Updated Area Servicing Plan (ASP) for Stormwater, Water & Wastewater

Downtown Burlington
Burlington, Ontario
Project # TPB198090; Client: City of Burlington

Prepared for:

City of Burlington
426 Brant Street, Burlington, ON L7R 3Z6

5/28/2020

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426 Brant Street, Burlington, ON L7R 3Z6

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1.0 Introduction

The City of Burlington (City), since 2017, has been planning for urban redevelopment (intensification) in four (4) designated locations across the City previously referred to as "Mobility Hubs", now referred to as Major Transit Station Areas (MTSA)[1], specifically: Downtown Burlington, Burlington GO, Appleby GO and Aldershot GO. Over this period of time, Wood Environment & Infrastructure Solutions (Wood) (then Amec Foster Wheeler) and Dillon Consulting (Dillon) supported the City in the evaluation of flood risk and environmental considerations [through an Environmental Impact Study (EIS)], as well as servicing needs for storm, water and wastewater (Area Servicing Plans). These assessments were conducted under the principles and assumptions associated with population projections to 2041. Since that time, through public and stakeholder consultation, concerns have been raised related to the projected densities in the various Mobility Hubs, particularly for Downtown Burlington. To this end, the City retained SGL Planning & Design Inc. (SGL) to re-examine Downtown Burlington in light of public and stakeholder feedback (ref. "Taking a Closer Look at the Downtown: Themes, Principles and Land Use Concepts, October 2019"). This process has resulted in revised precincts, as well as two (2) alternative concepts which have been taken to the Public. These land use concepts reflect population projections to 2031, with the acknowledgement of additional requirements for capacity/potential beyond the 2031 horizon.

The intent of this ASP is to document the servicing needs for storm, water and wastewater, specific to the land use and built form recommendations contained in the Taking a Closer Look at the Downtown: Final Report, and also highlight the flood risks in the updated/designated areas (per the Taking a Closer Look at the Downtown: Final Report).

Further, it should be noted that the City is conducting a separate technical assessment of the Hager-Rambo Flood Control System (ref. Hager Rambo Flood Control Facilities Study Report: Downtown and Burlington Mobility Hub, 2020) which was originally designed and constructed in the late 1980's and early 1990's through a three-way partnership with the City, MTO and Conservation Halton (CH). The intent of this separate but related investigation is to determine the structural and physical adequacy of the flood control system with respect to its ability to attenuate (manage) flood flows long-term, and protect the subject study area from flood risks.

As noted above, the City has conducted a separate Flood Risk assessment for the Burlington Mobility Hub and Downtown areas (ref. EIS – Phase 1), which has provided details on flood risks based on current and best available information. That study also acknowledges the need for future updates based on contemporary topographic mapping (LiDAR), as well as locally specific information related to re-development applications in the respective areas cited for re-development. The follow-on study (termed Phase 2) has had Terms of Reference developed by the City and CH to provide guidance accordingly

[1] The terms Mobility Hubs and Major Transit Station Areas (MTSA) are used in this report but refer to the same area.

2.0 Scope

The scope associated with this current update is outlined as follows:

Water/Wastewater

The current Water/Wastewater (W/WW) models, used by Wood to assess infrastructure requirements based on full build out of the Downtown Mobility Hub, have been updated by down scaling the population projections to the 2031 population estimate. The approximate distribution of this population within the Downtown Mobility Hub area has been per guidance from SGL and the City, based on sub-neighbourhood blocks (updated precincts). Based on the foregoing, Wood has updated the W/WW models and assessed capacity issues based on required Level-of-service (LOS) and where deficiencies exist, specific infrastructure requirements have been defined. These water / wastewater needs (for 2031) have been checked against the recommendations outlined in the Region's Water and Wastewater Master Plan (2011).

Wastewater infrastructure which services multiple Mobility Hubs (e.g., wastewater treatment plants, wastewater pump stations, etc.) has not been evaluated as part of this study and would be required in the future as part of broader scale studies.

Water infrastructure which services multiple Mobility Hubs (e.g., water purification plants, booster pump stations, etc.) has similarly not been evaluated as part of this study and would be required in the future as part of broader scale studies.

Stormwater Management (SWM)

The current draft SWM and EIS (flood hazard mapping) prepared for the Downtown Hub has been reviewed as part of this scope based upon the plan(s) provided by SGL for the 2031 land use (Concepts 1 and 2). This has included the anticipated built form, in terms of land use coverage to ensure that expectations with respect to existing and future land uses, remain consistent with the vision for the Downtown Mobility Hub. While it is recognized that the requirements will be the same or reduced from the earlier SWM plan (based on 2041 population), some nuances related to the proposed location of uses in the Downtown Mobility Hub have needed to be checked for SWM opportunities, as well as flood risks, which has required input on infrastructure staging, specific to the 2031 population and high-level flood risk management.

3.0 Land Use Assumptions

As noted earlier, SGL in "Taking a Closer Look at the Downtown: Themes, Principles and Land Use Concepts", October 2019, has developed two (2) land use concepts, and as part of this, updated the limits of the precincts and associated populations. These populations are derived from key assumptions in the memo: "Urban Growth Centre (UGC) Density Analysis" dated June, 2019. The precincts within the subject study area of the Downtown Burlington Mobility Hub which are expected to see change by 2031 are:

- Lakeshore Mixed Use Precinct
- Brant Main Street Precinct
- Downtown East Mixed-Use Precinct
- Mid-Brant Mixed-Use Precinct
- Upper Brant Mixed-Use Precinct

The population forecast (jobs and residential units) for the respective overarching concepts has been reported by SGL as follows:

Table 3.1: Population Forecast for 2031 (SGL, 2019)[2]

Concept	Retail Jobs	Office/Institutional Jobs	Residential Units
Concept 1	1440	1410	5750
Concept 2	1675	1480	5855

The foregoing estimates reflect full build-out of the respective concepts. Watson Economists (a subconsultant to SGL) has forecast that by 2031 (the target year for this ASP) there would be 450 Retail Jobs, 725 Office/Institutional Jobs and 2350 Residential Units. The breakdown by precinct has been advanced by SGL and Watson as follows (ref. Table 2 – SGL Report).

In order to support subsequent water and wastewater demand calculations, the preceding information must be converted to a population base. The residential population has been calculated from the residential units using a rate of 1.7 persons per unit as per the methodology applied for the previous assessment of 2041 land use ("Downtown Burlington Technical Memo – Projected Gross Floor Area, Units, People and Jobs Capacity", Brook McIlroy, February 27, 2018).

It should be noted that typically population is estimated using the estimated number of split of unit types (i.e. 1 bedroom, 2 bedroom, 3 bedroom) with the population assumed to be 2 persons per sleeping unit (as per the Ontario Building Code)). Notwithstanding, to ensure consistency with the previous analysis, the same rate of 1.7 persons per unit has been assumed.

2 Population has been obtained from "**Table 1: Potential Jobs and Residential Units by Concept**" of "Taking a Closer Look at the Downtown: Themes, Principles and Land Use Concepts"

Table 3.2: Precinct Breakdown for 2031 (SGL, 2019)3				
Precinct	**Concept (Jobs)**		**Concept (Residential Units)**	
	1	**2**	**1**	**2**
Lakeshore	230 (53)	275 (61)	605 (139)	515 (113)
Brant Main Street	265 (61)	335 (74)	745 (171)	645 (142)
Mid-Brant	410 (94)	450 (99)	1050 (242)	1110 (244)
Downtown East	1425 (328)	1575 (347)	1230 (283)	1465 (322)
Upper Brant	520 (120)	520 (114)	2120 (488)	2120 (466)
Total	**2850 (656)**	**3155 (695)**	**5750 (1323)**	**5855 (1287)**

Note: Figures in brackets represent Watson projections based on build out of 23% of Concept 1 and 22% of Concept 2 respectively.

For the purpose of updating the Water and Wastewater (W/WW) models to reflect the reduction in population, the more conservative concept, Concept 2 was selected for analysis. This results in a residential population of 9,954 and new employment population of 3,155, and associated total population of 13,109. This represents an overall population reduction of 1,316 from the 2041 population projections (13,000 new residents and 1,425 new jobs, or 14,425 people and jobs, as was applied in "Burlington Mobility Hubs Area Specific Plans – Functional Servicing Report", Wood October 2018).

3 Population has been obtained from "**Table 2: Potential Jobs and Residential Units by Precinct and Concept as Modeled**" of "Taking a Closer Look at the Downtown: Themes, Principles and Land Use Concepts"

4.0 Flood Risk Assessment

4.1 Potential Flood Impacts

4.1.1 Overview

For the updated flood risk assessment, the identified property locations for the two (2) concepts (as provided by SGL, November 15, 2019) has been used as a basis to identify those locations deemed at risk, due to the combination of pluvial (urban) and fluvial (riverine spill) flooding. As the City is aware, Wood has worked with City and Conservation Halton staff in developing updated analytical tools (PCSWMM & HEC-RAS) to establish those areas at greatest risk due to the combination of overland flooding (major system along roadways) and spill from riverine systems, including updated flood plains for open watercourses in the study area. This work, while not formally documented in final approved reports, has approached a final draft stage and has been used in this updated assessment. Graphics and analysis from this earlier reporting has been considered and referenced as part of this assessment accordingly.

4.1.2 Urban Flood Risk

As part of the previously noted modelling effort, Wood has developed a dual drainage (storm sewer and roadway) hydrologic/hydraulic model for the downtown area. This modelling has been applied to assess the urban (pluvial – rainfall based) flooding hazard for the Downtown area. For this type of flooding hazard, the 100-year Storm Event is the governing (highest) flood risk, due to the more intense rainfall associated with this event, as compared to the Regional Storm Event (i.e. Hurricane Hazel). Drawing 1 (attached) presents the associated 100-year urban flooding hazard for the Downtown area, including the limits of the Mobility Hub as well as the 2031 building options (as per SGL, November 15, 2019). Urban flood hazards have been presented based on simulated maximum roadway depths. A depth in the range of 0.15 m to 0.30 m would generally be above the roadway curb, but within the limits of the roadway right-of-way; a depth greater than 0.30 m would generally be expected to be outside of the right-of-way and impact adjacent private properties. A distinction is also made for roadway sag points (i.e. low points), as higher depths would typically be expected in these locations.

As evident from Drawing 1, the majority of the proposed development area includes areas that are either less than 0.15 m (i.e. not shown). Some depths between 0.15 m and 0.30 m are indicated along Brant Street in the vicinity of Ontario Street. The majority of the locations where more notable urban flooding depths are indicated (i.e. > 0.30 m) are at sag points along Lower Rambo Creek, as would logically be expected. The higher depths in these locations are likely attributable to the locations being natural low points, and also tailwater/backwater conditions from the watercourse.

4.1.3 Riverine Flood Risk

Riverine flood risks are presented in Drawings 2 and 3, along with the updated 2031 development option limits. Drawing 2 presents both the 100-year and Regional Storm Event (Hurricane Hazel) floodplain extents, as well as the resulting Regulatory limit (i.e. the greater of the 100-year or Regional Storm). Drawing 3 presents the Regional Storm Floodplain extents for the "with spills" scenario. This scenario includes additional spill flows estimated to occur from the Hager-Rambo Diversion channel further upstream along Fairview Street and Brant Street. Based on previous modelling analyses, this spill flow would drain southerly along Brant Street, ultimately draining to the Lower Rambo Creek between Ghent Avenue and Rambo Crescent. In addition, for this scenario the simulated floodplain extents have been developed differently upstream and downstream of Blairholm Avenue, in order to reflect the impacts of the Blairholm Avenue enclosure, which conveys flows across the St John's Catholic Church and Elementary School property. For areas downstream of Blairholm Avenue, the flows do not account for any flow attenuation or restriction

associated with the enclosure, consistent with Provincial Policy (MNRF, 2002). Floodplain extents upstream assume the enclosure is in place, as per existing conditions.

It should be noted that the analyses reported herein have assumed the hydrologic influence of the Hager-Rambo Flood control system to be as per design. The City is currently undertaking an assessment of the stability and robustness of the subject system (physical and technical analyses) to confirm the system's ability to attenuate flood flows long term. Depending on the results of this assessment the limits of the riverine flood risks may be subject to change.

Drawings 2 and 3 have included the preliminary development footprint as per SGL; properties expected to be potentially impacted by floodplain extents to some degree have been highlighted accordingly. In general the rear areas of properties backing on to Lower Rambo Creek between Blairholm Avenue and Caroline Street would be expected to have some flood susceptibility, to various degrees. A spill is also indicated at the upstream limits of the Caroline Street enclosure; the magnitude of this spill has not yet been definitively quantified but is generally expected to be minor. More detailed topographic survey of the site would be necessary to definitively confirm the spill risk in this area.

Proposed development properties downstream of the Caroline Street enclosure indicate various degrees of flood susceptibility, particularly in the vicinity of James and Martha Streets, where numerous future developments are anticipated. Properties downstream of the Waterfront Trail also indicate some flood susceptibility, albeit less so than the upstream area.

A distinction must be made between flood risk due to a riverine floodplain (i.e. floodplain directly along/adjacent to the watercourse) and due to spills (i.e. excess flow draining in an uncontrolled manner, potentially no longer following the path of the watercourse). Typically, the former (riverine floodplains) are regulated by Conservation Authorities, and prevent any development within the floodplain limits (plus a suitable buffer), unless a Special Policy Area or other exception applies. The Lower Hager and Lower Rambo Creeks are in a unique situation, as they were not historically formally regulated features by Conservation Halton, however, Conservation Halton may be anticipated to regulate applications in these locations going forward. The earlier exemption from formal regulation was due to the historical implementation of the Hager-Rambo Diversion Channel, which diverted upstream flows away from these receivers, leaving only local flows. In terms of management, the City of Burlington has historically applied a 6 m buffer from Lower Hager and Lower Rambo Creeks; it is recommended that this process be maintained in the future. As such, re-development of properties which contain identified floodplains could still proceed, subject to the previously noted 6 m buffer.

Furthermore, spills are not considered to be formally regulated (refer to Section 4.2.5 of Policies and Guidelines for the Administration of Ontario Regulation 162/06, Conservation Halton, Amended November 26, 2015), however, as agreed with City and Conservation Halton staff over the course of this project, the influence of spills will need to be considered as part of flood management for the subject re-development areas including flood proofing works, ingress/egress along public roadways, and the influence on flood conveyance for any re-developed properties. Any potentially affected buildings should be assessed further as part of Phase 2 undertakings.

It is understood that policies for flood hazard/risk areas will be developed through an Official Plan Amendment for this area.

It should again be noted that the hydrologic modelling applied for the current study, while technically sound and appropriate, has not been calibrated (i.e. adjusted to reflect actual observed responses to storm events). Typically, uncalibrated hydrologic models are conservative (i.e. over-predict flows and volumes as compared to existing conditions). Thus, further study could potentially result in a reduction in flood risk. In the absence of such information, the results generated by the current study are considered the best available data.

In addition to the preceding, it should be noted that the riverine hydraulic modelling (open channel – HEC-GeoRAS) has been developed using a digital elevation model (DEM) from the Region of Halton (2015). Hydraulic structures have been included based on elevations from this source, along with corrections from record drawings, and data from field observations/measurements. Recent (new) LiDAR data have been acquired by Conservation Halton, and the City of Burlington has entered into an agreement to use this mapping in an updated flood risk assessment for the Downtown Mobility Hub, to better confirm precise floodplain limits. This work (Phase 2) is out of scope to the current undertaking but will be required as part of, and prior to, future applications in the subject study area.

4.1.4 Mitigation and Flood proofing

In all identified flood risk locations (urban flood risk and riverine, including spills), it is recommended that appropriate flood mitigation and management strategies be employed. This would primarily include floodproofing of buildings. Passive floodproofing (i.e. floodproofing that does not require human intervention) is preferred, which would be expected to focus on grading of both the site and building, to ensure that openings are greater than spill elevations (plus a typical 0.30 m (+/-) freeboard). Active floodproofing (measures that require human intervention) may be warranted in some locations, where passive floodproofing cannot reasonably be achieved or impacts of grading are not considered supportable. It should be noted that CH generally does not support active flood proofing, however the subject reaches are not currently regulated by CH. In conjunction with the preceding, site grading should allow for the safe conveyance and routing of flood spill flows, and consider the safe ingress and egress of vehicles from the site and the local roadways servicing the lands. Safe ingress/egress should also be considered for pedestrians in these areas. Site grading in these locations should also work towards achieving a cut/fill balance below active water levels, in order to avoid the transference of potential off-site impacts. This should be more strongly enforced for riverine floodplain areas, where a cut/fill can more easily be achieved. For re-developments in spill areas, where filling is unavoidable, other compensatory measures may be warranted. The integrated hydrologic and hydraulic modelling tools developed as part of this study (and preceding assessments) should be considered for application to assess re-developments as they occur, to confirm potential impacts and the effectiveness of mitigation measures.

In some cases, riverine floodplain reduction can potentially be achieved through hydraulic structure upgrades; this would require review on a case by case basis to determine the overall cost-benefit to the city and area development. Potential improvements are discussed further in Section 4.2. Similarly, spill flows can potentially be better managed through purposeful grading of overland flow routes (including roadways), and where feasible, storage systems (likely sub-surface).

4.2 Potential Riverine (Creek) Infrastructure Improvements

A primary potential mitigation strategy for areas with riverine floodplain impacts involves infrastructure improvements, specifically hydraulic structures (culverts). Based on a review of the hydraulic modelling results, and the limits of the expected re-development (i.e. Lower Rambo Creek – no re-development along Lower Hager Creek), the following locations have been advanced for potential hydraulic structure upgrades:

a. Enclosure downstream of Blairholm Avenue (existing 1.73 x 2.69 m vertical elliptical – 2.1 m circular equivalent)
b. Victoria Avenue (existing 3.0 x 1.5 m box)
c. Martha Street (existing 2.95 x 2.35 m concrete arch)
d. Waterfront Trail (existing 6.4 x 0.9 m open bottom concrete)
e. Lakeshore Road (existing 3.0 x 2.1 m concrete box)

Culverts a) and b) are in close proximity to one another and the upgrades would likely be completed together (upstream portion of Lower Rambo Creek); similarly culverts c), d) and e) would all likely be considered together (most downstream portion of Lower Rambo Creek).

With respect to culverts a) and b), the Blairholm Avenue enclosure is notably undersized, given upstream floodplain extents and the evident overtopping. The Blairholm Avenue enclosure also has a smaller conveyance area than the downstream box culvert at Victoria Avenue. The enclosure passes through private property, but the City does hold an easement over this feature to permit upgrading if required. The Victoria Avenue structure, while larger, has a more notable impact to expected re-development lands, and thus may be a higher priority for upgrade/replacement. Further, at the time of assessment for these culverts, an accompanying culvert upgrade at Caroline St. should also be investigated to prevent spill in this location, premised on the updated mapping from the Phase 2 study cited earlier.

With respect to culverts c), d), and e), the hydraulic modelling results indicate that floodplain levels are most sensitive to hydraulic structure d) – the Waterfront Trail (existing 6.4 m x 0.9 m open bottom concrete), based on the extensive simulated backwater upstream of the structure. Although wide, this structure is fairly low, and thus results in a larger backwater impact. Notwithstanding, expected re-development areas would also benefit from a replacement of the Martha Street crossing (structure c) in conjunction with the upgrade to the Waterfront Trail structure, although the latter would have a greater overall impact, and a replacement of c) alone would have minimal benefit (as it would not address the tailwater constraint). The Lakeshore Road culvert crossing is indicated as being overtopped for both the 100-year and Regional Storm events. An upgrade in this location could eliminate the overtopping, which would benefit adjacent potential re-development lands.

5.0 Storm System

Based on dialogue with SGL and City staff, the anticipated hard surface coverage associated with either Concept 1 or Concept 2 is difficult to predict. Notably, identifying the specific location of land use change to 2031 (at the uptake rates of 23 and 22% respectively for Concepts 1 and 2) is considered even more uncertain by SGL and City staff. Regardless, current land surface coverage is generally high with most areas reflecting coverage in 90%+ range (Note: it is worthwhile to acknowledge that a paved parking lot would generally have the same runoff potential as a high-rise building, albeit the runoff from the parking lot would be more prone to contamination than the high-rise building, hence would need stormwater quality treatment).

Based on the preceding, the City of Burlington's typical quantity controls (post-development to pre-development peak flow controls for the 2 through 100 year storm events) are generally considered sufficient for re-development sites within the study area. Notwithstanding, a number of areas have been identified with sub-standard storm sewer capacity (i.e. surcharging or flooding for the 5-year event – refer to Appendix A – Drawing 13). Identified deficiencies with respect to the currently anticipated re-development areas include:

- Brant Street (Blairholm Avenue to Caroline Street)
- Caroline Street (Locust Street to Lower Rambo Creek)
- Martha Street (Near James Street)
- Lakeshore Road (Burlington Avenue to Locust Street)

In these locations in particular, it is recommended that the City of Burlington's current informal policy of over-control (100-year post-development peak flow controlled to the 5-year pre-development peak flow) be applied. Further, those areas outletting to trunk storm sewers with identified capacity constraints (refer to Appendix A, Drawing 13) should potentially require further over-control to the simulated capacity of the storm sewer receiver. The modelling tools developed as part of the current study, as updated through the Phase 2 scope, should be applied to further assess and validate quantity control measures and storm sewer capacity in these areas. This will ensure that the proposed strategy functions as intended, particularly in areas with identified conveyance capacity restrictions.

Given the highly urbanized nature of the downtown area, erosion control requirements are not considered as critical as in more undeveloped, greenfield areas. Notwithstanding, consistent with the City's current approach to site developments, erosion control should be implemented by adopting the 24-hour extended detention of the 4-hour 25 mm storm event. This could potentially also be achieved through the provision of Low Impact Development Best Management Practices (LID BMPs), as part of the overall site SWM strategy (including quality control). In cases where the proponent can demonstrate that the preceding requirement cannot be reasonably achieved for the site, best efforts should be implemented.

As re-developments proceed within the study, area there is also an opportunity to improve stormwater quality of discharges to the receiving system. The City of Burlington's current informal policy is to require "Enhanced" Water Quality treatment (80% average annual removal of Total Suspended Solids). This requirement accounts for treatment of the entire proposed impervious coverage, not only the "new" impervious coverage. It is recommended that this policy continue to be applied for re-developments within the study area, given the retroactive stormwater quality improvement to receivers.

The City of Burlington's Downtown Stormwater Quality Control Plan (Wood, November 2019) overlaps with a significant portion of the Downtown Mobility Hub study area. The recommendations and proposed measures from that study should be considered as part of the overall quality control strategy for new developments in the Downtown Mobility Hub (refer to Appendix A, and Drawings 4 and 5 from that study). Areas of overlap include

- Proposed Oil/Grit Separator (OGS) at Site 2 (Victoria Avenue at Lower Rambo Creek)
- Proposed Oil/Grit Separator (OGS) at Site 3 (Caroline Street at Elizabeth Street)
- Conveyance Control (LID BMP) at Site 1 (John Street from Caroline Street to Maria Street)
- Conveyance Control (LID BMP) at Site 5 (Lakeshore Road)
- Conveyance Control (LID BMP) at Site 6 (Locus Street from Caroline Street to Lakeshore Road)

In some cases, a cash-in-lieu approach for developments may be warranted, to support the implementation of larger off-site measures as noted above, or in the case where the site may not be able to fully provide the required degree of quality control with on-site measures alone.

Low Impact Development Best Management Practices (LID BMPs) can be implemented as part of the overall streetscaping design, including surface features (bioswales and bioretention areas, soil retention cells/tree planters) and sub-surface features (exfiltration pipes and storage chambers). These measures would benefit both water quantity, quality and water budget/infiltration/ erosion.

In addition, the City of Burlington is currently in the final process of updating its Stormwater Management Design Policies and Guidelines, thus additional stormwater management requirements, particularly with respect to climate change, erosion control, and water balance/infiltration may also result for future developments, beyond the basic quantity and quality requirements noted previously

6.0 Wastewater System

Existing wastewater services for the Burlington Downtown Mobility Hub is outlined in the "Burlington Mobility Hubs Area Specific Plans – Functional Servicing Report" (Wood, October 2018). The existing local sanitary sewer system is shown in **Figure 6.1 Existing Wastewater Servicing for Downtown Mobility Hub**.

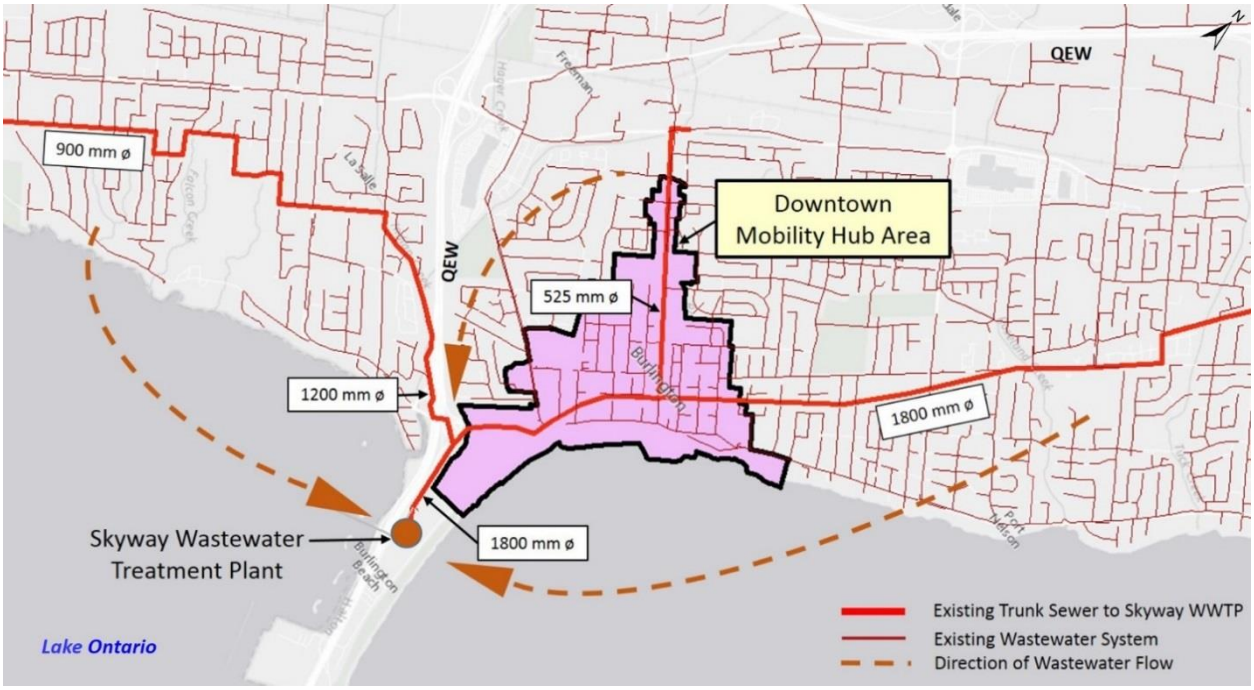


Figure 6.1: Existing Wastewater Servicing for Downtown Mobility Hub

The wastewater model (InfoSewer) has been updated to reflect the 2031 projected population as per the revised population forecast discussed previously in Section 3. The node loadings in the previous model have been pro-rated by the difference in population; i.e. 13,109/14,425, or 90.9% of the previous loadings. The model has been re-executed accordingly.

In general, given the relatively nominal difference in population and associated flow rates, the previously prepared sanitary sewer servicing upgrade recommendations made in the previous reporting (Wood, October 2018) based on a 2041 population forecast remain unchanged for the current 2031 forecast.

A summary of the proposed wastewater system upgrades is presented in **Figure 6.2 Recommended Wastewater System Upgrades**.

To summarize the proposed wastewater system upgrades:

- Hager Avenue
    - A 564 metre length sewer along Hager Avenue from Clark Avenue to Ontario Street should be upgraded from 200 mm / 250 mm diameter to 300 mm diameter to meet future demands

- Elizabeth Street
    - An 84 metre length of sewer along Elizabeth Street south of James Street should be upgraded from 200 mm diameter to 300 mm diameter to meet future demands.
    - The length of sewer along Elizabeth Street is the only wastewater main that shows significant q/Qf increase over 0.8.
    - This recommendation aligns with the upgrades to Elizabeth Street from James Street to approximately 15 meters north mentioned in the "Volume I Summary of Water and Wastewater Projects – Sustainable Halton Water and Wastewater Master Plan" document by the Region; refer to Region IPFS ID: 6708 for more information.
- New Street / Martha Street
    - It is recommended that a 250 metre length of sewer along New Street and Martha Street be upgraded from 250-mm / 300-mm diameter to 375-mm and 450-mm diameter respectively. This segment is under capacity and is not constructed to current design standards.
- Emerald Street / Caroline Street
    - It is recommended that a 265 metre length of sewer along Emerald Street and Caroline Street, which connects to a sewer at the Martha Street and Caroline Street intersection be upgraded from 200 mm / 250 mm diameter to 300 mm diameter to meet future demands.

According to Halton Region, the Maple Ave Wastewater main upgrade (ID 6492) has been removed from Halton Region's Development Capital Program. Therefore, individual development applications proposing intensification draining to the Maple Ave Trunk Sewer will need to be reviewed by the Region to ensure adequate capacity is available.

The internal servicing upgrade recommendations are not affected by the reduction of population from the 2041 to 2031 projected populations. The results are similar between the two scenarios and the recommendations remain unchanged.

As previously mentioned in the "Burlington Mobility Hubs Area Specific Plans – Functional Servicing Report", a segment of Brant Street on the North side of the lands has a local sewer and trunk sewer with a pipe size of 250-mm and 450-mm respectively. It is our recommendation that flows from future developments and connections be directed to this trunk sewer.

During the next stages of planning and design, upgrade requirements should be re-considered as long-term requirements may potentially change, rather than strictly the current 2031 recommendations.

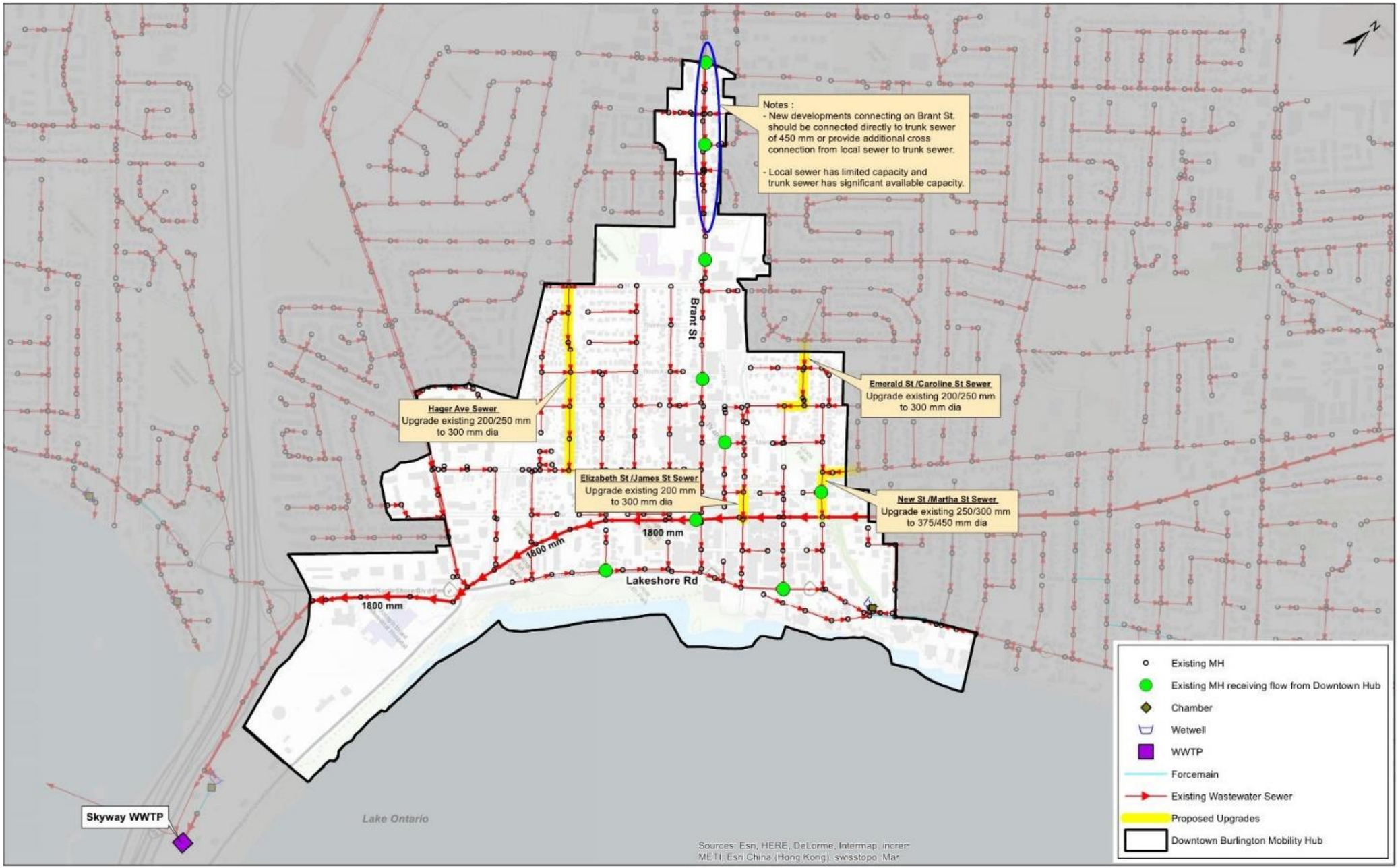


Figure 6.2: Recommended Wastewater System Upgrades

The internal servicing recommendations outlined in this report have been compared to the Water and Wastewater Master Plan by the Region of Halton and comments have been incorporated accordingly.

External capacity is evaluated by Halton Region as part of the Master Planning process; this includes the overall effect on major trunk systems like Skyway wastewater treatment plant and trunk collection systems. The following key external projects are planned for the Burlington WWTP catchment area:

Key External Planned Infrastructure Projects:

1. ***New 2400 mm Sewer Inlet at Skyway WWTP***
2. ***Junction St WWPS Capacity Upgrade to 150 L/s WWPS - Design and Construction (BUR)***
3. ***825-900 mm WWM on Maple Avenue East Between Lakeshore Rd and Plains Rd East***

7.0 Water System

Existing water services for the Burlington Downtown Mobility Hub are outlined in the "Burlington Mobility Hubs Area Specific Plans – Functional Servicing Report" (Wood, October 2018). The existing water services within this area are presented in **Figure 7.1 Existing Water Distribution System for Downtown Mobility Hub**.

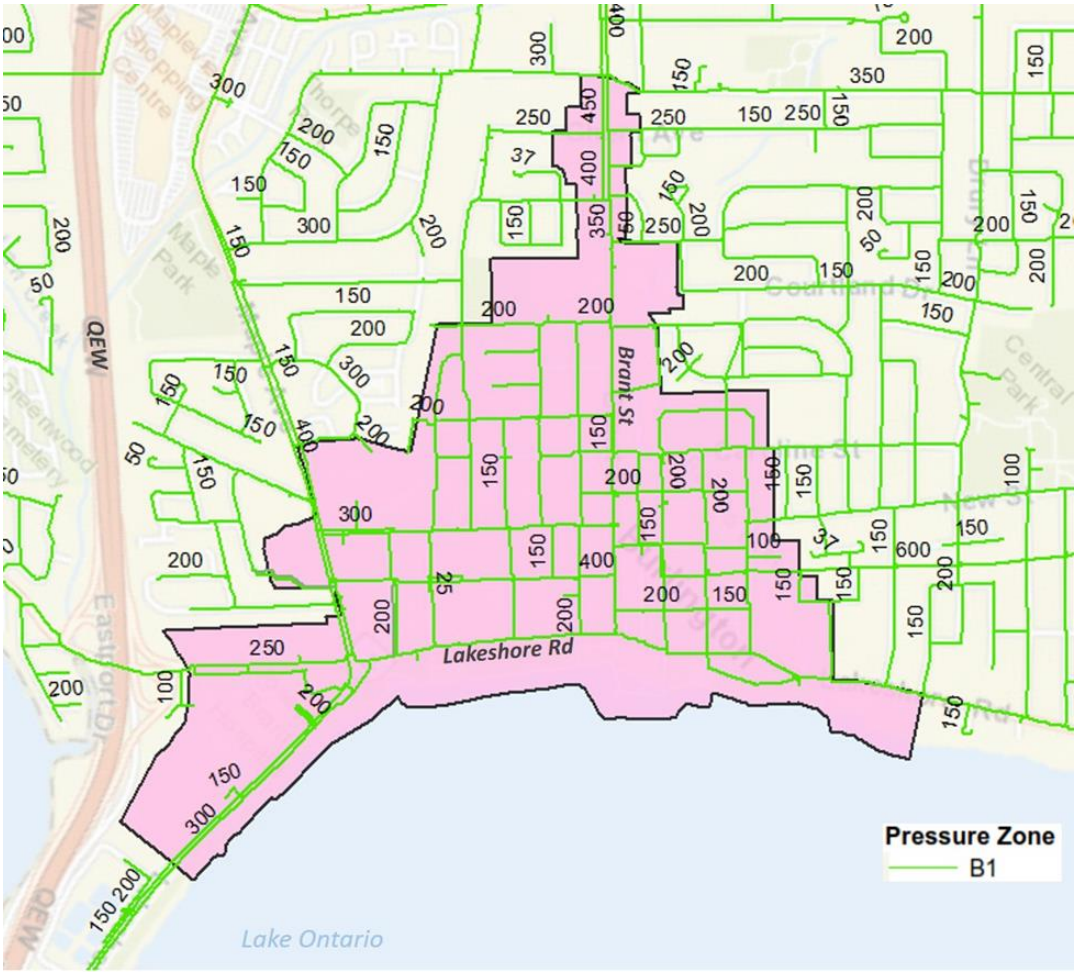


Figure 7.1: Existing Water Distribution System for Downtown Mobility Hub

The water model (InfoWater) has been updated to reflect the updated 2031 projected population presented in Section 3 and re-executed. Based on Wood's analysis of the revised modelling results, it has been concluded that the existing local network has sufficient capacity to address the pressure and demand requirements of the revised population information. The reduction of population from the 2041 to 2031 projected populations reduces the overall capacity requirements on the water system.

It is therefore concluded that no specific capacity upgrades are recommended for the study area. During the next stages of planning and design, upgrades should however be revisited based on any updated planning and population information available at that time, rather than the current 2031 estimates.

It is recommended that life-cycle maintenance and state of good repair investments are conducted through the Asset Management Program provided by the Region. This is a continuous improvement program and as assets approach the end of life-cycle or upgrades are planned, the upgrades are integrated with improvements as per industry BMPs:

- Replacement of watermains consisting of 300-mm looped distribution mains
- Removal of dead ends

External capacity is evaluated by Halton Region as part of the Master Planning process – this includes the overall effect on lake-based water supply system.

Key External Planned Infrastructure Projects

Halton's Planning model indicates a number of planned infrastructure components that are to be in-service by 2031. Key Components were identified, and Halton Region confirmed the status of the components as follows:

1. ***Zone 1 900 mm Feedermain from Guelph Line/Prospect Street to Washburn Reservoir.***
2. ***Additional watermain upgrades on Elizabeth Street, Brock Avenue, and Regina Drive.***

8.0 Summary and Conclusions

The updated Area Servicing Plan (ASP) for stormwater, water and wastewater systems for the Downtown Burlington Mobility Hub has been completed. The updated study has assessed the impacts of the revised population numbers generated through the work by SGL Planning & Design Inc. (SGL) to re-examine the Downtown Hub in light of public and stakeholder feedback (ref. "Taking a Closer Look at the Downtown: Themes, Principles and Land Use Concepts, October 2019"). Overall, the revised population forecasts and building extents are reduced from those assessed as part of the previous 2041 forecasts. As such, the overall recommendations and conclusions of the previously completed studies generally remain unchanged. To summarize:

- Flooding Hazards
    - Urban flood hazard mapping (i.e. roadway – pluvial flooding) has been presented in comparison to the proposed development areas to identify areas of potentially higher risk
    - Fluvial (riverine) flood hazard mapping has also been prepared and identified areas of potential risk, with adjacent properties highlighted
    - General recommendations for floodproofing and flood mitigation have been identified, including potential hydraulic structure upgrades
    - The foregoing is subject to refinement based on the outcomes from the City's investigations related to the Hager-Rambo Flood Control Study (on-going), as well as the future updates associated with the Phase 2 Study scope
    - Flood Mitigation strategies will need to be refined through the Official Plan update prior to re-development in the subject areas
- Other Hazards
    - While this assessment (ASP) has not considered other hazards related to erosion and shoreline impacts, these will need to be appropriately considered in future applications accordingly
- Storm Sewers
    - Areas with deficient simulated conveyance capacity have been identified; those within the expected development area have been further noted
    - Stormwater quality control measures should be integrated with the recommendations of the City of Burlington's Downtown Stormwater Quality Control Plan (Wood, November 2019)
- Wastewater
    - A series of upgrades to local sanitary sewers have been proposed (Ref **Figure 6.2 Recommended Wastewater System Upgrades**.)
- Water
    - No specific system upgrades are recommended

In addition to the above, it is understood that development and intensification within the Downtown Mobility Hubs may have a broader impact on the Regional water and wastewater system. In particular, system-wide impacts are anticipated for the water conveyance, storage, pumping and treatment, as well as wastewater trunk mains, pumping and treatment.

While It is recognized that the impact of the Downtown Mobility Hub intensification and development on a Regional scale needs to be evaluated, quantified and accounted for, it is also recognized that the trunks, pumping stations, storage reservoir and treatment plants have much broader service areas. As such, a Region-wide study at a Master Servicing Plan scale, or another study focusing on the system-wide analysis is better suited to evaluate the complete impact of overall development to the Regional infrastructure than the current study, which focuses on local infrastructure within the Downtown study area.

The information presented in the current report will be a useful resource for the completion of a subsequent study in relation to the Downtown study area.

FLOODPLAIN LIMITS TO THE NORTH OF BLAIRHOLM AVENUE ARE AS PER EXISTING CONDITIONS (BLAIRHOLM AVENUE ENCLOSURE IN PLACE). FLOODPLAIN LIMITS TO THE SOUTH OF THIS AREA ASSUME THE FUTURE REMOVAL OF THE BLAIRHOLM AVENUE ENCLOSURE AND ASSOCIATED FLOW ATTENUATION, AS PER PROVINCIAL POLICY (MNRF, 2002).

DOWNTOWN MOBILITY HUB

GHENT AVE.
BLAIRHOLM AVE.
DEYNCOURT DR.
WATERLOO ST.
BRANT ST.
COURTLAND DR.
BALDWIN ST.
LOCUST ST.
WELLINGTON AVE.
LORNE ST.
CAROLINE ST.
SPILL
ELIZABETH ST.
PEARL ST.
JAMES ST.
NEW ST.
SMITH AVE.
LAKESHORE RD.
Lake Ontario

461.05	92.10	92.14
453.63	92.11	92.16
446.21	92.11	92.16
386.21	91.80	91.84
376.21	91.84	91.92
366.21	91.83	91.89
356.21	91.46	91.74
329.13	91.06	91.18
299.13	90.95	91.07
267.85	90.80	90.86
237.85	90.70	90.65
174.80	90.93	90.20
207.85	90.63	90.45
177.85	90.60	90.32
147.85	90.59	90.18
117.85	90.59	90.19
87.67	90.59	90.18
58.72	90.59	90.16
144.80	90.68	90.16
114.80	90.66	90.15
84.80	90.58	90.15
54.93	90.59	90.15
24.60	90.58	90.15
646.55	90.58	90.13
631.28	90.58	90.12
39.17	90.59	90.13
616.02	90.58	90.12
435.25	89.75	88.69
420.46	88.71	88.45
405.68	88.61	88.38
375.25	88.56	88.33
348.25	88.53	88.30
313.30	88.34	87.98
283.30	88.29	87.95
253.30	87.72	87.59
222.95	87.74	87.43
193.30	87.67	87.37
156.07	87.15	87.01
120.52	87.18	86.99
92.93	86.96	86.76
62.93	86.80	86.33
32.93	86.33	85.72
2.93	86.33	85.47
538.23	83.12	83.07
498.35	83.05	82.99
497.73	83.05	82.99
488.54	83.03	82.98
479.34	83.03	82.98
449.51	79.84	79.77
419.51	79.86	79.87
389.51	79.81	79.84
359.23	79.73	79.78
329.23	79.67	79.74
299.23	79.69	79.75
269.23	79.68	79.75
239.23	79.65	79.73
208.97	79.69	79.75
179.23	79.69	79.75
149.15	79.69	79.75
89.23	78.29	78.34
52.40	76.89	76.91
29.23	76.40	76.42
612.08	83.12	83.08
582.08	83.14	83.09
552.08	83.12	83.07
524.37	83.11	83.06

LEGEND

- MOBILITY HUB STUDY AREA
- WATERCOURSE
- CONTOUR (1m)
- PARCEL FABRIC
- CULVERT LOCATION
- STORM SEWER SYSTEM
- CROSS SECTION NUMBER (100.25 / 101.00 / 100.00)
  - REGIONAL STORM (WITH SPILLS) FLOOD ELEVATION (m)
  - CROSS SECTION LOCATION
  - 100 YEAR STORM (WITHOUT SPILLS) FLOOD ELEVATION (m)
- REGIONAL STORM FLOODPLAIN (WITH SPILLS)
- 100 YEAR STORM FLOODPLAIN (WITHOUT SPILLS)
- 100 YEAR LAKE ONTARIO FLOOD LEVEL (EL. 76.0m)
- REGULATORY STORM FLOODPLAIN
- SPILL — SPILL LOCATION
- TRAFFIC ZONE LIMIT
- 2030 BUILDING OPTION #1
- 2030 BUILDING OPTION #2

SCALE VALID ONLY FOR 24"x36" VERSION

DOWNTOWN BURLINGTON OP RE-EXAMINATION

CITY OF BURLINGTON

REGIONAL FLOODPLAIN MAPPING WITH SPILLS (LOWER RAMBO CREEK)

wood.

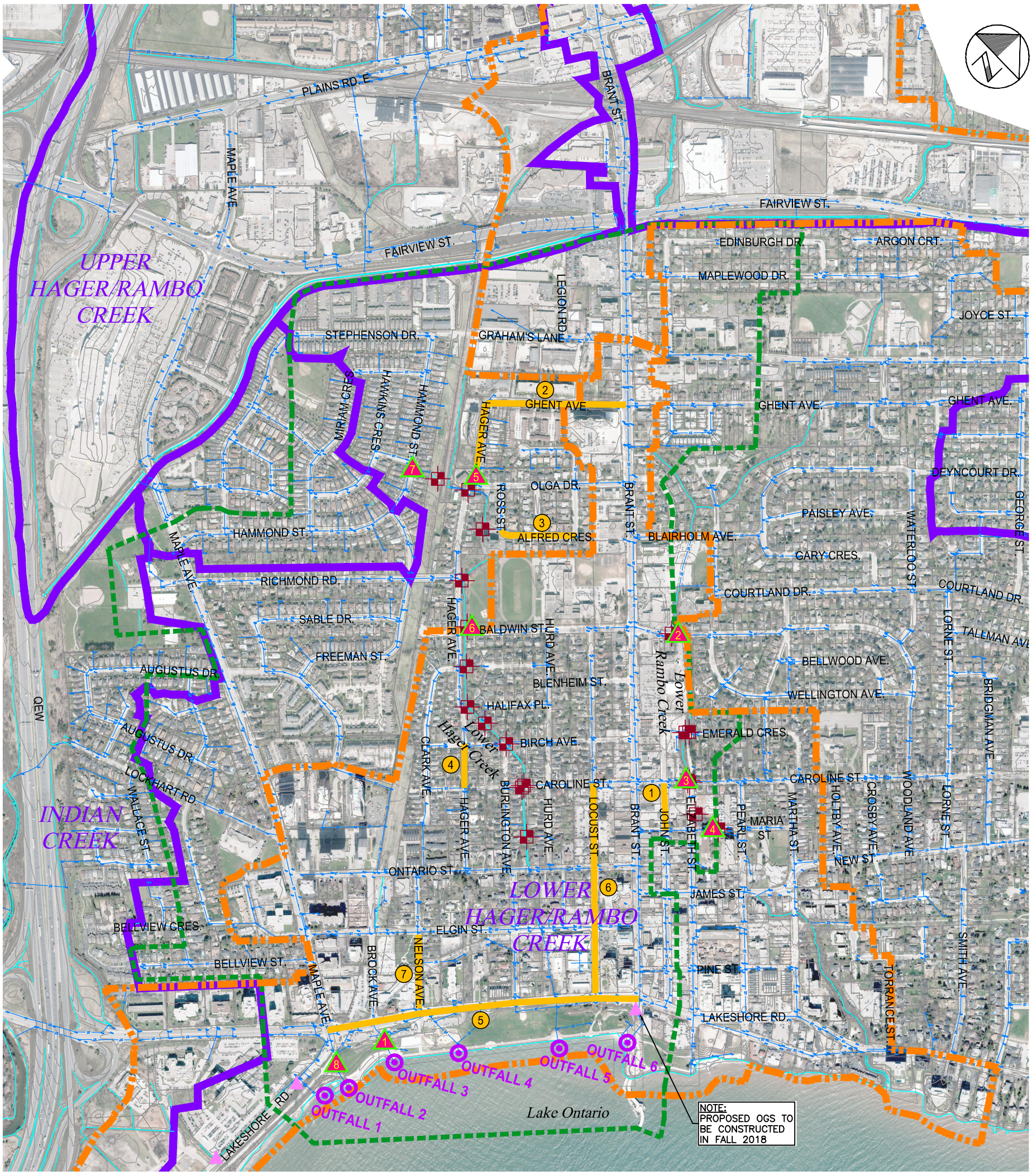
Scale 1:2500 (0, 25, 50, 100)

Consultant File No. TPB198090

Drawing No. 3

Path: P:\2019\Projects\TPB198090 - Downtown Burlington OP RE-Examination\06_DES-ENG\01_CAD\02_DWGS\2019-12\Dwg2-3 FloodPlain(Downtown).dwg
Plotted By: richard.bartolo
Plotted: 2020-01-08
Last Saved By: richard.bartolo
Last Saved: 2020-01-08

Appendix A:
Background Drawings



LEGEND

- STUDY LIMITS (STORM WATER QUALITY CONTROL PLAN)
- MOBILITY HUB PLANNING STUDY BOUNDARIES
- WATERCOURSE
- STORM SEWER SYSTEM
- PARCEL FABRIC
- CONTOUR (1m)
- WATERSHED BOUNDARY
- LAKE OUTFALLS
- WATERCOURSE OUTFALLS
- EXISTING OIL/GRIT SEPARATOR UNITS

PREFERRED ALTERNATIVES

- (1) CONVEYANCE (LID) MEASURE AND REFERENCE ID#
- (4) END OF PIPE MEASURE AND REFERENCE ID#

SCALE VALID ONLY FOR 24"x36" VERSION

STORM WATER QUALITY CONTROL PLAN

CITY OF BURLINGTON

PREFERRED ALTERNATIVES

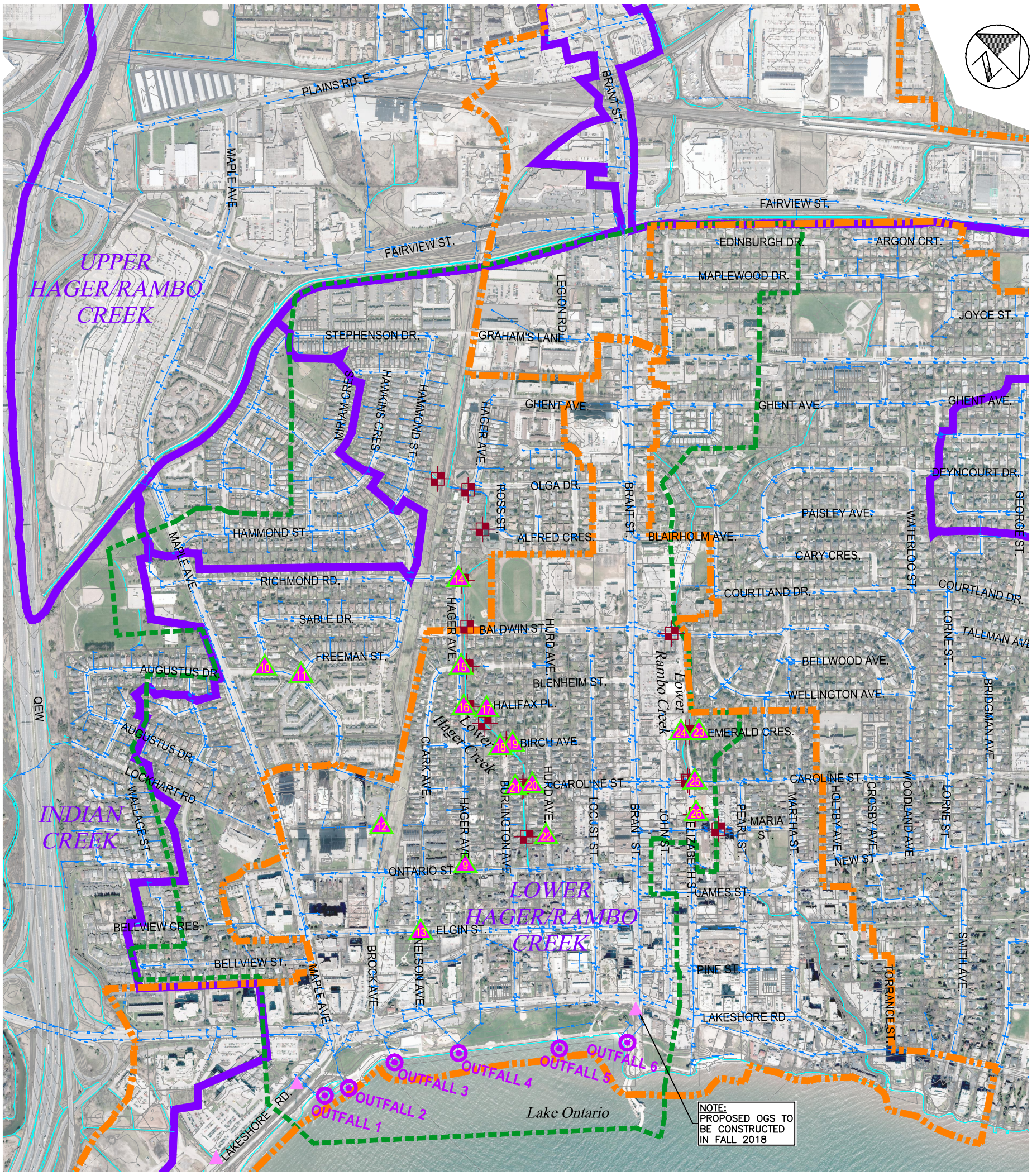
wood.

Scale 1:5000 (0 50 100 200)

Consultant File No. TPB178020S

Drawing No. 4

Last Saved: 2018-09-10 Last Saved By: richard.bartolo Plotted: 2018-09-10 Plotted By: richard.bartolo Path: P:\2017\Projects\TPB178020S - Stormwater Quality Control Plan\06_DES-ENG\01_CAD\02_DWGS\05_WR\2018-08\Dwg4 PrefAlts.dwg



LEGEND

- STUDY LIMITS (STORM WATER QUALITY CONTROL PLAN)
- MOBILITY HUB PLANNING STUDY BOUNDARIES
- WATERCOURSE
- STORM SEWER SYSTEM
- PARCEL FABRIC
- CONTOUR (1m)
- WATERSHED BOUNDARY
- LAKE OUTFALLS
- WATERCOURSE OUTFALLS
- EXISTING OIL/GRIT SEPARATOR UNITS
- POTENTIAL OIL/GRIT SEPARATOR UNIT AND REFERENCE ID#

SCALE VALID ONLY FOR 24"x36" VERSION

STORM WATER QUALITY CONTROL PLAN

CITY OF BURLINGTON

POTENTIAL ADDITIONAL OIL/GRIT SEPARATOR LOCATIONS

wood.

Scale 1:5000 (0 50 100 200)

Consultant File No. TPB178020S

Drawing No. 5

Last Saved: 2018-09-10 Last Saved By: richard.bartolo Plotted: 2019-03-26 Plotted By: richard.bartolo Path: P:\2017\Projects\TPB178020S - Stormwater Quality Control Plan\06_DES-ENG\01_CAD\02_DWGS\05_WR\2018-08\Dwg5 PotOilGritLoc.dwg

LEGEND

- MOBILITY HUB STUDY AREA
- WATERCOURSE
- CONTOUR (1m)
- PARCEL FABRIC
- CULVERT LOCATION
- STORM SEWER SYSTEM
- STORM SEWER SYSTEM NOT SURCHARGED
- STORM SEWER SYSTEM SURCHARGED
- STORM SEWER SYSTEM FLOODED

SCALE VALID ONLY FOR 24"x36" VERSION

MOBILITY HUB PLANNING STUDY

CITY OF BURLINGTON

STORM SEWER CAPACITY 5 YEAR STORM (DOWNTOWN AREA)

wood.

Scale 1:5000 (0 50 100 200)

Consultant File No. TP178008S

Drawing No. 13

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Last Saved: 2018-12-05 Last Saved By: richard.bartolo Plotted: 2018-12-06 Plotted By: richard.bartolo