APPENDIX C

Storm Sewer Memo

TECHNICAL MEMORANDUM

TO:	Mr. Inderjit Hans	**MTE FILE NO.:**	C-42054-100
COMPANY:	City of Bampton	**DATE:**	August 22, 2017
CC:	Mr. Dave Hallman / Mr. Vince Pugliese, MTE Consultants Inc.	**FROM:**	Jeremy MacCulloch
		PROJECT NAME:	City of Brampton Downtown Streetscaping Improvements

Re: Existing Storm Sewer Assessment

Project Description

MTE Consultants Inc. has been retained along with GSP Group by the City of Brampton to complete the Municipal Class Environmental Assessment Study for the City of Brampton Downtown Streetscaping Improvements. The limits of the study area are Main Street from Nelson Street East to Wellington Street and Queen Street from Mill Street South to Chapel Street. It should be noted that the study area falls within the floodplain of the Etobicoke Creek and as such is within the Toronto Region Conservation Authority's Regulated Area.

The proposed work for this project does not change the existing drainage area, nor does it change the coefficient of runoff, as the area of pavement and hard surfacing is not changing.

In addition to the functional design of the roadway width and alignment MTE was requested to complete an assessment of the existing storm infrastructure beneath Main Street and Queen Street. The storm sewers along Main Street drain from the north-west limits of the study area at Nelson Street East to the south-east limits of the study area at Wellington Street. Along Queen Street the storm sewers from the south-west limits of the study area at Mill Street South to Elizabeth Street North convey the storm runoff to Elizabeth Street South, where it then heads south-east down Elizabeth Street South towards Etobicoke Creek. The storm sewers from Elizabeth Street North to the north-east limits of the study area at Chapel Street convey the storm runoff to Main Street, where it then converges with the flows coming from the north-west limits of the study area and continues down Main Street to the south-east limits of the study area and ultimately to Etobicoke Creek. There is approximately 1,600m of storm sewers within the study limits. The storm sewers were assessed thru three factors; structural integrity, sewer capacity and conflicts with the new proposed curb alignments.

1- Sewer Structural Integrity

MTE was provided a CCTV Inspection Summary by the City of Brampton dated August 25, 2016 and is attached for reference. Along with this summary MTE was also provided marked up Plan and Profile Drawings denoting the locations of the various sewers with structural and/or other integrity issues. The sections of sewers that have structural and/or integrity issues amount to approximately 190 metres. Some of these sections were also identified as being surcharged and therefore should be sized appropriately when they are replaced.

2- Sewer Capacity

A PCSWMM dual-drainage Model for the 10 year design storm up to the 100 year design storm was provided to MTE by the City of Brampton along with a memo dated August 11, 2016. The Storm Sewer Model Memo has been attached for reference.

MTE reviewed the Maximum Full Flow percentage in the Link Flow Summary of the model output to assess which storm sewers were surcharging for the 10 Year 3 Hour Chicago Storm event. In addition to the sewers noted above, the model indicates that there is a small section of 250mm diameter storm sewer along Queen Street approximately 11 metres long at the intersection of Main Street that is surcharging as well as the existing 2100mm diameter storm sewer along Main Street from the intersection of Queen Street to beyond the south-east limits of the study area. The amount of 2100mm diameter storm sewer within the study limits that is surcharging is approximately 200 metres.

It should be noted that the drainage area within the model did not include the storm sewers on Queen Street West from Mill Street South to Elizabeth Street North.

MTE was also provided a Storm Sewer Capacity Analysis Memo dated August 26, 2016 from the City of Bampton of which is also attached for reference. The conclusions of this memo state that in order to eliminate the surcharging of the existing 2100mm diameter storm sewer along Main Street, during the 10 year design storm event, it would need to be upsized to a 3100mm diameter storm sewer from Queen Street to well beyond the limits of the study area to the outlet of the storm sewer at Etobicoke Creek. This would require the replacement of approximately an additional 1,000 metres of storm sewer along Main Street South beyond the study limit. However, the memo indicates that the model results show that the combined storm sewer and surface overland flow systems do function as intended and that all flows beyond the capacity of the storm sewer are conveyed on the street within the curb limits with a maximum flooding depth of 150mm.

3- Conflicts with New Curb Alignment

Based on the current proposed street cross sections and resulting curb alignments along Main Street and Queen Street, 34 of the 36 existing catchbasins along the existing gutter line within the study area will need to be relocated. The CB leads affected by the relocations of catchbasins that are not included within the structural integrity issues factor amounts to approximately an additional 150 metres of storm sewer.

Conclusions and Recommendations

Based on the information provided by the City of Brampton approximately 190 metres of storm sewer needs to be replaced due to structural and other integrity issues. There is approximately 11 metres of 250mm storm sewer that should be upsized on Queen Street to alleviate some local surcharging at the intersection of Main Street and Queen Street. Also 34 catchbasins will need to be relocated and as result there is approximately another 150 metres of storm pipe that will need to be either replaced or altered. Based on the City's Storm Sewer Capacity Analysis Memo the combined storm sewer and surface overland flow systems do function as intended and all flows are conveyed to Etobicoke Creek with a maximum flooding depth of 150mm within the curb limits. As a result, no storm sewers, other than the 11 metres of 250mm storm noted above, are proposed to be increased as part of this project.

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During detailed design the proposed new street cross section and centerline elevations should be reviewed to ensure that the overland flow for the larger storm events can be maintained within the curb limits and not negatively impact the buildings and properties along Main Street and Queen Street.

It is recommended that stormwater restrictions be implemented on new developments to help and possibly decrease the peak stormwater flows for the downtown area.

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Planning and Infrastructure Services
Engineering and Development Services

Date: 26 Aug 2016

To: Jayne Holmes, Bino Varghese, Laurian Farrell

From: Michael Heralall

Subject: Peel Phase 1 Works – Storm Sewer Capacity Analysis

File:

Analysis of the storm sewer system within the Peel Water and Sewer Works Phase 1 area has been completed, and the following is a brief summary of the findings, followed by our recommendation.

Model Results

A storm sewer model was prepared for the area shown in Figure 1. This includes the Phase 1 area, as well as the larger area that contributes flow to the Main Street trunk from areas upstream, as well as downstream of Queen Street. The behavior of the storm sewer system was investigated under a number of storm scenarios, ranging from the typical infrastructure design standard 10-year storm to the less frequent, more intense 100-year event.

For all events, the following are generally observed:

- The drainage system consisting of the street network and the underground storm sewer pipes functions as expected, with flow beyond the capacity of the storm sewer system being conveyed along the street within the curb limits. There is no excessive street flooding, with maximum flood depths of 15 cm for roadway flooding.

- The storm sewer along Queen Street West is flowing in a surcharge condition. There is flow from the storm sewer system on to street at the intersection of Queen and George Streets.

- The storm sewer along Queen Street East is mostly flowing in a surcharge condition, save for the most easterly segments. There is flow from the storm sewer system onto the street in the vicinity of Queen/Mary streets.

- North of Queen Street, there is flow from the storm sewers onto the surface of Main Street between Theatre Lane and Church Street. As storm severity increases, locations north of Alexander Street will see flow from the storm sewer system onto the surface.

Capacity Assessment

The storm sewer system along Main Street is the limiting factor in governing how quickly pipes connected to it can drain. Due to relatively shallow slopes, as well as the volume of stormwater being conveyed in the pipe south of Queen Street, the pipe is flowing in a surcharged condition from Queen Street all the way to the outlet at Etobicoke Drive. This constrains the ability of upstream connecting pipes to discharge efficiently into the Main Street trunk and as a result the water levels in connected pipes are higher than they would be under free flowing conditions.

- Pipe sizes along Queen Street were increased to investigate the benefits of pipe upgrades, and the results showed no discernible improvements in conveyance capacity, confirming the observation that downstream conditions are the controlling influence and not the capacity of the Queen Street sewers.

- As the capacity of the Main Street trunk is the limiting factor, the pipe size downstream of Queen Street was increased from the existing 2100 mm diameter pipe, in order to determine the required pipe size to improve the performance of the upstream connected sewers. The minimum pipe size to improve the upstream storm system performance is 3100 mm.

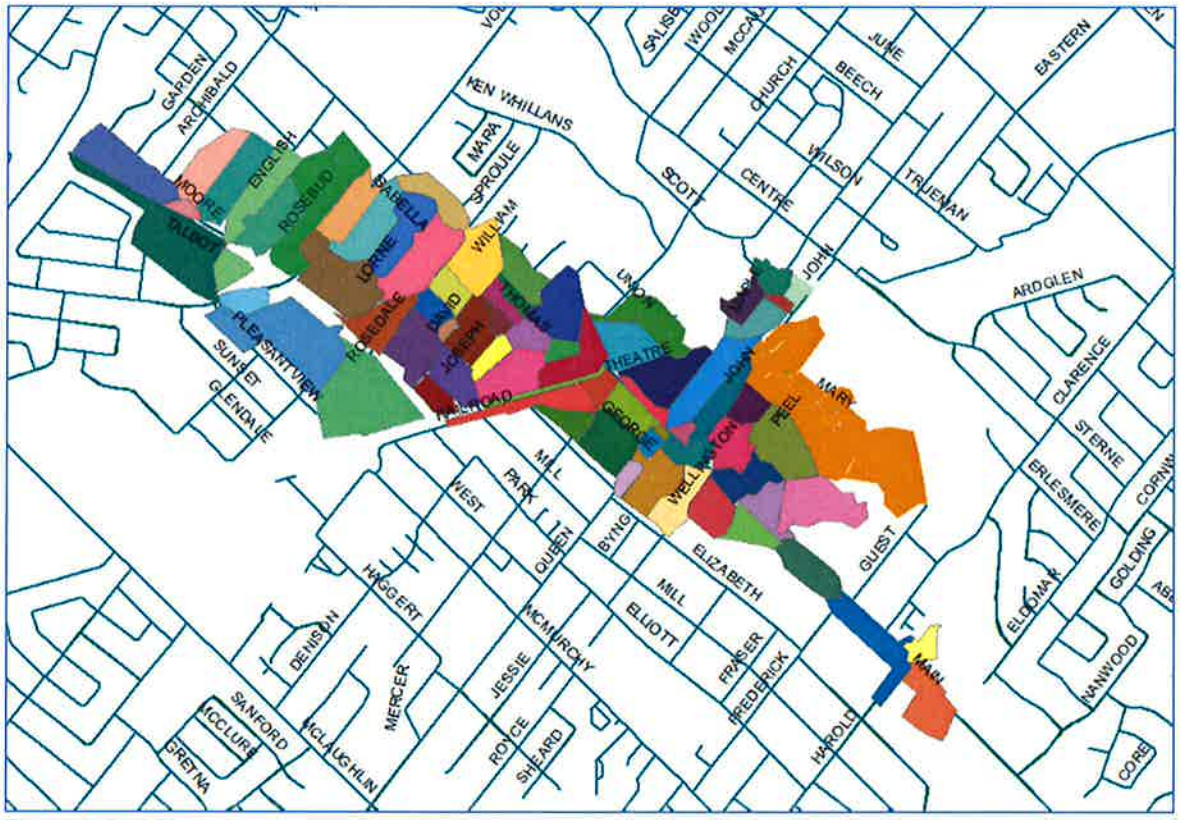

Figure 1: Peel Phase 1 Dual-Drainage Model Area

Conclusions and recommendations

- The current storm sewer system is downstream-limited by the Main Street trunk capacity, and the entire storm sewer from Queen Street to the outlet would have to be replaced with a 3.1 meter diameter pipe to improve the performance of the connected storm sewers along Queen Street.

- Model results show that the combined storm/surface system is functioning as intended, with flows beyond the capacity of the storm sewer system being conveyed on the street within curb limits, and with a maximum depth of flooding of 15 cm.

- The areas bordering the downtown corridor are characterized by high levels of impervious surfaces, future redevelopment will not affect this aspect or invalidate the model conclusions.

- Based on these observations, it is recommended that the Peel Water and Sewer Phase 1 works proceed without consideration of storm sewer capacity upgrades along Queen Street.

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Date: **25 August 2016**

To: **Bino Varghese, Laurian Farrell**

From: **Michael Heralall**
Subject: **Peel Phase 1 Water and Sewer Works: CCTV Inspection Summary**

File:

Closed-circuit video inspections were carried out from 19 May 2016 to 29 June 2016 by Dambro Environmental, for storm sewers within the area shown in Figure 1 (the study area). The purpose of the inspections was to assess the physical condition of the subsurface pipe network. This document presents a high-level summary of the observed conditions, and further details are available to inform the planning and design in specific areas as required.

Inspection Summary

A total of 5.8 kilometers of storm sewer pipes were inspected within the study area, which includes the Peel Phase 1 work area (except for Mary Street). Pipe material is predominantly reinforced concrete pipe, with 500 m of PVC, 50 m of Corrugated Metal Pipe, 42 m of Vitrified Clay Pipe, and 186 m noted as “Other”.

Areas of Concern

Within the Peel Phase 1 area, a large proportion of the storm sewer network remains in serviceable condition, and should be periodically assessed for signs of physical degradation. The following sections describe conditions present where degradation was noted, and what this means for the storm sewer network.

Collector Storm Sewers:

Cracking and Exposed Rebar:

Reinforced concrete pipe is expected to exhibit post-installation cracking, but over time cracks should stabilize and may undergo self-healing. Of particular concern however, are instances where cracking has exposed rebar, or where break-ins and taps have left rebar exposed. Over time, this will cause corrosion and weakening of the reinforcing steel, and ultimately an increase in vulnerability of the pipe to structural failure. Cracking and exposed rebar is present at multiple locations along Queen Street (East and West), Elizabeth Street, and George Street.

Root Intrusions

Root intrusions in joints will progressively increase the stress on the joint and cause a joint failure. These were noted along Queen Street West.

Separation and Misaligned Joints

Joint separations can cause water to leak into the bedding material and wash finer material away. Over time this will result in sagging pipes and a joint failure. These were noted on Queen Street West and George Street South.

Broken Pipes

Pipe breaks where soil is visible will compromise the pipe bedding as well, once flow conditions are enough to allow water to exfiltrate from the broken section. Broken pipes were encountered along Queen Street (East and West) and George Street.

Pipe Blockages

Where debris in the line has accumulated to levels that block more than 75% of the cross-sectional area of the pipe, the pipe should be considered non-functional and targeted for flushing and cleanout. Pipe blockages were encountered in some connections in the Queen/Main intersection area.

Deformed Pipes

A deformed pipe indicates a deviation in the loading conditions from those assumed during design and installation, and the pipe may continue to deform over time with eventual buckling of the pipe wall where the deforming load is present. A section of steel pipe along Queen Street West was noted as being deformed about 15% from its original shape, and should be investigated further.

Catchbasin Leads and Laterals:

A few catchbasin leads and laterals in the Peel Phase 1 project area exhibit many of the same characteristics as noted for the main sewer lines. As such, these can be rehabilitated or replaced as Peel Phase 1 work is undertaken.

Work Area	Number of CB leads/laterals for rehab/replacement
Main Street N	5
Main Street S	4
Queen Street E	13
Queen Street W	3

Conclusions

Based on the observed conditions, there are evident priority works that can be incorporated into the Peel Phase 1 works if feasible.

1. Remove twin 300 diameter pipes at Queen/George, and replace with 600 diameter single pipe.
2. Pipes that are broken with soil visible through the break should be remediated on Queen Street and George Street.
3. Compromised laterals should be replaced as identified in the inspection reports.

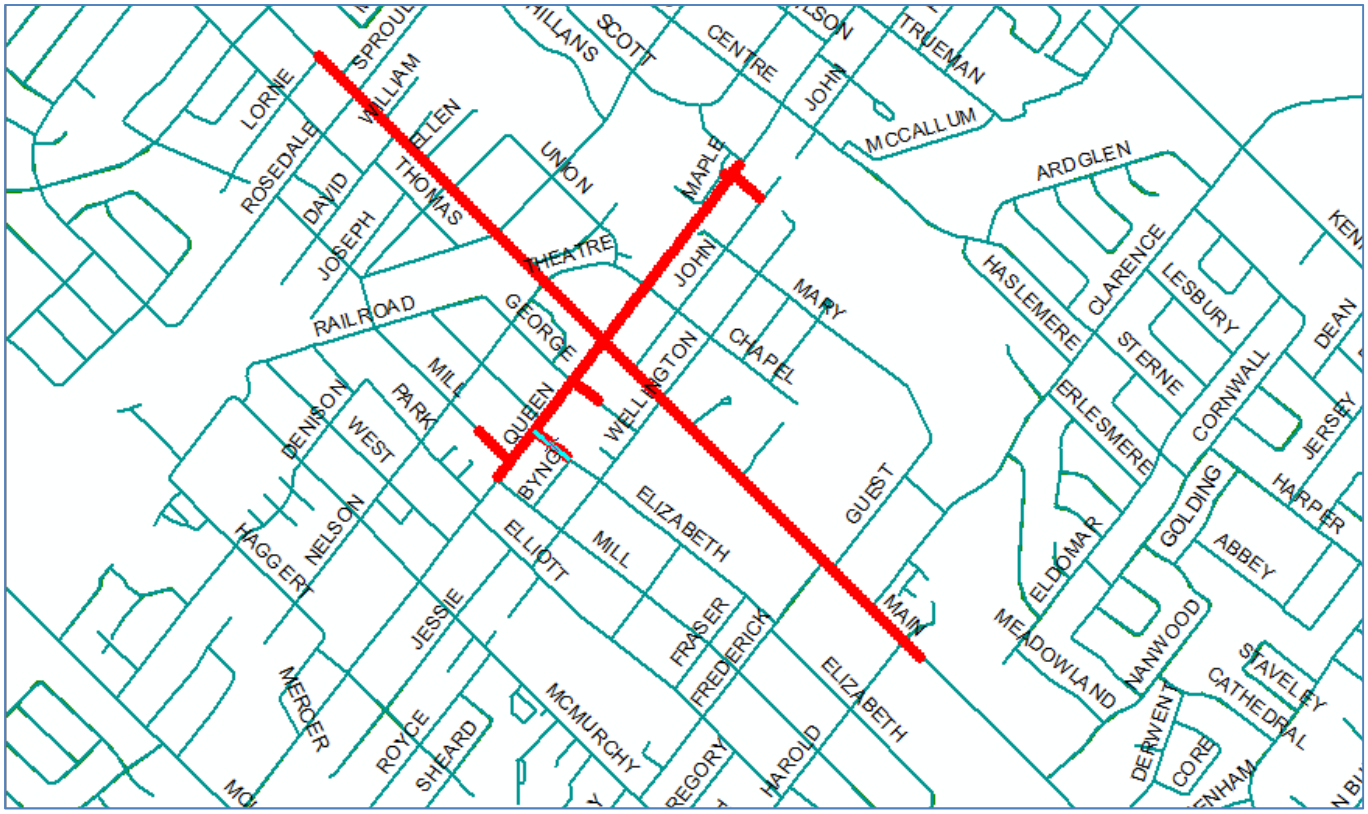

Figure 1: CCTV Inspection Limits

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Date: **11 August 2016**

To: **Compton Bobb**

From: **Michael Heralall**
Subject: **Downtown Brampton Storm Sewer Model**

File:

This memo is to provide a brief overview of storm sewer modelling efforts within the Downtown Brampton area. The intent is to inform consultant(s) who may be advancing bids to undertake the "*Environmental Assessment Study for Streetscaping Improvement for Main Street from Wellington Street to Nelson Street and Queen Street from Elizabeth Street to Chapel Street Within the City of Brampton*" (EA Study).

Model overview

The City has prepared a dual-drainage model for a portion of the Downtown Brampton area for the purposes of investigating capacity constraints and system improvement opportunities. The model has been created in PCSWMM 2016, which is based on EPA SWMM5, a well-known and accepted urban drainage model.

Study Area

The drainage area analyzed within the model is shown in Figure 1, and encompasses the project limits for the EA Study.

Model preparation

Within a densely built up area such as Downtown Brampton, the dominant processes are overland flow over impervious areas, rate-limited capture of flows by a subsurface storm-sewer system, and conveyance of remaining flows within a major system that resides on the surface (typically the street network) to a discharge location. The model has been set up to compute a fully dynamic solution, since it is expected there will be surcharging and exchange of flows in a time-varying manner between the various flow systems. Subcatchment areas were delineated utilizing ortho-imagery, topographic mapping, and references to storm sewer connectivity.

Within each subcatchment, building envelopes, parking pads, driveways, roadways, sidewalks and other impervious surfaces were digitized, and the areas of each aggregated to provide an estimate of the impervious fraction. Pervious losses were simulated using SCS Curve numbers, which is a justifiable time-saving approach given the high impervious fractions within the area. Rainfall inputs to the hydrologic engine are Chicago and AES design storms, representing typical urban design storms.

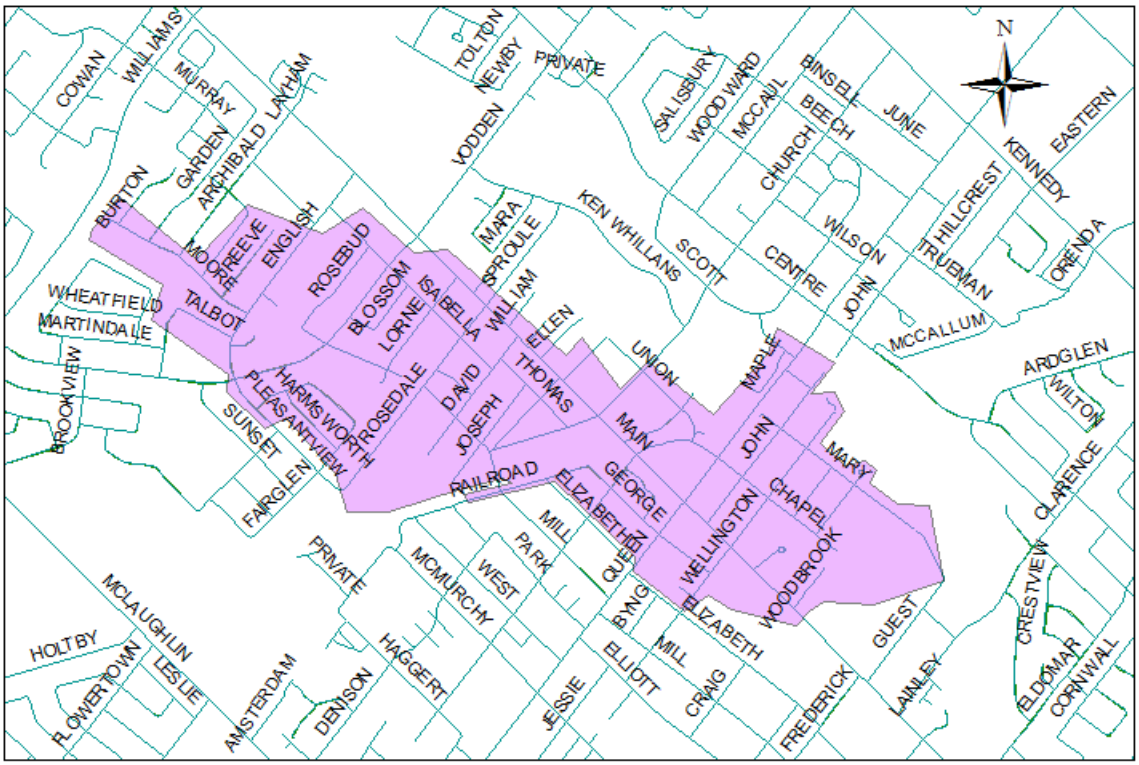

Figure 1: PCSWMM Dual-drainage model study area

Manhole and junction losses were accounted for by adjusting conduit roughness coefficients upward. Minor system inlet capacities were aggregated at the outlet of each subcatchment, and represent the sum of single catchbasins on continuous grade and double catchbasins at intersections.

Model usage

The model is uncalibrated, but has been parameterized using best practices. The consultant is expected to review the model with City of Brampton environmental engineering staff prior to further use, and subsequently may refine, enhance and extend the model to inform the objectives of the EA Study