the proposed framework of the traffic calming initiative.

Loyalist Township's and the County of Lennox and Addington's transportation divisions have in recent years obtained modern equipment for the monitoring of vehicle speeds, intersection turning movements, and traffic volumes; all of which are key pieces of information when analyzing traffic calming concerns. Dialogue and continuous cooperation between the two road authorities and the OPP are ongoing. It is expected that as the initiative develops, the new equipment will be used with greater frequency to monitor Township roads.

For the traffic calming initiative Loyalist Township will review the data available and develop:

1. A primary list of traffic calming concern locations
2. A secondary list of traffic calming concern locations
3. Detailed technical review of the locations on the primary list
4. Develop a policy for future evaluation of traffic calming concerns
5. Apply the policy to the secondary list of traffic calming concerns and any other locations that are submitted in the meantime
6. Evaluate the locations listed on the primary list and subject to the results of a review follow up with any recommendations regarding traffic calming measures.

Analysis

Traffic calming can often be a contentious issue for a variety of reasons. In the past, effective monitoring has been difficult and expensive. Residents often find the topic emotional. Modern equipment has made monitoring easier and more accurate. Enforcement is expensive and due to its nature, cannot be continuous. Due to the interaction of the many factors involved regarding traffic calming, the desired solution of the residents may not always be the recommended technical solution.

In reviewing the OPP accident data, it was noted that many of the accidents were at intersections and were speed-related. Township roads with higher accident frequencies were:

- Manitou Crescent West
- Sherwood Avenue
- Main Street, Bath
- Amherst Drive
- Speers Boulevard
- Kildare Avenue

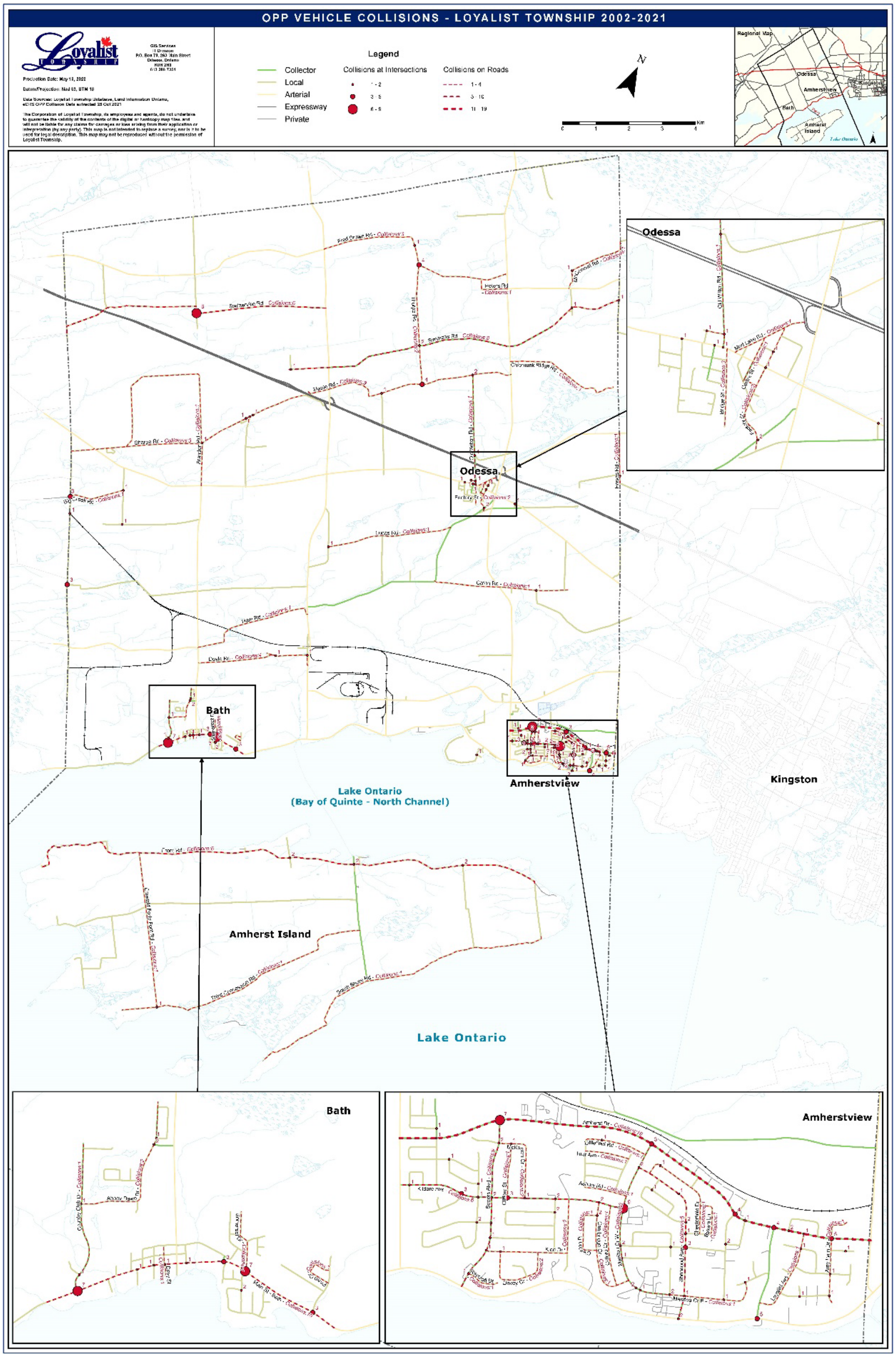


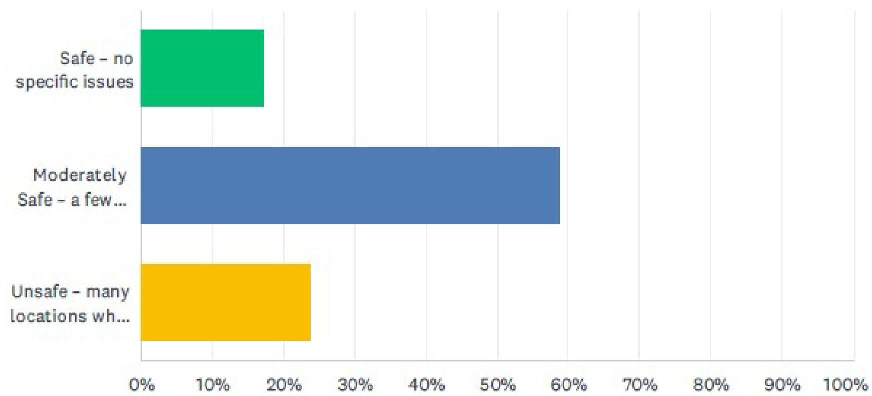
Figure 1 OPP Vehicle Collisions

The accident data clearly indicates a much higher number of accident incidents on the higher volume roads. Some of the higher accident counts may be due to higher traffic volumes; however, frequent comments in the OPP accident data referred to excessive speeds and improper stopping at intersections.

From the traffic survey, the following traffic calming comments have been summarized: as follows:

Q3 With respect to traffic, do you think streets in Loyalist Township are generally:

Answered: 360 Skipped: 17

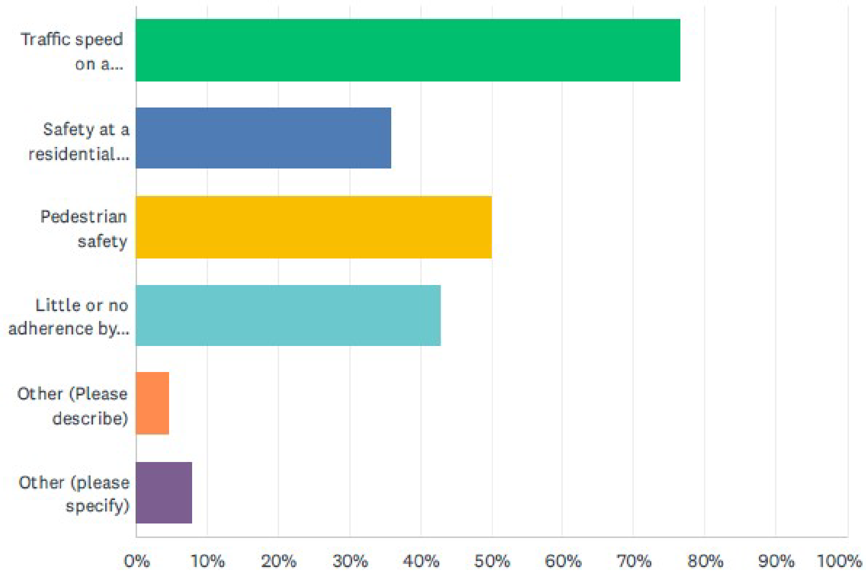


ANSWER CHOICES	RESPONSES	
Safe – no specific issues	17.22%	62
Moderately Safe – a few isolated locations of concern	58.89%	212
Unsafe – many locations where traffic is a concern	23.89%	86
TOTAL		360

Figure 2. Question 3 from Traffic Calming Survey, 2021

Q4 If you responded with “Moderately Safe” or “Unsafe” to the above question, are your concerns primarily due to: (Check all that apply)

Answered: 315 Skipped: 62



ANSWER CHOICES	RESPONSES	
Traffic speed on a residential street	76.51%	241
Safety at a residential intersection	35.87%	113
Pedestrian safety	50.16%	158
Little or no adherence by traffic to signage at intersections	42.86%	135
Other (Please describe)	4.76%	15
Other (please specify)	7.94%	25
Total Respondents: 315		

Figure 3. Question 4 from Traffic Calming Survey, 2021

1. The majority of respondents feel that there are no, or only a few, concerns regarding traffic calming in their community
2. Slightly more than 20% of the respondents indicated that there many traffic calming concerns in their community
3. Speeding was by far the primary concern of the respondents; and to a much lesser extent, general pedestrian safety, followed by safety concerns at intersections

The survey was designed to be a high-level screening tool to gauge a basic level of understanding of the community’s sense of traffic safety. The traffic calming initiative has been included within the IMP as in some cases physical modification to existing road infrastructure may be required. With respect to the various themes of Loyalist Township’s IMP, this would be considered as a remedial project.

From the IMP traffic calming online survey, locations of concerns that were most frequently mentioned were:

- Amherst Drive, between County Road 6 and County Road 24 (Coronation Boulevard)
- Manitou Crescent West, between Sherwood Avenue (southern intersection) and Amherst Drive
- Manitou Crescent East, southern intersection with Sherwood Avenue
- Front Road, intersection with Stella Forty-Foot Road
- Main Street, Bath, between Finkle's Shore Park and former Village east limit (civic address 5825 Bath Road/Highway 33)
- Park Crescent, between Manitou Crescent East and Amherst Drive
- Speers Boulevard, between Bath Road/Highway 33 and Amherst Drive
- Kildare Avenue, between County Road 6 and Manitou Crescent West

These locations illustrated by the survey results are consistent with complaints received in the past from Township residents.

There is a very strong correlation of traffic calming concerns between the OPP accident data, the priority locations obtained from the survey and Loyalist's higher volume urban roads. The combined data was used to develop an initial priority screening as follows:

Primary priority:

- Amherst Drive, between County Road 6 and County Road 24 (Coronation Boulevard)
- Manitou Crescent West, between Sherwood Avenue (southern intersection) and Amherst Drive
- Manitou Crescent East, intersection with Sherwood Avenue
- Front Road, intersection with Stella Forty-Foot Road and approaches
- Main Street, Bath, between Finkle's Shore Park and former Village east limit (civic address 5825 Bath Road/Highway 33)
- Park Crescent, between Manitou Crescent East and Amherst Drive
- Speers Boulevard, between Bath Road/Highway 33 and Amherst Drive
- Kildare Avenue, between County Road 6 and Manitou Crescent West

Secondary priority:

- Caton Road, between Fairbanks Street and Millhaven Road
- Factory Street, between Millhaven Road and Mud Lake Road
- Manor Road/Heritage Drive area, pedestrian crossing of Main Street, Bath
- Country Club Drive, both completed sections
- Manitou Crescent East, between Sherwood Avenue East and Park Street
- Front Road, section through Stella hamlet including school frontage
- Academy Street, between Bulch Avenue and Church Street

The following diagrams illustrate the primary (red) and secondary (yellow) priority road sections identified for traffic calming.

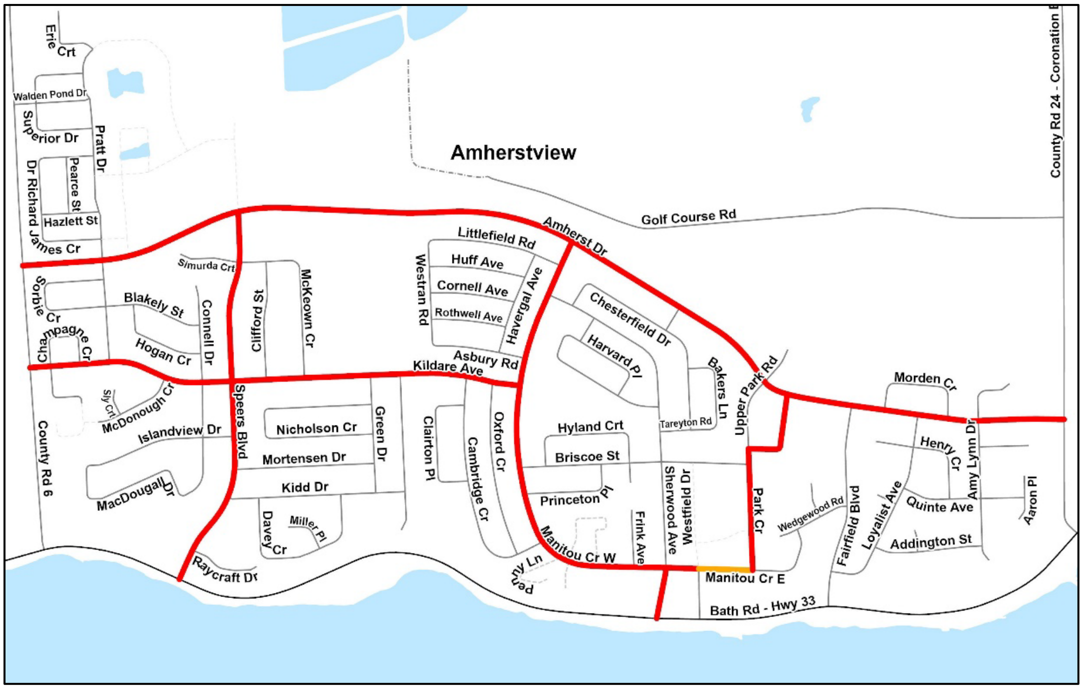


Figure 4 Amherstview traffic calming needs

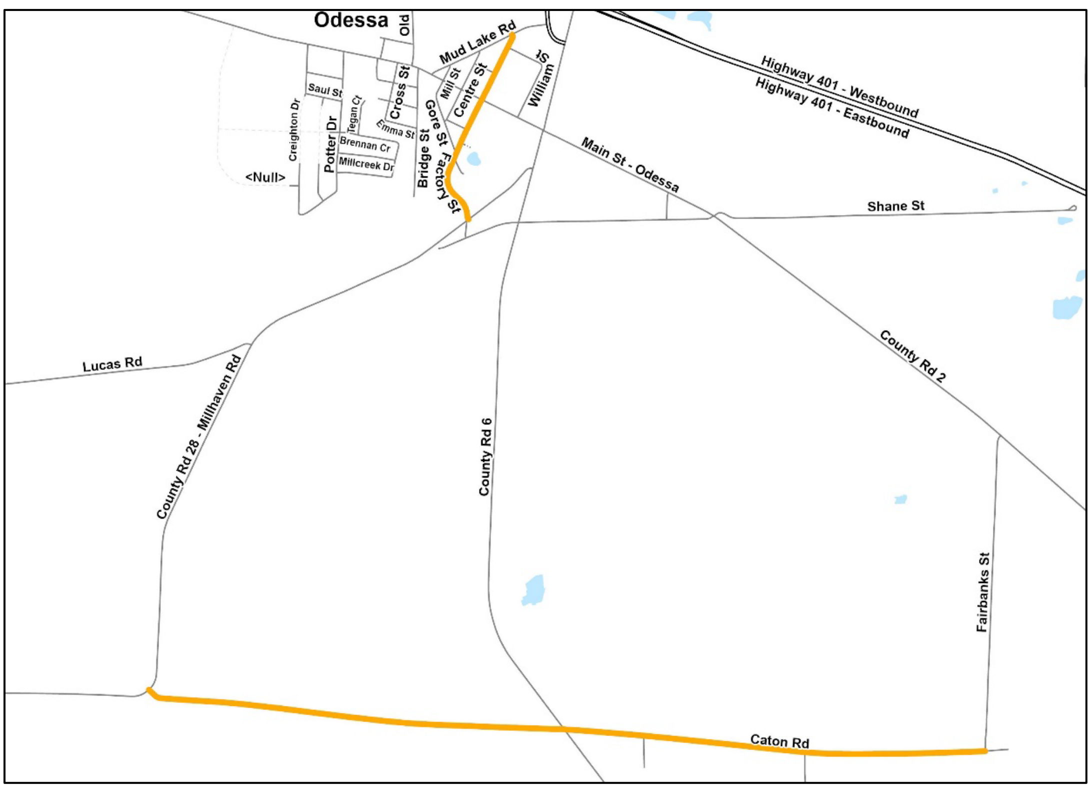


Figure 5 Odessa traffic calming needs

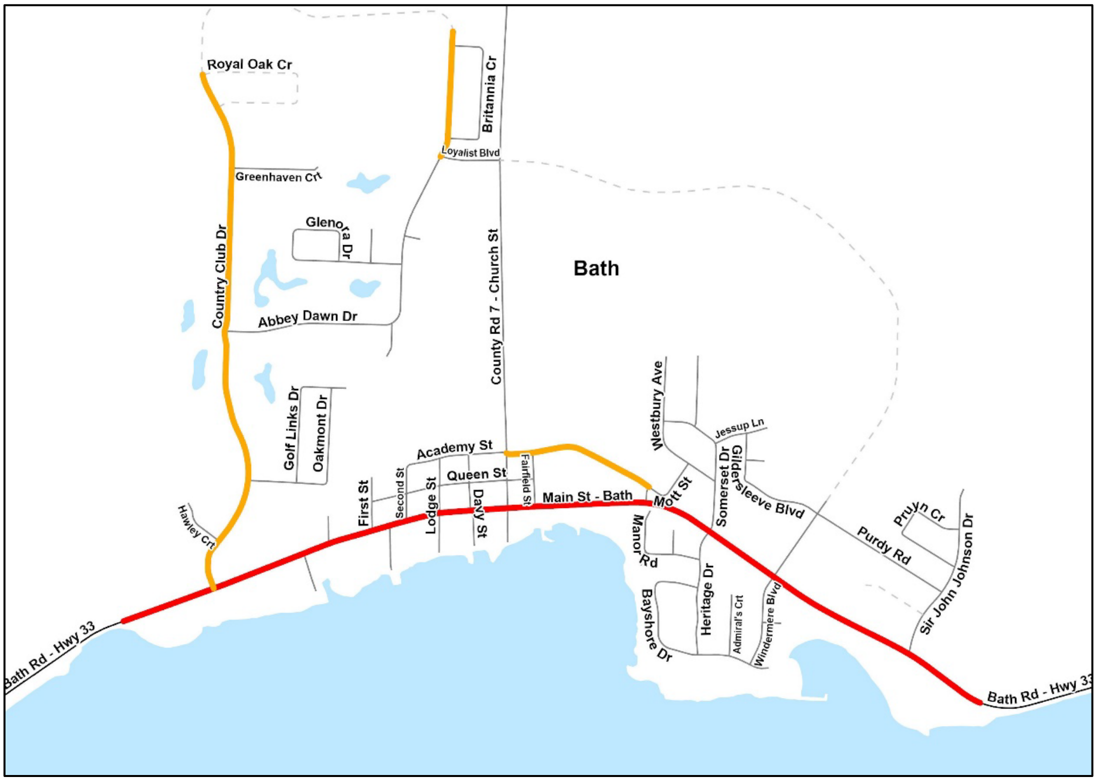


Figure 6 Bath traffic calming needs

Figure 7 Stella traffic calming needs

Many of the roads on the primary list are classified as collector roads. Collector roads are defined as roads designed to distribute traffic between arterial and collector streets. In some jurisdictions adjacent residential properties have had direct driveway access to collector roads, and that has been an accepted practice by Loyalist Township. Based on the traffic accident data and the frequency of complaints from homeowners living on collectors, the Township's design standards need to consider modifications such that future development proposals that include direct collector road access by low-density housing properties (single family or duplex), not be permitted within Loyalist Township.

In the past, roads were designed primarily for maximizing vehicle capacity. Today there is an increasing emphasis on active transportation. As the communities grow within Loyalist Township the arterial and collector roads have increasing traffic volumes. The increased volumes reduce safe times for crossings and turning movements and create increased opportunities for collisions with pedestrians. Road designers need to ensure for safe pedestrian and cycling opportunities, as well as the safe passage of vehicles.

The desire for traffic calming is often based on personal experience, and often is not the same for everyone. An example is an individual's perception of vehicle speed. Speed is very difficult for an individual to quantify, and experience has found that in some cases, perceived high-speed areas, when monitored, are in fact experiencing acceptable speeds. For this reason, an objective review of technical factors in line with a safe system approach is necessary to analyze whether the addition of traffic calming measures is warranted. This technical review can determine the specific problems related to a specific location.

The safe systems approach places the highest priority on safety and starts at the design level. Components of the safe systems approach may include:

1. The separation of different types of road users
2. Separating traffic, i.e., median barrier
3. Road designs that induce safe driving habits
4. Traffic reduction – divert traffic to collectors/arterials, promote transit and active transportation

New monitoring products can allow road authorities and police to establish traffic speed and volume monitoring at a much lower cost than in the past. This data can be used to evaluate the need for traffic calming and can assist with enforcement operations.

Many communities are considering the reduction of maximum speeds in urban communities to lower speed to reduce serious accidents. There are many studies which support this trend.

It is well established that most drivers operate their vehicles at the speed at which they feel comfortable. As a result, a reduction in speed limits without some sort of feature that results in a driver maintaining the lower speed may prove ineffective. Drivers need to feel that their road driving experience is providing feedback that they should maintain a reduced speed, for whatever reason. To support this comment, transportation specialists often refer to the term the “85th percentile”. The 85th percentile speed refers to a speed that 85% of the drivers will drive on a given road when unaffected by traffic congestion and weather, and is the speed that is considered by most drivers to be safe and reasonable under ideal conditions. Established speed limits should be appropriate for all right-of-way users.

Operations staff have suggested that the Township investigate the use of reduced speed limits on roads in areas such as school zones, parks, and other sources of high pedestrian volumes with an associated high safety risk.

Any modifications, whether physical alignment constraints, road graphics, or reductions in posted speed limits, should be accompanied by education programs. All modifications should be monitored for their effectiveness, both immediate and long-term.

Traffic calming solutions also need to keep in mind the role of the street. Solutions appropriate for low volume residential streets may not be appropriate for higher volume designated collectors and arterials, or streets that have high transit or emergency vehicle trips.

Based on the comments in the survey, many residents who reside on urban collectors are not comfortable with the traffic conditions on their street. Future developments should consider restricting low-density residential development that proposes individual driveway access to collector roads.

Figure 8. A roundabout in the Netherlands, combining safe transition for vehicles, bicycles, and pedestrians

Not all solutions are practical for any one location. Some modifications may result in undesirable impacts or cause traffic to divert to other locations, creating new issues. The use of a traffic calming solution should be based on the specific problems identified by a technical evaluation of the road. The list of potential traffic calming techniques and modifications is extensive. A few examples are:

- Use of pedestrian crossovers
- Use of raised sidewalks at crossings
- Use of raised intersections
- Use of speed and display boards
- Implementing selective on street parking programs
- Use of a variety of different line markings and pavement graphics
- Use of additional signage
- Implementation of road use separation techniques
- Modifications to the width and alignments of roads, including the use of roundabouts designed to encourage drivers to modify their driving behaviours in a manner that encourages traffic calming, may also be designed to divert through traffic

As an example, Amherst Drive has been reviewed for traffic calming (GHD, 2023). GHD has recommended various approaches that could be implemented on a temporary basis, and if successful could be used in a permanent configuration.

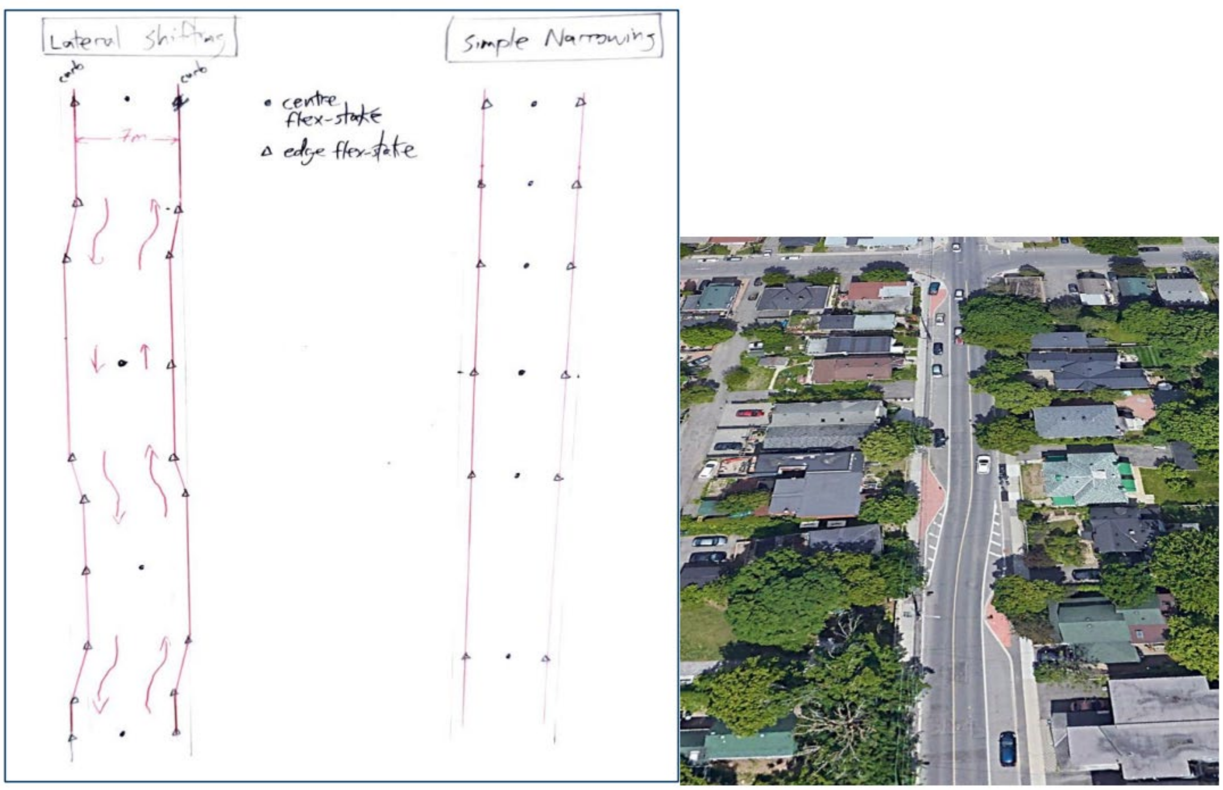


Figure 9 An illustration of lateral shifting to achieve traffic calming

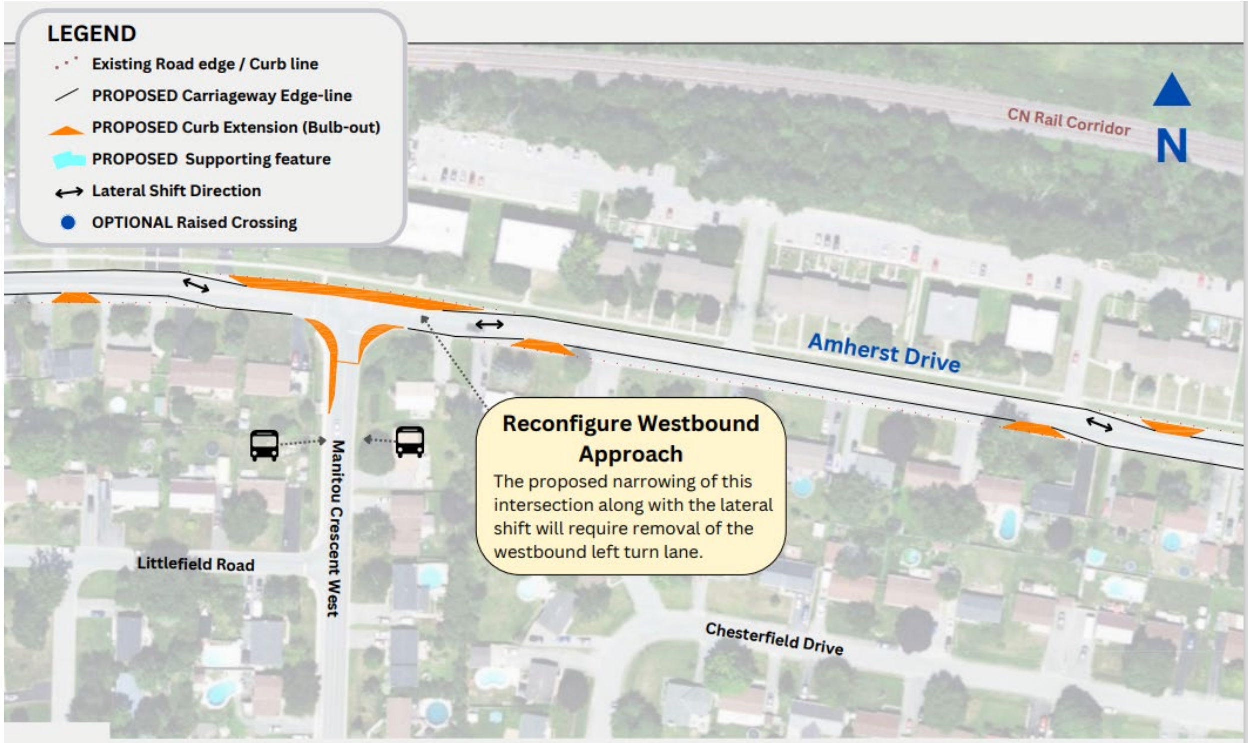


Figure 10 A concept drawing showing how lateral shifting could be applied to Amherst Drive

- Modifying substandard sidewalk situations, including the addition of second sidewalks on collector and arterial roads, eliminating discontinuous walkways, ensuring that sidewalks cross only at intersections or pedestrian crossovers, and ensuring AODA minimum standards are met
- Modifying pavement textures (use of rumble strips)

Figure 11. A digital speed radar display

Figure 12. A textured sidewalk panel at a crosswalk

There are many factors that affect the level of road safety in our communities. Key technical considerations are:

- How many lanes of traffic does the road have?
- What is the annual average daily traffic (AADT) volume of the road?
- How many heavy vehicles use the road?
- What is the posted speed?
- What does the actual speed data for the road section indicate?
- How much pedestrian traffic uses the road?
- Are the sidewalks on both sides of the roads continuous?
- Are AODA-approved pedestrian facilities available at intersections?
- Are there adequate facilities for bicycles?
- Are the adjacent land uses residential, institutional, industrial, or commercial?
- Is the road continuous or a cul-de-sac?

Both the results from the survey and frequent complaints to the Township note the concerns of many residents with respect to traffic crossings.

Growing traffic volumes have made it more difficult to cross some streets. Increased density in new subdivisions and the introduction of secondary residential units has resulted in a noticeable increase in on-street parking in certain neighbourhoods. On-street parking is reducing or eliminating sight lines and introducing additional safety concerns. One suggestion has been raised that the Township introduce no-parking zones on the inside curves of residential streets so that vehicles have improved sight lines.

Three projects that include similar pedestrian safety concerns that are currently in various stages of development:

1. Main Street – Odessa: proposed crossing near Ernestown Secondary School
2. Stella: improved pedestrian crossings at Front Road/Stella Forty-Foot Road intersection
3. Main Street – Bath: Windemere Boulevard and environs

It is recommended that this issue be reviewed by a transportation specialist in two stages:

1. Traffic crossings and parking policies will be reviewed at a high level Township-wide, with the objective of reviewing the current street layout and making appropriate recommendations with respect with respect to developing policies for improvements for safe pedestrian crossings.
2. Concurrent with the analysis of the need for traffic calming on the priority roads identified in this memorandum, the consultant will look specifically at the needs for both improved crossings and isolated parking restrictions.

Financial

Ideally any physical traffic calming measures will be a permanent installation, but this may not always be economically practical.

Proposed measures should be analyzed for both costs of installation and ongoing maintenance costs when considering appropriate solutions. The solution for a given location may require the testing of more than one solution method before deciding on a permanent approach.

Some of the typical traffic calming measures, such as lane narrowing, curb, bump-outs, medians, etc., have higher maintenance costs than a road with a typical urban cross-section.

Improvements will likely be financially more effective when combined with lifecycle renewal projects. It is recommended that any future traffic calming policies include a requirement that all capital reconstruction projects be screened with a view to improved traffic calming.

Climate Lens

Considering precipitation events are expected to increase in intensity and frequency, further stormwater management measures will need to be implemented. Incorporating stormwater management controls into traffic calming measures is an option. Depending on the traffic calming measure selected for implementation, there are opportunities to consider and apply climate mitigating initiatives. In the center of a roundabout, or in the area between roadways and sidewalks, a rain garden could be constructed. Encouraging this type of introduction wherever possible would help deal with stormwater events, lessening the impact on stormwater systems, as well as could offer opportunities for targeted planting such as wildflowers for pollinators, which in turn lessens maintenance requirements associated with snowplowing and grass mowing.

Linkages

Not applicable

References

City of Hamilton. (n.d.). Traffic Calming Policy.

City of Kingston. (n.d.). Traffic Calming Policy.

Corporation of Loyalist Township. (2021, December). Loyalist Township Traffic Calming Survey.

GHD. (2023). *Amherst Drive Traffic Calming Review.*

TAC & CITE. (2018). *Canadian Guide to Traffic Calming (Second Edition).*

Summary of Locations and Concerns Identified in Traffic Calming Survey, December 2021

Table 1 Amherst Island

Table 2 Amherstview
Table 3 Bath
Table 4 Odessa
Table 5 Rural

Conclusions

1. That an updated traffic calming policy be established which incudes safe systems concepts as soon as possible, and then apply the policy to the secondary list locations.
2. That the roads listed on the primary list for traffic calming review commence technical reviews.
3. That any future traffic calming policies include a requirement for all capital reconstruction projects to be evaluated for the need of improved traffic calming.
4. That a program that provides ongoing traffic calming education be established.
5. That the Township review the concept of a lower urban speed limit on residential streets and streets with similar pedestrian use, especially in areas of higher safety risks.
6. That the Township maintain a detailed program that monitors traffic speed and volumes and accident data for streets where traffic calming concerns have been raised, as part of a routine traffic monitoring program.
7. That Loyalist Township modify its development guidelines and restrict having future low-density housing with direct driveway access to urban collector and arterial roads.

It is recommended that this issue be reviewed by a transportation specialist in two stages:

8a. Traffic crossings and parking policies will be reviewed at a high-level Township wide with the objective of reviewing the current street layout and making appropriate recommendations with respect with respect to developing policies for improvements for safe pedestrian crossings.

8b. Concurrent with the analysis of the need for traffic calming on the priority roads identified in this memorandum, the consultant will look specifically at the needs for both improved both improved crossings and isolated parking restrictions

Summary of Locations and Concerns Identified in Traffic Calming Survey, December 2021

Table 1 Amherst Island

Location	Frequency	Summary of complaints
Front Road	19	Intersection with Stella Forty-Foot Road, visibility, pedestrian safety in school area and in front of Back Kitchen
South Shore Road	1	Safety
Third Concession Road	4	Traffic issues during beach season

Table 2 Amherstview

Location	Frequency	Summary of complaints
Addington Street	1	Additional stop signs, speed bumps
Amherst Drive	75	Speeding, disregard for traffic signs, pedestrian safety
Briscoe Street	12	Intersection with Park Crescent unsafe during school hours
Cambridge Crescent	2	
Chesterfield Drive	6	Speeding, disregard for traffic signs, pedestrian safety
County Road 6	33	Intersection with Taylor-Kidd Boulevard, requests for traffic lights
Green Drive	3	Blind left-hand turn onto Kildare Avenue
Highway 33/Bath Road	26	Pedestrian crossing to Fairfield Park, pedestrian safety risk at Sherwood intersection
Kildare Avenue	92	Frequent speeding, ignoring stop sign at Speers Boulevard, excessive parking causing congestion and safety concerns, blind intersection at Connell Drive
MacDougall Drive	5	Intersection at Islandview Drive is confusing – motorists assume it is an all-way stop
Manitou Crescent (both East and West)	93	Disregard for stop signs at major intersections, speeding, accessibility concerns for visually-impaired resident living on Frink Avenue
Park Crescent	5	Speeding, used as thoroughfare, congestion, decreased pedestrian visibility due to street parking
Sherwood Avenue	55	Pedestrian safety at Briscoe Street, requests for all-way stop or lights at southern intersection with Manitou Crescent East
Speers Boulevard	78	Unsafe intersections – Amherst Drive, Kildare Avenue
Wedgewood Road	1	Request for speed bumps

Table 3 Bath

Location	Frequency	Summary of complaints
Academy Street	1	Speeding, being used as a shortcut from Main Street – Bath to Church Street
Bayshore Drive	1	Speeding
Church Street	10	Speeding, racing, south of school
Country Club Drive	22	Speeding, requests for speed bumps, all-way stops, roundabouts, reduced speed limits
Fairfield Street	1	Speeding
Heritage Drive	7	Additional stop signs, speed bumps, concern re: intersection with Main Street – Bath
Main Street – Bath	72	All-way stop at Country Club Drive, speeding, pedestrian safety, poor drainage, sightlines at Heritage Drive, traffic lights and crosswalk needed at Somerset Drive, lack of sidewalk and safe pedestrian crossing east of water treatment plant
Windermere Boulevard	3	Design concerns related to intersection with Main Street – Bath

Table 4 Odessa

Location	Frequency	Summary of complaints
Factory Street	9	Speeding, intersection with Main Street – Odessa
Main Street – Odessa	22	Speeding, pedestrian safety, request for advanced green at County Road 6 intersection eastbound
Millhaven Road	8	Excessive speed
Potter Drive	5	Speeding
Shane Street	5	Speeding, intersection with County Road 2

Table 5 Rural

Location	Frequency	Summary of complaints
Caton Road	5	Speeding (west of County Road 6
Highway 33/Bath Road	2	Ferry intersection unsafe during unloading
Sharpe Road	6	
Simmons Road	46	Speeding, documented history of concerns

IMP Technical Memorandum: Fairfield Water Treatment Plant Projections

Asset Class: Water

Objective: To present the projected potable water demand for Amherstview and Odessa and adjacent lands serviced by the Fairfield Water Treatment Plant, over the course of the study period covered by the Infrastructure Masterplan. Developing an understanding of the potable water requirements of these communities, from a residential, industrial, commercial, or institutional perspective, will help ensure that any necessary plant expansion activities are planned in a timely manner.

Background

The Fairfield Water Treatment Plant (WTP) services Amherstview and Odessa. The population in these urban areas, along with the number of residential dwellings, is projected to increase by over 30% between 2021 and 2045, inevitably creating an increased demand for potable water.

The plant has a rated capacity of 8,000 m^3/d and draws its water from Lake Ontario. Raw water is treated using a membrane ultrafiltration system which consists of two parallel treatment trains, each containing a series of membrane cassettes used to filter water. The capacity of these treatment trains could be increased through the installation of additional cassettes. This may require the expansion of other steps in the facility's treatment train.

As a municipality, the Township has a responsibility to ensure that an acceptable quantity and quality of water supply is available for future development, and that the approval or buildout of new connections does not exceed the design capacity of the water system. As such, it is necessary to ensure that future demand will be met over the long term and that that sufficient time be allocated to plan for expansion activities, if necessary.

Assumptions

The following assumptions were made when developing these documents:

The number of connections to the plant includes both residential dwellings as well as industrial, commercial, and institutional (ICI) accounts.

Connections are expressed in equivalent residential units (ERUs).

ICI growth is assumed to be proportional to population growth.

For the sake of maintaining consistency with the uncommitted reserve capacity (URC) calculations developed each year, the methodology used to develop the figures presented in this technical memo are based on the MOE Procedure D-5-1. Specifically:

- Potable water needs are expressed in terms of maximum daily flow.

- The projected water demand for an ERU is based on the maximum daily flow value per ERU observed in the previous three years (between 2019 and 2021).

Methodology

Data Sources

The data used to develop the figures presented in these documents were obtained from the Population and Dwelling Growth memo included in the IMP, as well as the 2022 URC calculations for the Fairfield Water Treatment Plant (Loyalist Township, Annually, 2016-2022) and the 2021 Industrial-Commercial-Institutional Water Account Listing for Loyalist Township.

Residential Connections

Existing and Projected Residential Connections

The number of residential water connections in Amherstview and Odessa in the year 2021 was used as a starting point for these calculations.

Residential connections included single detached homes as well as multi-residential units, expressed as Equivalent Residential Units (ERUs).

The projected numbers of new residential water connections in each of the urban areas was assumed to increase at the same rate as new dwellings in those same areas.

$$RWC_t = RWC_{t-1} + (HH_t - HH_{t-1})$$

where

$$RWC_t = Residential\ Water\ Connections\ in\ year\ t$$
$$RWC_{t-1} = Residential\ Water\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- the number of households in Amherstview is projected to increase from 3,743 in 2021 to 4,150 in 2026, for a total of 407 new residential dwellings.
- The number of residential water connections in Amherstview in 2021 was 3,397 ERUs
- The projected number of water connections in Amherstview in 2026 can therefore be calculated as: 3,397+407 = 3,804

This process was repeated at five-year intervals between 2026 and 2046 for both Amherstview and Odessa.

In addition to the residential water connections in Amherstview and Odessa, 119 ERUs of potable water are also connected to the Fairfield Water system.

- These include 81 ERUs in Brooklands and Harewood, and an additional 38 ERUs in the City of Kingston.
- This figure is not projected to increase over time and is assumed to remain constant at 119 ERUs over the course of the study period.

Committed-but-Unbuilt Residential Connections

Once a new development or subdivision has been granted draft plan approval, it must be assumed connected to the water plant and, therefore, included in the uncommitted reserve capacity calculation of the system.

Although these units may not consume water until they are officially connected to the system, the theoretical amount of water that they will eventually consume must be subtracted from the available plant capacity in a given year.

The number of committed-but-unbuilt residential connections in an urban area was assumed to decrease at the same rate as new dwellings were constructed.

$$CURC_t = CURC_{t-1} - (HH_t - HH_{t-1})$$

where

$$CURC_t = Committed\ but\ Unconnected\ Residential\ Connections\ in\ year\ t$$
$$CURC_{t-1} = Committed\ but\ Unconnected\ Residential\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- 745 committed-but-unbuilt residential units remained in Amherstview in 2021
- 407 new residential dwellings are projected to be constructed in Amherstview between 2021 and 2026
- The number of remaining committed-but-unbuilt residential units projected to remain in Amherstview in 2026 can be calculated to be: 745-407=338

These calculations assume no new committed-but-unbuilt residential connections are approved over the course of the study period. The impacts of approving new residential developments will be covered in the Analysis section of this memo.

ICI Connections

Existing and Projected ICI Connections

The number of ICI water connections in Amherstview and Odessa in the year 2021 was used as a starting point for these calculations.

The projected numbers of new ICI water connections in Amherstview and Odessa was assumed to increase at the same rate as new dwellings.

$$\mathrm{ICI_t} = ICI_{t-1} * \left(1 + \frac{HH_t - HH_{t-1}}{HH_t}\right)$$

where

$$ICI_t = ICI\ Water\ Connections\ in\ year\ t$$
$$ICI_{t-1} = ICI\ Water\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- the number of households in Odessa is projected to increase from 652 in 2021 to 743 in 2026
- There were 68 ERUs of ICI water connections in Odessa in 2021
- The projected number of water connections in Odessa in 2026 can therefore be calculated as:

$$\mathrm{ICI}_{2026} = ICI_{2021} * \left(1 + \frac{HH_{2026} - HH_{2021}}{HH_{2026}}\right)$$
$$ICI_{2026} = 68 * \left(1 + \frac{743 - 652}{743}\right)$$
$$ICI_{2026} = 77\ ERUs$$

This process was repeated at five-year intervals between 2026 and 2046 for both Amherstview and Odessa.

Committed-but-Unused ICI

In addition to the existing ICI connections to Fairfield Water system, a number of ICI customers have agreements in place with the Township through which they have purchased a set amount of potable water. These include:

- Invista/KOSA: 210 m^3/day
- NPIF/AES: 4 m^3/day
- Bombardier/Alstom: 14 m^3/day (NB: approximately 8 m^3/day used, leaving 6 m^3/day unused)
- Direct Coil: 14 m^3/day (NB: approximately 5 m^3/day used, leaving 9 m^3/day of unused)
- Total committed-but-unused: 229 m^3/day

While these customers may not necessarily use the entirety, or any, of the capacity they have purchased in a given year, this volume of water needs to be included in capacity calculations.

In order to guarantee the delivery of potable water stipulated in each agreement, water losses in the system also need to be taken into account.

- The three-year average residential and multi-residential consumption based on billing records between 2019 and 2021 show that one ERU consumes 0.405 m3/day of potable water
- The three-year average residential and multi-residential consumption based on billing records between 2019 and 2021 show that one ERU consumes 0.405 m^3/day of potable water
- The three-year average treated water flows out of the plant show that 0.75 m^3/day of water are necessary to service each connection to the system.
- It can therefore be calculated that 1.85 m^3 of water must be treated by the plant to provide a connection with 1 m^3 of potable water.
- The total committed but unused ICI connections therefore require that $229 * 1.85 = 424 \frac{m^3}{day}$ of capacity be allocated to these customers.

Summary

A summary of the existing and projected connections to the Fairfield Water system can be found in the attached Excel spreadsheet.

Flow Projections

Flow per ERU

The yearly annual maximum day flow per ERU between 2016 and 2021 was calculated

$$\left(\frac{Flow}{ERU}\right)_t = \frac{(Q_{\max})_t}{ERU_t}$$

where

$$\left(\frac{Flow}{ERU}\right)_t = Flow\ per\ ERU\ in\ year\ t$$
$$Qmax_t = Maximum\ daily\ flow\ recorded\ in\ year\ t$$
$$ERU_t = ERUs\ in\ year\ t$$

Values ranged between 1.10 and 1.00 m^3/day per ERU between 2016 and 2021, as summarized in Table 1 below.

Table 1 - Maximum day flow per ERU for the Fairfield Water System between 2016 and 2021

Year	Max day flow / ERU
2016	1.10
2017	1.03
2018	1.02

2019	1.02
2020	1.06
2021	1.00

In order to maintain consistency with the URC calculations, the maximum observed value from the past 3 years, 1.06 m^3/day per ERU in 2020, was used as a factor to project future flows.

Residential Flows

Projected residential flows were calculated by multiplying the projected number of residential connections in a given year by the flow per ERU factor discussed above.

$$Q_{Res_t} = Res_{ERU_t} * f_{ERU}$$

where

$$Q_{Res_t} = Projected\ maximum\ residential\ day\ flow\ in\ year\ t$$
$$Res_{ERU_t} = \text{Residential}\ ERUs\ in\ year\ t$$
$$f_{ERU} = flow\ per\ ERU\ factor$$

ICI Flows

Projected ICI flows were calculated by multiplying the projected number of ICI connections in a given year by the flow per ERU factor discussed above.

$$Q_{ICI_t} = ICI_{ERU_t} * f_{ERU}$$

where

$$Q_{ICI_t} = Projected\ maximum\ ICI\ day\ flow\ in\ year\ t$$
$$ICI_{ERU_t} = ICI\ ERUs\ in\ year\ t$$
$$f_{ERU}$$

Committed-but-Unbuilt Residential Capacity

The capacity which must be set aside for committed-but-unbuilt residential units was calculated by multiplying the projected number of approved-but-unbuilt connections in a given year by the flow per ERU factor discussed above.

$$Q_{CUR_t} = CUR_{ERU_t} * f_{ERU}$$

where

$$Q_{CUR_t} = Projected\ Committed\ but\ Unbuilt\ capacity\ in\ year\ t$$
$$CUR_{ERU_t} = \text{Committed but Unbuilt Residential}\ ERUs\ in\ year\ t$$
$$f_{ERU} = flow\ per\ ERU\ factor$$

Remaining Plant Capacity

Once projected residential and ICI flows, along with purchased-but-unused and committed-but-unbuilt capacity, were calculated for a given year, the remaining plant capacity could then be determined for that year.

$$PC_{r_t} = PC - (Q_{Res_t} + Q_{ICI_t} + Q_{CUR_t})$$

where

$$PC_{r_t} = Remaining\ Plant\ Capacity\ in\ year\ t$$
$$PC = Plant\ Capacity$$
$$Q_{Res_t} = Projected\ maximum\ residential\ day\ flow\ in\ year\ t$$
$$Q_{ICI_t} = Projected\ maximum\ ICI\ day\ flow\ in\ year\ t$$
$$Q_{CUR_t} = Projected\ Committed\ but\ Unbuilt\ capacity\ in\ year\ t$$

Analysis

Projected Flows

The historical and projected residential and ICI flows for the Fairfield Water System, along with the purchased but unused ICI and committed but unbuilt residential capacity, between 2016 and 2046 are summarized in Table 2 and illustrated in Figure 1 below.

Table 2 – Historical and projected flows for the Fairfield Water System between 2016 and 2046, expressed in m³/day

Year	Residential flows	ICI flows	Total Projected Flows	Purchased but unused ICI	Committed but unbuilt residential	Remaining Plant Capacity
2016	3,920	635	4,556	424	1,680	1,340
2017	3,983	643	4,626	424	1,554	1,396
2018	4,068	664	4,732	424	1,478	1,365
2019	4,133	645	4,778	424	1,385	1,413
2020	4,249	678	4,927	424	1,252	1,397
2021	4,377	703	5,080	424	1,119	1,377
2022	4,520	724	5,244	424	962	1,370
2026	4,904	777	5,681	424	578	1,317
2031	5,381	841	6,222	424	109	1,245
2036	5,762	893	6,655	424	13	908
2041	6,123	941	7,064	424	0	512
2046	6,515	994	7,509	424	0	67

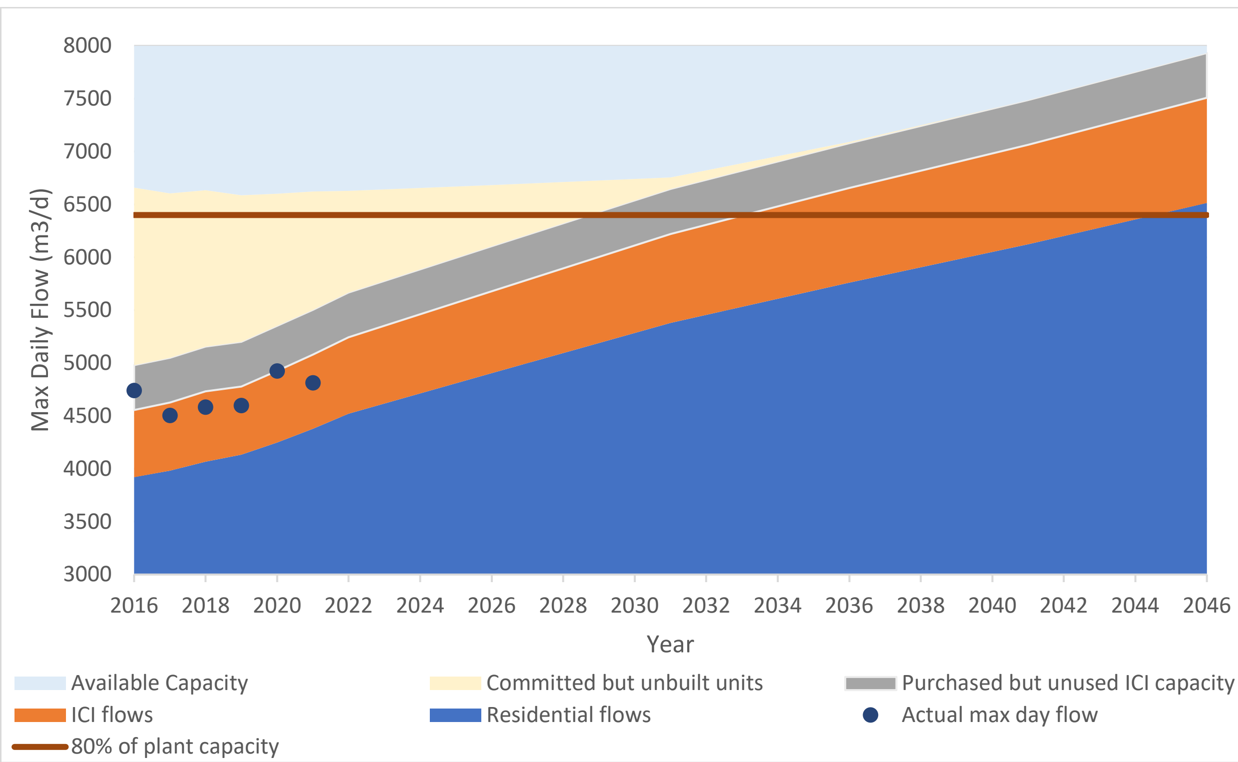


Figure 1 - Historical and projected flows and capacity of the Fairfield Water System between 2016 and 2046.

Based on these projections, the potable water demand up to 2046 is not expected to exceed the Fairfield WTP's rated capacity.

Potable water demand is anticipated to reach 80% of the plant's rated capacity around 2033.

- Plant expansions activities should begin once the 80% threshold is met or exceeded to allow for enough time for planning and consultation.
- Plant flows are evaluated on an annual basis as part of the Uncommitted Reserve Capacity process, allowing for the above projections to be regularly monitored and updated as necessary.

At the end of the year 2021, 1,377 m^3/day of capacity was available at the Fairfield WTP. This equates to 1,302 ERUs.

Scenarios

The projections presented above are based on a Business-As-Usual scenario and do not account for any additional residential capacity allocation, or the potential for one, or several, new ICI customer(s) who might require several hundred ERUs of capacity.

Projections which simulate these scenarios are presented below, with the intent of demonstrating their impact on the drinking water system.

Scenario A: Allocation of New Residential Units

- Figure 2 below illustrates the impact of approving 1,000 new residential ERUs from the Fairfield Water System in 2022.

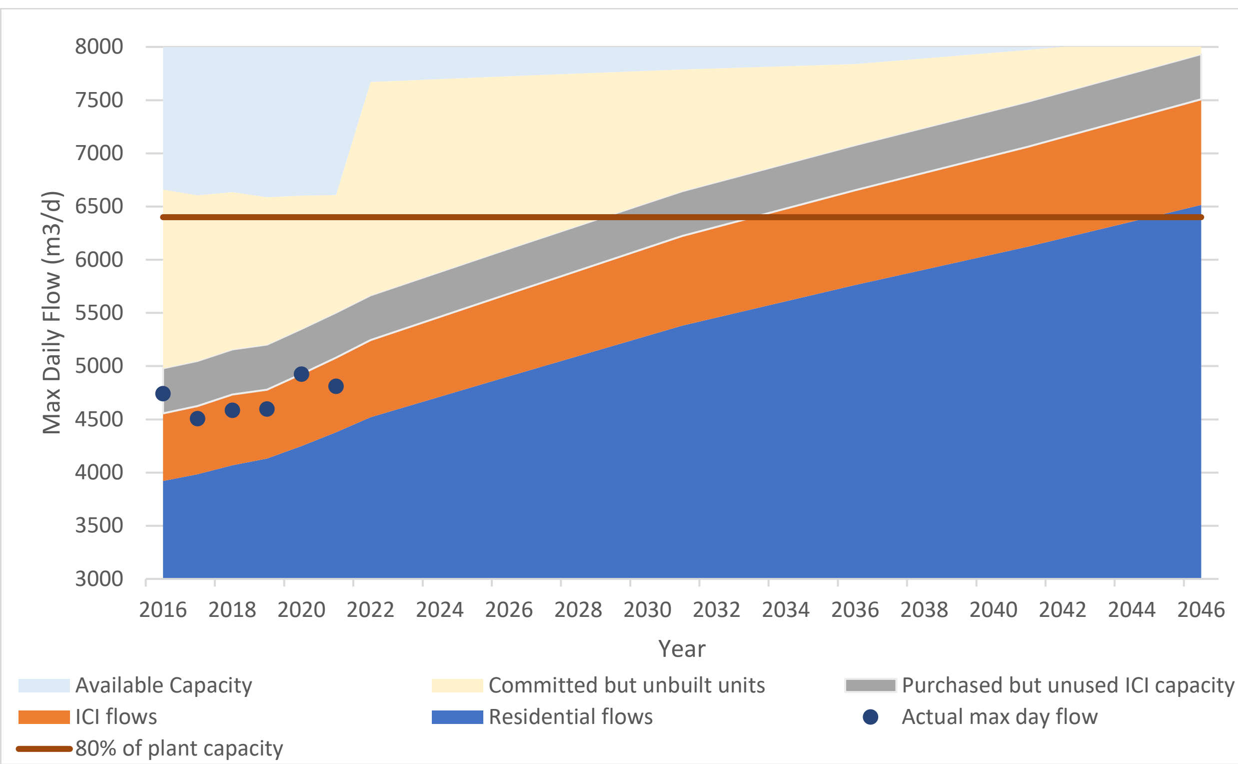


Figure 2 - Scenario A: Impact of allocating 1,000 Residential Units from the Fairfield Water System in 2022.

The allocation of 1,000 new residential ERUs would not have an impact on the amount of potable water which would need to be produced by the plant given that the approval of new units would not necessarily accelerate build-out rates.

However, due to the concurrent and gradual increase of ICI connections over the same period, the amount of available capacity would eventually reach 0 by 2040. This would result in no capacity being available to allocation without expanding the Fairfield WTP.

Scenario B: Simulated Heavy User

Figure 3 below illustrates the impact of a simulated heavy user connecting to the Fairfield Water System and beginning operations in 2022.

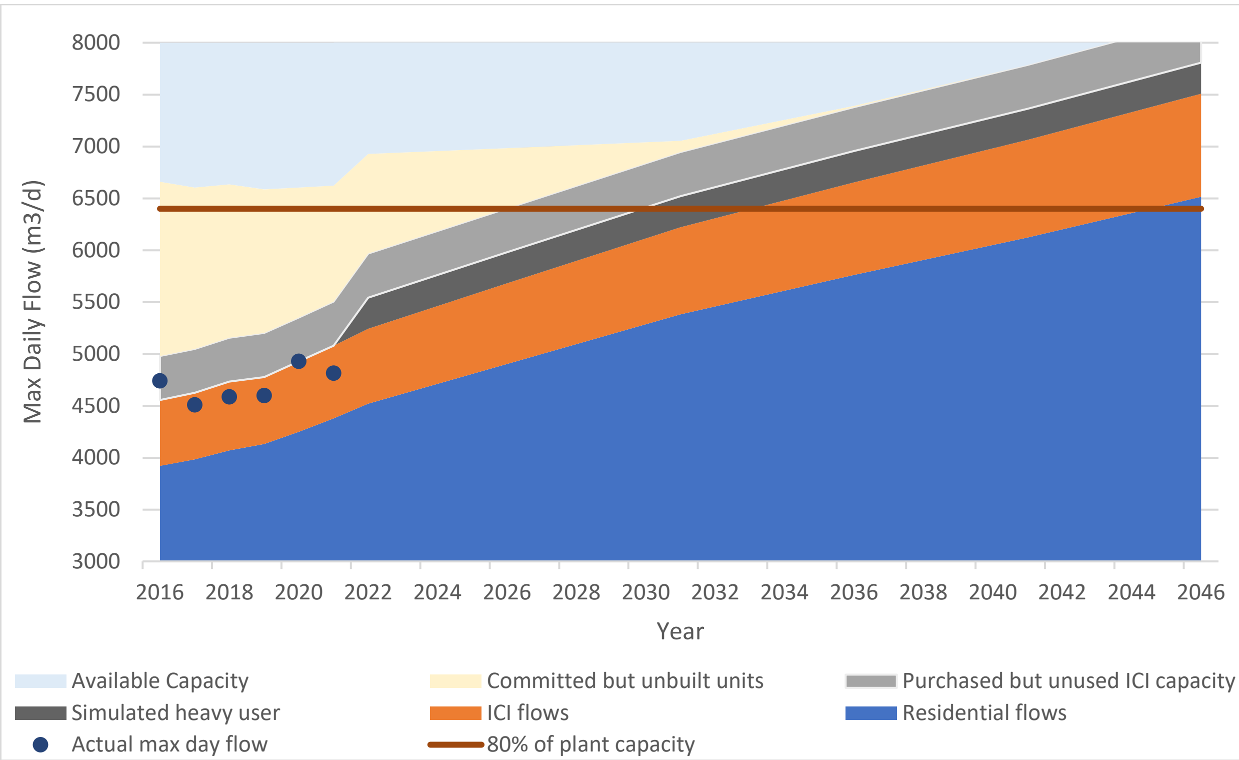


Figure 3 - Scenario B: Impact of a simulated heavy user connecting to the Fairfield Water System and beginning operations in 2022

In this simulation, the potable water demand in 2046 would be very close to the plant's rated capacity.

The 80% threshold would be met in 2030, approximately 5 years earlier than in the business-as-usual forecast.

Combining Scenarios A and B

Taken individually, Scenarios A and B do not have a significant impact on the Fairfield Water System.

However, if both scenarios were to happen concurrently, the amount of available capacity at the Fairfield WTP would rapidly approach, then fall below, zero, as illustrated in Figure 4 below.

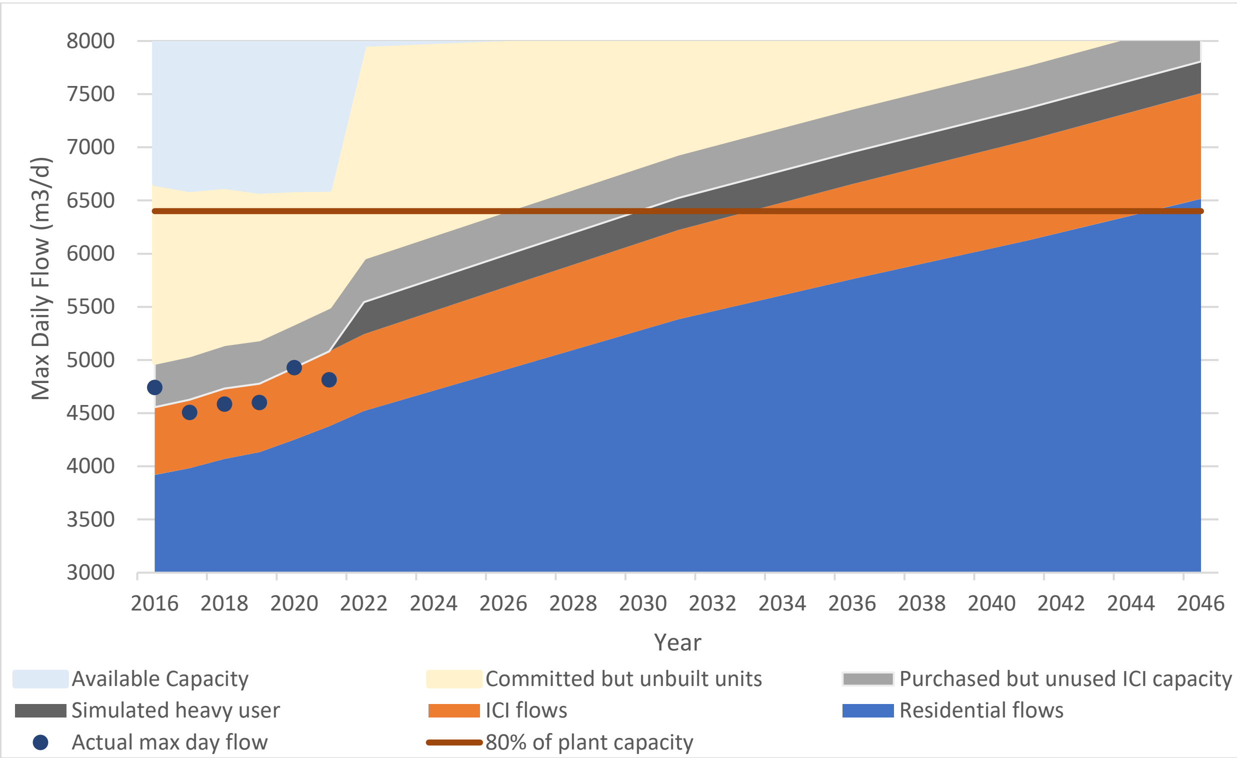


Figure 4 - Scenarios A + B

The possibility of a heavy ICI user connecting to the Fairfield Water System should therefore always be taken into consideration when making decisions around allocating additional residential capacity.

As the operator of the Fairfield Water System, the Township has a legal responsibility to ensure that the approved design capacity of the plant is not exceeded.

Additional Considerations

The production of potable water by the Fairfield WTP is also dependant on the “flow per ERU”, which can vary year over year.

- Efforts to reduce flows per ERU, either through water conservation initiatives or leak reduction projects, could result in additional capacity becoming available without expanding the Fairfield WTP
- This would allow for the deferral of costly expansion activities while reducing the cost of producing one unit of potable water.

Limitations

The potable water demand forecasts presented in this Technical Memorandum are linked to projected population and dwelling growth for Loyalist Township over the course of the study period. These projections are based on the best-available information at this point in time and are subject to change based on any number of scenarios.

Climate Change Considerations

An increase in temperatures and low amounts of precipitation during the summer months could result in an increase demand for potable water.

This would increase the per-capita potable demand from the Fairfield Water System, putting additional strain on the plant and reducing the amount of available capacity.

Linkages

Population and Dwelling Growth Technical Memorandum

References

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

Loyalist Township. (Annually, 2016-2022). *Uncommitted Reserve Capacity calculations.*

Conclusions

Potable water demand forecasts for the Fairfield Water Treatment Plant were developed based on projected dwelling growth in Amherstview and Odessa. Based on these projections, the potable water demand up to 2046 is not expected to exceed the Fairfield WTP's rated capacity of 8,000 m^3/day.

Potable water demand is anticipated to reach 80% of the plant's rated capacity around 2033. Expansion activities should begin to be undertaken when this threshold is hit.

Investing in water conservation initiatives or leak reduction programs could increase the available capacity of the Fairfield WTP by reducing "flows per ERU". This would defer the need for a large-scale plant expansion by a few years. Loyalist Township should continue to prioritize these initiatives.

At the end of the year 2021, 1,377 m^3/day of capacity was available at the Fairfield WTP. This equates to 1,302 ERUs.

The possibility of a heavy ICI user connecting to the Fairfield Water System should always be taken into consideration when making decisions around allocating additional residential capacity.

IMP Technical Memorandum: Bath Water Treatment Plant Projections

Asset Class: Water

Objective: To present the projected potable water demand for the Bath over the course of the study period covered by the Infrastructure Masterplan. Developing an understanding of the potable water requirements of the community, from a residential, industrial, commercial, or institutional perspective, will help ensure that any necessary plant expansion activities are planned for in a timely manner.

Background

The Bath Water Treatment Plant (WTP) services the community of Bath as well as several Correctional Services Canada (CSC) facilities. The population in these urban areas, along with the number of residential dwellings, is projected to increase by over 40% between 2021 and 2046, inevitably creating an increased demand for potable water.

The plant has a rated capacity of 6,000 m^3/d and draws its water from Lake Ontario. Raw water is treated using a membrane gravity filtration (MGF) system which consists of two parallel treatment trains, each containing a series of membrane cassettes used to filter water. The capacity of these treatment trains could be increased through the installation of additional cassettes; however, this may require the expansion of other steps in the facility’s treatment train. Through previous agreements, 2,672 m^3/day of potable water is allocated to CSC, leaving 3,328 m^3/day to service Bath. This technical memorandum will focus on the projected water demands for the community of Bath relative to its allocated plant capacity.

As a municipality, the Township has a responsibility to ensure that an acceptable quantity and quality of water supply is available for future development, and that the approval or buildout of new connections does not exceed the design capacity of the water system. As such, it is necessary to ensure that future demand will be met over the long term and that that sufficient time be allocated to plan for expansion activities, if necessary.

Assumptions

The following assumptions were made when developing these documents:

The number of connections to the plant includes both residential dwellings as well as industrial, commercial, and institutional (ICI) accounts.

Connections are expressed in equivalent residential units (ERUs).

ICI growth is assumed to be proportional to population growth.

For the sake of maintaining consistency with the uncommitted reserve capacity (URC) calculations developed each year, the methodology used to develop the figures presented in this technical memo are based on the MOE Procedure D-5-1. Specifically:

- Potable water needs are expressed in terms of maximum daily flow.
- The projected water demand for an ERU is based on the maximum daily flow value per ERU observed in the previous three years (between 2019 and 2021).

Methodology

Data Sources

The data used to develop the figures presented in these documents were obtained from the Population and Dwelling Growth memo included in the IMP, as well as the 2022 URC calculations for the Bath Water Treatment Plant (Loyalist Township, Annually, 2016-2022) and the 2021 Industrial-Commercial-Institutional Water Account Listing for Loyalist Township.

Residential Connections

Existing and Projected Residential Connections

The number of residential water connections in Bath in the year 2021 was used as a starting point for these calculations.

Residential connections included single detached homes as well as multi-residential units, expressed as Equivalent Residential Units (ERUs).

The projected numbers of new residential water connections in each of the urban areas was assumed to increase at the same rate as new dwellings in those same areas.

$$\mathrm{RWC_t} = RWC_{t-1} + (HH_t - HH_{t-1})$$

where

$$RWC_t = Residential\ Water\ Connections\ in\ year\ t$$
$$RWC_{t-1} = Residential\ Water\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- the number of households in Bath is projected to increase from 1,214 in 2021 to 1,425 in 2026, for a total of 211 new residential dwellings.
- The number of residential water connections in Bath in 2021 was 1,065 ERUs
- The projected number of water connections in Bath in 2026 can therefore be calculated as: 1,065+211 = 1,276

This process was repeated at five-year intervals between 2026 and 2046.

Purchased but Unbuilt Residential Connections

Most of the available capacity of the Bath WTP is controlled by developers through two ongoing agreements from the 1990s. As of 2021, 1,514 ERUs of purchased-but-unbuilt capacity were available under the terms of these agreements.

Once a new development or subdivision has been granted draft plan approval, it must be assumed connected to the water plant and, therefore, included in the uncommitted reserve capacity calculation of the system.

Although these units may not consume water until they are officially connected to the system, the theoretical amount of water that they will eventually consume must be subtracted from the available plant capacity in a given year when determining available capacity.

The number of committed-but-unbuilt residential connections in an urban area was assumed to decrease at the same rate as new dwellings were constructed.

$$CURC_t = CURC_{t-1} - (HH_t - HH_{t-1})$$

where

$$CURC_t = Committed\ but\ Unconnected\ Residential\ Connections\ in\ year\ t$$
$$CURC_{t-1} = Committed\ but\ Unconnected\ Residential\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- 1,514 purchased-but-unbuilt residential units remained in Bath in 2021
- 211 new residential dwellings are projected to be constructed in Bath between 2021 and 2026
- The number of remaining committed-but-unbuilt residential units projected to remain in Bath in 2026 can be calculated to be: 1,513-211=1,303

These calculations assume no new committed-but-unbuilt residential connections are approved over the course of the study period. The impacts of approving new residential developments will be covered in the Analysis section of this memo.

ICI Connections

Existing and Projected ICI Connections

The number of ICI water connections in Bath in the year 2021 was used as a starting point for these calculations.

The projected numbers of new ICI water connections in Bath was assumed to increase at the same rate as new dwellings.

$$\mathrm{ICI_t} = ICI_{t-1} * \left(1 + \frac{HH_t - HH_{t-1}}{HH_t}\right)$$

where

$$ICI_t = ICI\ Water\ Connections\ in\ year\ t$$
$$ICI_{t-1} = ICI\ Water\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- The number of households in Bath is projected to increase from 1,065 in 2021 to 1,276 in 2026
- There were 389 ERUs of ICI water connections in Bath in 2021
- The projected number of water connections in Bath in 2026 can therefore be calculated as:

$$\mathrm{ICI_{2026}} = ICI_{2021} * \left(1 + \frac{HH_{2026} - HH_{2021}}{HH_{2026}}\right)$$
$$ICI_{2026} = 389 * \left(1 + \frac{1{,}276 - 1{,}065}{1{,}276}\right)$$
$$ICI_{2026} = 454\ ERUs$$

This process was repeated at five-year intervals between 2026 and 2046.

Summary

A summary of the existing and projected connections to the Bath Water system can be found in the attached Excel spreadsheet.

Flow Projections

Flow per ERU

The yearly annual maximum day flow per ERU between 2016 and 2021 was calculated

$$\left(\frac{Flow}{ERU}\right)_t = \frac{(Qmax)_t}{ERU_t}$$

where

$$\left(\frac{Flow}{ERU}\right)_t = Flow\ per\ ERU\ in\ year\ t$$
$$Qmax_t = Maximum\ daily\ flow\ recorded\ in\ year\ t$$
$$ERU_t = ERUs\ in\ year\ t$$

Values ranged between 1.25 and 0.93 m^3/day per ERU between 2016 and 2021, as summarized in Table 1 below.

Table 1 - Maximum day flow per ERU for the Bath Water System between 2016 and 2021

Year	Max day flow / ERU
2016	1.25
2017	1.06
2018	1.01
2019	1.05
2020	0.93
2021	0.97

In order to maintain consistency with the URC calculations, the maximum observed value from the past 3 years, 1.05 m^3/day per ERU in 2019, was used as a factor to project future flows.

Residential Flows

Projected residential flows were calculated by multiplying the projected number of residential connections in a given year by the flow per ERU factor discussed above.

$$Q_{Res_t} = Res_{ERU_t} * f_{ERU}$$

where

$$Q_{Res_t} = Projected\ maximum\ residential\ day\ flow\ in\ year\ t$$
$$Res_{ERU_t} = \text{Residential}\ ERUs\ in\ year\ t$$
$$f_{ERU} = flow\ per\ ERU\ factor$$

ICI Flows

Projected ICI flows were calculated by multiplying the projected number of ICI connections in a given year by the flow per ERU factor discussed above.

$$Q_{ICI_t} = ICI_{ERU_t} * f_{ERU}$$

where

$$Q_{ICI_t} = Projected\ maximum\ ICI\ day\ flow\ in\ year\ t$$
$$ICI_{ERU_t} = \text{ICI}\ ERUs\ in\ year\ t$$
$$f_{ERU} = Flow\ per\ ERU\ factor$$

Committed-but-Unbuilt Residential Capacity

The capacity which must be set aside for committed-but-unbuilt residential units was calculated by multiplying the projected number of approved-but-unbuilt connections in a given year by the flow per ERU factor discussed above.

$$Q_{CUR_t} = CUR_{ERU_t} * f_{ERU}$$

where

$$Q_{CUR_t} = Projected\ Committed\ but\ Unbuilt\ capacity\ in\ year\ t$$
$$CUR_{ERU_t} = \text{Committed but Unbuilt Residential } ERUs\ in\ year\ t$$
$$f_{ERU} = flow\ per\ ERU\ factor$$

Remaining Plant Capacity

Once projected residential and ICI flows, along with purchased-but-unused and committed-but-unbuilt capacity, were calculated for a given year, the remaining plant capacity could then be determined for that year.

$$PC_{r_t} = PC - (Q_{Res_t} + Q_{ICI_t} + Q_{CUR_t})$$

where

$$PC_{r_t} = Remaining\ Plant\ Capacity\ in\ year\ t$$
$$PC = Plant\ Capacity$$
$$Q_{Res_t} = Projected\ maximum\ residential\ day\ flow\ in\ year\ t$$
$$Q_{ICI_t} = Projected\ maximum\ ICI\ day\ flow\ in\ year\ t$$
$$Q_{CUR_t} = Projected\ Committed\ but\ Unbuilt\ capacity\ in\ year\ t$$

Analysis

Projected Flows

The historical and projected residential and ICI flows for the Bath Water System, along with the purchased-but-unused ICI and committed-but-unbuilt residential capacity, between 2016 and 2046 are summarized in Table 2 and illustrated in Figure 1 below.

Table 2 – Historical and projected flows for the Bath Water System between 2016 and 2046, expressed in m^3/day

Year	Residential flows	ICI flows	Total Projected Flows	Committed but unbuilt residential	Remaining Plant Capacity
2016	1,055	283	1,338	1,220	770
2017	1,075	319	1,394	1,149	785
2018	1,093	361	1,454	1,138	736
2019	1,098	380	1,478	1,649	201
2020	1,105	427	1,531	1,608	188
2021	1,117	408	1,525	1,588	215
2022	1,138	416	1,554	1,567	207
2026	1,338	478	1,816	1,367	145
2031	1,588	553	2,141	1,117	70

2036	1,839	628	2,467	867	0
2041	2,089	703	2,792	617	0
2046	2,368	786	3,154	337	0

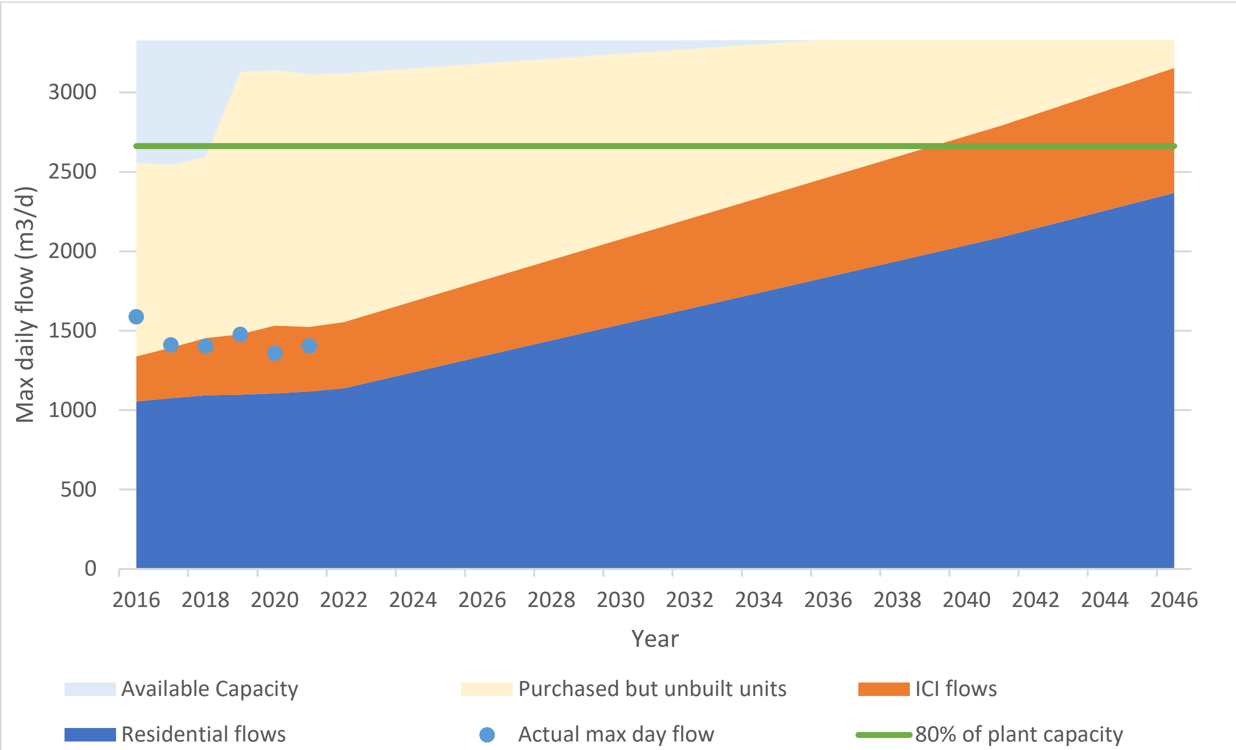


Figure 1 - Historical and projected flows and capacity of the Bath Water System between 2016 and 2046.

Based on these projections, the potable water demand up to 2046 is not expected to exceed the Bath WTP's rated capacity.

Potable water demand is anticipated to reach 80% of the plant's rated capacity around 2038.

- Plant expansions activities should begin once the 80% threshold is met or exceeded to allow for enough time for planning and consultation.
- Plant flows are evaluated on an annual basis as part of the Uncommitted Reserve Capacity process, allowing for the above projections to be regularly monitored and updated as necessary.

At the end of the year 2021, 215 m^3/day of capacity was available at the Bath WTP, which equates to approximately 205 ERUs. Based on projected growth rates this figure is expected to reach 0 by 2036.

It should be noted that the production of potable water by the Bath WTP is also dependant on the "flow per ERU", which can vary year over year.

- Efforts to reduce flows per ERU, either through water conservation initiatives or leak reduction projects, could result in additional capacity becoming available without expanding the Bath WTP.
- This would allow for the deferral of costly expansion activities while reducing the cost of producing one unit of potable water.

Limitations

The potable water demand forecasts presented in this technical memorandum are linked to projected population and dwelling growth for Loyalist Township over the course of the study period. These projections are based on the best information currently available, and are subject to change based on any number of scenarios.

Climate Change Considerations

An increase in temperatures and low amounts of precipitation during the summer months could result in an increase demand for potable water. This would increase the per-capita potable demand from the Bath Water System, putting additional strain on the plant and reducing the amount of available capacity.

An increase in water temperatures in Lake Ontario could lead to more frequent and severe algae blooms near the Bath WTP's intake, which could in turn impact treatment processes.

Linkages

Population and Dwelling Growth Technical Memorandum

References

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

Loyalist Township. (Annually, 2016-2022). *Uncommitted Reserve Capacity calculations.*

Conclusions

Potable water demand forecasts for the Bath Water Treatment Plant were developed based on projected dwelling growth in Bath.

Based on these projections, the potable water demand up to 2046 is not expected to exceed 3,328 m^3/day of capacity that is allocated to Bath.

Potable water demand is anticipated to reach 80% of the plant's rated capacity around 2038. Expansion activities should begin to be undertaken when this threshold is hit.

Continuing to invest in water conservation initiatives or leak reduction programs could increase the available capacity of the Bath WTP by reducing “flows per ERU”. This would defer the need for a large-scale plant expansion by a few years.

At the end of the year 2021, 215 m^3/day of capacity was available at the Bath WTP, which equates to approximately 205 ERUs.

The figures and projections presented in this document should be updated on a regular basis and incorporated into the URC calculations which are conducted each year.

IMP Technical Memorandum: Water Distribution System – Growth Needs

Asset Class: Potable Water System

Objective: The objective of this memorandum is to identify any municipal water distribution infrastructure needs required to facilitate growth within Loyalist Township.

Background

Population growth within Loyalist Townships water service areas is expected to grow more than 1% per year necessitating the need for long term planning of sufficient trunk servicing.

Over the past few decades Loyalist Township has completed several major watermain improvements including the Odessa trunk watermain, the trunk watermain along the Highway 33 corridor to the Taylor-Kidd Industrial Park, extension of a large diameter main to Bridge Street, and reinforcements within the communities of Bath, Odessa, and Amherstview.

Continued growth in each community requires that the system be analyzed to ensure that the piping is sufficient to meet the needs of the expanding communities. For the IMP this analysis was conducted through hydraulic modelling completed by J.L. Richards and Associates Limited (JLR) (J.L. Richards & Associates Limited, March 9, 2020, with update on December 1, 2021).

Assumptions

In the calculation of the water demand the following assumptions were made:

- To determine future demand expected residential and commercial areas of development were identified and classified based on the expected timeline of the development.
- Amherstview demand volumes equals Fairfield demand volume minus Odessa's demand volume.
- Average day demand equals the average monthly volume over three years.
- Maximum day demand was estimated by applying a peaking factor of 1.5 to the average day demand, based on Ministry of Environment, Conservation and Parks' (MECP) design guidelines for peaking flow factors (Ontario Ministry of the Environment, 2008).
- The modelling criteria used by JLR aligns with Onterio Building Code (OBC), and MECP guidelines.

Methodology

The Township engaged the services of J.L. Richards and Associates Limited to update the existing hydraulic models. The models were last updated in 2014 and 2015 for the Bath and Fairfield systems respectively. For the 2020 model JLR integrated the Fairfield and Bath models into one single hydraulic model even though the Fairfield and Bath systems operate separately of each other. The 2020 review was in response to unprecedented residential development within the Township and the need to plan for the longer term within the scope of the IMP.

JLR utilizes Bentley's WaterCad® software platform. The stated objectives of the JLR 2020 modeling assignment included:

- Gather and review background information to update the water model to reflect physical changes to the distribution system, based on new development, watermain replacements and upgrades, water demands, and system operating parameters
- Carry out a model validation through a pressure and flow program
- Model the distribution system with expected future demands
- Summarize the model results under existing and future conditions for the following demand scenarios:
    - average day
    - maximum day
    - peak hour
    - maximum day plus fire flow
- Identify system deficiencies based on fire flow availability, system pressures, and head losses
- Assess water quality and identify deficiencies
- Identify required infrastructure upgrades to correct deficiencies and improve overall system efficiency for future conditions
- Evaluate interconnection of the two drinking water systems (Fairfield and Bath)
- Evaluate key water quality parameters:
    - trihalomethanes (THM) formulation
    - chlorine residual
    - water age

This evaluation is focusing on those new piping segments that would be required to support the expansion of the Loyalist community which would be funded either directly or indirectly by the Township. This evaluation does not include the local piping that would be installed concurrent with the servicing of new local residential streets and funded completely by the relevant developers. The evaluation would include those pipe segments with a diameter greater than 300mm which are oversized specifically to meet future growth needs beyond the limits of the adjacent subdivision.

The evaluation includes a review of:

- The latest impost fee study completed by Hemson for growth-related piping (Hemson Consulting Ltd., 2019)
- The evaluation of the latest development conceptual drawings, secondary plans, and development applications
- The findings of the Township's hydraulic model

- Long-term (post-2046) evaluation of needs

Analysis

Existing Water Demand

JLR analyzed three years of flow data and updated the model accordingly for the Fairfield Water System (2016-2018) and Bath Water System (2015-2017). This data is summarized in the following tables:

Table 1 Amherstview Existing Water Demands

Amherstview – Total Treated Water (2016-2018)				
Average day demand	2440	m^3/d	28.24	L/s
Maximum day demand	3575	m^3/d	41.38	L/s
Peak hour demand	5363	m^3/d	62.07	L/s

Table 2 Odessa Existing Water Demands

Odessa – Total Treated Water (2016-2018)				
Average day demand	798	m^3/d	9.24	L/s
Maximum day demand	1191	m^3/d	13.78	L/s
Peak hour demand	1786	m^3/d	20.67	L/s

Table 3 Bath Existing Water Demands

Bath – Total Treated Water (2015-2017)				
Average day demand	1650	m^3/d	19.09	L/s
Maximum day demand	2654	m^3/d	30.72	L/s
Peak hour demand	3981	m^3/d	46.08	L/s

Future Water Demand

JLR used three future scenarios in their evaluation: near term (2024), mid term (2034), and long term (2044). Expected residential and commercial areas of development were identified with input from Township staff and classified based on the expected timeline of the development. The peak hour demand was estimated as 1.5 times the max day demand. The future average day water demands of each community are noted in the table below. These values are modified from Table 5 in the JLR report.

Table 4 Future Average Day Demands

Area	Near Term 2024 (m^3/d)	Mid Term 2034 (m^3/d)	Long Term 2044 (m^3/d)
Amherstview	2697	3216	3725
Odessa	1025	1313	1636

Bath	1782	1880	1890

Since the JLR study commenced, the Township requested that Hemson complete a population growth study (Hemson Consulting Ltd., 2019). After reviewing the most recent residential growth development and following input from the developer community in the Township, staff have developed a modified growth scenario as outlined in the projections for the treatment capacity of the Bath and Fairfield Water treatment plants found in the treatment plant growth memos.

Model Verification

Flow validation – JLR, assisted by SCG Flowmetrix, field-tested the model at various locations in the Fairfield system in April 2019. Model results were found to be close to the recorded field values.

Chlorine residual validation – The values predicted in the model for chlorine residual were found to be consistent with/slightly less than measured field values in the Fairfield Water System. The values of chlorine levels were found to be all lower in the field samples then the levels predicted in the Bath Water System model. This means that the models can be considered a slightly conservative comparator for water quality.

Since chlorine residual levels are linked to water age in the pipe system and to THM formation, the model has good correlation with these characteristics of water quality.

System Needs

Two areas of concern were noted in the recent study. One of these areas has now been addressed with the extension of the water main along the Queen Street alignment westerly in Bath. This new piping reinforced supply to the expanding Loyalist Estates development. The other deficiency is the need to upgrade the size of the watermain along Main Street – Bath between Mott Street and Heritage Drive. The latter project is required to improve supply to growth in the eastern portion of Bath and is planned to be completed in the near future concurrent with road upgrades on Main Street – Bath.

Fairfield System

Capacity of Trunk Main Servicing Odessa

With recent and future growth within the community of Odessa moving faster than previously expected, one of the main concerns of Loyalist Township is the ability to have sufficient supply and storage capability for the expanding community.

As part of the assignment to JLR to review long-term suitability of the storage capacity for Odessa, the consultant was asked to review the capacity of the trunk watermain from Amherstview to Odessa (J.L. Richards & Associates Limited, 2022).

With the benefit of the Township's water system hydraulic model and the use of some conservative operational setpoints, the firm modeled the long-term (2046) maximum day scenario for Odessa.

JLR summarizes their findings as follows:

> "Based on the forgoing model simulation, it is expected that the existing BPS [booster pump station] in operation can meet Odessa's long-term maximum day demand and refill the Odessa tower at a rate of 21.4 L/s, therefore, twinning of the watermain from the BPS to Odessa is not expected under the future demand scenario. It is recommended that potential BPS upgrades or watermain twining be considered as the future Odessa maximum day demand nears the expected maximum transmission flow rate of 49.7 L/s."

Miscellaneous Trunk Water Connections

This project is intended to complete connections from trunk mains to new development areas and would be used when the normal policy of the developers directly funding growth-based waterworks for a new development(s) don't apply.

Watermain Oversizing

This project is intended to be used when the Township requests an oversized watermain, so that a supply of water greater than needed for the planned development can be conveyed for future growth to adjacent lands. This funding is only available if the requested main is greater than 300mm. The Township's share of costs will be equivalent to the difference in costs to construct a pipeline with the pipe size required for only the development's needs, as indicated by the Township's hydraulic model, and the Township-requested pipe size. Oversized watermains that are currently planned in association with developments are discussed in the Future Development – Water Technical Memorandum.

Highway 33 Hydraulic Improvements – Amherstview West Secondary Plan

As the Amherstview West Secondary Plan is developed, there will be two key opportunities to relieve operating pressures and improve resiliency and capacity to the Bath Road/Highway 33 trunk main (WSP, 2023). The first opportunity will be a new watermain connection at or near the Edgewood Road intersection, which will improve resiliency. This improvement is currently expected to be beyond the IMP planning horizon, subject to the development schedule established for Amherstview West.

In the longer term, as Amherstview West approaches the Brooklands subdivision there will be an opportunity to link a trunk main into the Bath Road/Highway 33 main, such that the original 200mm diameter main placed on Bath Road/Highway 33 is by-passed. This new, larger-diameter main should have a direct connection to the 300mm main that starts just east of Parrott's Bay and continues to the Taylor-Kidd Industrial Park. The connection should have a noticeable impact on both pressure and capacity for the Bath

Road/Highway 33 main to the Taylor-Kidd Industrial Park and will reduce the length of umbilical cord style main on Highway 33, adding some additional resiliency.

The detailed design of the piping network within the Amherstview West Secondary Plan area should ensure that the Bayview connection maximizes the ability to convey water from the County Road 6 corridor to the beginning of the 300mm main running to the Taylor-Kidd Industrial Park on Bath Road/Highway 33 at the east side of the Parrott's Bay bridge.

This improvement may be beyond the IMP planning horizon, depending on the development schedule established for Amherstview West and the needs of industries in the industrial park. Should the Bath and Fairfield systems be connected in the distant future, this connection would add both resiliency and increased capacity.

Loyalist East Business Park Looping

The Loyalist East Business Park currently only has one feed point, from County Road 6. If the park is expanded westerly, consideration should be made to establish looping of the system. There are a couple of options to accomplish this:

- Ideally a loop could be established by connecting to the northwesterly extremes of the Amherstview West Secondary Plan system, but development of this section of the Secondary Plan is not expected in the 25-year IMP horizon.
- An alternative solution, though hydraulically less attractive, would be to connect the south end of William Henderson Drive to a point within the Amherstview West distribution system.

Future Fairfield Water System Storage Site Servicing Main

The overall Fairfield Water system is expected to need additional storage within the IMP study period.

Should this new storage be situated in Odessa, there will need to be adequate capacity in place to convey the required demands to the storage facility. Should the location of a new storage facility not be situated on a large trunk main, additional piping will be required to service the proposed site.

Odessa Tower Supply Redundancy

Consideration should be made by adding some resiliency to the existing piping that services the Odessa elevated tower. Currently the single feed servicing the Odessa Tower site extends from County Road 6 to the elevated tower along Main Street – Odessa. Ideally there would be a second trunk feed for this facility. Should the Shane Street corridor be developed, it would be recommended that trunk servicing from County Road 6 to the tower, possibly via Henzy Street or an alternate connection to the larger diameter Main Street – Odessa watermain, be considered.

Extension to the Taylor-Kidd Watermain

The watermain on Taylor-Kidd Boulevard extends 460m westerly from the Jim Snow Drive intersection. This main is expected to be extended approximately 600-1,000m further west to service the Umicore facility, currently in development. When the main is extended consideration should be given to continuing the extension to County Road 4. The total distance from the current end of the watermain to County Road 4 is approximately 2,100m. The main has a diameter of 300mm and therefore capable of servicing a large area. The main when extended will be available to service other industries in the area as well as address remedial needs in the vicinity of the hamlet of Millhaven.

Emma Street Watermain Installation

Although Emma Street was included in the original village plan for Odessa, the street has never been serviced. A new drainage project on Bridge Street has created an opportunity to develop this block. This project has been in the works for many years and construction began in the fall of 2023. This project is being completed under the Local Improvement Charge regulation, which requires local landowners to cover the costs associated with servicing their property.

Bath Water System

Main Street – Bath Watermain Upsizing, Mott Street to Heritage Drive

This project has two objectives. The first is to replace aging infrastructure, and the second is to increase the size of the main to assist in improved capacities in the east end of the growing community. The proposed section to be installed is from Mott Street to Heritage Drive.

The Township intends to resurface the section of Main Street – Bath from Mott Street easterly to Sir John Johnson Drive in the next few years and it is the intent to replace or rehabilitate all the watermain within the right-of-way, so that sidewalks and other active transportation infrastructure and boulevards can be constructed prior to or concurrent with road work.

Windermere Boulevard Corridor

Previous long-term planning exercises have identified the Windermere corridor as a route for a trunk watermain extending from Main Street – Bath to County Road 7. Based on the expected size of this main, it would be constructed as development proceeds in the Bath community and treated as a local watermain. To meet long-term community needs, this main should have a minimum diameter of 300mm. This project may include relocation or additions of PRVs, should the need for additional fire demand arise and subject to hydraulic modelling results. For further information on the PRV relocation, please refer to the Water Distribution System Remedial Needs Memorandum.

Connection Main – Bath to Fairfield System

It is envisioned that in the distant future the Fairfield and Bath water systems will be combined. The connection of these two systems would allow for additional redundancy with respect to the community water supplies especially when key components such as treatment and/or storage must be shut down for maintenance purposes. This project would not increase firm capacity.

With recent redundancy improvements at the Bath Water Treatment Plant resulting from the membrane filtration system installed in 2021, the urgency for this connection has diminished and is now considered to be beyond the 25-year horizon of the IMP.

Consideration of the eventual connection should be undertaken when rehabilitating any of the watermains along Main Street – Bath and the extension of the Taylor-Kidd main. Other options would be to follow the planned Taylor-Kidd Boulevard extension route and Doyle Road corridor, or to traverse the Correctional Services of Canada property which would be a very direct route.

Windemere PRV

As the community has grown with local interlinkages in the distribution system, the location and operating pressures of the Mott Street PRV are restrictive, and the unit is having difficulty meeting the expanding needs of the system. In order to accommodate new development, and meet fire requirements a new PRV will be required at Windemere Boulevard.

Financial

The Hemson study's Tables 1 and 3 contain detailed information on funding requirements for projects with growth components. In most cases the projects are fully funded as development charge or impost fee-funded projects. Exceptions are projects where existing mains are being replaced with larger mains. Information on growth-related watermain projects included in the Hemson study is reproduced below. The Hemson project list has been augmented with recent watermain growth projects.

Table 5 Bath Water Service Area growth-related capital projects. Adapted from Hemson study Table 1, Development-related capital program - Bath Water Service Area

New Water Projects – Linear Infrastructure	Gross project cost	Grants, subsidies, other recoveries	Net municipal cost	Total eligible DC costs	Impost Fee Eligible Costs			Percentage Developer Expense
					Available reserves	2019-2028	Post 2028	
Upsizing Main Street Bath from Mott to Heritage – Design	$32,104	$0	$32,194	$32,194	$32,194	$0	$0	
Windemere PRV	$250,000	$0	$250,000	$250,000	$0	$250,000	$0	

Upsizing Main Street Bath from Mott to Heritage – Construction	$485,250	$0	$485,250	$285,250	$263,711	$231,539	$0	
Windermere Corridor	TBC	$0	RBC	0%				100%

Table 6 Fairfield Water Service Area growth-related capital projects. Adapted from Hemson study Table 3, Development-related capital program - Loyalist East/Fairfield Water Service Area

New Water Projects – Linear Infrastructure	**Gross project cost**	**Grants, subsidies, other recoveries**	**Net municipal cost**	**Total eligible DC costs**	**Impost Fee Eligible Costs**			**Percentage Developer Expense**
					Available reserves	2019 - 2028	Post 2028	
Miscellaneous trunk growth connections	$200,000	$0	$200,000	$200,000	$0	$200,000	$0	
Watermain oversizing	$1,120,800	$0	$1,120,800	$1,120,800	$0	$1,120,800	$0	
Future Fairfield water system storage site servicing main	TBD		TBD	100%				
Odessa Tower Resiliency	TBD		TBD	100%				

In addition to the projects listed in the tables above, the following projects are noted. Funding conditions have yet to be finalized:

- Emma Street: funded through Local Improvement Charges
- Loyalist East Business Park Looping and Highway 33 Hydraulic Improvements: Amherstview West Secondary Plan are expected to be constructed in future years beyond the horizon of the IMP. Expenses for the Loyalist East Business Park Looping project should be a cost to both the developer of the business park phase and impost fees for the section of main outside of the Business Park.
- Extension of the Taylor-Kidd Watermain: part of negotiations associated with the Umicore project and the balance of the watermain expense for the extension to the County Road 4 intersection, to be funded by impost fees.
- Windermere Boulevard Corridor: If a pipe diameter of 300mm or smaller meets the long-term requirements of the municipality, the cost of installation of this main will be the responsibility of the local developer. If a larger main is deemed appropriate, then the oversizing condition would apply, and impost fees would be used to fund oversizing.

Climate Lens

Loyalist Township's water distribution system will require expansion to accommodate population growth. Expansion will include adding new watermains and connections to service new developments as well as upsizing of existing watermains in anticipation of expected growth in lands adjacent to developments.

Climate conditions that will impact the expansion of the water distribution system include increased temperature and a decrease in groundwater levels and moisture in subsurface soil.

Increased temperatures will result in an increase in demand. Increased demand will impact hydraulic capacity, possibly increasing head loss. Increased head loss has implications for energy dissipation throughout the system, which may result in decreased downstream pressures below acceptable limits. Should this occur, additional pumping would be required to boost or compensate for lowered delivery pressures.

Watermain breaks caused by frost penetration can be expected to decrease due to increasing future temperatures. However, a drop in groundwater levels and soil moisture during extreme dry periods, resulting an increase in shear stress exerted on buried pipes from soil shrinkage, could have the opposite effect, increasing watermain breaks (Roshani, Kleiner, Colombo, & Salomons, 2022). This would only be applicable for pipes that are buried in clay expansive soils, which are not typical in Loyalist Township.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Climate change requires extra hydraulic capacity. It is estimated that with an increase in temperature of between 2% and 6% by 2100, there will be an increase in demand of 14% to 45% (Roshani et al., 2022). Sizing of watermains should take this potential increase into consideration.
- Head loss criteria has implications for energy dissipation through the system whereby larger head losses in pipes mean lower downstream pressures, with possible implications for energy use if pumping is required to compensate for these lowered delivery pressures (Roshani et al., 2022). Design of distribution systems should consider the potential for an increase in head loss.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Consider optimizing the pumping schedule and reservoir capacity during the day to avoid using pumps when electricity rates/demand is high. Utilizing pumps with higher efficiency and filling larger reservoirs during off peak hours could lead to reduction in electricity use and bills.

- Reduce non-revenue water losses and waste.
- Optimize operational activities to prevent watermain breaks and improve leak detection methods to find leaks faster.
- Reduce energy consumption and carbon emissions by implementing energy efficient pumping operations and use hydraulic models to identify energy savings and reduce energy waste.
- Use pressure and gravity to move water in place of electrically powered pumps.
- Explore residential gray water use to lessen water demand during heat waves.

Linkages

This memorandum links with the following technical memos within the Infrastructure Masterplan:

- Water Systems Storage Technical Memorandum
- Population And Dwelling Growth Technical Memorandum
- Water Distribution System Remedial Needs Technical Memorandum
- Future Development – Water Technical Memorandum

References

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

Hemson Consulting Ltd. (2019). *Water Financial Plan.*

J.L. Richards & Associates Limited. (2022, December 20). Loyalist Township - Water Storage Analysis. Kingston.

J.L. Richards & Associates Limited. (March 9, 2020, with update on December 1, 2021). *Loyalist Township - Water Model Update.*

Ontario Ministry of the Environment. (2008). *Design Guidelines for Drinking-Water systems.*

Roshani, E., Kleiner, Y., Colombo, A., & Salomons, E. (2022). *Water distribution systems: climate change risks and opportunities.* National REsearch Council of Canada.

WSP. (2023). *Amherstview West Secondary Plan Water and Sanitary Infrastructure Servicing Report.*

Conclusions

Watermain reinforcement projects and oversizing of trunk mains has left the Township in a good position to expand as the communities grow.

The growth projects listed above have been prioritized as follows:

High Priority

- Lakeside Ponds watermain oversizing. Installation required to remain concurrent with development
- Main Street – Bath watermain upsizing, Mott Street to Heritage Drive. Main replacement concurrent with imminent Main Street – Bath road reconstruction
- Extension of the Taylor-Kidd watermain, Phase 1. Westerly extension to Umicore embarkation point to meet needs of new industry
- Miscellaneous trunk water connections. Potential application of this project for initial servicing of Amherstview West, otherwise projects classified as medium or low priority
- Windermere Boulevard corridor. Planning for the next phases of development along Windermere Boulevard, and the installation of the upgraded PRV to be relocated from Mott Street
- New Windemere PRV

Medium Priority

- Analysis of future draft plan applications to accommodate watermain oversizing needs
- Odessa Tower redundancy. Project planning may commence as Odessa community expands
- Windermere Boulevard corridor. Planning for long-term routing as Township reviews and approves development applications in immediate area.

Low Priority

- Loyalist East Business Park Looping. Deferral results in higher maintenance activity
- Future Fairfield Water System storage. Project likely to commence in later stages of IMP horizon, need to regularly re-evaluate future storage requirements
- Extension of the Taylor-Kidd watermain, Phase 2. From Umicore embarkation point westerly to County Road 7

IMP Technical Memorandum: Water Storage Needs

Asset Class: Water

Objective: The purpose of this technical memorandum is to present the Township's projected treated water storage requirements over the course of the IMP period. Areas of discussion will focus on population growth and maximum day flows, along with their project impact on water storage requirements for the two distribution systems.

Background

There are two water distribution systems in the Township that service the three urban centers.

The Fairfield Water Distribution System (WDS) services residential and commercial users in the communities of Amherstview and Odessa, with the potable water supplied by Fairfield Water Treatment Plant (WTP). Two elevated storage tanks serve the system, being the Amherstview and Odessa towers. An above-ground reservoir, located at County Road 6 and Taylor-Kidd Boulevard, stores treated water for the system as well.

The Bath WDS services residential and commercial users in the community of Bath, with potable water supplied by Bath WTP. One elevated storage tank, the Bath tower, serves the system.

Bath WTP also supplies water to the Correctional Services of Canada's (CSC) Bath and Millhaven Institutions. A dedicated water storage reservoir located on CSC property, which is owned and operated by CSC, is used by these two institutions to store potable water. Although this tank could technically be considered part of the distribution/storage network for the Village of Bath, it has not been included as part of this analysis given that it is operated by CSC in accordance with agreements between CSC and the Township and the tank does not have capability to pump water back into the public distribution system. This technical memo will therefore only consider the storage requirements for residential and ICI connections within the Village of Bath.

According to the Ministry of Environment, Conservation, and Parks (MECP) Design Guidelines for Drinking Water Systems ("the Design Guidelines"), treated water storage facilities should be designed to maintain adequate flows and pressures in the distribution system during peak hour water demand, and to meet critical water demands during fire flow and emergency conditions (Ontario Ministry of the Environment, 2008).

The Design Guidelines go on to say that the purpose of storage is to provide a continuous supply to and maintain system pressure in the system, and that it should be designed to minimize any contaminant risks to the treated water.

The purpose of this technical memorandum is to provide water storage requirements for Bath WDS and Fairfield WDS until 2046, the study period covered by the IMP. The primary focus is to determine projected water storage quantity requirements over the study period.

Assumptions

The following assumptions were made when developing these documents:

As detailed in the 2021 Canadian Census of Population, the average dwelling in Loyalist Township houses approximately 2.5 people. Therefore, a factor of 2.5 persons per household will be used to estimate population size in the water storage calculations.

The maximum daily flow per Equivalent Residential Unit (ERU) is 1.049 m^3/day/ERU for Bath, and 1.057 m^3/day/ERU for Fairfield, as presented in the WTP Projections technical memoranda. ERU is a notional value employed by Loyalist Township for the purposes of calculating excess treatment capacity and for water billing calculations. An ERU is a ratio of total water consumption billed within the water system divided by the number of units of housing within the system.

With the introduction of minimal planning controls for secondary units in 2022, there is insufficient data on the impact of new secondary units on average demand values. As a result, the expanded numbers of secondary units within the community have not been factored into these calculations.

Methodology

Projections were developed using several parameters presented in the Township-commissioned population, housing, and employment study (Hemson Consulting Ltd., 2019), as updated. Staff have also drawn from several other technical memoranda completed during the IMP process; these are referenced under the Linkages heading. The modified projections that are referenced are considered high growth scenarios.

Actual and projected maximum day flows for the Fairfield WTP between the years 2016 through 2021 have been used to develop projected maximum day flows for 2026 through 2046.

Loyalist Township building permit data has been used.

MECP’s Design Guidelines have been referenced to determine the total treated water storage requirement formula, as well as for the fire flow requirements data.

The Township employed J.L. Richards and Associates Limited (JLR) to review the Township’s potable water storage needs for Bath and the Odessa pressure zone (J.L. Richards & Associates Limited, 2022).

Water Storage Availability

Fairfield

The Fairfield Water Distribution System is made up of two elevated storage tanks, being the Amherstview and Odessa towers, and the above-ground reservoir on County Road 6 for potable water storage.

Based on the Design Guidelines, the clearwell in a treatment plant cannot be considered storage, since it is a part of the disinfection process.

The current available water storage for the Fairfield Water Distribution System is 6,225 m^3, as summarized below.

Facility	Storage Quantity (m^3)
Amherstview Elevated Storage Tank	1,100
Odessa Elevated Storage Tank	900
County Road 6 Reservoir	4,010
Total	**6,225**

Table 1 Available storage in Fairfield WDS

This value represents the maximum volume of potable water that can be stored in the Fairfield WDS.

There is currently no storage reservoir locally available to service the Bath Road/Highway 33 westerly watermain extension and Taylor-Kidd Industrial Park area. Due to the long distance from existing reservoirs and the diameter of the Bath Road/Highway 33 watermain west of County Road 6, the Township cannot provide sufficient fire flows to the industrial area. Therefore, the use of municipal potable water for fire suppression is prohibited in the industrial area. The large industrial properties have access to potable water supplied commercially under agreements with supplier.

Bath

Storage in the Bath WDS consists of the Bath tower.

Based on the Design Guidelines, the treatment plant's clearwell cannot be considered storage, since it is a part of the disinfection process.

Facility	Storage Quantity (m^3)
Bath Elevated Storage Tank	1,900

Table 2 Available storage in Bath WDS

This value represents the maximum volume of potable water that can be stored in the Bath WDS.

CSC Considerations

In 1994, an allocation agreement was made between the-then Village of Bath and CSC that specified 568 m^3 of the 1,900 m^3 volume of water in the Bath water tower be reserved for the exclusive use of CSC.

In 2005 CSC constructed their own water storage tank on their property. The reservoir has two tanks each hold 130,000 imperial gallons for a total of 260,000 gallons or approximately 1180 m^3. There are two fire pumps, each are 125 HP rated at 2000 gal/min at 90 psi. However, 2006 amendments to the original agreement did not amend this change, and the CSC allotment of the water in the tower remains in the agreement.

Given CSC now has their own fire storage located onsite, the agreement should be amended to reflect this. Until the agreement is amended, 568 m^3 of the 1,900 m^3 needs to be reserved for CSC use.

Water Storage Projections

The 'Total Treated Water Storage Requirement' formula presented in the Design Guidelines has been used to determine the size of the water storage facilities required to meet the needs of each WDS over the course of the study period.

Fire storage requirements, equalization storage, and emergency storage are all components of the equation to calculate storage requirements.

Total treated water storage requirements have been calculated by adding the fire storage, equalization storage, and emergency storage for the area serviced by each WTP, as shown in the equation below.

Tank volume references are for accessible volumes under normal operations and are less than actual tank volumes. For example, the County Road 6 reservoir has an actual volume of 4225 m^3, and an accessible volume of 4010 m^3.

$$Treated\ Water\ Storage\ Requirement = A + B + C$$

where

$$\mathrm{A} = Fire\ Storage$$
$$B = Equalization\ Storage$$
$$C = Emergency\ Storage$$

Projected water storage requirements are presented in five-year increments

Fire Storage Requirements (A)

The first component of the total treated water storage equation is fire storage, represented by A in the Treated Water Storage Requirement formula. A fire flow value must be factored into water storage determinations for systems providing fire protection. A table provided in the Design Guidelines can be used to determine the appropriate fire flow value based on the equivalent population connected to the system.

Equivalent Population	Suggested Fire Flow (L/s)	Duration (Hours)
500 to 1000	38 (10 ft/s)	2

1000	64 (17 ft/s)	2
1500	79 (21 ft/s)	2
2000	95 (25 ft/s)	2
3000	110 (29 ft/s)	2
4000	125 (33 ft/s)	2
5000	144 (38 ft/s)	2
6000	159 (42 ft/s)	3
10000	189 (50 ft/s)	3
13000	220 (58 ft/s)	3
17000	250 (66 ft/s)	4
27000	318 (84 ft/s)	5
33000	348 (92 ft/s)	5
40000	378 (100 ft/s)	6

Table 3 Fire flow requirements

Suggested fire flows are based on the equivalent population connected to the system. For each WDS this can be calculated by multiplying the total number of Equivalent Residential Units (ERU) by 2.5, which is assumed to be the number of persons per household over the course of the study period.

$$Equivalent\ Population = ERU\ x\ 2.5\ persons$$

ERUs are the total number of connections to the distribution system, which includes both residential dwellings as well as industrial, commercial, and institutional (ICI) accounts.

The equivalent population for Odessa and Amherstview between 2021 and 2046 is illustrated below.

Year	Total ERUs	Equivalent Population
2021	4,805	12,013
2026	5,373	13,433
2031	5,885	14,713
2036	6,294	15,735
2041	6,681	16,703
2046	7,102	17,755

Table 4 Equivalent population Odessa and Amherstview, 2021-2046

Year	Total ERUs	Equivalent Population
2021	1,454	3,635
2026	1,728	4,320
2031	2,038	5,095
2036	2,349	5,873
2041	2,659	6,648
2046	3,004	7,510

Table 5 Equivalent population Bath, 2021-2046

The 'Suggested Fire Flow (L/s)' is converted into hours and multiplied by the appropriate 'Duration (hours)' value specified in the Design Guidelines. The resulting value is the required fire storage for the system in litres.

$$Fire\ Storage\ (L) = Suggested\ Fire\ Flow\ (L/s)\ \times\ 60\ \times\ 60\ \times\ Duration\ (hours)$$

To obtain the final 'Fire Storage (m^3)', the 'Fire Storage (L)' is divided by 1000 to convert the value from L to m^3.

$$Fire\ Storage\ (m^3) = \frac{Fire\ Storage\ (L)}{1000\ (\frac{L}{m^3})}$$

Fire flow requirements are calculated using a specific duration based on the equivalent population connected to the system.

Equivalent Population	Suggested Fire Flow (L/s)	Duration (hours)	Fire Flow Volume Required (L)	Fire Flow Volume Required (m^3)
500 to 1000	38	2	273,600	274
1000	64	2	460,800	461
1500	79	2	568,800	569
2000	95	2	684,000	684
3000	110	2	792,000	792
4000	125	2	900,000	900
5000	144	2	1,036,800	1,037
6000	159	3	1,717,200	1,717
10000	189	3	2,041,200	2,041
13000	220	3	2,376,000	2,376
17000	250	4	3,600,000	3,600
27000	318	5	5,724,000	5,724
33000	348	5	6,264,000	6,264
40000	378	6	8,164,800	8,165

Table 6 Fire storage requirements based on flow volume required

Equalization Storage (B)

The second component of the water storage calculation is equalization storage, represented by B in the Treated Water Storage Requirement formula.

$$Equalization\ Storage\ (B) = 25\%\ of\ Maximum\ Day\ Demand$$

Maximum day demand in a given year can be calculated by multiplying the number of connections to the system, expressed in ERUs, by a flow-per-ERU factor. These factors were presented in the WTP Projections technical memorandums.

$$Qmax_t = ERU_t \ x \ f_{ERU}$$

Where

$$Qmax_t = Maximum\ daily\ flow\ in\ year\ t$$
$$ERU_t = Number\ of\ ERUs\ in\ year\ t$$
$$f_{ERU} = flow\ per\ ERU\ factor$$

Emergency Storage (C)

The third component of the water storage calculation is emergency storage, represented by C in the Treated Water Storage Requirement formula. This value is calculated by taking 25% of the combined total of fire storage and equalization storage (A + B).

$$Emergency\ Storage\ (C) = 25\ \%\ of\ (A + B)$$

The fire storage, equalization storage, and emergency storage requirements for each WDS between 2021 and 2046 are presented in Tables 7 and 8 below.

As mentioned previously, 568 m^3 of the available volume in the Bath Elevated Storage Tank is reserved for CSC fire flow use. This volume should be added to the Treated Water Storage Requirement to account for the CSC allocation.

Analysis

The following analysis is based on the calculations outlined in the Design Guidelines. It should be noted that these are guidelines, and therefore operational experience with the system will also play a part in determining when storage upgrades are required.

Projected Storage Requirements – Fairfield

The calculated water storage requirements for the Fairfield WDS between 2021 and 2046 are summarized in the following table:

Year	Fire Storage (A)	Equalization Storage (B)	Emergency Storage (C)	Total Storage Requirement (m^3)
2021	2,041	1,270	828	4,139
2026	3,600	1,420	1,255	6,275
2031	3,600	1,555	1,289	6,444
2036	3,600	1,663	1,316	6,579
2041	3,600	1,765	1,341	6,707
2046	5,724	1,877	1,900	9,501

Table 7 - Water storage requirements for Fairfield WDS (m^3)

The values from Table 7 have been plotted against the current volume of available storage in the Fairfield WDS (6,225 m^3) and are illustrated below.

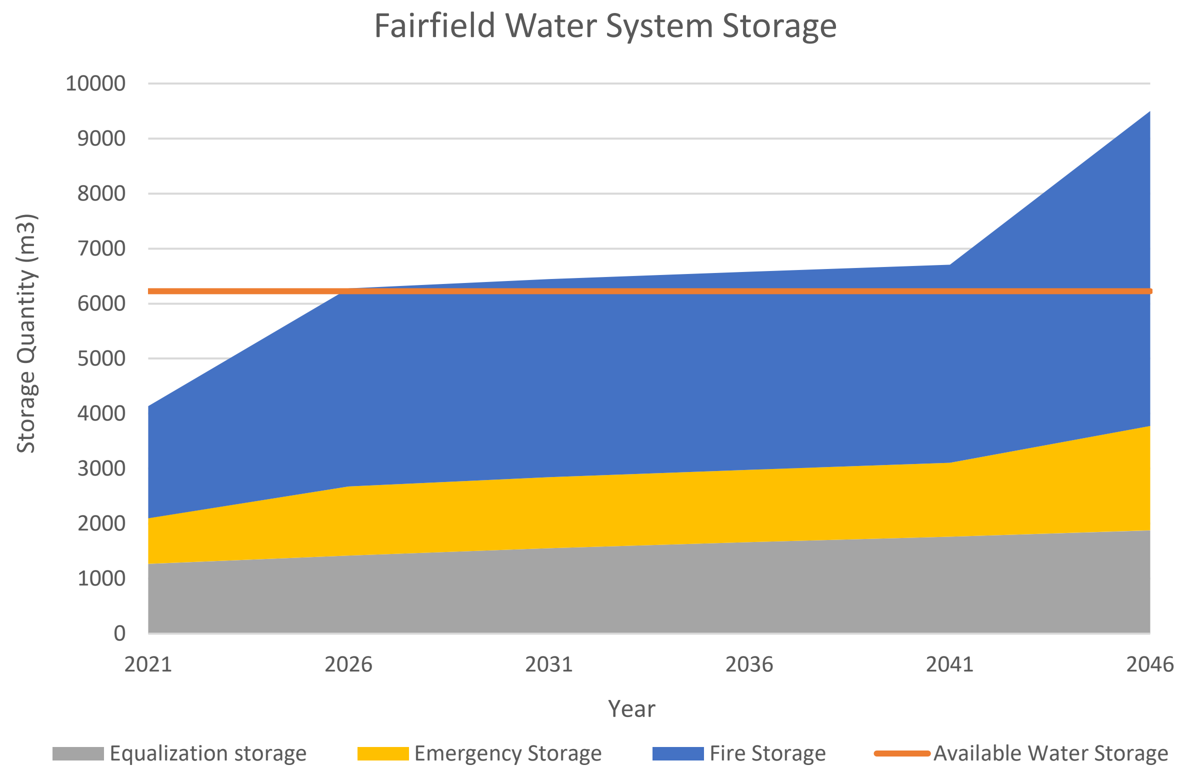


Figure 1 Projected water storage requirements, Fairfield WDS 2021-2046

Based on these projections, total storage requirements for the Fairfield WDS are expected to minimally exceed the system's current capacity of 6,225 m^3 around 2026.

This capacity restriction is mainly a result of the quantity of fire storage required. This value is heavily dependent on the population being serviced, which has been projected based on a high growth scenario. Actual growth trends may adjust the timing of when the threshold is reached.

The need for increased storage capacity could be delayed through a reduction in the flow per capita, such as through a water loss reduction program. Recent trends have indicated that the flow per capita is decreasing. Staff will continue to monitor this value to track when additional storage will be required.

Based on the information provided above, additional storage will be required in the Fairfield system within the IMP study period. It is recommended that growth and flow per capita trends are monitored annually to provide staff with more accurate information on when additional storage should be constructed. It is also important to have an emergency contingency plan as the storage requirement is close to the available storage volume.

Projected Storage Requirements – Bath

The calculated water storage requirements for the Bath Water System between 2021 and 2046 are summarized in the following Table 8 below:

Year	Fire Storage (A)	Equalization Storage (B)	Emergency Storage (C)	CSC Fire Flow Allocation	Total Storage Requirement (m^3)
2021	900	381	320	568	2,215
2026	1,037	453	373	568	2,485
2031	1,717	535	563	568	3,446
2036	1,717	616	583	568	3,558
2041	2,041	697	685	568	4,074
2046	2,041	788	707	568	4,198

Table 8 Water Storage Requirements for Bath WDS (m^3)

These values were plotted against the current volume of available storage in the Bath WDS (1,900 m^3), presented below

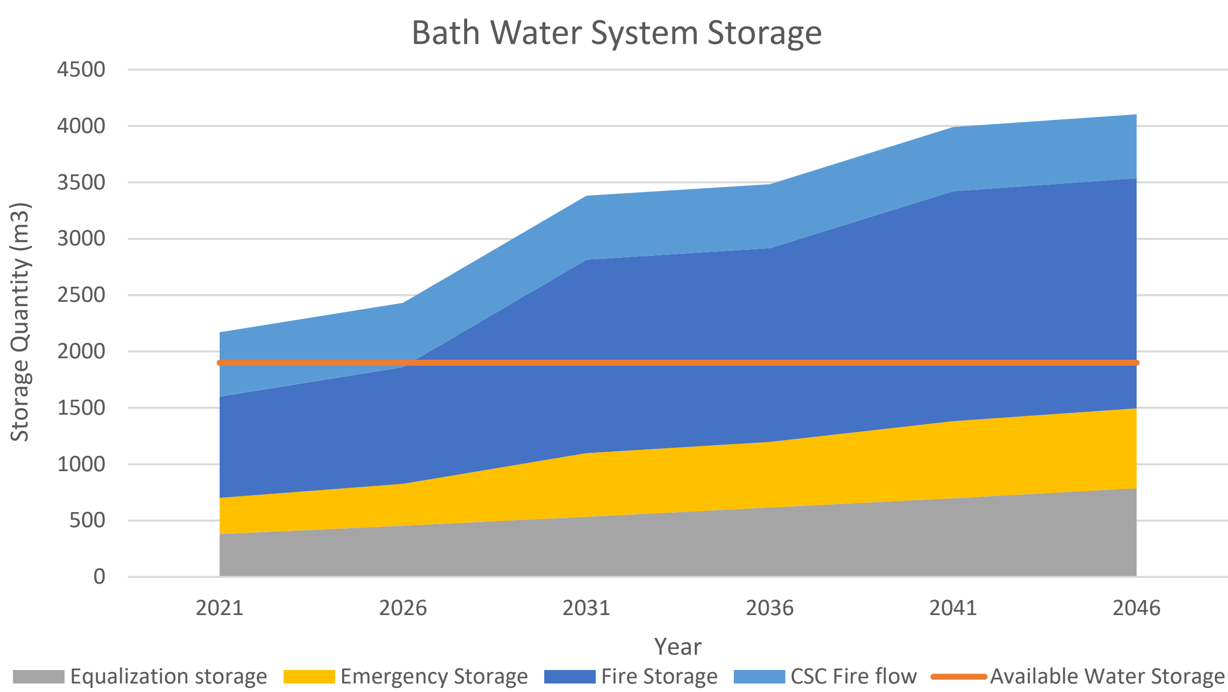


Figure 2 Projected water storage requirements, Bath WDS 2021-2046

Based on these projections, the total storage requirements for the Bath Water System have exceeded the current capacity. This capacity restriction is mainly caused by the following:

- Requirement for fire flow storage reserved for CSC. As indicated above, CSC has constructed storage on-site. It is possible they no longer require storage capacity from the Township. Until this change in storage requirement has been confirmed and amended in the CSC agreement, it must be considered in storage calculations.

- Large fire flow requirement based on population increase. The increase in fire flows appears more significant due to the use of a 5-year analysis. To provide a more accurate understanding of when the change in population will result in a need for greater fire storage, a year-by-year analysis has been completed, shown below.

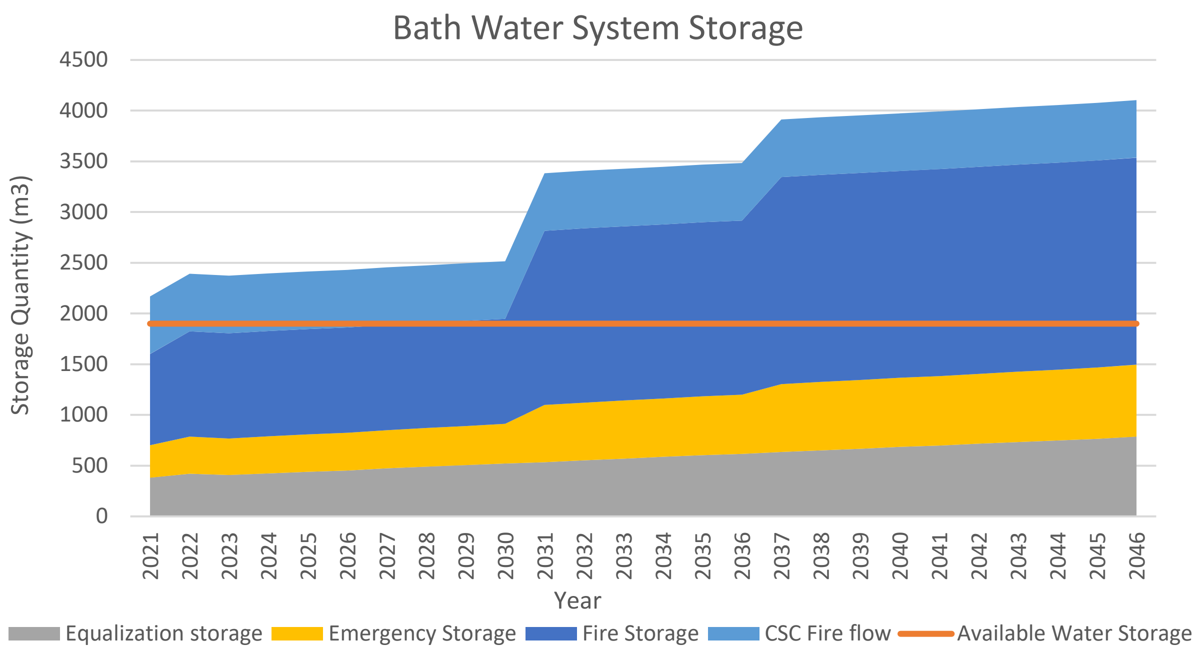


Figure 3 Year-by-year analysis of projected water storage requirements, Bath WDS 2021-2046

Based on this analysis, additional storage will be required in the Bath system within the IMP study period. The Township's first step should be to work towards amending their agreement with CSC so that the storage requirement can be removed. Depending on if the CSC agreement is amended or not, the timing for additional storage construction will be altered. Removal of this storage requirement will mean that the Township currently has sufficient storage available, and the need for additional storage will be based on residential growth and water usage. As with Fairfield, it is recommended that growth and flow per capita trends are monitored annually to provide staff with more accurate information on storage needs. With or without amendments to the CSC agreement, it is important to have an emergency contingency plan in place for Bath.

Emergency Contingency Plan

When the required storage approaches the amount of available storage it is important to have a contingency plan in place in case of an emergency. Staff will review these plans with the Fire Chief to ensure any storage concerns have been accounted for until additional storage is constructed.

Storage Options Study

Staff conducted an initial analysis of potential storage options in the Township. This analysis evaluated site options for additional storage, as well as storage configurations that were presented by JLR. The option of connecting the two water systems was also considered. Analysis of storage needs should include an examination of retiring one of the elevated storage facilities on the basis that continued maintenance costs may be a significant component of lifecycle storage costs. In an ideal situation, large capital expenditures for recoating and other maintenance costs would be deferred until the tower was taken out of service, and subsequently the funds retained.

The figures and recommendations presented above indicate the need for further study on storage options in the Township. It is recommended that a separate EA study is conducted to review all possible storage options in both distribution systems in order to determine the best path forward.

Limitations

The potable water demand forecasts presented in this technical memorandum are linked to projected population and dwelling growth for Loyalist Township over the course of the study period. These projections are based on the best-available information at this point in time and are subject to change based on any number of scenarios.

Climate Change Considerations

An increase in temperatures and low amounts of precipitation during the summer months could result in an increased demand for potable water.

This would increase the per capita potable water demand from the Fairfield WDS, increasing the quantity of storage required. This highlights the importance of a water loss reduction program.

Chlorine persistence in water is affected by temperature. Warmer temperatures will result in an increase in the quantity of chlorine required for disinfection and to maintain an appropriate chlorine residual within the treatment system.

Increased chlorine dosage would increase operational costs and increase the potential for water quality issues such as a rise in trihalomethanes (THMs). This is something that will need to be considered when establishing additional storage in the distribution systems.

Linkages

Population and Dwelling Growth Technical Memorandum
Bath Water Treatment Plant Projections Technical Memorandum
Fairfield Water Treatment Plant Projections Technical Memorandum
Bath Water System Water Loss Technical Memorandum

Fairfield Water System Water Loss Technical Memorandum

References

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

J.L. Richards & Associates Limited. (2022, December 20). Loyalist Township - Water Storage Analysis. Kingston.

Loyalist Township. (Annually, 2016-2022). *Uncommitted Reserve Capacity calculations.*

Ontario Ministry of the Environment. (2008). *Design Guidelines for Drinking-Water systems.*

Recommendations

The storage capacity for each water system in the Township was evaluated. The results of this evaluation determined that both systems will require additional storage within the IMP study period.

It is recommended that staff work towards amending the agreement with CSC to remove the requirement for fire flow storage in the Bath WDS.

It is recommended that growth projections and the flow per capita value are updated annually to help determine when additional storage will be required.

It is recommended that the emergency contingency plan is reviewed with the Fire Chief.

It is recommended that an EA study analyzing potable water storage options in the Township is conducted.

IMP Technical Memorandum: Water Future Development

Asset Class: Potable Water System

Objective: The objective of this memorandum is to recognize any growth-related water projects Loyalist Township will administer as proponent or be required to provide funding for the completion of the project. Funding may be direct, or indirect through development charges, impost fees, frontage fees, grants, or other funding sources. This process will include noting which projects are classified as Schedule B and C projects (Municipal Engineers Association, 2023) as per the Municipal Class Environmental Assessment (MCEA) process, as amended 2023. Municipal projects exempt from the MCEA process have also been listed to provide a holistic overview of work to be completed through developments to assist with future financial planning. Future local servicing projects which are entirely the responsibility of the developer and approved under the Planning Act are not included.

Background

Loyalist Township is projected to experience consistent growth throughout the IMP study period, as outlined in the Population and Dwelling Growth Technical Memorandum. This growth is being supported by development in all three urban centers. Additional water infrastructure will be required to service these developments as they continue to grow.

Developments use the Planning Act to identify projects and establish approvals. The MECP has recognized that much of the work done through the Planning Act process can be used to satisfy the MCEA process requirements. The combination of the Planning Act and MCEA is termed the Integrated Process (Muncipal Engineers Association, 2023), with the goal of avoiding duplicated steps for the same project. To meet the requirements for the Integrated Process any Schedule B or C projects that are concluded through the Planning Act must be recognized in the MCEA process. The IMP initiates the MCEA process and therefore must recognize any Schedule B or C projects associated with development.

Assumptions

The development documentation on file is up to date with required infrastructure.

The developments considered in the Infrastructure Masterplan include all subdivision applications listed in Table 1 below.

The Amherstview West Secondary Plan is being presented as a separate Master Plan. The summary of the major infrastructure included in that plan (WSP, 2023) has been included here for discussion only and for future financial DC and impost fee analysis.

Methodology

To identify any projects that need to be listed through the IMP, the Engineering Development Supervisor was consulted. All future developments of which staff are aware were reviewed against the MCEA project tables to determine which items would be considered Schedule B or C. Projects identified have been listed along with the status of the development in the planning process. Projects that are exempt based on the MCEA project tables have also been identified.

Analysis

After careful review of each future development on file, it was determined that there are no Schedule B or C water related projects to be recognized through the IMP.

The following are water infrastructure projects that are exempt based on the MCEA project tables. These projects will be completed through development but do not need to be recognized through the IMP. They may include watermain establishment, extension, or enlargement.

Table 1. List of water infrastructure projects associated with development

Location	Water Infrastructure Upgrade	Development	Status	Developer vs Impost Funded
Odessa	Babcock Boulevard extension of watermain	Fields of Loyalist	Pre-draft plan approval	Developer
	Proposed Street A establish watermain	Fields of Loyalist	Pre-draft plan approval	Developer
	Main Street extension of watermain	Shane Street Development	Draft plan approved	Developer
Amherstview	McKee Street establishment and oversizing of watermain	Lakeside Ponds	Draft plan received	Impost
	Speers Boulevard extension and oversizing of watermain	Lakeside Ponds	Draft plan approved	Impost
	Amherst Drive extension and oversizing of watermain	Amherstview West Secondary Plan	Plan under development	Impost
	Walden Pond Drive extension of watermain	Amherstview West Secondary Plan	Plan under development	Developer
	Kildare Drive extension of watermain	Amherstview West Secondary Plan	Plan under development	Developer
Bath	Country Club Drive extension of watermain	Loyalist Estates (Phase 12)	Draft plan approval	Developer
	Windemere extension of watermain	Aura by the Lakes (Phase 2)	Draft plan submission	Developer
	Windemere extension of watermain	Aura by the Lakes (Phase 3)	Pre-consultation	Developer

As noted above the watermain along Amherst Drive, west of County Road 6, will be extended and oversized. Oversizing is required to allow for full build-out of the Secondary Plan lands. The watermains for the Lakeside Ponds subdivision (along Speers Boulevard and McKee Street) will also be oversized. The oversizing ensures favourable hydraulics for conveying additional water to the County Road 6 trunk main from the core of Amherstview. The large main increases redundancy for the trunk main to Odessa and the ground-based water storage reservoir located at 243 County Road 6. Funding for these projects will be provided through impost fees.

Additionally, watermain extensions will be required along local roads once they are established.

Financial

The following projects are either being completely or partially funded through Impost Fees. Table 2 provides a breakdown of costs that the Township will be responsible for.

Table 2. List of Impost Fee funded projects and estimated costs.

Project	Cost Estimate
Amherst Drive watermain oversizing	$110,200
Lakeside Ponds watermain oversizing	$500,000

Linkages

Population and Dwelling Growth Technical Memorandum

References

Muncipal Engineers Association. (2023). A.2.9 Integration with the Planning Act. In *Municipal Class Environmental Assessment.*

Municipal Engineers Association. (2023). Appendix 1 - Project Schedules. In M. E. Association, *Municipal Class Environmental Assessment.*

WSP. (2023). *Amherstview West Secondary Plan Water and Sanitary Infrastructure Servicing Report.*

Conclusion

There are currently no Schedule B or C water infrastructure projects related to development to be made note of through the IMP.

IMP Technical Memorandum: Amherstview Water Pollution Control Plant Projections

Asset Class: Sanitary

Objective: To present the projected sanitary sewage demand for Amherstview and Odessa, both serviced by the Amherstview Water Pollution Control Plant, over the course of the study period covered by the Infrastructure Masterplan. Developing an understanding of the sanitary sewage treatment requirements of these communities, from a residential, industrial, commercial, or institutional perspective, will help ensure that any necessary plant expansion activities are planned for in a timely manner.

Background

The Amherstview Water Pollution Control Plant (WPCP) services the communities Amherstview and Odessa, as well as the Loyalist East Business Park. The population in these urban areas, along with the number of residential dwellings, is projected to increase by over 30% between 2021 and 2045, inevitably creating an increase in demand for sanitary sewage treatment.

The plant has a rated capacity of 6,400 m^3/d with a peak flow capacity of 16,000 m^3/day. Sanitary sewage received by the facility is treated through an extended aeration activated sludge process, and treated effluent is discharged into the Bayview Bog.

Assumptions

The following assumptions were made when developing these documents:

- The number of connections to the plant includes both residential dwellings as well as industrial, commercial, and institutional (ICI) accounts.
- Connections are expressed in Equivalent Residential Units (ERUs).
- ICI growth is assumed to be proportional to population growth.
- For the sake of maintaining consistency with the Uncommitted Reserve Capacity (URC) calculations developed each year, the methodology used to develop the figures presented in this technical memo are based on MOE Procedure D-5-1. Specifically:
    - Sanitary sewage treatment needs are expressed in terms of average daily flow
    - The projected water demand for an ERU is based on the average daily flow value per ERU observed in the previous three years (between 2019 and 2021).

Methodology

Data Sources

The data used to develop the figures presented in these documents were obtained from the Population and Dwelling Growth memo included in the IMP, as well as the 2022 URC calculations for the Amherstview WPCP.

Residential Connections

Existing and Projected Residential Connections

The number of residential sanitary sewer connections in Amherstview and Odessa in the year 2021 was used as a starting point for these calculations.

Residential connections included single detached homes as well as multi-residential units, expressed as ERUs.

The projected numbers of new residential sanitary sewer connections in each of the urban areas was assumed to increase at the same rate as new dwellings in those same areas.

$$RSC_{\mathrm{t}} = RSC_{t-1} + (HH_t - HH_{t-1})$$

where

$$RSC_t = Residential\ Sewer\ Connections\ in\ year\ t$$
$$RSC_{t-1} = Residential\ Sewer\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- The number of households in Amherstview is projected to increase from 3,743 in 2021 to 4,150 in 2026, for a total of 407 new residential dwellings.
- The number of residential sanitary sewer connections in Amherstview in 2021 was 3,324 ERUs
- The projected number of sanitary sewer connections in Amherstview in 2026 can therefore be calculated as: 3,324+407 = 3,731

This process was repeated at five-year intervals between 2026 and 2046 for both Amherstview and Odessa.

Committed-but-Unbuilt Residential Connections

Once a new development or subdivision has been granted draft plan approval, it must be assumed connected to the sewage treatment plant, and therefore included in the uncommitted reserve capacity calculation of the system.

Although these units may not produce sanitary sewage until they are officially connected to the system, the theoretical amount of sanitary sewage that they will eventually generate must be subtracted from the available plant capacity in a given year.

The number of committed-but-unbuilt residential connections in an urban area was assumed to decrease at the same rate as new dwellings were constructed.

$$CURC_t = CURC_{t-1} - (HH_t - HH_{t-1})$$

where

$$CURC_t = Committed\ but\ Unconnected\ Residential\ Connections\ in\ year\ t$$

$$CURC_{t-1} = Committed\ but\ Unconnected\ Residential\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$

$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- 702 committed-but-unbuilt residential units remained in Amherstview in 2021
- 407 new residential dwellings are projected to be constructed in Amherstview between 2021 and 2026
- The number of remaining committed-but-unbuilt residential units projected to remain in Amherstview in 2026 can be calculated to be: 702-407=295

These calculations assume no new committed-but-unbuilt residential connections are approved over the course of the study period. The impacts of approving new residential developments will be covered in the Analysis section of this memo.

ICI Connections

Existing and Projected ICI Connections

The number of ICI sanitary sewage connections in Amherstview and Odessa in the year 2021 was used as a starting point for these calculations.

The projected numbers of new ICI sanitary sewage connections in each of the urban areas was assumed to increase at the same rate as new dwellings in those same areas.

$$\mathrm{ICI_t} = ICI_{t-1} * \left(1 + \frac{HH_t - HH_{t-1}}{HH_t}\right)$$

where

$$ICI_t = ICI\ Wastewater\ Connections\ in\ year\ t$$
$$ICI_{t-1} = ICI\ Wastwater\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- the number of households in Odessa is projected to increase from 652 in 2021 to 743 in 2026
- There were 55 ERUs of ICI sanitary sewage connections in Odessa in 2021
- The projected number of sanitary sewage connections in Odessa in 2026 can therefore be calculated as:

$$\mathrm{ICI}_{2026} = ICI_{2021} * \left(1 + \frac{HH_{2026} - HH_{2021}}{HH_{2026}}\right)$$
$$ICI_{2026} = 55 * \left(1 + \frac{743 - 652}{743}\right)$$
$$ICI_{2026} = 62\ ERUs$$

This process was repeated at five-year intervals between 2026 and 2046 for both Amherstview and Odessa.

Flow Projections

Flow per ERU

The yearly average day flow per ERU between 2016 and 2021 was calculated

$$\left(\frac{Flow}{ERU}\right)_t = \frac{\left(Q_{avg}\right)_t}{ERU_t}$$

where

$$\left(\frac{Flow}{ERU}\right)_t = Flow\ per\ ERU\ in\ year\ t$$
$$\left(Q_{avg}\right)_t = Average\ daily\ flow\ recorded\ in\ year\ t$$
$$ERU_t = ERUs\ in\ year\ t$$

Values ranged between 1.14 and 0.96 m^3/day per ERU between 2016 and 2021, as summarized in Table 1 below.

Table 1 - Average day flow per ERU for the Amherstview WPCP System between 2016 and 2021

Year	Avg day flow / ERU
2016	0.93
2017	1.14
2018	1.07
2019	1.02
2020	0.96
2021	0.78

In order to maintain consistency with the Uncommitted Reserve Capacity calculations, the 3-year average day flow, 0.92 m^3/day per ERU, was used as a factor to project future flows.

Residential Flows

Projected residential flows were calculated by multiplying the projected number of residential connections in a given year by the flow per ERU factor discussed above.

$$Q_{Res_t} = Res_{ERU_t} * f_{ERU}$$

where

$$Q_{Res_t} = Projected\ average\ residential\ day\ flow\ in\ year\ t$$
$$Res_{ERU_t} = Residential\ ERUs\ in\ year\ t$$
$$f_{ERU} = flow\ per\ ERU\ factor$$

ICI Flows

Projected ICI flows were calculated by multiplying the projected number of ICI connections in a given year by the flow per ERU factor discussed above.

$$Q_{ICI_t} = ICI_{ERU_t} * f_{ERU}$$

where

$$Q_{ICI_t} = Projected\ average\ ICI\ day\ flow\ in\ year\ t$$
$$ICI_{ERU_t} = ICI\ ERUs\ in\ year\ t$$
$$f_{ERU} = Flow\ per\ ERU\ factor$$

Committed-but-Unbuilt Residential Capacity

The capacity which must be set aside for committed-but-unbuilt residential units was calculated by multiplying the projected number of approved-but-unbuilt connections in a given year by the flow per ERU factor discussed above.

$$Q_{CUR_t} = CUR_{ERU_t} * f_{ERU}$$

where

$$Q_{CUR_t} = Projected\ Committed\ but\ Unbuilt\ capacity\ in\ year\ t$$
$$CUR_{ERU_t} = Committed\ but\ Unbuilt\ Residential\ ERUs\ in\ year\ t$$
$$f_{ERU} = flow\ per\ ERU\ factor$$

Remaining Plant Capacity

Once projected residential and ICI flows, along and committed but unbuilt capacity, were calculated for a given year, the remaining plant capacity could then be determined for that year.

$$PC_{r_t} = PC - (Q_{Res_t} + Q_{ICI_t} + Q_{CUR_t})$$

where

$$PC_{r_t} = Remaining\ Plant\ Capacity\ in\ year\ t$$
$$Q_{Res_t} = Projected\ average\ residential\ day\ flow\ in\ year\ t$$
$$Q_{ICI_t} = Projected\ average\ ICI\ day\ flow\ in\ year\ t$$
$$Q_{CUR_t} = Projected\ average\ Committed\ but\ Unbuilt\ capacity\ in\ year\ t$$

Analysis

Projected Flows

The historical and projected residential and ICI flows for the Amherstview WPCP System, along with committed but unbuilt residential capacity, between 2016 and 2046 are summarized in Table 2 and illustrated in Figure 1 below.

Table 2 – Historical and projected flows for the Amherstview System between 2016 and 2046, expressed in m³/day

Year	Residential flows	ICI flows	Total Projected Flows	Committed but unbuilt residential	Remaining Plant Capacity
2016	3226	390	3617	1507	1276
2017	3281	359	3640	1291	1469
2018	3355	364	3719	1225	1456
2019	3411	410	3821	1119	1460
2020	3513	447	3960	1024	1416
2021	3624	444	4068	908	1423
2022	3748	459	4207	784	1409
2026	4082	496	4578	450	1372
2031	4497	541	5038	95	1267
2036	4829	577	5407	11	982
2041	5143	611	5754	0	646
2046	5485	648	6133	0	267

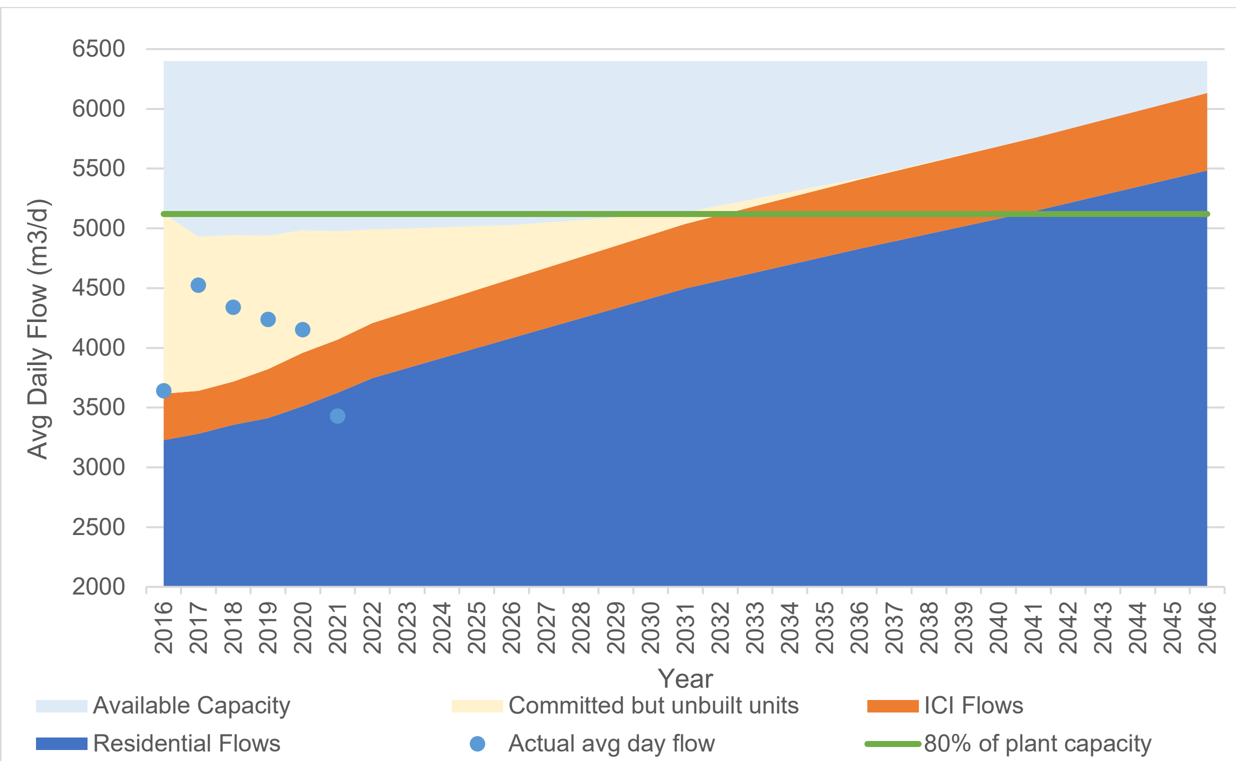


Figure 1 - Historical and projected flows and capacity of the Amherstview WPCP System between 2016 and 2046.

Based on these projections, the demand for sanitary sewage treatment up to 2046 is not expected to exceed the Amherstview WPCP's rated capacity.

Demand for sanitary sewage treatment is anticipated to reach 80% of the plant's rated capacity around 2033.

- Plant expansions activities should begin once the 80% threshold is met or exceeded in order to allow for enough time for planning and consultation.
- Plant flows are evaluated on an annual basis as part of the Uncommitted Reserve Capacity process, allowing for the above projections to be regularly monitored and updated as necessary.

At the end of the year 2021, 1,423 m^3/day of capacity was available at the Amherstview WPCP. This equates to 1,547 ERUs.

Scenarios

The projections presented above are based on a business-as-usual scenario and do not account for any additional residential capacity allocation, or the potential for one or several new ICI customer(s) who might require several hundred ERUs of capacity.

Projections which simulate these scenarios are presented below, with the intent of demonstrating their impact on the sanitary sewage treatment system.

Scenario A: Allocation of New Residential Units

Figure 2 below illustrates the impact of approving 1,000 new residential ERUs from the Amherstview WPCP system in 2022.

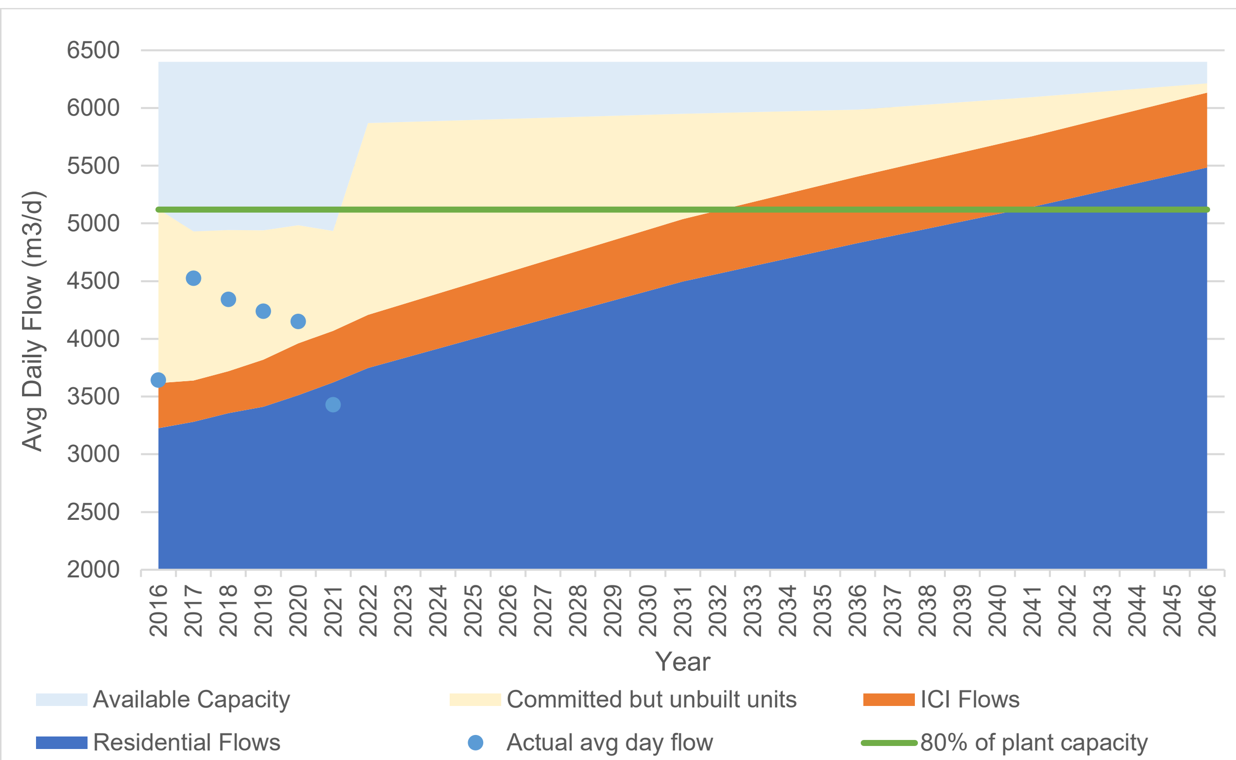


Figure 2 - Scenario A: Impact of allocating 1,000 Residential Units from the Amherstview WPCP System in 2022.

The allocation of 1,000 new residential ERUs would not have an impact on the amount of sanitary sewage which would need to be treated by the plant given that the approval of new units would not necessarily accelerate build-out rates.

However, a one-time allocation of 1,000 ERUs would reduce the amount of available capacity to 500 ERUs, potentially limiting future growth unless the plant were to be expanded.

Scenario B: Simulated Heavy User

Figure 3 below illustrates the impact of a simulated heavy user connecting to the Amherstview WPCP System and beginning operations in 2022.

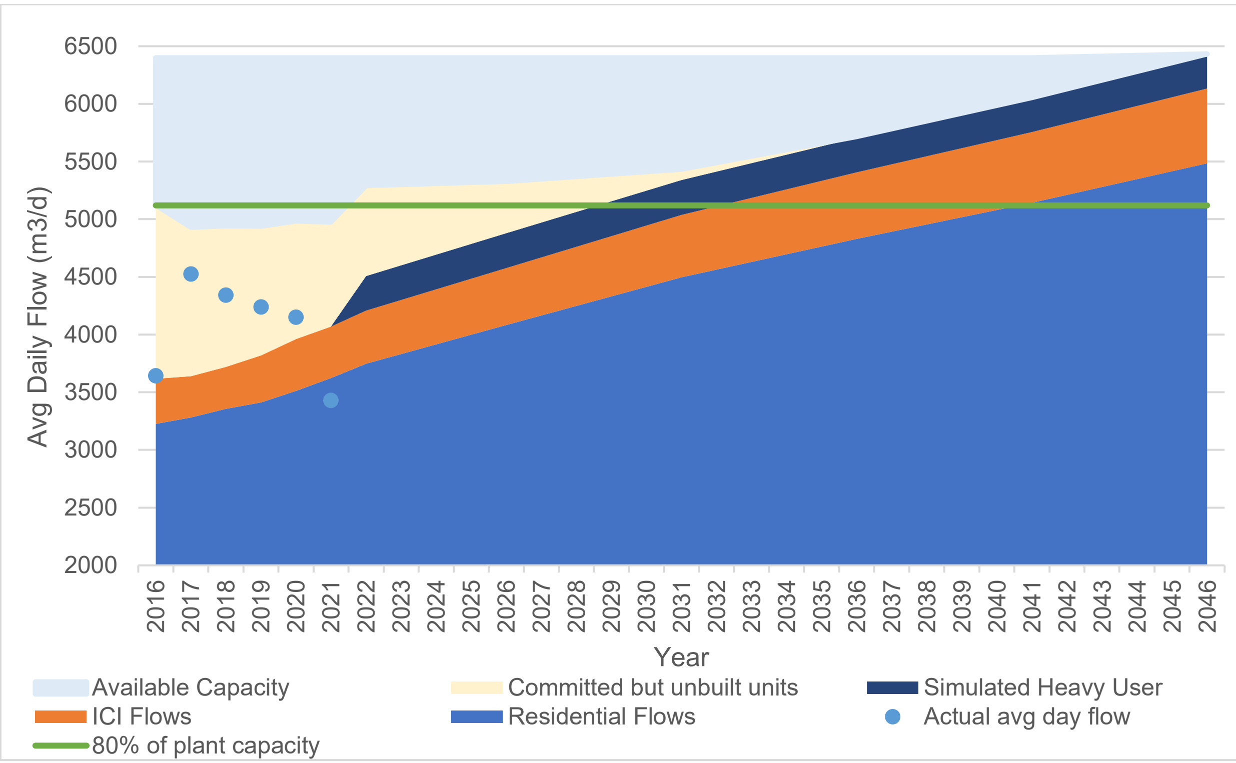


Figure 3 - Scenario B: Impact of a simulated heavy user connecting to the Amherstview WPCP System and beginning operations in 2022

In this simulation, demand for sanitary sewage treatment in 2046 would be very close to the plant's rated capacity.

The 80% threshold would be met in 2028, approximately 5 years earlier than in the business-as-usual forecast.

Additional Considerations

Demand for sanitary sewage treatment by the Amherstview WPCP is also dependant on the "Flow per ERU", which can vary year over year.

- Efforts to reduce Inflow and Infiltration (I&I) into the collection system, for example through leak reduction projects, could result in additional capacity becoming available without expanding the Amherstview WPCP.
- This would allow for the deferral of costly expansion activities while reducing the cost of treating one unit of sanitary sewage.

Limitations

The projections for sanitary sewage treatment demand presented in this Technical Memorandum are linked to projected population and dwelling growth for Loyalist Township over the course of the study period. These projections are based on the best information currently available and are subject to change based on any number of scenarios.

MOE Procedure D-5-1 calculates available capacity based on observed flows over the past three years. Past analysis using longer timeframes (ten years) has generally yielded more conservative values of available capacity, and as such the annual variations in flows can be expected to have notable impacts on annual basis as the calculations are updated.

Climate Change Considerations

An increase in high intensity precipitation events could lead to sudden surges in sanitary sewage flows to the plants, impacting treatment processes.

An increase in average yearly temperatures could impact treatment processes which are temperature dependent.

With inflow and infiltration linked to rainfall levels and increase in rainfall annual intensities will likely result in additional sanitary sewage flows and reduce available capacity.

Linkages

Population and Dwelling Growth Technical Memorandum

References

Loyalist Township. (Annually, 2016-2022). *Uncommitted Reserve Capacity calculations.*

Conclusions

Projections for sanitary sewage treatment from the Amherstview Water Pollution Control Plant were developed based on projected dwelling growth in Amherstview and Odessa. Based on these projections, the demand for sanitary sewage treatment up to 2046 is not expected to exceed the Amherstview WPCP's rated capacity of 6,400 m^3/day.

Demand for sanitary sewage treatment is anticipated to reach 80% of the plant's rated capacity around 2033. Expansion activities should begin to be undertaken when this threshold is hit.

Investing in inflow and infiltration reduction initiatives could increase the available capacity of the Amherstview WPCP by reducing "flows per ERU". This would defer the need for a large-scale plant expansion by a few years.

At the end of the year 2021, 1,423 m^3/day of capacity was available at the Amherstview WPCP. This equates to 1,547 ERUs.

The figures and projections presented in this document should be updated on a regular basis and incorporated into the Uncommitted Reserve Capacity calculations which are conducted each year.

IMP Technical Memorandum: Bath Sewage Plant Projections

Asset Class: Sanitary

Objective: The purpose of this technical memorandum is to present the projected sanitary sewage demand for Bath, which is serviced by the Bath Sewage Treatment Plant, over the course of the study period covered by the Infrastructure Masterplan. Developing an understanding of the sanitary sewage treatment requirements of this community, from a residential, industrial, commercial, or institutional perspective, will help ensure that any necessary plant expansion activities are planned for in a timely manner.

Background

The Bath Sewage Treatment Plant (STP) services the community of Bath as well as several Correctional Services of Canada (CSC) facilities. The population in these urban areas, along with the number of residential dwellings, is projected to increase by over 40% between 2021 and 2046, inevitably creating an increased demand for the treatment of sanitary sewage.

The Bath STP has a rated capacity of 3,008 m^3/d with a peak flow capacity of 12,032 m^3/day and is described as a secondary treatment plant comprising of preliminary treatment, aeration, final clarification, and effluent disinfection, with treated effluent eventually being discharged into Lake Ontario. Existing agreements between the Township and CSC have allocated 909 m^3/day of wastewater capacity to the facilities operated by the latter, leaving 2,099 m^3/day of capacity for the Village of Bath itself. As such, this technical memorandum will only consider the projected increase in sanitary sewage flows from the Village of Bath relative to a capacity of 2,099 m^3/day.

Assumptions

The following assumptions were made when developing these documents:

- The number of connections to the plant includes both residential dwellings as well as industrial, commercial, and institutional (ICI) accounts
- Connections are expressed in Equivalent Residential Units (ERUs).
- ICI growth is assumed to be proportional to population growth.
- For the sake of maintaining consistency with the Uncommitted Reserve Capacity (URC) calculations developed each year, the methodology used to develop the figures presented in this technical memo are based on the MOE procedure D-5-1. Specifically:
  - Sanitary sewage treatment needs are expressed in terms of average daily flow
  - The projected water demand for an ERU is based on the average daily flow value per ERU observed in the previous three years (between 2019 and 2021).

- The 909 m^3/day of capacity allocated to CSC will remain constant over the course of the study period.
- Projected sanitary sewage flows from Bath will be compared to the 2,099 m^3/day of capacity which is allocated to the Village.

Methodology

Data Sources

The data used to develop the figures presented in these documents were obtained from the Population and Dwelling Growth memo included in the IMP, as well as the 2022 UCRC calculations for the Bath Sewage Treatment Plant.
Based on discussions with Correctional Services staff in 2021, no expansion of the federal institutions is expected in the timeframe of the IMP.

Residential Connections

Existing and Projected Residential Connections

The number of residential sanitary sewage connections in Bath in the year 2021 was used as a starting point for these calculations.

Residential connections included single detached homes as well as multi-residential units, expressed as Equivalent Residential Units (ERUs).

The projected numbers of new residential sanitary sewage (sewer) connections in each of the urban areas was assumed to increase at the same rate as new dwellings in those same areas.

$$RSC_{\mathrm{t}} = RSC_{t-1} + (HH_t - HH_{t-1})$$

where

$$RSC_t = Residential\ Sewer\ Connections\ in\ year\ t$$
$$RSC_{t-1} = Residential\ Sewer\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- The number of households in Bath is projected to increase from 1,214 in 2021 to 1,425 in 2026, for a total of 211 new residential dwellings.
- The number of residential sewer connections in Bath in 2021 was 1,066 ERUs
- The projected number of sewer connections in Amherstview in 2026 can therefore be calculated as: 1,066 + 211 = 1,277

This process was repeated at five-year intervals between 2026 and 2046.

Committed but Unbuilt Residential Connections

Once a new development or subdivision has been granted draft plan approval, it must be assumed connected to the sanitary sewage plant and, therefore, included in the uncommitted reserve capacity calculation of the system.

Although these units may not produce sanitary sewage until they are officially connected to the system, the theoretical amount of sanitary sewage that they will eventually generate must be subtracted from the available plant capacity in a given year.

The number of Committed but Unbuilt Residential Connections in an urban area was assumed to decrease at the same rate as new dwellings were constructed.

$$CURC_t = CURC_{t-1} - (HH_t - HH_{t-1})$$

where

$$CURC_t = Committed\ but\ Unconnected\ Residential\ Connections\ in\ year\ t$$
$$CURC_{t-1} = Committed\ but\ Unconnected\ Residential\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- 1,444 Committed but Unbuilt Residential Units remained in Bath in 2021
- 211 new residential dwellings are projected to be constructed in Bath between 2021 and 2026
- The number of remaining Committed but Unbuilt Residential Units projected to remain in Bath in 2026 can be calculated to be: 1,444 – 211 = 1,233

These calculations assume no new Committed but Unbuilt Residential Connections are approved over the course of the study period. The impacts of approving new residential developments will be covered in the Analysis section of this memo.

ICI Connections

Existing and Projected ICI Connections

The number of ICI sanitary sewage connections in Bath in the year 2021 was used as a starting point for these calculations.

The projected numbers of new ICI sanitary sewage connections in each of the urban areas was assumed to increase at the same rate as new dwellings in those same areas.

$$\mathrm{ICI_t} = ICI_{t-1} * \left(1 + \frac{HH_t - HH_{t-1}}{HH_t}\right)$$

where

$$ICI_t = ICI\ Wastewater\ Connections\ in\ year\ t$$
$$ICI_{t-1} = ICI\ Wastwater\ Connections\ in\ previous\ year$$
$$HH_t = Households\ in\ year\ t$$
$$HH_{t-1} = Households\ in\ previous\ year$$

For example:

- the number of households in Bath is projected to increase from 1,214 in 2021 to 1,425 in 2026, for a total of 211 new residential dwellings
- There were 90 ERUs of ICI sanitary sewage connections in Bath in 2021
- The projected number of sanitary sewage connections in Bath in 2026 can therefore be calculated as:

$$\mathrm{ICI}_{2026} = ICI_{2021} * \left(1 + \frac{HH_{2026} - HH_{2021}}{HH_{2026}}\right)$$
$$ICI_{2026} = 90 * \left(1 + \frac{1{,}425 - 1{,}214}{1{,}425}\right)$$
$$ICI_{2026} = 103\ ERUs$$

This process was repeated at five-year intervals between 2026 and 2046.

Summary

A summary of the existing and projected connections to the Amherstview Water Pollution Control Plant system can be found in the attached Excel spreadsheet.

Flow Projections

Flow per ERU

The yearly average day flow per ERU between 2016 and 2021 was calculated

$$\left(\frac{Flow}{ERU}\right)_t = \frac{\left(Q_{avg}\right)_t}{ERU_t}$$

where

$$\left(\frac{Flow}{ERU}\right)_t = Flow\ per\ ERU\ in\ year\ t$$
$$\left(Q_{avg}\right)_t = Average\ daily\ flow\ recorded\ in\ year\ t$$
$$ERU_t = ERUs\ in\ year\ t$$

Values ranged between 1.14 and 0.96 m^3/day per ERU between 2016 and 2021, as summarized in Table 1 below.

Table 1 - Average day flow per ERU for the Amherstview WPCP System between 2016 and 2021

Year	Avg day flow / ERU
2016	0.81
2017	0.82
2018	0.83
2019	0.78
2020	0.72
2021	0.62

In order to maintain consistency with the Uncommitted Reserve Capacity Calculations, the 3-year average day flow, 0.70 m^3/day per ERU, was used as a factor to project future flows.

Residential Flows

Projected residential flows were calculated by multiplying the projected number of residential connections in a given year by the flow per ERU factor discussed above.

$$Q_{Res_t} = Res_{ERU_t} * f_{ERU}$$

where

$$Q_{Res_t} = Projected\ average\ residential\ day\ flow\ in\ year\ t$$
$$Res_{ERU_t} = Residential\ ERUs\ in\ year\ t$$
$$f_{ERU} = flow\ per\ ERU\ factor$$

ICI Flows

Projected ICI flows were calculated by multiplying the projected number of ICI connections in a given year by the flow per ERU factor discussed above.

$$Q_{ICI_t} = ICI_{ERU_t} * f_{ERU}$$

where

$$Q_{ICI_t} = Projected\ average\ ICI\ day\ flow\ in\ year\ t$$
$$ICI_{ERU_t} = ICI\ ERUs\ in\ year\ t$$
$$f_{ERU} = Flow\ per\ ERU\ factor$$

Committed but Unbuilt Residential capacity

The capacity which must be set aside for Committed but Unbuilt Residential units was calculated by multiplying the projected number of approved-but-unbuilt connections in a given year by the flow per ERU factor discussed above.

$$Q_{CUR_t} = CUR_{ERU_t} * f_{ERU}$$

where

$$Q_{CUR_t} = Projected\ Committed\ but\ Unbuilt\ capacity\ in\ year\ t$$
$$CUR_{ERU_t} = Committed\ but\ Unbuilt\ Residential\ ERUs\ in\ year\ t$$
$$f_{ERU} = flow\ per\ ERU\ factor$$

Remaining Plant capacity

Once projected residential and ICI flows, along and committed but unbuilt capacity, were calculated for a given year, the remaining plant capacity could then be determined for that year.

$$PC_{r_t} = PC - (Q_{Res_t} + Q_{ICI_t} + Q_{CUR_t})$$

where

$$PC_{r_t} = Remaining\ Plant\ Capacity\ in\ year\ t$$
$$Q_{Res_t} = Projected\ average\ residential\ day\ flow\ in\ year\ t$$
$$Q_{ICI_t} = Projected\ average\ ICI\ day\ flow\ in\ year\ t$$
$$Q_{CUR_t} = Projected\ average\ Committed\ but\ Unbuilt\ capacity\ in\ year\ t$$

Analysis

Projected Flows

The historical and projected residential and ICI flows for the Amherstview WPCP System, along with committed but unbuilt residential capacity, between 2016 and 2046 are summarized in Table 2 and illustrated in Figure 1 below.

Table 2 – Historical and projected flows for the Amherstview System between 2016 and 2046, expressed in m^3/day

Year	Residential flows	ICI flows	Total Projected Flows	Committed but unbuilt residential	Remaining Plant Capacity
2016	710	75	785	1102	212
2017	723	74	797	995	307
2018	735	70	806	947	346
2019	739	70	809	952	337
2020	743	68	811	966	322
2021	751	63	815	1018	266
2022	766	65	830	1004	265
2026	900	74	974	869	255
2031	1068	86	1154	701	244
2036	1236	98	1334	533	232
2041	1404	109	1514	365	220
2046	1592	122	1714	177	207

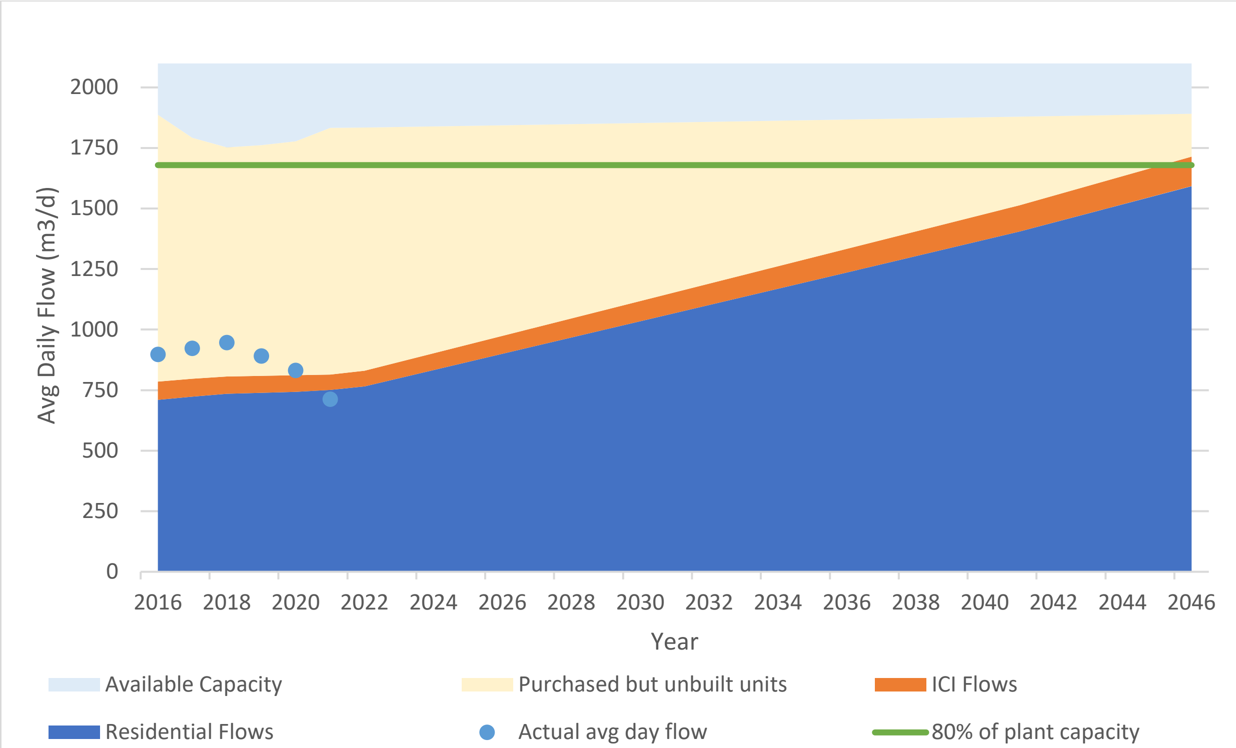


Figure 1 - Historical and projected flows and capacity of the Amherstview WPCP System between 2016 and 2046.

Based on these projections, the demand for sanitary sewage treatment up to 2046 is not expected to exceed the Bath STP's rated capacity.

Demand for sanitary sewage treatment is anticipated to reach 80% of the plant's rated capacity around 2045.

- Plant expansions activities should begin once the 80% threshold is met or exceeded in order to allow for enough time for planning and consultation.
- Plant flows are evaluated on an annual basis as part of the Uncommitted Reserve Capacity process, allowing for the above projections to be regularly monitored and updated as necessary.

At the end of the year 2021, 266 m^3/day of capacity was available at the Bath Sewage Treatment Plant (Bath STP). This equates to 377 ERUs.

Demand for sanitary sewage treatment by the Bath STP is also dependant on the "Flow per ERU", which can vary year over year.

- Efforts to reduce inflow and infiltration (I&I) into the collection system, for example through leak reduction projects, could result in additional capacity becoming available without expanding the plant.
- This would allow for the deferral of costly expansion activities while reducing the cost of treating one unit of sanitary sewage.

Limitations

The projections for sanitary sewage treatment demand presented in this Technical Memorandum are linked to projected population and dwelling growth for Loyalist Township over the course of the study period. These projections are based on the best information currently available and are subject to change based on any number of scenarios.

Climate Change Considerations

An increase in high intensity precipitation events could lead to sudden surges in sanitary sewage flows to the plants, impacting treatment processes.

An increase in average yearly temperatures could impact treatment processes which are temperature dependent.

Linkages

Population and Dwelling Growth Technical Memorandum

References

Loyalist Township. (Annually, 2016-2022). *Uncommitted Reserve Capacity calculations.*

Conclusions

Projections for sanitary sewage treatment from the Bath Sewage Treatment Plant were developed based on projected dwelling growth for Bath.

Based on these projections, the demand for sanitary sewage treatment up to 2046 is not expected to exceed the Bath STP's rated capacity of 3,008 m^3/day.

Demand for sanitary sewage treatment is anticipated to reach 80% of the plant's rated capacity around 2045. Expansion activities should begin to be undertaken when this threshold is hit.

Investing in inflow and infiltration reduction initiatives could increase the available capacity of the Bath STP by reducing "flows per ERU". This would defer the need for a large-scale plant expansion by a few years.

At the end of the year 2021, 266 m^3/day of capacity was available at the Bath STP. This equates to 377 ERUs.

The figures and projections presented in this document should be updated on a regular basis and incorporated into the Uncommitted Reserve Capacity calculations which are conducted each year.

IMP Technical Memorandum: Sanitary Future Development

Asset Class: Sanitary

Objective: The objective of this memorandum is to recognize any growth-related sanitary projects that Loyalist Township will administer as proponent or be required to provide funding for the completion of the project. Funding may be direct, or indirect through frontage fees, development charges, grants, or other funding sources. This process will include noting which projects are classified as Schedule B and C projects (Municipal Engineers Association, 2023) as per the Municipal Class Environmental Assessment (MCEA) process, as amended 2023. Municipal projects exempt from the MECA process have also been listed to provide a holistic overview the work that will be done through developments to assist with future financial planning. Future local servicing projects that are entirely the responsibility of the Developer and approved under the Planning Act, are not included.

Background

Loyalist Township is projected to experience consistent growth throughout the IMP study period, as outlined in the Population and Dwelling Growth Technical Memorandum. This growth is being supported by development in all three urban centers. Additional sanitary infrastructure will be required to service these developments as they continue to grow.

Developments use the Planning Act to identify projects and establish approvals. The MECP has recognized that much of the work done through the Planning Act process can be used to satisfy the MCEA process requirements. The combination of the Planning Act and MCEA is termed the Integrated Process (Muncipal Engineers Association, 2023), with the goal of avoiding duplicated steps for the same project. To meet the requirements for the Integrated Process, any Schedule B or C projects that are approved through the Planning Act must be recognized in the MCEA process. The IMP initiates the MCEA process and therefore will recognize any Schedule B or C projects associated with the proposed developments.

Assumptions

The development documentation on file is up to date with required infrastructure.

The developments considered in the Infrastructure Masterplan include all subdivision applications listed in Table 1 below.

The Amherstview West Secondary Plan is being presented as a separate Master Plan and the summary of the major infrastructure included in that plan (WSP, 2023) has been included here for discussion only.

Methodology

To identify any projects that need to be listed through the IMP, the Engineering Development Supervisor was consulted. All future developments of which staff are aware were reviewed against the MCEA project tables to determine which items would be considered Schedule B or C. Projects identified have been listed along with the status of the development in the planning process. Projects that are exempt based on the MCEA project tables have also been identified.

Analysis

After careful review of each future development on file it was determined that there are no Schedule B or C sanitary related projects to be recognized through the IMP.

The following are sanitary infrastructure projects that are exempt based on the MCEA project tables. These projects will be completed through development but do not need to be recognized through the IMP. They may include establishment, extension, or enlargement of sewage collection systems.

Table 1. List of sanitary infrastructure projects associated with development

Location	Sanitary Infrastructure Upgrade	Development	Status	Developer vs Impost Funded
Odessa	Babcock Boulevard sewer extension	Fields of Loyalist	Pre-draft plan approval	Developer
	Proposed Street A establish sewer	Fields of Loyalist	Pre-draft plan approval	Developer
	Shane Street sewer extension	Shane Street Development	Draft plan approved	Developer
Amherstview	McKee Street establish sewer	Lakeside Ponds	Draft plan received	Developer
	Speers Boulevard sewer extension	Lakeside Ponds	Draft plan approved	Developer
	Walden Pond Drive extension and oversizing of sewer	Amherstview West Secondary Plan	Plan under development	Impost
	County Road 6 and Taylor Kidd sewer extension	Amherstview West Secondary Plan	Plan under development	Impost
	Lakeside Phase 8 sewer extension	Amherstview West Secondary Plan	Plan under development	Impost
Bath	Country Club Drive sewer extension	Loyalist Estates (Phase 12)	Draft plan approval	Developer
	Windemere sewer extension	Aura by the Lakes (Phase 2)	Draft plan submission	Developer

	Windemere sewer extension	Aura by the Lakes (Phase 3)	Pre-consultation	Developer

Along with the projects listed above, sewage collection systems will be required along local roads once they are established. These systems will be funded by developers.

Sewage pumping stations (SPS) have also been evaluated through the IMP to determine if upgrades are required to accommodate projected growth. It was determined that the Lakeview SPS is in need of upsizing, which project is currently underway. Depending on the servicing requirements of the Amherstview West Secondary Plan, the Taylor-Kidd SPS may also need upsizing. Specifics of SPS upgrades are outlined in the individual SPS technical memoranda.

As noted in Table 1, the sewer connected to/along Walden Pond Drive will be extended and oversized. This will involve the following:

- Oversizing of Walden Pond Drive sewer extension
- Oversizing of trunk sewer to Taylor-Kidd Drive from Walden Pond Drive extension
- Oversizing of sewer from Walden Pond Drive to Amherst Drive

Oversizing is required to allow full build-out of the Secondary Plan lands. Funding for these projects will be provided through Impost Fees.

Financial

The following projects are either being completely or partially funded through Impost Fees. Table 2 provides a breakdown of costs that the Township will be responsible for.

Table 2. List of Impost Fee funded projects and estimated costs.

Project	Cost Estimate
County Road 6 and Taylor-Kidd Drive sewer extension	$35,000
Lakeside Phase 8 sewer extension	$28,000
Oversizing of Walden Pond Drive sewer extension	$58,000
Oversizing of trunk sewer to Taylor-Kidd Drive from Walden Pond Drive extension	$70,000
Oversizing of sewer from Walden Pond Drive to Amherst Drive	$98,000

Linkages

Population and Dwelling Growth Technical Memorandum
Capacity Assessment of Lakeview SPS Technical Memorandum
Capacity Assessment of Taylor-Kidd SPS Technical Memorandum

References

Muncipal Engineers Association. (2023). A.2.9 Integration with the Planning Act. In *Municipal Class Environmental Assessment.*

Municipal Engineers Association. (2023). Appendix 1 - Project Schedules. In M. E. Association, *Municipal Class Environmental Assessment.*

WSP. (2023). *Amherstview West Secondary Plan Water and Sanitary Infrastructure Servicing Report.*

Conclusion

There are currently no Schedule B or C sanitary infrastructure projects related to development of which to make note in the IMP.

IMP Technical Memorandum: Stormwater Future Development

Asset Class: Stormwater

Objective: The objective of this memorandum is to recognize any growth-related stormwater related projects that Loyalist Township will administer as proponent or be required to provide funding for the completion of the project. Funding may be direct, or indirect through frontage fees, development charges, grants, or other funding sources. This process will include noting which projects are classified as Schedule B and C projects (Municipal Engineers Association, 2023) as per the Municipal Class Assessment process, as amended 2023. Municipal projects exempt from the MECA process have also been listed to provide a holistic overview of the work that will be done through developments to assist with future financial planning. Future local servicing projects that are entirely the responsibility of the Developer and approved under the Planning Act are not included.

Background

Loyalist Township is projected to experience consistent growth throughout the IMP study period, as outlined in the Population and Dwelling Growth Technical Memorandum. This growth is being supported by development in all three urban centers. Additional stormwater infrastructure will be required to service these developments as they continue to grow.

Developments use the Planning Act to identify projects and establish approvals. The MECP has recognized that much of the work done through the Planning Act process can be used to satisfy the MCEA process requirements. The combination of the Planning Act and MCEA has been termed the Integrated Process (Muncipal Engineers Association, 2023), with the goal of avoiding duplicated steps for the same project. To meet the requirements for the Integrated Process, any Schedule B or C projects that are approved through the Planning Act must be recognized in the MCEA process. The IMP initiates the MCEA process and therefore will recognize any Schedule B or C projects associated with the proposed development.

Assumptions

The documentation provided by developers is up to date with required infrastructure.

The developments considered in the Infrastructure Masterplan include all subdivision applications listed in Table 1 below.

The Amherstview West Secondary Plan is being presented as a separate Master Plan and the summary of the major infrastructure included in that plan (WSP, 2023) has been included here for discussion only.

Methodology

To identify any projects that need to be listed through the IMP, the Engineering Development Supervisor was consulted. All future developments of which staff are aware, have been reviewed against the MCEA project tables to determine which items would be considered Schedule B or C. Projects identified have been listed, along with the status of the development in the planning process. Projects that are exempt based on the MCEA project tables have also been identified.

Analysis:

After careful review of each future development on file it was determined that there are no Schedule B or C stormwater related projects to be recognized through the IMP.

The following are stormwater infrastructure projects that are exempt based on the MCEA project tables. These projects will be completed through development but do not need to be recognized through the IMP. They may include any construction of stormwater management facilities which are required as a condition of approval on a plan of subdivision. Establishing new, replacing, or expanding existing stormwater detention/retention ponds is also exempt, provided all such facilities are in either an existing utility corridor or a road allowance where no additional property is required.

Table 1. List of developments planning to implement LID features.

Location	Development	Status	Developer vs DC Funded
Odessa	Fields of Loyalist	Pre-draft plan approval	Developer
	Shane Street Development	Draft plan approved	Developer
Amherstview	Amherstview West Secondary Plan	Being developed	Developer

Table 2. List of developments planning to establish a stormwater pond.

Location	Development	Status	Developer vs DC Funded
Odessa	Fields of Loyalist	Pre-draft plan approval	Developer
	Shane Street Development	Draft plan approved	Developer
Amherstview	Lakeside Ponds Phase 2 (Near Speers Boulevard)	Draft plan approved	Developer
	Amherstview West Secondary Plan	Plan under development	DC

Along with the projects listed above, stormwater management infrastructure will be required along local roads once they are established.

As shown above, the Amherstview West Secondary Plan will include the establishment of stormwater ponds. These stormwater ponds are required to allow for build-out of the Secondary Plan lands. Funding for these projects will be provided through development charges.

Storm drainage improvements are planned for Amherst Drive west of Speers Boulevard.

In negotiations completed prior to developing the Lakeside Ridge and Lakeside Ponds developments, a determination was made by the Developer to route their drainage from the east side of the Lakeside Ponds development, near Speers Boulevard corridor, easterly and north of the Amherstview Fire Station; thus, the Developer did not contribute funding to the extension of a new storm sewer along Amherst Drive constructed across the frontage of the Fire Station property. This sewer was designed to convey minor storm drainage from Amherst Drive, west of Speers Boulevard, when this section of road is urbanized.

Financial

The following projects are either being completely or partially funded through Development Charges (DC). Table 3 provides a breakdown of costs that the Township will be responsible for.

Table 3. List of Impost Fee funded projects and estimated costs.

Project	Cost Estimate
North Stormwater Management Ponds	$1,185,000
South Stormwater Management Ponds	$1,740,000

Linkages

Population and Dwelling Growth Technical Memorandum
Amherst Drive Upgrades – Speers Boulevard to County Road 6 Technical Memorandum

References

Muncipal Engineers Association. (2023). A.2.9 Integration with the Planning Act. In *Municipal Class Environmental Assessment.*

Municipal Engineers Association. (2023). Appendix 1 - Project Schedules. In M. E. Association, *Municipal Class Environmental Assessment.*

WSP. (2023). *Amherstview West Secondary Plan Water and Sanitary Infrastructure Servicing Report.*

Conclusion

There are currently no Schedule B or C stormwater infrastructure projects related to development to note through the IMP.

IMP Technical Memorandum: Roads Future Development

Asset Class: Roads

Objective: The objective of this memorandum is to recognize any growth-related transportation projects that Loyalist Township will administer as proponent or be required to provide funding for the completion of the project. Funding may be direct, or indirect through frontage fees, development charges (DCs), grants, or other funding sources. This process will include noting which projects are classified as Schedule B and C projects as per the Municipal Class Environmental Assessment process. Municipal projects exempt from the MCEA process have also been listed to provide a holistic overview of the work that will be done through developments to assist with future financial planning. Future local servicing projects, which are entirely the responsibility of the Developer and approved under the Planning Act, are not included.

Background

Loyalist Township is projected to experience consistent growth throughout the IMP study period, as outlined in the Population and Dwelling Growth Technical Memorandum. This growth is being supported by development in all three urban centers. Additional transportation infrastructure will be required to service these developments as they continue to grow.

Developments use the Planning Act to identify projects and establish approvals. The MECP has recognized that much of the investigative work done to support applications under the Planning Act, satisfies MCEA requirements. The combination of the Planning Act and MCEA is considered an Integrated Process (Muncipal Engineers Association, 2023), with the goal of avoiding duplicated steps for the same project. To meet the requirements for an Integrated Process, any Schedule B or C projects that are undertaken through the Planning Act must be recognized in the MCEA process. The IMP initiates the MCEA process and therefore will recognize any Schedule B or C projects associated with the proposed developments.

Assumptions

- The documentation provided by developers is up to date with required infrastructure.
- The developments considered in the Infrastructure Masterplan include all subdivision applications listed in Table 2 below.
- The Amherstview West Secondary Plan is being presented as a separate master plan and the summary of the major infrastructure included in that plan (WSP, 2023) has been included here for discussion only.

Methodology

To identify any projects that need to be listed through the IMP, the Engineering Development Supervisor was consulted. All future developments of which staff are aware have been reviewed against the MCEA project tables (Municipal Engineers Association, 2023) to determine which items would be considered Schedule B or C. Projects identified have been listed along with the status of the development in the planning process. Projects that are exempt based on the MCEA project tables have also been identified.

Analysis

Loyalist Township is a lower tier municipality within the County of Lennox and Addington (“the County”).

The County owns and administers the County road system that serves as the transportation backbone of Loyalist Township. In addition to the County road system, the Ontario Ministry of Transportation (MTO) maintains Highways 33 and 401 within the Township. These roads carry most of the higher traffic volumes within the Township, with a few exceptions, and are therefore the roads most impacted by area growth. Loyalist Township and County officials work closely on coordinating projects affecting these roads.

Main Street – Bath is identified as a connecting link of Highway 33, and subject to a formal agreement between MTO and Loyalist Township. MTO retains some administrative jurisdiction of this section of road under the terms of the agreement and has responsibilities with respect to capital funding.

GHD assessed the 2022 County traffic volumes and developed the following table (Vanessa Skelton, 2023) indicating average growth rates for County Roads for each lower tier municipality:

Table 1. Average growth rates for County roads.

Municipality	Average Growth Rate
Addington Highlands	1.78%
Stone Mills	1.76%
Loyalist	2.34%
Napanee	2.18%

With new development in the Township concentrated south of Highway 401, this is the area that will see the most impact with respect to road volumes.

Road projects identified for growth will be discussed below in two groups: projects due to local development, and projects due to broader growth.

Depending on the results of the Collector Roads and Archaeological Screening Processes, collector roads within new developments may be classified as exempt. If not exempt, then the project would have to proceed as a Schedule B or C project and require further evaluation. Some of the new developments in Loyalist Township have been recently approved under the Planning Act or are expected to receive draft plan approval prior to the commencement of the collector road project. The municipality intends to utilize the Integrated Process for those projects that meet the requirements.

The following description is provided in the MCEA project table:

> "Construction of a new collector road, or reconstruction or widening of an existing collector road that will not be for the same purpose, use, capacity or at the same location, and is required as a condition of approval on a plan of subdivision and/or the subdivision agreement which will come into effect under the Planning Act."

Projects that meet this description are eligible for screening; if all screening requirements are met, they are considered exempt from the MCEA process. Projects that do not meet screening requirements are considered Schedule B if they are less than $3M and Schedule C if the cost is greater than $3M.

The following collector road projects have been identified through the review of proposed developments.

Table 2. List of collector roads and associated development

Location	Road	Development	Status	Developer vs DC Funded
Odessa	Babcock Boulevard extension	Fields of Loyalist	Pre-draft plan approval	Developer
	Proposed Street A	Fields of Loyalist	Pre-draft plan approval	Developer
Amherstview	McKee Street	Lakeside Ponds	Draft plan received	Developer
	Speers Boulevard extension	Lakeside Ponds	Draft plan approved	Developer
	Amherst Drive and Speers Boulevard roundabout	Amherstview West Secondary Plan	Plan under development	DC
	Amherst Drive extension West of County Road 6	Amherstview West Secondary Plan	Plan under development	Developer
	Walden Pond Drive extension west of County Road 6	Amherstview West Secondary Plan	Plan under development	Developer
	Kildare Drive extension west of County Road 6	Amherstview West Secondary Plan	Plan under development	Developer

Bath	Country Club Drive extension	Loyalist Estates (Phase 12)	Draft plan approval	Developer
	Windemere extension	Aura by the Lake (Phase 2)	Draft plan submission	Developer
	Windemere extension	Aura by the Lake (Phase 3)	Pre-consultation	Developer

Figures showing the collector roads are included at the end of this memorandum.

Transportation projects that are considered exempt in the MCEA process include local roads, sidewalks, and multi-use pathways. These pieces of infrastructure will be constructed along with the collector roads listed above; however, the exact locations are not yet known. Developers will be responsible for construction of some local sidewalks and multi-use pathways. In addition to this, the Township will fund the following multi-use pathways through DCs:

- County Road 6 from Kildare Avenue to Highway 33
- Around northern stormwater management pond in Amherstview West Secondary Plan
- From Taylor-Kidd Boulevard to Parrott's Bay
- From County Road 6 to Parrott's Bay, close to Highway 33 with connection to Kildare Drive Extension
- Connecting from Amherst Drive extension to Parrott's Bay

Two other growth transportation projects, being the intersection upgrades at Windemere Drive and Main Street – Bath, and upgrades of Amherst Drive from Speers Boulevard to County Road 6 upgrades are discussed in other technical memoranda of this IMP, as outlined in the Linkages heading.

Financial

The following proposed projects are identified to be completely or partially funded through development charges. Table 3 provides a breakdown of costs for which the Township will be responsible.

Table 3. List of DC funded projects and estimated costs.

Project	Cost Estimate
Amherst Drive and Speers Boulevard roundabout	$1,200,000
Multi-use pathways (5 listed above)	$2,060,000

Linkages

The following technical memoranda included in this IMP link to this topic:

- Population and Dwelling Growth
- Main Street – Bath Remedial Needs
- Main Street – Odessa Remedial Needs
- Main Street – Bath-Windemere Boulevard Intersection Improvements
- Amherst Drive Upgrades, Speers Boulevard to County Road 6

Figures

Figure 1. Collector road locations in Odessa
Figure 2. Collector road locations in Amherstview
Figure 3. Collector road locations in Bath

References

Muncipal Engineers Association. (2023). A.2.9 Integration with the Planning Act. In *Municipal Class Environmental Assessment.*

Municipal Engineers Association. (2023). Appendix 1 - Project Schedules. In M. E. Association, *Municipal Class Environmental Assessment.*

Vanessa Skelton, G. (2023, January 12). Traffic Growth in the County. Ottawa, Ontario.

WSP. (2023). *Amherstview West Secondary Plan Traffic Analysis Report.*

Conclusion

The projects listed in Table 1 have been recognized through the IMP and will be included throughout the consultation phases of the master planning process.

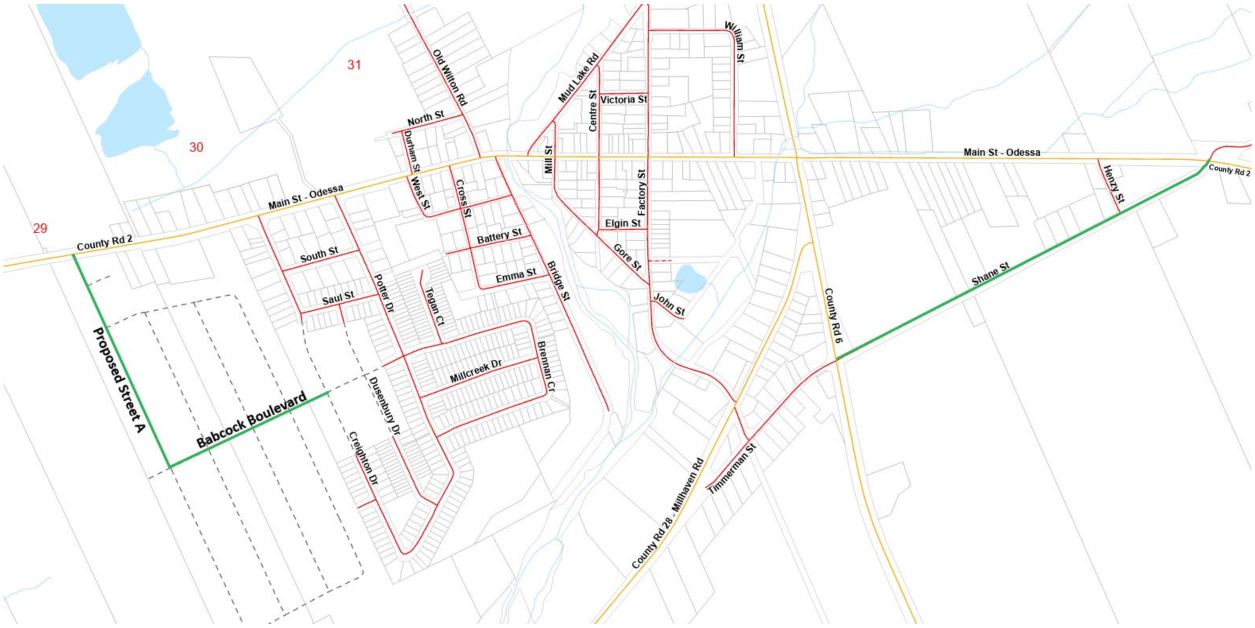


Figure 1. Collector road locations in Odessa

Figure 2. Collector road locations in Amherstview

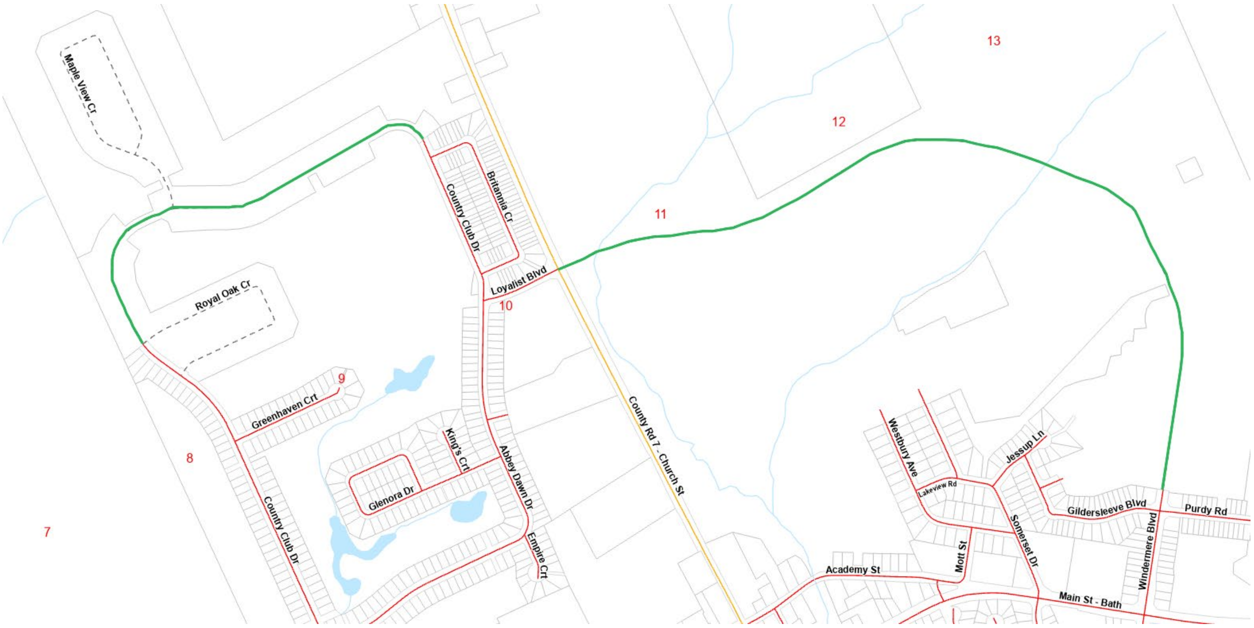


Figure 3. Collector road locations in Bath

IMP Technical Memorandum: Amherst Drive Upgrades, Speers Boulevard to County Road 6

Asset Class: Transportation

Objective: The objective of this memorandum is to describe the two sub projects within the main construction project.

Background

The development of this project is relatively unique to Loyalist Township. The unique aspect is due to the funding mechanisms used as well as the fact that the timelines of the development of this portion of Amherst drive precedes the establishment of Development Charge (DC) legislation.

This section of Amherst Drive, including the scope of the proposed widening, was included in the Plan 29R-1086 subdivision plan. This section of the roadway served as an important new transportation link to County Road 6. The original design included a three-lane wide paved surface with an urban style cross-section. Amherst Drive is complete east of Speers Boulevard.

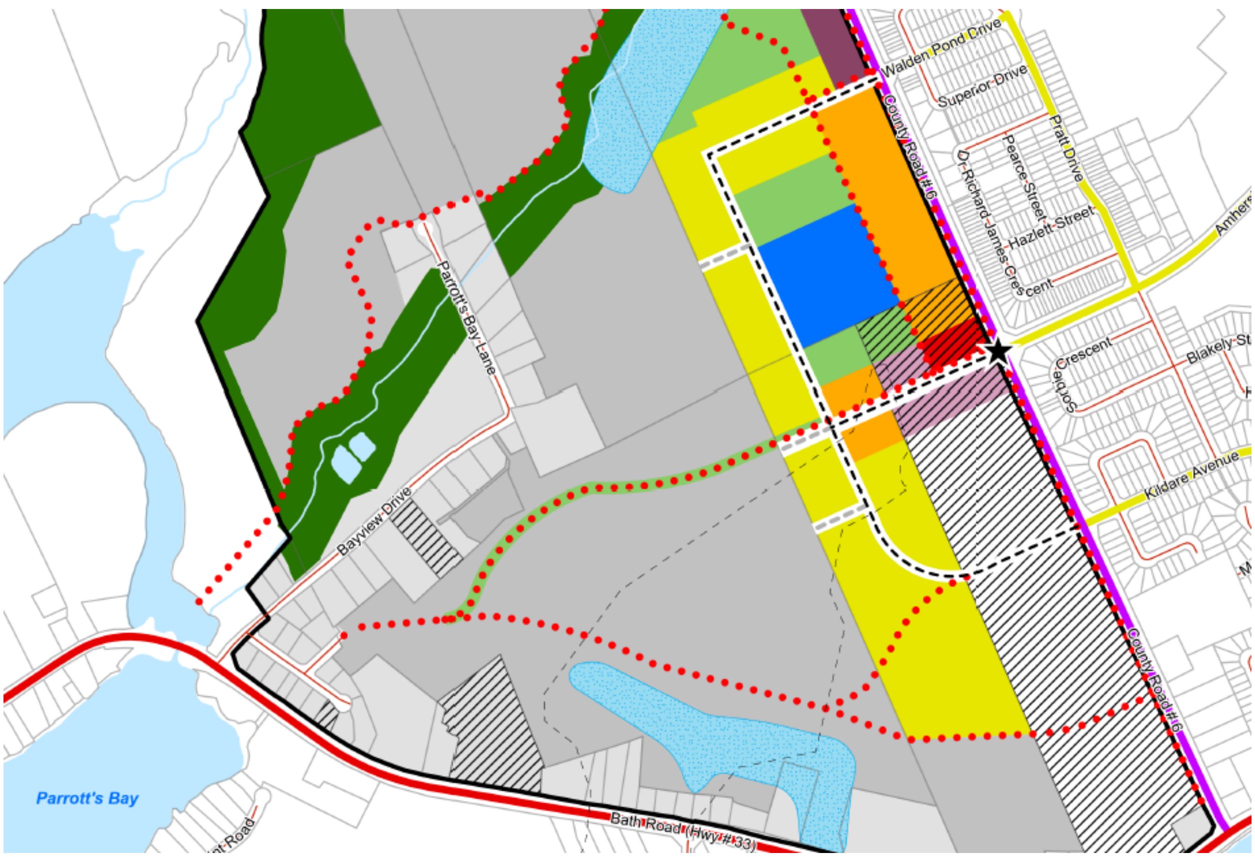


Figure 1 Potential road connections with Amherstview West Secondary Plan draft preferred concept – August 2023

Since its initial construction, traffic on Amherst Drive has gradually increased as the community of Amherstview was developed. In 2022 volume counts exceeded 3,000

AADT (Average Annual Daily Traffic) vehicles per day (WSP, 2023). WSP noted that the 2022 traffic volumes were notably lower than were projected in earlier traffic impact studies submitted in advance of the Lakeside Ponds development (McIntosh Perry Consulting Engineers Ltd., 2013) and historic traffic count data.

Drainage in this section of Amherst Drive is currently facilitated by roadside ditches. It is proposed that the ditches will be replaced by an upgraded drainage system.

The largest traffic destination is the undeveloped commercial site in the north-west quadrant of the Speers Boulevard-Amherst Drive intersection. Most of the residential area between Speers Boulevard and County Road 6 has been developed, with a portion of Lakeside Ponds and a light industrial area north of the Amherstview Fire Station yet to be developed.

The intersection of Speers Boulevard and Amherst Drive is currently controlled with a "one-way stop control" (OWSC), with a stop sign facing vehicles travelling northbound on Speers Boulevard, the north leg of Speers Boulevard not yet developed. The Pratt Drive-Amherst Drive intersection is controlled only by stop signs on Pratt Drive or "two-way stop control" (TWSC).

The initial roadway was constructed soon after the plan 29R-1081 subdivision was approved, and was upgraded early in the 2000s to a two-lane paved surface. In several of the past Official Plan (OP) documents the roadway has been shown as an urban collector road, and can be found in the latest version of the OP within Schedule C. This same document also shows Speers Boulevard and the future northerly extension as an urban collector.

The negotiations that preceded the development agreements for the western leg of Amherst Drive resulted in water and sewer mains not being located along this right-of-way. As well, the roadway's storm sewer system is being maintained for use for road drainage only. This means that adjacent development would be responsible for their share of expenses should they wish to utilize the road allowance for water, sanitary or storm servicing. These negotiations resulted in an agreement that outline "Frontage fees".

Assumptions

It is assumed that traffic volumes will continue to grow and that eventually Amherst Drive will be extended westerly into the proposed Amherstview West Secondary Plan lands, west of County Road 6.

Methodology

This memorandum will look at two aspects of the project separating the road urbanization phase from the proposed Speers intersection improvements. The final recommendations are based on comments from the traffic analysis report prepared by WSP as a component of the Amherstview West Secondary Plan (WSP, 2023).

Analysis

Intersection Improvements

The following table, recreated from Table 4-1 in the Traffic Analysis Report study indicates level of service criteria typical of traffic impact studies.

Table 1 HCM Intersection Level of Service Criteria

Unsignalized		Signalized	
Delay per vehicle (s)	**Level of service (LOS)**	**Delay per vehicle(s)**	**Level of service (LOS)**
<10	A	<10	A
10 to 15	B	10 to 20	B
15 to 25	C	20 to 35	C
25 to 35	D	35 to 55	D
35 to 50	E	55 to 80	E
>50	F	>80	F

WSP's analysis indicates that under existing conditions the Amherst Drive-Speers Boulevard and Amherst Drive-Pratt Drive intersections operate at Service Level A and B, representing a high level of service.

Much of the future growth will depend on the rate of development of the Amherstview West Secondary Plan area and the traffic volumes associated with the undeveloped commercial lands at Speers Boulevard.

To analyze future development, WSP used the reference growth and high growth scenarios examined in the 2019 population and employment growth forecast (Hemson Consulting Ltd., 2019).

For the Pratt Drive-Amherst Drive intersection, WSP concluded that two-way stop control signage would be sufficient in the long term (to 2046) under the high-growth scenario, with traffic levels of service ranging from A to C, apart from one leg during peak hour traffic being classified at Level E. This single example of a low level of service was reviewed with the Public Works division and determined to be acceptable at this location, as alternate traffic routes exist for many of the residents located in the Lakeside and Lakeside Ponds subdivisions located off Pratt Drive. The proximity of this intersection to the County Road 6-Amherst Drive intersection, being the intersection of an arterial route with a collector road, means prioritizing east-west traffic flow along Amherst Drive to prevent traffic slow downs at the County Road 6 intersection. The performance of this intersection will need to be monitored and the Township prepared to upgrade the intersection controls especially if traffic volumes increase more rapidly than anticipated.

When reviewing the Amherst Drive-Speers Boulevard intersection, WSP found that two-way stop controls would result in unacceptable traffic delays under the high-growth scenario, and they recommended improved intersection controls at this location. Having analyzed the impact of a signalized intersection vs. a roundabout, they found that under the high-growth scenario, the traffic signals operated at levels A-D and the roundabout at levels A-C. Traffic signals generally do not have the equivalent benefit of traffic calming and safety offered by a roundabout. As this has been identified as a priority location for traffic calming, a roundabout is the preferred option for this intersection.

It is noted that with the unpredictability of traffic growth and the impacts the COVID-19 pandemic had on traffic volumes, these should continue to be monitored into the future and reviewed against the assumptions made in the WSP report and other traffic impact studies.

As the Amherst Drive-Speers Boulevard intersection is immediately adjacent to the Amherst Fire Station, the Emergency Services Department has noted that any roundabout designs for Amherst Drive should include the capability for emergency vehicles to bypass traffic obstructions using a paved median strip. The median strip should be designed to manage the heavy weights associated with emergency response vehicles.

Roadway Urbanization

The existing road is not expected to have any underground piping except for traffic- and streetlight-related wiring and cabling, and the storm sewer system that will be installed to replace the existing ditches. The terrain may be suitable for roadside rain gardens when the design is amended.

This storm system will connect to existing piping that currently ends at Speers Boulevard. This piping is sized only for the minor storm drainage from the road right-of-way. The owner of the Lakeside Ponds development opted not to fund oversizing of this pipe, instead choosing to develop their own system that will ultimately drain easterly on lands north of the Amherstview Fire Station. Major storm flows from the upgraded section west of Speers Boulevard must be conveyed through the intersection so that the major storm can be directed to flow down the travelled portion of Speers Boulevard.

In consideration to improve active transportation opportunities the whole Amherst Drive corridor is being re-evaluated for long term improvements that may include additional sidewalks and/or multi-use paths. The traffic calming concerns are also acting as a stimulus for right of way improvements within the corridor. The initial concept is for Amherst Drive to have a consistent approach and presenting a similar “feel’ for all right of way users. These evaluations may lead to an alternative lane design concepts for the section between Speers Boulevard and County Road 6 as compared with the original three lane design completed by Jewell in 2010.

Financial

Intersection Improvement

The current traffic volumes do not require immediate intersection control improvements. As lands within Amherstview West and/or the vacant commercial lands at Speers Boulevard become developed there will be increasing pressure to install upgraded intersection controls at Speers Boulevard

Based on recent evaluations completed by GHD on behalf of the Township the estimated cost of the Speers Boulevard-Amherst Drive roundabout is $1.8M.

Roadway Urbanization

The “frontage fees” are fees paid by Developers when developing properties adjacent to Amherst Drive for the section of Amherst Drive between Speers Boulevard and County Road 6. The frontage fees are approximately equal to the expected costs to finalize the road cross section for all improvements beyond the curb line. This approach is unique to Loyalist Township and is a result of negotiations between the Developer and the Township regarding the scope of the Amherst Drive upgrades based on amendments to the original Plan 29R-1081 agreement prior to the draft plan approval of Lakeside Ponds.

This project has been included in the Township’s Development Charges (DC) By-law for several years. The DC funds are to be used to cover the expenses for constructing curbs, and additional asphalt. The developers have contributed to the frontage fees as their projects have been approved. The Township has followed the pace of development by finalizing walkways and multi-use paths along the right-of-way, using some of the frontage fees received to date.

A budget of approximately $2.79 million has been developed based on the original three-lane design. As mentioned above the original design is expected to be amended. It is expected that any changes to the design will end up with an estimated project cost of a similar magnitude.

The appropriate timeline to complete these two project components will be determined by when the large Speers Boulevard commercial development is operating and/or growth in Amherstview West is well underway.

Climate Lens

The Climate Lens process was developed by Infrastructure Canada to help address the climate change impacts and GHG emissions associated with infrastructure projects in Canada. By incorporating climate considerations during the planning and design of infrastructure projects, the Climate Lens is intended to help assess the potential impacts of projects, influence the design process, and inform funding decisions (WSP, 2020).

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of GHG emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the Amherst Drive Upgrades include the following:

- Mean temperatures are projected to increase annually, and in every season (ICLEI, 2021). More frequent heatwaves and shorter winter ice road season due to warming may result in softening and rutting of roads (Swanson, Murphy, Temmer, & Scaletta, July 2021)
- The number of days expected to reach above 30 degrees is expected to increase, while the number of days below -15 degrees is expected to decrease in the next 30 years (ICLEI, 2021)
- A decrease in the number of cold days, the number of icing and frost days and in the average number of freeze-thaw days. Per the 2021 ICLEI report, it is important to know how winters will change in the future because cold weather temperatures among other things “define how we design our buildings, vehicles, and shape our transportation and energy use”. On average, slightly less freeze-thaw cycles are projected for Loyalist Township in the next 30 years. Roads may not have to be built to sustain as many freeze-thaw cycles.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and overland flow.

Recommendations

It has been recommended that the Amherst Drive and Speers Boulevard intersection is upgraded, and that Amherst Drive is urbanized.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the management of excess soil materials with the general practice of reusing materials on-site when possible
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials, and using recycled materials when possible
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternative materials (low-carbon concrete, high-density recycled plastic, cross-laminated timber, alternative steel technologies, etc.) and designs (open bottom modular culverts, prefabricated/composite bridges, etc.) when appropriate. The cement portion of concrete is the world’s largest contributor to embodied carbon in the built environment. “Embodied

carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020)
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.
- Consider using roundabouts instead of 4-way stop at intersections to mitigate additional GHG emissions from idling vehicles (City of Fredericton, n.d.)

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Increase culvert capacities to manage increased precipitation and prevent washouts (Swanson, Murphy, Temmer, & Scaletta, 2021)
- Use heat-tolerant pavement mixtures to reduce pavement softening, rutting and bleeding (Swanson, Murphy, Temmer, & Scaletta, 2021)
- Consider the potential of increased water levels in roadside ditches when regrading and adjusting road elevations
- Use geotextiles to improve stability and reduce settlement of roadways (Swanson, Murphy, Temmer, & Scaletta, 2021)
- Use hedgerows to protect roadways from snow accumulation and wind gusts (Swanson, Murphy, Temmer, & Scaletta, 2021)
- Increase/improve natural infrastructure such as riparian buffers to mitigate shoreline erosion (Swanson, Murphy, Temmer, & Scaletta, 2021)

Linkages

Traffic Calming Technical Memorandum

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

City of Fredericton. (n.d.). *Roundabouts*. Retrieved from City of Fredericton: https://www.fredericton.ca/en/roads-parking/roundabouts

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

McIntosh Perry Consulting Engineers Ltd. (2013). *Traffic Impact Study - Lakeside Ponds Subdivision.*

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (July 2021). *Advancing the Climate Resilience of Canadian Infrastructure: A review of literature to inform the way forward.* International Institute for Sustainable Development.

WSP. (2020). *Bracebridge Community Multi-Use Complex, Draft Climate Lens Assessment – Climate Change Resilience, Bracebridge, Ontario.*

WSP. (2023). *Amherstview West Secondary Plan Traffic Analysis Report.*

Conclusions

It is recommended that the performance of Amherst Drive from the Speers Boulevard intersection westerly to County Road 6 be closely monitored, and when deemed appropriate, the two components of the described upgrades be implemented.

It is recommended that staff monitor traffic performance at the Pratt and Speers intersections with Amherst Drive with respect to the timing of upgraded installations.

IMP Technical Memorandum: Transportation Facility Growth

Asset Class: Transportation

Objective: The objective of this memorandum is to outline the departmental needs for operations space in the future and to identify possible funding sources.

Background

The existing Public Works Garage is located at 746 County Road 6 just south of Odessa. The original facility was constructed due to the departmental needs after amalgamation in 1998 and the decision to combine road maintenance operations of the Township with County operations.

In 2023 an initial expansion of the facility is underway that adds six bays and improved work bays and office areas for mechanics. When completed the expanded garage will have twenty bays.

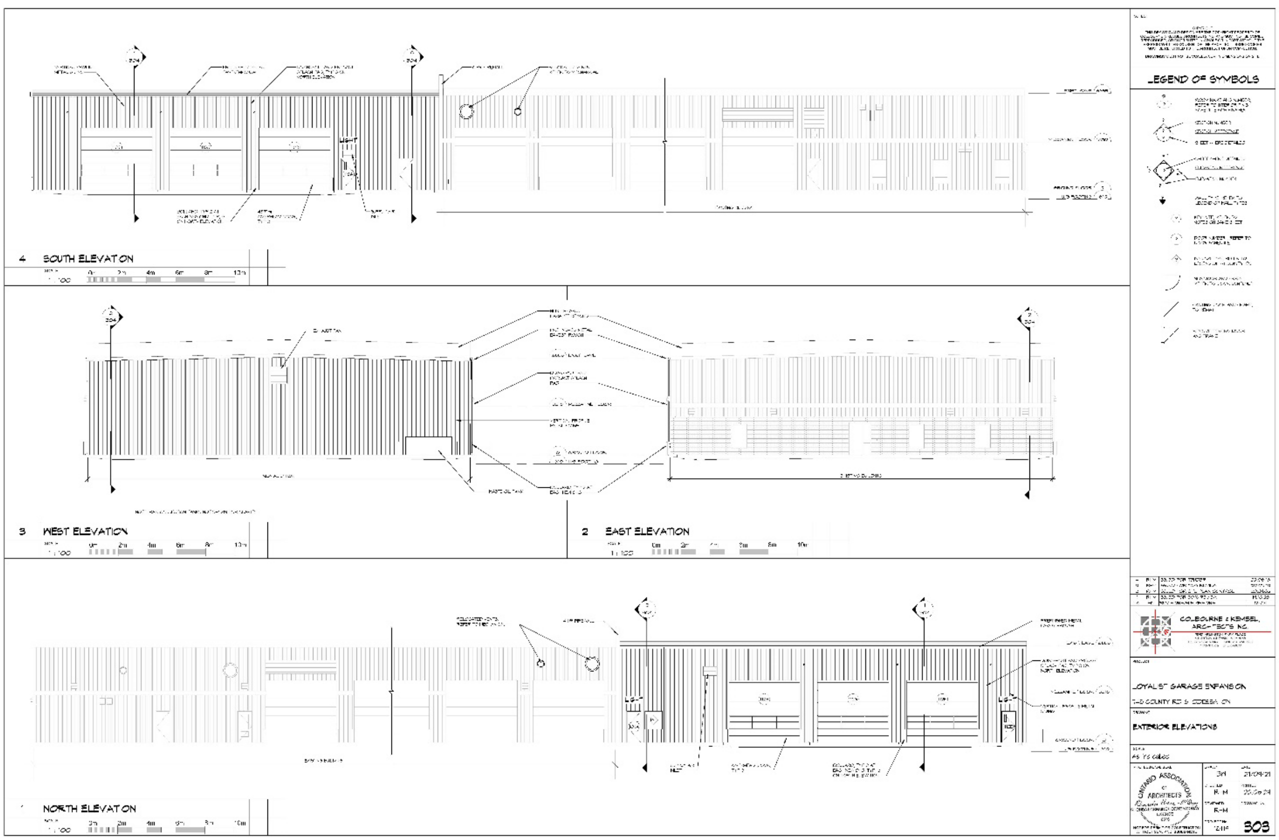


Figure 1 Illustration of 2023 expansion of Public Works Garage, 746 County Road 6

Figure 2 Exterior of Public Works Garage, showing original rear wall and expansion area

This project is the first part of a planned two-phase expansion.

Continued growth in the Township has resulted on the need for additional equipment and operations staff since the initial construction of the facility. As noted in the technical memorandum Population and Dwelling Growth, strong growth in Loyalist Township can be expected to continue for the study period of the IMP.

The current site is almost entirely situated within the environmentally sensitive area locally known as the Asselstine Alvar (GHD, 2023). In addition to the garage, the site houses salt and sand storage facilities, exterior equipment storage area; as well as the Loyalist Township Emergency Services' Fire Training Centre on the southern section. As a result, much of the native vegetation has been replaced by the developments on the site.

The area currently used on an informal basis as a snow dump is immediately north of the expansion area. Future expansion of the snow dump is potentially limited by the new extension and potential ecological constraints associated with the alvar.

Assumptions

It is assumed that growth continues as described in the technical memorandum Population and Dwelling Growth.

Methodology

This memorandum provides a high-level discussion outlining some of the options and constraints applicable to this project.

Analysis

The initial expansion of the County Road 6 garage includes two distinct components.

The initial component, currently nearing construction completion, is an expansion of the vehicle bays, a shift of the work area and offices for the mechanics and the Fleet Services Supervisor, and office space for 3-4 additional workstations.

The second component will be an expansion of the staff facilities, utilizing approximately 214 m^2 of undeveloped space on the second floor of the building.

The total staff complement at this site has continually grown as the community has expanded. The facility does not have any office space available to many of the operations staff, resulting in minimal access to computers, files, or record keeping. The facility has no meeting or staff training space, which is a major shortfall in a modern work environment. The lunchroom has reached capacity and is insufficient when additional staff are on site for winter maintenance.

The garage at the site houses the entire Public Works staff and equipment. The site includes winter maintenance storage for salt, sand, and brine.

An additional sand and salt storage facility is located at 240 County Road 4, just north of Millhaven. This location offers some seasonal unheated equipment space. The site is the operational base of Loyalist Township's water and sanitary sewage utilities division staff.

A second expansion of the number of truck/equipment bays is expected near the end of the IMP planning period, as well as a potential need for increased staff space.

Loyalist Township, as with the other lower tier municipalities in the County of Lennox and Addington, have a service agreement with the County for all maintenance services on County roads within the Township. This results in a portion of the garage being assigned to the vehicles that support County maintenance. Recent traffic counts indicate that County road traffic volumes are growing at a faster rate than the local population growth.

Current practices result in winter maintenance routes and service frequencies defining the size of the truck fleet required to service the roads. Ontario Regulation 239/02: Minimum Maintenance Standards for Municipal Highways (Government of Ontario) establishes the level of maintenance required for Ontario's roads, based on posted speed and traffic volumes.

As traffic volumes increase so does the level of service required, resulting in the need to adjust route frequencies. The addition of new roads, sidewalks, and multi-use pathways (MUP) increase local route completion times. Periodically there is a need to augment the fleet to be able to meet the level of service desired by Loyalist Township.

To successfully meet the requirements of the Minimum Maintenance Standards (MMS), it is necessary to plan to exceed the MMS under the typically-expected winter weather conditions, so that during more extreme winter events it can be normally expected that Loyalist will meet the MMS. Council may endorse a higher level of maintenance to meet the demands of the travelling public. The operational standard establishes the size of the fleet and subsequent staff complement needed to provide adequate winter maintenance in the desired time frame. Multiple storm events in a short time period or extremely heavy precipitation may exceed the Township's capabilities, and shouldn't be considered for establishing the level of service requirements.

Depending on the total length of new road, sidewalk, and MUP added to Loyalist Township's transportation system, it can be expected that within the 25-year study period of the IMP, there will be a need for additional vehicle storage of approximately 6 truck bays based on the timing of the current expansion now underway. A truck bay is approximately 6.0 m by 15.0 m.

Some of the equipment can be stored offsite on a seasonal basis, and some equipment does not require storage in a heated facility.

Analysis of the current site indicates that after the initial expansion there will be minimal space available for expansion. Some of the undeveloped lands around the site have been classified as alvar, meaning the area is environmentally sensitive and subject to environmental constraints (Greer Galloway Consulting Engineers, 2020). The vegetated area along the northern edge of the property cannot be developed due to its designation as an Area of Scientific and Natural Interest (ANSI).

Potential options for expansion of the site are:

- Relocation of staff parking facilities to alternate locations, possibly along the existing County Road 6 buffer strip
- Adding auxiliary structures on previously disturbed areas of the site
- Potential relocation of the Emergency Services Department's Fire Training Centre
- Expansion of operations on a new site, location to be determined in the future
- No expansion

These options are discussed below.

Relocation of staff parking

Currently staff parking is located on the north side of the building and a limited amount of visitor parking is provided on the east side.

There are some functional limitations in terms of site maintenance and worker safety concerns. Under this scenario parking would be further from the building and workers would have to cross the site's main vehicle entrances to access the building. During inclement weather safety would be an important concern. Vehicles parked close to the sand and salt storage buildings have a higher risk of damage from loaders and salt corrosion.

The septic system is located between the garage and County Road 6; the area occupied by the septic bed is not compatible for parking. This issue could be eliminated if the septic system was replaced with a connection to the sewage forcemain located in the County Road 6 right of way.

Addition of auxiliary structures

The option of expanding on this site should be pursued to maintain operational efficiency.

The first step will be to examine all site constraints, site zoning requirements, and opportunities. Consideration of smaller structures, designed for specific purposes, may be a solution.

The relatively flat topography of the site makes proper drainage difficult for the site. More intensive use of the site would likely require an expansion of the storm water management operations. The recently expanded stormwater management facility is constructed entirely in the bedrock in rock and required the installation of a clay liner.

Relocation of Fire Training Centre

The Emergency Services Department's fire training centre requires access to the municipal potable water system for its fire suppression training. Similar to the snow dump operations, the operation of the training facility does not strictly conform to today's environmental approval guidelines, but it is permitted to continue as a legacy item as it predates current environmental constraints. Relocating the training facility to an alternative site which also has access to portable water, is not considered realistic during the study period of the IMP.

Expanding the Public Works operation into the area currently occupied by the Fire Training Centre is not a feasible option.

Expansion of operations on a new site

This option recognizes the many constraints of the existing site.

Having a second operational facility would introduce some operational inefficiencies. While some inefficiencies could be partially mitigated with proper planning, including the possible combination with other sites, loss of operational efficiency is enough of a factor that this option is likely the least attractive from an operations perspective.

Another consideration is the vehicle and operational noise generated at the site, which may take place at any hour or any day depending on operational needs. Having adequate distance from sensitive receivers is a significant concern.

Typically, a site with this type of operation would be located on a road that does not have seasonal load limits, and good access to the balance of the Township and sufficiently buffered from sensitive land use such as residential areas, schools etc. Unless a new facility is primarily for storage, access to water and sanitary sewer servicing makes any site more attractive.

It may make sense to partner a new facility to house the needed public works expansion with another Township facility were space available. Potential locations that offer partnering opportunities include lands adjacent to the Amherstview WPCP, industrial-zoned land, the County Road 4 Utilities Division garage, or the to-be-determined site of a future snow dump or soil remediation facility.

Do not expand facility

As noted above, continued growth within the municipality will result in the need to expand the resources for road, sidewalk, and MUP maintenance. In the past the increased resources have been in the form of in-house staff and equipment.

Without a second planned expansion, more equipment would have to be stored outside and prone to degradation from the elements and vandalism/theft. Storing vehicles used for winter maintenance outside can be very problematic and inefficient, and is strongly discouraged.

An alternate option for consideration, might be the increased use of externally-contracted operations. This option might address some of the housing concerns but could create a host of other concerns regarding integration, scheduling, and contractual obligations and responsibilities. Most municipalities tend to maintain winter road services in-house due to many factors such as:

- The level of liability
- The varying nature of the services to be provided combined with operational flexibility
- The need to maintain a trained work force for other duties on an annual basis
- The need to efficiently deploy large equipment on an annual basis

Summary

It is premature to recommend any of the above options, but it may be prudent when looking at the broader needs of the Township to consider the potential of any future facility development to include a new satellite Public Works facility which has the primary objective of additional fleet housing.

Financial

The cost to improve the staff facilities and office space is estimated to be approximately $1.4 M. This budget is highly dependent on the final scope of the project. Included in this estimate is a personnel-lifting device (elevator), required under the accessibility components of the Ontario Building Code (Government of Ontario, 1992) to provide access to the second floor.

The cost of adding six bays to the existing site as part of the original expansion is estimated to cost $4.4M. If the building is expanded again in approximately twenty years estimated costs would be similar. If a decision is made to build on a new site, then the value of the land and associated site plan improvements would need to be considered.

Based on the options available, it is prudent to complete a detailed evaluation of all factors regarding a second expansion of the garage at the current site. If this evaluation demonstrates that the site is not suitable for further expansion, consideration should be given to developing at another location and potentially partnering with another Township use. Partnering the use of a site allows for some of the servicing costs to be shared. Possible candidate sites, subject to further detail evaluation, could include the Amherstview WPCP, the County Road 4 Utilities Division garage, or the to-be-determined site of a future snow dump or soil remediation facility

The costs for expansion are considered growth costs, and as such are eligible for consideration within the Development Charges By-law.

Climate Lens

The Climate Lens process was developed by Infrastructure Canada to help address the climate change impacts and GHG emissions associated with infrastructure projects in Canada. By incorporating climate considerations during the planning and design of infrastructure projects, the Climate Lens is intended to help assess the potential impacts of projects, influence the design process, and inform funding decisions (WSP, 2020).

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of GHG emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact transportation facility projects as well as operations working out of this facility include the following:

- Mean temperatures are projected to increase annually, and in every season (ICLEI, 2021). More frequent heatwaves and shorter winter ice road season due to warming may result in softening and rutting of roads (Swanson, Murphy, Temmer, & Scaletta, 2021)
- The number of days expected to reach above 30 degrees is expected to increase, while the number of days below -15 degrees is expected to decrease in the next 30 years (ICLEI, 2021)

- On average, slightly less freeze-thaw cycles are projected for Loyalist Township in the next 30 years. Roads may not have to be built to sustain as many freeze-thaw cycles.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and overland flow.

When this facility requires further expansion and upgrades climate conditions will need to be taken into account.

Climate Change Mitigation

How will upgrades to this facility assist in mitigating the impacts of climate change?

- Set the facility up to optimize roads operations in a fashion that minimizes emissions and fuel consumption.
- Following best management practices regarding the use of new materials such as materials that are mined including granular materials, and using recycled materials when possible.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternative materials (low-carbon concrete, high-density recycled plastic, cross-laminated timber, alternative steel technologies, etc.) and designs (open bottom modular culverts, prefabricated/composite bridges, etc.) when appropriate. The cement portion of concrete is the world's largest contributor to embodied carbon in the built environment. "Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050" (CarbonCure, 2020).
- Sourcing material as local as possible to reduce the amount of GHG emissions in transport.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Modify equipment set up to align with needs due to changes in frequency in weather events
- Increase culvert capacities to manage increased precipitation and prevent washouts (Swanson, Murphy, Temmer, & Scaletta, 2021)
- Use heat-tolerant pavement mixtures to reduce pavement softening, rutting, and bleeding (Swanson, Murphy, Temmer, & Scaletta, 2021)

- Consider the potential of increased water levels in roadside ditches when regrading and adjusting road elevations
- Use hedgerows to protect roadways from snow accumulation and wind gusts (Swanson, Murphy, Temmer, & Scaletta, 2021)

Linkages

Population and Dwelling Growth Technical Memorandum

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

Environment and Climate Change Canada. (2016). Pan-Canadian Framework on Clean Growth and Climate Change : Canada's plan to address climate change and grow the economy.

GHD. (2023). *Ecological Characterization Assessment - Unnamed Road Allowance.*

Government of Ontario. (1992). O. Reg. 332/12: Building Code. *Building Code Act 1992, S.L. 1992, c. 23*.

Government of Ontario. (n.d.). O. Reg. 239/02: Minimum Maintenance Standards for Municipal Highways.

Greer Galloway Consulting Engineers. (2020). *Updated Environmental Impact Study Report, Loyalist Public Works Garage Additions, 748 County Road 6, Odessa.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (2021). *Advancing the Climate Resilience of Canadian Infrastructure.* International Institute for Sustainable Development - IISD.

WSP. (2020). *Bracebridge Community Multi-Use Complex, Draft Climate Lens Assessment – Climate Change Resilience, Bracebridge, Ontario.*

Conclusions

Further development on the current Public Works garage site is not expected to be straightforward. To preserve operational efficiencies, it is recommended that Loyalist Township carefully examine the various options for increased utilization of the site. With continued growth, the need for eventual expansion is certain. A detailed evaluation of fleet and seasonal operations may indicate opportunities to direct some equipment storage away from the main garage floor area, or to relocate other activity such as office space in a way that optimizes the main functions of the garage.

IMP Technical Memorandum: Transportation Equipment Future Growth

Asset Class: Miscellaneous

Objective

The objective of this memo is to outline some of the expected changes to the Township's fleet size and composition over the 25-year study period of the IMP.

Background

Loyalist Township maintains a fleet of roads and sidewalk maintenance vehicles. The municipality performs all the road and sidewalk maintenance duties in-house and provides a similar function for the County of Lennox and Addington roads in the Township, through a service agreement.

A recent growth study (Hemson Consulting Ltd., 2019) notes that, between 2022 and 2046, the Loyalist Township population will grow by approximately 8,000 people under their high-growth scenario.

A review of the Township's plowing routes over the past few decades indicate that the Township adds two plow routes approximately every fifteen years. Loyalist's large truck needs are currently defined by the number of winter plows required to meet the required timelines for snow and ice removal from roads and sidewalks (Government of Ontario). A route requires a fully-equipped plow truck, plus operations staff of the minimum of one driver for two separate shifts per day, and potentially seven days a week.

The Township's current fleet is currently powered by vehicles equipped with internal combustion engines and all the larger vehicles use diesel fuel.

Assumptions

It is assumed that Loyalist Township's population growth will grow at the high rate of growth noted by Hemson.

For this memorandum it is assumed that, because of relatively low growth in the rural areas, equipment needs for the rural area will remain relatively static, resulting in the number of graders, excavators, and loaders remaining status quo. Loyalist's Public Works staff typically do not get involved in projects that require excavation in urban areas, which often entails specialized utility work.

When a new snow dump is operational there is the potential for additional equipment to be assigned to this site. With additional plows on the routes there may also need to be additional loading equipment for winter salt and sand.

The pace of proposed trail development within the Township may increase the need for new plows and small equipment like sweepers, at a pace that exceeds the additional equipment requirements based solely on community growth.

Methodology

This report has been developed based on historical observations and through discussions with senior Public Works staff.

Analysis

Fleet Components

The Public Works division currently has a fleet of 38 vehicles, not including graders, loaders, or excavators. The fleet is made up of 20 lighter service vehicles (pick-ups trucks, etc.), 4 sidewalk snowplows, and 13 heavy trucks.

A general recent trend observed is that many of these vehicles, once traditionally outfitted for one task, are now being designed so that the basic unit can be easily and quickly refitted with optional supplementary equipment so that the vehicle can be used for multiple purposes. Over time this trend will likely result in modifications to the composition of the fleet as individual units become more versatile. With an estimated useful equipment life of 10-20 years, this transition will take place slowly.

Sidewalk and Trail Development

The Infrastructure Masterplan proposes to improve the level of service for sidewalks, paths, and trails within Loyalist Township. Many of the urban areas developed prior to the mid 1990s were constructed without sidewalks. The IMP has identified new sidewalks to complete community linkages. Similarly, to address the need for improved active transportation facilities, the IMP has proposed an enhanced trail development initiative.

To provide a safe environment for users of these facilities, the Township will need to invest in additional equipment. Typical equipment includes multifunction units that offer plow, sweeping, and sanding, and are sized for the widths of the trails and sidewalks.

Figure 1 Prinoth track-driven sidewalk plow

Growth

Continued growth in the community will mean that additional plow routes will need to be added. Anecdotal information received from City of Kingston Public works staff suggest that:

- For every twenty kilometers of new sidewalk, a new sidewalk plow is required.
- For every forty kilometers of new roads, a new plow unit is required.

Changes in lot density and lot width have the potential to impact the requirements for snow removal equipment. Over the past few years some communities in Loyalist Township have been constructed with a significantly higher density of single-family homes than most other sections of the Township. In some cases, single-family homes have been converted to apartments. These factors result in much of the street frontage being driveways, and the boulevard area traditionally used to store snow is much reduced from older neighbourhoods. This results in slower snow removal rates and increased snow hauling after a snow event. With the current housing crisis in Ontario and the need for affordable housing, there is a good chance that there will be more developments with similar impacts. Therefore, the types of housing units may have an impact on the growth-related needs for additional equipment.

Based on the discussion above, a growth-related increase of approximately three truck/plow combination units can be expected during the study period of the IMP.

Hemson's evaluation of population growth can be summarized as approximately 1% growth per year over the 25-year study period. This would equate to an approximate fleet increase of 9.5 vehicles. If three units are plows, the balance would see an increase of approximately 6 smaller units (pickups, sidewalk plows, etc.).

Vehicle Types

Fleet managers have an increased variety of options when selecting new vehicles.

In the past, winter maintenance vehicles were solely plows with sanders. Increasingly, units offering salt/sand boxes and brine combinations are available. Technology to optimize salt use is now the norm.

Previously, any conversion of larger trucks for different types of uses, e.g., sander, truck box, tanker, etc.) was limited due to the effort and time required to make the physical changes to the vehicle. Options are now available where larger trucks are gaining some of the flexibility seen in smaller equipment, resulting in the ability to convert the use of the vehicle, e.g., from a dump to a sander, in more quickly. This ability greatly improves the efficiency of the fleet and may over time affect the number of vehicles required to maintain the fleet.

Low-carbon Fuel Alternatives

The need to meet net carbon neutrality is driving a transition from carbon-fuelled internal combustion equipment to greener options. This change is readily apparent in current passenger vehicles. Due the high power needs of the larger equipment and the economics of battery power, these sectors are generally behind in the transition to low-carbon fuels. Future options include electrification, hydrogen fuel cells, and hydrogen-based fuels.

Electric powered pickup trucks and similar-sized vehicles are now available and should be strongly considered when selecting new vehicles.

Loyalist staff will need to closely monitor the transition process for energizing larger equipment and be prepared to purchase new technology as it becomes available. With traditional equipment lasting a decade or more, failing to pursue lower-carbon options will delay meeting the Township's greenhouse gas (GHG) reduction initiatives (Corporation of Loyalist Township, 2021).

The use of alternative fuel and energy sources will mean that the Public Works Garage on County Roads 6 may need to be outfitted with increased energy supply capability for charging vehicles and for storing alternative fuels such as hydrogen.

Financial

Vehicles purchased due to growth in the community are eligible for funding through Development Charges (DC). This means it is important for the Township to monitor its fleet numbers accordingly, and to identify when the fleet is to be augmented due to growth, as opposed to life-cycle replacement of an existing vehicle. Vehicles that can be included in DC considerations include trucks, plows, and sweepers for both roads and sidewalks.

Actual DC funding is based on a per capita level of service. This calculation compares the existing value of all the equipment to establish a level of service and compares the projected value based on population growth.

Loyalist Township should be prepared to pay a premium for low-carbon-fueled equipment as the industry transitions to new fuel types. Managers should be encouraged to participate in training opportunities on low-carbon fuel options so that informed decisions can be made as soon as possible. Similar training should be made available to mechanics and senior operations staff in preparation of the transition to cleaner energy.

The list of equipment at Appendix A includes the purchase price for the base unit plus any ancillary equipment supplied at the time of the original purchase.

Climate Lens

The Climate Lens process was developed by Infrastructure Canada to help address the climate change impacts and GHG emissions associated with infrastructure projects in Canada. By incorporating climate considerations during the planning and design of infrastructure projects, the Climate Lens is intended to help assess the potential impacts of projects, influence the design process, and inform funding decisions (WSP, 2020).

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of GHG emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact transportation equipment in Loyalist Township include the following:

- Mean temperatures are projected to increase annually, and in every season (ICLEI, 2021). More frequent heatwaves and shorter winter ice road season due to warming may result in softening and rutting of roads (Swanson, Murphy, Temmer, & Scaletta, July 2021).
- The number of days expected to reach above 30 degrees is expected to increase, while the number of days below -15 degrees is expected to decrease in the next 30 years (ICLEI, 2021)
- A decrease in the number of cold days, the number of icing and frost days and in the average number of freeze-thaw days. Per the 2021 ICLEI report, it is important to know how winters will change in the future because cold weather temperatures among other things “define how we design our buildings, vehicles, and shape our transportation and energy use”. On average, slightly less freeze-thaw cycles are projected for Loyalist Township in the next 30 years. Roads may not have to be built to sustain as many freeze-thaw cycles.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and overland flow.

Recommendations

- Planning equipment for additional trails and sidewalks
- Considering new vehicle types to improve operational efficiency
- Looking into low carbon fuel options

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Improving operational efficiency and considering low carbon fuel options/electrified for new equipment will reduce greenhouse gas emissions and fuel consumption.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- New vehicle types that can be used for multiple functions will improve efficiency when dealing with changes to typical weather patterns.

Linkages

Transportation Regulatory and emerging Issues technical Memorandum

References

Corporation of Loyalist Township. (2021). *ResiLienT Loyalist Township Climate Action Plan.*

Environment and Climate Change Canada. (2016). Pan-Canadian Framework on Clean Growth and Climate Change : Canada's plan to address climate change and grow the economy.

Government of Ontario. (n.d.). O. Reg. 239/02: Minimum Maintenance Standards for Municipal Highways.

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (July 2021). *Advancing the Climate Resilience of Canadian Infrastructure: A review of literature to inform the way forward.* International Institute for Sustainable Development.

WSP. (2020). *Bracebridge Community Multi-Use Complex, Draft Climate Lens Assessment – Climate Change Resilience, Bracebridge, Ontario.*

Conclusions

It is recommended that staff monitor the needs for additional plow routes for roads, sidewalks, and trails for growth areas as opposed to existing community needs, so that appropriate information is available for future DC calculations.

It is recommended that Loyalist Township closely monitor the advances in low-carbon fuel technology and other emerging powertrain technologies, and prioritize the purchase of low-carbon-fueled vehicles as soon as efficient alternatives are available.

IMP Technical Memorandum: Taylor Kidd Industrial Park Servicing

Asset Class: Miscellaneous

Objective: The objective of this memorandum is to provide background into the decision-making process with respect to current and future servicing of the Taylor-Kidd Industrial Park. The memorandum also briefly discusses the lack of potential new industrial lands and the timelines to have suitable new sites available.

Background:

In 1955 Canadian Industries Limited (CIL) opened the Millhaven Fibers facility on a 70-acre site adjacent to Lake Ontario and the Highway 33/Jim Snow Drive intersection. This large plant had its own facilities for pumping water and for processing sanitary sewage, and therefore handled its own fire process water and sanitary sewage needs. In later years this facility operated as Celanese, KOSA, and as Invista. While the plant buildings were demolished several years ago, the raw water pumping station still provides process and fire water capabilities to the area.

Over time, other industries have established themselves in the industrial park. Adjacent to the former CIL site is GIP Millhaven Terminal, Direct Coil, Alstom Transport Canada, and Validus Power Corporation. The existing industries have a service agreement with Validus Power Corporation for the supply of raw water from Lake Ontario, which serves as both process water and fire water supply.

Validus Power Corporation ("Validus") purchased Kingston Cogen from Northland Power in April 2022. In November 2021 as part of the agency outreach for the IMP, Loyalist staff met with officials from Northland Power. At that time Northland Power was committed to offering process water and water for fire suppression on a commercial basis to any of the local industries who wished to form a long-term agreement. Loyalist Township has not officially inquired regarding Validus' position on this issue since they acquired the generating facility, although initial conversations with the senior management have indicated that the current agreements are being honoured and they are interested in expanding their customer base.

In the early 2000s Loyalist Township negotiated with KOSA, then owner of the site formerly owned by CIL, to extend a watermain along Bath Road/Highway 33 westerly to service their facility. Once the negotiations were completed with KOSA, similar agreements were established with the sites now owned by Direct Coil, Alston Transport Canada, and Validus. At that time Bombardier owned the properties now owned by Direct Coil and Alstom Transport Canada. Bombardier extended the watermain to their facilities, which also indirectly provided an opportunity for Kingston Cogen to connect to the municipal distribution system. Each of these industrial properties have individual agreements that limit the quantity of water available to each site, with provisions for additional water use. The benefiting industries collectively paid the full cost of the watermain extensions and the associated cost of treatment capacity.

GIP Millhaven Terminal is not connected to the municipal potable water system.

This municipal main provides potable water for domestic purposes and limited use as process water; however, the pressure and flow rate are not suitable for industrial fire suppression. The Township has included the statement that the potable water system is not to be used for fire suppression in the servicing agreements for these industrial properties.

The main is 300mm in diameter and was sized for future servicing of properties in the area, improved fire demand capability, and as a future potential back-up linkage between the Amherstview and Bath distribution systems.

The watermain follows Bath Road/Highway 33 westerly to Jim Snow Drive and then tracks north on the east side of Jim Snow Drive to Taylor-Kidd Boulevard, before extending westerly again along the south side of Taylor-Kidd Boulevard, to the main entrance of Alstom Transport Canada.

As of December 2022, only those properties noted above are serviced by the municipal potable watermain.

The former CIL property also has its own sanitary sewage plant, which remains onsite but has been decommissioned for several years. This facility treated industrial and domestic waste from the same properties that are now connected to the municipal water system. All of the associated piping for this system is privately owned. When the former CIL facility shut down, the provision of sanitary sewer services was discontinued. At that time Bombardier constructed its own subsurface treatment system on its property; this private septic system now serves both Alstom Transport Canada and Direct Coil.

The industrial area is serviced by two separate natural gas pipelines owned by Enbridge. Hydro One provides multiple levels of voltage linkages, including direct connection to the provincial high voltage electrical grid. CN operates a rail spur from the CN mainline to the north end of Jim Snow Drive north of Taylor-Kidd Boulevard, where it splits into two privately-owned rail spurs serving the former Invista site and the GIP Millhaven Terminal.

In 2022 Umicore N.V. purchased approximately 140 hectares of industrial land just west of the Validus property for the development of a new facility that will produce cathode active battery materials and their precursor materials.

Industrial Land Inventory

The Township's industrial land inventory is now low. At the time of writing this memorandum only a few undeveloped properties remain in the 60-acre Loyalist East Business Park (LEBP). The Township has sold approximately 800 acres in the last decade in the Taylor-Kidd Industrial Park. A few unserviced privately-owned, light industrial-zoned sites exist in Amherstview area. There is one larger undeveloped industrial-zoned site in Odessa that has municipal services available along County Road 2, but this site has serious physical constraints.

Assumptions

It is assumed based on preliminary discussions that Umicore N.V. will develop their own sanitary sewage processing facilities and a raw water intake from Lake Ontario for fire and process water. It is also assumed that Umicore N.V. will utilize potable water from the municipally owned water main, which will need to be extended to service their site in the west section of Taylor-Kidd Industrial Park. The watermain extension is a Schedule A, or exempt, project within the MCEA framework (Municipal Engineers Association, 2023).

Recent municipal industrial property land sales along the northern edge of the industrial lands to Kiley Paving and Tomlinson Group do not include the provision of municipal servicing, and there is currently no immediate provision to service lands east of Jim Snow Drive.

Past analysis has demonstrated that the provision of water and sanitary sewer serving typical of a municipal industrial park would not be feasible for the Taylor-Kidd industrial lands without a large financial capitalization of municipal infrastructure.

It is assumed that the average and peak volumes required by Umicore N.V. will not necessitate nearby water storage, and that the existing main to the industrial lands has sufficient capacity to meet the needs of the new industry. This volume is projected to be in the range of 200 m^3/day, which is similar to the historical use of Invista.

Methodology

Taylor-Kidd Industrial Area Servicing

Over the past three decades the municipality has explored various water and sanitary sewage servicing strategies for the Taylor-Kidd Industrial Park lands as inquiries were received from a variety of potential industrial occupants. These proposed industries represented a broad range of needs in terms of volume and treatment demands. As a result of these industrial enquiries, the municipality has developed various analyses which have been referenced in the preparation of this memorandum.

Future Needs

The topic of the requirements for future industrial growth are briefly discussed.

Analysis

Taylor-Kidd Industrial Area Servicing

Extending the potable water distribution system to the industrial lands made the servicing of additional industrial lands a relatively feasible prospect. With the construction of a suitably sized reservoir the Township could be in a position to address the fire suppression needs of the industrial facilities.

The Township's impost fee by-law (Corporation of Loyalist Township, 2019) includes a watermain construction project, from the Alstom entrance westerly to County Road 4. It is expected that this main will be completed in two phases. Phase 1 will be to Umicore N.V. demarcation point, which is yet to be established, and Phase 2 will complete the balance of the project to County Road 4.

The provision of sanitary sewage services to the Taylor-Kidd Industrial Lands has been a very complicated topic. There are several factors to consider, with the ultimate roadblock being the availability of suitable funding.

The design of sanitary conveyance infrastructure is based on average and peak flow demands. Treatment facilities are sized based on the various chemical and suspended solid concentrations in the sanitary sewage.

To properly size a sanitary sewage system including treatment capabilities, the designer needs to know the volume, the flow rates, and the characteristics of the sewage that will be received by the system. This information simply is not available when looking at a large industrial site with potentially multiple unknown users. Both undersized and oversized conveyance systems are very inefficient and can lead to potential serious operational issues. Piping and pumping station capacities need to match the daily demands within reasonable variances.

The Taylor-Kidd Industrial Park is located approximately 6.3 kilometers west of the Amherstview Water Pollution Control Plant (WPCP). The most direct route between the plant and the western boundary of the park includes two very deep valleys. Typical of Loyalist Township's topography, this route would require pipeline construction in areas consisting of shallow limestone bedrock. In view of the foregoing, extension of the conveyance system from the industrial lands to the Amherstview WPCP would be very expensive.

With recent strong growth in the residential sector of Amherstview and Odessa, there is very limited capacity at the Amherstview WPCP available for industrial use. Hence, it is likely that this facility would require an immediate expansion for any industry with a typical industrial sanitary sewage loading. Without the specifics of the volume of sanitary sewage to be produced by the industry(s), it is difficult to establish an efficient scope for treatment plant expansion and for sanitary sewage conveyance infrastructure.

For similar reasons, conveying industrial sanitary sewage for treatment at the Bath Sewage Treatment Plant also appears to be a very expensive alternative. A direct route between the Bath STP is complicated, as the route would cross federally-owned property, including the Bath and Millhaven correctional institutions. Bypassing the large federal institution property results in a route of similar length as the option of a route to the Amherstview WPCP. Treatment capacity is also limited at Bath STP for large industrial customers.

After analyzing various options, staff feel that the Township is unable to pre-service the Taylor-Kidd Industrial Park with dedicated sanitary sewage servicing capabilities, unless significant grant or private funding is received.

In 2020 staff approached Loyalist Township Council as part of the IMP process, to request direction as to the Township's vision with respect to future servicing provisions for the Taylor-Kidd Industrial Park. Council was provided the background information and analysis outlined above and were informed of the timelines to construct new capacity at the sanitary sewage treatment plant and the associated conveyance piping and pumping stations. As a result of the direction provided by Council, the IMP does not include any specific capacity for large industries to be supplied in the future with municipal water or sanitary sewage service. Small industries like the current occupants of the Loyalist East Business Park are typically not large water users, and the growth model includes an allowance for additional new small industries.

To guide the issue of capacity allocation in the future, staff have initiated the development of a capacity allocation policy. The objective of the policy will be to guide Council as they decide where and how much water and sanitary sewage capacity will be allocated, recognizing that the overall capacity is finite. Council can then use the policy guidelines to decide whether capacity is best used for new homes and small businesses, or for new large industrial customers.

Future Needs

A few large tracts of privately owned greenfield land suitable for industry remain along the Taylor-Kidd Boulevard corridor, close to Jim Snow Drive. These lands do not have, or have limited access, to Lake Ontario and water and sanitary sewage servicing is currently not planned for these sites.

The Invista site is a large brownfield property with some environmental constraints. The site has access to the Township's potable water supply and to process water, a rail siding, multiple electrical voltage supplies, and a high-pressure natural gas feed, and is adjacent to a potential cogeneration partnership. The site formerly included a sanitary sewage treatment facility that was designed specifically for sanitary sewage with a low solids content, characteristic of the site's industrial activities. The treatment facility is felt to no longer be viable without modification and subsequent permit revisions.

The available sewage and water treatment capacity will need to be expanded within the IMP planning period. Demand by smaller light industries have been accommodated in the plant capacity demand projections, but there has been no allowance for the needs of a potential new large industry. Servicing a new large industrial demand will mean that capacity available for growth in the smaller ICI and residential sectors.

With the exception of the Taylor-Kidd Boulevard corridor and the area immediately south of Highway 401 near Odessa, access to electrical power is limited. Improvements to the electrical distribution network require extensive planning.

Properties such as the former CIL site and the Umicore N.V.'s site were attractive and viable for these industries because of direct access to Lake Ontario and the natural assets available at the site, such as process water. The Township has very limited locations that offer similar benefit.

New industries require significant investment. Investors will not select a site where the services they require are not guaranteed to be available within the timeframes they require to secure their place in their markets. Loyalist Township has historically been unable to meet many of the expectations requested by prospective industries.

When making large investments most large industries prefer, and legislation requires, that their operations be adequately distanced from sensitive receptors (Province of Ontario, 2013). The definition of "sensitive receptors" varies according to the proposed facility's activities, but typically considers a nearby residence, childcare facility, healthcare facility, seniors' residence, long-term care facility, or school. This is another reason to manage rural growth in way that will not constrain future overall municipal growth. Like sensitive receivers, environmental constraints such as woodlands, alvars, etc., further limit potential industrial use.

The Township's main attributes are relatively inexpensive land, proximity to major markets and road based transportation linkages, and access to a trained labour force and academic institutions.

As a result, the ability of the Township to attract new industry, both large and small, is very limited in the near and medium future.

If the Township wishes to maintain a steady rate of industrial expansion, immediate steps will be required to evaluate and determine the appropriate locations for this type of development. The Official Plan and Zoning By-law will need to be amended to include the future industrial areas. A decision will be required on whether the municipality acquires the future industrial lands and acts as proponent, or whether the land is eventually developed by private interests. In either case, the municipality will have a major role in coordinating utilities, both those owned and not owned by the Township.

Recently the County received a growth and urban land needs report (Watson & Associates Economists Ltd., 2023) commissioned to support their Official Plan. The County OP states:

> "Planning authorities may plan beyond the twenty years for the long-term protection of employment areas, provided new lands are not designated beyond the planning period."

The study by Watson states:

> "While Amherstview, Bath, and Napanee have a large quantum of employment land area available for the planning horizon, Odessa's Employment Areas are not anticipated to be built out by 2048."

Township staff provided detailed comments to the consultant during the development of the report. They noted the following:

1. Much of the employment lands were under option to purchase agreements and these transactions have now been completed (i.e., Umicore, Tomlinson Group, Latham Pools, and most remaining lots in Loyalist East Business Park). The supply of preferred industrial lands is greatly reduced.
2. Many of the vacant employment lands are currently not serviced. The Taylor-Kidd corridor has been evaluated several times for sewer and water servicing extension to employment lands. Servicing this land remains impractical due to environmental, hydraulic, and topographical constraints. Most small to mid-sized industries require water and sanitary sewage servicing. Some of the employment lands considered lack road, water, and sewer access.
3. The former industrial site owned by Invista has site constraints dating back to other industrial activity, and although there are a few attractive attributes for the site (rail access, high voltage electricity, high pressure natural gas, potable water, process water, port potential), there has been little activity towards redevelopment since Invista terminated operations and demolished the old buildings.
4. With the removal of the lands described above, the total area of employment land is significantly reduced, the balance of remaining lands are predominantly a scattering of small lots, and many not serviced.
5. Most industries desire fully serviced lands, with separation from sensitive receivers such as schools and residences.
6. The largest vacant employment land in Odessa has extensive environmental constraints and an overhead high-voltage power line, making much of the land unsuitable for employment uses. The other sites listed in the Watson study are adjacent to residential areas and are generally small in size.

After receiving the Township's comments, Watson and Associates added a note to the final version of their report that many of the employment lands referenced do not have water and sewer servicing, or possibly road access to the site. The consultant did not take the time to re-evaluate and note the impacts of this statement on their previous calculations.

These factors combined with recent land sales means that, in the opinion of Township staff, the County's growth report conclusions with respect to available employment lands for Loyalist Township are misleading.

Financial

Potable Water

Umicore N.V. has stated that it will require municipal portable water.

The distance from the existing watermain to a central location along the Umicore N.V frontage is approximately 1,000 meters. To extend the existing system westerly to County Road 4 along Taylor-Kidd Boulevard, watermain of approximately 2,100 meters would need to be constructed.

Currently the ownership of the frontage along the west end of Taylor Kidd Blvd is limited to Umicore N.V. and Alstom Transport Canada and extension of the watermain beyond the needs of Umicore provides little immediate benefit to that industry.

In the longer term, and beyond the term of this IMP, an extension of the municipal water supply may be of benefit to:

- provide remedial relief to the hamlet of Millhaven, the former Ernestown Station area, and the properties in between;
- backup supply to Correctional Services of Canada's institutions;
- reciprocal backup support for Fairfield and Bath water systems;
- servicing future industrial expansion.

The longer term servicing options provide rationale for using impost fees for funding of the watermain extension to County Road 4 and beyond.

The extension of the municipal watermain westerly to service the Umicore N.V. site has been previously evaluated by the municipality and is considered a "routine" watermain extension project, since it arises from development. As such, it will be installed and financed by the developer and therefore is not included in this memorandum.

Evaluation of the water treatment capacity indicate that expansion costs for the Fairfield plant will likely be consistent with current impost fee rates for the treatment component.

Sanitary Sewage Servicing

With Umicore N.V.'s decision to provide on-site treatment of its sanitary sewage, and the fact that there is a minimal need in the vicinity for additional servicing, Loyalist Township is not pursuing development of sanitary sewage infrastructure in this area.

When estimating for a major expansion of a sanitary sewage treatment facility, costs can be expected to be in the range of $4,000 per cubic meter of average day flow of sanitary sewage that exhibits similar suspended solids and BOD loadings as domestic sanitary sewage. For smaller incremental increases in capacity, it is difficult to make a cost estimate as each of the sub-processes within the treatment system must be analyzed. Unusual chemical loadings inconsistent with the requirements of the Township's Sewer Use By-law (Corporation of Loyalist Township, 2011) may require industries to complete separate on-site pre-treatment of their sanitary sewage.

When defining future expansion capacities, it would make sense for Loyalist Township to add an allowance for large industry sewage demand volumes as a component of the estimated future total requirements for the Amherstview WPCP.

Future Needs

Cost estimates to service future industrial lands will be highly dependent on location and the proposed zoning conditions and as such, are not included in this memorandum.

Private Process Water and Fire Suppression System

The existing pumping station and distribution piping at Taylor-Kidd Industrial Park is located almost exclusively on private property. Most of the piping was constructed in the 1960s or early 1970s and is approaching replacement age. The pumping station's mechanical equipment has been recently refurbished. The condition of the Lake Ontario intake is unknown. Some of the lands on the former Invista property are registered as contaminated sites, adding a level of complication if the mains are to be replaced using conventional construction methods.

The Ontario Fire Code (Province of Ontario, 1997) states in clause 6.6.1.1:

> "Private and public water supplies for fire protection installations shall be maintained to provide the required flow under fire conditions".

Essentially, the property owner is responsible for maintaining adequate fire protection. The process and fire suppression water system is a necessary infrastructure element for the large industries who depend on it. This water system will require expensive retrofits in the foreseeable future and could be a potential liability were the municipality required to assume its operation and/or ownership.

Use of this privately-owned system results in the duplication of water piping infrastructure in the immediate vicinity. The existing system is approaching the timeframe for pipe replacement due to age. A future option for consideration may be the municipality being in a position to build it storage reservoir that would make the local distribution system capable of increased fire suppression capability and thus be in a position to replace the private system. It is likely that a major portion of a project of this type would require the financial support of the benefitting industries.

Climate Lens

If the Township is hoping to maintain industrial growth, it is important that environmental impacts of this growth are carefully considered. When planning and identifying new industrial lands, it is important to consider natural assets. Green infrastructure and natural assets are crucial in both mitigating and adapting to climate change. Protecting these assets through careful planning will allow for growth while maintaining climate resiliency.

When considering servicing options in the future it will be necessary to examine how self-servicing lots may impact the surrounding environment, in comparison to connection to the municipal systems. Along with the cost and feasibility of each type of servicing, the environmental impact should also be evaluated.

Linkages

The technical memoranda regarding growth in the Loyalist East Sewage Service Area and the costs of expanding capacity of the Amherstview WPCP will shed more light on the sanitary sewage expansion discussion.

References

Corporation of Loyalist Township. (2011). *By-law 2011-098, a By-law Respecting Sewer Use in Loyalist Township.* Retrieved from Loyalist Townsh9p: https://loyalist.civicweb.net/filepro/document/37279/2011-098%20-%20Sewer%20Use%20By-law.pdf

Corporation of Loyalist Township. (2019). *By-law No. 2019-099, a By-law Establishing Fees and Charges to Pay for the Capital Cost of Water Works and Sewage Works in the Fairfield Water Service Area, Loyalist East Sewage Service Area and Bath Service Area.* Retrieved from Loyalist Township: https://loyalist.civicweb.net/filepro/documents/?preview=134253

Municipal Engineers Association. (2023). Appendix 1 - Project Schedules. In M. E. Association, *Municipal Class Environmental Assessment.*

Province of Ontario. (1997). *O. Reg. 213/07: Fire Code.* Retrieved from Province of Ontario: https://www.ontario.ca/laws/regulation/070213

Province of Ontario. (2013). *Environmental Noise Guideline - Stationary and Transportation Sources - Approval and Planning (NPC-300)*. Retrieved from Province of Ontario: https://www.ontario.ca/page/environmental-noise-guideline-stationary-and-transportation-sources-approval-and-planning

Watson & Associates Economists Ltd. (2023). *Growth Analysis and Urban Land Needs Report, County of Lennox & Addington.*

Recommendations

It is recommended that Loyalist Township prioritize processes leading to the establishment of more land zoned appropriately for medium and large industrial expansion.

IMP Technical Memorandum: Potable Water Regulatory Issues

Asset Class: Water

Objective: The purpose of this memorandum is to bring attention to various regulation-related topics and emerging issues that may impact the operations and physical needs of the potable water system within Loyalist Township.

Background

Loyalist Township's two drinking water systems are owned and operated by the corporation. These systems are governed by various legislation overseen by the Ontario Ministry of the Environment, Conservation and Parks (MECP). The provincial objectives are safety and quality.

In general the same regulatory issues apply to each system, but impacts may vary based on local characteristics of each system.

Provincial requirements include:

- registering all municipal drinking water systems
- licensing system owners/operators
- authorizing operators to run and maintain drinking water systems
- issuing drinking water works permits to modify, repair, or extend drinking water systems

Every owner and operator of a drinking water system must ensure that:

- the system's water meets Ontario's Drinking Water Quality Standard
- anyone who operates or works on their system is properly trained and licensed
- drinking water tests are done by licensed, accredited laboratories
- adverse test results are reported to MECP and the local Medical Officer of Health

Provincial standards for water quality are set out in the S*afe Drinking Water Act* (Province of Ontario, 2002), Ontario Regulation 169/03 for drinking water quality standards (Province of Ontario, 2002); and Ontario Regulation 170/03 for drinking water systems (Province of Ontario, 2002).

Responding to new regulatory requirements can affect the municipality by requiring increased operational staff effort, increased costs related to monitoring equipment, physical improvements to infrastructure, and potential increases in energy and/or chemical demands for the system, primarily at the treatment stage.

The Sustainable Water and Sewage Systems Act (Province of Ontario, 2002) outlines framework for implementing full-cost accounting to ensure the long-term sustainability of municipal water and wastewater systems. The Act requires municipalities to assess the costs of water and wastewater systems, and to develop plans to charge appropriate rates and generate sufficient revenue to finance and/or lower operating costs of sanitary and water systems.

Loyalist Township is required to maintain an extensive sampling and monitoring program of water quality parameters as per provincial requirements.

No incidents of adverse water quality indicators (AWQI) were reported in 2022. The Township's drinking water annual summary report stated, "To the best of our knowledge, both drinking water systems are in compliance with all regulatory requirements of the Drinking Water Works Permit, Municipal Drinking Water License, Permit to Take Water, Safe Drinking Water Act and its regulations." (Loyalist Township, 2023) The report provides detailed results.

Ontario's potable water regulatory requirements often closely track amendments to American water quality regulations. The American Water Works Association (AWWA) is an excellent industry source of information in this regard.

Assumptions

The discussions included in memorandum are based on the flow projections presented in other technical memoranda in this IMP document.

Methodology

Information from this memorandum was gained from:

- Related literature reviews, webinars, etc.
- Interviews with Township's Utilities Compliance Supervisor, senior operations and utility administration staff, and engineering support staff
- Review of the annual reports for the Bath and Fairfield water systems

Analysis

The following outlines regulatory issues that staff expect to impact the Township's treatment and supply of potable water in the future.

Trihalomethanes (THM) and Haloacetic Acids (HAA)

THM and HAA are disinfection process by-products and are currently used as indicator chemicals for all potentially harmful compounds formed by the addition of chlorine to water. The level of THM and HAA in treated water depends on numerous factors including total organic carbon, temperature, pH, chlorination dose, and residency time in the distribution system.

THM and HAA have increased in the past year and are sometimes just below the maximum allowable concentration (MAC). Staff are optimizing the chlorination systems and flushing every section of the system on a regular basis, and these efforts have assisted in reducing concentrations overall within the past years.

It has also been demonstrated that changes in acidity levels (pH) influenced by the disinfection chemicals in the distribution system can result in the release of THM, HAA, and other undesired substances from the biofilm that congregates on pipe walls over time.

If the Township cannot maintain safe, compliant levels of THM and HAA, the methods of disinfection, storage, and watermain maintenance will need to be modified.

Any future changes to the disinfection processes should only be activated after careful consideration of the impacts on system wide THM and HAA.

The filter effluent turbidity for both drinking water systems did not exceed the limits of Ontario's Drinking Water Quality Management Standard (DWQMS) (Province of Ontario, 2017). All regulated physical, microbiological, inorganic, and organic chemical parameters tested in 2022 were well below the limits and/or MAC.

Turbidity

Turbidity is defined as the cloudiness of the water caused by suspended matter and is an important measure of filter performance. Its measurement is expressed in nephelometric turbidity units (NTU). Water becomes "cloudier" as the NTU increase. Turbidity in the water interferes greatly with the disinfection process, as the particles causing high turbidity can shield or entrap disease-causing organisms, making it difficult for the disinfectant to reach and destroy them. The filter performance criteria for membrane filtration (Fairfield and Bath) is ≤ 0.1 NTU in 99% of all turbidity readings taken over the course of one month.

Both the Fairfield and Bath Water Treatment Plants utilize membrane filtration that yields a dependable low-turbidity, high-quality effluent. This type of filtration is very sensitive to sustained periods of high levels of turbidity, as observed at the Bath Water Treatment Plant (WTP) occasionally and much more frequently than similar events at the Fairfield WTP. The intake for the Bath Water plant is located close to shore, and in relatively shallow water. A preliminary review of existing mapping indicates that an extension of the plant's intake pipe of 300-400 metres would be required to reach water depths comparable to the Fairfield intake.

The high turbidity incidents at Bath have caused some operational stresses, and staff continue to look at various options to deal with the problem. In the long term, consideration of extending the intake may be an option if satisfactory treatment cannot be maintained at the plant during the periods of extreme turbidity.

Algal Blooms

Over the past decade there has been increased focus on the harmful impacts of some algal blooms.

Blue-green algae are microscopic, plant-like organisms that occur naturally in ponds, rivers, lakes, and streams. They are not normally visible in the water, but populations can rapidly increase to form a large mass or scum, called a bloom, when conditions are favourable. Blooms most commonly occur in late summer and early fall. They thrive in areas where the water is shallow, slow-moving, and warm, but they may be present in deeper, cooler water.

One key factor in the growth of blue-green algae is the availability of contributing nutrients such as phosphorus and nitrogen. Blue-green algal blooms can be caused by agricultural and stormwater runoff as well as leachate from septic systems. In Ontario, phosphorus tends to be the nutrient that influences the growth of algae.

At both treatment plants, visual monitoring for harmful algal blooms at/near the source water intake(s) was conducted 3 times per week during the seasonal warm period (May through October) in 2022. Raw and finished water for both drinking water systems were sampled monthly for Microcystin L-R at both treatment plants during the same period. In August and September, Microcystin L-R was detected in the raw water of the Fairfield Drinking Water System but reported to be well below half the limit stated in the DWQS. Weekly sampling was started until three consecutive raw water samples were below the quantification limit, in accordance with the implemented Harmful Algal Bloom Plan and the drinking water license. For the Bath treatment plant, Microcystin L-R was detected above the limit of quantification but remained below half the DWQMS in the raw water in August 2022. Weekly sampling occurred until three consecutive sample results came back below the limit of quantification. The treatment process of both plants performed well, and concentrations determined in treated water were below the limit of quantification. The DWQMS was met at all times.

PFAS Substances

Per- and polyfluoroalkyl substances (PFAS) are a group of several thousand man-made chemicals. These chemicals are known for their negative effects on human and environmental health. PFAS were developed and used in a variety of household commercial and industrial products and are known as “forever chemicals”, due to the slow rate of breakdown of these substances in a natural environment.

Canadians have had direct exposure to PFAS, with levels of these substances in both human blood and drinking water having been observed broadly.

PFAS regulatory control is in transition. Currently very limited control is in place, but new regulatory standards are being developed. In 2021 the federal government issued a notice of intent to address the broad class of PFAS substances. In May 2022, the Government of Canada released new proposed regulations (Government of Canada, 2022) regarding prohibition of certain toxic substances, which would replace a 2016 toxic substances regulation currently in effect (Government of Canada, 2022) and eliminate the various exceptions allowing the use, sale, or import of PFAS in Canada. Similar attention is being paid to PFAS by the Environmental Protection Agency in the

United States. On May 19, 2023, Environment and Climate Change Canada issued a notice that they have initiated a major review of PFAS-related substances, with the intent of introducing regulations aimed at reducing exposure to PFAS, including drinking water and exporting of biosolids (Government of Canada, 2023). The notification includes more specifics on the proposed federal PFAS action plan.

Most municipalities, including Loyalist Township, have little-to-no sampling data recording PFAS in their drinking water systems. This makes it difficult assess the impacts that new regulations may have on the Township’s drinking water treatment requirements.

Early investigations suggest that activated carbon filtration may be an efficient method of managing PFAS found in raw water.

It is recommended that Loyalist Township staff monitor provincial and federal progress on the development of standards and regulations for PFAS substances.

Legionella

Legionella is a type of bacteria that can cause a serious type of pneumonia known as Legionnaires disease. Recognition of this bacteria as a health concern associated with plumbing is relatively new.

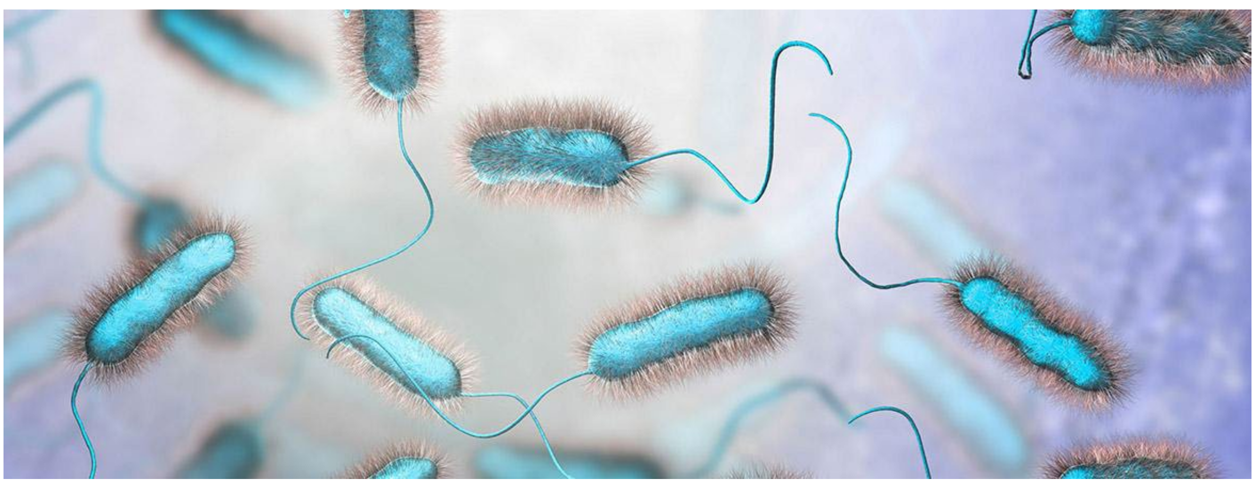


Figure 1 Legionella bacteria

Legionella bacteria are found both in natural water environments and can grow in human-made water systems such as plumbing, cooling towers, hot tubs, showers, and decorative fountains. Breathing in small droplets of vapour of contaminated water can cause mild infection or Legionnaires’ disease. In Ontario Legionella infections were observed to be higher in the Greater Toronto area. For the year 2018 infections were reported by Kingston, Frontenac, Lennox & Addington Public Health of having an incident rate of 1.39-2.78 cases per 100,000 (Public Health Ontario, 2019).

It appears that normal municipal disinfection processes, i.e., maintaining free chlorine levels greater than 0.5 mg/litre in the municipal piping, will control Legionella (U.S.

Department of Health and Human Services, 2021). Concerns are primarily with plumbing systems especially where water is allowed to stagnate. A routine sampling program to monitor for Legionella is recommended.

Like many bacterial pathogens, Legionella usually has the greatest impact on the very young, very old, or immune-depressed individuals.

Other Regulatory Compounds

In general, water quality for most other parameters from the Township's Lake Ontario source locations is consistently good.

All nitrate and nitrite concentrations were well below the established limits in 2022.

Yearly sampling of specific inorganic and organic parameters in a treated water sample is required by Schedules 23 and 24 of O.Reg. 170/03. All inorganic and organic parameters were well below the limit and all parameters were far below of the half of the standard prescribed by the DWQS.

The Fairfield and Bath Drinking Water Systems have qualified for reduced sampling of lead in residential plumbing and the distribution system, as samples collected in previous years indicated that lead concentrations did not pose a risk to public health under the DWQMS. All lead samples taken in 2020 met the criteria of the DWQMS. However, it may be anticipated that regulated allowable lead levels may be reduced, following recent moves by U.S. authorities. With most of Loyalist's system being comparatively new and thus largely developed after the common use of lead components, there are very few sources of lead in the municipal system. However, lead plumbing may exist within older homes and commercial/industrial facilities.

The pH and alkalinity of the samples taken in 2022 were within the range of the objectives and guidelines.

Tests for hardness, dissolved organic carbon (DOC), conductivity, total Kjeldahl nitrogen (TKN), ammonia/ammonium, colour, and temperature on raw and finished water are also conducted on a daily or quarterly basis at Bath and Fairfield WTP. The types and frequency of sampling are informed by recommendations from the Engineer's Report, operational experience, and specific treatment needs. A small amount of an aluminum derivative is used as coagulant for the Bath membrane filtration. The residual concentration of aluminium in the finished water is measured to keep the concentration below a level that could cause an adverse effect in the distribution system, such as coating of pipes and flocculation. According to the Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (Province of Ontario, 2003, Revised 2006) and Health Canada's guideline (Government of Canada, 2021), the treatment process should be optimized to reduce the residual to below 0.1 mg/L. The aluminum residual was well below this limit.

Source Water Protection

The Clean Water Act (Province of Ontario, 2006) is part of a multi-barrier approach to ensure clean, safe, and sustainable drinking water for Ontarians, by protecting sources of municipal drinking water such as lakes, rivers, and wells. The drinking water source protection program was developed under this legislation and lead to the development of local sourcewater protection plans. Sourcewater protection plans contain policies that either recommend or require action be taken to address activities identified as threats to drinking water sources. These policies assist in restricting only safe land uses within a drinking water source zone, but at this time have permitted some existing non-conforming activities which have potential risk for drinking water systems.

Loyalist Township is required to complete a drinking water risk assessment on an annual basis.

Based on discussions with MECP staff it is expected that the provincial government will be requesting more protective action.

Items such as fuel storage for emergency generators at sewage pumping stations, gas stations, and other liquid fuel sources within the protection zones are potential risks. Use of road salt for winter road maintenance is also an identified risk. The use of monitoring plans is strongly encouraged.

It is recommended that Loyalist Township identify drinking water risks in the source protection zone and develop plans that will:

1. Eliminate source water risks for facilities it owns
2. Develop programs to assist private property owners reduce their potential for source water contaminations.

Another potential threat is the release, either intentional or unintentional, of pollutants into the natural environment and conveyed by the municipal stormwater system or the sanitary sewer system. The Township would benefit from a detailed review of its sewer use by-law and related by-laws, with the objective of bringing these instruments up to current standards, including the strengthening of sourcewater protection elements.

Monitoring and Data Retention Systems

Much of the safety element necessary for administering the Township's potable water system relies on effective monitoring of sampling data. The sources of this data vary greatly and include flow data and volumes, frequency, date of sampling, physical condition assessments, and geographic location. Within the treatment plants, much of the flow, equipment status, energy demand, and automatic sampling data is stored in the supervisory control and data acquisition (SCADA) systems. Information from external sources and distribution system data are maintained in multiple locations. The Township would benefit by evaluating its data needs and operational needs and developing, maintaining, and continually improving a modern data collection and storage plan for the Utilities Division. This plan would include the use of electronic field data entry devices appropriate for the activity. Expanding this process to include stormwater data should also be undertaken considering the similarity in licensing and infrastructure types for storm and sanitary sewers systems. In this scenario Utilities staff would work closely with GIS and Engineering staff to develop a process to satisfy operational, financial (asset management), and regulatory requirements.

Emerging Planning Policies

Currently the Province of Ontario is working to modify planning and zoning requirements regarding residential units to address housing affordability and availability concerns. Two potential modifications, being increased densification and easier access to secondary units, have the potential to increase water demand. Currently, long-term planning for water demand has been based on new units only. Going forward, the municipality will need to recognize two streams: new units, and density changes in existing communities. Current by-law requirements include the need for a meter for each unit. With secondary units the requirements of installing, maintaining, and billing for a secondary unit may not be worthwhile when all factors are considered.

Financial

At the time of writing this memorandum there are no immediate regulatory issues that necessitate an infrastructure project. The ongoing periods of occasional high turbidity at the Bath WTP are being dealt with through operations and contractual warranties.

Climate Lens

As outlined above, the MAC for THM in drinking water is 0.100 mg/L (100 ug/L) based on a running annual average of a minimum of quarterly samples taken at the point in the distribution system with the highest potential THM levels. The decomposition of organic matter decreases with an increase in temperature; therefore, organic matter is expected to increase in surface water because of increased water temperatures affected by climate change (Valdivia-Garcia, Weir, Graham, & Werner, 2019). Increased organic matter in the surface water sources for the Fairfield and Bath water treatment systems will therefore result in an increase in the formation of THMs due to the disinfection of the source water using chlorine.

HAAs, being a by-product of chlorine disinfection, are produced when the chlorine reacts with naturally occurring organic matter in the water. Given that it is expected that organic matter will increase with an increase in water temperature, an increase in the production of HAA is likely to occur at the Fairfield and Bath water treatment plants.

Legionella bacteria are normally present in lakes or streams, but they can colonize and increase in man-made water reservoirs including potable water systems. Increased organic matter in source water will result in an increase in legionella species (Morey, 2010).

Linkages

Bath WTP Projections Technical Memorandum
Fairfield WTP Projections Technical Memorandum

References

Government of Canada. (2019, March). Guideline Technical Document - Lead. In H. Canada, *Guidelines for Canadian Drinking Water Quality.*

Government of Canada. (2021). Guideline Technical Document - Aluminum. In H. Canada, *Guidelines for Canadian Drinking Water Quality.*

Government of Canada. (2022, May 14). *Prohibition of Certain Toxic Substances Regulations, 2022 [Proposed]* . Retrieved from Government of Canada: https://pollution-waste.canada.ca/environmental-protection-registry/regulations/view?Id=2175

Government of Canada. (2022, March 8). *Regulations Amending the Prohibition of Certain Toxic Substances Regulations, 2012 (the 2016 Amendments)*. Retrieved from Government of Canada: https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/prohibition-certain-toxic-substances-regulations-questions.html

Government of Canada. (2023, May 19). *Government of Canada taking next step in addressing "forever chemicals" PFAS*. Retrieved from Government of Canada: https://www.canada.ca/en/environment-climate-change/news/2023/05/government-of-canada-taking-next-step-in-addressing-forever-chemicals-pfas.html

Loyalist Township. (2023). *2022 Drinking Water Quality Report.*

Morey, P. R. (2010). *Climate Change and Potential Effects on Microbial Air Quality in the Built Environment.* U.S. Environmental Protection Agency.

Province of Ontario. (2002). *O. Reg. 169/03: Ontario Drinking Water Quality Standards*. Retrieved from Ontario: https://www.ontario.ca/laws/regulation/030169

Province of Ontario. (2002). *O. Reg. 170/03: Drinking Water systems*. Retrieved from Province of Ontario: https://www.ontario.ca/laws/regulation/030170

Province of Ontario. (2002). *Safe Drinking Water Act, 2002, S.O. 2002, c. 32*. Retrieved from Province of Ontario: https://www.ontario.ca/laws/statute/02s32

Province of Ontario. (2002). Sustainable Water and Sewage Systems Act.

Province of Ontario. (2003, Revised 2006). *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines.*

Province of Ontario. (2006). *Clean Water Act*. Retrieved from Province of Ontario: https://www.ontario.ca/laws/statute/06c22

Province of Ontario. (2017). *Ontario's Drinking Water Quality Management Standard - Pocket Guide*. Retrieved from Province of Ontario: https://www.ontario.ca/page/ontarios-drinking-water-quality-management-standard-pocket-guide

Public Health Ontario. (2019). *Epidemiologic Summary: Legionellosis in Ontario, January 1, 2018 to December 31, 2018.*

U.S. Department of Health and Human Services. (2021). *Toolkit for Controlling Legionella in Common Sources of Exposure.* Centers for Disease Control and Prevention.

Valdivia-Garcia, M., Weir, P., Graham, D. W., & Werner, D. (2019). Predicted Impact of Climate Change on Trihalomethanes Formation in Drinking Water Treatment. *Scientific Reports*.

Conclusions

The last few decades have seen improvements in treatment, sampling, and analysis capabilities, and increased concern on the forces that cause environmental degradation. The regulatory agencies can be expected to respond to these changes and update the regulatory framework accordingly. In turn the Township will need to analyze its requirements from time to time and update its processes and procedures. Currently the greatest concerns for Loyalist Township are:

- Staying abreast of THM and HAA concerns
- Source water protection requirements, and
- High turbidity events that impact the Bath WTP

Recommendations regarding regulatory concerns are:

1. That any future changes to disinfection processes should only be activated after careful consideration of the impacts on system-wide THM and HAA.
2. That Loyalist Township staff monitor MECP and federal progress on the development of standards and regulations for PFAS substances.
3. That Loyalist Township identify drinking water risks in the source protection zone and develop plans that will:
   i. Eliminate sourcewater risks for facilities that it owns.
   ii. Develop programs to assist private property owners reduce their potential for sourcewater contaminations.
4. That Loyalist Township complete a detailed review of its sewer use by-law and related by-laws to bring these instruments up to current standards, including the strengthening of sourcewater protection elements.
5. That Loyalist Township evaluate its data and operational needs, and then develop and maintain a data collection/storage plan for the Utilities Division. This plan would include the use of modern field data entry devices appropriate for the activity and would include processes leading towards continuous improvement of

the plan. Expanding this process to include stormwater should also be undertaken considering the similarity in licensing and infrastructure types for stormwater and sanitary sewer systems.

6. That the Township closely monitor trends in density changes including secondary unit consumption and modify Township policies accordingly.

IMP Technical Memorandum: Sanitary Sewage Regulatory Issues

Asset Class: Sanitary Sewage

Objective: The purpose of this memorandum is to bring attention to various regulatory related topics and emerging issues that may impact the operations and physical needs of the sanitary sewage system within Loyalist Township.

Background

Loyalist Township's two sanitary sewage systems are owned and operated by the corporation. These systems are governed by various legislation, overseen primarily by the Ontario Ministry of the Environment, Conservation and Parks (MECP). The provincial objectives are public safety and protection of the natural environment. There are also federal requirements for sanitary systems.

Provincial requirements include:

- Registering all municipal sanitary sewage systems
- Licensing system owners/operators
- Authorizing operators to run and maintain sanitary sewage systems
- Issuing sewage works permits to modify, repair, or extend drinking water systems
- Ensuring that municipal sanitary sewage systems do not impact the natural environment
- Oversight through established monitoring and reporting requirements

Federal requirements include:

- Protecting the environment and human health
- Setting effluent quality standards
- Monitoring, reporting on effluent quality and quantity, and record keeping
- Reporting exceedances, spills, and by-passes

Assumptions

The discussions included in this technical memorandum are based on the flow projections outlined elsewhere in the IMP technical memoranda.

Methodology

Information from this memorandum was gained from:

- Related literature reviews, webinars, etc.
- Interviews with the Township's Utilities Compliance Supervisor, senior Utilities operations administration staff, and Engineering support staff
- Review of annual reports for the Bath and Loyalist East Sanitary Sewage Systems

Analysis

The regulatory framework for municipal sanitary sewage systems is in the latter stages of a major transition with recent changes to the regulations under the Ontario Water Resources Act (Province of Ontario, 1990).

The Ontario Water Resources Act regulates sewage disposal and sewage works and prohibits the discharge of polluting materials, focusing on the protection of groundwater and surface water.

The Environmental Protection Act (Province of Ontario, 1990) prohibits discharge of any contaminants into the environment that cause or likely to cause adverse effects this act also requires that any spills of pollutants are reported and cleaned up properly.

The Sustainable Water and Sewage Systems Act (Province of Ontario, 2002) outlines framework for implementing full cost accounting to ensure long term sustainability of municipal water and sanitary sewage systems. This legislation requires municipalities to assess the costs of water and sanitary sewage systems and to develop plans to charge appropriate rates so that sufficient revenue is generated to finance and lower operating costs of water and sanitary sewage systems.

The Ministry of Agriculture and Food administers the Nutrient Management Act (Province of Ontario, 2002). This Act governs municipal activities related to the disposal of waste sludge from sanitary sewage treatment facilities, providing standards for nutrient storage and how nutrients are applied to farmland, to reduce the likelihood of ground or surface water contamination.

The federal Fisheries Act (Government of Canada, 1985) and its regulations, such as the Wastewater Systems Effluent Regulation (Government of Canada, 2012), also applies to potential pollutants that enter the natural system via treated sanitary sewage effluent.

Compliance Overview

Both Township sanitary sewage systems complied with the federal Fisheries Act in 2022.

Amherstview Water Pollution Control Plant (WPCP) - Elevated pH and e-coli concentrations (occasional exceedances)

In most circumstances effluent from Amherstview WPCP meets effluent criteria and the passive wetland is performing well.

The pH levels for the final effluent are prescribed for the Amherstview WPCP as outlined in the system’s Environmental Compliance Approval (ECA).

pH attenuation occurs as partially treated effluent flows through the natural wetland and prior to the release of final effluent to the natural environment. Monitoring indicates pH exceedances in October and November 2022. With some minor operational changes to wetland flow patterns the issue was corrected, and no additional pH incidences were recorded. The cause of the elevated pH is believed to be natural phenomena involving algal blooms and daily photosynthesis. Variations in pH and high pH can be toxic to some organisms; as such, the objective is to maintain the pH level at as neutral a state as possible.

Figure 1. Constructed wetland at Amherstview WPCP

E. coli exceedances in the final effluent took place during summer months when flows were low, and it is believed that the E. coli levels may be impacted by the wild birds that frequent the lagoons and treated wetland immediately upstream of the monitoring locations. With minor modifications to the wetland flow pattern, operations staff were able to mitigate somewhat this effect.

To permanently address the E. coli exceedances, Township staff and MECP have discussed relocating the regulated E. coli sampling location in the process, on the basis of confidence in the passive disinfection process in the lagoons. A modification of this magnitude would require an amendment to the ECA. The amendment would consist of a proposal to sample (grab sample) for E. coli at the outfall of Cell 1 and maintain all other sampling at the final effluent outfall. Testing at the final outfall would confirm that pH, total phosphorus, and related nutrients are removed from the treated sanitary sewage.

MECP advised that if increased E. coli levels are the result of wildlife activities that are beyond the control of the Township, and it can be proven that the upstream passive disinfection process is working as intended, there is no need to relocate the sampling location.

Odour Complaints

Periodically the Amherstview WPCP has received odour complaints from the public. Upon further investigation it has been established that some of the complaints are genuine while others are due to local area agricultural practices. Operations staff have reviewed operational conditions at the time of the odour complaints and have modified operations in an effort to eliminate any odour concerns. At the plant site there are multiple potential sources of odour, and these depend on various factors such as flow volumes, weather conditions, plant operational decisions, and temperature; as well as a consequence of handling waste sludge after it has been processed.

Supervisory staff are aware of these concerns and continue to look for operational improvements to minimize odour occurrences in the future.

Bath Sewage Treatment Plant (STP) - Elevated total phosphorus concentration (one exceedance)

Bath STP, due in part to its function of serving the Correctional Services of Canada's (CSC) Bath and Millhaven Institutions, is prone to sudden, unexpected high flow rates, and influent toxic to the plant's biological components that support the overall treatment process; as a result, additional monitoring is required. Additionally, the Institutions send high loadings of fats, oils, and grease (FOG), potentially from the kitchen facilities, to the sewage treatment plant and these are detrimental to the treatment process. The presence of elevated FOG levels at the facility may be favourable to organisms that create excess foam in the sanitary sewage during the treatment process, leading to poorer effluent quality.

Collectively the stresses on the Bath STP make it difficult to operate and to maintain compliance, resulting in higher operational effort. Operational adjustments have been made, to the limits of the existing equipment's ability, to address the effect of high sudden flows and toxic loadings on the treatment process. Staff have developed an action plan involving both increased maintenance and additional testing to maintain effluent quality at Bath STP (Loyalist Township, 2022).

One exceedance of the ECA was observed in January 2022 for elevated phosphorus in the final effluent after a plant upset and TSS leaving the plant. In 2022 the Bath STP met the quality limits under the federal Wastewater Systems Effluent Regulation (Fisheries Act).

Continued High Extraneous Sewage Flows

The Loyalist East Sanitary Sewage system periodically experiences high levels of extraneous flows, more so than is observed in Bath although annual extraneous flows rates are trending higher in Bath over the past few years.

A review of daily flow records reveal that the systems are impacted greatly during heavy rains which cause sewage inflow and infiltration (I&I) and low raw sewage concentrations.

Peak flow ratio is defined as the ratio equivalent to the highest annual measured daily flow, divided by the average daily flow at the point of flow measurement.

The peak flow ratio of 4.96 was the second highest recorded in the last decade, following 2021 which yielded the lowest ratio value.

A review of longer-term flow data reveals the high variance in peak flow values and the vulnerability of only using a three-year average when evaluating the capacity of the system, which is the accepted norm for current capacity analysis. Timing of a "snapshot" period can lead to erroneous conclusions.

The specific geological condition of Loyalist Township exacerbates I&I, as the limestone bedrock prevents groundwater from seeping deep into the earth and bypassing the collection piping. As a result, more groundwater can seep into any deficiencies within the piping system.

Sustained peak flow ratios in the range of the 2022 values are very problematic. Investigative work is required to identify I&I sources and have these locations repaired expediently. Diluted sewage flows lead to poor plant operation and poor effluent quality, reduced ability to accommodate growth, and increased energy and operational costs.

The province issued the consolidated linear infrastructure ECA (CLI-ECA) for sewage collection systems in September 2023, which stipulates general operational considerations, duties of owners and operating authorities and operators. The CLI-ECA requires studies to be completed within specific timeframes, such as sewer modelling, wet weather modelling, significant drinking water threat assessment, increased monitoring and record keeping activities, and the implementation of operation and maintenance manuals. When conducting the modelling and increased monitoring, data collection should be automated when possible. Performance reports are to be prepared for both collection systems on an annual basis. These must include a summary of efforts made to reduce collection system overflows, bypasses, spills, and sewage plant overflows. Establishing these models should also help to identify areas of high I&I which will feed into the I&I reduction program discussed in the Sanitary Sewage Collection Systems technical memorandum.

Sludge Quality

A review of the chemical analysis results of the sewage sludge indicate a consistently good grade of results based on current acceptable concentration limits. These limits are subject to change from time to time. The autothermal thermophilic aerobic digestion (ATAD) process at the Amherstview WPCP has demonstrated that it can produce a quality sludge that can be safely used in many applications. When a high temperature is maintained in the ATAD for a minimum of 10 days, pathogens are destroyed. This gives results in a product that can meet the MECP's Non-Agricultural Source Material (NASM) CP1[1] biosolids pathogen requirements (Province of Ontario, 2002). There is an opportunity to reduce site costs if the sludge quality can demonstrate that it meets the CP1 requirements consistently, increasing the opportunities for disposal of this material. The sludge quality at Bath STP has higher E. coli and nutrient levels than that of Amherstview WPCP, due to the digestion process that is used at the plant. This lower class of sludge limits the opportunities for disposal, a point to consider for future plant upgrades.

The American Water Works Association (AWWA) has noted that random sampling for per- and polyfluorinated substances (PFAS) in sludge from filtration processes indicates that the PFAS is concentrated in the sludge. The association cautions that as PFAS regulatory limits are implemented, there may be impacts on how sanitary sewage treatment sludge is managed. Staff should be prepared for regulatory changes for PFAS, as well as any other emerging contaminant.

Sewer Use and Sewage Works By-laws

The Township's by-laws should be updated to reflect current topics and parameters of concern. The use of automatic fines instead of laying a charge should be promoted within the Township. Procedures could employ occasional inspections and monitoring to ensure compliance with the by-laws.

Monitoring and Data Retention Systems

Much of the public safety and environmental protection elements necessary for administering the Township's sanitary sewage system relies on effective monitoring of sampling data. The source of this data varies greatly; and includes flow data and volumes, frequency, date of sampling, varying nutrient loadings, physical condition assessments, weather related factors, and geographic location. In the treatment plants much of the flow, equipment status, energy demand, and automatic sampling data is stored in the SCADA systems. Information from external sources and distribution system data are maintained in multiple locations. The Township would benefit by evaluating its data needs and developing, maintaining, and continually improving a modern data collection and storage plan for the Utilities Division. This plan would include the use of electronic field data entry devices appropriate for the activity. Expanding this process to include stormwater data should also be undertaken, considering the similarity in licensing and infrastructure types for storm and sanitary sewer systems. In this scenario Utilities staff would work closely with GIS and Engineering staff to develop a process that satisfies operational, financial (asset management), and compliance requirements.

Financial

[1] Equivalent to United States Environmental Protection Agency's Class A

Financial implications of plant improvements are discussed in the respective technical memoranda assessing the treatment plants.

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the needs related to sanitary sewage regulatory issues in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season which could lead to process upsets and increased odour concerns (ICLEI, 2021).
- Annual precipitation is expected to increase, increasing the amount of I &I. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase. This will also increase the risk of high I&I (ICLEI, 2021).

Recommended projects related to sanitary sewage regulatory concerns include the following:

- Working to reduce I&I throughout the collection system
- Update sewer by-laws and policies to better protect the sanitary system
- Focus on operational strategies and training that prove effective in managing odours that are developed on the site
- Work with CSC to reduce the factors in their contributing flows that affect sanitary sewage effluent quality

The projects highlighted above will help staff adapt to the impact climate change will have on the Township sanitary systems. As highlighted above, climate change will likely result in higher I&I, process upsets, and odour concerns. It is important that Loyalist Township is prepared to adapt to these changes so that the sanitary system continues to function in an effective and efficient manner.

Linkages

Sanitary Sewage Collection Systems Technical Memorandum

Amherstview WPCP Needs Assessment Technical Memorandum

Bath STP Needs Assessment Technical Memorandum

Sludge Management Options Technical Memorandum

References

Government of Canada. (1985). *FIsheries Act (R.S.C., 1985, c. F-14).* Retrieved from https://laws-lois.justice.gc.ca/eng/acts/f-14/

Government of Canada. (2012). *Wastewater Systems Effluent Regulations, SOR/2012-139.* Retrieved from https://laws-lois.justice.gc.ca/eng/regulations/sor-2012-139/fulltext.html

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Loyalist Township. (2022). *2022 Annual Report - Sewage Treatment Plants.*

Province of Ontario. (1990). *Environmental Protection act, R.S.O. 1990, c. E.19.* Retrieved from https://www.ontario.ca/laws/statute/90e19

Province of Ontario. (1990). *Ontario Water Resources Act, R.S.O. 1990, c. O.40.* Retrieved from https://www.ontario.ca/laws/statute/90o40

Province of Ontario. (2002). *Nutrient Management Act, 2002, S.O. 2002, c. 4.* Retrieved from https://www.ontario.ca/laws/statute/02n04

Province of Ontario. (2002). *O. Reg. 267/03 under Nutrient Management Act, 2002.* Retrieved from https://www.ontario.ca/laws/regulation/030267/v12

Province of Ontario. (2002). *Sustainable Water and Sewage Systems Act, 2002, S.O. 2002, c. 29 - Bill 175.* Retrieved from https://www.ontario.ca/laws/statute/s02029

Recommendations

It is recommended that increased resources be applied to the reduction of inflow and infiltration (I&I) within the municipal sanitary sewer systems.

It is recommended that staff continue to work with representatives from CSC in an effort to reduce peak flow variation, FOG content, and toxic loadings from sanitary sewage flows originating from the Millhaven and Bath Institutions.

It is recommended that staff continue to monitor odour conditions at the Amherstview WPCP and develop SOPs that focus on operational strategies, and training that prove effective in managing the odours that originate from the site.

It is recommended that Loyalist Township update its sewer use and sewer works by-laws, to ensure the by-laws give staff the tools to reduce negative impacts to the Townships sanitary sewer system.

It is recommended that Loyalist Township evaluate its data and operational needs and develop and maintain a data collection and storage plan for the Utilities Division. This plan would include the use of modern field data entry devices appropriate for the activity, as well as processes leading to continuous improvements of the plan. Expanding this process to include stormwater should also be considered due to the similarity in licensing and infrastructure types for storm and sanitary sewer systems.

IMP Technical Memorandum: Biosolids Management and Storage

Asset Class: Sanitary

Objective

The objective of this technical memorandum is to provide an assessment of the sludge digestion processes at both Bath Sewage Treatment Plant (STP) and Amherstview Water Pollution Control Plant (WPCP). Based on this assessment, alternatives to manage and store projected future sludge production are presented.

Background

The IMP growth technical memorandum projects a population increase of 30% in the Township between 2021 and 2046. This will inevitably create an increase in demand for sanitary sewage treatment.

The sanitary sewage treatment system in Loyalist Township consists of two treatment plants: Bath STP which services the community of Bath and Correctional Services of Canada (CSC) facilities; and Amherstview WPCP which services the communities of Amherstview and Odessa and the Loyalist East Business Park. A needs assessment has been conducted for each plant to determine what upgrades will be required to meet future capacity. These assessments have determined that there are sludge digestion and biosolids storage needs to be addressed.

Assumptions

The following assumptions were made when developing these documents:

- The current capacity and future needs of each process unit at Bath STP are based on the assessment outlined in the Bath STP Needs Assessment Technical Memorandum.
- The current capacity and future needs of each process unit at Amherstview WPCP are based on the assessment outlined in the Amherstview WPCP Needs Assessment Technical Memorandum.

Methodology

To assist the Township in developing a plan for biosolids management and storage, RVA undertook an evaluation of potential alternatives and has presented their recommendations in two technical memoranda.

Additionally, Township staff involved with water and sanitary sewage operations have provided input with respect to plant deficiencies and operational.

Data Sources

The data used to develop the figures presented in these documents were obtained from the plant projections memos included in the IMP, as well as sanitary sewage flow data from 2015 to 2021.

Analysis

Sludge Digestion

A desktop capacity assessment was conducted for the sludge digestion processes at both Bath STP and Amherstview WPCP, using projected average flows for 2046. This involved evaluating several alternatives to manage future sludge production and biosolids storage. The evaluation determined that there is excess capacity at Amherstview WPCP, whereas Bath STP is lacking in digestion capacity.

Table 1 Sludge digestion capacity of Amherstview and Bath treatment plants

Location	Maximum Digestion Capacity (kg/d)	Projected Solids Production (kg/d)	Excess Capacity (kg/d)
Amherstview WPCP	1,700	733	967
Bath STP	257	372	-115

Based on this analysis it was determined that sludge could be hauled from Bath STP to Amherstview WPCP to use the excess capacity there. Four options were evaluated to identify the best option to handle sludge at Bath STP:

- Alternative 1: Digestion of only excess Bath STP sludge at Amherstview WPCP
- Alternative 2: Digestion of all Bath STP sludge at Amherstview WPCP
- Alternative 3: Convert Amherstview WPCP’s ATAD unit to an aerobic digester and digest only excess sludge from Bath STP
- Alternative 4: Convert Amherstview WPCP’s ATAD unit to an aerobic digester and digest all sludge from Bath STP

After initial evaluation, it was determined that converting the ATAD unit to aerobic digesters would not be desirable for the following reasons:

- Requires large and costly capital upgrades
- Energy savings are diminished as sludge production grows
- Class A biosolids would no longer be produced

Due to this, Alternatives 3 and 4 are not recommended and will not be discussed further.

Alternatives 1 and 2 offer similar benefits to the Township in terms of sludge handling. To determine the recommended alternative a net present value (NVP) analysis was conducted.

Table 2 Net present value of Bath STP sludge management alternatives

Parameter	Alternative 1	Alternative 2
NPV to 2046	$7.50 M	$8.90 M

Based on the current results from the NPV analysis, along with recommendations from operations staff, it has been determined that Alternative 1 - Digestion of Excess Bath STP Sludge at Amherstview WPCP, is the best option to manage the sludge from Bath STP. However, RVA recommends that updated polymer and hauling costs be obtained for a more accurate comparison of the NPV between Alternatives 1 and 2. Depending on these costs, it may be more desirable to haul all sludge to Amherstview WPCP. Loyalist Township plans to conduct a pilot study hauling excess sludge from Bath the Amherstview WPCP. The results from this study will help to inform the preferred solution moving forward. These sludge handling options were also considered in conjunction with the biosolids storage options at Amherstview WPCP. This additional consideration, along with the associated costs, is outlined below.

Biosolids Storage

Biosolids produced at Amherstview WPCP are stored in a biosolids lagoon and are periodically pumped and hauled away by a third party contractor. Exposed to precipitation, the stored biosolids become more dilute than what the ATAD produces, meaning more hauling loads are needed to reduce the volume. Biosolids storage and dewatering options have investigated with the aim of reducing the amount of hauling required. These options also consider Alternative 1 and 2 for Bath STP's sludge management.

Alternative 1 – Liquid Biosolids Storage at the Amherstview WPCP: Construction of an above grade tank to store biosolids. The tank would be equipped with decanting pipes and a mixing pump.

Alternative 2 – Biosolids Dewatering and Storage at the Amherstview WPCP: Installation of a rotary press to dewater the biosolids to 25%. A cake storage building would be constructed on site.

Table 3 Biosolids Storage Options at Amherstview WPCP

Alternatives	Advantages	Disadvantages
Alternative 1	• Reduction in biosolids volume (50%) • Avoid on-going cleanout of storage lagoon • Minimal operating costs • Simplified biosolids truck loading	• Volume of biosolids is still greater than with a dewatering and storage system • Greater capital costs than a dewatering system

Alternative 2	• Reduction in biosolids volume (90%) • Fewer trucks to haul biosolids • Lower upfront capital costs • Avoid on-going cleanout of storage lagoon	• Required loading of trucks via telehandler • Filtrate from dewatering process has a greater impact on the plant (shown to be minimal through modelling) • Additional equipment and operations

The NPV for each of these storage alternatives was determined, along with the base case of using the lagoons. The sludge digestion alternatives of hauling excess sludge or hauling all sludge from Bath STP were also evaluated with the storage options.

Table 4 Net present value of biosolids storage alternatives combined with Bath STP sludge management options

Storage Option	NPV (CAD)	
	Excess Sludge to AWPCP	All Sludge to AWPCP
NPV – Alternative 1	$12,240,000	$13,940,000
NPV – Alternative 2	$12,300,000	$13,510,000
NPV – Base Case	$10,250,000	$11,210,000

It was noted that although the NPV of the Base Case is lower than Alternative 1 and 2, the value is very sensitive to the solids content in the lagoon. This means that the NPV value would change significantly with a small change in solids content, which could be caused by precipitation. Due to this sensitivity the Base Case was not recommended for use as a future storage option.

The financial differences between Alternative 1 and Alternative 2 are marginal. Due to the similarity in cost, it was recommended that staff consider the greenhouse gas (GHG) emissions related to each alternative. Alternative 2 – dewatering and storage, significantly reduces the amount of hauling required, which will reduce the amount of GHG emissions.

Based on this, hauling excess sludge from Bath STP, along with Alternative 2 – Biosolids Dewatering and Storage at the Amherstview WPCP, is the recommended option for biosolids management. In evaluating this option Township staff toured the Mississippi Mills facility that dewaters sludge from an ATAD to learn more about how this system would operate.

After touring the Mississippi Mills facility, staff made the following notes to keep in mind if this project moves forward:

1. An additional operator would likely be required after installation of the rotary press.
2. This project would result in Amherstview WPCP becoming a Class III treatment facility, meaning operations staff would need to be trained accordingly.

3. Proper drainage would be required from the rotary press back to the WAS storage tank.
4. The cake storage building design must ensure that it can be drained properly to allow for further drying. Operators at Mississippi Mills recommended a sump in the cake storage building.
5. Ensure that we acquire a new generation press with stainless steel plates.

With these observations in mind, Township staff continue to recommend Alternative 2, dewatering and cake storage. The following information should also be obtained prior to a final decision:

- Have the Township's polymer supplier undertake testing to determine an appropriate type and dosage of polymer for dewatering, and provide updated costing information if necessary; and
- Engage the Township's third-party contractor to determine how hauling rates may change under the various alternative presented and determine if any cost efficiencies can be found.

Future System Connection

As noted in the Amherstview WPCP Needs Assessment technical memorandum, staff have had high-level discussions regarding connecting the Bath sanitary sewage system to the Loyalist East sewage system. This would involve converting the current Bath STP to a pumping station and sending all sewage to Amherstview WPCP with a forcemain. Staff recommend a feasibility study be conducted to review this option in detail. The outcome from this study may impact future decisions regarding biosolids handling.

Financial

The upgrades outlined in this document are initial recommendations. Further investigation and design will take place before implementation. The costs presented below are estimates based on these initial recommendations. They may not be representative of the actual cost of the project when it takes place.

Sludge Digestion – Alternative 1: Digestion of Excess Bath STP Sludge at Amherstview WPCP

This alternative is considered a growth item. As flow increases with growth, the sludge digestion capacity at Bath STP will be surpassed. To address this issue, Alternative 1 is being considered. The table below shows the Net Present Value (NPV) up to 2046 to haul excess sludge from Bath STP to Amherstview WPCP. It should be noted that only a one-year trial of this alternative is being recommended at this time, which will only require the annual O&M costs presented below.

Biosolids Storage – Alternative 2: Biosolids Dewatering and Storage at the Amherstview WPCP

This alternative is considered both a growth and remedial item. There are inefficiencies with the current storage system which should be addressed. It will become more crucial to address these inefficiencies as growth continues and flows increase. The table below shows the NPV up to 2046 to dewater and store biosolids at Amherstview WPCP. This cost accounts for the excess sludge that will be transported from Bath STP.

Table 5 Net present value and capital costs of recommended options

Recommendations	NPV to 2046 (CAD)	Capital Cost
Sludge Digestion – Alternative 1	$7,480,000	$ 50,000
Biosolids Storage – Alternative 2	$12,300,000	$ 3,112,000

System Connection Feasibility Study

It has recommended that a feasibility study regarding the connection of the two sanitary systems is conducted. A study of this type would likely cost around $50,000.

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of GHG emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact the needs of AWPCP in Loyalist Township include the following:

- Mean temperatures are projected to increase annually and in every season (ICLEI, 2021).
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021).

Recommended option for biosolids management and storage included the following:

- Installation of a rotary press to dewater biosolids to 25% and construction of a cake storage building at Amherstview WPCP.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Dewatering biosolids and facilitating on-site storage will decrease the quantity biosolids for off-site disposal, thereby decreasing hauling and associated GHG emissions.
- The use of biosolids as a substitute for fertilizer reduces energy associated with synthesis of commercial fertilizers.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Construction of the storage building will consider using materials that are lower in embodied carbon where possible to reduce GHG emissions.
- Construction of the storage building will consider protection of surrounding environment during extreme weather events (i.e. precipitation and surface water runoff) from stored biosolids.

Linkages

Amherstview WPCP Needs Assessment Technical Memorandum

Bath STP Needs Assessment Technical Memorandum

References

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

R.V. Anderson Associates Limited. (2023). *Amherstview WPCP and Bath STP Technical Memorandum 1: Sludge Digestion Options.*

R.V. Anderson Associates Limited. (2023). *Amherstview WPCP and Bath STP Technical Memorandum 2: Biosolids Storage Options.*

R.V. Anderson Associates Limited. (2023). *Amherstview WPCP and Bath STP Wastewater Modelling and Capacity Assessment Report.*

Conclusions

A needs assessment was conducted for sludge management and storage at the sanitary treatment plants in Loyalist Township. It was determined that sludge digestion capacity at Bath STP needs to be upgraded, and biosolids storage at Amherstview

WPCP was also identified as being in need of improvements. The following recommendations have been made based on consultant feedback and discussions with operations staff.

It is recommended that the sludge hauling pilot study be implemented within the next two years. The results of this study will inform how to handle sludge at Bath STP in the future.

It is recommended that staff have the Township's polymer supplier undertake testing to determine an appropriate dosage and type of polymer for dewatering, along with associated costing information. It is also recommended that staff ask the Township's third-party contractor to review how hauling rates may change under the various alternatives presented and whether any cost efficiencies can be found.

It is recommended that a rotary press to dewater biosolids be installed at Amherstview WPCP. A cake storage building should also be constructed onsite. After the implementation of this new equipment and operations step, an additional operations staff should be hired, along with conducting training for existing staff.

IMP Technical Memorandum: Stormwater Regulatory and Emerging Issues

Asset Class: Stormwater

Objective: The objective of this memorandum is to outline stormwater regulatory and policy-related topics.

Background

The Ontario Ministry of the Environment, Conservation, and Parks (MECP) has prioritized improvements to stormwater management quantity and quality controls. Over the past several decades stormwater quantity and quality have become major considerations for land development.

The recent implementation of the Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA) is a culmination of many years of stewardship where the administration and responsibility of stormwater systems has shifted from the Province to local municipalities.

Assumptions

n/a

Methodology

The content of this report is based on direct participation in stormwater policy discussions with senior MECP policy advisors, and with Loyalist Township management and engineering staff responsible for design and operation of the Township's stormwater infrastructure.

Analysis

The MECP and federal government have established various regulations that are designed to protect natural watercourses and waterbodies from all forms of pollution. Modern treatment and conveyance infrastructure has been designed to meet the established requirements.

The developing impacts of climate change are a disruption to this process. There is an immediate need to confirm the adequacy of the Township's stormwater systems to handle future stormwater requirements due to climate change. Resilience has become an important concept when it comes to flood prevention. Removal of sediment and suspended pollutants is an important factor in quality control.

At this time there are few regulatory tools in place that would force municipalities to initiate remediation of older neighbourhoods to improve stormwater management, but municipalities need to be aware that these regulatory requirements could come into effect at any time. Since both quality and quantity control are most efficiently managed by large treatment ponds, Loyalist Township encounters an issue similar to many older existing urban communities: that suitable lands are generally not available to construct a suitably sized stormwater management pond. As a result, future remedial stormwater treatment improvements will have to rely on solutions that treat a localized area. This approach is generally more expensive than the stormwater management pond approach to treatment. The Ontario government’s Low Impact Development Stormwater Management Guidance Manual, posted in draft on the Environmental Registry of Ontario in early 2022, poses some issues for implementation in Township, because of the Township’s thin soil cover and shallow bedrock with low permeability rates.

Lake Ontario has a large enough volume that minor or major storm events within any of the catchment areas within Loyalist Township has a negligible impact on lake levels. Under current regulatory requirements, quantity control is at this time generally not required adjacent to Lake Ontario. This has the potential to make site level or sub-catchment level quality control improvements more viable where Lake Ontario is the direct receiver. However, if existing regulations in this regard were to change, remedial projects can be expected to become more expensive.

Consolidated Linear Infrastructure Environmental Compliance Approval

The CLI-ECA is a new regulatory framework developed by the Ontario government (Province of Ontario, 2023). This regulation replaces a system based on individual approvals of new infrastructure as it is constructed with a system wide comprehensive inventory that is updated as the systems expand. Loyalist Township recently received its stormwater license from MECP.

The CLI-ECA requires additional administrative and monitoring efforts for the sanitary and stormwater systems. It is not, however, expected to result in the need for new or improved infrastructure, i.e., no capital improvements. The Township will be required to create watershed plans for the portions of the communities with storm sewers as defined by the Ontario Water Resources Act (Province of Ontario, 1990). These changes will increase operational costs, but no capital costs are anticipated. Once an area that was previously regulated under legacy stormwater quality criteria has been improved with updated infrastructure, the area serviced by the new storm infrastructure must meet current stormwater quality and quantity requirements.

A watershed plan identifies overall watershed conditions and identifies and prioritizes measures to protect, restore, or enhance the health of the watershed. Watershed plans provide a comprehensive understanding of the ecological form and function in the watershed, the importance of different water resource and natural areas and features, factors that sustain them, and indicators to monitor the long-term health of the watershed. Watershed planning provides a holistic view of how land use changes and the provisions of water, sanitary sewage, and stormwater infrastructure impact and interact with watershed ecosystems and water resources. A sub-watershed plan is carried out for a sub-drainage area of a larger watershed and provides a higher level of detail than a watershed study. Sub-watershed plans reflect the goals of a watershed plan but are tailored to tributary needs and local issues. They provide detailed objectives, targets, actions, and best management practices for development, for water, sanitary sewage, and stormwater management, for managing and minimizing impacts related to severe weather events, and to support ecological needs.

The CLI-ECA framework requires several tasks to be completed, with respective due dates through 2026, to fulfil the Township's obligations. The Township is required to develop a watershed plan for its stormwater systems. The regulation applies primarily to urban stormwater piped systems, related appurtenances, and treatment facilities. The regulation does not include roadside ditches and swales.

Loyalist Township has little information on hydraulic capability of the ditching systems and swales in older parts of the urban areas not serviced by storm sewers. Since these systems often drain into the piped system covered by the CLI-ECA, Township staff feel that the priority is to obtain accurate drainage mapping and develop modelling of the storm systems in the older areas. Mapping of the piped systems and technical information required for modelling is essentially complete. The regulation doesn't specifically require full hydraulic modelling of the stormwater system. Modelling is required when making important decisions on storm system rehabilitation. Staff have determined that first developing a sub-watershed plan for Odessa in 2024 will facilitate the proposed Main Street – Odessa reconstruction project, with plans for Amherstview and Bath to follow before the required completion in 2026.

Once complete, these sub-watershed plans will form the foundation of future stormwater drainage improvements.

Land development overview

Stormwater treatment units, such as oil/grit separators (OGS), require operational and maintenance effort. To mitigate long-term expenses, the Township will strive to minimize the number of OGS units. Care and effort should be made to enable a single treatment unit to provide for as large a catchment area as possible. Outlets of the facilities should be the same location as pre-development outlets for the catchment area. The use of underground treatment units with limited access should be discouraged.

Green Streets

Many Ontario municipalities have initiated a Green Streets program (Professional Engineers Ontario, 2021). Green Street projects are usually developed by experienced multi-disciplinary teams. Green Streets offers many opportunities for urban improvements and typically offer the following benefits:

- Manage stormwater runoff, reduce erosion, and enhance resilience
- Provide opportunities to enhance biodiversity
- Mitigate urban heat island effect
- Enhance air quality
- Promote infiltration in areas where soil conditions permit

- Conserve greenhouse gas
- Beautify neighbourhoods


Figure 1 Fairford Avenue intersection with Coxwell Avenue, Toronto, before and after green street initiative

Although a Green Street initiative may increase the costs of an urban road rehabilitation project, the added value to the overall community may make the project a beneficial alternative.

It is recommended that Township staff study the advantages of implementing a Green Street program.

Stormwater Service Areas

Some larger municipalities, such as Oshawa, Ontario, have evaluated the option of establishing stormwater as a separate service area within the municipal financial structure, similar to how water and sanitary sewer services are funded in Loyalist Township. This system gives landowners the potential to optimize their assessments by minimizing runoff volume. A landowner who can demonstrate a reduction in runoff from their property under specified conditions can expect to see their municipal stormwater costs reduced. Large landowners would have an incentive to assess their property and make modifications that could reduce their stormwater expenses. This user-pay style for stormwater offers a potential tool for equalizing the costs of stormwater management across the Township based on the benefits received. Unfortunately, this type of program is expensive to administer, as detailed records must be maintained so that the condition of individual properties can be accurately recorded, monitored, and assessed on a periodic basis. This concept may become more attractive over time if maintenance costs for stormwater management facilities become excessive, particularly if contaminated sediments require special handling. It is recommended that Township staff monitor the results of programs in municipalities where stormwater service areas have been implemented.

Maintenance of Treatment Units

Maximum density within developed areas has some benefits with respect to infrastructure servicing, but one conflict that often arises during the design process is stormwater quality treatment on smaller sites. For smaller development sites a traditional stormwater management pond is often impractical, and alternate quality treatment must be sought. Numerous products are available which may be grouped into three main categories:

1) Infiltration: precipitation is absorbed directly into the soil. Methods include mulched gardens and permeable pavements. No further maintenance action is required from staff.
2) Continuous deflective separation (CDS) units, referred to in the CLI-ECA as OGS units: These underground structures use a combination of swirl concentration and indirect screening to separate most suspended solids from the stormwater, which is then conveyed towards a suitable outlet. The solids are stored separately until cleaned out by maintenance staff
3) Holding tanks: large underground structures designed to retain a large volume of stormwater underground so that suspended particles have sufficient time to settle. Release of stormwater is partially restricted from the holding tank and the solids are stored separately until cleaned out by maintenance staff.

Operations staff have noted that cleanout costs for OGS and holding tanks are relatively high. Staff have expressed that the processes used to approve the use of these facilities should include discussions that recognize the additional inspection and maintenance costs to the municipality.

By-law Updates

Township staff recommend that existing by-laws applicable to stormwater works and operation and lot grading should be updated to reflect regulatory changes (e.g., excess soil regulations) and the responsibility and liability to the municipality if the systems are not well administered and maintained. The municipality is responsible for stormwater quality once the water enters the storm system; therefore, pollutants such as chlorine must be adequately buffered or not allowed to enter the system. Increased public education on this topic might be beneficial.

Due to a relatively low level of development until recently, the Township has not had sufficient volume of work to maintain technical staff as stormwater subject matter experts. As a result, the developments were approved without an overall framework. This resulted in a variety of service levels throughout the Township as new developments were built out.

As the pace of development picked up in the mid-1990s the Township, realizing it didn’t have either the time or expertise to develop its own standards and policies, relied on provincial guidelines and used the City of Kingston’s stormwater design standards.

In light of regulatory changes and climate change impacts, it is necessary for the Township to formalize stormwater design requirements for both new residential developments and for industrial, commercial, and institutional (ICI) developments. This includes consideration of two recent products from the Canadian Standards Association: CSA W204:19, a standard for flood-resilient design of new residential communities (CSA Group, 2019); and CSA PLUS 4013:19, a technical guide to applying intensity-duration-frequency (IDF) information (CSA Group, 2019).

Township staff are working on a set of comprehensive development design guidelines, and it is recommended that this project be maintained as a priority.

Financial

Some recent smaller developments have been constructed with sub-surface stormwater management structures with very limited maintenance access. These treatment units usually include some sort of tank. The maintenance costs of these facilities are considerably higher than those of similar developments with typical storm water management facilities. It would be preferable if this type of treatment unit were not employed, but if they are used the Township should seek a method of reducing the impact of future higher maintenance costs.

Budgets will need to be adjusted to allow for the development of sub-watershed plans for the communities of Amherstview, Bath, and Odessa.

Climate Lens

See climate lens comments in the Minor and Major Storm Technical Memorandums.

Linkages

Stormwater Major System Technical Memorandum

Stormwater Minor System Technical Memorandum

References

CSA Group. (2019). *CSA PLUS 4013:19 Technical guide: Development, interpretation and use of rainfall intensity-duration-frequency (IDF) information: Guideline for Canadian water resources practitioners.* Retrieved from CSA Group: https://www.csagroup.org/store/product/CSA%20PLUS%204013:19/

CSA Group. (2019). *CSA W204:19 Flood resilient design of new residential communities.*

Professional Engineers Ontario. (2021, January 2021). Implementing Green Infrastructure to Support Climate Resilience.

Province of Ontario. (1990). *Ontario Water Resources Act, R.S.O. 1990, c. O.40.* Retrieved from https://www.ontario.ca/laws/statute/90o40

Province of Ontario. (2023). *Municipal Consolidated Linear Infrastructure Environmental Compliance Approvals.* Retrieved from Province of Ontario: https://www.ontario.ca/page/municipal-consolidated-linear-infrastructure-environmental-compliance-approvals

Conclusions

It is recommended that staff study the possibility of implementing a Green Street program as a general policy within Loyalist Township.

It is recommended that staff monitor the results of municipal programs that have implemented stormwater service areas.

It is recommended that that existing by-laws applicable to stormwater works and operation and lot grading be updated to reflect the changes in the regulatory environment.

It is recommended that the completion of the Township's stormwater design standards be maintained as a priority project.

It is recommended that the use and funding of CDS and holding tank-style stormwater quality and quantity control systems, be reviewed in light of the additional maintenance efforts required over the service life of these elements.

IMP Technical Memorandum: CSA PLUS 4013:19 – Intensity Duration Frequency

Asset Class: Stormwater

Objective: This memorandum will outline assumptions regarding climate change as it pertains to stormwater management and its effect on existing and future infrastructure, as informed by CSA PLUS 4013:19.

Background

This memorandum discusses the publication, “CSA PLUS 4013:19 Technical guide: Development, interpretation and use of rainfall intensity-duration-frequency (IDF) information: Guideline for Canadian water resources practitioners”, hereinafter referred to as the Guideline (CSA Group, 2019). The Guideline provides information and instruction regarding the development of one of the key tools utilized by stormwater management designers, that of rainfall IDF information. Much of this document is not of prime interest to the IMP; however, the section related to how IDF information will likely be affected by climate change is significant.

Loyalist Township has a responsibility to help protect lives and property, including both natural and man-made infrastructure, within the Township. This is the primary goal of stormwater management. The establishment and use of engineering design standards for greenfield development, brownfield redevelopment, infill development, and general replacement and reconstruction and continued maintenance represent a significant opportunity to increase protection from flooding associated with stormwater.

The Guideline is not a substitute for the provincial stormwater management design guidelines, but rather a reference document that describe how IDF curves are developed and implemented by stormwater management professionals, including a discussion of the estimated impacts of climate change on stormwater management design and infrastructure.

Assumptions

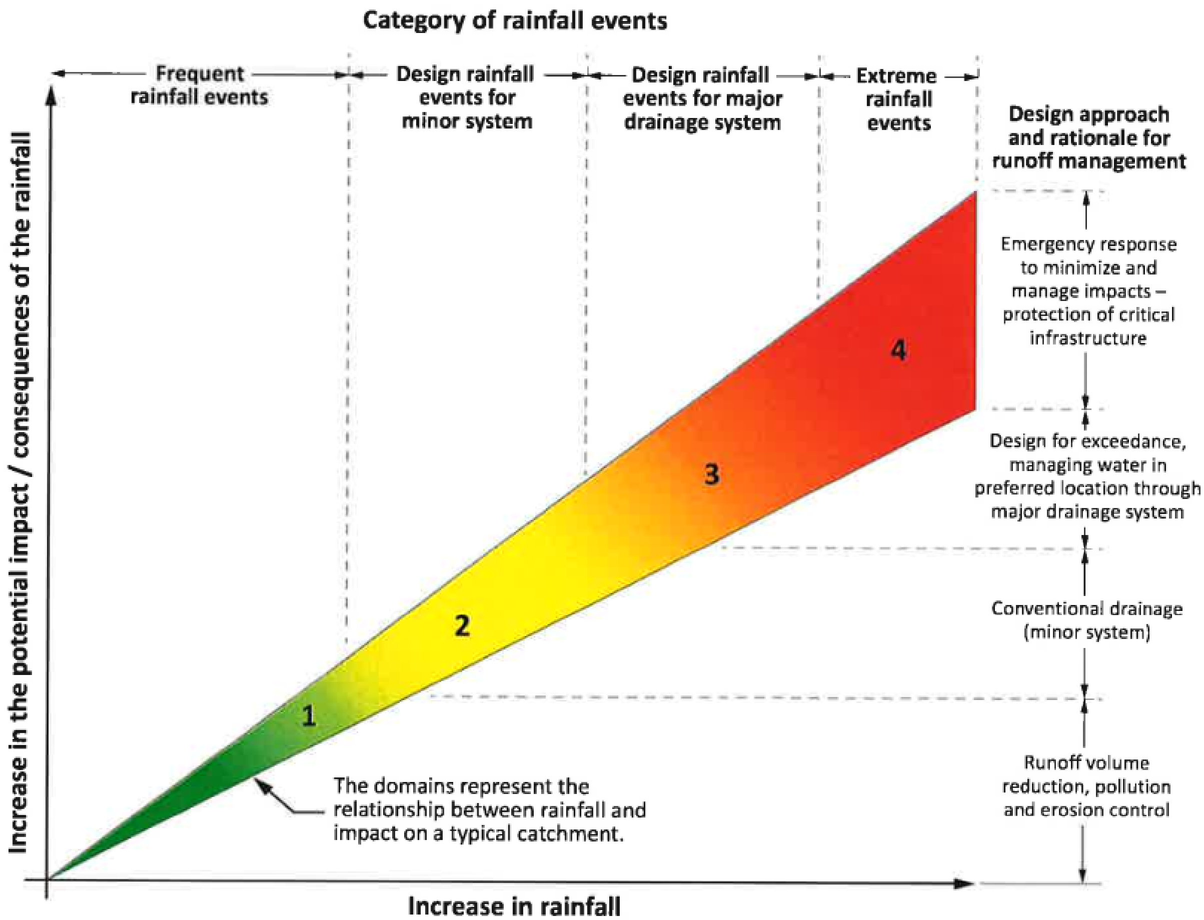
This memorandum will focus on the climate change effects on stormwater management and the resultant impact on existing stormwater management infrastructure. Future infrastructure will be impacted by designing for climate change impacts in all future developments, as per Township and provincial development and design standards.

Methodology

This examination will consider the four ranges of rainfall events considered for stormwater management design, to identify classes of existing stormwater management infrastructure that may be threatened by climate change.

Analysis

The four rainfall event types are: frequent, minor storm, major storm, and extreme. They generally represent progressively greater rainfall intensities as well as greater rainfall amounts and present increasing short-term risk to lives, private property, and infrastructure (natural and constructed). They each represent different types of risks to existing infrastructure as they are modified by climate change.



Note: *Adapted from CIRIA (2014).*

Figure 1 Types of rainfall events

Frequent Rainfall Events

Frequent rainfall events are categorized as the smallest 90% of average annual event. While there is variability across Ontario, the 90% percentile storm event is approximately 25 mm of rainfall. These rainfall events wash surface contaminants from the catchment and thus are the greatest concern for stormwater quality treatment facilities.

The primary design variables for water quality facilities are the area of contributing catchment to the facility and the imperviousness of the development (Province of Ontario, 2003).

It is noteworthy that the recommended minimum volumes for the permanent pool of a wet pond type of stormwater treatment facility are roughly equivalent to the expected runoff from a 25 mm storm event.

Water cycle maintenance has become an increasing focus for the provincial government in the last decade, with expansion of the role of low-impact design (LID) features and practices seeking to minimize the disruption of the natural water cycle caused by land development. Generally, LID is used to intercept runoff before it can enter the stormwater sewer system, primarily by infiltrating the runoff into the ground.

Minor Storm Events

A minor storm event is a larger rainfall event with its upper limit between a 1:2 year and a 1:10 year event. Existing Township stormwater systems are based on either a 1:5 year or a 1:2 year event, with the current Township design standard being a 1:5 year minor event. The minor storm event is used to size the stormwater collection system, i.e., catch basins, storm sewers, swales, driveway culverts, and ditches. The intent is to ensure roadways and pathways do not accumulate water on the road surfaces during more common rainfall events, while ensuring the capital cost for the stormwater infrastructure remains balanced.

A design requirement for the minor system is that peak flows during the design minor storm event must match the theoretical pre-development flows during the same design storm event. Some form of storage and release control is required. This is to ensure that downstream natural and constructed infrastructure and landowners are not negatively affected.

A related requirement from the Cataraqui Region Conservation Authority is that the 1:2 year event must not exceed the pre-development flows where the discharge from the system enters a natural receiver subject to erosion, like a creek, stream, or pond.

Major Storm Events

A major storm event is a significant rainfall event between the design limit of the minor storm and the 1:100 year storm event. The major storm exceeds the capacity of the minor stormwater system, and therefore drains primarily overland across the catchment area toward the outlet. For flood management, a major flow route is designed into land development to ensure that all building openings remain safely above the 1:100 year design flood elevations; that maximum depths of water ponding are limited to the Township maximum; and that the major storm is contained within public land as much as possible. The road right-of-way is the primary component of the major storm route, with ditches and channels used where necessary. In some isolated instances, the major storm is piped.

A design requirement for the major system is that peak flows during the design major storm event must match the theoretical pre-development flows during the same design storm event, again to protect downstream infrastructure and landowners. The upper limit for design peak flow control is the 1:100 year storm event.

A critical feature of the storage and release system is that the system must safely operate should the primary outlet become blocked. Typically, this is ensured through the requirement of freeboard for the storage structure above the 1:100 year maximum fill level, and an emergency outlet which only functions once the fill level is exceeded.

Road cross culverts are part of the major storm system but are typically not designed for the 1:100 year event. They are usually sized for the 1:20 to the 1:50 year events, depending on the importance of the roadway, i.e., collectors and arterial roadways. However, the road crossing, which includes the culvert, is designed to carry the 1:100 year event, with the runoff that cannot be passed by the culvert passing over the roadway.

Extreme Storm Events

An extreme storm event is a massive event that exceeds the 1:100 year storm. Generally, no typical municipal infrastructure is specifically designed for extreme conditions. However, the design of the major system has requirements in place to withstand extreme events while still minimizing risk to health and property. As previously discussed, stormwater management facilities are designed with overflows to safely release runoff beyond the 1:100 year design limit. Major flow routes are designed primarily as open channel flow, meaning that flow greater than the 1:100 design flow can be accommodated but with higher flow depths and velocities.

Recently the Township has begun requiring that stormwater facilities' emergency outflows and downstream outlet channels be sized to accommodate a peak flow 20% larger than the 1:100 year flow. These accommodation costs are negligible when included in initial construction of the facilities.

There is no design requirement to match pre-development and post-development flow rate for extreme storm events. However, the major storm system is still in place which will help mitigate the peak flow difference due to development.

Effects of Climate Change on Stormwater Systems

Climate change will alter the rainfall patterns. As discussed in the Guideline, the warming climate is expected to lead to increases in extreme precipitation without necessarily changing the total annual rainfall; that is to say, rainfall events will be more intense. The IDF curves used to estimate these events will change. In general, the increase in temperature will lead to an increase in evaporation and carrying capacity of the atmosphere. The theoretical Clausius-Clapeyron (CC) relation (7% increase per degree Celsius mean temperature increase) appears to be the maximum increase assuming all other factors remain the same. Increasing rainfall amounts based on temperature is referred to as temperature scaling and has been recommended as the basis for estimating future IDF values.

Various models exist for how much climate change may warm the atmosphere. The Coupled Model Intercomparison Project Phase 5 (CMIP5) has been developed with international participation to provide coordinated climate model experiments (Lawrence Livermore National Library, 2013). For Canada, three scenarios have been modeled: low emission, medium emission, and high emission. These scenarios correspond to aggressive reductions in greenhouse gas (GHG) emission as described in the Paris Agreement, 'moderate' greenhouse gas reductions, and "business as usual" where no effort is made to reduce or address GHG emissions. The designations for these scenarios are RCP2.6, RCP4.5, and RCP8.5.

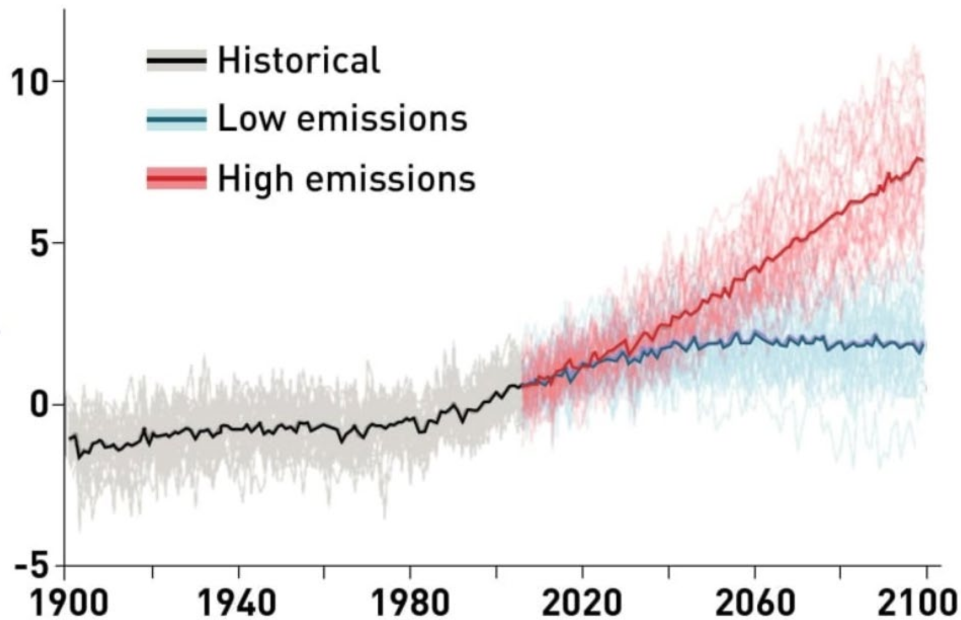


Figure 2 Projected annual temperature change in Canada (°C)

For Ontario, the mean values (equivalent to the darker lines in Figure 2) for RCP2.6 and RCP8.5 are 1.5 °C and 2.3°C, respectively for 2050 and 1.7°C and 6.3°C, respectively for 2100.

The Guideline expands on the strengths, limits, and uncertainty of the precipitation increases due to climate change; however, it suggests that using the CC relation with an assumed temperature change based on an RCP model for the design service life for new infrastructure provides a reasonable adaptation for climate change.

Using the average of the RCP2.6 and RCP8.5 values for 2050 (essentially assuming progress toward the Paris Agreement targets, but not full compliance) yields a value of 1.9°C. Assuming the CC relation and the increase in moisture carrying equates to a matching increase in precipitation, with this value being $(1.07)^{1.9}$ = 14% increase in rainfall intensities.

Effects on Existing Stormwater Quality Infrastructure

Frequent events transport most stormwater contaminants. In the Township, most of these contaminants are currently treated in end-of-pipe facilities, such as wet ponds, dry ponds, hybrid wetlands, wetlands, and oil/grit separators (OGS). These facilities have been sized using the guidelines described above, which are primarily based on the surface imperviousness and overall development area, neither of which are affected by an increase in storm intensity. However, as shown earlier there is an inferred relationship between the total storage values and the annual 90th percentile storm volume.

An increase in rainfall volume does not necessarily corelate to an increase in pollutants. The generated sediment will still be washed to the treatment facilities, with a corresponding proportional decrease in concentration. An increase in the volume of water but without an increase in sediment loading rate may not affect the quality of the discharged water, given that the existing drawdown time was set by the original water volume for storage-based treatment system. An increase in total water volume would result in an increase in drawdown time which in turn may reduce any potential negative effect of an increase in rainfall intensity.

Existing flow-through treatment systems, e.g. OGS, have been size-selected based on the 90th percentile storm events. Generally, their removal efficiency rate is reduced at higher flow rates. Release water quality may be slightly reduced.

Under the IMP, examination of all current Township water quality facilities will be undertaken to identify any potential water quality concerns, including those generated by the potential effects of climate change.

Effects on Existing Stormwater Conveyance Infrastructure

Conveyance infrastructure is made up of both the minor and major storm systems and exist to collect and transfer stormwater to the end-of-pipe stormwater management facilities.

The existing minor systems were designed for either the 1:2 year or 1:5 year storm events. If more intense storms occur more often, the effect will be that the urban storm sewers and semi-urban ditches will be operating at capacity more often. Runoff will use major storm routes, as they were designed to do.

In effect, nothing will change in terms of performance. The minor system will shed excess runoff to the major storm system as intended.

Road cross-culverts are designed with a design storm usually less than the 1:100 year storm event and normally well above the minor storm event. Typically, the culvert’s capacity is higher for collector and arterial roads, recognizing their importance for moving emergency vehicles. Should a cross-culvert’s capacity be exceeded, stormwater will flow over the road to reach the downstream side. This is normal, expected behaviour for any culvert.

For the major storm system, significant events will occur more often. As reported in the CSA PLUS 4013:19 document, for 2050 under the RCP8.5 scenario, the 1:50 year 24-hour event is projected to occur as often as the current 1:30 year event.

The effect for storm events weaker than the current 1:100 year storm event is expected to be more frequent events. The current systems were designed to transport and manage all major storms up to the current 1:100 year event. It is only for events that exceed the 1:100 year design event that the behaviour of the major storm systems will be affected.

Road cross culvert capacities will be exceeded more often; however, these culvert crossings were designed to pass the runoff beyond the capacity of the culvert over the roadway.

For extreme events, i.e., those greater than the 1:100 year design event, the major system will be over capacity. Given that most of the major system is open channel, i.e., open ditches and roadways, the system will work in the same way but with elevated water levels and potentially higher velocities. Areas of concern include piped major storm sections, as these will surcharge, leading to backwater effects upstream. These areas will be assessed as par of the IMP to identify where overflow relief can occur under these conditions.

Stormwater management facilities were designed to control the peak flow rate of the 1:100 year storm event. With an increase in storm intensity, the frequency of flows escaping via emergency overflows will increase. There is no expectation of the facilities to completely control these events, but the fact that these facilities can control high flows up to the 1:100 year event will help mitigate the damage from extreme flows. The current Township practice to design the emergency overflows and outflow channels to 20% above the 1:100 year storm event will be beneficial in an extreme event.

Financial

The financial implications of climate change on existing stormwater management facilities will be included in the review of those sections elsewhere in the IMP.

Climate Lens

This document has viewed stormwater management concerns through a climate lens.

Linkages

Stormwater – Major System Technical Memorandum

Stormwater – Minor System Technical Memorandum

References

CSA Group. (2019). *CSA PLUS 4013:19 Technical guide: Development, interpretation and use of rainfall intensity-duration-frequency (IDF) information: Guideline for Canadian water resources practitioners.* Retrieved from CSA Group: https://www.csagroup.org/store/product/CSA%20PLUS%204013:19/

Lawrence Livermore National Library. (2013). *CMIP5 - Coupled Model Intercomparison Project Phase 5 - Overview*. Retrieved from Program for Climate Model Diagnosis & Intercomparison: https://pcmdi.llnl.gov/mips/cmip5/

Province of Ontario. (2003). *Stormwater Management Planning and Design Manual.*

Recommendations

It is recommended that existing major overland routes throughout the Township be identified and reviewed for the impacts of increased rainfall intensity as part of the IMP.

It is recommended that existing major flow routed through piped systems be identified with their corresponding overflow pathways and reviewed for potential impacts from increased rainfall intensity.

It is recommended that existing road cross-culverts in the IMP's study area be identified along with their overflow pathways and reviewed for potential impacts from increased rainfall intensity.

It is recommended that existing stormwater treatment systems be compared to current stormwater design standards and evaluated to see if increases in rainfall intensity will significantly affect released water quality.

It is recommended that existing stormwater management facilities be compared to current stormwater design standards and evaluated to see if increases in rainfall intensity will have increased of flood damage. Older facilities are to have their overflows and overflow channels reviewed.

IMP Technical Memorandum: CSA W204:19 – Flood Resilient Design

Asset Class: Stormwater

Objective: This memorandum considers the potential benefits and costs of including the CSA W204:19 standard as part of Loyalist Township's development standards, for the purpose of improving flood resilience in residential development.

Background

This memorandum draws on the standard, "CSA W204:19 – Flood resilient design of new residential communities", hereinafter referred to as the Standard (CSA Group, 2019).

Loyalist Township has a responsibility to help protect lives and property, including both natural and man-made infrastructure, within the Township. This is the most important function of stormwater management. The establishment and use of engineering design standards for greenfield development, brownfield redevelopment, infill development, and general replacement and reconstruction represent a significant opportunity to increase protection from flooding associated with stormwater.

The Standard is not a substitute for the provincial stormwater management design documents, but rather a set of design standards that describe how residential land development systems can enhance flood resilience, beyond the specific design guidelines that govern the design of stormwater management infrastructure.

While the Standard is specifically intended for greenfield residential development, the overall design intent and concepts included may be useful in all types of development in the Township.

The Standard, however, may not be enforced in Loyalist Township unless it is specifically referenced in the Township's Engineering Design Guidelines.

Assumptions

While flood resilience is a worthwhile goal, it must be tempered with fiscal realities.

The Standard does not have to be adopted in its entirety. The Township may modify or exclude aspects not demonstrated to be of net benefit to the Township.

Methodology

Land development is primarily driven by private interests. The Township maintains its own design standards in concert with provincial policies, standards, and guidelines. Additionally, best practices used by design professionals contribute to delivering good design outcomes in land development.

Through the IMP process, the Township has identified opportunities to improve stormwater elements and associated infrastructure. Evaluating the myriad of potential choices requires having a solid technical screen. The Standard is herein examined for design approaches that differ from past and current practices, to determine if these differences would be beneficial to the Township.

Differences between the Standard and current practices will only be identified if the Standard has a potential positive impact on development before the quantitative benefits and costs of the difference are examined. Additionally, should the Standard directly conflict against Loyalist Township standards or accepted practices, the practice will be noted for potential exclusion.

Where practice or requirement within the Township exceed that within the Standard, the difference will not be noted.

Analysis

- Section 6.2 Other Objectives, Clause d). Include the following in the preservation of public safety and management of flooding during major storm and extreme events, item 1: “Efficient allocation of capital and maintenance costs”. Management of capital and maintenance costs are activities that are far outside flood resiliency and are not important during major storm and extreme events.
- Section 6.5.1 Minor System, clause 6.5.1.2. This section indicates that the maximum hydraulic grade line (HGL) should be 0.3 m below underside of foundation footings. Current Township standard is 0.3 m below the top of basement floor elevation. Given typical residential construction, the difference in the standards is an additional 0.3 m. As most of the current residential developments within the Township have been constrained by the storm sewer system and already are net importers of clean fill, the requirement for additional fill to raise the development by approximately 0.3m represents a significant cost, in the order of $60,000 per hectare of development. The benefit to the development would be a potential reduction in the amount of basement flooding within new developments during extreme events, as the HGL line would remain well below the basement floor elevation. This section should be excluded or amended to match the existing Township Standard.
- Section 6.7.2 General Requirements of Major System Design, item g). Freeboard of 0.3 m above major storm water levels to all building openings. This isn’t stated specifically in Loyalist Township’s standards but has been typical practice. The benefit for this is clear, the additional cost is expected to be minimal, as building openings are already a minimum of 0.3 m above the lot corners, and there are few locations where a major flow route passes close to buildings.
- Section 6.7.3 Design of Major System Components. This section addresses specific requirements for the major flow route for safety of pedestrians in the areas affected by overland flow (streets, walks, sidewalks, pathways, parks). These requirements also help control erosion and surficial damage to the major flow route by limiting the flow depth and flow velocities. These concepts are not specifically addressed within the Provincial design guidelines. The benefits are that vehicle passage during major storms are maintained, including those for

emergency vehicles, and that pedestrians can safely navigate without high risk of serious injury of loss of life. Costs would remain within the design work necessary to calculate the flow depth and velocity at key locations. It is possible that major flow routes would have to be rerouted to avoid crossing an urban arterial roadway, but this is a design stage effort.

- Section 6.7.4 Major System Ponding. This section outlines the requirements for a major overland flow route, including location planning, required storage (if necessary), and the requirements for emergency overflow systems. Benefits are clear for life and property protection and costs are minimal, as they are primarily in the planning/design phase and minor grading for the few overland flow routes through a development.
- Section 6.7.7.4.2 Residential lot drainage swales. This section isn't consistent with previous sections regarding standing water depths, and existing Loyalist Township standards offer higher levels of protection. This section should be excluded.
- Section 7 Sanitary Sewer Design. This section addresses risk associated with the sanitary sewer system which, under ideal conditions should not contain any stormwater or groundwater. Of particular concern is item 7.1 b) which requires that the I/I (infiltration / inflow) allowance of 0.3 L/s/ha be utilized. This value is more than twice the current value used in Loyalist Township, the current value being 0.14 L/s/ha. Examining the most recent greenfield developments in Loyalist, it was found that setting the infiltration rate to 0.3 L/s/ha would increase the largest pipes by one pipe size larger but would have no effect on most (>80%) of the total sanitary sewers within the development. The most recent residential developments feature the greatest housing density levels which would place the most generated flow in comparison to the infiltration flow, which depends only upon the development area. With higher residential development densities more likely in the future, the financial impact of this increased infiltration allowance will be even less.

Financial

This standard is intended to be applied for greenfield residential developments and most costs identified above will be limited to the design and planning phases rather than construction costs.

For each non-greenfield development, a case-by-case review of the implications of these standards should be considered with the goal of improving flood resilience without unduly increasing development costs.

Climate Lens

The Standard is intended to inform greenfield development that will have climate adaptations and mitigation aspects designed into them. While this type of development is outside the IMP process, a case-by-case review of all IMP projects can examine these opportunities to find mitigation aspects that can be implemented.

Linkages

Stormwater Major System Technical Memorandum

Stormwater Minor System Technical Memorandum

CSA PLUS 4013:19 – Intensity Duration Frequency Technical Memorandum

References

CSA Group. (2019). *CSA W204:19 Flood resilient design of new residential communities.*

Recommendations

It is recommended that the Township include referencing CSA W204:19 Flood Resilient Design of New Residential Communities within its development guidelines, with the exclusions identified above.

IMP Technical Memorandum: Roads New Technology and Regulatory Issues

Asset Class: Roads

Objective: The objective of this memorandum is to highlight new regulations and emerging issues which have the potential to impact the Township roads infrastructure and operations. Due to the expected broad impacts from climate change and local population growth these topics has been reviewed separately within this memorandum.

Background

Emerging issues develop from many sources including changing technologies, climate change, changing social attitudes and objectives and growth pressures and proposed changes in regulatory requirements.

Methodology

This memorandum has been developed primarily from recent literature reviews and participation in a variety of technical webinars, and industry workshops and conference seminars and discussions with staff familiar with the topic**.**

Analysis

Many impacts from a variety of sources are expected to affect Loyalist Township's infrastructure and departmental transportation throughout the IMP study period. This analysis will be broken down under two headings, New Technology and Regulatory Issues.

New Technology

Automated vehicle[1] integration into common use is expected to require the standardization across all road jurisdictions of road markings, signage, signalization controllers, camera data, traffic sensors, and data controllers. Municipalities will be required to modify their operations, safety features, and processes to meet these changes. Many municipalities will need support to acquire and manage the new automation equipment.

The development of automated vehicles is well underway. Their broad introduction for public use is being held back for a few reasons, including liability concerns and lack of roadside standardizations.

The public can expect to see a broad range of automated vehicles in the near future – not only private passenger vehicles, but also robotic delivery type vehicles, transit vehicles, trucks, and roadside maintenance vehicles.

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[1] While the terms "autonomous vehicle" and "automated vehicle" are sometimes used interchangeably, for the purpose of this memorandum "automated" has been selected to indicate a vehicle that will operate itself after receiving human direction.

The legal issues around liability for automated vehicles is complex. The introduction of automated vehicles locally will necessitate the need to have bylaws and insurance documentation updated accordingly in advance of the introduction of these vehicles on public rights-of-way.

Internet security is another potential risk for vehicles depending on connectivity. Vehicles will rely on communications both with each other and with traffic control by means of V2X, or “vehicle to everything” systems. Communications expect to involve both public and privately-owned digital spectrum bands and be fully functional in all expected climatic conditions. Standards for communications processes and hardware become increasingly important with the many manufacturers involved in the sharing of the functioning automation systems. Some devices may utilize and depend on cloud-based processing, adding an additional level of complexity.

Communication systems will require a full build-out of broadband and true 5G services everywhere automated vehicles are expected to be used. While many countries are well underway with national broadband service, in Canada and the United States these improvements are limited to the most populous areas. Locally, non-availability of reliable high speed internet is well-documented in rural areas such as Amherst Island. The more remote northern areas of the County of Lennox and Addington are not well served by land-based internet systems.

Communication systems are being developed with the ability to digitally label emergency vehicles such as ambulances, police cars, and fire trucks, so that these vehicles’ movements can be prioritized and efficiently deployed. Many municipalities have upgraded signal equipment such that they can be remotely operated by emergency vehicles. Loyalist Township’s Emergency Services Department does not have this equipment.

Large volumes of data volumes will be generated by automated vehicles. How this data is used and stored will have the traditional data concerns such as privacy, overall volume, data sharing, and infrastructure owner liability. One potential model includes a public-private ownership model, in which the data is available only for specified purposes related to vehicle communication and may possibly be extended to road use billing, traffic management, and tolling systems.

Larger municipalities already maintain centrally-operated traffic and signal monitoring facilities. These existing systems will need to be updated to meet the communication needs of the automated vehicles, such as a universal key device that links the multiple sensors required by the introduction by the automated vehicles.

Safety is the prime public concern, but automated vehicle developers note that most accidents are due to human error and are preventable, such as improper intersection or turning movements. Developers have asserted that the deployment of automated vehicles will lower accident rates from those seen with traditionally-operated vehicles.

With some delivery vehicles expected to use sidewalks as well as equipment like automated sidewalk snowplows, increased standardization of sidewalk features, physical roadside encroachments such as utility poles, and curb heights and alignments will be needed. Physical changes to existing curbs and sidewalks are typically expensive projects.

Traffic Management Systems

Technology is already being employed by larger jurisdictions such as City of Toronto and MTO that can monitor volumes, provide real-time viewing via internet links, implement lane and road closures, and operate signalization to modify traffic patterns. These systems are known as Traffic Management Systems (TMS). These systems are designed to monitor roadways and intersections with higher volumes to manage congestion. With an increasing number of drivers and vehicles being “connected” there are increased expectations that traffic information is available instantaneously and accessible to V2X systems. Loyalist Township and the County of Lennox and Addington have not invested in TMS to date; however, staff have started to participate in advanced notification process discussions with other road authorities.

Vision Zero

“Vision Zero is a strategy to eliminate all traffic fatalities and severe injuries” (Vision Zero Network), predicated on the idea that all transportation-related accidents are preventable. As noted in the Traffic Calming technical memo, there is increased public concern and desire to improve safety for vehicles, pedestrians, cyclists, and other road users. Some of the momentum for Vison Zero has come from numerous well-stated public opinions on social media platforms. Public sentiment in this area is putting pressure on municipalities for improvements, which can be expected to result in more applications of traffic calming measures, the increased implementation of traffic direction partitions, and speed reduction initiatives.

The monitoring of traffic and pedestrian volumes and speeds, accident data, and road conditions is needed to make informed decisions and ensure appropriate levels of service are being maintained. Loyalist Township needs to have the processes and resources in place to both obtain and manage this data.

Electric Vehicles

The policies developed to reduce greenhouse gas (GHG) emissions have increased interest in the use of electrical vehicles. Recent studies note that ownership costs for new electric vehicles are now more favourable than traditional combustion-powered alternatives.

Manufacturers are now introducing Class 7 and Class 8 vehicles to the Canadian market. Class 8 include large tractor trailer combinations and dump trucks. Class 7 include municipal maintenance vehicles, such as street sweepers and garbage trucks.

Municipalities often express reluctance to switch from a proven product to a new technology. There is also stress associated with budget limits, especially if the new technology doesn't meet expectations and additional resources are required. The introduction of new equipment necessitates additional training resources. There is also the concern of charging electric vehicles in the event of a sustained power outage.

New vehicles will require new maintenance procedures. The charging of larger vehicles will require increased capacity of the garage's electrical system. This will likely entail replacing the electrical service to the building and outfitting the garage with appropriate charging units.

The recent (2022) expansion the County Road 6 garage included to an 800 amp-240V service. This service has approximately 140 amps available for future electric vehicle chargers, or other electrical needs, which is likely insufficient for servicing a quick response for winter control vehicles.[2] Based on the expected demand for each charger and the number of large trucks, it would be expected that conversion of most of the fleet to electric vehicles would require a second electrical service to the building.

A major ongoing criticism of the roll-out of electric vehicles (EV) in Ontario has been the lack of publicly accessible charging stations. While in Quebec chargers are widely accessible, the same can't be said for Ontario. Loyalist Township has not provided chargers for public use. There are two publicly accessible EV charging stations located in the Township, but these are located at ONroute stations and are accessible only from Highway 401. Consideration should be made for the installation of public charging stations at key locations such as the W.J. Henderson Recreation Centre and the Odessa Municipal Office. Similarly, as staff acquire and depend on electric vehicles, consideration should be given for access to charging at worksites.

To address the urgent need for EV chargers, it is recommended that the Township develop a corporate EV charger strategy to direct municipal decisions regarding installation of EV chargers, with an objective of rolling out a program as soon as possible.

In October 2023, Hydro One announced that they will offer customers the choice to switch to ultra-low overnight pricing (Hydro One, 2023). The objective of this adjustment is a policy maneuver aimed at making it more inexpensive to charge an electric vehicle.

Electric vehicles are not a perfect alternative. Concerns have been raised on how an electric-powered winter fleet would respond during a prolonged power outage. It would be very expensive to install charging stations, as well as backup generators capable of rapidly charging heavy vehicles. The power requirement to move large loads for a sustained period such as a multi-day winter storm works well with conventional fuels, but electric options are restricted by the battery solutions now on the market. Removing

[2] In comparison, the 2023 Ford F150 Lightning, a fully electric model, uses an 80 amp at-home charger (Ford Motor Company, 2023). This vehicle has a significantly smaller powertrain than a winter plow unit.

a plow truck for a prolonged period to recharge in the midst of an extended winter event is not ideal as this vehicle would likely require a back up while being charged.

The advancement in green powertrains is not limited to electrical only. Toyota is making progress with the development of a combustion engine using ammonia as fuel. Ammonia is felt to be a greener fuel alternative to fossil fuels, particularly if the local electricity supplied to the ammonia manufacturing facility is considered green. Hydrogen fuel cells are now in use, and many believe that this source of energy is better suited for heavier vehicles. Ammonia maintains a relatively high energy/weight ratio, similar to fossil fuels. Toyota, Honda, and Hyundai have each produced hydrogen fuel cell-powered models for public use. Most of the major vehicle car manufacturers are continuing research on this green technology. Kenworth, a major truck manufacture is also piloting this powertrain.

Using vehicles powered by any other fuel source will mean maintenance staff will require training specific to these vehicles. As well, specialized tools and related maintenance equipment may be required.

Municipal maintenance vehicles using all electric power trains, varying from sidewalk snowplows to street sweepers and garbage trucks, are being introduced to the marketplace. Innisfil, Ontario, recently piloted two robotic, automated, electric-powered sidewalk plows over two winter seasons (Town of Innisfil, 2021).

The complex task of purchasing new expensive equipment becomes more challenging when trying to meet environmental objectives.

Improvements in Battery-powered Vehicles

Battery design has led to an explosion of improvements for vehicles ranging from motorized scooters to moped-like devices and motorcycles. Improved speeds and operating ranges for these vehicles are increasing. The technical improvements, combined with increased energy prices and personal desires to have a smaller carbon footprint, have led to a significant increase in the use of these vehicles, with sales in Canada anticipated to grow by 20% between 2024-2029 (Mordor Intelligence, 2024). Although not as visible in Loyalist Township, Toronto, Montreal, and many European cities are transitioning rapidly towards these vehicles. Higher volume roads in Loyalist Township in both the Township's and the County's jurisdiction do not have sufficient space for both automobiles and increased volumes of bicycles and equivalent type vehicles. As the smaller vehicle sector continues to grow in popularity there will need to be a review of appropriate road designs suitable for smaller vehicles.

Regulatory

Automated Vehicles

The introduction of automated vehicles will require modification to existing provincial regulations and local by-laws with a focus on liability topics.

Vehicle and Road-based Pollutants

Monitoring of roadside stormwater sediments often encounter levels of pollutants of varying types. This is why stormwater management facilities and structures like water gardens are being promoted. There are several chemicals of concerns that may impact vehicle use or the use of certain components in the manufacturing process. These discoveries are not necessarily new, and the findings often lead to future changes. Recently a new concern has been exposed.

A rubber stabilizer used in the manufacturing of vehicle tires has been evaluated to be extremely toxic, especially to aquatic life, particularly coho salmon (Tian, et al., 2020). The compound is called 6PPD-quinone (6PPD-q). In the United States, a petition to ban the chemical has been made on behalf of several Indigenous Tribes (Strout, 2023) This type of discovery is not unusual and mirrors the public response when the negative impacts of lead additives in vehicle fuels became widely known. California has alerted manufacturers that limits on the use of this compound are imminent (Government of California, 2023).

Sodium chloride, the chemical typically used by road authorities to melt winter snow and ice and to reduce frozen material from binding to road surfaces, can be toxic to aquatic life (Government of New Hampshire, 2021). Environmental agencies are pushing for reduced use of this compound. Unfortunately, a safe, technically equivalent product remains elusive, while alternative products remain costly. The environmental benefits of not using salt are contrasted against vehicle driver demands, legislation, and insurance claims, which force municipalities to meet high winter control standards. The road maintenance industry has responded by developing salt application equipment which controls and monitors the salt dispensing equipment. The use of brine to reduce ice adherence is felt to reduce the overall use of salt. The industry continues to transition on this issue with improved methods of using road salt.

Calcium chloride is used to control dust on gravel roads. This compound has similar toxicity traits as sodium chloride. Products are being evaluated that can be used as an alternative to calcium chloride which have less environmental impacts than calcium chloride. As these alternatives become mainstream there may be a need to upgrade equipment, as was the case when fleets were outfitted with modern road salt dispensing equipment. There are several agencies looking at alternative bio-friendly products. A product known commercially as Greenroads, an aggregate stabiliser, is being piloted locally (Bio Diffusion Technologies). This product claims to be effective in maintaining and enhancing road surfaces with both aggregate and asphalt grindings. It is expected that the use of these and similar alternative products will expand when they are proven to be either a beneficial product or are found to be fiscally effective. There is an ongoing need to monitor the application of these products. Improved, longer lasting rural road surfaces would reduce costly annual maintenance.

E-bikes

Due to increasing popularity, the Ontario Ministry of Transportation (MTO) is currently evaluating proposed changes to how e-bikes are regulated. Currently all e-bikes, motorcycles, and related vehicles are classed as vehicles under the Highway Traffic Act. Proposals are being evaluated that are based on re-designating these vehicles based on weight and operating speed, and whether they are powered with human effort or an independent motor/engine.

With the ease of travelling longer distances using e-bikes it is expected that e-bikes will be used increasingly for short and medium-length commutes. With the speed of cars and bikes being so varied it will be important that roads are designed to handle increased bicycle and e-bike use.

Loyalist Township roads have historically been designed to accommodate conventional motorized cars and trucks, and not bicycles.

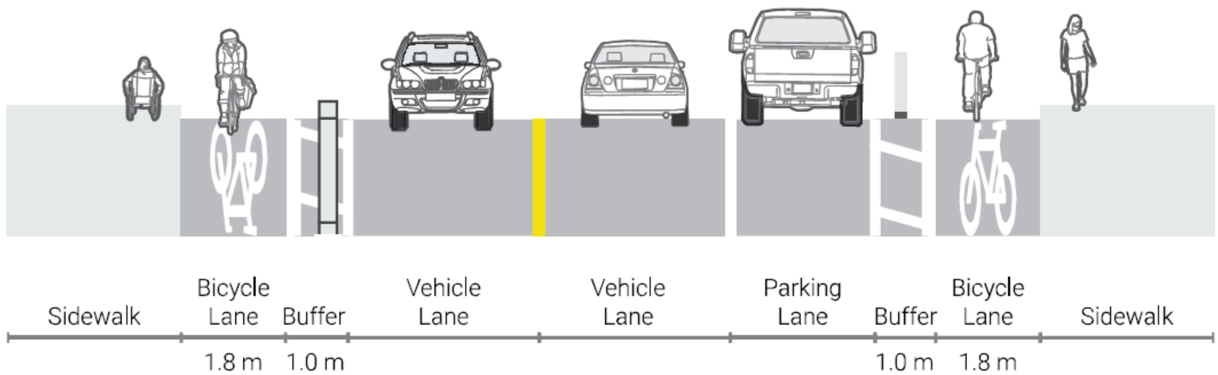


Figure 1 Cross-section of one-way physically separated bicycle lanes. Source: Ontario Traffic Manual Book 18

Fifteen Minute Communities

A fifteen-minute pedestrian-scale community is a residential area divided according to the principle that residents can meet their material, living, and cultural demands by walking no more than fifteen minutes. The concept is based on many successful applications in Europe. The communities of Amherstview, Bath, and Odessa, to varying degrees, are almost at the other end of the spectrum of the fifteen-minute community. Life in Loyalist Township is very car centric. Much of this is because most residents commute to larger centres, particularly Kingston, to work and frequent the many large commercial establishments that exist along their routes. Due to relatively low population density and long commuting distances, it has been challenging to develop good transit models.

The establishment of new neighbourhoods that reflect the fifteen-minute community would reduce vehicle traffic volumes and put less stress on the existing road systems, and should be promoted.

Reduced Load Seasonal Restrictions

Most older roadbeds were not constructed to convey the heavier vehicles often used today, and a large truck can cause severe damage to a road with a soft road base. Softer road bases are common during the spring as the frost breaks up in the ground. By regulating loads municipalities attempt to mitigate the negative impacts of trucks on rural roads. Unfortunately, this restriction can have economic impacts for farmers, construction, and the shipping industry.

The traditional period for reduced loads has been the months of March and April in Loyalist Township. During this period large vehicle weights are restricted to five tonnes per axle. With increased warming due to climate change, the weather patterns that necessitate half loads have meant half load restrictions must be imposed earlier than in the past.

To accommodate climate change, municipalities are adapting their reduced load by-laws such that they can offer increased flexibility both to manage exceptional requests and to modify the posted periods for half loads.

Good Roads and MTO have created an application to assist municipalities with determining the most effective time to apply half load limitations. This application, the Reduced Load Periods Onset and Removal Model (Good Roads, 2023) uses local weather data to improve risk management, reduce liability, prevent damage to road infrastructure, and assist businesses in addressing their logistics issues.

Emergency Detour Routes

Emergency detour routes (EDR) are designed as a formal alternate route to accommodate traffic when the Ontario Provincial Police must close a provincial highway, often due to an accident.

In Loyalist Township the EDR of primary interest is the use of County Road 2/Main Street – Odessa as an alternative to Highway 401. Multiple times a year, and particularly during winter months the EDR is activated, typically at very short notice.

Under ideal situations the local road is able to manage the additional traffic flow for a short duration. Unfortunately, the EDRs are a great concern to local municipalities including Loyalist for a number of reasons:

1) EDR routes often are quickly at capacity, creating local gridlock with vehicles seeking alternate routes.
2) Local maintenance vehicles getting stuck in gridlock often creating more stress for the balance of their system when the EDR is activated during a winter storm event.
3) During winter storm events the edge of pavement is sometimes difficult to see, and often large trucks will create ruts along the inner edge of the shoulders creating a safety hazard. These ruts need to be repaired quickly, which is difficult in winter.

4) Vehicles detoured from the highway will use GPS options to attempt to bypass gridlocked EDR routes. This leads to both high volumes and physical stress on rural roads, most of which are not constructed to handle this type of traffic. The result is safety concerns and a quick degradation of the road surface and potentially the road base.
   An anecdotal example is a prolonged EDR event east of Belleville, Ontario in April 2022 that lasted more than 24 hours, leading to hundreds of transport truck drivers attempting to bypass gridlocked sections of the official EDR route using their GPS devices. Some of the roads they chose were not able to manage the turning movements of large trucks due to the traffic congestion, and many trucks crashed into the ditches, as the narrow road widths were not designed to handle high-speed transport truck traffic. Many of the road surfaces were not designed for heavy truck traffic, and as a result, several kilometres of municipal roads were severely damaged.
5) Further to Item 4, municipal staff, if available, are required to establish temporary roadblocks to attempt to circumvent truck traffic on non-EDR routes.
6) Congested EDR routes result in municipalities not being able to respond to local emergencies.
7) OPP, by law, are the only individuals authorized to override streetlight signals. OPP seldom have the human resources available to address traffic management during an EDR event.
8) MTO does not provide funding for the many municipal costs created by the activation of EDRs.

Financial

The scope of developing financial models for the topics included in this technical memorandum are beyond the capacity of the report due to the multitude of alternatives that are expected to develop during the planning period of the IMP.

Climate Lens

The Climate Lens process was developed by Infrastructure Canada to help address the climate change impacts and greenhouse gas (GHG) emissions associated with infrastructure projects in Canada. By incorporating climate considerations during the planning and design of infrastructure projects, the Climate Lens is intended to help assess the potential impacts of projects, influence the design process, and inform funding decisions (WSP, 2020).

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of GHG emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions are closely related to transportation regulatory and emerging issues, including the following:

- Mean temperatures are projected to increase annually, and in every season (ICLEI, 2021). More frequent heatwaves and shorter winter ice road season due to warming may result in softening and rutting of roads (Swanson, Murphy, Temmer, & Scaletta, 2021)
- The number of days expected to reach above 30 degrees is expected to increase, while the number of days below -15 degrees is expected to decrease in the next 30 years (ICLEI, 2021)
- A decrease in the number of cold days, the number of icing and frost days and in the average number of freeze-thaw days. Per the 2021 ICLEI report, it is important to know how winters will change in the future because cold weather temperatures among other things “define how we design our buildings, vehicles, and shape our transportation and energy use”. On average, slightly less freeze-thaw cycles are projected for Loyalist Township in the next 30 years. Roads may not have to be built to sustain as many freeze-thaw cycles.
- Changes to the freeze-thaw cycles will impact the time of year that half load requirements will be in place.
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and overland flow.

Assessment of Alternatives

Considering emerging issues and regulatory changes is essential to the functionality of the Township moving forward. The conditions of many of these issues are controlled by government standards and regulations, limiting the opportunities to consider alternative approaches for implementation. Where possible staff will develop strategies, policies and by-laws that will help navigate the topics discussed above.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Following best management practices regarding the use of new materials such as materials that are mined including granular materials and using recycled materials when possible.
- Limiting the use of harmful vehicle and road-based pollutants will protect natural features that provide mitigation to extreme weather events.
- Reducing the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.). and using alternative materials (low-carbon concrete, high-density recycled plastic, cross-laminated timber, alternative steel technologies, etc.) and designs (open bottom modular culverts, prefabricated/composite bridges, etc.) when appropriate. The cement portion of concrete is the world’s

largest contributor to embodied carbon in the built environment. “Embodied carbon is expected to account for nearly 50% of the overall carbon footprint of new construction between now and 2050” (CarbonCure, 2020).
- Promoting use of e-bikes and environmentally friendly fuels/electric vehicles will reduce the carbon footprint related to transportation.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Use of heat-tolerant pavement mixtures to reduce pavement softening, rutting, and bleeding, and geotextiles to improve stability and reduce settlement of roadways, will limit the negative impact from EDR routes. (Swanson, Murphy, Temmer, & Scaletta, 2021)
- Modifying seasonal reduced load restrictions to align with local weather patterns should reduce negative impact on residents while protecting roads as required.

Linkages

Active Transportation Technical Memo

References

Bio Diffusion Technologies. (n.d.). *Green Roads*. Retrieved from Bio Diffusion Technologies: http://www.biodiffusion.ca/products/green-roads/

CarbonCure. (2020, September 22). *What is Embodied Carbon?* Retrieved from CarbonCure: https://www.carboncure.com/concrete-corner/what-is-embodied-carbon/

City of Fredericton. (n.d.). *Roundabouts*. Retrieved from City of Fredericton: https://www.fredericton.ca/en/roads-parking/roundabouts

Environment and Climate Change Canada. (2016). Pan-Canadian Framework on Clean Growth and Climate Change : Canada's plan to address climate change and grow the economy.

Ford Motor Company. (2023). *Explore 2023 F-150 Lightning*. Retrieved from Ford Motor Company: https://www.ford.ca/trucks/f150/f150-lightning/ev-charging/#charge_station_pro

Good Roads. (2023). *MTO Reduced Load Period Calculator*. Retrieved from Good Roads: https://goodroads.ca/technical-solutions/reduced-load-periods/

Government of California. (2023, July 26). *California Requires Tiremakers to Look for Safer Alternatives to Chemical that Kills Coho Salmon*. Retrieved from

Department of Toxic Substances Control: https://dtsc.ca.gov/2023/07/26/news-release_t-06-23/

Government of New Hampshire. (2021). *Road Salt and Water Quality Fact Sheet WMB-4.* Retrieved from NH Department of Environmental Services: https://dtsc.ca.gov/2023/07/26/news-release_t-06-23/

Hydro One. (2023). *Electricity Pricing and Costs*. Retrieved from Hydro One: https://www.hydroone.com/rates-and-billing/rates-and-charges/electricity-pricing-and-costs

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Mordor Intelligence. (2024). *Canada E-bike Market Size & Share Analysis - Growth Trends & Forecasts Up to 2029*. Retrieved from Mordor Intelligence: https://www.mordorintelligence.com/industry-reports/canada-e-bike-market

Strout, N. (2023, November 8). *US Environmental Protection Agency begins investigation of tire chemicals harming salmon*. Retrieved from Seafood Source: https://www.seafoodsource.com/news/environment-sustainability/us-epa-grants-petition-on-tire-chemicals-harming-salmon

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (2021). *Advancing the Climate Resilience of Canadian Infrastructure.* International Institute for Sustainable Development - IISD.

Tian, Z., Zhao, H., Peter, K., Gonzalez, M., Wetzel, J., Wu, C., . . . odziej, E. P. (2020). A ubiquitous tire rubber-derived chemical induces acute mortality in coho salmon. *Science, 371*, 185-189. doi:https://www.science.org/doi/10.1126/science.abd6951

Town of Innisfil. (2021). *Snow clearing robot coming to Cookstown*. Retrieved from Town of Innisfil: https://innisfil.ca/en/news/snow-clearing-robot-coming-to-cookstown.aspx

Vision Zero Network. (n.d.). *What is Vision Zero?* Retrieved from Vision Zero Network: https://visionzeronetwork.org/about/what-is-vision-zero/

WSP. (2020). *Bracebridge Community Multi-Use Complex, Draft Climate Lens Assessment – Climate Change Resilience, Bracebridge, Ontario.*

Conclusions

More so than in the past few decades, it will be important for roads and traffic engineers, roads supervisors, fleet supervisors, and public works managers to monitor advances in road construction and maintenance techniques and in powertrain alternatives. Significant changes can be expected in these topics, and it will be critical to be familiar with the impacts of the changes

If the trend for the use of bicycles and similar equipment increases as expected, there will be a need to review and modify roadways, especially those with higher traffic volumes and/or higher operating speeds, to safely accommodate the smaller vehicles.

Consideration of employing as many features as possible of fifteen-minute communities into Loyalist's new developments would be an improvement for many reasons, including traffic relief, more efficient community, and climate change benefits due to less use of vehicles.

It is recommended that the Township develop a corporate EV charger strategy to direct municipal decisions regarding installation of EV chargers, with an objective of rolling out a program as soon as possible.

IMP Technical Memorandum: Active Transportation Initiative

Asset Class: Transportation

Objective: The objective of the Active Transportation Initiative is to review existing active transportation infrastructure and to develop a focused plan for active transportation infrastructure improvements in Loyalist Township over the next 25 years that will provide more recreational opportunities and increase the general health and safety of the community. An important side benefit of improved active transportation is less reliance on automobiles, which can help locally reduce the production of greenhouse gases.

Background

Loyalist Township’s Official Plan includes a high-level identification of proposed pathway routes within the Township. Very little of this pathway system has been developed to date.

The level of service for sidewalk installations has varied over time, with the result that not all areas are served as well as others. Typically, older sections of the Township’s urban communities were constructed without sidewalks, or the sidewalks were constructed at widths now considered substandard, and existing sidewalks can present both accessibility and continuity issues.

Technological improvements have resulted in a variety of vehicles that rely on battery power, which greatly expands the practical use of bicycles, scooters, and similar vehicles for local transportation and recreation. Compact powerful engine technology combined with improved suspensions has made motorized vehicles such as ATVs increasingly popular.

With encouragement to rely less on carbon-based fuels and a desire for improved health, there has been an increase in the demand for recreational opportunities using human-powered locomotion.

The Active Transportation Initiative is divided into four components:

- Identify routes for pathway planning and development
- Identify locations where new sidewalks should be considered to ensure continuity and increase public safety within the existing sidewalk system
- Identify locations and develop a plan to replace sections of substandard sidewalk and to address locations where there are disconnected sections of sidewalks and poor or inadequate road crossing alignments, or sidewalks don’t meet AODA (Accessibility for Ontarians with Disabilities Act) requirements
- Identify policy areas that would assist in improving the facilitation of active transportation

Of the many projects within the IMP, the active transportation proposed improvements have generated the most discussion and community interest.

Assumptions

For this memorandum, unless stated otherwise, the use of the term “pathway” means a multi-use linear facility that can safely accommodate walking and cycling for most individuals. Depending on the type of surface the pathway may also accommodate wheelchairs, scooters, in-line skates/roller skates, etc. Reference documents may have used the term “trail”, and where this is the case, the original term is included.

Cycling and the term “bicycle” includes single, dual, and multiple-wheeled self-propelled vehicles and may be assisted or directly powered by small electric motors, i.e., e-bikes.

Unless stated otherwise multi-use pathways will not include the use of higher speed motorized vehicles such as motorcycles, ATVs, and go-karts.

Appropriate pathway routes may be designed and designated to accommodate local farm-based vehicles and access to agricultural lands where pathways have been established on unmaintained road allowances.

Individual pathways should consider design considerations for accessibility objectives, but it is recognized that not every location can accommodate all needs.

It is expected that each individual pathway and perhaps sub-sections of specific pathways will be designed and designated for certain uses such as pedestrian use, cycling, and/or ATVs based on local criteria.

Whenever higher-speed vehicles are combined with lower-speed vehicles and/or pedestrians, there will likely be a need to control speeds, and separation of faster vehicles should be considered.

For this memorandum, remedial sidewalk needs refer to urban locations where existing sidewalk standards vary greatly from current Township and/or Ontario Provincial Specifications (OPS) design standards or where the sidewalk is discontinuous.

Methodology

Completion of this review of active transportation within Loyalist Township relied upon:

- A review of alignments and widths of existing sidewalks and pedestrian crossing locations.
- A review of Loyalist Official Plan documentation and similar documentation from adjacent municipalities (City of Kingston, Township of Stone Mills, Township of South Frontenac, and Town of Greater Napanee).
- A review of recreation department documentation including the Recreation Master Plan (“RMP”) (Mehak, Kelly & Associates Inc. & Oraclepoll Research Ltd., 2017), and the Recreation Department Service Review (urbanMetrics Inc., 2022).

- Internal staff-level review of sidewalk and pathway recommendations from the perspectives of both residential and economic development and remedial needs.
- Coordination of active transportation needs with the County of Lennox and Addington's Infrastructure Services Department (County roads).
- Evaluation of community needs based on expected community growth, existing draft plan-approved subdivisions, and the Amherstview West Secondary Plan.
- Introduction of a Township-wide active transportation-themed public survey as part of the public engagement of the Infrastructure Masterplan, and an analysis of the responses from the survey.
- A review of capital budget plans, examining opportunities for projects.
- A review of recent topics involving pathway development, traffic calming, eco-tourism, reduction in greenhouse gases from transportation, safe practices, and community health benefits.
- Most local infrastructure and recreation sites included in a plan of subdivision or site plan approvals are classed as Schedule A projects and are considered exempt from further evaluations under the Municipal Class Environmental Assessment (MCEA). For clarity purposes only, this IMP will include proposed pathways and sidewalks to be constructed in parks to demonstrate the continuity of the overall network within the communities.
- The former road allowances that are now being proposed to be used as pathways were reviewed by natural heritage specialists to identify any current heritage that may require preservative efforts.

Analysis

Public Engagement – IMP Active Transportation Survey 2021

Loyalist Township's Infrastructure Masterplan hosted a very successful online survey entitled Inter-Community Trails and Urban Sidewalks in the fall of 2021. 331 residents responded.

A key takeaway from the survey was that 75% of the respondents indicated that they would like to see increased investment in active transportation infrastructure. It is noted that a small proportion of residents felt strongly that expenditures for pathways and sidewalks would be a misuse of tax dollars.

The survey results indicated that only 7.6% of the respondents were already participating in active transportation for their commute to work, confirming the community's current dependence on automobiles. Greater than 85% of the respondents travel five kilometres or more to work, and greater than 65% travel more than 10 kilometres, making many forms of active transportation impractical. The results are also supported by recent growth study data prepared by Hemson on behalf of Loyalist Township (Hemson Consulting Ltd., 2019).

Over 39% of the respondents noted that the next largest barrier to active transportation, after distance to work, was the lack of physical separation from traffic.

With respect to the general state of active transportation infrastructure, 42% felt that the active transportation systems were described as “good to excellent” while 48% felt that the systems were rated “poor to bad”.

Several sections of the survey allowed for broader public comments. The following items were mentioned multiple times by respondents:

- There was a very high response from all communities concerning County Road 6, Coronation Boulevard, and Highway 33/Bath Road. These roads are outside Loyalist’s direct jurisdiction, but the Township will have some influence on future levels of service regarding sidewalks and/or pathways. Officials at both the Ministry of Transportation (MTO) and the County of Lennox and Addington (“the County”) have been advised of these results.
- In Amherstview the biggest concerns are the desire for improvements along Bath Road, including a crossing to Fairfield Park, County Road 6, Coronation Boulevard, Amherst Drive, and linkages to existing trails in Parrott’s Bay and a pathway link to Odessa. There were several responses promoting local sidewalk improvements within the older sections of Amherstview.
- The lack of sidewalks along both sides of Main Street - Bath is the biggest concern in the Bath community, followed by concerns regarding County Road 7 (Church Street) and lack of sidewalks on Sir John Johnson Drive.
- Many of the older narrow streets in Odessa do not have sidewalks, so it was not surprising that there would be broad support for localized sidewalk improvements within the community. Lack of sidewalks along County Road 6 is the largest concern identified, and support was expressed to redevelop the unmaintained road allowance south of Timmerman Street to Caton Road.
- The respondents from Amherst Island identified the need for sidewalks in the vicinity of Front Road in Stella and including access to the school as a primary concern. Residents indicated support for improved locations for walking including pathways.

Public Engagement – Loyalist Public Transit Survey 2020

A year prior to the IMP Active Transportation Survey, Loyalist Township hosted an online survey focusing on public transit issues that yielded helpful data on active transportation (Loyalist Township, 2021). The survey collected feedback from approximately 495 residents. 60% of respondents indicated interest when asked whether an active transportation network, such as walking trails and bike paths, should be incorporated into the design of a transit system in Loyalist Township. The full breakdown of these responses is shown below:

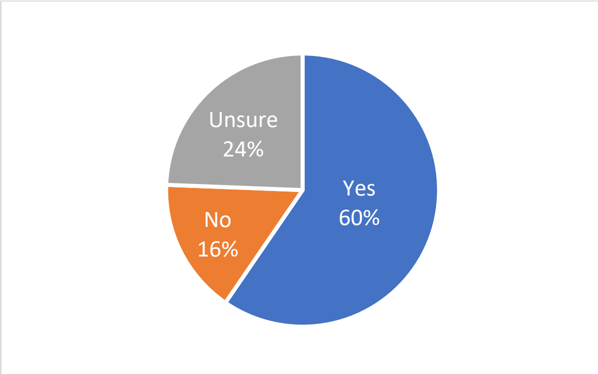


Figure 1: Responses to whether an active transportation network, such as walking trails or bike paths, should be incorporated into the design of a transit system in Loyalist Township; 410 responses.

Interest in several possible modes of active transportation as identified by the survey is shown below, with some variation of walking or running being the most selected method. Several responses to "other," indicated the need for stroller accessibility.

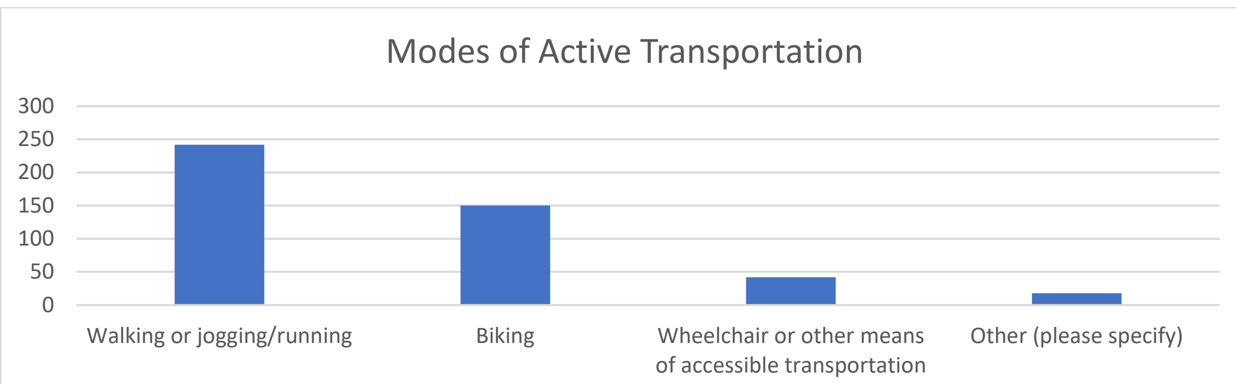


Figure 2: Potential modes of active transportation respondents would be likely to use in conjunction with a public transit system (multi-select); 368 responses.

From the public engagement processes the biggest demand for new sidewalks appears to be Coronation Boulevard, County Road 6 within both Amherstview and Odessa, Main Street – Bath, and along Highway 33/Bath Road. Some of these routes may be of most benefit if these routes are developed as multi-use pathway as they offer opportunities to connect to major active transportation linkages.

The survey results indicate that there is a solid demand for extension of a multi-use pathway system.

Generally, the existing sidewalk system meets public expectations, though some remedial concerns have been noted.

Health Benefits of Active Transportation

By expanding facilities for active transportation Loyalist Township can assist in improving the quality of life for residents.

Some of the acknowledged health benefits of active transportation (Leahy, O'Grady, Sauve, & Stroud, 2020) are that it:

- Lowers the risk of Type 2 diabetes
- Lowers the risk of heart disease, stroke, and high blood pressure
- Lowers the risk of some cancers, including breast and colon
- Improves mood
- Promotes better sleep
- Lowers stress levels

When coupled with good planning policies such as creating local employment, the opportunities for active transportation increase. New development within Loyalist has included active transportation elements in addition to standard sidewalks for several years. Many older streets have been retrofit with sidewalks to provide some connectivity in established areas. Adding sidewalks to an older street is not always practical due to right-of-way width and stormwater drainage concerns. There are many environmental, resilience, and financial benefits realized by using open ditches versus typical underground storm sewer systems. For these reasons the Township is reluctant to replace open roadside ditches with storm sewers.

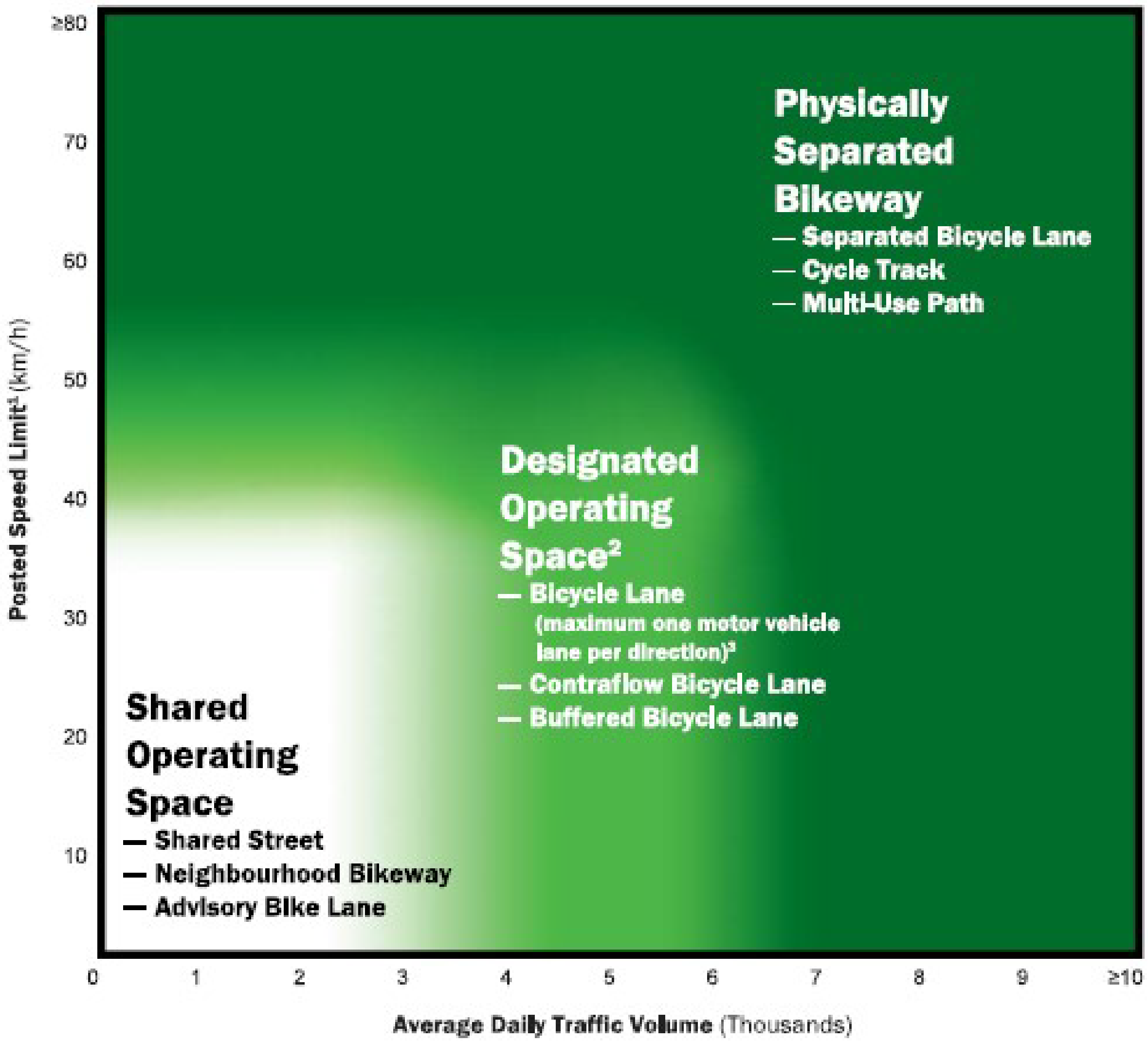
Safe Design Methodology

Sidewalks and pathways also offer an element of public safety especially when compared to walking or riding on the side of a high-volume, high-speed road.

Canada lags behind many countries in the acceptance of bicycles for regular transportation, but trends are rapidly changing. To meet this demand there has been recent research undertaken at the municipal level. In 2020 the Transportation Association of Canada (TAC) published Safety Performance of Bicycle Infrastructure (Montugar, Chapman, Poapst, & Bahar, 2020), and in 2021 the Ontario Traffic Manual Book 18 (Ontario Ministry of Transportation, 2021), which includes bicycle infrastructure and signage, was completely overhauled. Both documents provide design guidelines.

The Ontario Traffic Manual (OTM) includes nomographs for both urban and rural situations for use in the consideration of the level of cycling infrastructure, which are illustrated in the figures below.

Desirable Cycling Facility Pre-Selection Nomograph Urban/Suburban Context (Step 1)



1. Operating speeds are assumed to be similar to posted speeds. If evidence suggests this is not the case, practitioners may consider using 85th percentile speeds or implementing measures to reduce operating speeds.
2. Physically separated bikeways may always be considered in the designated operating space area of the nomograph.
3. On roadways with two or more lanes per direction (including multi-lane one-way roadways), a buffered bicycle lane should be considered the minimum with a typical facility being a physically separated bikeway.

Figure 3 Desirable Cycling Facility Pre-selection Nomograph, Urban Context

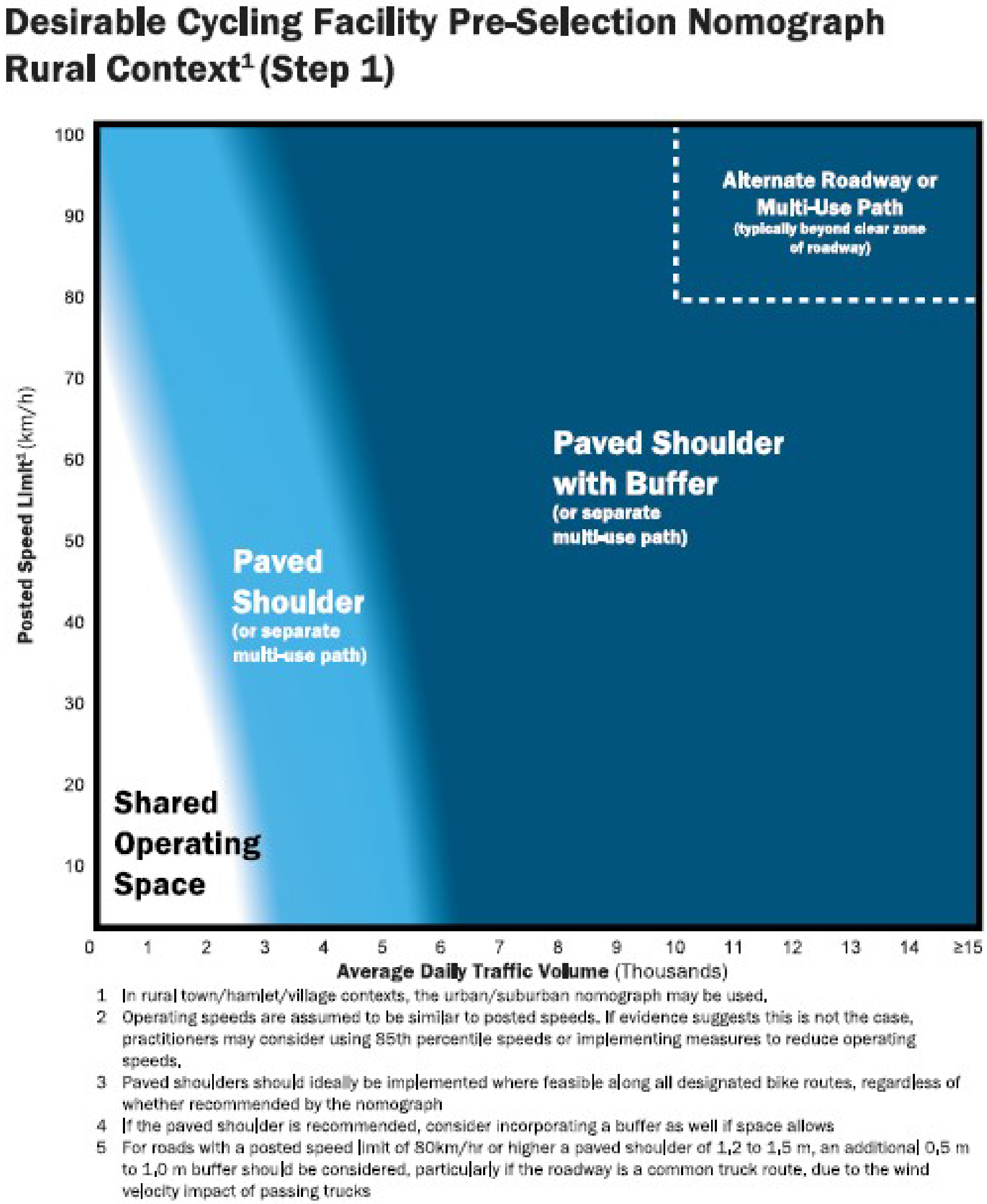


Figure 4 Desirable Cycling Facility Pre-selection Nomograph, Rural Context

The design guidelines are based on the rider's sense of security. The needs for physical spatial separation and for physical barriers increase when traffic volumes and traffic speeds increase. The new OTM bases the current design level on a medium-secure (competent) rider and would represent a family outing or perhaps an older rider. The new guidelines suggest a separate bicycle lane at a minimum for all roads with higher capacity than a “local” road. For example, the new design standards suggest roads like Amherst Drive, Kildare Avenue, and Church Street/County Road 7 should have protected bicycle lanes whenever possible.

Locally there is currently limited local demand for additional bicycle infrastructure. This is likely because the local cycling infrastructure is in its infancy and there are very few continuous options. Observations of other countries, and cities like Ottawa and Montreal where cycling routes have been popular for a few decades, indicate that when dedicated infrastructure is available and the environment feels safe for the riders, these facilities are heavily used. Observations of the popular year-round use of the trails at Parrott’s Bay and at other locations reflect a genuine public interest for opportunities to both enjoy nature and recreation at the same time. Well-designed and easily accessed pathways are well used by the community.

Loyalist Pathway Development Opportunities

This section has been compiled using information derived from studies and plans administered by local and adjacent municipalities, and local knowledge of Loyalist Township’s roads and parks network.

Lennox and Addington Transportation Masterplan

Section 5.4.1 of Lennox and Addington’s Transportation Master Plan Update (AECOM, 2014) describes the County’s paved shoulder program. For over a decade the County has been providing paved shoulders on the County roads network. Although technically not bicycle lanes, the paved shoulders do provide room for walking and are often used by competent cyclists, even though in some locations traffic volumes are high and motorized vehicle velocity is also high. With the passage of time, more County roads have paved shoulders installed and local communities are becoming better connected.

There may be times when traffic volumes and speeds on the lower-volume County roads are compatible with the new OTM for cycling. For higher-volume County roads such as County Roads 2, 4, 6, 7, and 23, and the northern section of County Road 24, the combination of traffic volume and posted speed limit approaches the threshold at which active transportation should have a greater separation from traffic lanes more than what a paved shoulder on its own will offer.

There is a good opportunity for Loyalist Township to efficiently expand the pathway system within the Township, particularly if the County upgrades its standards to match the new OTM requirements for the pathway routes that link Loyalist communities. Ideally the two levels of government would coordinate improvements along priority routes. It is recommended that Loyalist Township request that the County upgrade its paved shoulder standard to match TAC requirements for bicycle lanes. Loyalist Township should also request that the County prioritize the creation of east-west bike lanes within Loyalist Township between County Road 4 and 7, where there are currently no facilities south of Highway 401.

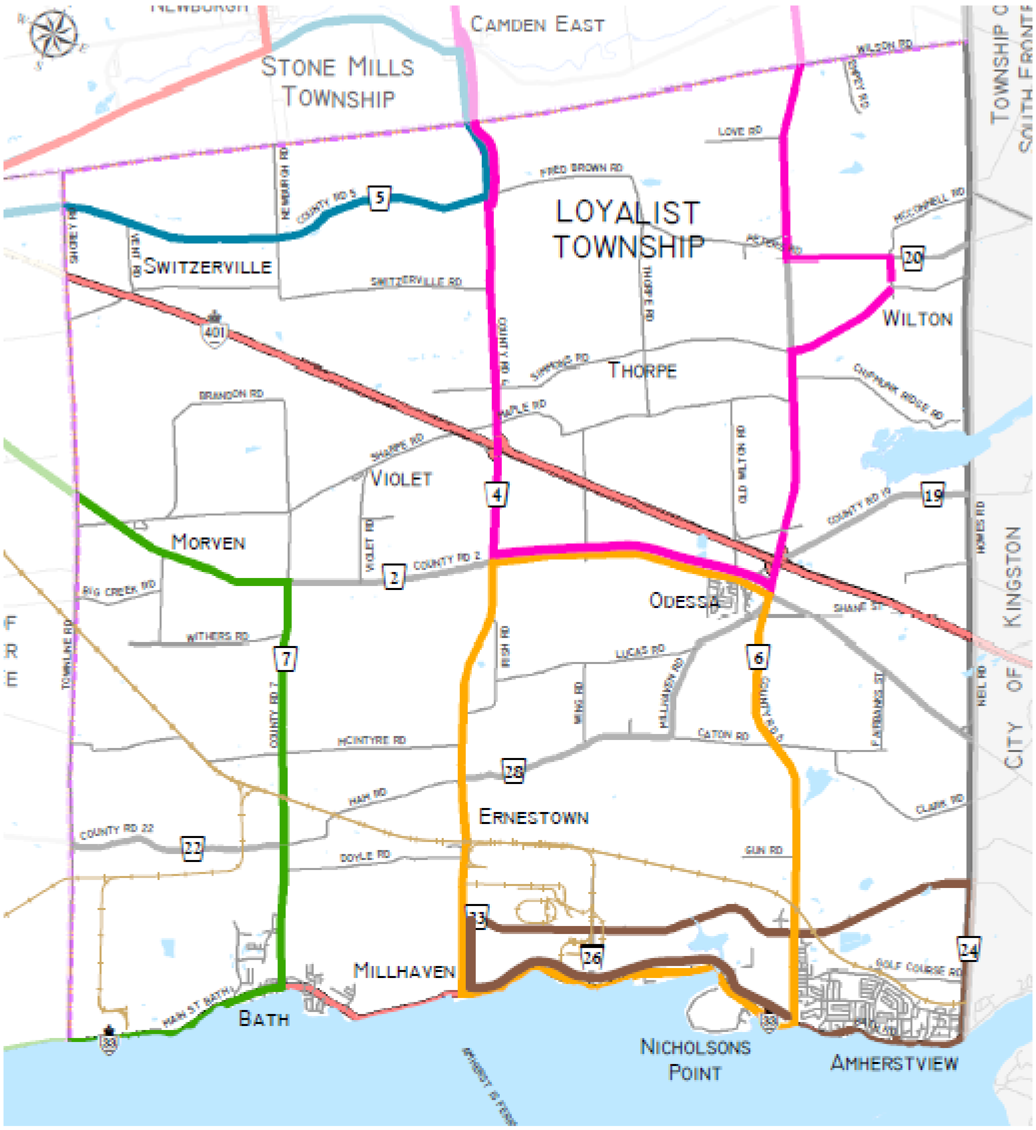


Figure 5 County Roadside Bicycle Pathways within Loyalist Township

It is noted the County currently does not fund sidewalks within the County road system. This means that any new sidewalks within Loyalist Township are to be funded either by the Township or available grants, directly by a developer, or indirectly through development charges or local improvement charges.

Loyalist Township Official Plan – General

The Loyalist Township Official Plan (Loyalist Township, 2022) includes Schedule I entitled “Trail System”. Schedule I is a high-level schematic map of a long-term pathway program for the Township. The Infrastructure Masterplan is the next step in developing the pathway system.

The conceptual routes noted in the Official Plan (OP) have been further screened by Township staff for suitability as part of the IMP process. It is noted it is not economically feasible, within the planning horizon of this IMP, to implement all the routes noted in the OP. The intent of this section is to review the proposed OP trail network and note a recommended status of the various trail sections. These recommendations are being made after reviewing the IMP Active Transportation survey results, known future development plans, and a detailed review of the Township’s sidewalk and pathway system and existing road conditions. There are three possible outcomes to this review:

Outcome 1: The pathway section should be prioritized and included as a recommended project in the IMP.

Outcome 2: The pathway section is now deemed impractical due to environmental, economic, or social constraints, and alternatives should be sought/this section eliminated in future reviews of the Township’s OP.

Outcome 3: It is felt that the pathway section is an important link. Due to other factors, this will not be recommended as a priority project within the current IMP but should remain in the OP for future consideration or when dedicated funding opportunities and partnerships present themselves.

Loyalist Township OP - Millhaven Creek Corridor

The OP illustrates a corridor extending from Mud Lake at County Road 6 southwesterly to the outlet of Millhaven Creek into Lake Ontario. There has been little work completed to date on this pathway with the exception of improvements to a short section along Bridge Street within Babcock Mill Park. It is recommended that except for the four sections noted below the balance of this program be considered Outcome 3.

Staff have identified three options for extending the existing section to Main Street – Odessa. One option is to extend the pathway directly to Main Street – Odessa along Bridge Street; or alternatively construct a bridge across Millhaven Creek and intersect Main Street – Odessa at a location to be determined between Main Street – Odessa, Millhaven Creek Bridge, and Mill Street.

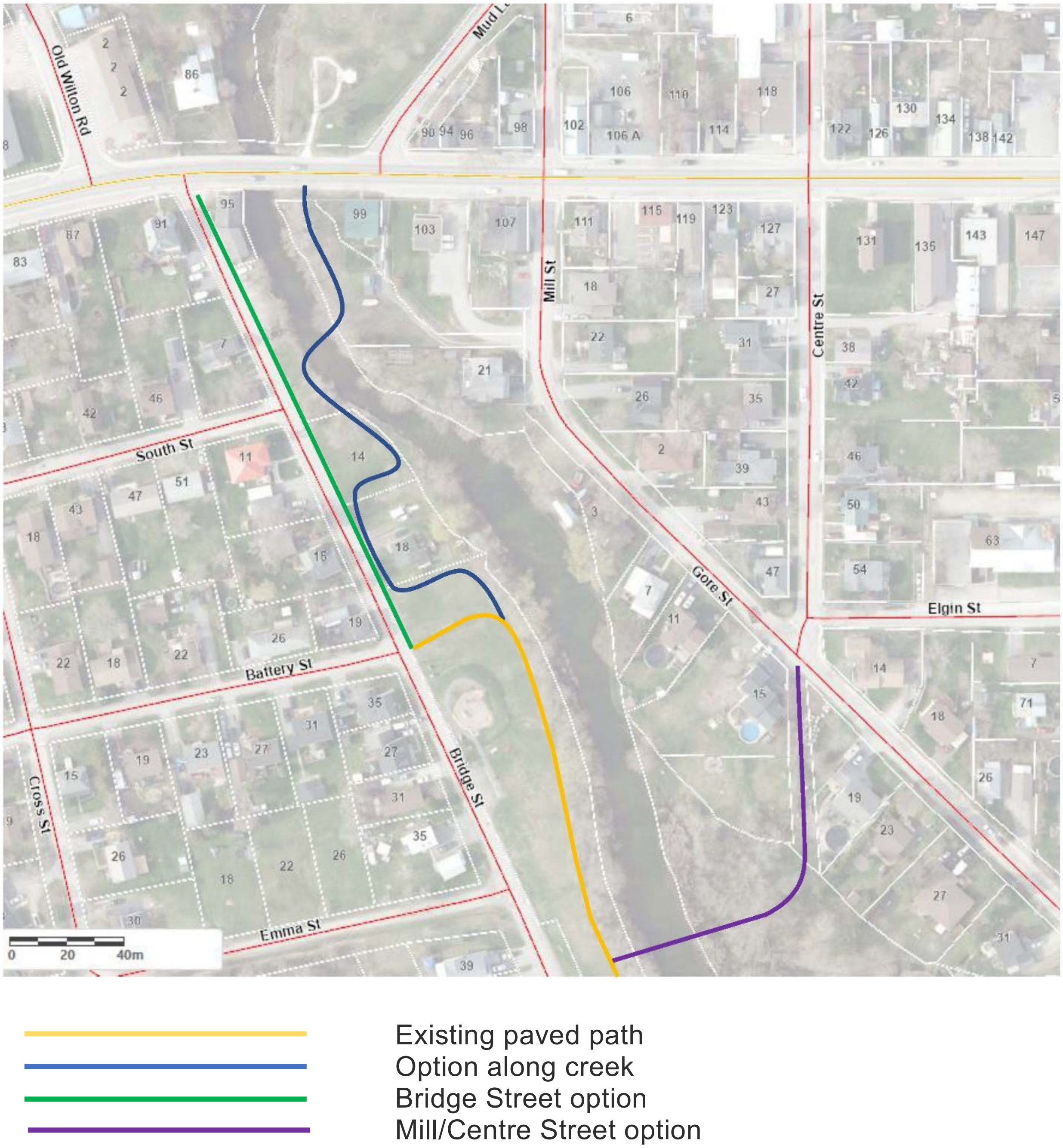


Figure 6 Odessa Existing Pathway and Future Pathway Options

This section is classed as an Outcome 1 project. These options will need to be further reviewed prior to proceeding with property acquisition and design process. This section of the pathway should be funded by a combination of DC funding using background growth rate and Loyalist Township or alternative funding.

The existing Bridge Street section pathway has been extended to the west, parallel to the north side of Millhaven Creek. This completes a link from Babcock Mill Park to creek-side lands adjacent to the new Odessa West permanent stormwater facility, where it links to a paved pathway into the Babcock Mills Phase Three development. This project, considered an Outcome 1 project, is be funded by a combination of Township internal and grant funding and direct developer contribution.

The Township recently received an application for draft plan of subdivision for the lands defined as Ernestown Con 3 4 Pt Lot 3; RP 29R5027 Parts 1, 2. Consideration should be given to extending this pathway concurrently with that development and that this pathway to be funded either by direct developer contribution or development charges.

Within the timeline of the IMP, it is expected that County Road 23 (Taylor-Kidd Boulevard) will be extended westerly to County Road 7, requiring a bridge over Millhaven Creek near the Millhaven Institution.

It is recommended that when the County re-establishes the environmental assessment for the westerly extension of County Road 23 (Taylor-Kidd Boulevard) or commences detailed design, the Township request that the design team consider a design that either supports or includes the development of a portion of the Millhaven Creek Pathway in that vicinity. Ideally the new bridge would have sufficient capacity to accommodate a multi-use pathway, as Millhaven Creek at this location provides accessibility challenges.

It is expected that the balance of the Millhaven Creek Corridor Pathway would be classified as an Outcome 3 project, should dedicated funding opportunities and partnerships present themselves.

Loyalist OP - Lake Ontario Waterfront

The OP indicates a conceptual route commencing at the Township's western border and following the lakeshore easterly to Coronation Boulevard, the Township's eastern border with the City of Kingston.

Recreation staff within Loyalist Township anticipate the initiation of a comprehensive Waterfront Strategy in the near future that will coordinate opportunities and provide vision for recreational services along the waterfront.

Within the Bath and Amherstview communities the OP mapping indicates the pathway being located slightly north of the lakeshore, generally following the alignment of Bath Road/Highway 33.

Highway 33 has a paved shoulder, approximately one meter in width, in most locations. This detail is substandard for a dedicated bicycle lane when traffic speed and volumes are considered. Much of the proposed route as found in the OP is within MTO's Highway 33 right-of-way, and therefore outside of the direct jurisdiction of the Township. Loyalist Township does have jurisdiction over Main Street – Bath. MTO's current standards for bicycle lanes requires separation from the travelled lanes. Due to shoreline and property constraints, horizontal separation requirements between a proposed pathway and traffic may be difficult to achieve in many locations.

Any improvements in terms of new sidewalks or pathways must be funded by the Township and approved by MTO if the pathway is to be situated within or near Bath Road/Highway 33. Traditionally MTO has not financially supported funding of active transportation elements, but anecdotally that position may be evolving. MTO coordinated sidewalk improvements along Bath Road/Highway 33 over the past few years and there is now a continuous sidewalk from Collins Bay (City of Kingston) to Lakeview Park in Amherstview. Based on the many comments from the public survey and the popularity of waterfront pathways in other communities, it is felt that a waterfront pathway along the shoreline of Lake Ontario should be pursued.

Throughout the public survey there were several comments concerning the need for a safe pedestrian crossing to Fairfield House. Fairfield House and the waterfront park are popular local attractions.

Figure 7 Example of a waterfront boardwalk - Sault Ste. Marie, Ontario

In addition to the objectives for active transportation noted earlier, this route has an economic development driver as it would provide a draw for regional tourism.

It is recommended that Loyalist Township undertake a masterplan-level evaluation of the waterfront route and evaluate the best route and appropriate infrastructure type (sidewalk, pathway, etc.), so that elements with the corridor can eventually be provided for in a coordinated fashion. The plan should include a crossing of Bath Road/Highway 33 near Lakeview Park to Fairfield Park. This crossing should be considered a priority. A crossing will require approval from MTO.

It is recommended that the evaluation of the Waterfront Trail route be completed in close conjunction with the proposed Waterfront Strategy.

It is recommended that Loyalist Township lobby MTO and the Province and actively participate in future environmental assessments regarding Bath Road/Highway 33 within Loyalist Township and environs, for the inclusion of a pathway system along the waterfront, consistent with the results of the waterfront pathway masterplan noted above. The completion of the masterplan would allow improvements to be completed in a focused manner over a longer timeframe.

The waterfront masterplan should be considered an Outcome 1 project and should be funded jointly by the Township and by development charges. It is recommended that the Township budget for the waterfront pathway masterplan, and that portions of the pathway be constructed when funding permits.

Within this route it is expected that Amherstview West, defined as the lands immediately west of County Road 6, will be developed. A secondary plan process for this area is underway at the time of the preparation of this IMP. The development of a pathway along the southern flank of this development area should be considered an Outcome 1 project and this section funded as a growth project.

The Main Street – Bath corridor is within the jurisdiction of Loyalist Township. There is a continuous sidewalk along the north side of the street, and a few blocks of sidewalk in the central older area on the south side of the street. The road cross-section varies considerably, and in some areas of the section west of Church Street a substandard width bicycle lane has been included. This section was resurfaced in 2020. Development of a proper bicycle lane(s) or multi-use pathway for the western section is considered an Outcome 1 project. The eastern section of Main Street - Bath is currently due for reconstruction, and consideration of a proper bicycle lane(s) or a multi-use pathway is proposed for this project. This section should be considered an Outcome 1 project, and should be funded by growth, either directly where appropriate or through development charges, as this section is currently experiencing a high concentration of new development. The westerly portion of Main Street – Bath west of Fairfield Street has been recently developed, and as such, the development of a dedicated multi-use pathway or bicycle lane in this section is considered to have a non-growth portion with the balance funded by development charges. The west end of Main Street – Bath is not expected to be resurfaced until late in the horizon of this IMP but should be considered an Outcome 1 project.

The balance of the improvements along this route would be completed as funding becomes available.

It would be appropriate that when a pathway is developed along Main Street – Bath, it would also serve as a portion of the waterfront pathway.

Loyalist OP - Bayview Bog Conceptual Trail

From Parrott's Bay the conceptual route of the Bayview Bog Trail is northeasterly, generally following the lower levels of the watershed through the Bayview Bog area to the east side of the Township. It is expected that much of this route, as indicated in the OP, is within or near both seasonal and permanent wetlands.

The western portion of this route is within or adjacent to the Amherstview West Secondary Plan area. This pathway would also intersect the proposed waterfront pathway near Parrott's Bay. The concept of this pathway has been included in the development of the Secondary Plan, and as such, will be considered an Outcome 1 project funded by growth in the development area. Funding beyond the development area is beyond the current planning horizon. The development of the multi-use pathway infrastructure in this area will provide direct linkage to the existing Parrott's Bay pathway system maintained by the Cataraqui Region Conservation Authority and the balance of Amherstview to the east.

The section east of County Road 6 is routed near or through the large wetland complex associated with the Bayview Bog. This section should be considered an Outcome 3 project unless specific funding or a partnership opportunity becomes available.

Loyalist OP - Amherst Island

Schedule I of the Township's OP includes a circumferential shoreline pathway route around the Island. The proposed pathway would be used for pedestrians and cyclists. Much of the proposed route follows the existing road network, apart from sections along the western end of the Island between the west end of South Shore Road and Front Road. The western section should be considered an Outcome 3 project unless specific funding or a partnership opportunity becomes available.

Most of the roads on Amherst Island are gravel-surfaced, and as such, may only be considered safe for bicycles by the most competent riders. Additionally, some styles of bicycle tires may be less suitable for gravel roads than others. Some of the road system on Amherst Island has retained the historic forty-foot-wide road allowances, making it difficult to make room for additional infrastructure without a formal road widening program. Many of the roads are forced roads, with the result that the Township's jurisdiction is limited to that portion of road and boulevard that is maintained by the Township. The narrow roads must be used cautiously by pedestrians and drivers. Therefore, it is believed that improvements for a bicycle pathway system that meets OTM standards is not recommended in the short term, except potential routing along Front Road or Stella Forty-Foot Road where road widenings may better accommodate active transportation. Stella Forty-Foot Road is currently not indicated on Schedule I as a future pathway.

Development of pedestrian hiking facilities on portions of Front Road between Emerald Forty-Foot Road and Lower Forty-Foot Road should be considered an Outcome 1 non-growth-related project.

Consideration should be given to permanent road closure of Marshall Forty-Foot Road. This road allowance can be easily converted to a multi-use pathway. This pathway route would need to be able to accommodate authorized users access to their agricultural facilities on adjacent lands and would provide for pedestrian access to the Owl Woods.

It is recommended that the OP's Schedule I be amended to show a pathway route along the entire length of Stella Forty-Foot Road and Marshall Forty-Foot Road.

There is an unmaintained road allowance which runs west to east from Stella Forty-Foot Road to the east tip of the Island, on what is known as the concession between the North and South concessions on Amherst Island. Due to its length and natural setting this route was initially considered by Township staff as a potential trail option. Further analysis has indicated that much of the actual allowance is wetland, and as such environmental impacts would be significant. While the route could be improved to a multi-use pathway, it is expected that the pathway would need to be elevated in any wetland area or rerouted onto private lands to avoid the wetlands. Either option would add considerable cost to developing a substantial portion of this route. The planning/design process would likely be an interactive process between route evaluations and land access negotiations. Some of the desirable traits of this route are the tree canopy and the proximity of the Owl Woods. Staff expect that, should this project proceed to the planning stage, there would have to be a lengthy process of evaluating various options and detailed ecological impact assessments for any route to be evaluated. Based on proposed construction methods, archeological assessments may also be required. The potential length of this trail is also of interest to pedestrians as it would be free of traffic. Consideration would need to be given to ensure continued access by local agriculture operations, where required.

Considering the foregoing, there are too many unknown factors to recommend inclusion of this route in the IMP. Staff recommend that the route be further evaluated to determine viability of a multi-use pathway along this right-of-way. Should the route prove viable, it could then be considered in further evaluations of pathway development.

The development of a walking pathway along Stella Forty-Foot Road should be considered an Outcome 1 non-growth-related project. This pathway would commence at the recently improved Island ferry terminal. Road widening has been secured on the west side of front road between Front road and Second Concession Road.

Development of a pathway on the Marshall Forty-Foot Road should be considered an Outcome 1 non-growth-related project.

The balance of the route, i.e., Lower Forty-Foot and South Shore Roads, should be considered an Outcome 3 project unless specific funding or a partnership opportunity becomes available.

Development of a hiking pathway along the road network is somewhat feasible due to the relatively lower traffic volumes. An education program should be developed for all types of road users on how to share the road safely. This program would include signage. Consideration should be given to lowering the posted speed on unsigned rural roads on Amherst Island to 60 km/h. The reduction would make roads safer for pedestrians and could be introduced with the education program. Ideally, road widenings would be prioritized along hiking routes so that road surfaces could be safely widened for pedestrians and cyclists in designated areas.

It is recommended that the posted speed on Amherst Island roads be 60 km/h unless there is a localized safety requirement for a lower speed, and that an education program be developed to assist with the transition.

Loyalist Parks and Recreation Masterplan

In 2017 Loyalist Township completed a Parks and Recreation Masterplan (Mehak, Kelly & Associates Inc. & Oraclepoll Research Ltd., 2017). Section 2.1.3 of the Parks and Recreation Masterplan (PRM) states that, “For children, participation in physically active and social recreation is a preventative approach to lifetime ‘personal culture’ of activity and connectivity.” The PRM also notes that “the benefits and resultant health outcomes of physical activity participation by older adults are well established, and physical activity is now identified as the single most important factor in maintaining independence.”

The PRM suggests that all efforts should be made to make recreational facilities as accessible as possible to all members of society. This is important when reviewing the list of substandard sidewalk widths and misaligned or discontinuous sidewalks, which are discussed in more detail below.

Section 3.4.3 of the PRM is a detailed assessment of the Township’s mainland shoreline recreation assets. The report notes that many of these sites could be updated and would benefit if they were made more attractive. These facilities are consistent with the OP’s proposed Waterfront Trail location. It is important to note that the Township already owns some sections of the waterfront, and according to the PRM, these lands are underutilized recreational assets.

The PRM noted in Section 3.4.1 that one of the key trends in recreation in Ontario is creating opportunities for creating passive recreation in sustainable areas of the natural heritage system: “Parks, trails and natural areas offer low or no-cost opportunities for all ages to be active outdoors". Natural buffer areas are also valuable assets for other reasons such as preserving natural habitat and storm water management.

Section 3.4.1 notes, "The justification for additional trail development within Loyalist Township is well supported by leisure trends and healthy objectives." The PRM notes the results of the public survey that accompanied the PRM process. These results have a few variances from the comments received in the IMP survey.

The proposed pathway locations as noted in the PRM and the current status are noted as follows:

- Bath Water Tower: included in IMP as Windermere/Briscoe Park connecting to Main Street – Bath via the pathway linkage adjacent to the Aura by the Lake stormwater management facility (located immediately east of Windemere Boulevard at Main Street – Bath), complete with a tie-in to Jessup Lane Park. The pathway would extend northwesterly in an alignment approximately parallel with the future alignment of Windemere Boulevard to County Road 7. The section of this pathway is under construction from Main Street - Bath to Purdy Road.
- Jessup Lane Park: see above.
- Odessa Centennial Park: see comments regarding improvements to Old Wilton Road.
- Odessa, west of Bridge Street: Babcock Mills Park Natural Playground was developed along the banks of Millhaven Creek opposite Emma Street. See below for more details.
- Amherstview waterfront: Sidewalk was extended easterly to Coronation Boulevard and westerly from Sherwood Drive to Lakeview Park. See below for Lakeview Park and related pathway and sidewalk details.
- Main Street – Odessa: The existing sidewalks should be revised with a design that is both bicycle- and pedestrian-friendly and supportive of local commercial activities. This design should extend the full extent of Odessa. This project should be funded jointly by Loyalist Township, the County of Lennox and Addington, and development charges.

The design should include a pedestrian crossing to the schools and crossings in all directions at County Road 2.

City of Kingston - Coronation Corridor

In April 2021, Loyalist staff met with senior officials from the City of Kingston and Utilities Kingston to discuss various aspects of the IMP, including opportunities for joint servicing and transportation linkages.

The City of Kingston has decided to limit greenfield development, instead focusing on infill and intensification along existing corridors. Subsequently, no road extensions from the City are expected to impact Loyalist Township's road system within the timeframe of the IMP.

As part of their climate action initiatives, between 2016-18 the City undertook its active transportation masterplan (City of Kingston, 2019). The plan prioritizes a series of infrastructure improvements, including pathway delineation and intersection improvements throughout the City, with an emphasis on developing an initial network.

Three routes have been identified with specific impacts for Loyalist Township:

- Taylor-Kidd Boulevard, becoming County Road 23
- Princess Street, becoming County Road 2
- Waterfront section along Bath Road/Highway 33

Of these routes, Taylor-Kidd Boulevard was noted to commence immediate improvements in various phases however improvements in the vicinity of Coronation Blvd. are expected to be long term.

With the completion of the City of Kingston's Waaban Crossing of the Cataraqui River early in 2023, the Gore Road-John Counter Boulevard-Taylor-Kidd Boulevard-County Road 23 corridor forms one of the primary east-west links in the City and extends as an important arterial road within Loyalist Township. Within the IMP study period it is expected that Taylor-Kidd Boulevard/County Road 23 will be extended westerly beyond County Road 4, to County Road 7 north of Bath.

Coronation Boulevard south of Taylor-Kidd Boulevard is a boundary road under joint jurisdiction of the City of Kingston and the County of Lennox and Addington.

It is recommended that Loyalist Township monitor the Taylor-Kidd Active Transportation project and, in conjunction with the City of Kingston, evaluate extending a new walkway or multi-use pathway along Coronation Boulevard from Bath Road/Highway 33 northerly to Taylor-Kidd Boulevard. Similarly, the Township's Official Plan should be modified to include the Taylor-Kidd proposal.

Development of a sidewalk or pathway on Coronation Boulevard should be considered an Outcome 1 project. Funding mechanisms would have to be developed with potential cost sharing with the City of Kingston, County of Lennox and Addington, and potentially long-term development, especially if there is potential development in the immediate vicinity.

Since the City's plan was released, a sidewalk has been extended from Collins Bay within the City of Kingston westerly along Bath Road/Highway 33 to Lakeview Park in Loyalist Township.

Loyalist Township in cooperation with the County of Lennox and Addington should work with the City of Kingston to improve the active transportation infrastructure along County Road 2.

City of Kingston – Power Transmission Corridor

The provincial electrical transmission grid corridor crosses Loyalist Township from west to east and extends north-easterly in the City of Kingston. Use of this alignment as a future pathway has significant benefits. This route could be easily accessed from the County Roads system and potentially link to many of the pathways proposed in this documentation. Specifically, the electrical corridor is close to the Bath community and the proposed Millhaven pathway, the proposed pathway south of Odessa, the proposed Bayview Bog pathway, and the Coronation corridor. If established, this route could provide important linkages to existing regional pathways and be a major attraction. The transmission corridor is illustrated on the Rural Sidewalks, Trails & Bike Routes figure.

It is recommended that Loyalist Township approach the Independent Electricity System Operator (IESO) and propose a feasibility study of a multi-use pathway for the power transmission corridor within Loyalist Township. This should be considered an Outcome 1 project.

Stone Mills

The Stone Mills Official Plan promotes the development of active transportation and hosts two significant pathway routes, the Trans-Canada and Cataraqui Trails. Section 5.14.4 of the Stone Mills OP notes that trails provide a significant recreational opportunity, and their development is encouraged. Section 5.14.4 (g) notes that use of unmaintained road allowances will be encouraged.

The Cataraqui Trail travels approximately east-west just north of Loyalist Township's northern border and through the community of Yarker. The Cataraqui Trail extends from Strathcona easterly to Smith Falls, with connections to the K&P Trail into Kingston and Sharbot Lake and other regional trail systems.

Figure 8 Empey Road Allowance, Loyalist Township near Wilton

Empey Road is primarily an unmaintained road allowance which extends north from McConnell Road near Wilton almost to Wilson Road, south of Yarker. There are a few homes on Empey Road near Wilson Road. Most of this route is currently only used to access farm fields, with 2.3 km of this route running through forested areas. This route could be easily upgraded as a multi-use pathway and should be developed as an Outcome 1 project. This section should be funded as a non-growth project. Loyalist Township can work with the County of Lennox and Addington and the Township of Stone Mills to finalize route connections to the remainder of Loyalist Township, most likely utilizing Old Wilton Road as a connection to Odessa. Empey Road could immediately be used as a hiking trail, providing four-season recreation in a rural and unique natural setting. Much of this route exhibits an exposed, weathered karst topography due to the minimal soil cover. The northern section of Empey Road within Loyalist Township is maintained and services a few homes. As such, a limited length of road sharing would be required.

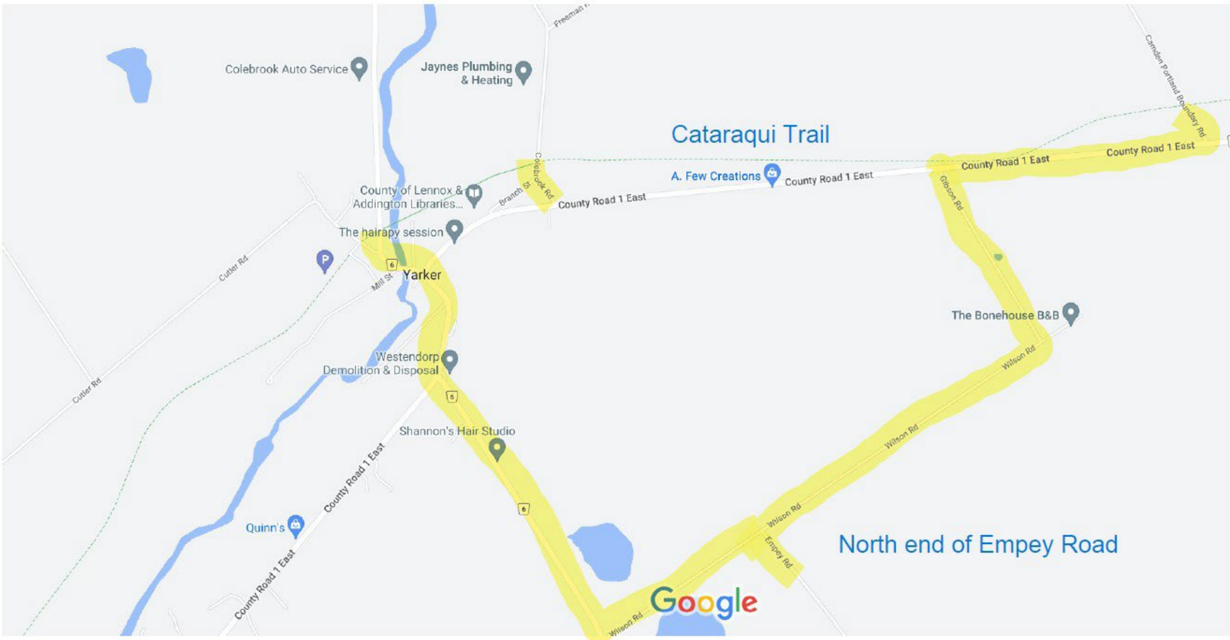


Figure 9 Potential connections from north end Empey Road to Cataraqui Trail

The final connection of a proposed dedicated route to the Cataraqui Trail would ultimately require cooperation from Stone Mills, and preliminary indications are that this may be possible. The connection would provide a linkage from Loyalist Township to the regional trail networks of the County of Lennox and Addington, Frontenac County, and the City of Kingston. These linkages would be of value for both local recreation and regional tourism. In the short term, the current local road networks could provide access where a dedicated route has not been developed.

There are a variety of options to connect this route from Odessa to Wilton that include utilizing Maple Road and County Road 6 or Thorpe road to Simmons Road, as illustrated in the figure below.

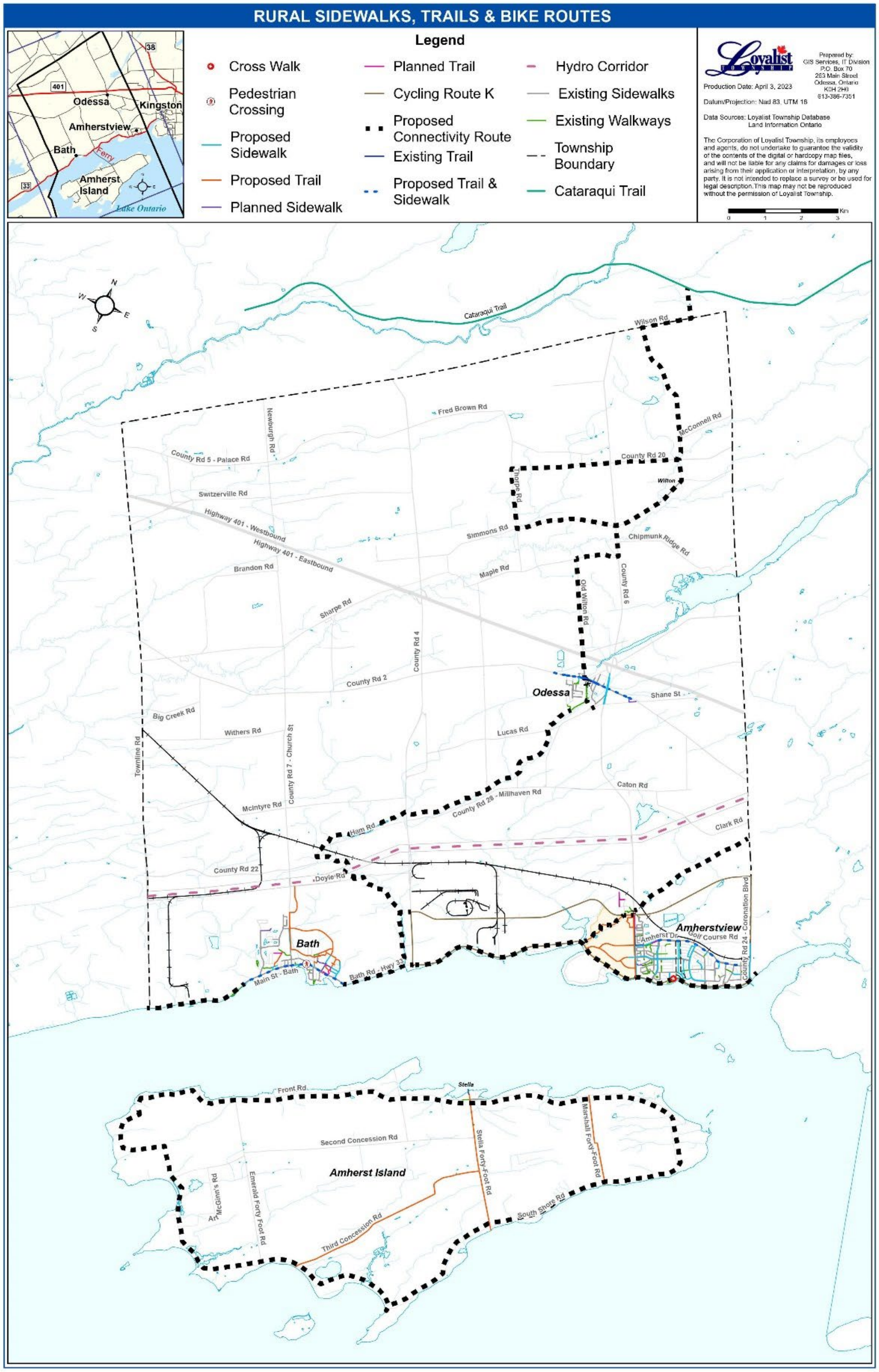


Figure 10 Rural Multi-use Pathway Options

The only apparent option proceeding north from Amherstview is along County Road 6, with an eventual tie-in to Caton Road and north on the proposed trail to Timmerman Street. The Canadian National Railway right-of-way prevents consideration of other routes.

It is recommended that Loyalist Township continue planning efforts to complete a trail route between Amherstview and the Cataraqui Trail via Empey Road.

South Frontenac

Loyalist Township's border with South Frontenac Township is very short, and no direct active transportation linkages are anticipated.

Greater Napanee

With much of Loyalist's urban population residing on the eastern side of the Township, there are fewer opportunities for active transportation links between Loyalist Township and Napanee, other than utilizing the County roads system which predominantly runs in a grid fashion within Loyalist Township. It is recommended that Loyalist should pursue any opportunities with the Town of Greater Napanee and the County to upgrade and maintain County road shoulder bicycle lanes to designs that meet current OTM and TAC standards. As noted above, there are no County roads with paved shoulders running east-west between County Road 4 and 7 south of Highway 401.

Similarly, it is recommended Loyalist should seek Napanee's support in developing the waterfront pathway system along Lake Ontario.

Other Pathway Locations within Loyalist Township

With many of the Township roads being relatively low volume, the IMP has prioritized active transportation infrastructure along key transportation routes. Many of the proposed routes are consistent with the IMP Active Transportation survey results, while some of the selected routes represent opportunities in natural settings for near-term improvements with minimal financial impacts. In addition to the potential pathway improvements noted above, the following locations are recommended for consideration:

- Bath east end improvements: A new multi-use pathway commencing at Main Street – Bath and following new pathway routing adjacent to the expanded Aura by the Lake's stormwater management facility northerly to a connection to Purdy Road. The pathway would extend northerly using Block 20, owned by the Township, to Briscoe Park. The pathway would then traverse the park, and as the lands to the north and east are developed, this pathway would be extended either within or parallel to the future Windermere Boulevard right-of-way to County Road 7. The project's recommended funding source would be as a growth project, funded by a combination of direct developer funding and development charges, and is considered an Outcome 1 project. The initial phases would include a connection from Briscoe Park to the Windemere right-of-way within the IMP planning period. At some point a connection would be extended through the new development to the existing Jessup Lane Park. The balance of the project would be completed as Windemere Boulevard and related development are extended northerly toward the water tower. The section of pathway adjacent to the stormwater management facility is being constructed in 2022.

A new sidewalk or pathway will be constructed along Sir John Johnson Drive between Main Street - Bath and Briscoe Park. This sidewalk is a growth project and funded by the development charges as the local developer has agreed to alternate sidewalk connections from the adjacent proposed development (Ernestown BF Pt Lots 13 and 14, RP29R102238 parts 1-5).

With the increase in traffic along Purdy Road due to the imminent development of Windemere Boulevard, a new sidewalk should be located on Purdy Road. This sidewalk should be funded by development charges. This sidewalk should tie into the new pathway and the Sir John Johnson sidewalk.

The existing western terminus at Somerset Drive of the pathway within Jessup Lane Park will be extended westerly to a location opposite the Bath Public School on County Road 7. This route will provide a direct link to the school for future development along Windemere Boulevard. This should be considered a growth-related project funded either by local development or development charges and should be considered an Outcome 1 project.

- Bath Park Pathway improvements: The existing pathway adjacent to the north side of Bath Creek and east of Country Club Drive is proposed to be extended to First Street at Queen Street, with branches to Raglan Street (and ultimately Main Street – Bath) and to Empire Court. This is a growth project to be funded by development charges and should be considered an Outcome 1 project. As the Bath Park area is developed, this pathway will eventually link to internal pathways within the park and link to County Road 7. Raglan Street is a short public road where the pathway will have to share the narrow road with a few local vehicles.

- Church Street/County Road 7, between Loyalist Boulevard and Bath Fire Station: Staff are recommending a multi-use pathway be developed within or adjacent to the west boulevard of County Road 7 from Loyalist Boulevard southerly to the park property south of Bath Public School and adjacent to the Firehall. This pathway can eventually be linked to other pedestrian facilities within the park as the park is developed. This section of pathway along Church Street/County Road 7 should be considered a growth expense.

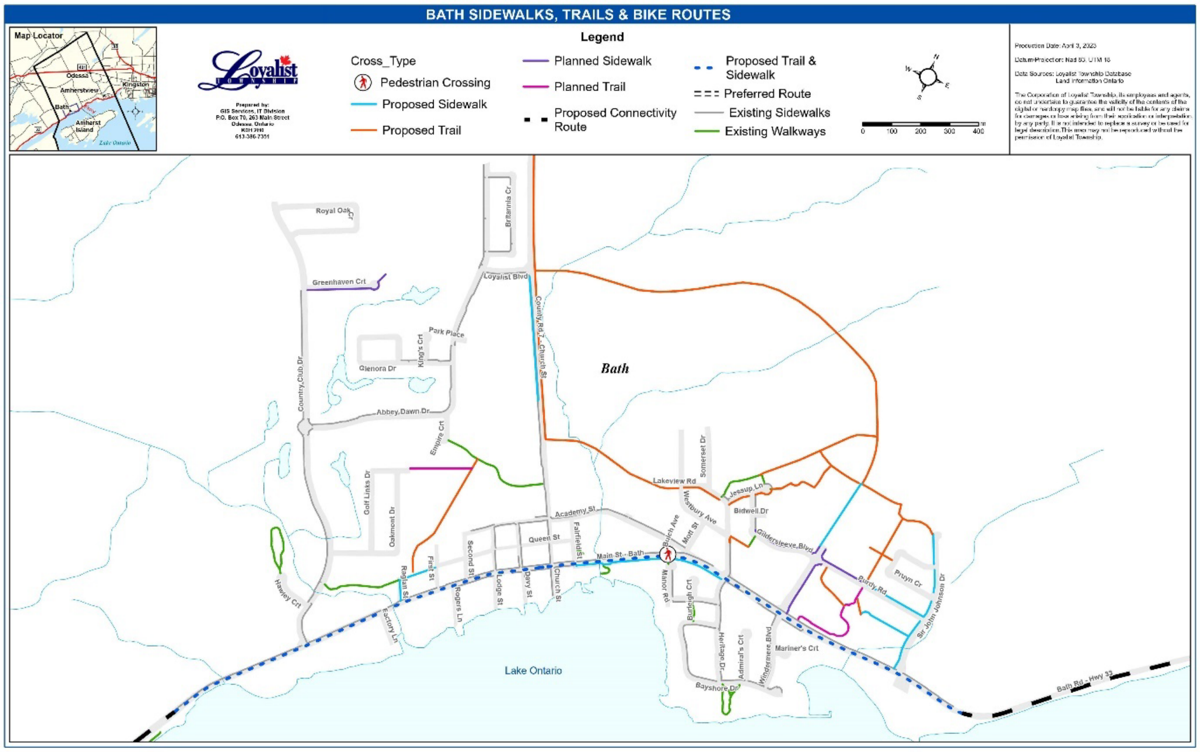


Figure 11 Bath Existing & Proposed Sidewalks, Multi-use Pathway Options

- Amherstview Lakeview Park multi-phase project: A new multi-use pathway extending from Lakeview Park northerly to Amherst Drive. The route would follow the location of the block of land used by the existing sanitary forcemain that extends north from the Lakeview Pumping Station. This route is east of Kidd Drive and west of Westran Road and Clairton Place. This project would be recommended to be funded by Loyalist Township or grant funding as a non-growth project and is considered an Outcome 1 project.

  The new internal Lakeview Park pathway system will be designed to connect to any adjacent inter-block walkways and will include security lighting along the main corridor(s). Completing internal sidewalk or multi-use pathway infrastructure within Lakeview Park is intended to link active transportation features together, with the park acting as a hub. This project would connect the existing sidewalk constructed adjacent to Bath Road/Highway 33 and opposite Jordyn's Court to the new Lakeside Park routes, and then extend westerly to a new pedestrian crossing of Bath Road/Highway 33 to Fairfield Park and northwesterly to Davey Crescent. The link to Davey Crescent would require an easement or land purchase from the owners of the Briargate Residence (Revera). This project should be considered a non-growth project funded by Loyalist Township or grant funding and is considered an Outcome 1 project.

The internal pathway system within the park will include a bridge suitable for pedestrian and bicycle use over the storm sewer outlet just north of Bath Road/Highway 33.

The design of this network should consider any improvements associated with the proposed Waterfront Trail improvements.

- Amherst Drive: Develop a multi-use pathway or bicycle lanes along the Amherst Drive right-of-way from Coronation Boulevard to Speers Boulevard. This initiative is considered an Outcome 1 project, with the section east of Speers Boulevard being considered a non-growth project.

  The design of this system should tie into the Lakeview Park walkway and the multi-use pathway system constructed on Amherst Drive west of Pratt Drive.

  Consideration should be provided to meshing this project with proposed traffic calming improvements for this corridor.

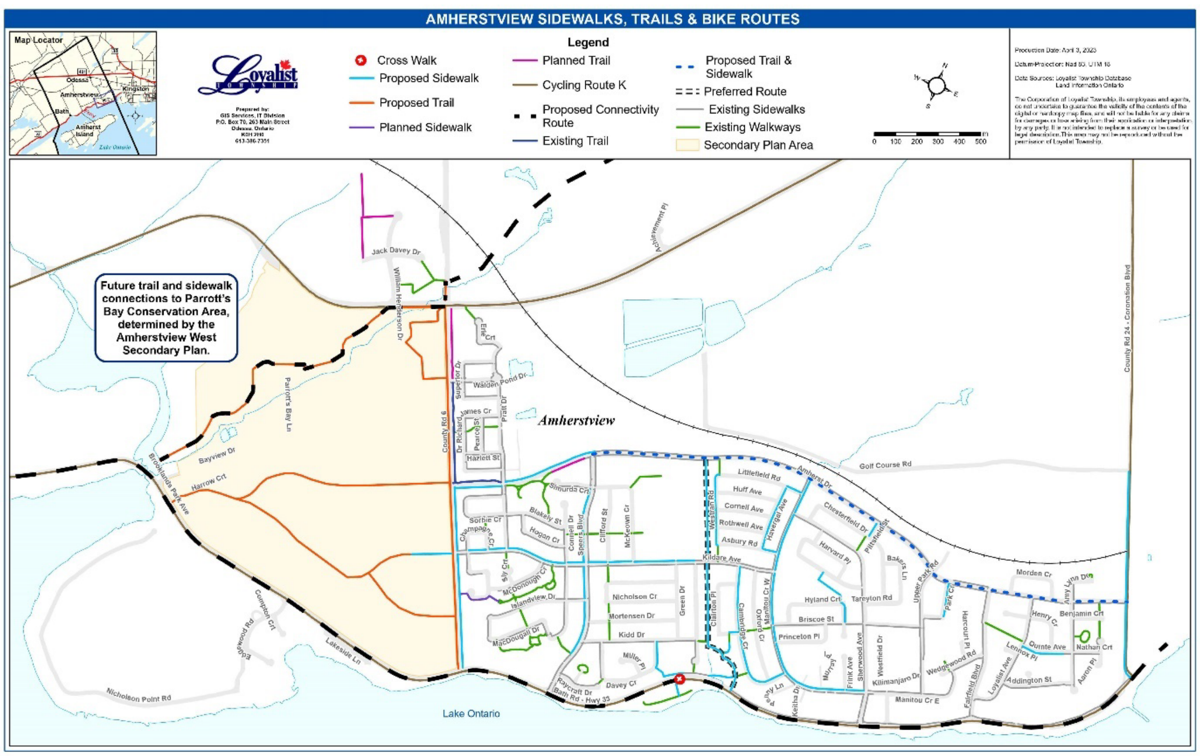


Figure 12 Amherstview Existing & Proposed Sidewalks, Multi-use Pathway Options

- County Road 6, Odessa: Develop sidewalk or pathway infrastructure along County Road 6 from the commercial properties south of the 401, southerly through the community of Odessa. This project should be considered a growth project funded by a combination of development charges and direct developer contribution, and is considered an Outcome 1 project

- County Road 6, Amherstview: Develop sidewalk or pathway infrastructure along County Road 6 from Taylor-Kidd Boulevard and the Loyalist East Business Park, southerly to Bath Road/Highway 33, where not already approved in existing development agreements. This project should be considered a growth project funded by a combination of development charges and direct developer contribution and is considered an Outcome 1 project.

- Develop a multi-use pathway along the unmaintained road allowance within Lot 32, Concession 3 extending between Caton Road and Timmerman Street. This right-of-way is already suitable for limited vehicle use being a former maintained road, and with minor effort, could be converted to a public pathway. Care should be taken that any improvements in the vicinity of the pathway preserve and maintain the alvar ecosystem located south of Odessa. This initiative is considered an Outcome 1 project and is a non-growth project. Should motorized vehicles be used on this pathway, additional effort will be required to ensure these vehicles are restricted to the pathway and avoid adjacent rare natural heritage.

  A natural heritage evaluation was completed for this corridor and is summarized below.

- Work with the County of Lennox and Addington to establish a linkage between the proposed Lot 32 pathway and the County Road 6 pathway infrastructure in Amherstview that is designed to meets OTM and TAC requirements. This initiative is considered an Outcome 1 project considered as a non-growth project.

- In conjunction with Main Street – Odessa/County Road 2 reconstruction through the community of Odessa, Loyalist Township and the County of Lennox and Addington will develop active transportation facilities within a revised cross-section that accommodates pedestrians and bicycles, consistent with OTM standards.

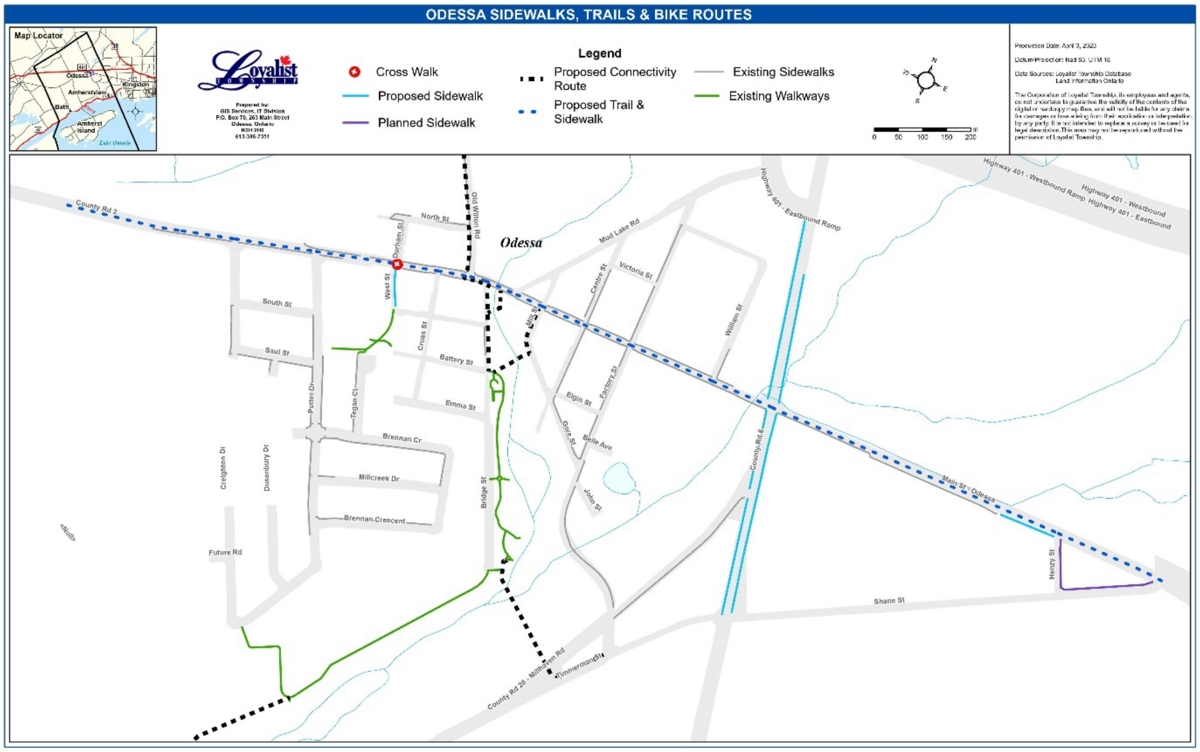


Figure 13 Odessa Existing & Proposed Sidewalks, Multi-use Pathway Options

- Develop a continuous pathway route commencing on Old Wilton Road, from the Scotland Road intersection in a general north-easterly direction to the south end of the proposed Empey Road pathway.

Loyalist Township has been developing the Loyalist East Business Park (LEBP), with Phase 2 partially constructed. A pathway system has been included within the LEBP, with the dual function as a pedestrian linkage for people who work in the area and as a link to future pathway extensions on the east side of Parrott's Bay. One section of the LEBP pathway system will connect at the intersection of Taylor-Kidd Boulevard and County Road 6 and then split, with one link routed between Lots 1 and 2, serving W.J. Henderson Drive and the second link between Lots 9 and 10 serving Jack Davey Drive. The other section extends along the western side of the LEBP towards the railway corridor. These pathways are intended to connect to pathways established along the County Road 6 corridor heading south; future pathways into Amherstview West, west of County Road 6; and possibly the Bayview pathway in the more distant future.

It is recommended that Loyalist Township's OP be amended to reflect the pathway system improvements noted above in the section "Other Trail Locations – Loyalist Township".

Pathway Design Considerations

The detailed design for the pathways should include an assessment of the potential pathway users. Consideration of the proposed users of the pathway, such as ATVs or similar vehicles, bicycles, snow mobiles and pedestrians, will be required. Special circumstances such as access for agricultural vehicles and for pathway maintenance equipment will also need to be considered both for establishing appropriate widths and roadbed design. Decisions for surface type will include a review of maintenance needs, liability concerns, and special objectives. For example, the municipality has received feedback from dog owners requesting granular surfaces, suggesting that this surface choice is better for the animal's paws in warm weather.

Natural Heritage Assessment - Rural Pathways

The Township has examined redeveloping three sections of former road allowances as multi-use pathways. These roads sections are the Marshall Forty-Foot Road; a portion of Empey Road; and Lot 32 between Caton Road and Timmerman Street in Odessa passing behind the Public Works Garage at 748 County Road 6. The Township hired the engineering firm GHD to complete ecological characterization assessments of the proposed pathway routes. This work was completed during the latter half of 2022, and the subsequent reports form appendices to this technical memo.

The following is a summary of the assessments' findings.

Marshall Forty-Foot Road pathway: During their assessment (GHD, 2022), GHD did not observe any species at risk. GHD did observe features that indicated the potential for species at risk and noted that the presence of two small wetland areas and the presence of an intermittent water course and some woodlands. GHD has recommended that the appropriate agency(ies) responsible for ecological heritage be consulted on any design proposals that would remove habitat or require other mitigations.

Figure 14 South-facing view of the central potion of Marshall Forty-Foot Road

The intent of the project would be to restore drainage features so that water is conveyed across the road surface, promoting sheet surface flows wherever possible and minimizing the intensification of natural surface flows. Tree removal and trimming would be limited to that required for the safe movement of the intended users. The intended users of this pathway may include local farmers who have adjacent fields and require the right-of-way for access.

Specific GHD recommendations for Marshall Forty-Foot Road are:

1. The construction envelope must be clearly defined and delineated, and a line be staked and clearly marked in the field prior to any construction activities occurring in the study area.
2. Prior to any site preparation activities (grading, placement of fill), erosion and sediment control measures should be installed along the construction envelope to ensure sediment-laden runoff does not interfere with the adjacent water courses or natural features. The silt fence should be inspected and maintained throughout the construction phase and remain in place until the soils are stabilized and revegetated.
3. Removal of vegetation (e.g., trees, shrubs) within the construction envelope and/or along access routes shall be done outside of the breeding bird timing window of April 15 to August 15, as per Environment and Climate Change Canada guidelines.
4. The project manager and contractor(s) are obligated to ensure that all mitigation measures are strictly observed.
5. Construction should be undertaken during normal weather conditions, to the extent possible, and the project shall be designed to appropriate specifications to withstand variable weather conditions.

Lot 32 Concession 3 pathway, Timmerman Street to Caton Road: Prior to the construction of the current County Road 6, this road allowance served as the only north-south road between Odessa and Lake Ontario. For the past few decades, the only authorized users were adjacent landowners and Bell, who maintain an overhead transmission line within the road allowance. The road allowance is closed, which means the public does not currently have a general right of passage. The Township has gated access to the allowance at each end.

GHD has observed (GHD, 2023) that this existing right-of-way is adjacent to many interesting and diverse ecological features. A quick description of the pathway route would characterize the adjacent lands as being in various stages of forest succession. Apart from the northernmost meadow, there does not appear to be any sign of recent agricultural activity. In particular, GHD observed mixed forest, portions of the Asselstine Alvar, wetlands, cattail marsh, and pine and cedar coniferous forests. Some of these ecological units have the potential for being habitat to sensitive and endangered species. The report noted the presence or expected presence of a broad variety of plants and animals. GHD notes that no natural habitat should be removed without additional consultation.

The local area has been impacted by ATV movements and any intensification of use of the road allowance will need to consider methods that will restrict unauthorized off-road movements in the area or any changes in the drainage pattern. GHD did note in Section 3.2.4; “Upgrading the road allowance to permit a multi-use trail should not have an impact on the woodland features or their functions.” In Section 3.2.5 GHD cautioned that prior to any alterations to wetlands and water courses the Township should consult the CRCA.”

The GHD document should be referenced during the design stage of the project.

The following recommendations were included in the GHD report:

1. *The construction envelope must be clearly defined and delineated and a line be staked and clearly marked in the field prior to any construction activities occurring in the study area.*
2. *Prior to any site preparation activities (grading placement of fill) erosion and sediment control measures should be installed along the construction envelope to ensure sediment laden runoff does not interfere with the adjacent water courses or natural features. the silt fence should be inspected and maintained throughout the construction phase and remain in place until the soils are stabilized and revegetated.*
3. *All sediment and erosion control products will be selected for the site based on the manufacturer’s product specifications. Product installation and maintenance will follow the manufacturers guidelines.*
4. *Where possible, biodegradable materials are to be used for sediment/erosion control.*

5. *Settlement control measures shall be installed prior to the commencement of work and shall be maintained throughout the project to prevent the entry/outward flow of sediment into the watercourse.*
6. *All sediment and erosion control measures will be inspected regularly during the construction phase and periodically thereafter to ensure they are functioning properly, maintained, and upgraded as required. Sediment fence to be checked regularly to ensure they are maintained and working properly. Accumulated silt and debris will be removed from the fence and site after every precipitation event.*
7. *Construction will be undertaken during normal weather conditions, to the extent possible, and will avoid large precipitation events to minimize the risk of sedimentation off-site.*
8. *In the event that sediment and erosion control measures are not functioning, the construction supervisor shall order the work to be stopped. No further work shall be carried out until the construction methods and or the sediment control plan is adjusted to address the sediment erosion problem(s). Such occurrences should be documented by the site inspector and provided to a qualified biologist.*
9. *Silt fencing should be a dense woven material and not contain wire mesh or plastic mesh that can entangle wildlife such as snakes.*
10. *should work conditions change such that it is possible that fish or fish habitat may potentially be impacted, all works shall cease until the problem has been corrected or authorization has been obtained from the appropriate authorities.*

Wetlands

1. *Overall existing drainage patterns for the study area will be maintained, particularly in the vicinity of (i.e., 30.0 metres adjacent to) identified wetlands and water courses.*
2. *Wetland habitat(s) will be maintained with the project manager, contractor(s), and others ensuring there is no loss of wetland habitat and no negative impacts two it's/their function(s).*
3. *The construction area must be fenced off prior to and during construction to ensure no heavy equipment or heavy machinery enter or negatively impact wetland habitats.*
4. *Where feasible, efforts should be made to reduce public access to these communities particularly recreational vehicles (e.g., through fencing signage and/or marked trails) as wetland species and/or functions can be negatively impacted through disturbances such as the introduction of invasive species.*
5. *To maintain hydrologic connectivity and flows where wetlands crossed a trail, culverts are to be installed.*

Rare Vegetation Communities

1. *Are very thin and/or lacking in alvar communities. efforts will need to be made to ensure soils are retained where alvars are in close proximity to the proposed rail. Appropriate erosion control measures must be implemented.*
2. *Existing drainage patterns in the vicinity of alvars must be maintained as modifications can affect the quality of underlying aquifers and/or alter the community's structure and function. For example, ditches should not be built in the vicinity of the alvar unless air constructed to be above the original grade. Sufficient coverage should be installed to allow water to flow unimpeded from one side of the trail to the other.*
3. *The construction area must be fenced off prior to and during construction to ensure no equipment or heavy machinery enter either alvar habitats*
4. *Where feasible, efforts should be made to reduce public access to alvar communities, particularly recreation vehicles (e.g., through fencing, signage and/or marked trails) as natural vegetation (and rare species) may be negatively impacted through disturbances such as trampling, tire damage/ruts and the introduction of invasive species.*
5. *If there are plans to plant/add vegetation in the vicinity of the identified alvars, a wild flower or grass mix of species indigenous to the area should be used.*
6. *No herbicides should be used along the trailway in the vicinity of the identified alvars.*
7. *Consideration should be given to public outreach or education to increase the understanding of these rare vegetation communities (e.g., interpretive signage, communication materials).*

Empey Road pathway: McConnell Road to Wilson Road

The current corridor has a poorly maintained gravel or bare limestone bedrock as a road surface. The right of way is generally bordered by woodlands. The road is accessible by pedestrians and by automobiles at low speed, but is not currently suitable for cycling. The travel lane is typical of a single lane road with minimal room for passing vehicles.

Similar to the other unmaintained road evaluations GHD examined (GHD, 2023) a 120-metre-wide corridor centered on the road allowance. GHD completed both a literature review and a detailed field assessment.

GHD noted the presence black ash, an identified species-at-risk. The potential for the presence of additional species-at-risk was noted. There are two designated wetland areas immediately west of the GHD study area.

GHD developed recommendations to mitigate negative impacts to the corridor, including reviewing any work required within 30 metres of wetlands or watercourses with the appropriate agency. The following recommendations were included in the GHD report:

General

1. *The construction envelope must be clearly defined and delineated and a line be staked and clearly marked in the field prior to any construction activities occurring in the Study Area.*
2. *Prior to any site preparation activities (grading, placement of fill), erosion and sediment control measures should be installed along the construction envelope to ensure sediment laden run off does not enter or interfere with adjacent water courses or natural features. The silt fence should be inspected and maintained throughout the construction phase and remain in place until the soils are stabilized and re-vegetated.*
3. *Removal of vegetation (e.g., trees, shrubs) within the construction envelope and/or along access route shall be done outside of the Breeding Bird timing window of April 15 to August 15 (as per Environment and Climate Change Canada guidelines).*
4. *The Project Manager and Contractor are obligated to ensure that all mitigation measures are strictly observed.*
5. *Construction be undertaken during normal weather conditions, to the extent possible, and the project shall be designed to appropriate specifications to withstand variable weather conditions*

Sediment and Erosion Control

1. *All sediment and erosion control products will be selected for the site based on the manufacturer's product specifications. Product installation and maintenance will follow the manufacturer's guidelines.*
2. *Where possible biodegradable materials are to be use for sediment/erosion control.*
3. *Sediment control measures shall be installed prior to the commencement of work and shall be maintained throughout the project to prevent the entry/Edward flow of sediment into the watercourse.*
4. *All sediment and control measures will be inspected regularly during the construction phase and periodically thereafter to ensure they are functioning properly, maintained, and upgraded as required. Sediment fence to be checked regularly to ensure they are maintained and working properly. Accumulated silt and debris will be removed from the fence and site after every precipitation event.*
5. *Construction will be undertaken during normal weather conditions, to the extent possible, and will avoid large precipitation events to minimize the risk of sedimentation off-site.*
6. *In the event that sediment and erosion control measures are not functioning, the construction supervisor shall order the work to be stopped. No further work shall be carried out until the construction methods and/or the sediment control plan is adjusted to address the sedimentation/erosion problem(s). Such occurrences should be documented by the site inspector and provided to a qualified biologist.*

7. *Should work conditions change such that it is possible that fish or fish habitat may potentially be impacted, all works shall cease until the problem has been corrected or authorization has been obtained from the appropriate authorities.*

Wetlands

1. *Overall existing drainage patterns for the study area will be maintained, particularly in the vicinity of (i.e., 30 meters adjacent to) identified wetlands and watercourses.*
2. *Wetland habitats will be maintained, with the project manager, contractor(s) and others ensuring there is no loss of habitat and no negative impacts to the wetland function(s).*
3. *Construction area must be fenced off prior to and during construction to ensure no equipment or heavy machinery enter or negatively impact wetlands in the Study Area.*
4. *Where feasible efforts should be made to reduce public access to these communities, particularly recreational vehicles (e.g., through fencing, signage and/or marked trails as wetland species and/or functions can be negatively impacted through disturbances such as the introduction of invasive species.*

Rare Vegetation Communities

1. *Soils are very thin and or lacking in alvar communities. Efforts will need to be made to ensure soils are retained where alvars are in close proximity to the proposed trail. Appropriate erosion control measures must be implemented.*
2. *Existing drainage patterns in the vicinity of valve arms must be maintained as modifications can affect the quality of underlying aquifers and or alter the community structure and function. For example, ditches should not be built in the vicinity of the alvar unless they are constructed to be above the original grade. Sufficient coverage should be installed to allow water to flow unimpeded from one side of the trail to the other.*
3. *In the case of rock barrens, drainage should be directed away from the habitat in order to maintain species composition.*
4. *The construction area must be fenced off prior to and during construction to ensure no heavy equipment or heavy machinery enter either alvar or rock barrens habitats.*
5. *Where feasible efforts should be made to reduce public access to these communities, particularly recreational vehicles (e.g., through fencing, signage and/or marked trails as wetland species and/or functions can be negatively impacted through disturbances such as the introduction of invasive species.*
6. *If there are plans to plant/add vegetation in the vicinity of identified alvars, a wild flower or grass mix indigenous to the area should be used.*
7. *No herbicides should be used along the trail way in the vicinity of identified alvars. If de-icing of the trail is proposed, consideration should be given to using materials other than salt.*

8. *Consideration should be given to public outreach or education to increase the understanding of these rare vegetation communities (e.g., interpretive signage, communication materials).*

Sidewalk Improvements

All new developments are requested to build local sidewalks within the project, except short cul-de-sacs. Unfortunately, this policy was not always the case, and many areas were originally not serviced by sidewalks. Older standards often had narrower sidewalk widths than current standards. As a result, there is a wide variety of sidewalk widths present throughout the older sections of the community. In the mid-1990s the Township ramped up activity to address the level of service disparity and constructed new sidewalks on key linkages.

The retrofitting program was intended to allow for local neighbourhood connectivity but was never intended to place sidewalks on every street. Although it would be ideal if every street had sidewalks on both sides of the street, this scenario is tied to affordability and there is usually a trade-off resulting in the level of sidewalk servicing being much lower than the ideal scenario.

It is recommended that, for each of the listed rural pathway projects, an overall education plan be developed specific for that route. The education plan would be intended for all types of users, i.e., drivers, pedestrians, and cyclists, and would outline route sharing requirements and any limitations on the types of use. The plan would highlight cultural and natural heritage encountered along the route and provide directions for sustaining any natural heritage that may be encountered. In some circumstances, the use of the pathway may be expanded to motorized vehicles such as ATVs. The municipality will need to clarify the intended users of the facilities prior to the design process.

In the implementation of some of these projects, there may be isolated resistance to new sidewalks in established neighbourhoods. This is to be expected. The objective of these remedial projects is to find a balance between safe active transportation and enjoyment of one’s property. Consideration of the increased liability applicable to the Township where a sidewalk is not available, is another important consideration. It is hoped that these projects will make all our communities safer for people to enjoy their neighbourhoods.

It has also been observed that for unknown reasons many sections of existing sidewalk are discontinuous or do not have proper road crossing alignments.

It is noted that many of the older streets within Odessa, Bath, and Amherst Island were built to an historic standard width of 40 feet (12.19 metres). Within this roadway width, it is difficult to accommodate a sidewalk and maintain two-way traffic, especially if the provision of a sub-surface storm drainage system is not practical – which is often the case. These roads are typically low-volume, low-speed roadways, which mitigates some safety concerns. For narrow rights-of-way, one alternative for the design team to consider when introducing sidewalks to an older street, would be to establish a one-way street pattern and use part of the existing right-of-way for a sidewalk or pathway. This approach should only be considered when supported by a traffic report prepared by a traffic professional, and community consultation should be undertaken prior to implementation.

Township staff examined the Bridge Street, Cross Street, Battery Street, and West Street neighbourhood in Odessa to evaluate the addition of sidewalks in the manner noted in the preceding paragraph, as an alternative design option when the streets are reconstructed. These rights-of-way are all sub-standard in width, and most are in the range of 12.0 metres (40 feet). Because the road network has been intentionally maintained as immediate local traffic with no possibility for through traffic, and thus relatively low volume, it was determined that the status quo (no sidewalks) would be preferable to developing a one-way street network with sidewalks in suitable locations.

Proposed formal sidewalk standards for Loyalist Township will not require sidewalks on new cul-de-sacs with an overall length of 150 metres or less, except where these roads connect to other public property or to other walkway systems, i.e., an inter-block walkway.

As part of the IMP, staff have organized sidewalk improvements based on the following criteria:

- Remedial need to link disparate areas of the community
- Improper mid-block discontinuity of sidewalks, not meeting AODA criteria, and improper crossing alignments
- Sidewalks with sub-standard widths

The objective of the AODA is to “achieve accessibility in goods, services, facilities, accommodation, employment, buildings, structures, and premises”. Loyalist Township is required to abide by this legislation. Sidewalks are required to meet specific standards; however, the Act allows for certain existing infrastructure which does not meet current requirements. It is the intent of Loyalist Township for sidewalks within any street improvement projects to meet or exceed the AODA requirements. Similarly, the existing network shall be upgraded to meet current requirements wherever feasible. Many of these upgrades will be most efficiently dealt with when the street is eligible for lifecycle improvements or addressed as part of a focused sidewalk improvement project. It is not the intent of the IMP to suggest that every sidewalk upgrade should be immediately addressed. Ideally, all the sub-standard elements of the sidewalk would be replaced in the 25-year horizon of the IMP.

At the end of this technical memorandum, Table 1 lists locations where the sidewalk is of sub-standard width and would preferably be replaced. Replacement priority would typically be based on pedestrian usage levels, the degree of variance from standard width, and timing of other infrastructure lifecycle replacements in the same area, so that work can be coordinated. Replacements where applicable should be completed within the IMP planning period. Due to constraints such as adjacent encroaching buildings and landscaping, narrow road rights-of-way, and surface drainage courses, sidewalk widening may not be feasible for all locations without a notable reduction in the width of the driving surface.

It is noted that where the road allowance is constrained, there may not be an immediate ability to provide a wider sidewalk. In cases where an alternate route is not locally available, road widenings may be considered to accommodate a new walkway.

There are several locations observed within the Township where sidewalks stop mid-block, or are misaligned with another sidewalk, pathway, or inter-block walkway or commercial entrance. A list of locations with deficiencies can be found in the appendices to this technical memo. These deficiencies may also occur where part of the crossing detail is missing or does not meet specifications. These deficiencies may present a larger safety liability than the locations with sub-standard widths and should be prioritized over the life of the IMP.

It was noted, particularly on Main Street – Odessa, that some sidewalks stop at the edge of commercial entrances. These locations should be replaced with continuous sidewalks and have clear definition at every entrance. The objective is to clarify a safe corridor for pedestrians.

The Township design standards indicate that collector and arterial streets should have sidewalks on each side of the road. In many locations this was not done concurrent with the initial construction. This may have been because the traffic counts at early stages of development didn't warrant the need for two sidewalks. Consideration should be given to correcting this. Priority for the work would be based on factors such as proximity to transit routes, accident frequency, proximity to focal points such as schools and parks, and completing new sidewalk concurrent with other infrastructure construction on the street.

Adding sidewalks to a mature streetscape is not an easy task and may not be favourably viewed by some property owners. It is recommended that all sidewalks, whether single or twin sidewalks on arterial and collectors, be installed prior to assumption of the street.

New Sidewalks to Connect Communities and Improve Safety

The following locations are recommended for new pedestrian infrastructure to provide for improved safe linkages within their community. This list has been developed based on input from the survey and Loyalist staff's knowledge of traffic and pedestrian levels.

Bath – New Sidewalks

- Main Street – Bath, from Fairfield Street easterly to Heritage Drive on south side. Includes connection at Manor Road. Growth project, development charge-funded.
- Purdy Road, from new Gildersleeve sidewalk easterly to Sir John Johnson Drive. Growth project, development charge-funded.
- Sir John Johnson Drive from Main Street - Bath to the end of the cul-de-sac at Briscoe Park. This project to be funded by development charges
- Main Street – Bath, balance of south side easterly from east of Windermere Boulevard to Sir John Johnson Drive. Non-growth project, funded by Loyalist Township.
- Main Street – Bath Crossing, Heritage Drive/Somerset Drive area. Growth project should be development charge-funded. Loyalist Township engaged GHD Engineering Consultants, who have recommended that a proper crossing of Main Street – Bath be developed at Bulch Avenue/Manor Road (GHD, 2022). Adequate signage and pavement markings should be implemented to notify motorists and pedestrians of the crossing. Both projects are growth projects, to be funded by development charges based on recent local development.
- Main Street – Bath crossing, Windermere Boulevard. The ultimate preferred design for intersection improvements will include pedestrian crossing facilities.
- Somerset Drive to Gildersleeve Boulevard connection, either along Somerset Drive to Jessup Lane or a direct connection via an easement across the privately-owned commercial property described as 234 Main Street Bath, to the walkway at the southwest corner of Gildersleeve Boulevard. This is considered a growth project, funded by development charges.
- Somerset Drive and Lakeview Road link, extending from Jessup Lane westerly to Westbury Avenue. This is considered a non-growth project to be funded by Loyalist Township.
- Mott Street, from Westbury Avenue southerly to tie to the sidewalk on Academy Street. This project is considered a non-growth project to be funded by Loyalist Township. Consideration should be made to extend this walkway easterly to a suitable connection on Somerset Drive. This would enable linkages to the central community from the newer developments in the Gildersleeve Boulevard area.
- Church Street (County Road 7), west side from Bath Fire Station to Loyalist Boulevard. There is currently no sidewalk in this area and the shoulder is used by pedestrians and cyclists.

Amherstview – New Sidewalks

- Quinte Avenue, Amy Lynn Drive to Loyalist Boulevard. This project is intended to link the Parkside subdivision to the existing pedestrian path across Centennial Park and leading to Amherstview Public School. This is a non-growth project recommended, to be funded by Loyalist Township or grant funding.

- Coronation Boulevard. See pathway section comments. If support for a pathway along the entire length of Coronation Boulevard is not available by the two road authorities, consideration of a local sidewalk between Golf Course Road and Bath Road/Highway 33 should be considered a high priority. This is a non-growth project, to be jointly funded by the various municipal partners.
- Park Crescent, Upper Park Drive northerly to Amherst Drive. This project is intended to provide a north-south linkage to the local schools and Amherst Drive. This is a non-growth project, recommended to be funded by Loyalist Township or grant funding.
- Pittsfield Street, Amherst Drive to Chesterfield Avenue. Remedial sidewalk placement along busy connector street to Amherst Drive. This is a non-growth project, recommended to be funded by Loyalist Township or grant funding.
- Subdivision Plans 29R-843, 29R-863, and 29R-1081 Amherstview. The above plans define the subdivisions west of Manitou Crescent West and east of Speers Boulevard in Amherstview. These subdivisions were approved in the 1960s and 1970s when sidewalk standards were in their early development stages. Very few of the streets in these subdivisions were constructed with sidewalks. Many of the streets in these subdivisions did include inter-block pathways that allow for some direct pedestrian movements.

One of the objectives of the active transportation section of the IMP is to extend safe pedestrian routes throughout the community. Recognizing the difficulty of retrofitting older neighbourhoods, the IMP tries to balance the objectives with the reality that the ability to add sidewalks to every street is not practical for a variety of reasons. These subdivisions were examined by Township staff, and the following streets were identified as candidates for new sidewalks based on:

- Their ability to provide connection within the neighbourhood to existing and proposed pathways
- Parks,
- Schools,
- Transit routes,
- Inter-block walkways
- Level of mitigation required to accommodate existing stormwater works
- Traffic counts on street (actual or estimated)

Streets with lower traffic counts were more likely to get screened out of the list of new sidewalk locations.

In this evaluation process it was felt that the desired level of service for the local community would supersede the concerns of an individual property owner, should a new sidewalk be constructed.

After evaluating streets within these plans of subdivision, the recommended locations for new sidewalks are:

- Asbury Road, Manitou Crescent West to Havergal Avenue
- Littlefield Road, Manitou Crescent West to Havergal Avenue
- Havergal Road, Asbury Road to Littlefield Road
- Westran Road, Asbury Road to Littlefield Road. This also links, by inter-block walkway, directly to proposed pathway from Lakeview Park to Amherst Drive, Fairfield Elementary School, W.J. Henderson Recreation Centre, and to Amherst Drive and Kildare Avenue
- Oxford Avenue, Kildare Avenue to Cambridge Crescent
- Cambridge Crescent, Oxford Avenue to Manitou Crescent West
- Green Drive, Kildare Avenue to Kidd Drive
- Kidd Drive, Kildare Avenue to Jordyn's Court. This street could be removed from the list if transit is relocated to another street, on the basis that the proposed pathway from Lakeview Park and new sidewalk on Green Drive could provide local connectivity

The retrofitted sidewalks in this list will be considered non-growth projects and funded by Loyalist Township or alternative funding. Implementation of these sidewalks will likely be concurrent to lifecycle infrastructure renewal for the streets unless there is an immediate safety need.

Odessa – New Sidewalks

- Main Street – Odessa. The existing sidewalk should be extended from the seniors' residence at 295 Main Street, easterly to Henzy Street. The design of this section should be consistent with the long-term plan developed for Main Street – Odessa. This project should be funded by development charges, based on the multi-residential property being developed east of Henzy Street.
- County Road 6. If suitable pathway infrastructure is not feasible, it is recommended that a sidewalk be constructed from the Highway 401 south limits southerly to Shane Street. This project should be funded by development charges, based on current and proposed growth in the area.
- Shane Street. Subject to ultimate development plans on lands south of Shane Street, a sidewalk should be constructed the entire length of the street and would ultimately link to Main Street –Odessa via Henzy Street. This sidewalk should extend to the proposed pathway/sidewalk on County Road 6. This project should be funded directly by development or possibly jointly with funding augmentation by development charges.
- Main Street – Odessa, extent of village. See comments in pathway section recommending an updated cross-section that will be suitable for pedestrians and bicycles.
- Potter Drive and Creighton Drive, from Main Street – Odessa to South Street. Potter Drive to have sidewalks added to both the east and west sides of the street, to connect Main Street – Odessa to the new development area.
- William Street. A new sidewalk is recommended for the length of the street, as medium-density housing proposal is anticipated on the vacant lots and open space between Factory Street and William Street.

Stella – New Sidewalks

- Front Road. This project extends from Amherst Island Public School easterly to approximately civic address 5220 Front Road (Neilson Store). This project is intended to replace substandard and discontinuous sections of walkway. The design includes connections to the sidewalk at the ferry terminal along Stella Forty-Foot Road. Designs for this project should have consideration for the Island pathway route, outlined in the Township's OP and the pathway section of this report. This project should be considered a non-growth project, funded by Loyalist Township or alternate funding.

New Equipment Needs

The expansion of the active transportation routes within Loyalist Township will necessitate expanding the fleet of smaller maintenance vehicles to accomplish regular maintenance activities. Typical equipment for these operations would be similar to skid steer loaders with specialized sweeping or snowplow/snow blower attachments and/or customized equipment that specializes in sweeping or snow removal. Staffing will need to be expanded to meet the level of service applied for these operations.

Financial

It is recognized that the active transportation plan is an ambitious undertaking. The Township will need to consider prioritizing projects. Suggested broad criteria for prioritizing the active transportation projects are:

1. Reducing immediate safety concerns
2. Promoting access to public transit
3. Coordinating with other adjacent construction opportunities
4. Promoting access to recreation and educational facilities
5. Promoting access to employment and commercial hubs

When budgeting for additional maintenance equipment for expanded pathways and sidewalks it will be important to analyze how much of the expanded system was due to growth as opposed to an improved level of service for these facilities. It is recommended that the ratio of the level of growth to the total growth in the sidewalk/ pathway system, expressed as a percentage, be applied to the growth portion of any sidewalk/pathway equipment expenses.

The following estimates are based on a broad conceptual project scope, and where applicable, assumes works are constructed in conjunction with planned road reconstruction.

Multi-use pathway projects:

- Amherst Drive multi-use pathway, Coronation Boulevard to Speers Boulevard - $1,631,437
- Main Street – Bath multi-use pathway, Centennial Park easterly to village limit - $894,7281
- Main Street – Bath multi-use pathway, Centennial Park westerly to village limit - $845,218
- County Road 6 multi-use pathway, Bath Road/Highway 33 to Taylor-Kidd Boulevard - $636,666
- Empey Road multi-use pathway - $253,693
- Lakeview Park multi-use pathway - $752,404
- Multi-use pathway connecting Lakeview Park to Amherst Drive - $375,692
- Loyalist East Business Park connection, multi-use pathway connecting the intersection of County Road 6 and Taylor-Kidd Boulevard to Jack Davey Drive - $266,676
- Asselstine Alvar Trail, multi-use pathway along the unmaintained road allowance between Timmerman Street and Caton Road - $587,646
- Marshall Forty-Foot Road allowance conversion to multi-use pathway - $213,426
- Millhaven Creek Corridor continuation of existing multi-use pathway from natural playground to Main Street – Odessa
    - Option 1, creek option. Includes 3m wide bridge able to support sidewalk snow-clearing equipment - $1,181,178
    - Option 2, Bridge Street right-of-way option – potential property acquisitions not included in estimate - $88,365
    - Option 3, Mill Street-Centre Street option - $1,159,616
- Main Street – Odessa - Active transportation components included in Main Street – Odessa technical memorandum
- Stella Forty-Foot Road multi-use pathway, Amherst Island ferry dock southerly to Lanes End Park - $1,445,890
- Windermere loop multi-use pathway, Briscoe Park westerly to County Road 7 – $940,902

Sidewalk projects

- Purdy Road sidewalk, eastern limit of Aura by the Lake subdivision easterly to Sir John Johnson Drive - $237,053
- Sir John Johnson Drive sidewalk, Main Street – Bath north to Briscoe Park - $314,490
- Substandard sidewalk width replacement program, various locations - $6,128,472

Waterfront Strategy

- Undertake a masterplan-level evaluation of the waterfront route and evaluate the best route and appropriate infrastructure type (sidewalk, pathway, etc.), so that elements with the corridor can eventually be provided for in a coordinated fashion. The plan should include a crossing of Bath Road/Highway 33 near

Lakeview Park to Fairfield Park. This crossing should be considered a priority. A crossing will require approval from MTO. - $100,000

Climate Lens

The transportation sector is the largest emitter of GHG in Ontario, accounting for approximately 32% of emissions (Canada Energy Regulator, 2023). Improving access to active transportation methods in Loyalist Township could reduce the use of vehicles powered by fossil fuels which would reduce GHG emissions.

Linkages

The technical memoranda Main Street – Bath, Main Street – Odessa, and Traffic Calming include content related to this technical memorandum.

References

AECOM. (2014). *County of Lennox and Addington Transportation Master Plan Update.* Ottawa, ON.

Canada Energy Regulator. (2023). *Provincial & Territorial Energy Profiles*. Retrieved from Canada Energy Regulatot: https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-ontario.html#:~:text=GHG%20Emissions,-Ontario's%20GHG%20emissions&text=The%20largest%20emitting%20sectors%20in,23%25%20

City of Kingston. (2019). *Active Transportation 5 Year Implementation Plan 2019-2023.*

GHD. (2022). *Ecological Characterization Assessment - Marshall Forty-Foot Road, Amherst Island.*

GHD. (2022, July 12). Main Street Pedestrian Facilities and Somerset Drive Improvements.

GHD. (2023). *Ecological Characterization Assessment - Empey Road.*

GHD. (2023). *Ecological Characterization Assessment - Unnamed Road Allowance.*

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

Leahy, D., O'Grady, M., Sauve, S., & Stroud, L. (2020). *Reports and Data.* Retrieved from Peterborough Public Health: http://www.peterboroughpublichealth.ca/wp-content/uploads/2020/12/ATI-Report-2020-WEB-Acc.pdf

Loyalist Township. (2021, May 25). *Staff Report - Improving Public Transportation Progress Report.*

Loyalist Township. (2022, April). Official Plan Update (Amendment No, 38).

Mehak, Kelly & Associates Inc. & Oraclepoll Research Ltd. (2017). *Parks and Recreation Master Plan.*

Montugar, J., Chapman, S., Poapst, R., & Bahar, G. (2020). *Publications and Resources.* Retrieved from Transportation Association of Canada: https://www.tac-atc.ca/sites/default/files/site/doc/Bookstore/2020/ptm-spbi-e.pdf

Ontario Ministry of Transportation. (2021, August). *Ontario Traffic Manual Book 18 - Cycling Facilities.* Retrieved from Ontario Ministry of Transportation.

urbanMetrics Inc. (2022). *Recreation Service Delivery Review - Loyalist Township, Ontario.*

Tables

Table 1 Sidewalks of substandard width

Table 2 Sidewalk deficiencies and discontinuities

Recommendations

- That the projects listed in this plan be considered in future capital budgets and development charges bylaws.
- That Loyalist Township request that the County of Lennox and Addington upgrade its paved shoulder standard to match TAC requirements for bicycle lanes.
- That when the County re-establishes the Environmental Assessment for the westerly extension of County Road 23/Taylor-Kidd Boulevard or commences detailed design, the Township request that the design team consider a design that either supports or includes the development of the proposed Millhaven Creek Trail in that vicinity consistent with the intent of the Township's Official Plan.
- That Loyalist Township undertake a masterplan-level evaluation of the waterfront route and evaluate the best route and the type of route (sidewalk, pathway, etc.) so that elements with the corridor can eventually be provided for in a coordinated fashion. The plan should include a crossing of Bath Road/Highway 33 near Lakeview Park to Fairfield Park. This crossing should be considered a priority.
- That the Township budget for and implement the waterfront pathway masterplan.
- It is recommended that the evaluation of the Waterfront Trail route be completed in close conjunction with the proposed Loyalist Township Waterfront Strategy.

- That the OP’s Schedule 1 be amended to show a pathway route along the entire length of Stella Forty-Foot Road and Marshall Forty-Foot Road.
- That the posted speed on Amherst Island roads be 60 km/h unless there is localized safety requirement for a lower speed, and that an education program be developed to assist with the transition.
- That Loyalist Township monitor the Taylor-Kidd Active Transportation project and, in conjunction with the City of Kingston, evaluate extending a new walkway or multi-use pathway along Coronation Boulevard from Bath Road/Highway 33 northerly to Taylor-Kidd Boulevard. Similarly, the Township’s Official Plan should be modified to include the Taylor-Kidd proposal.
- That Loyalist should pursue any opportunities with Napanee and the County to upgrade and maintain its county road shoulder bicycle lanes to designs that meet current OTM and TAC standards.
- That the Township should seek Napanee’s support in developing the waterfront pathway system along Lake Ontario.
- That a proper crossing be developed at Bulch Avenue/Manor Road.
- That the next edition of the Township’s OP be amended to include the proposed pathways as outlined.
- That Loyalist Township initiate discussions with Hydro One Networks with the objective of developing a pathway within the high voltage grid corridor within Loyalist Township.
- That the Township work with Stone Mills to improve trail linkages from Empey Road north to the Cataraqui Trail.
- That Loyalist Township continue planning efforts to complete a trail route between Amherstview and the Cataraqui Trail via Empey Road.
- That the Township evaluate the use of the concession road between the North and South Concession on Amherst Island as a future multi-use pathway

Table 1 Sidewalks of substandard width

ID #	Sidewalk Section #	Side	From	To	Side-walk Type	Road Section #	Length (m)	Width (m)	Notes
2	1006B	North	Manitou Crescent W. Intersection	Upper Park Road Intersection	Conc.	1006	720	1.37	
4	1006D	South	Henderson Recreation Centre	Crosswalk / Littlefield Road	Conc.	1006	582	1.37	
5	1006E	South	Upper Park Road Intersection	Park Crescent Intersection	Conc.	1006	70	1.37	
129	1011A	West	South Street Intersection	65 m. South of South Street	Conc.	1011	65	0.92	
21	1013A	South	Sherwood Avenue Intersection	Park Crescent Intersection	Conc.	1013	245	1.37	
115	1017A	East	Elgin Street Intersection	County Road # 2 Intersection	Conc.	1017	141	1.22	
116	1017B	East	County Road #2 Intersection	Victoria Street Intersection	Conc.	1017	120	1.22	
117	1017C	West	County Road #2 Intersection	70 m. North of County Road # 2	Conc.	1017	70	1.22	
96	1026D	South	West Street Intersection	Cross Street Intersection	Conc.	1026	88	1.22	
97	1026E	South	Cross Street Intersection	Bridge Street Intersection	Conc.	1026	88	1.22	
98	1026F	South	Bridge Street Intersection	Mill Street Intersection	Conc.	1026	112	1.22	
99	1026G	South	Mill Street Intersection	Centre Street Intersection	Conc.	1026	80	1.22	
100	1026H	South	Centre Street Intersection	Factory Street Intersection	Conc.	1026	95	1.22	
101	1026I	South	Factory Street Intersection	County Road # 6 Intersection	Conc.	1026	300	1.22	

102	1026J	South	County Rd. # 6 Intersection	500 m. East of Cty. Rd. # 6	Conc.	1026	500	1.22	
103	1026K	North	175 m. West of Durham Street	Durham Street Intersection	Conc.	1026	175	1.22	
104	1026L	North	Durham Street Intersection	Old Wilton Road Intersection	Conc.	1026	138	1.22	
105	1026M	North	Old Wilton Road Intersection	Mud Lake Road S. Intersection	Conc.	1026	90	1.22	
106	1026N	North	Mud Lake Road S. Intersection	Mill Street Intersection	Conc.	1026	45	1.22	
107	1026O	North	Mill Street Intersection	Centre Street Intersection	Conc.	1026	81	1.22	
108	1026P	North	Centre Street Intersection	Factory Street Intersection	Conc.	1026	94	1.22	
109	1026Q	North	Factory Street Intersection	William Street Intersection	Conc.	1026	173	1.22	
110	1026R	North	William Street Intersection	34 m. East of William Street	Conc.	1026	34	1.22	
118	1045A	North	Factory Street Intersection	Centre Street Intersection	Conc.	1045	139	1.22	
34	1060D	South	Kidd Drive Intersection	Cambridge Crescent Intersection	Conc.	1060	182	1.37	
35	1060E	South	Cambridge Crescent Intersection	Oxford Crescent Intersection	Conc.	1060	62	1.37	
36	1060F	South	Oxford Crescent Intersection	Manitou Crescent W. Intersection	Conc.	1060	64	1.37	
9	1066A	West	Amherst Drive Intersection	Littlefield Road Intersection	Conc.	1066	62	1.37	
10	1066B	West	Littlefield Road Intersection	Asbury Road Intersection	Conc.	1066	286	1.37	
11	1066C	West	Asbury Road Intersection	Kildare Avenue Intersection	Conc.	1066	65	1.37	

12	1066D	West	Kildare Avenue Intersection	Cambridge Crescent Intersection	Conc.	1066	478	1.37	
13	1066E	South	Cambridge Crescent Intersection	Keitha Drive Intersection	Conc.	1066	110	1.37	
14	1066F	South	Keitha Drive Intersection	Sherwood Avenue Intersection	Conc.	1066	270	1.37	
23	1076A	West	Upper Park Road Intersection	Briscoe Street Intersection	Conc.	1076	42	1.37	
22	1093A	West	Amherst Drive Intersection	Park Crescent Intersection	Conc.	1093	215	1.37	
27	1111A	South	Addington Court Intersection	.3 km East of Loyalist Blvd.	Conc.	1111	142	1.37	
120	1113B	West	Gore Street Intersection	Elgin Street Intersection	Conc.	1113	92	1.22	
121	1114C	West	Elgin Street Intersection	County Road # 2 Intersection	Conc.	1114	144	1.22	
111	2004A	West	County Road #2 Intersection	North Street Intersection	Conc.	2004	82	1.37	
113	2033A	West	County Road #2 Intersection	North Street Intersection	Conc.	2040	80	1.22	Old Wilton Road
114	2033B	West	North Street Intersection	300 m. North of North Street	Conc.	2040	300	1.22	Old Wilton Road
125	2034A	North	165 m. West of Bridge	Fisk Road Intersection (includes bridge)	Conc.	2034	880	1.22	
122	2037D	West	County Road #2 Intersection	Victoria Street Intersection	Conc.	2037	119	1.22	
123	2037E	West	Victoria Street Intersection	William Street Intersection	Conc.	2037	128	1.22	
82	4001A	East	Loyalist Boulevard Intersection	283 m. South of Loyalist Blvd.	Conc.	4001	263	1.37	
83	4001B	West	250 m. South of Loyalist Blvd.	Glenora Drive Intersection	Conc.	4001	67	1.37	

84	4001C	West	Glenora Drive Intersection	600 m. South of Glenora Rd.	Conc.	4001	600	1.37	
77	4004A	South	County Rd. # 7 Intersection	Davy Street Intersection	Conc. /Pav.	4004	96	1.07	
78	4004B	South	Davy Street Intersection	Lodge Street Intersection	Pav.	4004	70	1.07	
79	4004C	North	County Rd. # 7 Intersection	37 m. West of Cty. Rd. # 7	Conc.	4004	37	1.22	
80	4004D	North	Lodge Street Intersection	Second Street Intersection	Conc.	4004	66	1.07	Section width is sub-standard and needs to be considered in re-construction program
91	4006A	East	Heritage Drive (north) Inters.	Heritage Drive (south) Inters.	Conc.	4006	360	1.22	
92	4006B	North	Heritage Drive (south) Inters.	38 m East of Heritage Drive	Conc.	4006	38	1.22	
64	4009A	East	Main Street Intersection	Hawley Court Intersection	Conc.	4009	134		
73	4011A	West	Main Street Intersection	Queen Street Intersection	Conc. /Pav.	4011	65	1.22	Replaced in 2013, this ID is disposed
74	4011B	West	Queen Street Intersection	Academy Street Intersection	Conc.	4011	68	1.22	Replaced in 2013, this ID is disposed
75	4011C	West	Academy Street Intersection	Loyalist Boulevard Inters.	Conc. /Pav.	4011	736	1.22	Partly replaced, original 840m length, southern 100m renewed

									during Church St reconstruction
69	4012B	East	Main Street Intersection	Queen Street Intersection	Conc.	4012	64	1.22	
70	4012C	East	Queen Street Intersection	Academy Street Intersection	Conc.	4012	66	1.22	
71	4012D	West	Main Street Intersection	40 m. North of Main St. Inters.	Conc. /Pav.	4012	40	1.22	
87	4023A	East	Hwy. #33 Intersection	Bayshore Drive (south) Inters.	Conc.	4023	340	1.22	
66	4027A	East	Main Street Intersection	Queen Street Intersection	Conc.	4027	64		
67	4027B	East	Queen Street Intersection	Academy Street Intersection	Conc.	4027	67		
88	4030A	South	Heritage Drive Intersection	Burleigh Court Intersection	Conc.	4030	75	1.22	
89	4030B	South	Burleigh Court Intersection	80m West of Burleigh Int.	Conc.	4030	80	1.22	
90	4030C	East	80m West of Burleigh Int.	90m to the north	Conc.	4030	89	1.22	
50	4045C	North	Factory Lane Intersection	First Street Intersection	Conc.	4045	202		
51	4045D	North	First Street Intersection	Second Street Intersection	Conc.	4045	88		
52	4045E	North	Second Street Intersection	Lodge Street Intersection	Conc.	4045	85	1.2	
60	4045M	South	Rogers Lane Intersection	Lodge Street Intersection	Conc.	4045	130		
63	4045P	South	Church Street Intersection	Fairfield Street Intersection	Conc.	4045	62	1.07	

48	4046A	North	550 m. West of Village Limit	Country Club Drive Intersection	Conc.	4046	550		
49	4046B	North	Country Club Drive Intersection	Factory Lane Intersection	Conc.	4046	280	1.2	
72	4053A	West	Lake Ontario	Main Street Intersection	Conc.	4053	100	1.07	
126	5018A	South	200 m. West of Stella 40 Foot	Stella 40 Foot Intersection	Gravel	5018	200		
127	5018B	South	Stella 40 Foot Intersection	210 m.East of Stella 40 Foot	Conc.	5018	210	1.2	
128	5018C	North	220 m. East of Stella 40 Foot	445 m. East of Stella 40 Foot	Conc.	5018	225	1.2	
28	6001A	North	Sherwood Avenue Intersection	Westfield Drive Intersection	Conc.	6001	95		
						Total	**13760**		

Table 2 Sidewalk deficiencies and discontinuities

Odessa and Wilton				
Issue/proposal	**Potential Solution**	**Location**	**Marked as**	**Notes**
Sidewalk access	Signage, access ramp at end	Old Wilton Road - end of sidewalk across from park	A	sidewalk across from park that is raised; loose gravel is currently connecting sidewalk to the road
Planned new sidewalk		County Road 2 - Senior's Home East to Henzy	B	135 m of sidewalk and a culvert
Planned new sidewalk		Odessa STP Site to Pumping Station (Millhaven creek)	C?	Multi-use pathway - 565 m

Connectivity		Park behind fire hall		Planned developments could create issues for connectivity to park
Street width		Older areas (Cross, battery, south street east)		Joe provided comment on status ->
Bath				
Issue/proposal	**Potential Solution**	**Location**	**Marked as**	**Notes**
Road crossing	Signage, improve ramp	Highway 33 - across from Finkle's Shore Park	B	sidewalk ends across street from park – way to make crossing safer?
Blocked path	Signage, canada post issue	Abbey Dawn Dr - path closest to Country Club Dr	C	mail boxes placed in the middle of the golf course path
Sidewalk condition		County Road 7 - from Loyalist Blvd to Bath Public School	D	Bad sidewalk conditions, some sections are just gravel. Likely to be developed soon (next 10 yrs), owned by developer
Narrow sidewalk		Queen Street - from Davy Street to County Road 7	E	Paved shoulder? Kind of a sidewalk but not really
Sidewalk access	Concrete deficiencies east to west	Heritage Dr - intersection with Manor Road	F	raised lip on sidewalk connector to cross street. Misdirecting large radius on end of manor rd sidewalk (north side)
Road crossing	Overhead signage or lights?	Highway 33 - Bulch Ave intersection to via path to manor road	G	possible traffic calming measure for crossing to path? Bad sightlines because of corner

Sidewalk access		185 Highway 33 - across street	H	sidewalk ends on lake side of road, no connection to sidewalk which continues across the street
New proposed sidewalk		Sir John Johnson Drive - between Purdy Road and Highway 33	I	New sidewalk to add to sidewalk put in by developer
New pedestrian path		Raglan Street link to beside Phase 4 SWMF		Raglan Street pedestrian link to path beside Phase 4 SWMF
Amherstview				
Issue/proposal	**Potential solution**	**Location**	**Marked as**	**Notes**
Path/sidewalk access	Signage	120 McDonough Cres - across street	A	only dirt connecting road to sidewalk and path - currently a dead end street but could have higher volume sin the future
Sidewalk access		Between 60 and 56 Kildare Ave	B	no connection to sidewalk across the street from the end of the path.
Sidewalk ending		Highway 33 - at the end of Jordyns Court	C	this stretch of sidewalk ends randomly (no connection to road)
High volume access point	Priority	Pittsfield St		Narrow road with no sidewalk providing access to section of subdivision
Bus stop access		Amherst Dr - bus stop on lake side near Pittsfield St	D	bus stop with no connection to sidewalk

				on other side of street/bench
Sidewalk access	Linkage, signage	Quinte Ave - between Henry Crescent and Amt Lynn Dr	E	only dirt connecting road to sidewalk (*this may have changed)
Planned new sidewalk		Highway 33 - lakeview park	F	connecting sidewalk (340 m) and pedestrian bridge
Planned new multi-use pathway		County Road 6 - Kildare Ave. to Amherst Drive	G	Multi-use pathway - 295 m - in conjunction with County work
Planned new multi-use pathway		County Road 6 - Connection Across Existing South of Taylor Kidd	H	Multi-use pathway - 200 m - in conjunction with County work

IMP Technical Memorandum: Snow Storage Facility

Asset Class: Miscellaneous

Objective: The objective of a new snow storage facility study is to locate a site for the development of a snow storage facility that meets a broad range of site criteria.

The snow storage facility will:

- Be safe, secure, and operationally efficient
- Protect and enhance natural environment
- Comply with provincial and municipal environmental and land use requirements
- Minimize social impacts
- Meets climate change mitigation and resiliency expectations

Background

The usual practice of municipal snow storage for the transportation system is to wing back the snow onto boulevards using traditional snow ploughs. Where space allows, snow is stored on site at various Township facilities.

This practice is not practical in commercial areas such as Main Street – Bath and Main Street – Odessa. In these areas, Township crews remove snowbanks once the snow event has passed and haul the snow to another location.

As the number of cul-de-sacs in residential subdivisions increases, there is a proportionate need to remove snow from the on-street storage areas.

In recent years the trend to narrower lot widths in new subdivisions has resulted in a significant reduction in the volume of available snow storage along the streets. This resulted in the need to remove snow from residential streets for the first time in the winter of 2021-22. In the past this activity was limited only to selected intersections and cul-de-sacs after major snowfalls.

It is expected that with the needs of maintaining affordable housing that this trend will continue which will increase the demand for offsite snow storage.

Where it is no longer practical to store snow in the boulevard, it becomes necessary to haul the accumulated snow to a site where it can be stored until it melts. This snow may be impacted by various contaminants:

- Salts or other snow and ice control chemicals
- Oil, grease, and heavy metals from vehicles
- Litter and debris
- Roadside dirt, dust, and airborne pollutants

These contaminants should be handled, stored, and disposed of in an appropriate manner that protects the environment (Transportation Association of Canada, 2013).

Loyalist Township has utilized vacant space adjacent to the Public Works Garage site (748 County Road 6) as an informal snow storage site since the building was constructed. In recent years the site has been barely large enough to accommodate the snow volumes removed from Township roads.

This site does not meet current regulatory standards for this type of facility and with the expansion of this building underway in 2023, the current location of the storage area will be problematic.

Development of a new facility, even if that facility is constructed at the same location, will need both formal environmental permitting and municipal site plan approvals. Under the current MCEA criteria (based on March 2023 amendment) this project is outside of EA requirements if the cost of the facility is less than $3.5 million.

A major expense associated with snow storage is the cost to haul snow from the local streets to the snow storage facility. Thus, there is a desire from Operations staff to have the new facility located such that it can efficiently service the areas where snow removal is required the most.

In the Climate Lens section below, it is suggested that a slight reduction of snowfall accumulation of 5-10% can be expected within the horizon of the IMP. Additionally, annual snowfall accumulations vary significantly from year to year. As an example, the City of Kitchener's hauled volumes have varied between 100,000 and 250,000 m^3 in any particular year (Andrew, Engel, & Lusk, 2016).

Using an approach that calculates the population centroid of the Township, staff have previously concluded that a location slightly north and west of the Loyalist East Business Park is the population centroid. Looking solely at haul distances, a site in this general vicinity would be very practical as it would minimize the distanced required to haul snow.

Assumptions

It is assumed that the trend towards the development of smaller residential lots will continue, which will result in an overall decrease in boulevard snow storage capacity. As more commercial areas are developed in the Township with street access, there will be an increased demand for snow removal from these locations.

It is also assumed that developers will prefer to develop subdivisions with cul-de-sacs, as lots on these streets have a higher profit margin.

For reasons identified below, the design volumes for snow storage do not include volume changes due to climate change, or account for the addition of snow hauled by private contractors.

The proposed storage volumes assume that the stored snow continues to take up the same amount of space throughout the snow-clearing season until spring melt. On the contrary, staff have reported that the stored snow generally shrinks with time over the hauling cycles as ambient temperatures rise and fall. This means that the capacity calculation approach in this tech memo is conservative. If one considers the potential increase in magnitude of our design volume, the lack of data on historic hauled snow volumes indicates a potential for a sizable error, which the melting rate can potentially balance. Additional data from future years of annual hauled snow volumes will be of great benefit to this analysis.

Methodology

The Township has the benefit of mirroring processes on similar projects recently undertaken by the cities of Guelph and Kitchener. The experiences of these two projects were considered in developing this memorandum.

The Township sought input from the Cataraqui Region Conservation Authority (CRCA) regarding site selection criteria, and made use of the TAC guideline, Synthesis of Best Practices - Road Salt Management (Transportation Association of Canada, 2013).

The initial step was developing an estimate of the volume of snow being hauled for storage at the existing facility. The second step is to develop site screening criteria to evaluate the merits of each potential location for storage. This is followed a detailed assessment of properties within a reasonable study area.

A project of this type will be subject to the Township's site plan approval process. Once detailed design is underway, a permitting process must take place. The types of permits are partially based on project design and location. The result will be a permit issued by MECP which notes applicable chloride concentration limits for the release of meltwater beyond the site, and mitigative requirements should the concentrations be greater than the prescribed limit. The permit will also include monitoring requirements in the effluent for total suspended solids, pH, and heavy metals.

If the preferred site is not owned by the Township, staff will need to seek an agreement in principle for the purchase of the property. This would occur ahead of the formal site plan and permitting process. Ideally an agreement of this type would be in place to allow for early assessments of existing groundwater and surface water characteristics prior to any site work.

For the IMP the original goal was to complete the selection of a preferred site within the Masterplan. Staff developed a site selection criteria document, and CRCA supported the criteria. It was hoped that the preferred site would be selected prior to the public review stage of the draft IMP document.

These criteria were applied to several properties in a broad study area bordered by Lake Ontario, Highway 401, County Road 4, and County Road 24 (Coronation Boulevard).

After reviewing the various properties that met the initial selection criteria, staff have reached a consensus that each site has associated risk factors, and none can be considered with clarity as the preferred option. Factors considered potentially a risk to successfully completing the project are:

- Proximity to residential and other potentially sensitive users
- Potentially unfavourable geologic conditions regarding infiltration, with limestone bedrock exhibiting both low permeability and karst conditions in the immediate vicinity of Amherstview
- Inaccurate mapping data presents a difficulty in assessing extent and impact of significant woodlands coverage within the study area, resulting in the need for more detailed on-site assessments
- Meltwater impacts to potentially sensitive streams and vegetation will likely require mitigation
- Limited snow storage volume data

The snow dump facility is a project identified partway through the development of the Infrastructure Masterplan and as such, detailed background information is not readily available.

Staff observed various rates of natural succession of former farm fields and felt that the use of internal mapping of sensitive woodlands may lead to erroneous results. Future evaluation will require on site observations by qualified ecologists.

After substantial initial review it was decided that the IMP would identify the rationale for the snow dump project and recommend a detailed site evaluation be undertaken in the future. This decision was based primarily on two factors:

1. Operational costs could be very high if chloride levels in the meltwater cannot be reduced sufficiently to allow its release without further treatment.
2. Mapping for woodlands is not sufficiently accurate for a desktop evaluation process.

Analysis

A new snow storage facility should be designed to include a reasonable growth factor based on the expected land development trends and changes in climate. Consideration should be given for:

- snow storage volume
- vehicle access, parking, and queueing
- site access controls
- site drainage and treatment of meltwater, including management of contaminants
- site equipment storage and maintenance
- proximity to major haul routes
- haul distances
- local groundwater conditions and groundwater use

- condition of receiving water and source water protection requirements
- soil permeability
- local land use
- proximity to sensitive users.

Loyalist Township currently utilizes vacant area on the north side of the existing County Road 6 Public Works Garage. With the current expansion underway for this building, the existing site will be very constricted for continued use as a snow dump. This facility is not specifically permitted for this use.

Unfortunately, the Township has limited historical data on the annual volume of snow stored at this site. It is known that over the past several years the weather patterns have been very variable and that volumes from year to year can very significantly. For the winter seasons 2021/2022 and 2022/23 the following volumes have been recorded. Volumes are based on manual counts of individual truck loads that are hauled to this site.

The volume of snow in an average load is 16m^3 based on the tandem trucks typically used in Loyalist's snow hauling operations.

For the winter season of 2021-22, load counts were as follows:

	Loads
Odessa	371
Bath	192
Amherstview	327
Other (Bridges)	63
2021-22 Total Loads	**953**

This converts to a total volume of 15,248 m^3 for 2021-22.

For the winter season of 2022-23, load counts were as follows:

	Loads
Odessa	300
Bath	361
Amherstview	355
Other (Bridges)	7
2022-23Total Loads	**1023**

This converts to an average total volume measured over two winter seasons of 989 m^3 based on the two-year period ending March 31, 2023.

This data is insufficient to make accurate estimates for future needs, due to the observed large annual variances of the volume of snow required to be hauled. Since the value of 989 m^3 is the best data available, this quantity of waste snow will be used for this report.

It is recommended that annual data for hauled snow volumes be maintained in the future.

Hemson estimates that the increase in population is estimated to be 1.0% and the growth in households is 1.57% per annum (Hemson Consulting Ltd., 2019). It is felt that the growth rate per household is indicative of the growth in hauled snow volumes based on each house having a certain width of frontage on a street.

A possible use of this site would be to allow private contractors access for snow dumping in the future. However, operations staff have advised that this has not been considered a best practice by neighbouring jurisdictions; therefore, no contribution by external users has been included for this purpose.

A longer design period for this site might be appropriate considering the amount of complementary infrastructure required for this type of facility. A growth factor of 40% has been used as a long-term growth factor for this calculation.

Average volume of hauled snow 989 m^3

(A)

Apply growth factor of 1.57% growth /25 years 1.29

(B)

25-year volume Township use 1278

m^3

(C= A*B)

Total design volume (25 year) 1278 m^3

(F= C+D+E)

Design size (long term) 1800 m^3

(G=1.4*F)

The current storage area at County Road 6 is approximately 30m by 40m, or 1,200m^2 (0.12 hectare/0.3 acres). This area does not allow for anything else except snow storage.

A review of the recently completed Guelph and Kitchener sites indicate that the pad represents approximately 25 and 50% of the total site area, respectively.

Kitchener's pad was based on a pile design height of 10m, and the total area of the site is 11 acres. Loyalist Township currently does not have equipment suitable to operate a pile with a height of 10m; however, staff have advised that they are currently considering the acquisition of a high-power commercial snow blower which could easily stockpile snow to that height. Guelph used a former unpermitted snow dump, and the site was bigger than they needed resulting in larger vegetated buffer areas (Adhikari, 2021).

As an initial guide, and assuming pad size as 40% of total area, Loyalist should be looking at a minimum size site that could accommodate a storage pad of approximately 1 acre in size on a 2.5-acre site, based on a 10m pile height. As this area includes room for growth a smaller area could be viable, but likely most of the other treatment and monitoring outlet elements would need to be completed. Actual conditions of the preferred site will impact the minimum area size. The desired water quality of the stormwater effluent from the site along with expected runoff volumes will be the major factors in the sizing of the site's stormwater management facility. Access to a sanitary sewer outlet may be an advantage as an alternative discharge point for site effluent that doesn't meet the surface water quality regulatory limits of the facility

When looking at the total area requirements of a snow storage site it is necessary to consider all the requirements for the site, which will include many of the following features:

- snow storage area and related impervious pad. This is a function of operational height of pile and volumes hauled to the site
- stormwater management facilities including outlet channels and structures, treatment cells, monitoring stations, pumping stations, and oil and grit separation (OGS) units. Drainage swales are often designed with vegetative filter strips and check dams
- entrance roads and queuing lanes for snow haulers
- room for blower, dozer, or excavator operations, parking, and storage, and fuel storage
- site maintenance facilities
- sanitary facilities for site operators, operators' facilities
- security fencing
- buffer strips on exterior edges of site and landscaping
- access to electrical supply, as well as adequate room for site lighting, power poles, generators, transformers, potential pumping equipment, electrical vehicle charging, energizing water quality and flow monitoring equipment
- sufficient space for any other concurrent and complementary uses of the site, e.g., temporary storage for excess soil, road sweeper residue, organics, etc.; as well as gravel, sand, and topsoil stockpiles (recognizing that snow storage is a very seasonal activity)
- common design slopes are 2:1

- round-the-clock access for trucks to site
- access to sanitary sewer
- policy decision regarding third party access to the site

Although the Guelph and Kitchener sites are designed to handle increased snow volumes and thus require a larger pad, many of the other site features' sizes will be relatively similar in size, possibly excepting the stormwater management facility.

Key design considerations are mitigation of noise and chloride contamination. It is expected that a snow dump will typically be operated at night when ambient noise is low.

To mitigate potential damage to the environment, the site will need facilities that can monitor chloride levels and will hold meltwater with high concentrations of chlorides, on the site if necessary. Other contaminants of concern often associated with snow dumps are heavy metals and total suspended solids (TSS). Varying pH levels are also a concern.

Monitoring of contaminants and pH are necessary. Having background levels of these contaminants in the receiving body of water can be very helpful both for permitting and for ongoing mitigation efforts. It is typical to monitor both ground and surface water using both continuous and discrete sampling methods.

Typically the pads are both impervious and sloped so that meltwater is directed to receiving swales. An additional design consideration is to orient the pad to maximize the influence of solar energy for melting. In the Kitchener example, meltwater with chloride levels greater than 640 mg/L are directed to the municipal sanitary sewer system. When meltwater chloride concentrations are greater than 10,000 mg/L the meltwater must be retained and diverted away from the sewer system and the chloride concentrations reduced. In Kitchener this is achieved with dilution with other meltwater. This option then requires an offline storage facility that allows for mixing and dilution. Pads are sometimes constructed with an asphalt layer, an impervious geotextile, or both.

Site designs should include the use of vegetation that is resistant to salt and suitable to local growing conditions. It has been demonstrated that plants can filter larger particles from waterways and soil, transferring certain material including salt ions to their leaf and stem structures where these chemicals are safely dispersed, or the contaminants are transferred to biomass and can be safely removed from the site. Specific vegetation can aid in lowering chlorides in meltwater effluent when established in the drainage swales. A study completed at the nearby (McSorley K. , Rutter, Zeed, & Cumming, 2016) evaluated several species of plants for their phytoremediation capabilities in a local environment (McSorley K. , Rutter, Cumming, & Zeeb, 2016).

Experience has demonstrated that chloride concentrations are impacted greatly by temperatures. At lower temperatures (approximately -10C) concentrations may be very high. This is analogous to the temperatures where the use of salt because ineffective for winter control on roads.

Experience at Kitchener also found that the chloride monitoring equipment in this environment was not as accurate as expected, and alternative control measures using conductivity levels were being evaluated.

Diversion to sanitary sewer of chloride-laden meltwater increases operational costs and is not beneficial to the sewage treatment process. Dilution using tankage on site may be an acceptable option but is also expensive. The option of a sanitary sewer being close to a potential dump site in Loyalist is limiting when all the other potential site constraints are reviewed during a screening process. There are a couple of exceptions to this that should be explored.

When considering all the above considerations, the IMP team decided that it would be impractical to decide on a preferred site until further screening resources are available.

A site selection criteria screening document was developed based on the Kitchener and Guelph examples and input from CRCA. The weightings used in these criteria should be considered as a preliminary draft, and staff recommend they evaluated by specialists who are familiar with treating water with chloride loadings in an area like Loyalist, with shallow limestone bedrock geology and hydrogeological interactions.

Construction of a formal snow dump at the existing Public Works Garage site is problematic due to property limit constraints, proximity of sensitive alvar features, and to some wetland environments.

If access to this site is allowed for third parties additional area should be considered to allow for an increased volume of snow storage.

With the first expansion of the roads garage now underway the spatial constraints at this site will become more intensive. This means that the “Do Nothing” option is impractical. A new snow dumpsite that meets prevailing regulatory requirements is necessary.

The following chart is an initial version of a screening document for a snow dump facility (not included on this chart are a valuation for the presence of site servicing for large truck access, access to sanitary sewer, or access to a power source):

Evaluation Criteria			Site #1	Site #2	Site #3
Criterion	**Factors Considered**	**Criterion Weight**	**Score**	**Score**	**Score**
Social Impact	Proximity to residential areas, amount of surrounding residential areas, proximity to recreational areas, proximity to businesses, proximity to future developments, population density, noise.	0.2			
Accessibility / Ease of use	Traffic access, proximity to snow removal areas/city centre, adjacent road infrastructure, ability to capture and control site runoff, access to necessary utilities.	0.15			
Environmental Impact	Sensitivity of surface water receptors, proximity to sensitive surface water receptors, proximity and extent of surrounding Natural Heritage Systems, proximity to potential identified species at risk habitats, proximity to flood plains, potential for air quality concerns.	0.15			
Source Water Protection	Vulnerability of site and surrounding area, permeability of surficial soils, proximity to municipal drinking water supply, proximity to domestic water supply wells, proximity to well head protection areas.	0.15			
Cost	Capital cost to establish Site, operational costs, hauling costs, cost/complexity of required studies (e.g., EIS, traffic etc.) cost of completing engineering design.	0.1			
Alternate Site Use	Potential for other uses such as equipment storage, vehicle parking, street sweepings management area, soil storage, recreational use.	0.1			
Available Area	Available area, future expansion, proximity of the site to future projects.	0.05			
Security	Access control, proximity to populated areas, potential for flood risk, proximity to future projects.	0.05			
Ease of Permitting	Number of permits required, complexity of the permits required, likelihood of agency acceptance, compatible current land-use.	0.05			

Evaluation Criteria			Site #1	Site #2	Site #3
Criterion	**Factors Considered**	**Criterion Weight**	**Score**	**Score**	**Score**
Social Impact	Proximity to residential areas, amount of surrounding residential areas, proximity to recreational areas, proximity to businesses, proximity to future developments, population density, noise.	0.2			
Accessibility / Ease of use	Traffic access, proximity to snow removal areas/city centre, adjacent road infrastructure, ability to capture and control site runoff, access to necessary utilities.	0.15			
Environmental Impact	Sensitivity of surface water receptors, proximity to sensitive surface water receptors, proximity and extent of surrounding Natural Heritage Systems, proximity to potential identified species at risk habitats, proximity to flood plains, potential for air quality concerns.	0.15			
Source Water Protection	Vulnerability of site and surrounding area, permeability of surficial soils, proximity to municipal drinking water supply, proximity to domestic water supply wells, proximity to well head protection areas.	0.15			
Cost	Capital cost to establish Site, operational costs, hauling costs, cost/complexity of required studies (e.g., EIS, traffic etc.) cost of completing engineering design.	0.1			
Alternate Site Use	Potential for other uses such as equipment storage, vehicle parking, street sweepings management area, soil storage, recreational use.	0.1			
Available Area	Available area, future expansion, proximity of the site to future projects.	0.05			
Security	Access control, proximity to populated areas, potential for flood risk, proximity to future projects.	0.05			
Ease of Permitting	Number of permits required, complexity of the permits required, likelihood of agency	0.05			

	acceptance, compatible current land-use.				

Financial

The 11-acre Kitchener site had a $2.6M budget in 2016/7. Prorating this cost over a 2.5-acre site results in an estimated cost of $0.6/M. In addition to this amount would be property costs and engineering and approval expenses.

Considering inflation and factors of scale, an estimated 2023 budget for Loyalist would be $1.5M.   Staff will be recommending that budgeting for this project be initiated as soon as possible.

A portion of the project costs should be funded by both short term and long term growth based on the final design life and growth potential of the site. The balance will need to be funded directly by Loyalist Township's general rate funding or grants, if available.

Climate Lens

Trend analyses based on a study using 40 years of historical climate data from 13 climate stations across Ontario indicates winter rainfall has been increasing, and snowfall has been decreasing in Ontario (Ahmed, et al., 2022).

In general, it is expected that the amount of precipitation that falls as snow will decrease, the number of icing days will decrease, and the mean maximum winter temperature will increase over the next few decades in the Kingston area (Prairie Climate Centre, 2019). Annual precipitation is expected to increase between 7% and 24% and there will continue to be a shift in precipitation from snow to rain (Government of Canada, 2019). Despite the occurrence of heavy storms, without consistently cold temperatures, the snow is likely to melt and won't contribute to the snowpack. A reduction of 5% to 10% in seasonal snow accumulation is projected through to mid-century for most of Canada (Government of Canada, 2019).

Based on the climate forecasts the area required for a snow storage site has not been increased by a factor for future increased snow aggregation.

Mitigation

How will snow storage help to mitigate the effects of climate change?

- Storing snow in a central location would decrease the trucking/hauling distance, reducing the GHG emissions associated with transportation
- Removal of contaminants at a storage facility prior to discharging melt water into the environment will result in recharging of aquifers in a controlled manner, and reducing the potential for erosion and accumulation of salt in the potable water supply

Adaptation

How will snow storage adapt to the effects of climate change?

- The amount of space required to store snow should be adjusted to consider snow accumulation will be decreasing over the next century
- Storage of snow should take into consideration an increase in rainfall during the winter months which may increase run-off of contaminants from stored snow

Alternatives

What are the alternatives to snow storage?

- Increase the length of time required for the Township to respond remove snow from roadways. Given that the mean winter temperatures will increase, it is likely the snow will melt in less amount of time. However, this may negatively impact accessibility for residents and emergency services.
- Design new developments/subdivisions to include space for temporary snow accumulation to avoid having to haul it to a storage facility. This would decrease GHG emissions generated from trucking and hauling and prevent the concentration of contaminants in one location.

Linkages

References

Adhikari, P. (2021, November). *The City of Guelph's Snow Disposal Facility*. Retrieved from Municipal Engineers Association: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjZ0Ln1psP-AhUSkIkEHQAnB7sQFnoECAwQAQ&url=https%3A%2F%2Fmunicipalengineers.on.ca%2Ffiles%2FWorkshops%2F2021%2FPresentations%2FCOG%2520Snow%2520Disposal%2520Facility%25

Ahmed, S., Rudra, R., Goel, P., Amili, A., Dickinson, T., Singh, K., & Khan, A. (2022). Change in Winter Precipitation Regime across Ontario, Canada. *Hydrology, 9*(5), 81.

Andrew, S., Engel, M., & Lusk, R. (2016, November). *City of Kitchener Snow Storage and Disposal Facility.* Retrieved from Municipal Engineers Association: https://municipalengineers.on.ca/files/Workshops/2022/Slides/12_Nov%2016_Snow%20Storage%20&%20Disposal%20Facility_Roslyn%20Lusk.pdf

Government of Canada. (2019). *Canada's Changing Climate Report*. (E. Bush, & D. Lemmen, Editors) Retrieved from http://www.changingclimate.ca/CCCR2019

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

McSorley, K., Rutter, A., Cumming, R., & Zeeb, B. (2016). *Chloride accumulation vs chloride excretion: Phytoextraction potential of three halophytic grass species growing in a salinized landfill.*

McSorley, K., Rutter, A., Zeed, B. A., & Cumming, R. (2016, April 26). Phytoremediation of salt and (&PHC) impacted soils using Biochar Augmentation; Implications of Salt Tolerance Mechanisms (test site: Lafarge Holcium - Bath Works).

Prairie Climate Centre. (2019). *Climate Atlas*. Retrieved from https://climateatlas.ca/map/canada/plus30_2030_85#

Transportation Association of Canada. (2013). *Syntheses of Best Practices - Road Salt Management (2013): 8.0 - Snow Storage and Disposal.* Retrieved from Transportation Association of Canada: https://www.tac-atc.ca/en/publications/bp-rsm8-e

Conclusions

The initial objective of providing a preferred location has been deferred. Staff realized that the financial risks of error in site selection were too high with the list of unknowns noted above. After reviewing the interim findings and completing an initial site screening it was decided that further evaluation of the project would be deferred until the masterplan process was completed.

Recommendations:

1. That data for hauled snow volumes be maintained on annual basis in the future.
2. That Loyalist consider a site selection process for a new snow dump location with a minimum size of 2.5-3.0 acres, or larger if access to sanitary sewers for the site are not available.
3. That Loyalist prioritize the development of a snow dump site.

IMP Technical Memorandum: Cyber Security for Water and Sanitary Sewage Systems *(Summary)*

Asset Class: Water, Sanitary Sewage

Objective: The primary mandate of the Township's potable water and sanitary sewage systems is to provide safe and environmentally acceptable levels of treatment and minimize pipe failures. With an ever-increasing level of automation incorporated into the operation of the Township's systems, the stability of the water and sanitary sewage information technology (IT) infrastructure is an important element. The objective of the memorandum is to identify suggested best practices and to recommend next steps in the Township's cyber security efforts.

Summary

The full technical memorandum outlines current IT infrastructure supporting water and sanitary sewage systems, including vulnerabilities, and makes several recommendations to improve cyber security.

The memorandum has been deemed confidential, and will be shared with operational and management staff in the Utilities and Information Technology divisions.

IMP Technical Memorandum: Natural Assets

Asset Class: Miscellaneous

Objective: The objective of the memorandum is to signify the importance of formally recognizing the value of green infrastructure as a municipality.

Background

Municipal natural assets refers to natural resources and/or ecosystems that contribute to the provision of one or more services required for the health, well-being, and long-term sustainability of a community and its residents. Natural assets and green infrastructure are often used interchangeably, although natural assets are technically a subset of green infrastructure. The Province of Ontario defines green infrastructure as,

> "Natural and human-made elements that provide ecological and hydrological benefits. Green infrastructure can include components such as natural heritage features and systems, parklands, storm water management systems, urban forests, permeable surfaces, and green roofs." (Province of Ontario, 2017)

Many municipal assets are considered grey infrastructure which consists of built, non-natural assets including bridges, roads, culverts pipes etc.

Municipalities are recognizing that green infrastructure features can provide equivalent or better services than many grey infrastructure assets for a fraction of the cost. Using natural assets, when possible, offers a sustainable solution that can also increase community resiliency to extreme weather events.

Historically, green infrastructure, specifically natural assets, have not been considered in capital asset management plans. As the Township's asset management process evolves in conjunction with provincial initiatives, green infrastructure should be identified and managed appropriately. This type of financial recognition will allow for green infrastructure to be considered on more equal footing to grey infrastructure, providing a sound basis for economic comparison when evaluating solutions.

Loyalist staff have recently commenced the development of an urban forest management plan. It is anticipated that this plan will be completed in 2024, with funding estimated to be available in 2025. This is an important first step in the development of a natural asset plan.

Assumptions

n/a

Methodology

To signify the importance of green infrastructure in the Township, staff conducted a high-level overview of existing natural assets and green infrastructure, also investigating a process of formally recognizing this infrastructure though asset management. Staff relied on resources from the Natural Assets Initiative (MNAI) and Green Infrastructure Ontario (Green Infrastructure Ontario Coalition).

Analysis

Green infrastructure can typically be split into three categories: natural (i.e., natural assets), engineered, or combined. Natural green infrastructure includes solutions such as wetlands, lakes, and forests. Engineered green infrastructure consists of low impact solutions such as rain gardens, green roofs, and urban trees. A high-level overview of potential green infrastructure in the Township identified the following items:

Green Stormwater Infrastructure	Urban Forests	Parks and Recreation
• Wetlands	• Streets	• Trails (paved, woodchips)
• Waterbodies (rivers, creeks, streams)	• Meadows (savannah, tall grass)	• Parks (parkette, neighbourhood destination)
• LID (bioswales, green roofs, permeable pavements, etc.)	• Forests (natural, managed)	

There are many benefits to implementing green stormwater infrastructure. Wetlands can help treat and polish wastewater, which is currently done at the Amherstview Water Pollution Control Plant. LID and wetlands also help to improve flood resiliency and reduce the amount of runoff entering the stormwater system. Waterbodies are important in improving resiliency to extreme storms, and also provide an opportunity for recreation.

Urban forests offer increased tree cover which presents a variety of benefits. Tree cover helps to reduce air temperature through shade and evapotranspiration. The canopy also reduces the amount of rainwater that makes it to the ground, which reduces runoff and can help protect habitats. Urban forests also provide a more balanced ecosystem that helps to improve pest control. Increased root systems from a variety of plants also help to prevent erosion.

Trails and parks offer many of the same benefits described above. In addition to this, trails create active transportation opportunities. An increase in active transportation helps to reduce greenhouse gas emissions that are typically caused by vehicular transportation. Trails and parks also provide safe areas for residents to enjoy the outdoors.

This overview demonstrates that green infrastructure plays a key role in the services provided by the Township. These assets should be recognized formally so they can be maintained or replaced as required. The following are reasons to include green infrastructure in the Township’s asset management plan:

- Compliance with O.Reg. 588/17, where green infrastructure meets the definition of a municipal infrastructure asset. All municipal infrastructure assets must be included in the asset management plan before July 1st, 2024, per the regulation.
- Increased infrastructure resiliency to climate change.
- Use of natural assets can potentially reduce operating expenses when compared to expected expenses for those expenses typical of grey infrastructure.
- Assist in maintaining a level of service to community.

The key factor is the requirement to include green infrastructure in the Township asset management plan. To address this, staff should work on developing a strategy to evaluate and include the infrastructure. The following steps can be used to inform this strategy:

1. Determine the state of infrastructure
    - What assets are owned?
    - What is the value of these assets?
    - What is the age of these assets?
    - What is the current condition of these assets?
2. Determine the level of service
    - Measure of the quality, quantity, and/or reliability of a service from the public perspective
    - What types of services are provided?
    - Who receives the services?
    - Current performance
    - Performance target
3. Life cycle management strategy
    - Management options
    - Risks
    - Costs
4. Financial strategy
    - Funding sources, gaps, and approaches

Green infrastructure, specifically natural assets, bring different challenges when being evaluated for asset management. Some of these potential challenges have been listed below:

- Natural assets often have non-typical lifecycles
- In some cases, there is a delay in service provision (i.e., trees)
- Some assets will appreciate in value over time
- The level of service can be difficult to analyze
- There are no generally accepted accounting principles for valuation

To initiate this process, it is recommended that an inventory of municipal owned green infrastructure and natural assets be undertaken. This inventory could be completed internally by staff through a desktop study and rapid field assessment or by an external contractor, depending on resources. After the inventory is developed, values will need to be assigned to each asset. The final task will be to complete the asset management plan for green infrastructure. This will include a summary of assets and implementation to the Township database. Some steps in the process may require support from an external consultant(s).

Financial

The accounting world has some contradiction where natural assets are evaluated. The Public Sector Accounting Board (PSAB) Standard 3150 establishes the accounting and reporting standards for tangible capital assets in government financial statements (Chartered Professional Accountants of Canada [CPA]). Valuation is based on historical cost less accumulated depreciation and/or amortization. This definition restricts the inclusion of natural assets as tangible capital assets (TCA). Asset management plans rely on current replacement cost, used for financial planning. It is felt by many municipal finance professionals that asset management plans should include any asset that has a role in service delivery and requires deliberate management, whether or not they are deemed to be TCA under PS 3150.

Natural assets vary from traditional assets in that:

- They are naturally-forming, as opposed to acquired
- They have no end life
- Desired service life can take months to years to complete as opposed to expected service levels achieved immediately after construction
- Natural assets do not currently have industry accepted accounting standards for valuation

These disparities result in a general lack of appreciation of the value of the services provided by natural assets. Developing a program with the objective of identifying natural assets is an important initial step for the municipality. Continuing to work towards developing generally accepted accounting principles (GAAP) for natural assets is a beneficial objective.

The following costs have been estimated for the projects required to include green infrastructure in the Township asset management plan:

- Municipal green infrastructure asset inventory: $30,000
- Valuation of assets and inclusion in asset management plan: $200,000

Climate Lens

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of greenhouse gas (GHG) emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact natural assets/green infrastructure in Loyalist Township include the following:

- The number of days expected to reach above 30 degrees is expected to increase, while the number of days below -15 degrees is expected to decrease in the next 30 years (ICLEI, 2021)
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and overland flow.
- A decrease in the duration of ice cover of Lake Ontario (ICLEI, 2021) resulting in periods of increased open water conditions, will result in increased wave action and subsequent potential increased shoreline erosion during weather events.

Assessment of Recommendations

The proposals in this technical memorandum will promote the use and protection of green infrastructure in the Township. These are important initiatives from a climate change viewpoint since green infrastructure and natural assets have been shown to improve climate resiliency. Projects such as the natural asset inventory and promoting the use of green infrastructure with contribute to the Townships ability to mitigate and adapt to climate change.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Using a natural asset in place of engineered infrastructure typically limits the negative impact on the environment. For example, the wetland at AWPCP provide disinfection without energy consumption or GHG emissions.
- Green infrastructure often provides natural CO_2 sequestering. For example, forests help to cool urban areas and remove air pollutants.
- Promoting natural assets will reduce the use of materials that are high in embodied carbon (concrete, steel, aluminum, etc.).
- Increasing parks and trails will encourage active transportation and reduce emissions typically caused by vehicular travel.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Green stormwater infrastructure will help to reduce runoff and flooding during heavy precipitation events.
- Urban forests can help to reduce air temperatures and provide shade.
- Increase/improve natural infrastructure such as riparian buffers to mitigate shoreline erosion (Swanson, Murphy, Temmer, & Scaletta, 2021)

Linkages

n/a

References

Chartered Professional Accountants of Canada [CPA]. (n.d.). CPA Canada Public Sector Accounting Handbook.

Green Infrastructure Ontario Coalition. (n.d.). *GI - Asset Management Planning*. Retrieved from Green Infrastructure Ontario Coalition: https://greeninfrastructureontario.org/gi-asset-management-planning/

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

MNAI. (n.d.). *Natural Assets Initiative*. Retrieved from MNAI: https://mnai.ca/

Province of Ontario. (2017). *O. Reg. 588/17: Asset Management Planning for Municipal Infrastructure.* Retrieved from Province of Ontario: https://www.ontario.ca/laws/regulation/r17588

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (2021). *Advancing the Climate Resilience of Canadian Infrastructure.* International Institute for Sustainable Development - IISD.

Conclusion

The significance of formally recognizing green infrastructure as an asset has been highlighted through this technical memorandum. The Township recognizes the increased importance of these assets as limiting environmental impact continues to be a consideration when conducting projects.

It is recommended that a complete an inventory of current Township green infrastructure assets is completed.

It is also recommended that municipal owned green infrastructure is incorporated into the asset management plan.

Staff will also work towards prioritizing natural assets/green infrastructure whenever possible.

IMP Technical Memorandum: Source Water Protection

Asset Class: Source water is not a part of the Township's Capital Asset Plan. It is an important natural asset.

Objective: The objective of this memorandum is to illustrate the importance of source water protection in Loyalist Township.

Background

Source water is untreated water from lakes, rivers, and aquifers that is used for drinking water. The goal of source water protection, typically through source protection plans, is to protect the quality and quantity of water available for current and future drinking water sources. Source water protection is considered the first layer of protection in the multi-stepped process to protect drinking water. A major component of source water protection is developing a source protection plan. In the case of Loyalist Township, the source protection plan was completed by Cataraqui Region Conservation Authority (CRCA) in 2014 (Cataraqui Source Protection Committee, 2014).

The 2014 source protection plan highlights areas of sensitive groundwater and surface water intake protection zones. In the Township, surface water intakes are the primary concern since the source for the two municipal system is Lake Ontario. Both the Fairfield Water Treatment Plant (WTP) and Bath WTP take raw water from Lake Ontario. These treatment plants provide drinking water to 14,314 people, which is approximately 80% of the total population in the Township.

Each plant intake has an intake protection zone (IPZ). An IPZ will show where in Lake Ontario the supply of water is coming from, and how long it takes to reach the intake. The IPZs for Fairfield and Bath WTP are split into two out of three possible levels.

- IPZ 1 – a set area – typically a one-kilometre radius around the intake
- IPZ 2 – based on water movement – sized to account for a two-hour time of travel to reach the intake

The IPZs for each plant can be seen in the figures below.

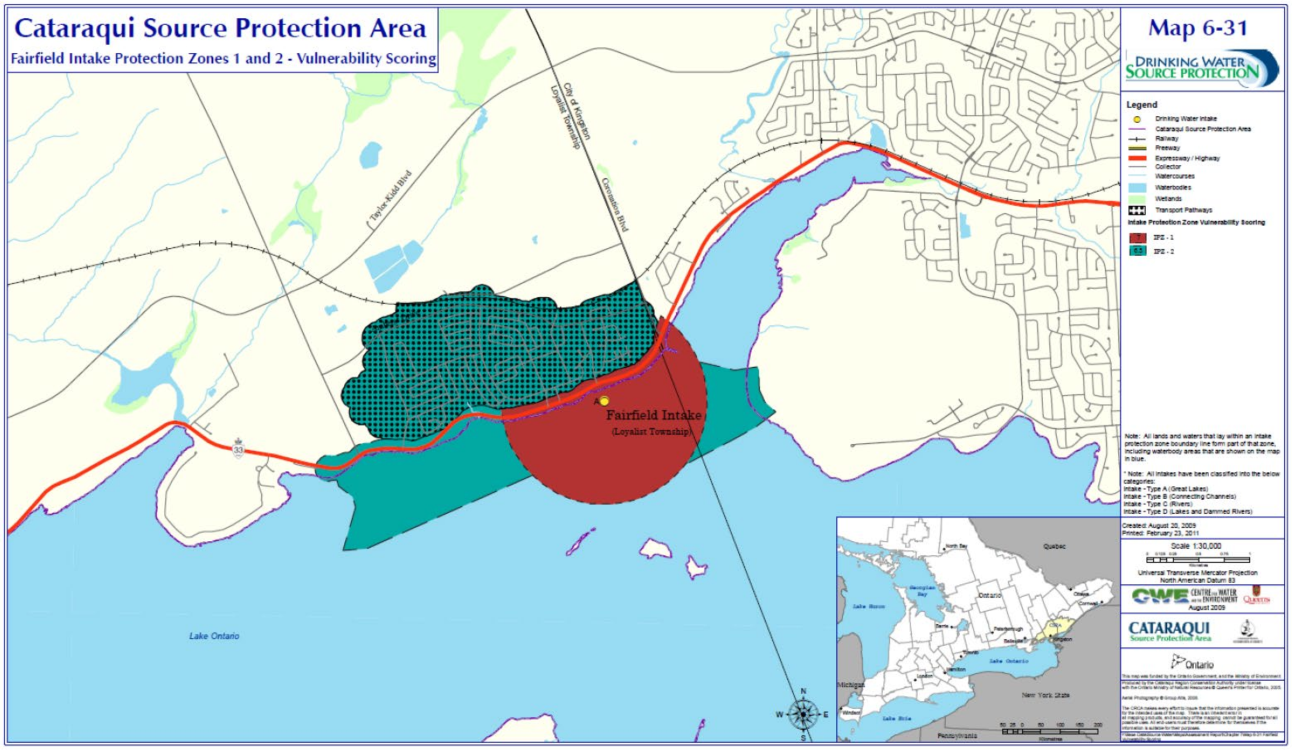


Figure 1. Intake protection zones for Fairfield Water Treatment Plant.

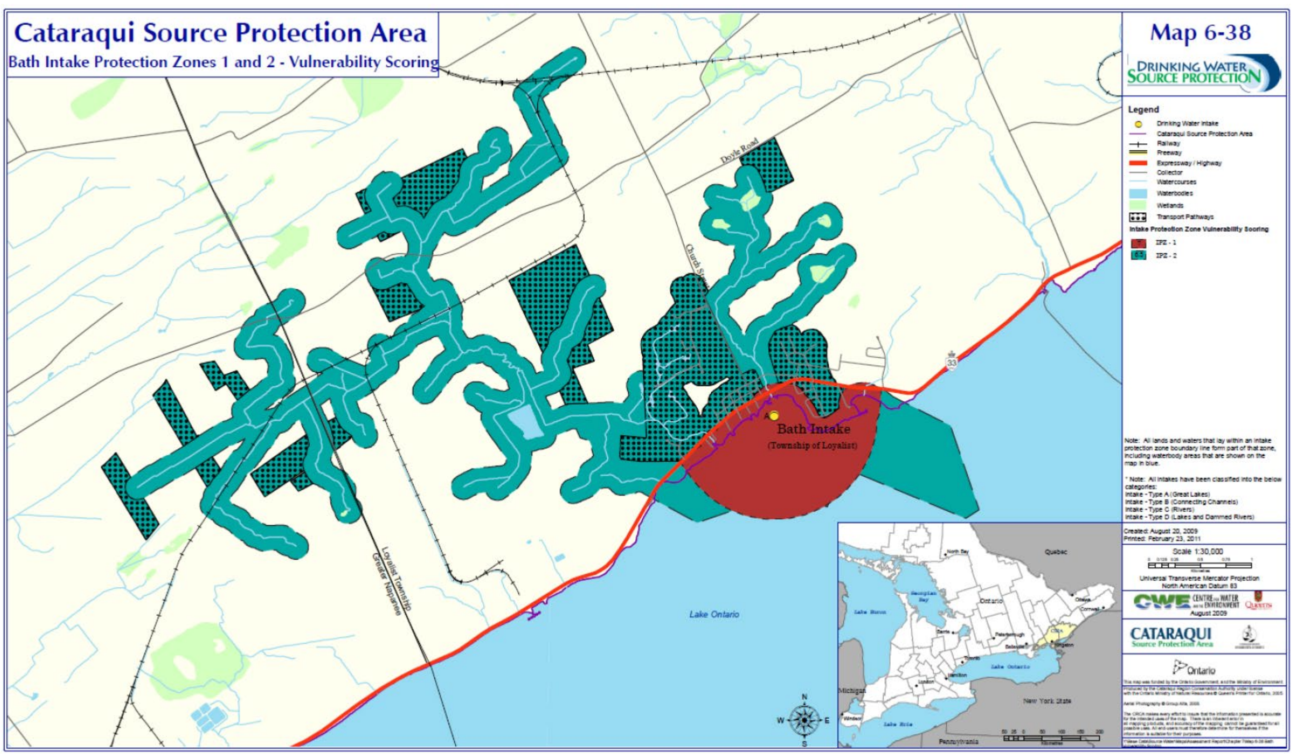


Figure 2. Intake protection zones for Bath Water Treatment Plant.

Each IPZ is also assigned a vulnerability score based on the vulnerability of the intake and surrounding area. The vulnerability scores consider factors such as how deep and close to shore the intake is, the geography and topography of land in the IPZ (how easily surface contaminants could reach the intake), and the time it would take contamination to reach the intake. The vulnerability scores for each WTP intake are as follows:

- Fairfield WTP
  - IPZ 1 – 7.0
  - IPZ 2 – 6.3
- Bath WTP
  - IPZ 1 – 7.0
  - IPZ 2 – 6.3

These scores were based on the assessment report (Cataraqui Source Protection Committee, 2014). According to this report, the scores listed above indicate that the water is susceptible to contamination.

The assessment report also identifies drinking water threats within the IPZs. Drinking water threats may items such as include application of agricultural source material, application of fertilizer, waster disposal, fuel storage, application of road salt, or sewage systems (Government of Ontario, 2013, 2017-18). Threats are rated as low, moderate, or significant depending on proximity to the drinking water source. The table below shows the number of threats that were identified for our IPZs in the 2014 report.

	Bath WTP	**Fairfield WTP**
Significant Threats	0	0
Moderate Threats	34	7
Low Threats	82	173

Although there were no significant threats identified, the source protection plan did identify some specific policies to consider for the Bath IPZ. The plan recommends the Township require proponents to incorporate stormwater management features that provide enhanced protection, to reduce the amount of sediment and contamination draining to the IPZs. It also recommends staff investigate the cause of increased sedimentation at the WTP by evaluating samples from watercourses in the IPZs. The primary reason for these recommendations was the documented history of increased sediment at the Bath WTP intake.

Staff have noted that there are still high levels of suspended solids at the Bath plant during intense weather events and with seasonal changes. Operational and process changes have been made at the plant to adapt to the suspended solids in the raw water. To deal with the issues in the raw water itself, further work will be required. This will include the monitoring of water courses within the IPZ for sediment/suspended solids, as recommended through the source protection plan. When this project is conducted, it should consider at run off distances to the creeks and proper landscaping and agriculture practices within the IPZs.

In 2020 CRCA completed an evaluation of the four most westerly drinking water intakes in their area of concern, to determine if there was value in revisiting the vulnerability scores associated with the IPZs (Cataraqui Region Conservation Authority, 2017). This report explains that there is a level of inherent vulnerability with the Township intakes as they are both shallow and close to shore. As mentioned above, there was also a history with sediment at the Bath WTP. It was therefore noted by CRCA when they revisited this study in 2019 that it may be warranted to reevaluate the vulnerability scores (Evans, 2020). The Township elected not to increase the vulnerability scores as sediment is not considered a threat or issue under the *Clean Water Act*.

If the vulnerability scores were to be changed, both the Fairfield and Bath intakes would require binding policies to address significant threats. If the scores were increased, there would 98 significant threats in the Bath IPZs, and 5 in the Fairfield IPZs. The source protection plan presents different actions that may be required depending on the type of significant threat. These include education & outreach, land use planning, risk management plans, and prohibition. The 2017 study estimated that 30 parcels would require risk management plans for the Bath intake, and 2 parcels for the Fairfield intake. The change in vulnerability scores would require a significant amount of work, much of which would likely need to be completed by a qualified risk management official or inspector. This is something the Township would need to consider if the vulnerability scores are ever changed.

As described above, source water is an important factor in providing drinking water to the residents of Loyalist Township. Source water protection has been carefully analyzed by the CRCA and Township staff. An important consideration for source water protection in the Township is private groundwater servicing. Groundwater concerns are discussed in detailed in the Groundwater Concerns and Private Servicing technical memorandum.

This document highlights potential projects that the Township can undertake to continue improving source water protection.

Assumptions

n/a

Methodology

Multiple steps were taken to determine how source water protection could be improved in the Township. The first step was to review the source protection plan from the CRCA. This document provides key information on the status and requirements (as of 2014) for source water protection in this area. Since this plan was developed in 2014, the next step was to discuss any source water changes noted by operations staff. Finally, staff met with the Source Protection Coordinator from CRCA to discuss potential projects that could help improve source protection in the Township.

Analysis

The information presented in the background of this memo was gathered through review of the CRCA source protection plan. It was determined that there are no significant drinking water threats in the IPZ for either water treatment plant. In 2019/2020 CRCA revisited the Western Intake Study that was done in 2017 and noted that it may be warranted to revisit the vulnerability scores for the IPZs in the Township. Through discussions with Township staff, it was decided that revisiting the vulnerability scores was not needed. Operations staff have noted that they continue to monitor the raw water intake at each plant carefully so that any concerns would be identified quickly.

The importance of source water in the Township is evident based on the large percentage of residents that relay on municipal drinking water. Staff met with the CRCA Source Protection Coordinator to discuss further improvements that could be made to strengthen this layer of protection for drinking water. The following projects and initiatives have been proposed.

- **Best practices for source water protection**: In 2021 a guide to best practices was developed to inform both private and municipal drinking water sources (Government of Ontario, 2021). It is recommended that staff become familiar with this guide through the information sessions that are being provide by the local conservation authorities. This document can also be used to update information that is provided to residents.
- **Outreach to residents:** Depending on whether a property is connected to the municipal drinking water system or a private well, owners will have different responsibilities in terms of source water protection. It is recommended that the Township website is updated to provide more information on source water protection for both private and municipal systems. In areas of specific high concerns mailouts may be effective in indicating the need for enhanced protection.
- **Water budget:** A water budget is a study that accounts for all of the water flowing in and out of a specific area. This study could be conducted for the Township, with the priority of examining private sources (groundwater).
- **Incentive for clean water:** The Township could provide incentives to residents willing to implement changes that promote clean water, especially within the IPZs. Examples of incentives that may be effective in certain areas of the Township would be cover crops that help to reduce run off and erosion, well and septic condition assessments, and improved stormwater systems. These incentives would be especially useful along the creek systems that drain to the lake and therefore towards the intake.
- **Monitoring and improvement program:** The Township should conduct a monitoring program within the Bath IPZs. This would involve sampling watercourses and storm sewers within the IPZs to try and determine the cause of increased sediment/suspended solids at the WTP intake. After monitoring is complete, the Township should work with landowners to reduce incidents and volumes of sedimentation.

- **Source water protection reserve fund:** In order to undertake the recommended projects and initiatives, funding will be required. It is recommended that a Source Water Protection Reserve Fund is developed in the Township. This fund could be set up to receive $25,000 each year for six years, then once at $150,000 it would be maintained at that level. This fund could be used to support projects that protect municipal intakes as well as groundwater. Details on groundwater in the Township can be found in the Groundwater Concerns and Private Servicing technical memorandum.

Climate Lens

The Climate Lens process was developed by Infrastructure Canada to help address the climate change impacts and greenhouse gas (GHG) emissions associated with infrastructure projects in Canada. By incorporating climate considerations during the planning and design of infrastructure projects, the Climate Lens is intended to help assess the potential impacts of projects, influence the design process, and inform funding decisions (WSP, 2020).

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of GHG emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact source water in Loyalist Township include the following:

- The number of days expected to reach above 30 degrees is expected to increase, while the number of days below -15 degrees is expected to decrease in the next 30 years (ICLEI, 2021). This may increase concerns with taste & odour and harmful algal blooms.
- Annual precipitation is expected to increase, which will produce more runoff that may impact water intakes. Winter and spring are projected to get significantly wetter with a slight decline in the summer (ICLEI, 2021). The runoff will likely contain emerging contaminants, such as microplastics, that have been building up in sediment layers.
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and overland flow, which also impacts the amount of groundwater recharge and the amount of runoff that flows towards water intakes (Jyrkama & Sykes, 2006).

As outlined in this report, source water protection is an important layer in protecting drinking water. The recommendations in this memo are to improve awareness and funding to support initiatives that will enhance source water protection.

Climate Change Mitigation

How will these projects assist in mitigating the impacts of climate change?

- Clean water initiatives should result in better quality water at the plant intakes, meaning the treatment process will not be as strenuous, ideally resulting in less consumption and GHG emissions
- Less dissolved organic carbon and other nutrients from runoff at the intake means free chlorine levels used during treatment can be reduced

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Updated information and studies will help to inform decisions that account for changes in climate over the last 10 years
- The climate impacts listed above may alter the raw water at plant intakes with minimal notice. Having funding and information available will help the Township be prepared to make changes if and when they are needed.
- Improved management of runoff will help to reduce nutrient levels and therefore help protect against concerns regarding taste & odour and harmful algal blooms.

Linkages

Groundwater Concerns and Private Servicing

References

Cataraqui Region Conservation Authority. (2017). *Initial Technical Evaluation of Vulnerability Scoring Changes to Shallow, Nearshore Intake Protection Zones in the Cataraqui Source Protection Area.*

Cataraqui Source Protection Committee. (2014, September). *Assessment Report Summary.* Retrieved from Cataraqui Source Protection Plan: https://cleanwatercataraqui.ca/PDFs/Studies-and-Reports/AppendixA-Assessment-Report-Summary.pdf

Cataraqui Source Protection Committee. (2014, September). *Explanatory Document for the Source Protection Plan.* Retrieved from Cataraqui Source Protection Plan: https://cleanwatercataraqui.ca/studies-and-reports/cataraqui-source-protection-plan-explanatory-document/

Evans, H. (2020, February 19). Municipal Decisions Regarding Western Lake Ontario Intake Vulnerability. *Cataraqui Source Protection Committee*.

Government of Ontario. (2013, 2017-18). *Drinking Water Threats and Circumstances*. Retrieved from Government of Ontario: https://www.ontario.ca/page/tables-drinking-water-threats

Government of Ontario. (2021). *Best practices for source water protection*. Retrieved from Government of Ontario: https://www.ontario.ca/document/best-practices-source-water-protection

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (2021). *Advancing the Climate Resilience of Canadian Infrastructure.* International Institute for Sustainable Development - IISD.

WSP. (2020). *Bracebridge Community Multi-Use Complex, Draft Climate Lens Assessment – Climate Change Resilience, Bracebridge, Ontario.*

Conclusion

This memo highlights the importance of source water protection in ensuring safe drinking water for residents. It is recommended that the Township complete the following actions to improve source water protection:

- Review best practices for source water protection
- Outreach to residents
- Water budget study
- Incentives for clean water
- Monitoring and improvement program in Bath IPZs
- Source water protection reserve fund

IMP Technical Memorandum: Rural Groundwater Concerns and Private Servicing

Asset Class: Miscellaneous. Groundwater is not currently a component of the Township's Tangible Capital Asset Plan. It is an important natural asset.

Objective

The objective of this memorandum is to illustrate the importance of groundwater availability in rural settings and some of the constraints frequently experienced by property owners within Loyalist Township for rural properties in being able to provide a consistent and adequate and safe supply of this important natural resource using private wells.

Background

Groundwater is an important natural asset that is often not available to rural residents within Loyalist Township at a quality and quantity level that most Ontarians are accustomed to. Contaminated groundwater is not uncommon within the Township, posing a threat to public health. Groundwater concerns are experienced across the broader region beyond the Township, wherever the limestone bedrock is found at or near the surface.

In the year 2000 Loyalist Township contracted Oliver Mangione McCalla and Associates (OMM) to undertake a Township-wide groundwater study (Oliver, Mangione, McCalla & Associates, 2001). Subsequently the Ministry of Environment (MOE, now MECP) supported the Cataraqui Region Conservation Authority (CRCA) to prepare a groundwater study for an expanded area covering portions of four municipalities including the Town of Greater Napanee, Loyalist Township, City of Kingston, and Township of South Frontenac (Trow Consulting Engineers, 2002). The CRCA-sponsored study included and built on the local data and information contained in the Township's 2001 study. References to groundwater data and mapping in this technical memorandum were taken from the CRCA groundwater study.

The objectives of the studies were similar and included compiling a groundwater resource inventory and characterizing the groundwater across the study area. The CRCA study also included an evaluation of potential options to protect existing groundwater resources.

Loyalist Township was eager to participate in the initial study due to staff's anecdotal understanding that much of the rural portion of the municipality has difficulty accessing a safe and dependable supply of drinking and domestic water on a continual, year-round basis. This fact was not well noted in the public realm and as such created both a potential public health concern and potentially a water supply issue. At the same time there was an ongoing demand for rural lot creation by severance.

The Township's rural water shortage is generally due to the limestone bedrock, present near (i.e., less than 1 metre below) the surface almost everywhere in the Township.

Limestone is known to have a relatively low level of transmissivity, defined as the horizontal flow rate through a substance, making it difficult for groundwater to flow through and be stored in limestone. Localized flows can be enhanced by the presence of sub-surface rock fractures.

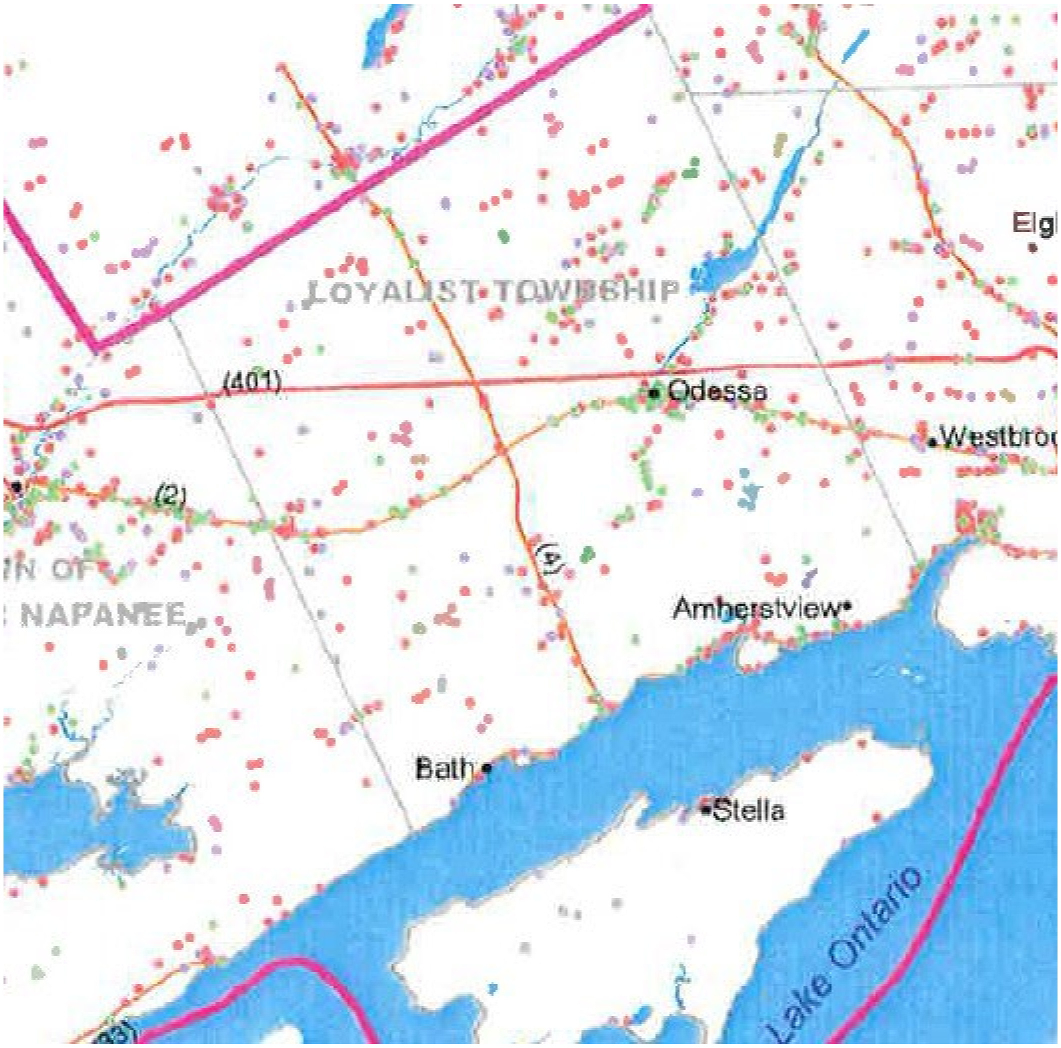


Figure 1 Availability of Groundwater in Loyalist Township

The figure above from the Trow study illustrates private wells throughout Loyalist Township and neighbouring areas that produce 3 US gallons per minute (gpm)[1] or less, representing approximately half of private water wells in Loyalist Township, with green dots indicating 0 gpm, red indicating 1-2 gpm, and lavender indicating 3 gpm. For the remaining private wells in Loyalist Township, approximately one-third are considered to have a moderate yield (3-10 gpm).

The OMM study was completed and presented immediately prior to the disastrous Walkerton E. coli outbreak and documented many local concerns. Immediately after

[1] 1 US gallon = 3.78 Litres. Most pumping equipment is rated in US gallons.

presenting the report to the public, the formerly mundane discussion of rural groundwater quality became a topic of much public concern.

The CRCA western region study revealed that:

Of the 2765 wells sampled for bacteria across the study area, approximately one-third (29%) had coliform bacteria counts greater than Provincial criteria. It is noted that counts of E-coli exceedances were highest in Loyalist Township at 17%. Of particular note is that Township groundwater is considered to be in the high to very high range for susceptibility to contamination, particularly in the vicinity of Odessa along the County Road 2 corridor.

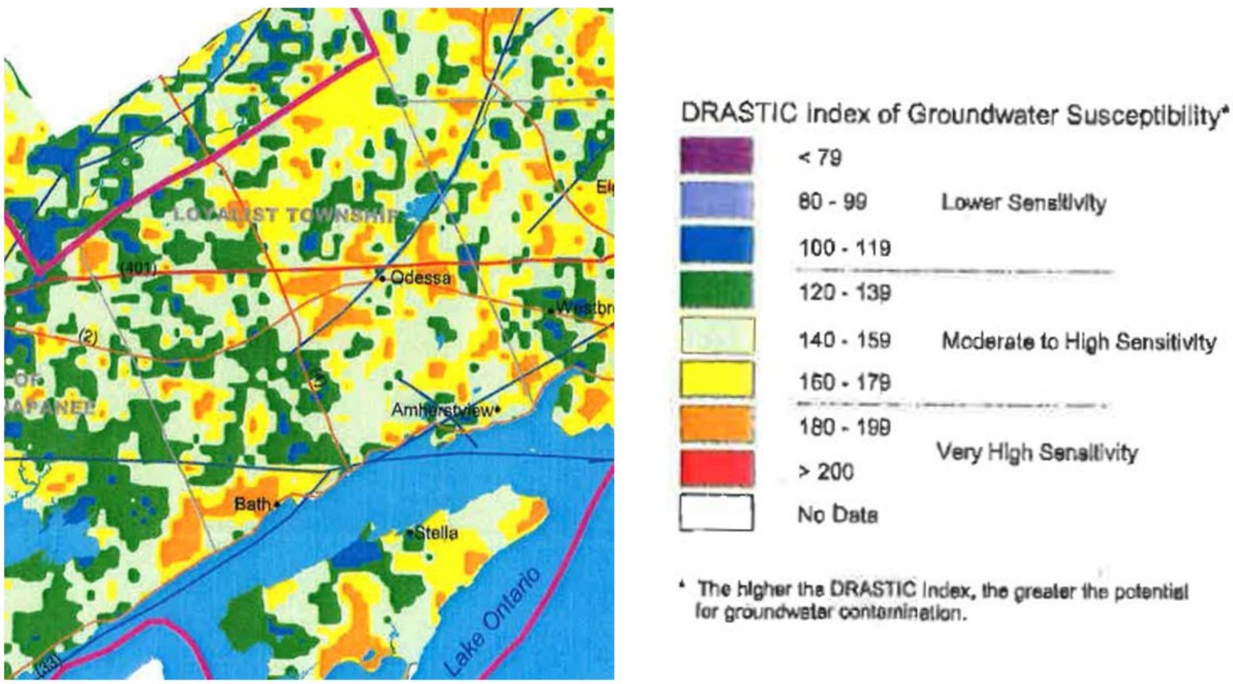


Figure 2 Groundwater susceptibility

About two thirds of the CRCA study area is estimated to be vulnerable to potential contamination. Vulnerability to contaminants is highest in the limestone plains where there is relatively shallow depth to water, thin/absent soils, exposed fractured bedrock. and karst[2] terrain. Soil over bedrock creates a natural filer that helps maintain groundwater quality. Unfortunately, in Loyalist Township the depth to limestone bedrock is usually much less than 1 m, and these local conditions result in groundwater that is unprotected from surficial contamination. These areas are also the most populated in the region, and hence contain the most potential sources of contamination.

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[2] Karstic limestone is an area where most/all of the drainage takes place by underground streams, with the surface being generally dry and barren.

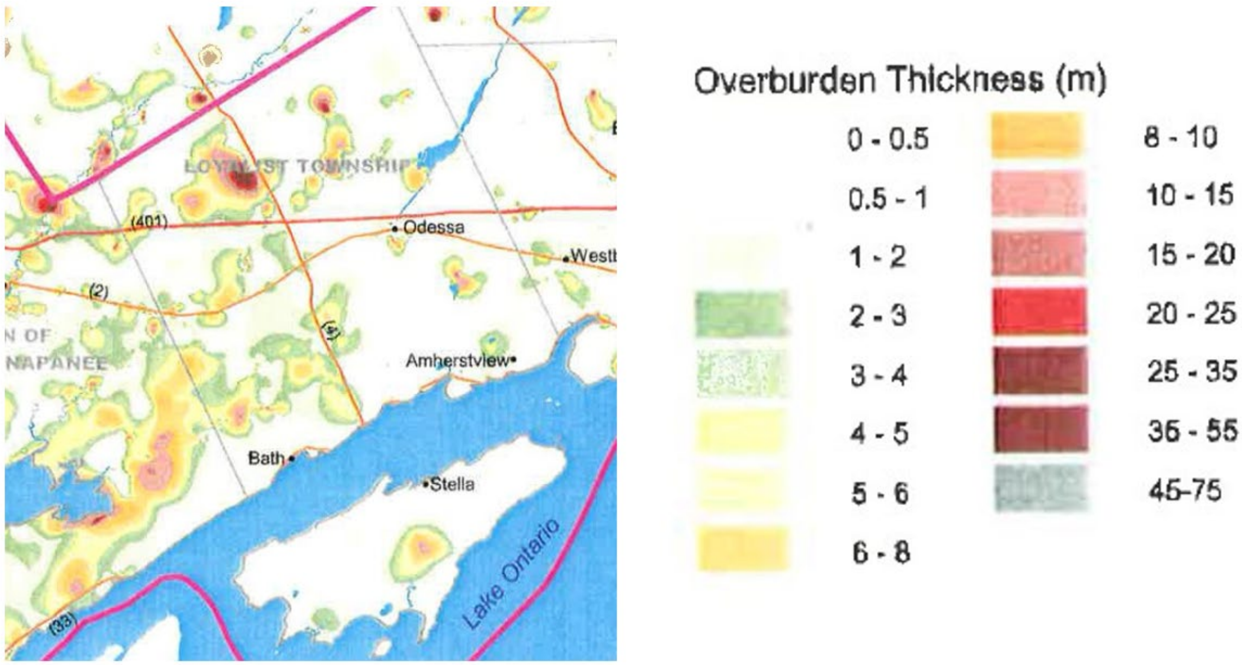

Figure 3 Soil overburden depth

All of the surficial bedrock within Loyalist Township is limestone. Limestone can be prone to karstic conditions at shallow depths, but at deeper depths is typically dense and doesn't provide good hydrogeologic conductivity, leading to the poor condition of many wells in Loyalist Township and surrounding area. A localized area may be impacted by faults in the bedrock which may experience higher conductivity.

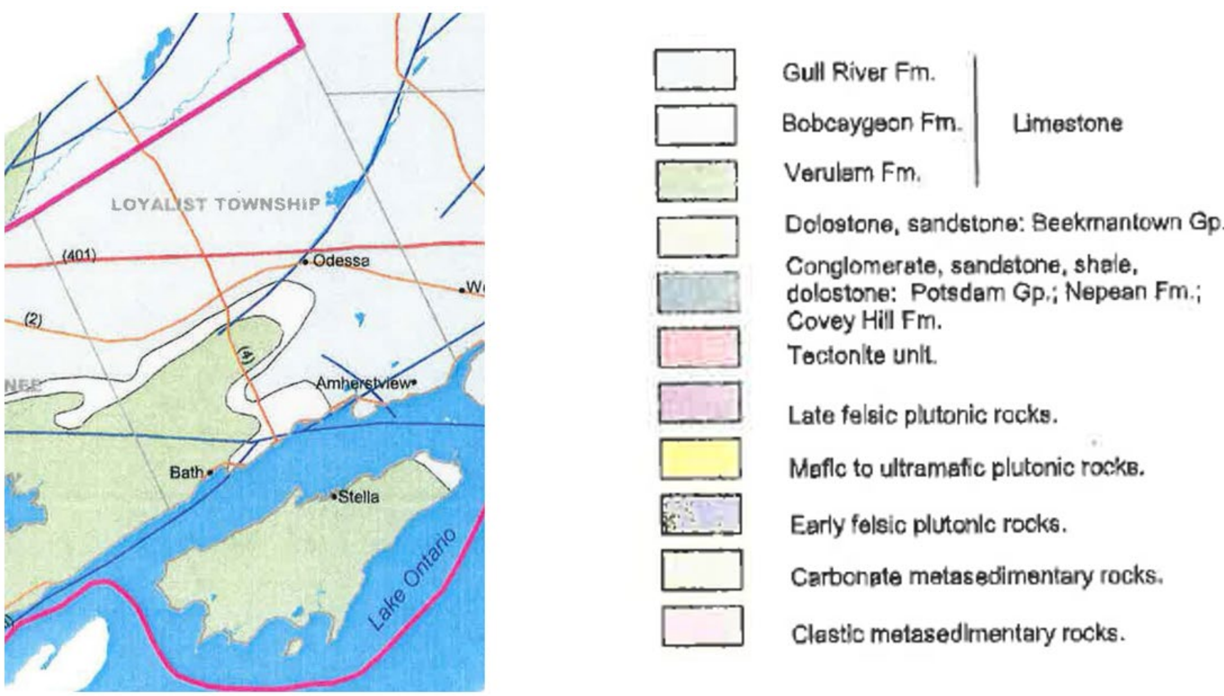

Figure 4 Bedrock geology

The Odessa area has some of the highest density of properties serviced by private wells within the study area. Odessa is a relatively old community. Rural properties are often serviced by wells that are either poorly constructed relative to modern well construction requirements, or not deep enough to intersect water bearing rock strata.

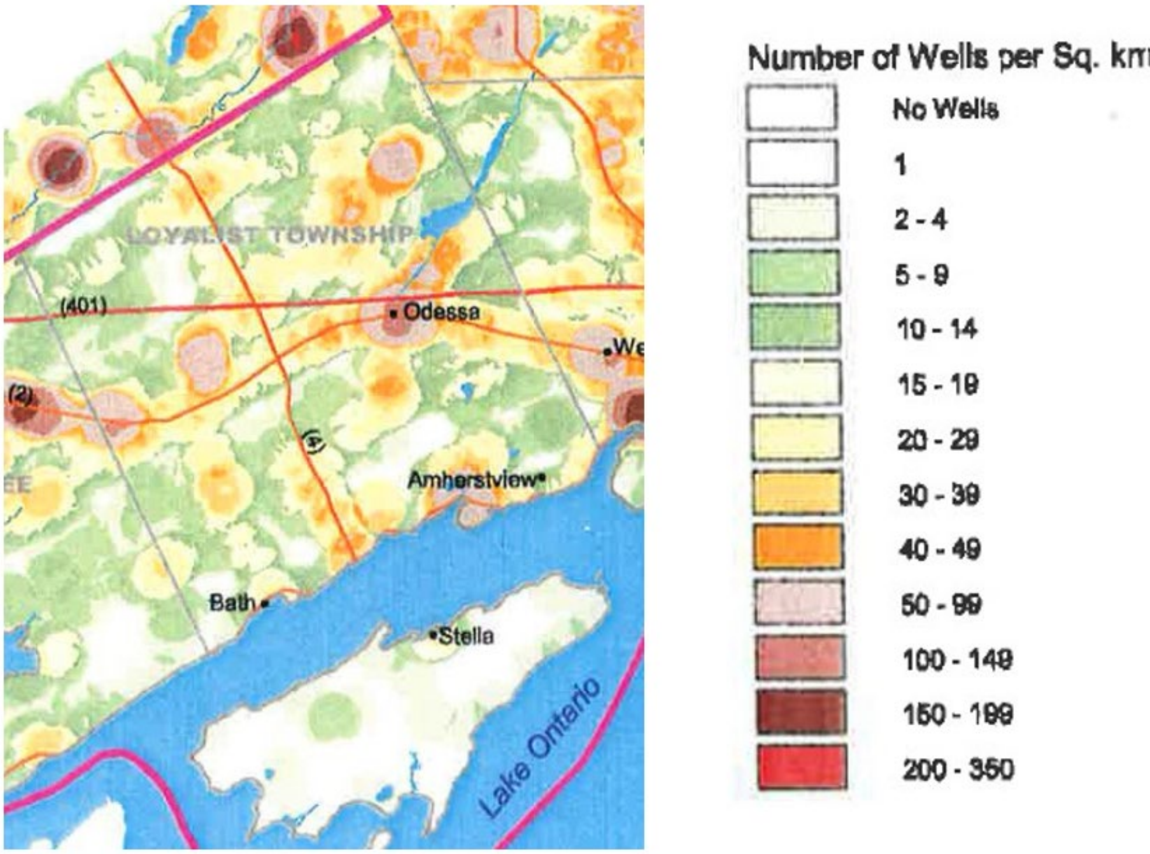

Figure 5 Well density

These older settlement areas have the highest number of old wells that were established prior to provincial regulations requiring minimum distance separation (MDS) between wells and subsurface sewage disposal systems (septic tanks), well casing specifications, depth, and installation protocols. It also is more likely that the sewage disposal systems operated at these locations are aging as well. These areas also have the highest number of wells with short casings, and the highest density of unused wells that have not been properly abandoned (i.e., sealed and plugged) according to provincial regulation.

All of these factors increase the potential of these older wells to become contaminated and to serve as conduits for surficial contamination to reach the groundwater.

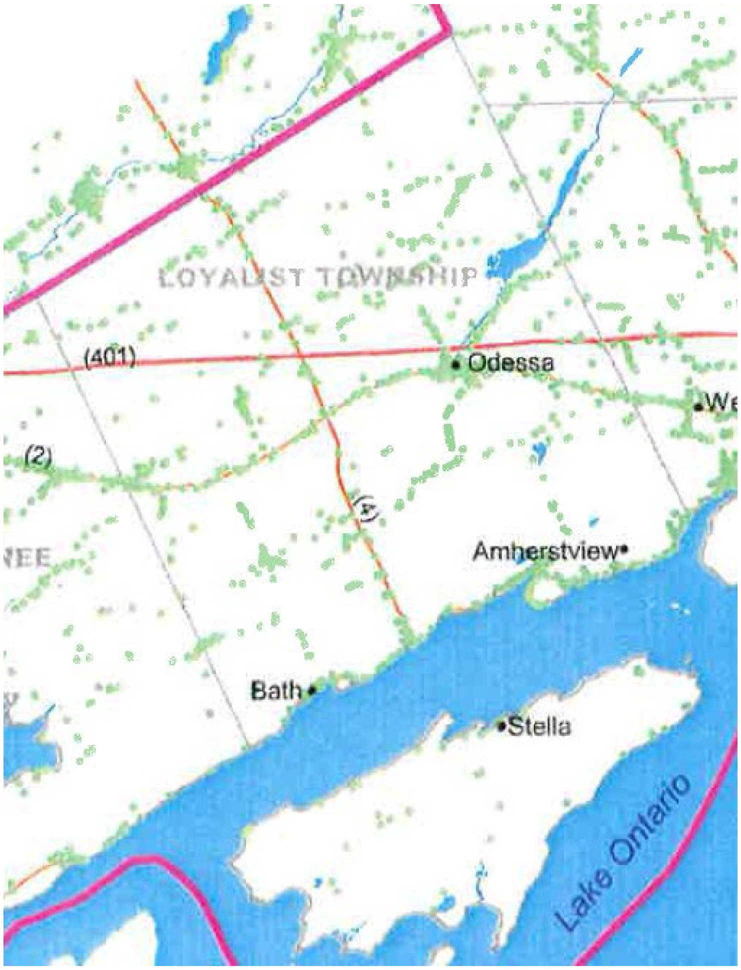

Figure 6 Wells constructed between 1907-1973, prior to MDS regulations

Lower yields and more dry wells occur in limestone. Yields tend to be progressively lower towards the western part of the CRCA Study Area due to inherent differences in the limestone bedrock. Bacteria sodium, salt (chloride), nitrates, iron and manganese, hardness, and hydrogen sulfide readings are above provincial standards in a significant number of wells.

Loyalist Township and the immediately adjacent area's limestone bedrock and shallow soil depths combined is relatively unique in Ontario. This results in a large area where groundwater supply is often inappropriate for sustainable rural development.

The CRCA's report made several recommendations to protect groundwater wells:

- That municipalities strengthen groundwater protection measures by means of wording in their Official Plan (OP) and zoning by-law
- Develop and maintain aground and surface water GIS database for water quality analytical results, water well records, static water levels, etc.
- Provide an education program for the public and develop a template of a residential groundwater protection plan.

Assumptions

It is generally assumed that bedrock can be found within 1.0 m of the surface for much of the Township and soil depths much less than that are common.

Rural development in this discussion includes that which requires individual private water and sanitary sewage facilities (i.e., wells and septic systems). Municipally serviced development, on the other hand, means that which has access to municipally-owned potable water and sanitary sewer systems and treatment.

Communal systems are a group of buildings connected to a water source(s), typically a standard or shore well. Communal systems usually have a higher demand, for which it would be difficult to locate an adequate supply in most of rural Loyalist Township.

Methodology

This technical memorandum will briefly review the findings of the previous studies and the specific groundwater concerns of well owners in Loyalist Township. The overview focuses on the findings of the 2002 CRCA report.

The report discusses the Township's current practices with respect to rural development, and best practices which could be adopted to improve rural groundwater concerns. The report reviews the benefits of urban servicing with relevance to the local groundwater scenario.

Note: Shore wells, which use surface water sources, are not within the scope of this review. These wells are generally able to produce safe and secure supplies when used with modern, multi-barrier treatment methods.

Analysis

The main questions are:

- What is the appropriate level of rural development within Loyalist Township?
- How does a well owner know their water is safe?
- How can a rural property owner be confident that their well can supply adequate water quantity to meet their needs year-round, while not negatively affecting their neighbours?

In 1996 the Township commissioned a well to be drilled immediately adjacent to the Amherstview sewage lagoons, which are located a few hundred metres from both Lake Ontario and Lost Lake, in the hope of accessing an adequate groundwater supply that it could be used as the process water at the sewage treatment plant. Drilling encountered no water and the well remained dry until the drill encountered granite at a depth of approximately 60 metres, at which drilling ceased. Despite having located some water, the production was very low, in the range of 1.0 gpm, and insufficient for its intended use. Due to poor yield, the thought of using a well to provide process water was abandoned and instead, a potable water service was provided from the Fairfield water distribution system to the sewage treatment plant to address domestic and process water needs.

Many people find rural living an attractive option. Rural development varies substantially but typically there are five general types within Loyalist Township:

- Traditional agriculture-based activity including support building(s), and accompanying residence
- Single lot rural road severances
- Shoreline severances, e.g., Front Road on Amherst Island
- Small commercial operations
- Rural subdivision and hamlets, e.g., Morven and Wilton

Rural homes with direct access to Lake Ontario have the option to obtain surface water directly from the lake. The quality of Lake Ontario water is normally sufficient that cost-effective, safe treatment options are locally available. Surface water supply is not an option available for most rural properties. The availability of a safe and adequate supply of groundwater becomes a “hit or miss” type of situation within the Township for many properties. It is important for rural residents to have water available on a consistent year-round basis. The alternative is to establish onsite storage facilities either to receive hauled water and/or to collect and store rainwater. Unfortunately, reduced rainwater availability often coincides with groundwater levels being at their lowest. Rainwater catchment systems are also prone to contamination. It is therefore prudent for Loyalist Township to monitor and control the level of development in rural areas through the current OP severance policy so that existing rural properties can remain sustainable, and any new development proposals have access to a proven safe and secure supply of groundwater.

Modern well installation requirements reduce the potential for contamination from surface water sources. The Ontario provincial guide D-5-5 Private Wells: Water Supply Assessment provides some good basic information (Province of Ontario, 1996), though generally written with larger multi-unit developments in mind. Regular well testing for bacteria and viruses, available through KFLA Public Health to private well owners, can confirm the safety of the supply and should be done at different times throughout the year. Water sources with minor contamination levels may benefit from onsite treatment to eliminate organics that can cause water-borne diseases. Inorganic concerns of groundwater from a modern drilled well are usually less of a factor in the Township and testing can confirm levels of multiple compounds, which are generally considered an aesthetic concern rather than a safety concern.

The Ontario government has also provided an implementation guide, D-5 Planning for Sewage and Water Services (Province of Ontario, 1996). This guide is consistent with the provincial policy statement under Section 3 of the Planning Act, and states:

> "This document is intended to guide municipal planning for sewage and water servicing. It describes an approach for municipal planning for sewage and water services to ensure an acceptable quantity and quality of water supply and the proper collection treatment and disposal of sewage wastewater for development. It is consistent with the Provincial goal to manage growth and change to foster communities, that are socially, economically, environmentally, and culturally healthy, and that make efficient use of land, new and existing infrastructure, and public service facilities."

Well-planned services are built efficiently and avoid the costs for later upgrading or rehabilitation that are common with poorly planned servicing. Objectives of the D-5 guide include:

- Planning for and directing development to areas where municipal water and sewage facilities are available.
- Using communal water and sewage services where multi-lot/unit development is considered for areas without full municipal services to ensure the long-term viability of the services through municipal responsibility to protect the environment and public health.
- Determining in the context of long-term planning and approved growth management objectives, that the consideration of development in areas without fullness will services is appropriate and site specific environmental and public health considerations are addressed

The D-5 guide provides a hierarchy of servicing preferences, with development on full municipal services being the preferred mode of servicing where there is sufficient uncommitted reserve capacity or where there is the capability for full municipal services to be expanded.

With respect to communal sewage and water services the D-5 guide provides the following guidance:

> "Where a municipality has determined that it is appropriate, consistent with the Provincial Policy Statement, to accept the principle of planned development in areas with out existing full municipal services, the preferred method of servicing multi-lot/unit development is public sewage and water servicing. "

The MECP recommends that municipalities develop long-term servicing plans to accommodate growth, a key focus of this IMP. MECP also notes:

> "The better understood the interrelationship between sewage and water servicing and natural water features and functions, the greater the efficiency of servicing over the long term and more effectively can the natural environment be maintained".

A water supply that services six or more properties is defined as a municipal water supply, making the municipality responsible to ensure the system to meets regulatory operational requirements including testing, records maintenance, and oversight, to the same level as larger systems. The per-capita cost of administering a small municipal communal water system is disproportionately high compared to that of a distribution system serving a much larger population. In most cases the portion of operating costs associated with physically producing and treating the groundwater for a small service area is generally equivalent to a larger centralized system; as such, this option is should be avoided.

MECP requires municipalities to enter into an agreement for municipal owner and/or responsibility for public communal services with the project developer, with the objective being to protect the municipality from being left with the responsibility for the system should its owners be unwilling/unable to operate it. Past advice, however, from the Township's solicitor has indicated that the only true protection for the municipality in this scenario would be an unrestricted and automatically renewable letter of credit, with a value equal to the municipality's potential financial exposure if the system(s) fail or are abandoned by the owner. These types of agreements are generally not very popular with the development community, with there being little interest to post the sufficient financial security.

Some older rural developments in the Township were constructed with communal systems before the ownership responsibility agreements were not yet required. Where these have failed, they have required various levels of municipal financial support. The municipality's expenditures for corrective action were not insignificant, but benefited only those serviced by the communal system.

Current requirements outlined in Guide D-5 state that, before a communal development may be approved, the proponent must complete, "a terrain analysis and hydrogeological report or an assimilation capacity study that demonstrates that the proposed development project will not have an adverse effect on the environment or public health."

Whether a well is for a private individual supply or a communal supply, the professional hydrogeologist has the responsibility to decide whether a well can meet long-term demands as required in Guide D-5-5. This is an important requirement and was recently emphasized when Loyalist staff discussed this topic with local MECP officials.

The diagram below illustrates the areas serviced by municipal water and sewer in the study area of the CRCA study, being the western region of their catchment.

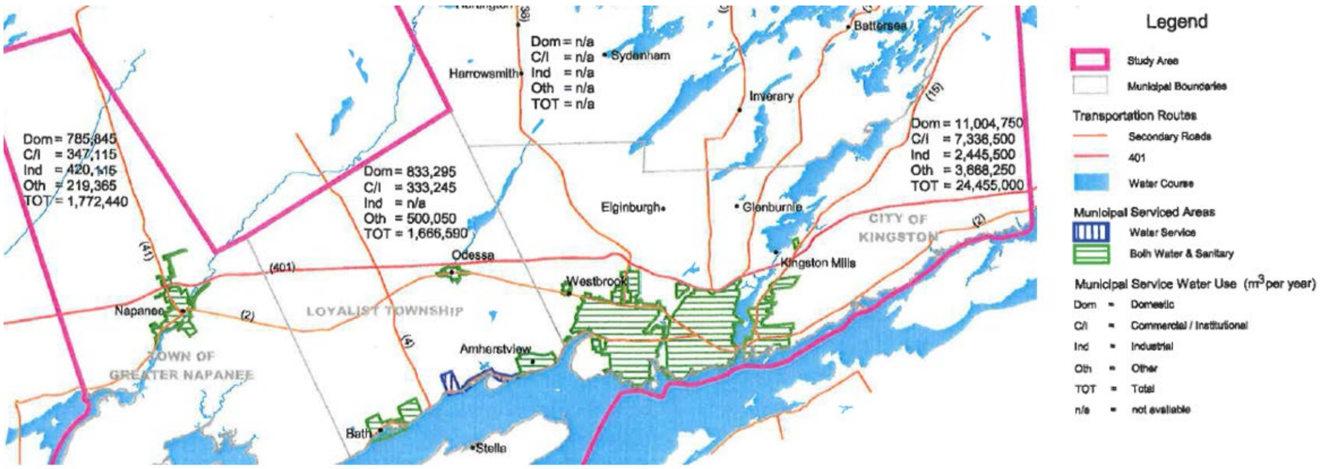

Figure 7 Areas serviced by water or water & sewer within study area

In Loyalist Township full municipal servicing is limited to the communities of Amherstview, Bath, and Odessa. Municipal servicing provides assurance to urban dwellers that the properties will have a safe and secure connection to water and sanitary sewage servicing year-round. Urban services are not reliant on weather patterns or local geological conditions, in contrast to the experiences of many rural properties. It is expected that service areas will expand to accommodate most of the planned growth within Loyalist Township for the next twenty-five years and beyond. Under the High Growth Scenario described in the population, employment and housing projections study commissioned by the Township (Hemson Consulting Ltd., 2019) and updated in 2022, the serviced areas are expected to accept 85% of the predicted new dwellings in the Township within the study period.

Guide D-5 requires that municipalities should ensure, when considering any servicing plans or proposals for development on individual onsite services and areas without full municipal services, the following:

- Planned development can be justified consistent with Comprehensive Set of Provincial Policy Statements; and
- Municipal officials' plans do not anticipate or identify the provision of municipal services; and
- Areas for development proposed to be served by individual onsite sewage and water services are designated based on evaluation of environmental constraints that confirms that the principle of development is appropriate.

The D-5-5 document regarding water supply assessment was developed by the province as a technical guideline for developments on individual private wells, with the following objectives:

- To provide technical guidance to professionals involved in land development in particular hydrogeologists in the assessment of groundwater quality and quantity

- To provide an interpretation of the application of MECP policy to development of individual private well water supplies; and
- To ensure development proposals are submitted with required technical support.

Guide D-5-5 outlines the expectations for water quality and water quality for each future domestic well, describing acceptable flow rates and the methodology of pump tests. This information is to be accurately compiled and presented to the appropriate authority in the form of a hydrogeological study report prepared by an experienced consultant.

The guide highlights that consultants must provide a statement indicating that, based on their investigations, it is their professional opinion that the probable well yield is representative of the yields which residents of the development are likely to obtain from their wells in the long term. Guide D-5-5 also notes that developments must not result in water quality interference conflicts between users in the development or on adjacent lands. This is an important criterion for an area like Loyalist Township where water supplies may be limited.

Loyalist Township's current policy on conditions of severance is that the owner must establish a well that is pump-tested to ensue it meets or exceeds MECP guidelines. Well water must also be sampled and tested and comply with MECP's D-5-5 parameters. The submitted well report must support water quality requirements. If some water quality aspects do not comply (e.g., aesthetic parameters), a development agreement must be undertaken to ensure the proper equipment is installed to address the quality issues. These requirements must be fulfilled before the lot can be created. If testing provides evidence that the well or water will not meet the standards, the condition cannot be fulfilled and the lot will not be created. If neighbours of a proposed lot advise the Township of well water quantity issues, the Township may include a condition for a well interference study to also be completed.

Provincial guidelines are unclear as to whether a municipality can demand certain requirements for a consent process or for approval of communal systems. It is recommended that the Township confirm its authority with the MECP.

Local concerns

The number of wells within Loyalist Township with high E. coli counts are an indication that many of the private septic systems in the Township are not functioning properly. This may be caused by several factors.

The Province downloaded septic system inspection to the municipal level approximately two decades ago. KFL&A Public Health acted as the Township's agent for septic systems until January 2021, at which time the Township's Building Inspection Division assumed the role. Part 8 of the Ontario Building Code requires a property owner to demonstrate that their system is operating effectively and that regular maintenance is being performed. Systematic inspections of existing septic systems by Township staff are not currently undertaken, but rather existing systems are inspected only when a complaint has been received.

There are several factors that contribute to septic system failure. The geology of Loyalist Township is such that a failed system is very problematic especially in rural areas with higher densities. Improper agricultural practices can also be a factor for the presence of E. coli in groundwater.

Since residential water treatment systems for biologically contaminated groundwater are relatively affordable, it is difficult to analyze whether there is an overall economic benefit to increased testing of septic systems. Without established systematic testing, it may be expected that an increasing number of drinking water systems will have difficulty in meeting water quality criteria, over time increasing the sewage-based contamination rates in the Township.

Flow rates are based on data collected from MECP files and are primarily based on information well drillers are required to submit when a new well is developed. This type of testing is referred as a well yield test. Unfortunately, this data has not been separated by date within the CRCA study. It is recognized that there are major differences in the quantity of groundwater available at certain times of the year for most locations. This fact can lead to well yield data not being truly representative of the property on an annual basis. The flow data is simply a snapshot of the yield on the specific date tested.

The Guide to Conduct Pumping Tests (Province of British Columbia) provides the following comment:

> “Well yield tests are not as reliable as a pumping test in the following situations:
>
> - when well capacity is low (i.e. typical bedrock well);
> - when the maximum yield from the well is required;
> - when reliable estimates of aquifer properties are needed; and
> - when assessing impacts of proposed pumping on neighbouring wells.”

A pumping test is a practical method of estimating well performance, well capacity, the zone of influence of the well, and aquifer characteristics. A pumping test should also measure changes in water level after the pumping stops, which will assist in verifying results of pump test. To be reliable, a professional with competency in hydrogeology must design, perform, or directly supervise and interpret the pumping test results.

With water supply already a concern in the rural area, seasonal variations in water availability become increasingly important. The result of a well yield test on its own may not be representative of water supply for a site on a long-term, sustained basis, and should not be used for establishing the long-term capabilities of a well. This is where the statement of a professional hydrogeologist declaring that there is a safe sustainable supply available becomes critical. The only definitive alternative is to perform well monitoring over a sufficiently long period to monitor the well supply, which can significantly delay development.

A review of best practices notes that in many cases pumping tests are mandated, with the British Columbia guide noting:

> "An approving agency may require a pumping test to be conducted during a low recharge period. (i.e., dry period) or other time of the year for fractured bedrock and other low yielding wells should be done during a dry period."

Loyalist Township could develop a policy that requires successful pump tests during specific critical periods prior to approving a severance. This policy could be based on the results of CRCA's 2002 study. The groundwater susceptibility mapping and other details would be beneficial in establishing the policy. Input from a local professional hydrogeologist in establishing the policy would be beneficial. Implementing a policy with tighter controls on the establishment of adequate groundwater supplies would protect existing and future rural property owners.

It is recommended that the Township, with guidance from its solicitor and MECP staff, consider establishing an enhanced policy for rural severances that includes the requirement of a pump test, prepared by a professional hydrogeologist, that considers the dry seasonal variances, based on Guide D-5-5, groundwater susceptibility, and other factors. The professional reports from the pump tests should include an evaluation of the well's ability to maintain adequate water supply during periods of low ground water levels, and confirm the long-term sustainability of the well. Either the hydrogeologist or designated Township staff should oversee the collection and submission of water quality samples.

It is important ensure that a new policy does not overstep any legal authority regarding information the Township is permitted to request, and respect the prescriptive timelines established for consent approvals (Province of Ontario, 1990).

As the Township gains knowledge and data from various studies, it may become possible to designate areas in the Township where groundwater studies are generally deemed adequate, in which case a future policy could allow for relaxed requirements for consents, etc. A first step may be to have a hydrogeologist review the CRCA groundwater study in this regard.

There is an opportunity for Loyalist Township to offer assistance for a small fraction of rural property owners with problematic wells. At present the Township's by-laws are generally restrictive of rural properties outside of development zones being eligible to connect to existing public watermains. The municipality could amend the zoning requirements to allow, under specific and strict conditions, the opportunity for these properties to connect to a municipal watermain. The suggested amendment would include the following specific requirements:

- The subject property must currently be serviced by its own private well supply (or shore well)

- The property must have frontage on a road allowance that contains a municipal watermain
- The property's well water does not meet the supply or chemical requirements of Guide D-5-5, as demonstrated by testing and analysis
- The property owner agrees to be responsible for all costs of the new water service and relevant impost fees including an allowance for installation costs of the original main
- The property is not part of a new development.

The benefit of this type of amendment(s) would be:

- Eases Township administration of servicing requests for applicable properties
- Provide an immediate improvement in water supply for the property once serviced
- The number of potential services is not significant with respect to capacity required for new development.

There are also concerns with this approach:

- It would be important that any new zoning requirements would not promote strip development.
- To supply only water, but not sanitary sewer, service to new developments is contrary to provincial policy requirements.

The intent of these changes is strictly to provide municipal water servicing, as a remedial option only, to residents along an existing watermain where their existing well has failed.

An additional area of concern is the elevated risk of septic system failures. An important element for consideration in any new policy is education of the property owner. The potential for sewage system failure is elevated after a rural property connects to a municipal water supply. There are two reasons for this: one factor may be that the rural resident, no longer restricted to conservative water use by an under-producing well, dramatically increases water consumption, resulting in a flooded septic system; the septic system may be undersized for the hydraulic loading. The second issue is that the chlorine added to municipal water to kill organics is also toxic to many of the microorganisms that work to break down waste in the septic digestion process, creating a potential loss of efficiency of the septic system.

The Township should evaluate the benefits of enhancing its current practice regarding septic bed inspection. Although regular inspection would be an excellent practice, it is not clear whether the Ontario Building Code has sufficient authority to enforce improvements to failing septic beds when there is not an alteration to the bed. As well, political support for these types of inspections has traditionally not been strong. With the Drastic mapping indicating the high potential for groundwater contamination and the number of older wells, there are few places where a regular septic system inspection program could potentially produce immediate benefits.

The introduction of zoning amendments to accommodate the above should be coincidental with the Township updating its requirements for pump tests for severances.

Financial

Groundwater is an important natural asset. Protection of this resource has traditionally not been in the forefront.

Increased attention to septic systems could potentially increase costs to rural residents.

Pump tests for rural severances are not inexpensive and must be balanced against the benefit and needs of the future property owner.

Climate Lens

The Climate Lens process was developed by Infrastructure Canada to help address the climate change impacts and greenhouse gas (GHG) emissions associated with infrastructure projects in Canada. By incorporating climate considerations during the planning and design of infrastructure projects, the Climate Lens is intended to help assess the potential impacts of projects, influence the design process, and inform funding decisions (WSP, 2020).

The Climate Lens consists of two elements: an assessment of the ability of a project to assist in the mitigation of climate change impacts/reduction of GHG emissions, and an assessment of the potential for the project to adapt to climate conditions.

Climate conditions that will most likely impact groundwater in Loyalist Township include the following:

- Mean temperatures are projected to increase annually, and in every season (ICLEI, 2021). More frequent heatwaves and shorter winter seasons due to warming may result more intensive evaporation and less snow melt for groundwater recharge (Swanson, Murphy, Temmer, & Scaletta, 2021)
- The number of days expected to reach above 30 degrees is expected to increase, while the number of days below -15 degrees is expected to decrease in the next 30 years. This may result in more drought like conditions. (ICLEI, 2021)
- Annual precipitation is expected to increase. Winter and spring are projected to get significantly wetter with a slight decline in the summer, which will result in less recharge in the already dry season (ICLEI, 2021).
- Weather events in general are projected to become more intense and extreme. For example, it is expected that more rain will fall in a shorter amount of time. Rainfall during more infrequent, extreme storms, is projected to significantly increase (ICLEI, 2021). This will impact road conditions, specifically drainage and

overland flow, which also impacts the amount of groundwater recharge (Jyrkama & Sykes, 2006).

Climate Change Mitigation

The projects outlined in this memo fall under the Adaptation category.

Climate Change Adaptation

How will these projects be designed or developed to adapt to the impacts of climate change, ultimately creating climate resilient infrastructure?

- Changing the well testing requirements will ensure there is sufficient recharge in dry seasons.
- Policy changes to allow for connections to the WDS in remedial situations will result in less residents being reliant on groundwater that may be negatively impacted by climate change.

Linkages

Population and Dwelling Growth Technical Memorandum

References

Environment and Climate Change Canada. (2016). Pan-Canadian Framework on Clean Growth and Climate Change : Canada's plan to address climate change and grow the economy.

Hemson Consulting Ltd. (2019). *Loyalist Township Population, Housing and Employment Projections to 2046.*

ICLEI. (2021). *Loyalist Township Climate Science Report.* International Council for Local Environmental Initiatives.

Jyrkama, M. I., & Sykes, J. F. (2006). The Impact of Climate Change on Groundwater. In *The Handbook of Groundwater Engineering* (pp. 28-1 - 28-42).

Oliver, Mangione, McCalla & Associates. (2001). *Groundwater Management Study and Protection Plan.*

Province of British Columbia. (n.d.). *Guide to Conducting Pumping Tests.* Retrieved from Province of British Columbia: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-wells/guide_to_conducting_pumping_tests.pdf

Province of Ontario. (1990). Planning Act, R.S.O. 1990, C. P.13.

Province of Ontario. (1996, August). *D-5 Planning for Sewage and Water Services.* Retrieved from Province of Ontario: https://www.ontario.ca/page/d-5-planning-sewage-and-water-services

Province of Ontario. (1996, August). *D-5-5 Private Wells: Water Supply Assessment.* Retrieved from Province of Ontario: https://www.ontario.ca/page/d-5-5-private-wells-water-supply-assessment

Swanson, D., Murphy, D., Temmer, J., & Scaletta, T. (2021). *Advancing the Climate Resilience of Canadian Infrastructure.* International Institute for Sustainable Development - IISD.

Trow Consulting Engineers. (2002). *Western Cataraqui Regional Groundwater Study.*

WSP. (2020). *Bracebridge Community Multi-Use Complex, Draft Climate Lens Assessment – Climate Change Resilience, Bracebridge, Ontario.*

Recommendations

It is recommended that the Township, with guidance from its solicitor and MECP staff, consider establishing an enhanced policy for rural severances that includes the requirement of a pump test, prepared by a professional hydrogeologist, that considers the dry seasonal variances, based on Guide D-5-5, groundwater susceptibility, and other factors. The professional reports from the pump tests should include an evaluation of the well's ability to maintain adequate water supply during periods of low ground water levels, and confirm the long-term sustainability of the well. Either the hydrogeologist or designated Township staff should oversee the collection and submission of water quality samples.

It is recommended that the Township consider amending zoning requirements such that a property with an existing well that does not meet Ontario Provincial Guideline D-5-5 can connect to the municipal water system, with appropriate restrictions, if the property includes frontage on a road allowance that has a watermain in the right-of-way.

It is recommended that the Township evaluate the costs and benefits of establishing a comprehensive septic system inspection program, perhaps gauging the level of inspection activity on the frequency of discovering failed systems.

It is recommended that the Township develop processes to monitor local groundwater quantity and quality conditions.

IMP Technical Memorandum: Integrated Workflow Procedures and Standards

Asset Class: Multiple

Objective: The objective of this memorandum is to highlight the importance of established procedures that describe the technical requirements of gathering, maintaining, and improving engineering and asset information for various operational, development, and construction phases of the Township's infrastructure.

Background

The focus of this review is based primarily on linear and related infrastructure as required for road, sewer, water, and sidewalk infrastructure. These are typically repetitive for most municipal and development related construction and operations. Some of the content may have similar applications for other project types, particularly with respect to asset reporting.

Construction projects and new development are typically administered by a small group of specialized staff who become well versed in the many specific details of a project. Similarly, there are operations staff who become subject matter experts within their scope of operations. The information these individuals gather has great value, especially if it is accurately retained and available to other staff.

Construction contracts, development agreements, and infrastructure asset data are based on highly detailed technical content. These drawings and specification documents are designed to ensure that the municipality receives the specific infrastructure requested, and that the method of construction meets or surpasses the designated industry standards for that component. Quality specifications protect both the municipality and the contractor by clarifying specific objectives.

Ontario Provincial Standards (OPS) Specifications (OPSS) and Drawings (OPSD) have provided a baseline from which Township staff can work (Ontario Ministry of Transportation and Municipal Engineers Association, 1984 as amended). Local contractors and consulting engineers are familiar with and use OPSS and OPSD documentation almost exclusively for all municipal lineal infrastructure. These standards also allow the flexibility to replace OPS requirements with municipal preferences using Special Conditions which document any variance from the standard OPS requirement. OPSS and OPSD documentation remain the basic standards for lineal municipal infrastructure.

Municipalities must examine the many changes for materials and construction methods and choose which options are most beneficial to the municipality. Standards are continually being amended to reflect the changing preferences of the municipality in response to product changes or new regulatory requirements.

The level of accuracy for geographic data has traditionally been relatively low, both for design drawings and for the "as-built" drawings which note the actual location(s) of the constructed infrastructure. This former level of accuracy may have been suitable for rural road installations but is problematic in more complex urban environments. Urban rights-of-way usually contain a myriad of underground infrastructure, all buried at different depths. Without a high standard of tolerances for geographic references in as-built drawings, the values of these drawings can be severely diminished. Comparatively, highly accurate as-built drawings provide a level of confidence when planning new projects in the vicinity, rendering expensive field verification of utilities prior to construction unnecessary.

The introduction of the Utilities Division’s Quality Management System (QMS) in the early 2010s resulted in improved methods of maintaining and relaying important information and procedures internally. Loyalist Township’s QMS program focused on water, and to a lesser degree, sanitary sewer operations. To date other groups within the Township have not developed a similar structured approach to change management. The QMS procedures in Utilities have not been expanded into the realm of asset management but the program has sufficient flexibility that expansion in this direction is possible.

In the past staff often collected only specific data as requested, rather than collecting broad data for multiple individuals and/or purposes and storing this data where it can easily be retrieved. Subsequently, recorded data varies widely. Items such as road sign inspections and water hydrant conditions are some of the many infrastructure elements that are tracked. The current practice results in many data files that are not readily accessible by all staff.

Two major factors have complicated the process of data management: product advancements, and the arrival of digital documentation.

Starting around the year 2000 there was a rapid shift from manually produced engineering drawings and specifications, to digital versions of these documents. These advancements were concurrent with the initial development of municipal geospatial information systems (GIS). Over time the GIS became the repository of some infrastructure data. The initial focus was on developing the property fabric and the major infrastructure elements. The original data compilation within the emerging Township GIS did not impose any restrictions or tolerance requirements for the level of accuracy required in as-built drawing details.

Most operational records were maintained in a hard copy paper format and usually maintained in files assessable to the staff person who created the file, but not always easily accessible to other staff. There has been a slow transition to the use of digital equipment and specialized application to record various information in the field.

During the last decade the use of handheld portable computing devices has advanced the field of data acquisition and often complements automatic stationary devices used to store data. These devices have slowly replaced hard copy records in many instances although handwritten records are still produced. This equipment can reduce field labour costs and data can be exported efficiently to accessible files. Global positioning system (GPS) devices have become both relatively inexpensive and increasingly accurate, and assist in accurately pinpointing the location of all infrastructure.

Historical approaches to data collection (usually for a single purpose to meet an immediate operational need) and storage (the data is kept by the requestor in a location that is inaccessible or unknown to other staff) have led to data inefficiency, limiting staff's ability to use existing data for further analysis.

The Township is now establishing its budgets based on its asset management program (AMP). To be most effective the accuracy of the information in the AMP is very important. The AMP uses the Township's GIS and financial data to rationalize infrastructure rehabilitation and maintenance programs. With so many concurrent Township operations, it is a challenge to ensure that infrastructure condition updates are properly recorded.

Because these topics are so important, much of the groundwork is underway with respect to the objectives noted above.

Assumptions

n/a

Methodology

This memorandum is based on input from Township staff who work regularly with current engineering design details and specifications; staff involved with collection and maintenance of infrastructure GIS data and related asset management data; and senior project managers. The objective of this discussion is to establish a framework for a corporate infrastructure workflow procedure.

The framework for the procedure(s) would include three components:

1. Develop and maintain engineering drawings and technical specifications
2. Standardize asset management and GIS best practices for the collection and maintenance of data
3. Develop workflow practices that support Township infrastructure

Analysis

Engineering Drawings and Technical Specifications

The need for a comprehensive engineering drawing and standards document has gradually been addressed over several years in the Engineering & Environment Division, and finalizing the draft document, tentatively titled Development Engineering Technical Guidelines, has recently been underway with formal adoption planned for mid-2024. This extensive document outlines the technical requirements of engineering drawings and specifications for road, water, sanitary sewer, and storm sewer systems, including the description of supporting documentation for formal submissions.

The availability and use of this document will help staff and external development teams administer large infrastructure and development projects. It will benefit new staff by providing a clear outline of the requirements for each project.

It is recommended that the completion and support of this initiative be prioritized.

Asset Management and GIS Best Practices

When adding new or changed information to the asset management data, the as-built drawings are used to record the specific attributes and physical locations of the various infrastructure assets. Without standardizing these requirements, the municipality is missing out on opportunities to strengthen its asset management data. It is widely recognized that good asset management program leads to better decision making.

From a GIS inventory perspective, each of the following information sources are needed to capture new/changed infrastructure features: subdivision as-built drawings; site plan works; capital project works; staff-created forms/GPS data to update individual fields. Typically GIS staff initially receive a subdivision plan in pdf format. Drawings based on AutoCAD formats and as-built GPS enhanced drawings are not consistently submitted to GIS staff, but given the amount of work to accurately update GIS features, a georeferenced AutoCAD drawing is an enormous benefit to GIS technicians. The GPS points are a good way of evaluating changes that were not caught on the engineering drawings, and small changes are often captured when completing the GIS data entry process. Staff involved with development and construction project have recently improved their processes based on a better understanding of corporate needs including asset management, and increasingly provide this information. The overall process for each project/development is complicated by the fact that the timelines are usually measured in years for these projects, and over time different staff may be assigned to administer a project. New staff are unlikely to recognize which operation groups require specific information and what information should be forwarded to GIS to augment the asset data. The deliverables can vary slightly for new development and new construction data. This is where detailed workflows would be most beneficial.

Staff are working on adding new specific GPS asset data to the list of deliverable items in the subdivision agreement templates, as well as geographically referenced AutoCAD drawings, to be submitted by the Developer’s engineer. It has traditionally been difficult to obtain quality as-built information from Developers’ engineering consultants. Recent enforcement of the Township’s requirements has led to some reporting improvements. Engineering firms are now usually complying with AutoCAD requirements, but more recently have transferred the acquisition of GPS measurements to professional land surveyors.

This creates a potential concern as the field person using GPS may be unfamiliar with why certain measurements are being requested and as a result key information may be lacking due to the inexperience of the GPS operator.

There is a need for Loyalist Township to include improved and enforceable location tolerance specifications in its engineering guideline specifications, with these specifications possibly varying by project. Knowing exact positioning of buried infrastructure in a congested urban cross-section is more crucial than in a similar but less crowded rural right-of-way. There is also a need to carefully select which infrastructure requires strict adherence to enhanced location surveys during the preparation of as-builts drawings, as this information is costly. Recognizing the costs involved, a reasonable balance is required when deciding the scope of items requiring an enhanced georeferencing.

GIS staff have expressed their preference that AutoCAD drawings received from a consultant should be georeferenced to the Township's preferred standard coordinate/datum system (NAD83 Zone 18N) and that the resulting digital file (e.g., .dwg) be required.

The following text, taken from the Township's development agreement, outlines the Township's current specific drawing and location information requirements:

> Development Agreement Drawing Specifications
>
> The Contractor shall keep one (1) set of the most recent signed drawings on site solely for as-built recording purposes. The Contractor shall record, neatly in red ink, any deviations from the above original signed drawings on the As-Built drawings **as the work is performed.** Deviations shall include changes, additions, deletions, and different site conditions encountered. All deviations shall be recorded, including where applicable:
>
> a) Plan View Deviations: Curb and Gutter, Sidewalk, Fences, Retaining Walls, Driveways, Watercourses, Ditches, Culverts, Maintenance Holes, Catch Basins, Sewer Mains, Sewer Laterals, Watermains, Valves, Hydrants and Water Services, Utility Poles, Utilities, Trees, Miscellaneous.
> b) Profile Deviations: Road Centreline Elevations, Sewer Size and Inverts, Sewer Lateral Inverts, Watermain Size and Depth, Water Service Depth, Ditch Inverts, Culvert Size and Inverts.
>
> The As-Built drawings shall be kept in the field office or in the Contractor's Supervisor's possession if no field office was required as part of the Contract. The As-Built drawings shall be available for review, on demand, by the Inspector throughout the duration of construction. Failure to record changes in a timely manner may result in delays to the issuance of progress payments.
>
> Within 45 days of the publication date of the Certificate of Substantial Performance, the Contractor shall deliver to the Contract Administrator the As-Built drawings showing all deviations in a form acceptable to the Contract Administrator. The drawings must be legible and clean, otherwise will not be accepted. The Township will not consider As-Built drawing submissions in any

form other than the form described above. Failure to deliver As-Built drawings in the time frame noted above will result in a delay of holdback release.

It is recommended that a Township-wide geographic reference system be established and be generally required on all drawing submissions for major infrastructure projects and new development as a component of the Development Engineering Technical Guidelines.

Development of Workflow Practices that Support Township Infrastructure

For a variety of reasons, including rapid growth, evolving technologies, and introduction of new staff, there is a need to improve workflow procedures within Loyalist Township.

The objective of these procedures would be to standardize collection and maintenance of operational and related financial data, record standardized procedures, and develop a solid basis for staff training.

Operations staff who work daily with various infrastructure, staff who administer development agreements, and staff who administer construction and rehabilitation projects contribute in many various ways to the efficiency and success of the municipality.

Many of the current procedures have developed haphazardly over time based on experiences of the staff involved. By contrast, development agreements are very prescriptive, with the immediate expectations of the Township and the Developer outlined in clear legal language. What is not prescribed are the municipality's subsequent follow-up tasks. Development project administration staff and various departmental support staff have numerous tasks initiated by development, and must be thoroughly familiar with the operational, regulatory, financial, and insurance factors that apply. These tasks include:

- Notifying operations staff of the location and operating requirements of all new municipal infrastructure created as part of the development
- Ensuring that the legal, financial, and technical requirements of subdivision agreements have been achieved, including infrastructure testing, inspections, and adherence to municipal standards
- Transferring as-built drawings, GPS location information, and financial reports to the GIS Division and to appropriate corporate records management
- Coordinating development activity with external utilities, i.e. Hydro One, Enbridge, etc., when applicable
- Updating water, sanitary, and storm system records for MECP regulatory licensing documentation and for internal data collection requirements
- Tracking and resolving issues brought by private property owners which arise from the development
- Initiating updated by-laws for stop signs, parking, road assumptions, etc.

- Coordinating inspection and implementation of new recreational facilities as they are developed
- Coordinating development related activity with the County of Lennox and Addington, when applicable
- Ensuring asset management information is updated appropriately
- Coordinating development related activity with Canada Post, school boards, and other agencies active in the local community

Infrastructure rehabilitation and construction projects have a similar list of tasks associated with the project, with the obvious absence of development staff. At times the Township contracts some functions of the project to external engineering consultants.

Township-wide, a broad range of infrastructure data is collected and maintained for many purposes. Much of this data is often collected for a single purpose and may not be recorded in a fashion that makes the data accessible and usable by other staff. Data is collected to:

- Ensure operational demands are met
- Ensure infrastructure is operating within its physical capacity
- Alert staff to operational deficiencies and potential hazards
- Minimize liabilities through regular inspections and repairs

As an illustration, workflow procedures and related concerns for the Utilities Division, which may be considered a step ahead of other operational groups with its implementation of QMS, are outlined below.

Much of the public safety element necessary for administering the Township's potable water system relies on effective monitoring of sampling data. Data sources vary greatly and include flow and volume data, sampling frequency, date of sampling, physical condition assessments, and geographic location. In the Division's treatment plants much of the flow, equipment status, energy demand, and automatic sampling data is stored in the plant's supervisory control and data acquisition (SCADA) system. Unfortunately, information from external sources and distribution system data are maintained in multiple locations.

The QMS system includes many components that could be used to develop framework for a workflow procedure. The Township would benefit by systematically evaluating its data and operational needs and developing a modern data collection and storage plan. This plan would include the use of electronic field data entry devices appropriate for the activity, and information gained by the Township's SCADA content and water meter data. Expanding the process to include sanitary sewage systems and stormwater data should also be considered, given the similarity in licensing and infrastructure types for storm and sanitary sewers systems. In this scenario Utilities staff would work closely with GIS and Engineering staff to develop a process that satisfies operational, financial (asset management), and compliance requirements.

The water system data is just one example of the numerous types of data used by Township staff. The collection of road sign data, traffic volumes, road maintenance schedules, etc., although measuring different infrastructure, utilizes similar processes.

The municipality sacrifices significant efficiency when data is not recorded and stored such that it can be used again later, by a wide range of staff, and with confidence in the data quality, leading to the need for the data to be re-collected. Accurate data reinforces the accuracy of the asset management decision, which in turn leads to improved financial decision making. Having the various steps laid out in a procedure will improve consistency in collecting and maintaining data, and provide a document that will benefit staff training programs.

Taking a few pages from the Utilities Department’s QMS, a workflow procedure could be enhanced by:

- Developing, implementing, and continuously improving a modern data collection, storage, and reporting system. If staff can easily report all of the data/assets collected that would improve efficiency.
- Considering a formal periodic review of Township design specifications,
- Having defined GIS specifications and reporting methods for capital projects and developments, to help with data updates/entries in GIS

Senior staff experienced in the administration of these types of projects, road and utility operations, asset management, and GIS functions can develop detailed workflow procedures that can make the processes both easier and efficient by ensuring appropriate and complete information is documented. There are opportunities in some cases to collect additional data during field testing that would be beneficial to another program.

In the past, data collection processes haven’t been developed with a view to GIS needs. By including GIS staff early in the process, GIS staff can ensure that all appropriate data attributes are being captured. This can help ensure quality data and reduce the need to correct the data later.

To demonstrate the importance of having procedures developed by a broad interdisciplinary team, consider the process of testing a hydrant. Typically this entails taking samples for water quality analysis, flow and pressure measurement, and confirmation of physical status of the hydrant. By simply adding the elevation of the water tower level at the time of the pressure/flow measurements this hydrant test can be used later to audit/evaluate the accuracy of the Township’s hydraulic model. As the latter measurement is not a regulatory requirement, a utilities operator wouldn’t often record that data unless trained to do so.

While developing participatory workflow procedures will initially be time-consuming, it will lead to improved efficiencies and consistent results. It is recommended that the Township formally implement a strategy to develop detailed workflow procedures for infrastructure data collection and maintenance, development, and construction activity, and includes asset management requirements.

Linkages

n/a

References

Ontario Ministry of Transportation and Municipal Engineers Association. (1984 as amended). *Ontario Provincial Standards for Roads and Public Works (OPS).* Retrieved from Province of Ontario: https://www.library.mto.gov.on.ca/SydneyPLUS/TechPubs/Portal/tp/opsSplash.aspx

Loyalist Township (n.d.) *Standard Subdivision Agreement Template*

Conclusions

It is recommended that the completion and support of the draft Development Engineering Technical Guidelines be prioritized.

It is recommended that a Township-wide geographic reference system be established and be generally required on all drawing submissions for major infrastructure projects and new development as a component of the Development Engineering Technical Guidelines.

It is recommended that the Township formally implement a strategy to develop detailed workflow procedures for infrastructure data collection and maintenance, development and construction activity, that includes asset management requirements.