FINAL REPORT

King Street Investigation & Rehabilitation

Water Quality Monitoring Report for Data Collected from 2018 to 2020

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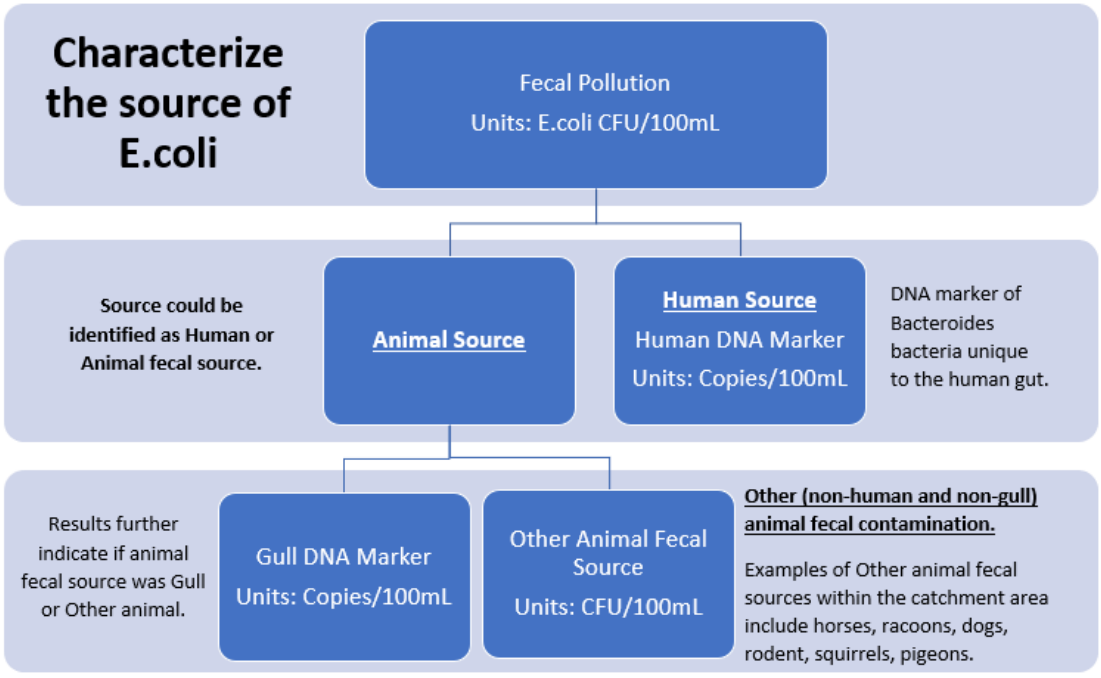
APPENDICES

1 EXECUTIVE SUMMARY

GM BluePlan Engineering Limited (GMBP) is pleased to submit this report to the Town of Niagara-on-the-Lake (Town). The report provides an analysis of water quality samples from the storm sewer collection system which discharges to Queens Royal Beach (QRB) at the foot of King Street in the Town of NOTL. This beach is located in the Niagara River Area of Concern (AOC), having historical water quality problems related to high level of bacteria and resulting in beach postings to warn the water may be unsafe for swimming. The King Street Storm Sewer Outlet (KSSO) was identified as a potential source of bacterial contamination at the QRB impacting water quality goals as part of the Niagara River Remedial Action Plan (RAP). A water quality monitoring program, extensive field investigation program, and rehabilitation of identified infrastructure deficiencies were enacted within the KSSO drainage area from 2018 to 2020 with focus on *Escherichia coli* (*E. coli*) reduction.

Figure 1 summarizes the water quality analysis performed on grab samples collected within the KSSO catchment area to understand fecal sources of *E. coli*.

Figure 1: Analysis of Water Quality Grab Samples



The results within this report have been provided to the King Street Working Group (MECP, NPCA, Region of Niagara, Public Health, ECCC) as well as the Niagara River RAP Implementation Committee. The King Street Working Group and RAP Implementation Committee members have agreed storm sewer and QRB water quality have improved and RAP goals have been met. The process to remove the related water quality impairment for the Niagara River AOC will be initiated by the RAP Team in 2021.

QRB has achieved Beneficial Use Impairment (BUI) re-designation criteria which indicates the beach has met the 80% open threshold, prominent fecal pollution sources were investigated and are now known, all practical remedial actions have been taken to eliminate and reduce sewage contamination, and measures such as informative public signage being installed by the Town.

2 INTRODUCTION

With funding support from Environment and Climate Change Canada and the Ontario Ministry of Environment, Conservation and Parks, GM BluePlan Engineering Limited (GMBP) was retained by the Town of Niagara-on-the-Lake (Town) to develop and implement a water quality sampling program and rehabilitation action plan for the King Street Storm Sewer Outlet (KSSO) drainage area. This area ultimately discharges to Queens Royal Beach (QRB), located within the Niagara River Area of Concern. The KSSO catchment area is located within the Town's tourist corridor and has a mixture of residential and commercial properties. The King Street Storm Sewer Outlet (KSSO) was identified as a potential source of *Escherichia coli* (*E. coli*) contamination at the QRB leading to beach postings to advise of unsafe swimming conditions and impacting water quality goals as part of the Niagara River Remedial Action Plan (RAP). The RAP goals are related to (1) identifying and addressing prominent fecal pollution sources, (2) at least 80% of beach samples meeting provincial recreational water quality goals, and (3) risk management in place to protect public health.

The provincial recreational water quality guidelines used to monitor beach quality is a geometric mean of 5 water samples taken from the beach with *E. coli* less than or equal to 200 CFU/100mL (CFU is "colony forming units"). A water quality monitoring program was developed and applied to the KSSO catchment area from 2018 (pre-existing state) to 2020 (post-rehabilitation state), in addition to a separate beach monitoring program. An infrastructure rehabilitation program was developed and implemented following a field investigation of the sewer systems.

The purpose of this report is to analyze sampling results collected to date within the KSSO catchment area. There are separate reports on QRB water quality monitoring results (Laufman & Patel 2020; Laufman & Moura 2019) which are both available at www.ourniagarariver.ca/document-library.

Figure 2: KSSO Catchment Area

Table 1: Project Timeline Summary

Year	Action
2018	• Develop and implement a water quality sampling program to understand the existing state of the KSSO catchment area. • Investigate and collect wastewater asset condition information through field investigations and existing data. • Develop a prioritized list of rehabilitation recommendations for infrastructure improvements to ultimately reduce *E. coli* loading to the KSSO catchment area.
2019	• Implement infrastructure improvements for "Quick Wins" and short-term recommendations for *E. coli* reduction and monitor resulting water quality improvement.
2020	• Complete prioritized recommendations including infrastructure improvements requiring greater capital budget and implementation time.

Appendix A includes sample locations and *E. coli* result maps from the 2018-2020 sample programs. **Appendix B** includes a map of rehabilitation improvements implemented for the KSSO catchment area.

2.1 Rainfall Event Summary

For reference on characterizing storms during each sampling season:

- Wet weather samples were taken during rain fall events of at least 10mm within a 24 hours period.
- Dry weather sampling requires no rain occurring 48 hours prior to the sample date.
- A rainfall event is considered ≥ to 5mm of rain.
- An intense rainfall event is considered ≥ 20mm of rain within a 24-hour period.
- A dry year is characterized by ≤ to 5 rainfall events
- A wet year is characterized by ≥ to 10 rain fall events
- As it relates to the sampling season between 2018 to 2019
    - 2018 and 2019 were considered average precipitation years
    - 2020 was considered a dry year

2.2 Project Funding

The technical advisory group acknowledge Environment and Climate Change Canada for providing project funding of $150,000 over 3 years. This includes $70,000 toward the initial study and area investigation from July 2018-March 2019 and $80,000 for the subsequent remediation & monitoring from April 2019-March 2020. Acknowledgement to Ministry of the Environment Conservation and Parks for $65,000 to support the design-build of the Low Impact Development stormwater biofiltration facility installed within Simcoe Park.

2.3 Technical Advisory Group

The Town and GMBP have facilitated bi-monthly workshops with the following advisory group (Working Group) since 2018 to demonstrate project progress and to ensure RAP program initiatives are met:

- Ministry of the Environment Conservation and Parks (MECP)
- Niagara Peninsula Conservation Authority (NPCA)
- Environment and Climate Change Canada (ECCC)
- Edge-Water Research and Consulting
- Niagara Region Public Health
- Region of Niagara
- Town of NOTL.

The Town successfully implemented restoration actions and subsequent monitoring for the Working Group.

2.4 Report Reference

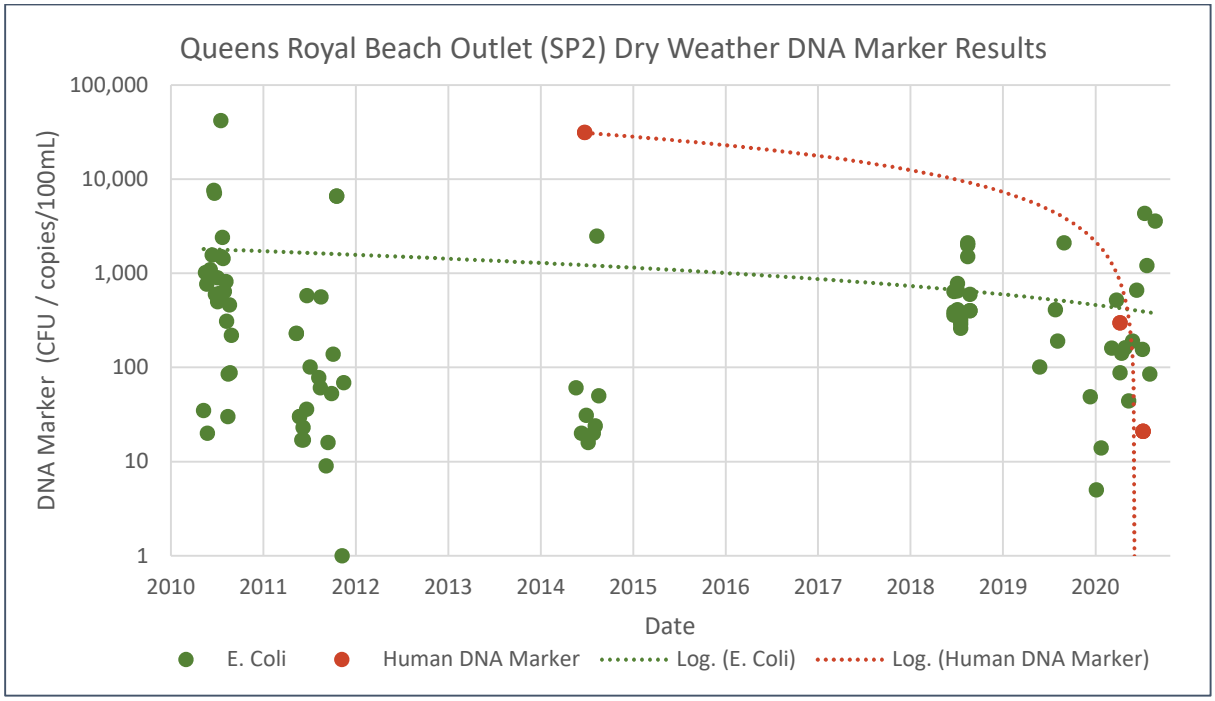
The following reports are provided under separate cover to the Town:

1. QRB monitoring reports (Laufman & Patel 2020; Laufman & Moura 2019).
2. King Street Rehabilitation based on new CCTV Data Collected Nov. 2020 (GMBP; 2020)

3 SAMPLE RESULTS SUMMARIZED FOR DRY AND WET WEATHER

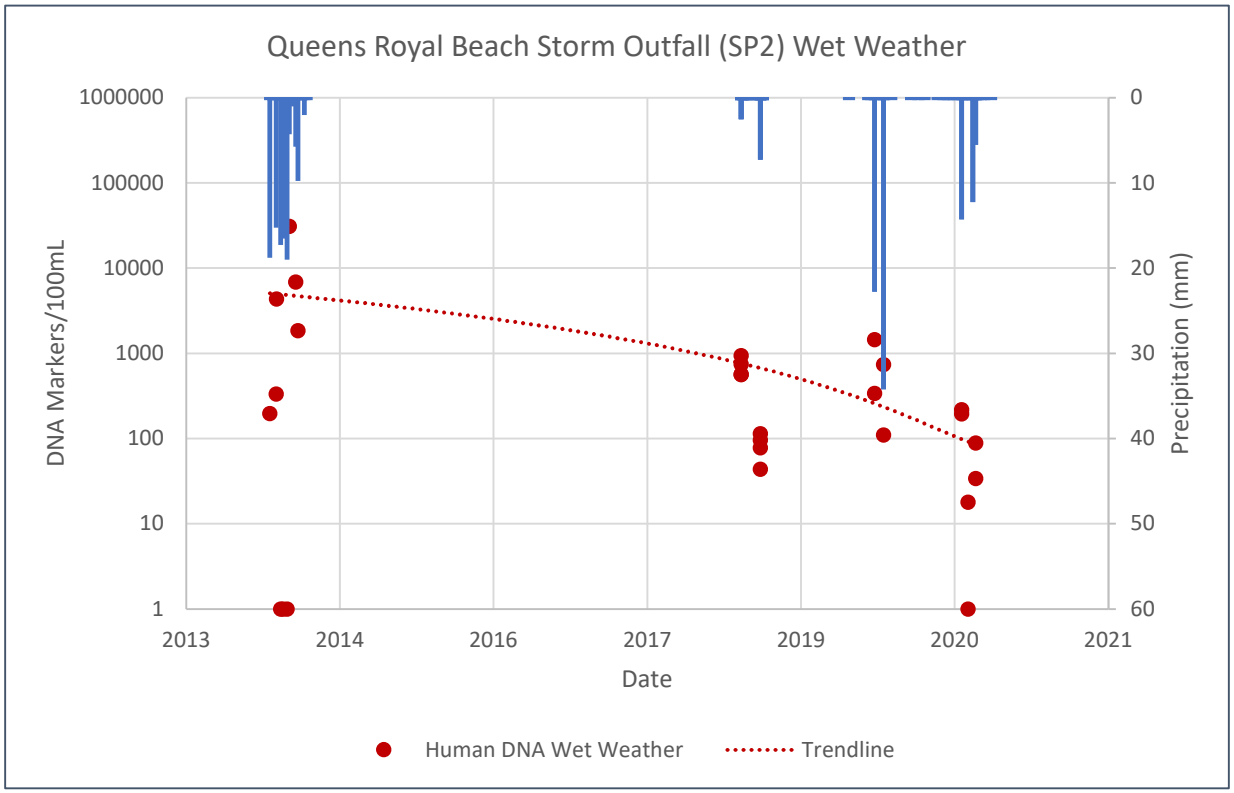
Water quality DNA marker testing results shown in **Figure 3** suggest that **fecal contamination from Other Animal sources (non-human and non-gull) contribute larger amounts of *E.coli* to the KSSO area as is typical for urban stormwater systems**. Most dry weather stormwater samples had measurable *E. coli* levels without detection of the human DNA marker or gull DNA markers. Animals are regularly contributing *E.coli* loading to the catchment in comparison to the rare detection of the Human DNA marker. Examples of Other Animal fecal sources within the catchment area include horses, racoons, dogs, rodents, squirrels, and pigeons. After 2020 remedial actions, large spikes in *E. coli* in KSSO are generally not associated with large spikes in human DNA marker, but more associated with animal fecal sources and are consistent with samples collected during wet events. Significant spikes in the gull DNA marker were found associated with spikes in *E. coli* following some rain events. Horses are likely a main contributing source as multiple commercial horse carriages run daily within the KSSO catchment area.

Figure 3: Historic Comparison of KSSO Water Quality Pre vs. Post Rehab



The Working Group agreed that the focus for *E. coli* reduction is from human sewage sources as this relates to local issues with sanitary sewer infrastructure and local contamination concerns within the Area of Concern. It should be noted, however, that beach postings from Public Health only account for the amount of *E. coli* colony forming units, not the fecal source of *E. coli*.

Figure 4: Historical Data for Human DNA marker for KSSO during Wet Weather



The precipitation data is from Niagara Open Data. Rain data for Niagara-on-the-Lake is from the Line 2 Precipitation Station, located within 5 km of the King Street project area. In **Figure 4**, the displayed precipitation (in millimeters) is a summation of all the rain that fell within a 24-hour period of each wet weather sampling day. This is intended to show the correlation between high-intensity rain events and high results of Human DNA marker. The 2020 results displayed on the graph only show the post-rehabilitation results. It is apparent that the Human DNA marker is showing lower levels even with larger storm events. While 2020 was generally a dry year, the Human DNA marker was mostly associated with rain events at the KSSO site.

4 2020 SAMPLING RESULTS ANALYSIS

In the 2020 season, the Town collected storm sewer grab samples during dry weather (from May to October on a bi-weekly basis) and wet weather (during rain events ≥ 10mm) for submission to Edge-Water Research and Consulting for an innovative analysis using Digital PCR (Microbial Source Tracking) to understand occurrence of human and gull DNA markers. This analysis provides additional information associated with each sample to help interpret the source of *E. coli*. The following indicator areas within the sub-catchment of KSSO were used to summarize monitoring results:

- KSSO – The storm outlet discharging to QRB
- Davy Street
- King Street
- Low Impact Development (LID) Biofiltration Facility installed at Simcoe Park in 2020.

This report does not contain sampling results analysis from QRB as beach sampling was not part of GMBP's scope of work. Grab samples were collected by the Town and analyzed in a separate report noted in the Section 2.4 References.

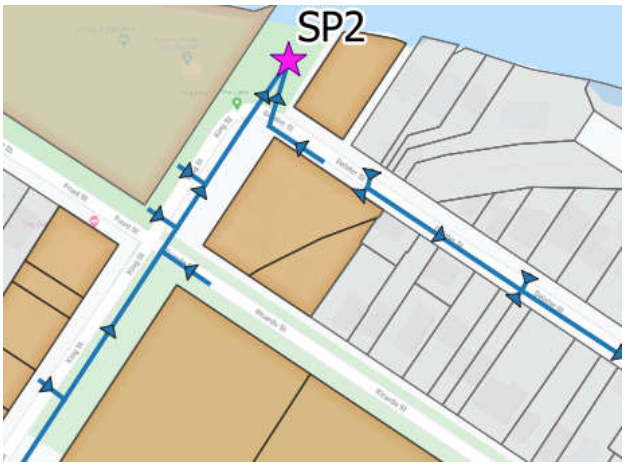
Table 3 shows the percentage of time there were postings at QRB due to *E. coli* levels exceeding the guidelines for recreational water.

Table 2: History of QRB Postings

Year	Sample Size (n)	% Beach Postings
2011	27	48%
2012	43	33%
2013	43	56%
2014	40	50%
2015	30	27%
2016	16	25%
2017	14	29%
2018 (*E. coli* limit increase to 200CFU/100mL from 100CFU/100mL in previous years)	35	17%
2019	37	19%
2020	42	10%

4.1 KSSO – Outlet Results

Previous Microbial Source Tracking studies have indicated that there are Niagara River upstream sources that deliver frequent low levels of human *E. coli* to QRB. The KSSO may negatively impact QRB during rain events but **post remediation sampling in 2020 has shown minimal levels of Human DNA markers from KSSO and that the KSSO is no longer a prominent source of human *E. coli*.** Post-rehabilitation sampling of KSSO only had 2 grab samples with Human *E. coli* present, the remaining 8 grab samples collected over the 2020 sampling season had **no detectable human DNA marker**. The Niagara River sampling point located upstream of the KSSO continues to indicate human *E. coli* but it does not seem to impact overall water quality at the beach.



The following summarizes results of the KSSO which discharges near QRB. Results are compared from 2018 to 2020 during both dry and wet weather sampling at Sample Point #2 (SP2).

Positive Improvements:

- Amount of Times No Human DNA marker was Detected at SP2 (Dry Weather) **–** 100% of samples had Human DNA marker present in 2018. 20% of samples had Human DNA marker present in 2020 resulting in an **80% reduction** in Human DNA marker present at an outlet (SP2) grab sample from 2018 to 2020.
- Historic Monitoring of Human DNA marker at SP2 **– 99% reduction** in Human DNA marker level since the highest recorded value in 2014.
- Max Human DNA marker (Dry Weather) **– 68% reduction** from 2018 to 2020.
- Max Human DNA marker (Wet Weather) **– 85% reduction** from 2019 and **77% reduction** from 2018.
- Max Other Animal Source (non-human and non-gull) *E. coli* (Wet Weather) **– 82% reduction** from 2018 to 2020.

Area for Improvement, Reason for Result and Future Action:

- The 2019 season focused on completing rehabilitation items (smaller data set of sampling). The maximum human DNA marker detected was 36 DNA copies/100mL during dry weather in 2019. The 2020 season (post rehab) had a larger sample data set and thus detected a higher maximum value in comparison to 2019. The 2020 value in comparison to 2018 did show a **68% reduction** in maximum Human DNA markers detected.

- Max Other Animal Source (non-human and non-gull) *E. coli* (Dry Weather) – the *E.coli* amount was highest during dry weather in 2020 compared to 2018.
    - Although the *E. coli* was unusually high on this particular grab sample day, **the human DNA marker was not detected**.
    - During wet weather, the *E. coli* showed an **82% reduction from 2018**. Wet weather is typically a more probable time for higher levels of fecal and nutrients loading the storm sewer.
    - *E.coli* levels could be a result of multiple commercial horse carriages traveling the catchment area daily.

The reason for the spikes in *E. coli* without detection of the human or gull DNA markers is likely due to the 2020 season having fewer precipitation events acting to flush the storm sewer system.

It is recommended that the Town continue to regularly flush the system based on rainfall frequency during the summer season (i.e. schedule more flushing if an overly dry season). For further reduction in the number of beach postings, it is also recommended that the horse carriages be re-routed away from the KSSO catchment area.

Currently, storm sewer outfalls do not have to adhere to specific water quality regulations. The guidelines for Canadian recreational water quality for *E. coli* to be less than or equal to 200 CFU/100mL was used as a general level to compare KSSO catchment sample results.

Table 4 summarizes sampling results from the KSSO (SP2) which discharges to QRB.

Table 3: SP2 Sampling Results

Location	Comparison Type	Dry or Wet Weather	Parameter	Year	Comparison Parameter	Year	Comparison Parameter	Year	Comparison Parameter	% Reduction (2018 - 2020)
								Note: 2018 DNA analysis only completed on wet weather samples		
Storm Outlet to QRB	Amount of Times KSSO outlet was **> 200 CFU/100mL** (Other Animal Source, Non-Human and Non-Gull)	Dry	E. coli	2020 (post rehab)	4/10 grab samples	2019	2/5 grab samples	2018	15/15 grab samples	**100% of samples in 2018 exceeded limits while in 2020 40% of samples exceeded limits** for Other Animal Sources (non-human and non-gull) during dry weather.
	Amount of Times KSSO outlet was **> 200 CFU/100mL** (Other Animal Source, Non-Human and Non-Gull)	Wet	E. coli	2020 (post rehab)	6/6 grab samples	2019	4/4 grab samples	2018	7/7 grab samples	Consistent loading of catchment area with Other Animal Source (Non-Human and Non-Gull) during wet weather.
	# of samples **≤ 1,000 CFU/100mL** (NRPHU limit) (Other Animal Source, Non-Human and Non-Gull)	Dry	E. coli	2020 (post rehab)	7/10 grab samples	2019	4/5 grab samples	2018	12/15 grab samples	Consistent loading of catchment area with Other Animal Source (Non-human and Non-Gull) during dry weather.

Location	Comparison Type	Dry or Wet Weather	Parameter	Year	Comparison Parameter	Year	Comparison Parameter	Year	Comparison Parameter Note: 2018 DNA analysis only completed on wet weather samples	% Reduction (2018 - 2020)
	# of samples ≤ **1,000 CFU/100mL** (NRPHU limit) (Other Animal Source, Non-Human and Non-Gull)	Wet	E. coli	2020 (post rehab)	3/6 grab samples	2019	0/4 grab samples	2018	0/7 grab samples	100% of samples exceeded limit in 2018/2019, while in **2020 the limit is exceeded 50%** of the time.
	Amount of Times KSSO outlet was > **200 copies/100mL**	Dry	Human	2020 (post rehab)	1/10	2019	0/5	2018	4/8	50% of samples in 2018 exceeded limit while in **2020 10% of samples exceeded the limit**.
	Amount of Times KSSO outlet was > **200 copies/100mL**	Wet	Human	2020 (post rehab)	1/6	2019	3/4	2018	4/8	50% of samples in 2018 exceeded limit while in **2020 17% of samples exceeded the limit.**
	# of samples ≤ **1,000 copies/100mL** (NRPHU limit)	Dry	Human	2020 (post-rehab)	10/10	2019	5/5	2018	8/8	Consistent that all grab samples were below NRPHU limit for Human DNA markers.
	# of samples ≤ **1,000 copies/100mL** (NRPHU limit)	Wet	Human	2020 (post-rehab)	6/6	2019	3/4	2018	8/8	Consistent that grab samples were below NRPHU limit for Human DNA markers.
	Amount of Times **No Human DNA marker detected**	Dry	Human	2020 (post rehab)	8/10 grab samples	2019	4/5 grab samples	2018	0/8 grab samples	**80% of grab samples in 2020 had zero human DNA markers** compared to 100% of the time present in 2018.
	Long Term Monitoring - Max Human DNA marker	Wet	Human	2020 (post rehab)	220 (copies/ 100mL)	2014	31,258 (copies/ 100mL)	-	NA	**99% reduction** in human DNA marker since the highest recorded value in 2014.
	Max Human DNA marker amount	Dry	Human	2020 (post-rehab)	298 (copies/ 100mL)	2019	36 (copies/ 100mL)	2018	942 (copies/ 100mL)	**68% reduction** from 2018 to 2020.
	Max Human DNA marker amount	Wet	Human	2020	220 (copies/ 100mL)	2019	1,457 (copies/ 100mL)	2018	942 (copies/ 100mL)	There was an **85% reduction** from 2019 results, and **77% reduction** from 2018 results.
	Max Other Animal Source Amount (non-human & non-gull)	Dry	E. coli	2020	4,340 (CFU/ 100mL)	2019	2,100 (CFU/ 100mL)	-	NA	Higher levels of *E. coli* from 2019 to 2020. Likely due to a drier 2020 season and 2019 smaller data set.
	Max Other Animal Source Amount (non-human & non-gull)	Wet	E. coli	2020	25,600 (CFU/ 100mL)	2019	84,000 (CFU/ 100mL)	2018	142,000 (CFU/ 100mL)	**82% reduction** from 2018 to 2020.

4.2 Davy Street Results

The following section summarizes results of the Davy Street storm sewer, which discharges to Simcoe Park. Davy Street infrastructure improvements occurred in sanitary laterals on private property and owned by the Town and included mainline structural lining of the Davy Street storm sewer. The following analysis compares results from the Davy Street storm sewer point of discharge (SP8) prior to entering the new LID system installed in May 2020 to further improve water quality objectives.

Positive Improvements:

- Amount of times Human DNA marker Detected (Dry Weather) **– 100% reduction of Human DNA detected** during dry weather in 2019 and 2020 compared to 2018 when samples always had Human DNA marker present.
- Amount of times Human DNA marker Detected (Wet Weather) **– 83% of samples showed no Human DNA in 2020**, compared to 0% (all samples has human DNA detected) in 2018 and 2019.
- Maximum value of Human DNA marker (Dry Weather) – **100% reduction** in Human DNA from 2018 to 2020. Zero Human DNA marker present in 2020 dry weather samples.
- Maximum Other Animal Source (non-human and non-gull) *E. coli* (Dry Weather) – **99.1% reduction** from 2019 to 2020 and **99.9% reduction** from 2018 to 2020.
- Maximum Other Animal Source (non-human and non-gull) *E. coli* value (Wet Weather) – **89% reduction** from 2019 to 2020 and **88% reduction** from 2018 to 2020.

Area for Improvement, Reason for Result and Future Action:

- Maximum value of Human DNA marker (Wet Weather) – a **reduction of 15%** of Human DNA markers maximum amount comparing 2019 to 2020, yet an increase of 40% occurred comparing 2018 to 2019 data. Potential reasons for an increase from 2018 to 2019 maximum human DNA markers during wet weather at SP8 outlet:
    - The max human DNA marker grab sample from 2018 occurred during a wet weather storm event of 40.75mm. This is large storm event that cause significant flushing to the storm sewer, thereby lowering the Human DNA markers value for 2018. The rain events during the highest readings of human DNA markers in 2019 and 2020 were 34 mm on Oct. 31, 2019 and 8.5 mm Oct 19, 2020.
    - The max human DNA marker amount from **2019 was collected from the sump**, which in 2019 was a soil channel that collected the discharge from the outfall. Sediment acts as a host environment for *E.coli* to multiply. For the 2020 season, this location is now part of the LID collection and filtration system.
    - The max human DNA marker amount from **2019 was a grab sample taken prior to improvements being completed** upstream on the sanitary laterals on Davy Street.
    - The max human DNA marker amount from 2020 occurred on Oct 19, 2020. Prior to this date, this location in the 2020 season had **no human DNA markers detected from 5 other grab samples**. The groundwater table rises in the fall and aids in cross-connection flow from potential historic infrastructure in the area. Near this location, an arched brick sewer is located on Picton Street (unknown if previously used for sanitary, storm or combined sewer and if abandoned or active connections exist).
    - On a positive note, post-LID infiltration reduced the 2020 max value of human DNA marker by an additional **93%**.
    - Another positive is that during wet weather events, **83% of grab samples had zero Human DNA marker detected in 2020,** while in contrast, **100% of grab samples had Human DNA marker in 2018 and 2019.**

Previous mainline sewer condition assessments used existing Closed-Circuit Television (CCTV) condition information collected in 2017 prior to GMBP involvement. Additional CCTV was completed in the area in November 2020 to understand the origin of remaining Human DNA marker occurrences in the 2020 sampling season. This identified improvements which could be made to segments of the wastewater collection system to further improve SP8 and SP6. Additional rehabilitation items have been provided under separate cover to the Town (References Section 2.4).

Table 5 summarizes sampling results from the Davy St. Outlet (SP8) which flows to Simcoe Park.

Table 4: Davy Street Sampling Results

Location	Comparison Type	Dry or Wet Weather	Parameter	Year	Comparison Parameter	Year	Comparison Parameter	Year	Comparison Parameter	% Reduction (2018 - 2020)
								Note: 2018 DNA analysis only completed on wet weather samples		
Davy Street	Outlet amount of times **Human DNA marker detected**	Dry	Human	2020	0/2 grab samples	2019	0/3 grab samples	2018	5/5 grab samples	**100% of samples showed no human DNA marker** in 2020 and 2019 vs. 0% in 2018 in dry weather.
	Outlet amount of times **Human DNA marker Detected**	Wet	Human	2020	1/6 grab samples	2019	4/4 grab samples	2018	5/5 grab samples	**83% of samples showed no human DNA marker** in 2020 vs. 0% in 2018 and 2019 in wet weather.
	Outlet max Human DNA marker	Dry	Human	2020	0 (copies/ 100mL)	2019	0 (copies/ 100mL)	2018	367 (copies/ 100mL)	**100% reduction** in human DNA marker from 2018 to 2020 in dry weather.
	Outlet max Human DNA marker	Wet	Human	2020	512 (copies/ 100mL)	2019	600[1] (copies/ 100mL)	2018	367 (copies/ 100mL)	**Reduction of 15%** from 2019 to 2020 values. Additional reasoning provided in text for results.
	Max Other Animal Source Amount (non-human & non-gull)	Dry	E. coli	2020	121 (CFU/ 100mL)	2019	13,500 (CFU/ 100mL)	2018	220,000 (CFU/ 100mL)	2020 compared to 2019: **99.1 % reduction.** 2020 compared to 2018: **99.9% reduction.**
	Max Other Animal Source Amount (non-human & non-gull)	Wet	E. coli	2020	26,700 (CFU/ 100mL)	2019	251,000 (CFU/ 100mL)	2018	220,000 (CFU/ 100mL)	There was an **89% reduction** from 2019 results, and **88% reduction** from 2018 results.

[1] – sump sample

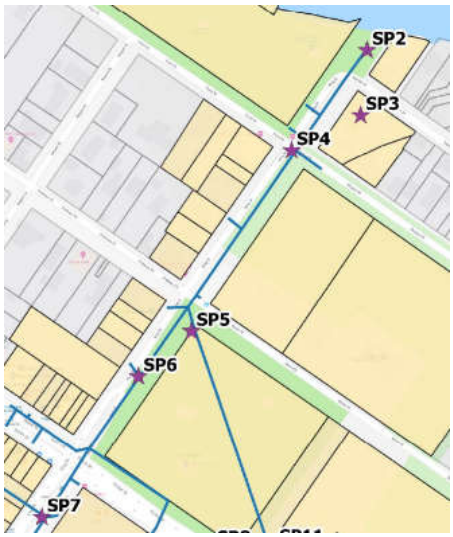
4.3 King Street Results

The following summarizes results of the King Street storm sewer, which discharges near QRB. King Street infrastructure work included improvements to private property sanitary laterals, disconnection and re-routing of two direct improper connections, manhole rehabilitation and segments of structural storm sewer mainline lining. The following analysis compares results from the **King Street storm sewer sampling points (SP2, SP4, SP6, SP7)**.

Positive Improvements:

- Maximum amount of Human DNA marker (Wet Weather) – There was an **85% reduction** from 2019 to 2020 and a **77% reduction** from 2018.
- Maximum amount of Other Animal Source (non-human and non-gull) *E. coli* (Dry Weather) – **99% reduction** from 2018 to 2020.

- Maximum amount of Other Animal Source (non-human and non-gull) *E. coli* (Wet Weather) – **89% reduction** from 2018 to 2020.



Area for Improvement, Reason for Result and Future Action:

- Maximum amount of Human DNA marker (Dry Weather) – a higher value of dry weather Human DNA was experienced at SP6 in comparison to 2018 and 2019 levels.
  - At this sample location, **60% of grab samples in 2020 had no human DNA marker detection**.
  - SP6 Other Animal Source (non-human and non-gull) *E. coli* levels during dry weather had a **94% reduction** from 2019 to 2020 and a **60% reduction** from 2018 to 2020 results comparing maximum grab sample results.
  - Rehabilitation efforts on King Street implemented improvements downstream of SP6.

New CCTV data collected in November 2020 identified a likely sewage entry point, and a prioritized rehabilitation report outlines suggested improvements to further improve SP6 and SP8 grab samples. Suggested rehabilitation to specific wastewater segments has been provided under separate cover.

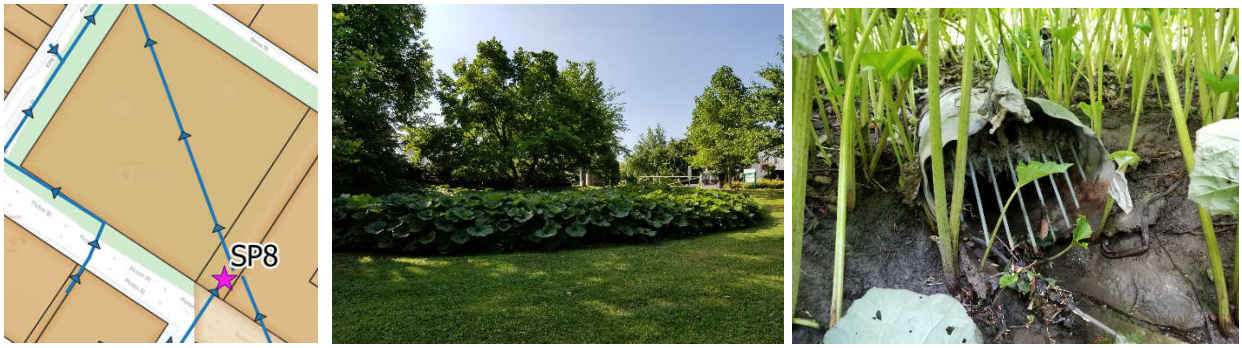
Table 6 summarizes sampling results from the King Street storm sewer sampling points (SP2, SP4, SP6, SP7).

Table 5: King Street Results

Location	Comparison Type	Dry or Wet Weather	Parameter	Year	Comparison Parameter	Year	Comparison Parameter	Year	Comparison Parameter	% Reduction (2018 - 2020)
								Note: 2018 DNA analysis only completed on wet weather samples		
King Street	Maximum amount of Human DNA marker	Dry	Human	2020	4,811 (copies/ 100mL)	2019	58[1] (copies/ 100mL)	2018	942 (copies/ 100mL)	3/5 grab samples at SP6 in 2020 showed no human DNA markers. Levels of human DNA markers may relate to a mainline defect nearby.
	Maximum amount of Human DNA marker	Wet	Human	2020	220 (copies/ 100mL)	2019	1,487[1] (copies/ 100mL)	2018	942 (copies/ 100mL)	There was an **85% reduction** from the 2019 results, and **77% reduction** from 2018 results.
	Maximum Other Animal Source Amount (non-human & non-gull)	Dry	E. coli	2020	24,500 (CFU/ 100mL)	2019	400,000[1] (CFU/ 100mL)	2018	2,000,000[1] (CFU/ 100mL)	**99% reduction** from 2018 to 2020. **94% reduction** from 2019 to 2020.
	Maximum Other Animal Source Amount (non-human & non-gull)	Wet	E. coli	2020	25,600 (CFU/ 100mL)	2019	166,000[1] (CFU/ 100mL)	2018	223,000 (CFU/ 100mL)	**89% reduction** from 2018 to 2020.

[1] indicates a grab sample taken from a manhole sump.

4.4 LID Results



Simcoe Park Before LID

Simcoe Park Post-LID Construction

With funding support from ECCC and MECP, a biofiltration LID was designed by GMBP and installation coordinated by the Town within Simcoe Park. The LID construction was completed on May 28, 2020. The biofiltration facility uses one meter of engineered filter media comprised of sand, soil and organic matter to provide quality control treatment for two stormwater outfalls with a 4.2 ha catchment area. Wet weather DNA sampling was completed at the LID site at the inlet and outlet of the LID system to determine the *E. coli* reduction capability.

<u>Comparative sample results comparing the LID inlet to LID outlet:</u>

- Maximum values for Human DNA marker during wet weather – **93% reduction.**
- Maximum values for Other Animal source (non-human and non-gull) *E. coli* during wet weather – **95% reduction.**
- Average values for Human DNA marker during wet weather – **89% reduction.**
- Average values for Other Animal source (non-human and non-gull) *E. coli* during wet weather – **94% reduction.**

The Town will be responsible for future LID maintenance and ECA report tracking of maintenance activities as previously provided under separate cover.

Table 7 shows the sampling results from the LID in Simcoe Park.

Table 6: LID Sampling Results

Location	Comparison Type	Dry or Wet Weather	Parameter	Year	Comparison Parameter	Year	Comparison Parameter	Year	Comparison Parameter	% Reduction (2018 - 2020)
								Note: 2018 DNA analysis only completed on wet weather samples		
LID	Inlet vs. Outlet Max	Wet	Human	2020 (Inlet)	512 (copies/ 100mL)	2020 (Outlet)	34 (copies/ 100mL)	-	NA	**93% reduction** from the inlet to the outlet.
	Inlet vs. Outlet Max Other Animal Source (non-human and non-gull)	Wet	E. coli	2020 (Inlet)	23,000 (CFU/ 100mL)	2020 (Outlet)	1,050 (CFU/ 100mL)	-	NA	**95% reduction** from the inlet to the outlet.
	Inlet vs. Outlet Average	Wet	Human	2020 (Inlet)	85 (copies/ 100mL)	2020 (Outlet)	9 (copies/ 100mL)	-	NA	**89% reduction** from the inlet to the outlet.
	Inlet vs. Outlet Average for Other Animal Source (non-human and non-gull)	Wet	E. coli	2020 (Inlet)	14,767 (CFU/ 100mL)	2020 (Outlet)	848 (CFU/ 100mL)	-	NA	**94% reduction** from the inlet to the outlet.

5 CLOSING RECOMMENDATIONS

5.1 Zero *E. coli* Unlikely

GMBP notes it will be normal for the area to have low *E. coli* concentrations from urban animal sources within the storm sewer system and zero *E. coli* at QRB or the KSSO is unlikely. The following additional contributors may continue to load the KSSO catchment area:

1. **Historic Infrastructure:** Based on a historical drawing review, the Town may have had a **past practice of not filling abandoned pipes**, which now aid as drainage conduits for cross-connection flow between wastewater assets with defects (i.e. allows flow from leaks to travel further). Queen Street contains at a minimum seven abandoned shallow sanitary sewers. Abandoned pipes with no fill added upon abandonment were identified during the investigation (King Street & Platoff Street).
2. **Arched Brick Sewers:** An arched brick sewer was identified on Picton Street which is still connected to the storm sewer system, discharging to Simcoe Park which ultimately drains to King Street and QRB. A second arched brick sewer was identified on King Street during rehabilitation efforts.
3. **Upstream Contributors to the KSSO:** The following locations act as contributors to the KSSO catchment area:
    a. A drainage ditch from The Commons park discharges to the Wellington Street storm sewer and ultimately the KSSO. This drainage ditch has shown elevated levels of *E. coli* from sampling completed pre and post of an annual horse polo match hosted in the upstream park area.
    b. One Mile Creek is a watercourse directly upstream of the KSSO catchment area which has impaired water quality exceeding provincial *E. coli* standards by a factor of 10 to 20 since 2003.
    c. A shallow aquifer discharges to a catchbasin which connects to the KSSO outlet. NPCA sample data from July 2019 at this location had a maximum amount of *E. coli* of 369 CFU/100mL.

Multiple contributing sources surrounding the King Street catchment area, and the age of infrastructure, imply the catchment area will likely always experience some presence of *E. coli* from urban animal sources (e.g. bird and mammal wildlife) and occasional low concentrations of the Human DNA marker, despite best practical efforts at reducing sources within the study area.

5.2 Proactive Long-Term Plan

GMBP has identified long-term continual improvements of infrastructure for the area to have a reactive plan for any future asset deterioration in the catchment area. These actions are recommended for the Town of NOTL, unless otherwise specified.

- **Year 2021**
  - Town has confirmed sampling in summer season of 2021 and beyond will focus on sampling the beach waters at QRB to maintain its public beach status. GMBP recommends that the KSSO (SP2) be sampled for additional supplemental data to confirm the source of any potential *E. coli* loading (Human, Gull, Other Animal Source). The DNA analysis will assist to record the source of *E. coli* loading for any future beach postings. The Working Group confirms that long term beach monitoring is a focus for Town resources.
  - Town of NOTL to track the daily number of horses and working times travelling the catchment area for supplemental information to understand and address future beach postings that may be linked to 'Other' *E. coli* sources as noted in this report. It is recommended that the horse carriages ideally be re-routed off King Street or other horse waste management options be considered to reduce droppings on the roads.
  - For further improvement to water quality for the King Street and Davy Street storm outlets, suggested structural trenchless lining to select sewer segments has been provided under separate cover.
- **Year 2025**
  - Collect new CCTV data of storm and sanitary mainlines with sanitary lateral launch within the KSSO catchment area to ensure the most up to date condition information.
- **Annual area maintenance**:
  - LID maintenance and associated maintenance tracking (ECA stipulation) to ensure effective filtration.
  - Storm sewer flushing with frequency dependent on wet weather events during the summer season.
  - KSSO catchment area manhole and catchbasin sump cleaning annually. Simcoe Park manhole sumps will require manual labour for sump maintenance due to inadequate access for vacuum trucks.
  - Smart Sponge installed at King Street and Byron Street to be manually cleaned (once every 4 months) and monitored (bi-annually) on a continuous basis to ensure debris removal and status of sponge. Town to coordinate receiving new sponges and installation.
- **Signage**
  - To further reduce human health risks, signage should be installed at QRB to inform people about potential bacteria in the water and how to prevent getting sick (check results on NOTL website, avoid swimming within 24-48 hours after rain event, wash hands after swimming, etc.). This item is currently a task in progress with the Town.

6 CLOSING

The Town has successfully completed an innovative project for the KSSO catchment area. The lessons learned as part of this project will aid other municipalities for future storm sewer management initiatives. The success of this project has led the Town and GMBP to receive the **2020 Consulting Engineers of Ontario (Niagara Region Chapter) Award for Engineering Excellence**. This project was selected for exhibiting engineering excellence, improving or enhancing the quality of community life and supporting sustainable growth through uniqueness, ingenuity and creativity.

APPENDIX A: SAMPLE DATA SUMMARY MAPS FROM 2018-2020

Niagara-on-the-Lake King St. Investigation

2020
Study Area Sampling Points
Dry Weather Flow Results

K-SP32	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Jun 15/20	10	109	44
Jun 30/20	5	125	ND
Jul 15/20	23	61	34
Jul 31/20	36	174	25
Aug 24/20	13	72	ND
Sept 1/20	5	136	ND
Sept 11/20	40	260	35
Sept 22/20	1	115	ND
Oct 14/20	7	256	20

K-SP31	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Jun 15/20	12	148	103
Jun 30/20	1	133	25
Jul 15/20	3	61	ND
Jul 31/20	11	269	17
Aug 24/20	16	52	ND
Sept 1/20	12	125	17
Sept 11/20	16	275	53
Sept 22/20	5	141	26
Oct 14/20	4	215	ND

K-SP2	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Jan 28/20	49	20	ND
Feb 21/20	5	231	ND
Mar 12/20	14	37	ND
Apr 23/20	160	569	ND
Rehab Complete			
May 12/20	520	323	ND
May 26/20	88	110	22
LID Installation Complete			
Jun 1/20	142	ND	53
Jun 15/20	162	298	ND
Jun 30/20	44	ND	ND
Jul 15/20	190	ND	ND
Jul 31/20	660	ND	ND
Aug 24/20	155	ND	ND
Sept 1/20	4340	ND	ND
Sept 11/20	1210	21	ND
Sept 22/20	85	ND	ND
Oct 14/20	3600	ND	ND

K-SP5	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
May 26/20	5*	ND*	ND*
Jun 15/20	49*	37*	ND*

K-SP6	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Apr 23/20	120	ND	ND
May 12/20	2	ND	ND
May 26/20	1	ND	ND
Jun 15/20	9600	4811	ND
Oct 14/20	24,500	451	ND

K-SP7	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Apr 23/20	43	ND	ND
May 12/20	17,100*	85*	98*
May 26/20	27*	22*	ND*
Jun 15/20	19,700*	ND*	ND*

K-SP8 IN	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Apr 23/20	32	ND	ND
May 12/20	121	ND	116

K-SP30	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Jan 28/20	250	370	ND
Feb 21/20	310	49	ND
Mar 12/20	210	546	ND

SP32, SP31, SP2, SP3, SP4, SP16, SP5, SP6, SP7, SP15, SP8, SP11, SP12, SP9, SP13, SP10, SP14, SP30

Simcoe Street, Queen Street, King St, Prideaux St, Queen St, Gate St, Victoria St, Byron St, Britton St, Ricardo Street, Delater Street, Bell Street, Turntable Mews, Lockhart Street, Melville Street, Read Lane, Haines Lane, Davy Street, Platoff Street, Wellington Street, Castlereagh St, Nelles St, Picton St, Queen's Parade, Veterans Lane, Veterans Memorial Park, Simcoe Park, St Mark's Anglican Church, Shaw Festival Theatre, Fort George National Historic Site, Niagara Parkway Recreational Trail

N

0 50 100 150 200 m

Sampling Points

Storm Sewer Network
- Pipes to be Sampled
- Study Area Pipes
- Out of Scope Pipes
- Storm Manholes

Note: Dates flagged with a * indicate sample was taken from sump

Flushing of catchment area occured on May 11 and May 12, 2020 (Sampling immediately following flushing)

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K-SP32	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
July 11/20 Sample 1	3000	142	1002
Sample 2	1160	206	349
Aug 01/20 Sample 1	11	85	21
Sample 2	18	106	ND
Aug 26/20 Sample 1	36	71	325
Sample 2	27	52	293

K-SP31	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
July 11/20 Sample 1	24,000	234	4951
Sample 2	16,000	257	4120
Aug 01/20 Sample 1	4	49	ND
Sample 2	8	98	ND
Aug 26/20 Sample 1	15	116	ND
Sample 2	10	108	ND

K-SP2	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
LID Installation Complete			
July 11/20 Sample 1	25,600	196	3905
Sample 2	22,200	220	2227
Aug 01/20 Sample 1	510	ND	ND
Sample 2	930	18	ND
Aug 26/20 Sample 1	310	34	ND
Sample 2	2400	89	31

LID In	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Aug 01/20 Sample 1	26,700	ND	ND
Sample 2	17,700	ND	ND
Aug 26/20 Sample 1	3300	ND	ND
Sample 2	3500	ND	116
Oct 19/20 Sample 1	23,000	512	ND
Sample 2	14,400	ND	ND

LID Out	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Aug 26/20 Sample 1	650	ND	ND
Sample 2	560	ND	ND
Oct 19/20 Sample 1	1130	34	ND
Sample 2	1050	ND	ND

0 50 100 150 200 m

N

Niagara-on-the-Lake King St. Investigation

2020
Study Area Sampling Points
Wet Weather Flow Results

- Sampling Points

Storm Sewer Network
- Pipes to be Sampled
- Study Area Pipes
- Out of Scope Pipes
- Storm Manholes

Note: Dates flagged with a * indicate sample was taken from sump

Storm Values

-
July 11= 14.25 mm
August 1= 0.25 mm
August 26= 5.5 mm

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November 2019
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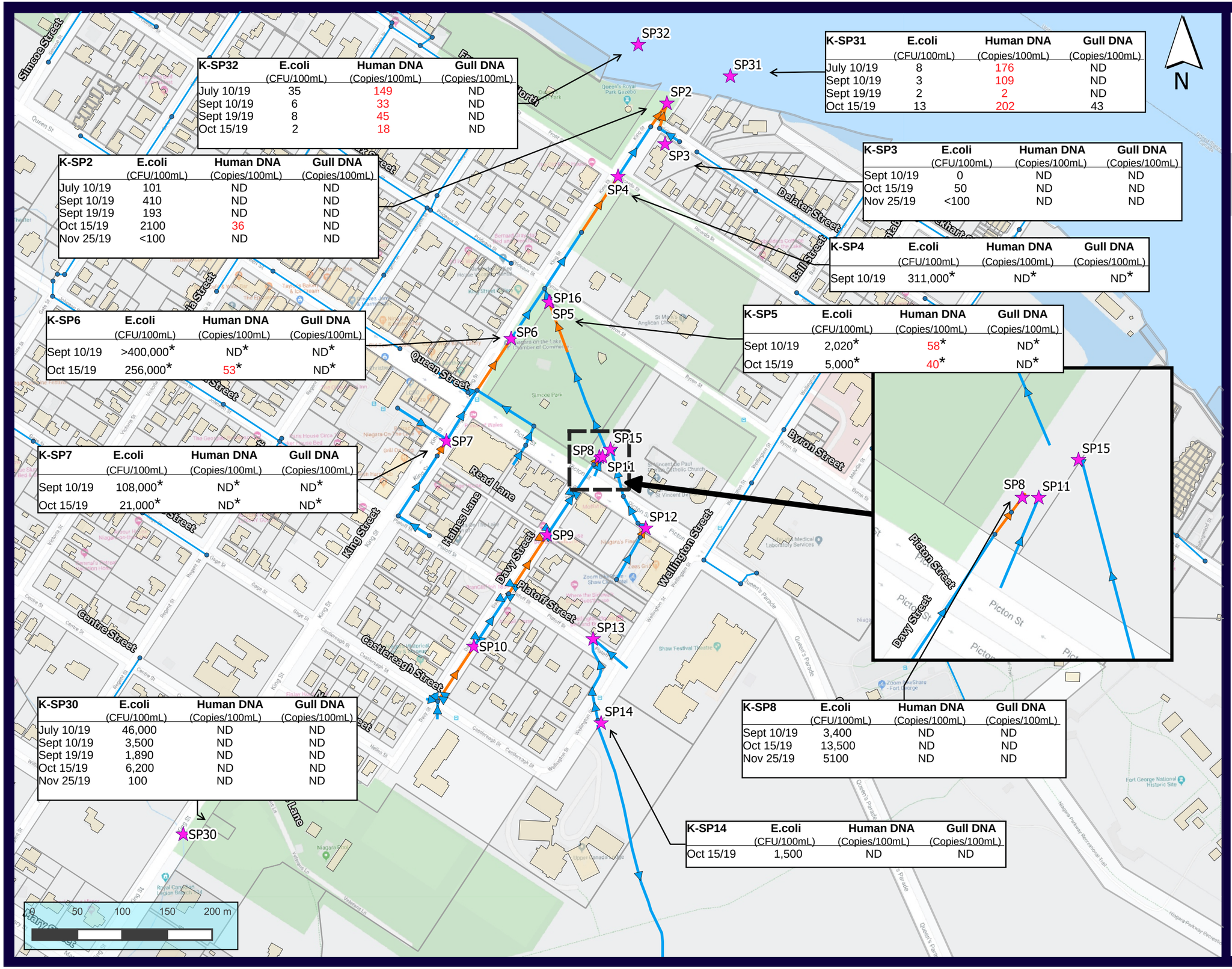
NAD83 / UTM zone 17N



K-SP32	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
July 10/19	35	149	ND
Sept 10/19	6	33	ND
Sept 19/19	8	45	ND
Oct 15/19	2	18	ND

K-SP31	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
July 10/19	8	176	ND
Sept 10/19	3	109	ND
Sept 19/19	2	2	ND
Oct 15/19	13	202	43

K-SP2	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
July 10/19	101	ND	ND
Sept 10/19	410	ND	ND
Sept 19/19	193	ND	ND
Oct 15/19	2100	36	ND
Nov 25/19	<100	ND	ND

K-SP3	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Sept 10/19	0	ND	ND
Oct 15/19	50	ND	ND
Nov 25/19	<100	ND	ND

K-SP4	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Sept 10/19	311,000*	ND*	ND*

K-SP6	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Sept 10/19	>400,000*	ND*	ND*
Oct 15/19	256,000*	53*	ND*

K-SP5	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Sept 10/19	2,020*	58*	ND*
Oct 15/19	5,000*	40*	ND*

K-SP7	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Sept 10/19	108,000*	ND*	ND*
Oct 15/19	21,000*	ND*	ND*

K-SP30	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
July 10/19	46,000	ND	ND
Sept 10/19	3,500	ND	ND
Sept 19/19	1,890	ND	ND
Oct 15/19	6,200	ND	ND
Nov 25/19	100	ND	ND

K-SP8	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Sept 10/19	3,400	ND	ND
Oct 15/19	13,500	ND	ND
Nov 25/19	5100	ND	ND

K-SP14	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 15/19	1,500	ND	ND

Niagara-on-the-Lake

Niagara-on-the-Lake King St. Investigation

2019 Study Area Sampling Points Dry Weather Flow Results

- Sampling Points

Storm Sewer Network
- Pipes to be Sampled
- Study Area Pipes
- Out of Scope Pipes
- Storm Manholes

Note: SP9, SP10, SP11, SP12, SP13, SP14 and SP15 did not exhibit any DWF during the sampling times.

Note: Dates flagged with a * indicate sample was taken from sump

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November 2019
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NAD83 / UTM zone 17N

K-SP32	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 31 Sample 1	40	413	ND

K-SP31	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 31 Sample 1	80	538	ND

K-SP16	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 2 Sample 1	10,900	41	ND

K-SP2	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 2 Sample 1	28,000	340	ND
Sample 2	14,900	1457	303
Oct 31 Sample 1	6,400	740	58
Sample 2	84,000	111	ND

K-SP5	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 2 Sample 1	25,000*	86*	41*
Sample 2	15,000*	117*	ND*
Oct 31 Sample 1	30,000*	546*	ND*

K-SP15	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 2 Sample 1	38,000*	37*	48*
Oct 31 Sample 1	30,000*	383*	ND*

K-SP6	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 2 Sample 1	21,000*	712*	ND*
Oct 31 Sample 1	117,000*	1480*	58*

K-SP8	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 2 Sample 1	49,000*	65*	ND*
Sample 2	10,400*	411*	ND*
Oct 31 Sample 1	251,000*	172*	ND*
Sample 2	30,000*	600*	ND*

K-SP7	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 2 Sample 1	17,000*	218*	ND*
Oct 31 Sample 1	166,000*	1487*	43*

K-SP11	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 31 Sample 1	2,600	164	ND

K-SP30	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 2 Sample 1	79,000	467	ND
Oct 31 Sample 1	3,900	42	ND

K-SP14	E.coli (CFU/100mL)	Human DNA (Copies/100mL)	Gull DNA (Copies/100mL)
Oct 2 Sample 1	9,300*	37*	67*
Oct 31 Sample 1	10,100*	ND*	ND*

SP32 SP31 SP2 SP3 SP4 SP16 SP5 SP6 SP7 SP8 SP15 SP11 SP12 SP9 SP10 SP13 SP14 SP30

Simcoe Street, Queen Street, King Street, Victoria Street, Regent Street, Gage Street, Centre Street, Castlereagh Street, Nelles Street, Byron Street, Ricardo Street, Delater Street, Bell Street, Melville Street, Simcoe Park, Read Lane, Heales Lane, Davy Street, Platoff Street, Wellington Street, Picton Street, Queen's Parade, Evans Lane, Veterans Lane, Niagara River, Fort George National Historic Site, Niagara Parkway Recreational Trail

0 50 100 150 200 m

N

Niagara-on-the-Lake King St. Investigation

2019 Study Area Sampling Points Wet Weather Flow Results

- Sampling Points

Storm Sewer Network
- Pipes to be Sampled
- Study Area Pipes
- Out of Scope Pipes
- Storm Manholes

Note: Dates flagged with a * indicate sample was taken from sump

Storm Values

August 27 = 11.3mm
October 2 = 22.75mm
October 31 = 34.2mm

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November 2019
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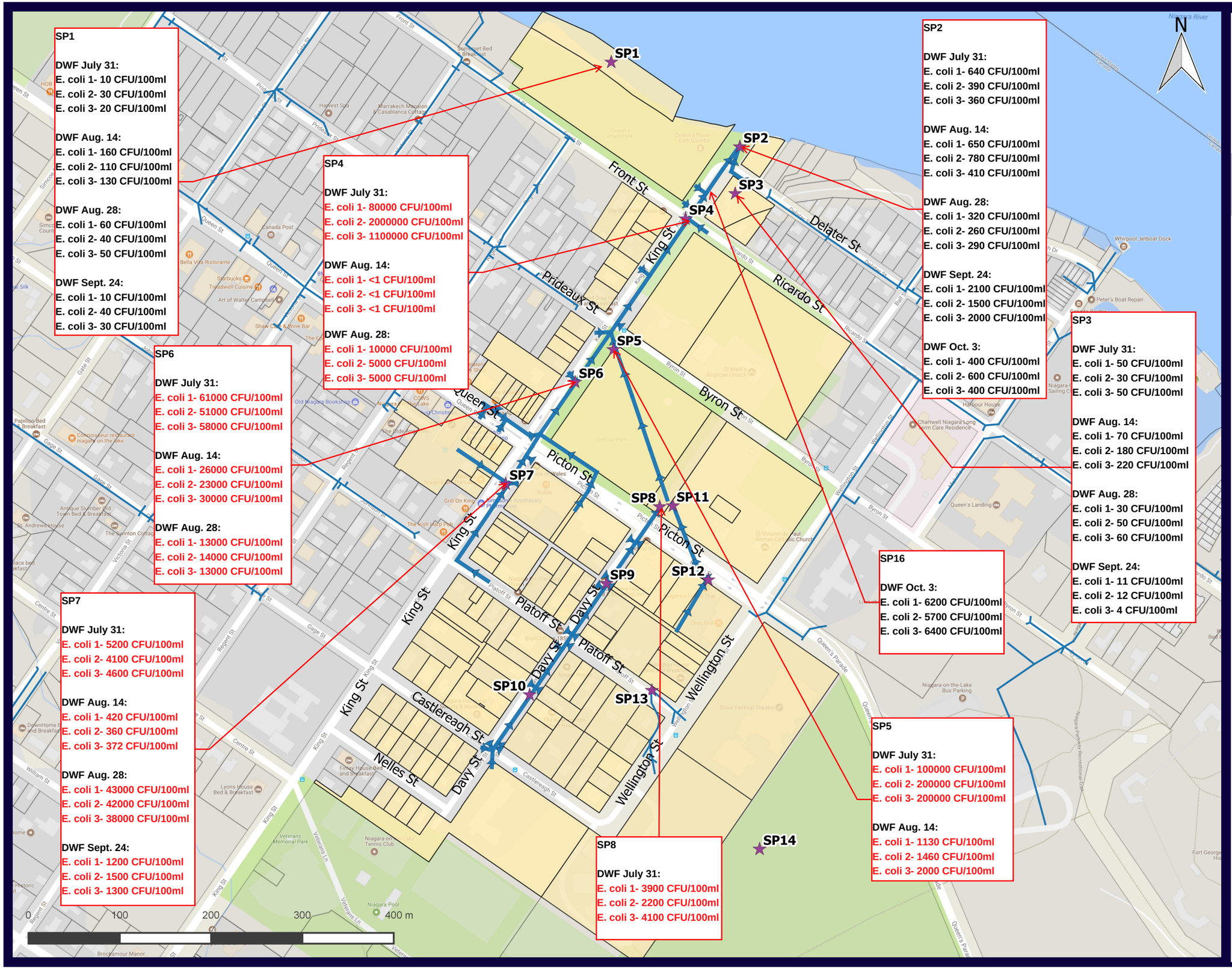

Niagara-on-the-Lake

King Street Investigation

Project Area
Sampling Locations 2018

Legend

- New sampling locations

Storm Sewers
- In Scope
- Out of Scope

Property Parcels
- In Scope
- Out of Scope

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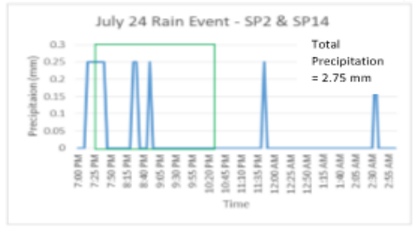
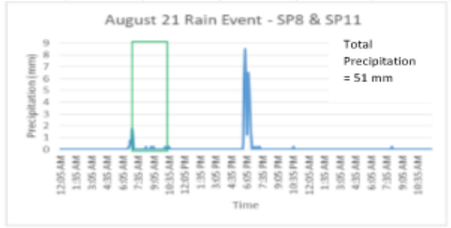
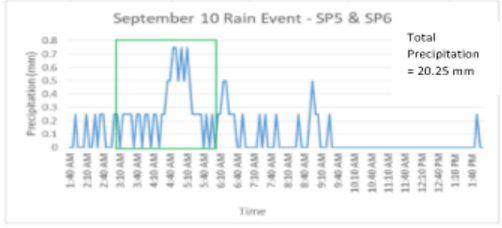
June 2018
Figure #4
WGS 84 Pseudo Mercator

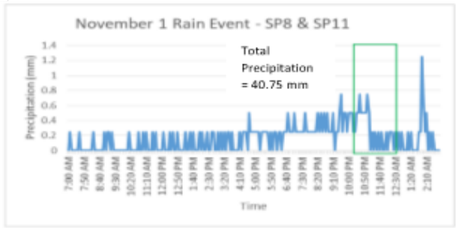
		Total E.coli (CFU/100mL)					Human DNA (DNA copies/100mL)					Gull DNA (DNA copies/100mL)				
		24-Jul	21-Aug	10-Sep	24-Sep	1-Nov	24-Jul	21-Aug	10-Sep	24-Sep	1-Nov	24-Jul	21-Aug	10-Sep	24-Sep	1-Nov
SP2	SP2-1	10*			142,000		747			96		449			No detection	
	SP2-2	94,000			67,000		942			115		46,329			No detection	
	SP2-3	86,000			45,000		567			78		95,004			No detection	
	SP2-4	46,000			21,000		570			44		33,200			No detection	
SP14	SP14-1	4,900			71,000		No detection			No detection		210			No detection	
	SP14-2	5,700			56,000		No detection			No detection		51			No detection	
	SP14-3	9,600			68,000		No detection			No detection		64			No detection	
	SP14-4	7,400			71,000		No detection			No detection		53			No detection	
SP5	SP5-1			204,000					126					98		
	SP5-2			108,000					No detection					No detection		
	SP5-3			223,000					76					No detection		
	SP5-4			40,000					183					No detection		
SP6	SP6-1			0*					No detection					No detection		
	SP6-2			23,000					No detection					1,250		
	SP6-3			11,800					51					350		
	SP6-4			4,800					No detection					186		
SP8	SP8-1		8,200			11,800		273			138		53			No detection
	SP8-2		12,000			112,000		110			100		No detection			No detection
	SP8-3					220,000					367					No detection
SP11	SP11-1		210			6,400		64			119		No detection			No detection
	SP11-2		6,600			1,770		191			128		117			No detection
SP18 (Wellington St. Storm Outlet)	SP18-1					116,000					226					No detection
	SP18-2					22,000					233					No detection
	SP18-3					17,700					192					82

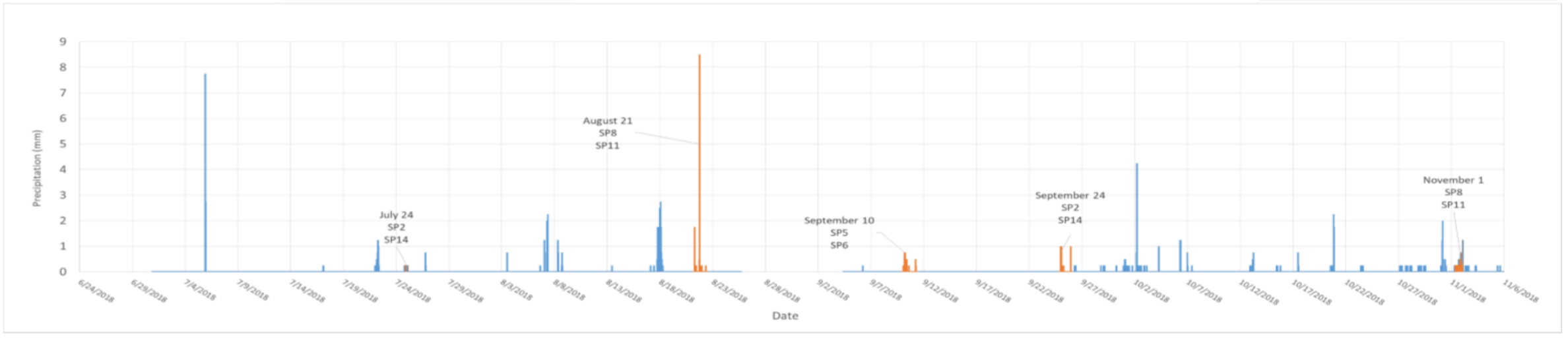
* indicates inaccurate laboratory reading due to high levels of suspended solids











APPENDIX B: REHABILITATION IMPROVEMENTS SUMMARY MAP

Niagara-on-the-Lake

Niagara-on-the-Lake King Street Investigation

King Street Project Area

SP2

N

Sanitary manhole rehabilitation at intersection of King and Front Street (April 2020)

WaStop inline check valve installed at QRB outlet (October 2019)

Re-routed 123 King Street Sanitary Lateral (March 2019)

Re-lining of King Street mainline storm sewer from Queen Street - Front Street (December 2019)

Abandonment of poor condition mainline not in NOTL GIS (March 2020)

Storm manhole rehabilitation at intersection of King and Front Street (April 2020)

Abandoned arched-brick sewer

Smart Sponge implemented in King Street catchbasin with high E. coli counts (October 2019)

Lateral launching of businesses on Queen Street (April 2019)

Simcoe Park Wading pool disconnected from storm sewer (May 2019)

King Street root removal in sanitary mainline (February 2020)

Simcoe Park sump debris removal (February 2020)

Annual storm system flushing and catch basin and manhole sump cleaning

Identification of abandoned arched brick sewer discharging to King Street storm mainline (July 2019)

Sanitary lateral repaired at 230 Davy Street (September 2019)

Improved grating on Wellington Street Outlet (October 2019)

Sanitary lateral repaired at 270 Davy Street (October 2019)

Biofiltration facility (LID) site installed (May 2020)

Re-lining of Davy Street mainline storm sewer (December 2019)

Town in-house repair of 5 sanitary laterals on Davy Street

0 25 50 75 100 m

- QRB Outlet
- Storm Sewers
- Sanitary Sewers
- Project Area Parcels

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October 2020
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NAD83 / UTM zone 17N
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