



Wellington Sanitary Sewer

Capacity Analysis for Proposed Development

Draft

Prepared for:
County of Prince Edward

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1.0 BACKGROUND

The following technical memorandum is a summary of the hydraulic capacity analysis of the Wellington sanitary sewer system completed for the County of Prince Edward. Hydraulic modelling was performed to review the capacity of the existing system and its ability to accommodate four proposed developments (Berkhout, Schickedanz, Kaitlin and Hirschfield).

1.1 Existing Conditions

The Wellington sanitary sewer system services a population of approximately 1932 (2016 census). The system has pumping stations at the bottom of Wellington Street and Wharf Street that lift flows into a gravity trunk sewer on Main Street that discharges to the main pumping station at the Wellington wastewater treatment plant (WWTP). Figure 1.1 presents an overview of the sanitary sewer system.



Figure 1.1 – Wellington Sanitary Sewer Plan

1.1.1 Flows Measured at Wellington WWTP (2017)

The Wellington WWTP has a rated capacity of 1,500 m³/day (17.4 L/s) and an approved peak daily flow rate of 4,550 m³/day (52.7 L/s). The flows at the WWTP as reported in the 2017 Annual Performance Report were as follow in Table 1.1.

Table 1.1 – Wellington WWTP Influent Quantity Flow Data, 2017

Month	Monthly Average		Monthly Peak	
	m ³ /day	L/s	m ³ /day	L/s
January	1,157	13.4	1,882	21.8
February	855	9.9	1,240	14.4
March	830	9.6	1,112	12.9
April	1,278	14.8	3,790	43.9
May	1,718	19.9	5,202	60.2
June	1,203	13.9	3,453	40.0
July	911	10.5	1,264	14.6
August	632	7.3	778	9.0
September	620	7.2	1,557	18.0
October	774	9.0	2,343	27.1
November	1,095	12.7	2,648	30.6
December	683	7.9	844	9.8
2017	980	11.3	5,202	60.2

* Wellington Wastewater Treatment Plant, Operations Reports 2017, Prince Edward County.

The following observations were made based on the 2017 flow data:

- The average flow to the WWTP plant was 11.3 L/s and equated to approximately 500 L/capita/day (including inflow and infiltration).
- The average flow during the driest month (September) was 7.2 L/s and equated to approximately 320 L/capita/day (including inflow and infiltration). This is less than the typical residential design flow of 450 L/capita/day.
- The highest daily flow in May was 60.2 L/s and equated to approximately 2,700 L/capita/day (including inflow and infiltration). This is an indication of significant inflow and infiltration during wet conditions (106.4 mm over 3 days at Belleville climate station).

1.1.2 Collection System Pumping Capacities

Table 1.2 presents the current capacities of the 3 pumping stations in the Wellington sanitary sewer system. These capacities are as reported in the Wellington Water Pollution Control Plant's Certificate of Approval (2006) and have not been field confirmed.

Table 1.2 – Sanitary Sewer System Pumping Capacities

Pumping Station	# Pumps	Rated Capacity
Belleville Street PS	2	30.3 L/s @ 13.7 m TDH
Wharf Street PS	2	34.1 L/s @ 11.6 m TDH
WWTP	3	29.5 L/s @ 6.7 m TDH

1.2 Proposed Developments

Four primarily residential developments have been considered in the analysis of the sanitary sewer system's capacity to accommodate increased wastewater flows. The proposed developments are as follow, with their location shown on Figure 1.2 (following page):

Table 1.3 – Proposed Development Population Summary

Proposed Development		# Units	Est. Population
Berkhout	Phase 1	100	200
	Phase 2	287	574
Schickedanz	---	95	190
Kaitlin	Phase 1	300	600
	Phase 2	160	320
Hirschfield	Phase 1	164	328
	Phase 2	355	710
Proposed Development		1,461	2,922
Existing Development		---	1,932
Total at Full Buildout		---	4,854

The number of units proposed for development and the associated population increase (approximately 150%) indicate that wastewater flows in the Wellington sanitary sewer system would increase significantly.

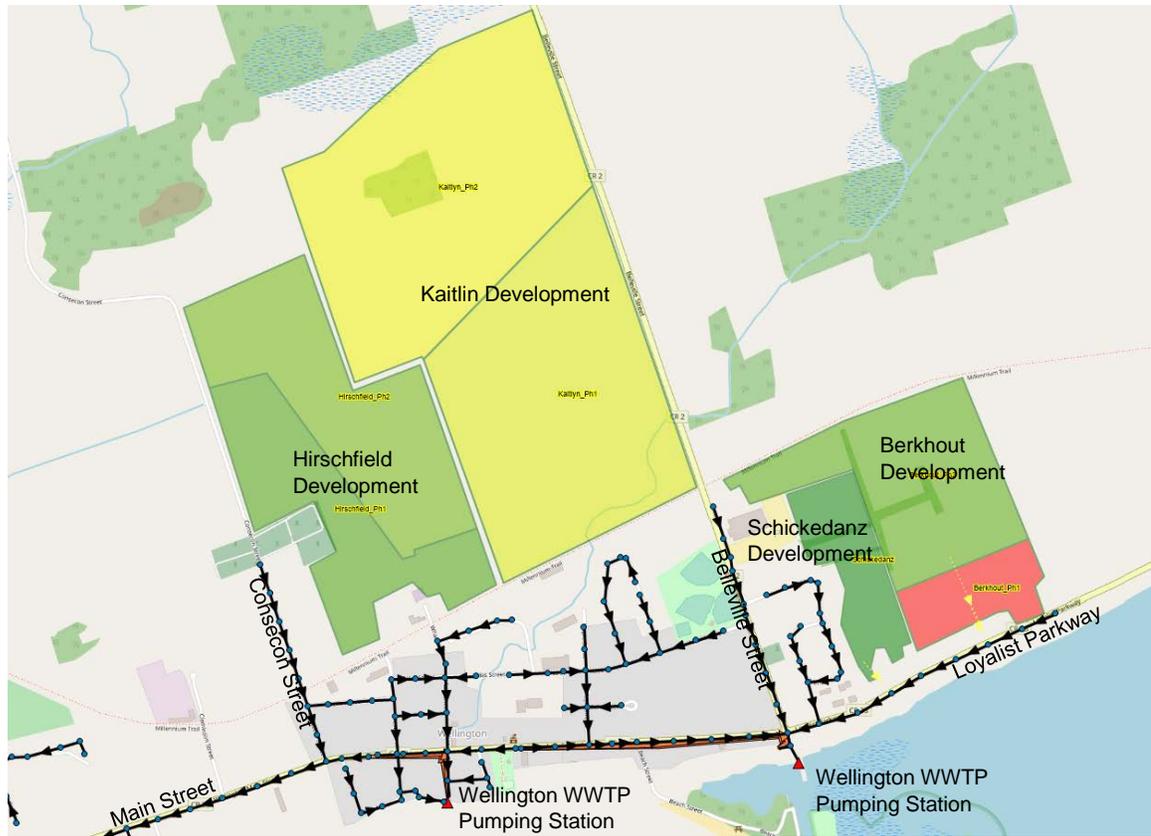


Figure 1.2 – Locations of the Proposed Developments

Table 1.4 –Wastewater Flow Summary for the Proposed Developments

Proposed Developments		Residential		Infiltration (L/s)	Design Flow (L/s)
		Daily Avg (L/s)	Peak (L/s)		
Berkhout	Phase 1	1.0	4.2	1.4	5.6
	Phase 2	3.0	11.9	2.4	14.3
Schickedanz	---	1.0	4.0	1.1	5.1
Kaitlin	Phase 1	3.1	12.5	4.0	16.5
	Phase 2	1.7	6.7	4.0	10.7
Hirschfield	Phase 1	3.1	12.3	1.6	13.9
	Phase 2	3.2	13.0	2.6	15.6
Total Proposed Development		16.1	64.6	17.1	81.7

2.0 CAPACITY ANALYSIS

The following paragraphs present the results of the capacity analyses performed for the sanitary sewer system for current development and the development scenarios requested by the County.

2.1 Current Development

Capacity analysis was performed for the current level of development. The County suggested that wet weather flow conditions match those of a 25-year return period storm, and as such would be less than the maximum daily flow (60.2 L/s) measured during May 2017. A review of recent wastewater treatment plant operational reports suggested that this peak flow would be approximately 50 L/s. This is 4.4 times the average flow during 2017, 6.9 times the dry month average flow (September) and 2.5 times the wet month average flow (May).

The wastewater flow for current development was distributed throughout the sanitary sewer model based on population, length of sewer, number of manholes and age of development. The age of development was used to account for the likelihood that inflow and infiltration would be higher in the older sewer sections rather than recent development such as Wellington on the Lake.

The following tables summarize the results of the current development capacity analysis.

Table 2.1 – Pumping Capacity Summary – Current Development

Location	Capacity (L/s)	Peak Flow (L/s)
Belleville Street	2 pumps rated @ 30.3 L/s ea.	18
Wharf Street	2 pumps rated @ 34.1 L/s ea.	39
WWTP	3 pumps rated @ 29.5 L/s ea.	49

During wet weather conditions the second (standby) pump is required at both the Wharf Street pumping station and the WWTP. The flow is elevated at the Wharf Street pumping station due to the pump cycles from the Belleville Street station which discharges approximately 300 m upstream with insufficient attenuation in this length of sewer to reduce the peak flow. During dry weather conditions and lesser rainfall events there is sufficient capacity within the Wharf Street wet well to attenuate the peak flow such that only one pump (duty pump) is required.

There is attenuation in the Main Street sewer downstream of the Wharf Street pumping station (approximately 1,000 m length) as the peak flow is reduced from 70 L/s near Consecn Street to 49 L/s at the WWTP.

A review of the pump operations during normal (average) flow conditions indicates that sufficient capacity exists at all 3 pumping stations.

Table 2.2 – Trunk Sewer Capacity Summary – Current Development

Sewer Section	Diameter (mm)	Peak Flow (L/s)	Percentage of Capacity
Loyalist Parkway (east of Belleville)	200	3	10
	250	6	15
Main Street d/s of Belleville FM	300	33	30-35
Main Street d/s of Wharf St FM	355	70	55-65
	400	49	30-45

Table 2.2 presents the peak flows modelled in the trunk sewer along Loyalist Parkway / Main Street from the east end of Wellington to the WWTP. The peak flows indicate that the existing gravity sewers have sufficient capacity to accommodate all peak wet weather flows.

It should be noted that no capacity issues were identified for the gravity sewers that discharge to the Loyalist Parkway and Main Street trunk sewers. As such, they are not included in the capacity summary tables.

2.2 Berkhout Development

The Berkhout development is expected to proceed in two phases. Phase 1 will include 100 units to be completed by 2021. Phase 2 (287 units) will proceed at a rate of approximately 30 lots per year to full buildout of 387 lots.

The capacity of the sanitary sewer system to accommodate Phases 1 and 2 of the Berkhout development are summarized in the following sections.

2.2.1 Berkhout Development Phase 1

Phase 1 of the Berkhout development is expected to increase the peak flow in the gravity sewer east of Belleville Street by approximately 5.6 L/s. This increases flow to the Belleville Street pumping station, however, the impacts are not evident in the downstream peak flow rates (i.e. single pump operation maintained at Belleville Station pumping station). The main impacts are an increased number of pump cycles at the pumping stations, higher average flows in the gravity sewers and an increased daily volume of wastewater to the WWTP.

Tables 2.3 and 2.4 present capacity summaries for the pumping stations and main trunk sewer.

Table 2.3 – Pumping Capacity Summary – Berkhout Phase 1

Location	Capacity (L/s)	Peak Flow (L/s)
Belleville Street	2 pumps rated @ 30.3 L/s ea.	23
Wharf Street	2 pumps rated @ 34.1 L/s ea.	39
WWTP	3 pumps rated @ 29.5 L/s ea.	49

Table 2.4 – Trunk Sewer Capacity Summary – Berkhout Phase 1

Sewer Section	Diameter (mm)	Peak Flow (L/s)	Percentage of Capacity
Loyalist Pkwy (east of Belleville)	200	3	10
	250	6	15
Main Street d/s of Belleville FM	300	33	30-35
Main Street downstream of Wharf St FM	355	70	55-65
	400	49	30-45

No upgrades to the gravity sewer are required to accommodate the first phase of the Berkhout development.

2.2.2 Berkhout Development Full Buildout

Full buildout of the proposed Berkhout development is expected to increase the peak flow in the gravity sewer east of Belleville Street by approximately 19.9 L/s. This will impact the flow in the gravity sewer as well as pumping required at the Belleville Street station. Tables 2.5 and 2.6 present results of the capacity analysis.

Table 2.5 – Pumping Capacity Summary – Berkhout Full Buildout

Location	Capacity (L/s)	Peak Flow (L/s)
Belleville Street	2 pumps rated @ 30.3 L/s ea.	38
Wharf Street	2 pumps rated @ 34.1 L/s ea.	69
WWTP	3 pumps rated @ 29.5 L/s ea.	89

The increased peak flow from the Berkhout development results in dual pump operation at the Belleville Street pumping station. This has downstream impacts, as the peak flow to the Wharf Street station increases accordingly. The peak flow to the Wharf Street station (69 L/s) would exceed its dual pumping capacity (68 L/s). This could be significant if there is a loss of pumping efficiency associated with the two pumps sharing a header / forcemain. As such, an upgrade to the Belleville pumping station would be required to accommodate peak flows from the full Berkhout development.

There is a significant increase in the peak flow to the WWTP as well. The expected peak flow is equivalent to the combined capacity of all 3 pumps operating at the plant. As noted above, this could be significant if there is a loss of pumping efficiency associated with pumps sharing a header / forcemain. As such, an upgrade to the WWTP pumping station would be required to accommodate peak flows from the full Berkhout development.

Table 2.6 – Trunk Sewer Capacity Summary – Berkhout Full Buildout

Sewer Section	Diameter (mm)	Peak Flow (L/s)	Percentage of Capacity
Loyalist Pkwy (east of Belleville)	200	23	100-110
	250	26	70
Main Street d/s of Belleville FM	300	63	60-65
Main Street downstream of Wharf St FM	355	74	55-65
	400	74	40-65

The data in Table 2.6 indicates that 500 m of 200 mm diameter trunk sewer on Loyalist Parkway east of Belleville Street would operate at or above capacity during peak flow conditions. This is the only section of gravity sewer that would need to be upgraded (to 250 mm diameter) to accommodate full buildout of the Berkhout development.

2.3 Full Buildout of Proposed Developments

Full buildout of Berkhout, Schickedanz, Kaitlin and Hirschfield developments is expected to increase the population in Wellington by approximately 150% (1,461 units, 2922 people). Capacity analyses were performed to identify which sections of the sanitary sewer system would require upgrades to accommodate the peak flow (81.7 L/s) expected from these developments.

Conceptual servicing plans for the Hirschfield and Kaitlin developments included a new trunk sewer along the Millennium Trail. This sewer would convey wastewater from each development to Cleminson Street then Main Street. The proposed gravity sewer shown on the Kaitlin development plan was proposed to be 250 mm diameter but based on our analysis we'd recommend that it be 300 mm from the Kaitlin development to the Hirschfield development connection and 375 mm diameter downstream to Main Street.

The capacity of the sanitary sewer system to accommodate full buildout of the proposed developments is summarized in the following tables.

Table 2.7 – Pumping Capacity Summary – Full Development Buildout

Location	Capacity (L/s)	Peak Flow (L/s)
Belleville Street	2 pumps rated @ 30.3 L/s ea.	43
Wharf Street	2 pumps rated @ 34.1 L/s ea.	69
WWTP	3 pumps rated @ 29.5 L/s ea.	147

Peak flow (43 L/s) to the Belleville pumping station will require dual pump operation, however the average daily flow (10 L/s) will remain much less than the capacity of a single pump. No upgrades are required based on capacity, however the County should review the wet well sizing and expected cycling of pumps on/off to ensure the mode efficient operation of the station.

As with full buildout of the Berkhout development, dual pump operation will be required for peak flow to the Wharf Street station. The peak flow (69 L/s) would exceed the existing dual pumping capacity (68 L/s). This could be significant if there is a loss of pumping efficiency associated with the two pumps sharing a header / forcemain. As such, an upgrade to the Wharf Street pumping station would be required to accommodate peak flows from full buildout. It should be noted that the conceptual plans do not route any wastewater flows from the Kaitlin and Hirschfield developments to the Belleville Street and Wharf Street pumping stations. We agree with this concept of maximizing gravity flow as a preferred routing option.

The most significant peak flow increase is expected at the WWTP. The expected peak flow (147 L/s) greatly exceeds the combined capacity of all 3 pumps operating at the plant. An upgrade to the WWTP pumping station would be required to accommodate peak flows from full buildout of the 4 proposed developments.

Table 2.8 – Trunk Sewer Capacity Summary – Full Development Buildout

Sewer Section	Diameter (mm)	Peak Flow (L/s)	Percentage of Capacity
Loyalist Parkway (east of Belleville)	200	28	100-130
	250	31	80
Main Street d/s of Belleville FM	300	63	60-65
Main Street downstream of Wharf St FM	355	74	55-65
	400	119	70-110

The Schickedanz development is proposed to be adjacent to the Berkhout development and will also discharge to the trunk sewer on Loyalist Parkway east of Belleville Street.

An upgrade of 500 m of 200 mm diameter trunk sewer to 250 mm diameter would be required to accommodate the Berkhout and Schickedanz developments.

The only other section of gravity sewer that would not have sufficient conveyance capacity is the 400 mm diameter sewer on Main Street between Cleminson Street and the WWTP. Upgrading the pipe to 450 mm diameter would have it operate at 80-90% of capacity. It may be preferable to upgrade to 525 mm diameter to accommodate additional growth or added Wharf Street pumping capacity.

3.0 CONCLUSIONS

The existing sanitary sewer system has sufficient capacity to convey current peak design flows. Flows presented in the 2017 Operations Report for the WWTP indicate that the sewer system is susceptible to wet weather inflow and infiltration and that flows (5,202 m³/day) exceed the rated capacity of the plant (4,500 m³/day) at least one day in May.

Four proposed developments (Berkhout, Schickedanz, Kaitlin and Hirschfield) could increase the population in Wellington by 150% from 1,932 (2016 census) to approximately 4,854. This is expected to increase the daily average wastewater flow to the plant from 11.3 L/s (2017 Operations Report) to 43.5 L/s and the peak instantaneous flow from approximately 50 L/s to 147 L/s. These flow increases require the following conveyance capacity upgrades to the sanitary sewer system.

- The 500 m long section of 200 mm diameter sewer downstream of the proposed Berkhout and Schickedanz developments will need to be upgraded to 250 mm diameter to operate between 60% and 80% of capacity.



Figure 3.1 – Loyalist Parkway sewer upgrade to 250 mm (shown as red).

- The capacity of the Wharf Street pumping station (approximately 68 L/s) would need to be increased to accommodate a peak flow of 69 L/s. This would not require a significant increase in pumping capacity and could likely be accomplished by upgrading the pumps without replacing the existing forcemain. It should be noted, however, that the pumping station, header and forcemain should all be inspected to confirm the state of repair.
- A new 300mm / 375 mm diameter gravity sanitary sewer should be installed to collect wastewater from the Kaitlin and Hirschfield developments. As proposed in the conceptual plans for these developments, the sewer would be constructed along the Millennium Trail and turn down Cleminson Street to connect to the sanitary sewer on Main Street.



Figure 3.2 – Proposed sewer along Millennium Trail (shown as red).

- The approximately 635 m long section of 400 mm diameter sewer downstream of Cleminson Street on Main Street will need to be upgraded to a minimum 450 mm diameter to operate between 80% and 90% of capacity. It may be preferable to upgrade to 525 mm diameter to accommodate additional growth or added capacity at the Wharf Street pumping station.



Figure 3.3 – Main Street sewer upgrade to 450 mm (shown as red).

- The capacity of the main pumping station at the Wellington WWTP (approximately 90 L/s) would need to be increased to accommodate a peak flow of 147 L/s. This is a significant increase in pumping capacity and could also require modifications to the header and forcemain, which should be inspected to confirm sizes and the states of repair.

4.0 CLOSING

We trust the information presented in this report will be sufficient to assist the County in assessing the sanitary sewer system upgrades required to accommodate the four proposed developments. If you have any questions or require additional information, please contact us at your convenience.

Yours very truly,

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