Prepared By:

City of Toronto

Mount Dennis Planning Framework Study – Master Servicing Plan Report

GMBP File: 719006

December 3, 2021

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1. INTRODUCTION

The City of Toronto (City) is conducting a Framework Study on the Mount Dennis area to determine future needs within the neighbourhood. As part of this study, a Master Servicing Plan (MSP) is being conducted on the existing and future Toronto Water infrastructure which includes the water, wastewater, stormwater, and combined sewer systems. This MSP will recommend infrastructure upgrade needs within the local study area to address existing and future system needs.

This report, Master Servicing Plan, reinstates the existing condition and baseline system performance of water, wastewater, stormwater, and combined sewer systems. Further, this report details the growth projections, assumptions and criteria for future system analysis, system opportunities and constraints, servicing strategy and capital programs.

1.1 Study Area

The Mount Dennis study area, in the City of Toronto, is generally along Weston Road from Tyrone Avenue to the north and Humber Boulevard North to the south covering an area of 370 hectares and servicing approximately 2,831 properties. The Study Area is shown below in **Figure 1**.

2. RELEVANT STUDIES AND BACKGROUND INFORMATION

The following completed studies and documents have been reviewed and considered within this Master Servicing Plan:

- Toronto Region Conservation Authority. (2014). *Black Creek (Rockcliffe Area) Riverine Flood Management Class EA.*
- City of Toronto. (2020). *City of Toronto InfoWorks Basement Flooding Model Guideline.*
- City of Toronto. (2021). *Basement Flooding Remediation and Water Quality Improvements Master Plan Class EA* (Basement Flooding Study).

3. PLANNING AND GROWTH PROJECTIONS

Perkins & Will provided planning projections which contains population and employment forecasts for Mount Dennis Study Area to ultimate buildout. **Table 1** below shows the summary of existing population and employment as well as the projected growth within the Study Area.

Table 1 – Mount Dennis Study Area Growth Projection

Type	Existing	Buildout	Growth
Residential	16,404[1]	37,236	20,832
Employment	5,511[2]	6,860	1,349
Total	**21,915**	**44,096**	**22,181**

1. Existing 2016 Residential
2. Existing 2019 Employment

4. WATER SYSTEM

The Mount Dennis study area's existing water system is located within Pressure District 3 (PD3) and is primarily supplied by the 1050 mm transmission watermain that is generally parallel to Eglinton Ave and bisects the study area. The distribution watermains provide local servicing to the properties within the study area. **Figure 2** shows the existing water system within the study area.

4.1 Water Systems Criteria

The design criteria section outlines the methodology and values used to estimate growth related demands as well as the decision-making rationale related to infrastructure capacity and the trigger for upgrades as it relates to the water system.

4.1.1 Design Criteria

The Master Servicing Plan has used the following design criteria to project water demands, determine capacity requirements, and establish the infrastructure program as outlined in the *City of Toronto's Design Criteria for Sewers and Watermains*:

- Residential Growth
  - For growth areas which were designated to contain low rise or townhouse units, a per capita rate of 310 L/capita/day and maximum day demand (MDD) peaking factor of 1.5 was used.
  - For growth areas which were designated to contain mid rise or apartments, a per capita rate of 190 L/capita/day and MDD peaking factor of 1.3 was used.
- Employment Growth
  - For growth areas which were designated as employment or mixed use, a demand allowance of 28 m^3/ha/day and MDD peaking factor of 1.1 was used.

4.1.2 Level of Service (LOS)

The water system performance was evaluated using criteria as provided in the *City of Toronto's Design Criteria for Sewers and Watermains* outlined below:

- All water system pressures, under typical operations, will be maintained between 40-100 psi.
- Through discussion with City staff, fire flows will be evaluated using a representative fire underwriter's survey (FUS) approach based on land use. This approach considered 9 properties within Mount Dennis study area which reflected a "typical" building for each land use type. The average of this sample was used in the fire flow evaluation as it presented more conservative targets rather than the insurance services office (ISO) approach both outlined in the City's Design Guidelines. The detailed FUS calculations are provided in **Appendix A** noting that building footprint, construction material, occupancy type, and sprinkler system type are unknown and were reasoned based on previous typical building type. Further, future building location, type, and construction practises are unknown at this time; as such, the fire flow targets were generally applied throughout dissemination areas based on planned land use. Additionally, a detailed evaluation of each new development's fire flow targets should be completed as they are further in the planning/design phase. The landuse fire flow targets to be achieved while maintaining 20 psi throughout the local system are as follows:
    - Low rise (single family) residential – 117 L/s
    - Medium rise residential, townhouse residential, and commercial – 183 L/s
    - High rise residential, apartment residential, and industrial – 356 L/s
- Watermain velocities will be maintained under 2 m/s under typical operating conditions.
- Watermain headlosses will be maintained under 5 m/1000 m under peak hour conditions.

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Mount Dennis Planning Framework

- Distribution Watermain
- Transmission Watermain

General Features

- Property Parcels
- Mount Dennis Study Area

Environmental Features

- Watercourses
- Waterbodies
- Green Space

0 250 500 m

Figure 2

Existing Water System

Existing Water System

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November, 2021
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Projection EPSG:26917

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4.1.3 Demand Projections

The population and employment projections outlined in **Section 3** and the design criteria within **Section 4.1.1** were utilized to calculate the average day demand (ADD) and maximum day demand (MDD) projections. The additional growth flows to the local Mount Dennis study area are shown in **Table 2** and **Table 3**. These demands were allocated to the City's water model based on Dissemination Area population and employment distribution developed by Perkins and Will, shown in **Figure 3**, and proposed land use designation within each Dissemination Area. Strategic allocation was placed primarily along corridors identified for intensification or where intensification was not identified within a Dissemination Area, spread evenly throughout the area.

Table 2 – Water Demand Projections: Projected Growth Population

Residential Population	Employment Area (ha)
20,832	73.1 ha

Table 3 – Water Demand Projections: Projected Growth Demand

Average Day Demand (L/s)	Maximum Day Demand (L/s)
72.7 L/s	91.0 L/s

4.1.4 Costing Methodology

Development and costing of the capital program considered a unit rate-based approach to generate base construction costs plus an additional 40% for engineering and contingency due to projects being proposed at conceptual level. All projects are currently costed to be constructed by open cut construction methodology; the need for trenchless technology (tunnelling) to avoid various constraints and mitigate impacts/disruption would be further reviewed during subsequent infrastructure upgrade implementation stages.

4.2 Water Model Update

The City of Toronto provided GM BluePlan with the latest InfoWater model for PD3 (received April 2021) and was subsequently updated to further reflect the response of the Mount Dennis study area. Further, the scope of the water model update and review was limited to the study area to evaluate any direct impacts from the immediate surrounding area.

Mount Dennis Planning Framework

- Distribution Watermain
- Transmission Watermain

General Features

- Property Parcels
- Mount Dennis Study Area
- Dissemination Area

Environmental Features

- Watercourses
- Waterbodies
- Green Space

Figure 3

Existing Water System

Disseminations Areas

0 250 500 m

BluePlan ENGINEERING

November, 2021
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Projection EPSG:26917

4.3 Existing Water System Conditions

The baseline system performance, under existing infrastructure conditions, was evaluated using the updated PD3 water model. The system performance was assessed under an ADD, MDD (at peak hour conditions), and MDD plus fire flow (MDD+FF) scenarios to determine the study area pressure range, available fire flows, velocities, and headlosses and outlined as follows:

- ADD Maximum Pressures
    - Due to local system topography, generally with low elevation areas to the south of the study area, maximum pressures range from approximately 80 psi at the north extremity of the study area to >100 psi, south of Jasper Avenue.
- Peak Hour Minimum Pressures, Maximum Velocities, and Maximum Headlosses
    - Minimum, peak hour pressures within the study area range from approximately 70 psi at the north extremity of the study area to >100 psi, south of Jasper Avenue.
    - Velocities are maintained below the 2.0 m/s criteria throughout the local study area.
    - High headlosses, exceeding 5 m/1000 m, are experienced along Clouston Avenue, east of Weston Road primarily due to the large industrial demands serviced from this watermain and along Goldwin Avenue and Pinehill Crescent.
- MDD+FF Available Fire Flows
    - Due to the proximity of the 1050 mm transmission watermain along Eglinton Avenue, fire flows exceeding 200 L/s are experienced along Weston Avenue with lower flows ranging for 50 to 75 L/s along Brownville Avenue and the local dead end watermains.
    - Using the conservative FUS landuse based approach (further generalized to single, multi, and commercial land uses) outlined in **Section 4.1.2**, 60% of hydrants within the study area have a fire flow deficiency (hydrants which do not meet the fire flow target) under baseline conditions indicating that the majority of the existing watermains have either a low conveyance capacity or are undersized.

Baseline system performance maps are provided in **Appendix A**.

4.4 Future Water System Conditions

As growth demands were applied to the local Mount Dennis study area, the future water system performance was assessed under ADD, MDD (at peak hour conditions), MDD+FF scenarios. The pressure, fire flow, velocity, and headloss impacts are outlined as follows and will be used to develop a future system understanding for infrastructure upgrade recommendations:

- ADD Maximum Pressures
    - Due to local system topography, generally with low elevation areas to the south of the study area, maximum pressures range from approximately 80 psi at the north extremity of the study area to >100 psi, south of Jasper Avenue.
- Peak Hour Minimum Pressures, Maximum Velocities, and Maximum Headlosses
    - Minimum, peak hour pressures within the study area range from approximately 70 psi at the north extremity of the study area to >100 psi, south of Jasper Avenue.
    - Velocities are maintained below the 2.0 m/s criteria throughout the local study area.
    - High headlosses exceeding 5 m/1000 m are experienced along Clouston Avenue, Oxford Drive, Denarda Street, Goldwin Avenue, Pinehill Crescent, Keelesdale Road, and at the dead end on Emmett Avenue.
- MDD+FF Available Fire Flows
    - Under future conditions, fire flows along Weston Avenue are decreased from existing conditions below 200 L/s due to the high demands along the corridor, resulting in a substantial decrease in fire flows less than 100 L/s west of Weston Road and north of Eglinton Road.
    - Using the FUS landuse based approach 61% of hydrants within the study area have a fire flow deficiency under future conditions, this is similar to existing conditions as a large number of deficiencies are due to existing watermain condition and size, these fire flows are further decreased with the addition of growth demands to the study area.

Future system performance maps are provided in **Appendix A**.

4.5 Water System Opportunities and Constraints

The existing and future water system opportunities and constraints were developed through a review of the water system performance and hydraulic analysis outlined in the previous sections. The following opportunities and constraints, as shown in **Figure 4**, were used to evaluate and recommend servicing strategies:

- High pressures exceeding 100 pound per square inch (psi) exist within the south study area, generally south of Jasper Avenue, and further reducing these pressures below 100 psi is not possible unless a local sub pressure district was to be created, supplied by a number of pressure reducing valves (PRV); however, the constructability and system operation of this system modification, due to current local system configuration, will be complex.
- Due to high growth and intensification anticipated along Weston Road and the age and condition of the existing watermain, replacement or rehabilitation is necessary to address capacity constraints creating fire flow deficiencies on Weston Road and along the watermains to the east and west; this upgrade will enhance the primary distribution watermain within the study area.
- Due to large employment growth planned along Eglinton Avenue, west of Weston Road, rehabilitation or replacement and additional local connections are necessary to the 400 mm watermain primarily necessary to improve local fire flows.
- Additional connection to the primary transmission watermain along Eglinton Avenue (1050 mm) will provide additional security of supply to the local study area and relieve high headlosses along Jane Street.
- Local watermain rehabilitation, replacement, and/or upsize is necessary to address primarily existing fire flow deficiencies and improve existing areas of high headlosses.
- Twinned watermain along Buttonwood Avenue requires either the consolidation and replacement or the rehabilitation of the 300 mm watermain to address local fire flow deficiencies and facilitate the additional connection to the transmission 1050 mm watermain along Eglinton Avenue.

Consolidation of twinned watermain or rehabilitation of 300 mm watermain on Buttonwood Avenue to improve local fire flows and facilitate conveyance from new interconnection at Eglington Avenue

Rehabilitation, replacement, or upsizing of existing watermains to improve local fire flows

Watermain upgrades along Eglington including new watermain and interconnection to address large anticipated growth north and south of Eglington Avenue

New connection to primary transmission watermain (1050 mm) on Eglington Avenue to improve security of supply to the local study area

Weston Road watermain acts as a primary north/south conveyance within the study area. Upgrades to this watermain are necessary due to intensification along this corridor, as well as the watermain's condition, material, and age

Area of high pressure due to local topography, complex servicing adjustments required to reduce pressures in this area

DENISON RD W
LIPPINCOTT ST W
CLOUSTON AVE
EDMUND AVE (YK)
CHAPMAN RD
LA ROSE AVE
SCARLETT RD
RICHVIEW RD
FONTENAY CRT
TOUCHSTONE DR
PLATINUM DR
CENTREPARK DR
MILLENNIUM DR
VIA CASSIA DR
BROOKHAVEN DR
PARKCHESTER RD
BLACK CREEK DR SB
BLACK CREEK DR NB
WESTON RD
COBALT ST
NICKLE ST
MAHONEY AVE
CRAYDON AVE
RUTHERFORD AVE
VICTORIA BLVD
BUTTONWOOD AVE
GOLDWIN AVE
EMMETT AVE
BALA AVE
RAY AVE
INDUSTRY ST
BERTAL RD
TODD BAYLIS BLVD
TRETHEWEY DR
CLEARVIEW HTS
JANE ST
PEAREN ST
EGLINTON AVE W
SYNDICATE AVE
GUESTVILLE AVE
DENNIS AVE
BROWNVILLE AVE
PHOTOGRAPH DR
YARROW RD
BICKNELL AVE
WESTBURY CRES
HYDE AVE
ASTORIA AVE
LAMBTON AVE
CHRYSSA AVE
GRAY AVE
TESTON BLVD
ROCKCLIFFE BLVD
GREENDALE AVE
BUSHEY AVE
JASPER AVE
CLIFF ST
LANGDEN AVE
CORDELLA AVE
[N] HUMBER BLVD (YK) [BRANCH]
AVON AVE
ALLIANCE AVE
0
500
1,000 m

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Mount Dennis Planning Framework

Distribution Watermain
Transmission Watermain

General Features
Property Parcels
Mount Dennis Study Area

Environmental Features
Watercourses
Waterbodies
Green Space

Figure 4

Water System Opportunities and Constraints

BluePlan ENGINEERS 4G

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Projection EPSG:26917

4.6 Water System Servicing Strategy

The water servicing strategy addresses both existing and future system constraints as well as improving existing system security of supply. The proposed water system upgrades are presented in **Figure 5** and outlined in **Table 4**.

Table 4 – Proposed Water System Upgrades

#	Road	From	To	Length (m)	Upgrade Type	Existing Diameter (mm)	Future Diameter (mm)
1	Weston Road	Clouston Avenue	Black Creek Drive	2,500	Rehab/ Replace	300	300
2	Clouston Avenue	Weston Road	Jane Street	230	Upsize	150	300
3	Jane Street	Clouston Avenue	Weston Road	320	Upsize	150	300
4	Easement East of Jane Street	Jane Street	Cobalt Drive	200	Upsize	150	200
5	Buttonwood Avenue	Weston Road	Emmett Avenue Easement	800	Rehab/ Replace	300	300
6	Emmett Avenue	Buttonwood Avenue Easement	Eglinton Avenue	290	New	n/a	300
7	Emmett Avenue	Jane Street	Easement	210	Rehab/ Replace	150	150
8	Jane Street	Emmett Avenue	Pinehill Crescent	180	Upsize	150	200
9	Goodwin Avenue	Jane Street	70 m West of Jane Street	70	Upsize	150	200
10	Bala Avenue	Jane Street	Bartonville Avenue	300	Upsize	150	200
11	Cornell Avenue	Jane Street	Bartonville Avenue	150	Rehab/ Replace	150	150
12	Ernest Dockray Avenue	Weston Road	Bala Avenue	80	Upsize	150	200
13	Bartonville Avenue	Weston Road	Dead End	300	Rehab/ Replace	150	150
14	Sunnybrae Crescent	Weston Road	Bartonville Avenue	330	Rehab/ Replace	150	150
15	Somerville Avenue	Weston Road	Gilmour Crescent	180	Rehab/ Replace	150	150
16	Gilmour Crescent	Somerville Avenue	Glenvalley Drive	100	Rehab/ Replace	150	150

#	Road	From	To	Length (m)	Upgrade Type	Existing Diameter (mm)	Future Diameter (mm)
17	Glenvalley Drive	Gilmour Crescent	Weston Road	240	Rehab/ Replace	150	150
18	Pearen Street	Glenvalley Drive	Eglinton Avenue	220	Rehab/ Replace	150	150
19	Hollis Street	Weston Road	Dead End	130	Rehab/ Replace	150	150
20	Verona Avenue	Buttonwood Avenue	Dead End	150	Upsize	150	200
21	Denarda Street	Weston Road	Marston Street	100	Upsize	150	200
22	Marston Street	Denarda Street	Oxford Drive	100	Upsize	150	200
23	Oxford Drive	Weston Road	Marston Street	80	Rehab/ Replace	150	150
24	Eglinton Avenue	300 m west of Weston Road	Municipal Drive	1,400	Rehab/ Replace	400	400
25	Keelesdale Road	Eglinton Avenue	Black Creek Drive	220	Upsize	200	300
26	Black Creek Drive	Keelesdale Road	Eglinton Avenue	210	New	n/a	300
27	Brownville Avenue	Eglinton Avenue	Weston Road	720	Rehab/ Replace	150	150
28	Jasper Avenue	Weston Road	Langden Avenue	250	Upsize	150	200
29	Langden Avenue	Jasper Avenue	Cordella Avenue	420	Upsize	150	200
30	Cordella Avenue	Langden Avenue	Weston Road	800	Upsize	150	200

Upsize existing watermain (300mm)

Watermain rehabilitation or replacement along Weston Rd (300 mm)

Consolidation of twinned watermain or rehabilitation of 300 mm watermain

New watermain (300 mm) to complete looping

New connection to primary transmission watermain

Rehabilitation or Replacement (150 mm) or select upsizing (200 mm) of existing watermains connecting to Weston Rd

New connection to transmission watermain

Watermain rehabilitation or replacement along Eglinton Ave (400 mm)

New watermain (300 mm) to complete the loop

Upsize existing watermain (200mm)

DENISON RD W
LIPPINCOTT ST W
CLOUSTON AVE
EDMUND AVE (YK)
CHAPMAN RD
LA ROSE AVE
SCARLETT RD
RICHVIEW RD
FONTENAY CRT
EMMETT AVE
BUTTONWOOD AVE
WESTON RD
JANE ST
EGLINTON AVE W
TOUCHSTONE RD
PLATINUM DR
CENTREPARK DR
MILLENNIUM DR
VIA CASSIA DR
BROOKHAVEN DR
PARKCHESTER RD
BLACK CREEK DR SB
BLACK CREEK DR NB
COBALT ST
NICKLE ST
MAHONEY AVE
CRAYDON AVE
RUTHERFORD AVE
GOLDWIN AVE
BALA AVE
VICTORIA BLVD
RAY AVE
INDUSTRY ST
BERTAL RD
TODD BAYLIS BLVD
GREENBROOK DR
TRETHEWEY DR
CLEARVIEW HTS
PEAREN ST
SYNDICATE AVE
DENNIS AVE
BROWNVILLE AVE
PHOTOGRAPHY DR
GUESTVILLE AVE
ASTORIA AVE
LAMBTON AVE
ROCKCLIFFE BLVD
CHRYESSA AVE
GRAY AVE
TESTON BLVD
GREENDALE AVE
BUSHEY AVE
JASPER AVE
CLIFF ST
LANGDEN AVE
CORDELLA AVE
[N] HUMBER BLVD (YK) [BRANCH]
AVON AVE
WESTON RD
HYDE AVE
WESTBURY CRES
YARROW RD
ALLIANCE AVE
0
500
1000 m

TORONTO

Mount Dennis Planning Framework

Distribution Watermain
Transmission Watermain
Proposed Watermain Upgrades

General Features
Property Parcels
Mount Dennis Study Area

Environmental Features
Watercourses
Waterbodies
Green Space

Figure 5

Water System Upgrades

BluePlan ENGINEERS 4D

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Projection EPSG:26917

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4.7 Capital Program

Using the costing methodology outlined in the **Section 4.1.4**, the recommended water system projects and preferred capital program have a total cost of $21,508,000, and its details are outlined in **Table 5**.

Although the costs provided are generally considered to be stand-alone upgrades/replacements, it is anticipated that any infrastructure upgrades such as watermains, sewers, roads, etc. will be coordinated on a corridor basis. This will likely gain construction cost efficiencies for items related to traffic control, mobilization/demobilization, utility relocations, restoration, etc. Further, cost reduction may be possible through the rehabilitation rather than replacement of watermains.

Table 5 – Water System Conceptual Level Costs

#	Road	Length (m)	Future Diameter (mm)	Unit Rate	Base Construction Cost	Engineering / Contingency	Total Project Cost
1	Weston Road	2,500	300	$1,640	$4,100,000	$1,640,000	$5,740,000
2	Clouston Avenue	230	300	$1,640	$377,200	$151,000	$528,200
3	Jane Street	320	300	$1,640	$524,800	$210,000	$734,800
4	Easement East of Jane Street	200	200	$1,100	$220,000	$88,000	$308,000
5	Buttonwood Avenue	800	300	$1,640	$1,312,000	$525,000	$1,837,000
6	Emmett Avenue	290	300	$1,640	$475,600	$190,000	$665,600
7	Emmett Avenue	210	150	$820	$172,200	$69,000	$241,200
8	Jane Street	180	200	$1,100	$198,000	$79,000	$277,000
9	Goodwin Avenue	70	200	$1,100	$77,000	$31,000	$108,000
10	Bala Avenue	300	200	$1,100	$330,000	$132,000	$462,000
11	Cornell Avenue	150	150	$820	$123,000	$49,000	$172,000
12	Ernest Dockray Avenue	80	200	$1,100	$88,000	$35,000	$123,000
13	Bartonville Avenue	300	150	$820	$246,000	$98,000	$344,000
14	Sunnybrae Crescent	330	150	$820	$270,600	$108,000	$378,600
15	Somerville Avenue	180	150	$820	$147,600	$59,000	$206,600

#	Road	Length (m)	Future Diameter (mm)	Unit Rate	Base Construction Cost	Engineering / Contingency	Total Project Cost
16	Gilmour Crescent	100	150	$820	$82,000	$33,000	$115,000
17	Glenvalley Drive	240	150	$820	$196,800	$79,000	$275,800
18	Pearen Street	220	150	$820	$180,400	$72,000	$252,400
19	Hollis Street	130	150	$820	$106,600	$43,000	$149,600
20	Verona Avenue	150	200	$1,100	$165,000	$66,000	$231,000
21	Denarda Street	100	200	$1,100	$110,000	$44,000	$154,000
22	Marston Street	100	200	$1,100	$110,000	$44,000	$154,000
23	Oxford Drive	80	150	$820	$65,600	$26,000	$91,600
24	Eglinton Avenue	1,400	400	$1,980	$2,772,000	$1,109,000	$3,881,000
25	Keelesdale Road	220	300	$1,640	$360,800	$144,000	$504,800
26	Black Creek Drive	210	300	$1,640	$344,400	$138,000	$482,400
27	Brownville Avenue	720	150	$820	$590,400	$236,000	$826,400
28	Jasper Avenue	250	200	$1,100	$275,000	$110,000	$385,000
29	Langden Avenue	420	200	$1,100	$462,000	$185,000	$647,000
30	Cordella Avenue	800	200	$1,100	$880,000	$352,000	$1,232,000

5. WASTEWATER, STORMWATER, AND COMBINED SYSTEMS

The Mount Dennis study area consists of wastewater, combined, and stormwater sewerage. The majority of the Mount Dennis study area along Weston Road is covered by combined system, with some areas serviced by separated sanitary and storm system. **Figure 6** shows the existing sewer system (sanitary, combined, and storm) within the study area.

- The existing sanitary system only covers the northeast and southeast corners of the study area. The local sanitary system drains to the Black Creek Sanitary Trunk Sewer along the Black Creek.
- The existing combined system covers the majority of the study area, and it received local sanitary inflows. The combined sewer eventually drains to the Black Creek Sanitary Trunk Sewer south of the study area.
- The stormwater system discharges to the Black Creek to the east and south, and the Humber River to the west.

TORONTO

Mount Dennis Planning Framework

- Sanitary Sewer
- Storm Sewer
- Combined Sewer

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

Figure 6

Existing Wastewater, Stormwater, and Combined Systems

BluePlan ENGINEERS

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Projection EPSG:26917

0 500 1,000 m

5.1 Wastewater, Stormwater and Combined Systems Criteria

The design criteria section outlines the methodology and values used to estimate growth related demands/flows as well as the decision-making rationale related to infrastructure capacity and the trigger for upgrades.

5.1.1 Design Criteria

The Master Servicing Plan has used the following design criteria to project wastewater flows, determine capacity requirements and establish the infrastructure program:

- Per capita rate of 240 L/cap/d for growth population and the flow monitor diurnal pattern used in the baseline model as outlined in Section 5.1.2.2 of *City of Toronto InfoWorks Basement Flooding Model Guideline*.

5.1.2 Level of Service (LOS)

System performance is related to the level of service criteria for each system type as outlined in Section 8.6.3 of *City of Toronto InfoWorks Basement Flooding Model Guideline*.

- Sanitary Sewerage System: The maximum hydraulic grade line (HGL) of the sanitary system shall be maintained below basement elevations (approximately 1.8 m below street centerline) during a storm event equivalent to the May 12, 2000 storm as gauged at the City's Oriole Yard (Station 102) located at Sheppard Avenue and Leslie Street. This design standard provides an enhanced level of protection against basement flooding from sanitary sewer backup for a storm event with a return frequency between 1 in 25 and 1 in 50 years.
- Storm Drainage System: During the 100-year design storm, the maximum HGL in the storm sewer (minor) system shall be maintained below basement elevations. The overland flow (major) system shall be maintained within the road allowance and no deeper than the recommended standard which varies depending on the type of road.
- Combined Sewerage System: Same as the storm system for the 100-year event. Annually, combined sewer overflows must meet the objectives of the Ministry of Environment, Conservation and Parks (MECP) Procedure F-5-5 for volumetric capture during April to October in a continuous simulation for the City defined typical year 1991.
- Overland flow depths and velocity must be considered for public safety, as shown in **Table 6.**

Table 6 – Overland Flow Depth and Velocity Target

Water Velocity (m/s)	Permissible Depth (m)
2.0	0.21
3.0	0.09

- Shallow Sewers: Shallow sewers are defined as having obverts less than 1.8 m below the ground surface. The required level of protection for shallow sewers are:
    - For shallow storm sewers, no surcharging conditions during a 100-year design storm event. In case that a sewer improvement is needed, the shallow storm sewer should be lowered to at least 1.8 m below ground if feasible; however, if not feasible, the proposed pipe obvert should be not be higher than the existing pipe obvert and the HGL during the 100-year storm event under proposed conditions should be maintained within the pipe obvert (i.e., the pipe is not surcharged).
    - For shallow sanitary sewers, maintain the HGL freeboard of 1.8 m or greater under May 12, 2000 storm event. In case that a sewer improvement is needed, the shallow sanitary sewer should be lowered to at least 1.8 m below ground if feasible; if not feasible, the proposed pipe obvert should not be higher than the existing pipe obvert and maintain the HGL freeboard of 1.8 m or greater under May 12, 2000 storm event (i.e., the flow is within the pipe).

5.1.3 Flow Projection

The population and employment projections outlined in **Section 3** and the design criteria within **Section 5.1.1** were utilized to calculate the average dry weather flow (ADWF) projections. The additional growth flows are shown in **Table 7** and **Table 8** below.

Table 7 – Wastewater Flow Projections: Projected Growth Population

Population	Employment	Total
20,832	1,349	22,181

Table 8 – Wastewater Flow Projections: Projected Growth Flows

Average Dry Weather Flow (L/s)	Peak Dry Weather Flow (L/s)
61 L/s	94 L/s

5.1.4 Costing Methodology

The Basement Flooding Remediation and Water Quality Improvements Master Plan Class EA (Basement Flooding Study) was completed in 2021 by IBI Group. It provided a detailed analysis of recommended improvement projects (preferred solution capital program) and conceptual level cost estimates. Cost estimates were derived using the City's Basement Flooding Protection Cost Estimating Tool (Version 3.0). The cost estimates include construction costs, property acquisition, additional scope, provisional allowances, and 30% contingencies.

For the purpose of this study, the preferred solution proposed in the Basement Flooding Study will be analysed with additional growth of Mount Dennis Study Area. The Capital Program recommendation will be referenced from the Basement Flooding Study as well as the conceptual level estimate of implementation cost.

5.2 InfoWorks ICM Hydraulic Models

For the baseline review, City of Toronto provided GM BluePlan with three separate hydraulic models containing sewer network relating to the catchment area (received April 2021). Following a review of the models, the Area 45 baseline models were identified as the primary models for the analysis. These models were divided into six separate catchments and networks with 'A45C-1/C-3/C-4_EA_Baseline_Exist' the network covering the study area, containing sanitary, combined, and storm sewerage. The details of this model indicated that it was the most recent model, with updates made in 2019. In addition, an older 2014 model named 'TBF 456' contained the downstream trunk sewer network and will be used to establish the boundary conditions and identify any limitation in the downstream trunk sewer.

For the baseline analysis, these models were used as provided, with no updates to the network or loading. The design storms used for analysis are the storms which were provided with the model.

For the growth analysis under future scenario, City of Toronto provided the A45 models with 2041 projection and preferred sewer upgrade projects, which was presented in the *Basement Flooding Remediation and Water Quality Improvements Master Plan Class EA* (Basement Flooding Study). The growth analysis will utilize the "A45C-1/C-3/C-4_EA_PreferredSolution_2041" network to compare the results pre- and post- integrating the projected growth within Mount Dennis Study Area in order to confirm if the preferred sewer upgrade projects in the Basement Flooding Study can accommodate projected growth.

5.2.1 Growth Loading Methodology

The future sewer system analysis will compare the results of **Pre-Growth scenario** and **Post-Growth scenarios** (with additional growth within Mount Dennis Study Area) in order to confirm if the preferred sewer upgrade projects in the Basement Flooding Study can accommodate the additional growth within Mount Dennis Study Area.

The methodology of integrating the projected growth within Mount Dennis Study Area is outlined as:

- Use received A45 model with 2041 projection and preferred sewer upgrade projects as **Pre-Growth scenario**.
- **Post-Growth scenario** will include the Mount Dennis projected growth, which are added as a new layer of subcatchments with growth population and design criteria presented in **Section 5.1.1**. Growth subcatchments are identified with "_Growth" in the subcatchment ID field and are assigned to the same nodes as existing subcatchments underneath.
- No additional baseflow or I&I is added to Post-Growth scenario because they are all accounted for in the baseline condition.

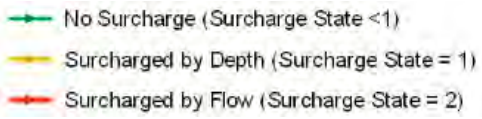
5.2.2 System Performance Evaluation

The system performance, under existing and future infrastructure conditions, was evaluated using the City of Toronto's wastewater and storm water models, as provided. The system performance was assessed for the following scenarios:

- Dry weather flow
- 5-Year 6-Hour Chicago
- 100-Year 6-Hour Chicago
- Oriole May 12, 2000 (historic event)

Thematic maps are provided for each scenario with wastewater and combined presented on separate maps than stormwater to ensure clarity of the maps; however, it is acknowledged that the storm system does interact with the sanitary and combined systems through the connection of overland flow channels. The combined system can also spill into the stormwater system at Weston Road and Ray Avenue. The thematic maps show:

- Surcharged state by flow as the pipe full capacity.
- Surcharge state by depth as a result of backwater conditions.



5.2.3 Growth Scenario Assumptions

Perkins & Will provided planning projections within Mount Dennis study area by Dissemination Areas. **Figure 7** presented the received A45 model network coverage and Dissemination Areas. **Table 9** summarized the growth population and projected average dry weather flows (ADWF) for each Dissemination Areas.

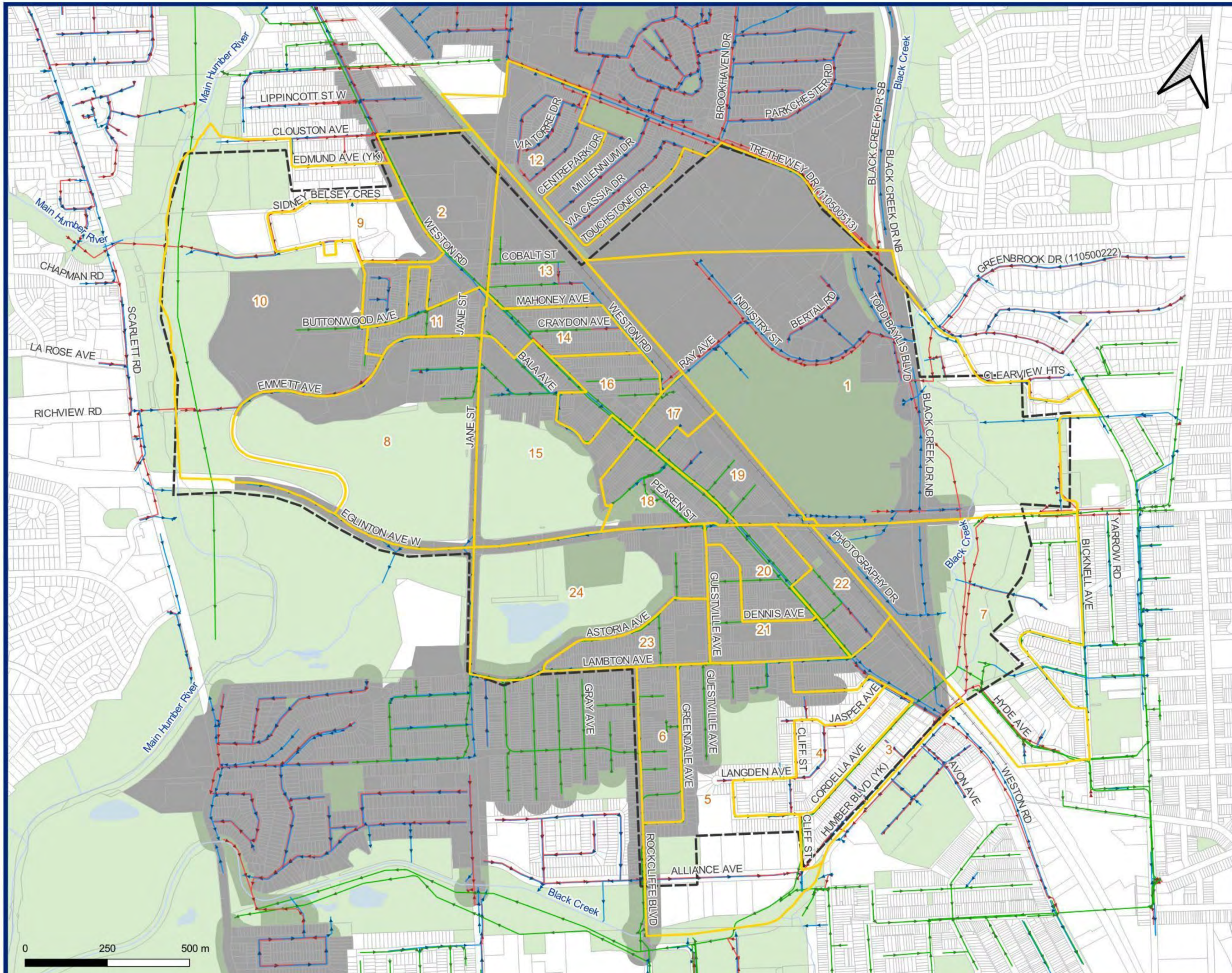
Growth in each Dissemination Areas will be further broken into growth subcatchments. The new layer of growth subcatchments contains growth population and design criteria presented in **Section 5.1.1**. Growth subcatchments are assigned to the same loading nodes as the existing subcatchments underneath.

It should be noted that Dissemination Area 4, and 9 are not covered by the A45 model.

- Dissemination Area 4 (near Cordella Ave.) is a wastewater/stormwater separate network that flows south to the 1350mm Black Creek Sanitary Trunk Sewer directly.
- Dissemination Area 9 (near Sidney Belsey Cres.) is a wastewater/stormwater separate network that drains west to the 1650mm trunk sewer along Humber River.

The population and employment growth in Dissemination Area 4 and Dissemination Area 9 are 112 and 121 people respectively. Due to the coverage of received A45 model and negligible amount of growth in Dissemination Area 4 and Dissemination Area 9, growth in these two Dissemination Areas was disregarded in the growth analysis.

For other Dissemination Areas that are partially covered by the A45 model, it is assumed that all growth will be distributed within A45 model covered area, which may slightly overestimate the growth-generated sanitary flows.



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Mount Dennis Planning Framework

- Sanitary Sewer
- Storm Sewer
- Combined Sewer
- Model Subcatchments

General Features

- Dissemination Area
- Property Parcel
- Mount Dennis Study Area

Environmental Features

- Watercourses
- Waterbodies
- Green Space

Figure 7

Wastewater, Stormwater, and Combined Systems Upgrades

Dissemination Area

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Table 9 – Growth Population and Projected Flows by Dissemination Areas

Dissemination Areas	Growth Population	Growth Employment	ADWF (L/s)	PDWF (L/s)
1	0	534	1.5	2.4
2	94	0	0.3	0.4
3	806	0	2.2	3.1
4*	113	0	0	0
5	185	0	0.5	0.7
6	79	0	0.2	0.3
7	4,230	213	12.3	23.1
8	61	0	0.2	0.3
9*	121	0	0	0
10	1,542	0	4.3	6.8
11	58	0	0.2	0.3
12	0	47	0.1	0.2
13	76	0	0.2	0.3
14	202	35	0.7	0.9
15	298	80	1.0	1.4
16	1,288	58	3.7	5.1
17	1,606	19	4.5	6.2
18	1,182	44	3.4	4.7
19	3,844	104	11.0	15.0
20	2,450	137	7.2	9.8
21	223	27	0.7	1.0
22	1,886	54	5.4	7.4
23	68	0	0.2	0.3
24	421	0	1.2	1.6
Total**	**20,599**	**1,349**	**61.0**	**91.2**

* Dissemination Area 4, and 9 are not covered by the A45 model, and will not contribute additional flows.

** The total does not include Dissemination Area 4 and Dissemination Area 9.

5.3 Existing Sewer System Conditions

The sanitary, combined, and stormwater system baseline models were analyzed for dry weather flow conditions, as well as using a 1 in 5yr, 1 in 100yr, and historic storm event, as provided by the City of Toronto. Sewer profile showing system performance issues under existing conditions will be presented in Section 5.4 to show the impact of preferred sewer upgrade projects.

For the 1 in 5yr design storm when reviewing the sanitary and combined system, there is significant surcharging south of Eglinton Avenue. Surcharging starts just north of Eglinton Avenue on Weston Road and continues south along Guestville Avenue, onto Greendale Avenue, to the trunk sewer on Rockcliffe Boulevard. However, the surcharging does not reach a level that would be considered a basement flooding risk.

For the storm system during the 1 in 5yr design storm, there are pockets of surcharging across the catchment, with flooding being shown to the south of the catchment, to the west of Jane Street along Eglinton Avenue. The flooding occurs due to a lack of capacity in the modelled outfall sewer but is within the flood plain and away from properties so may not present a major threat in relation to basement flooding.

For the 1 in 100yr design storm and the historic design storm there are high HGL conditions across the majority of the study area. Sewer separation and inflow & infiltration (I&I) removal will be reviewed as options when undertaking the growth analysis. Surcharging for a 1 in 100yr storm is difficult to prevent, especially in the combined system. The objectives when analyzing potential for growth will be to see if risks such as basement flooding and overland flows that exceed LOS criteria can be managed.

5.4 Future Sewer System Conditions

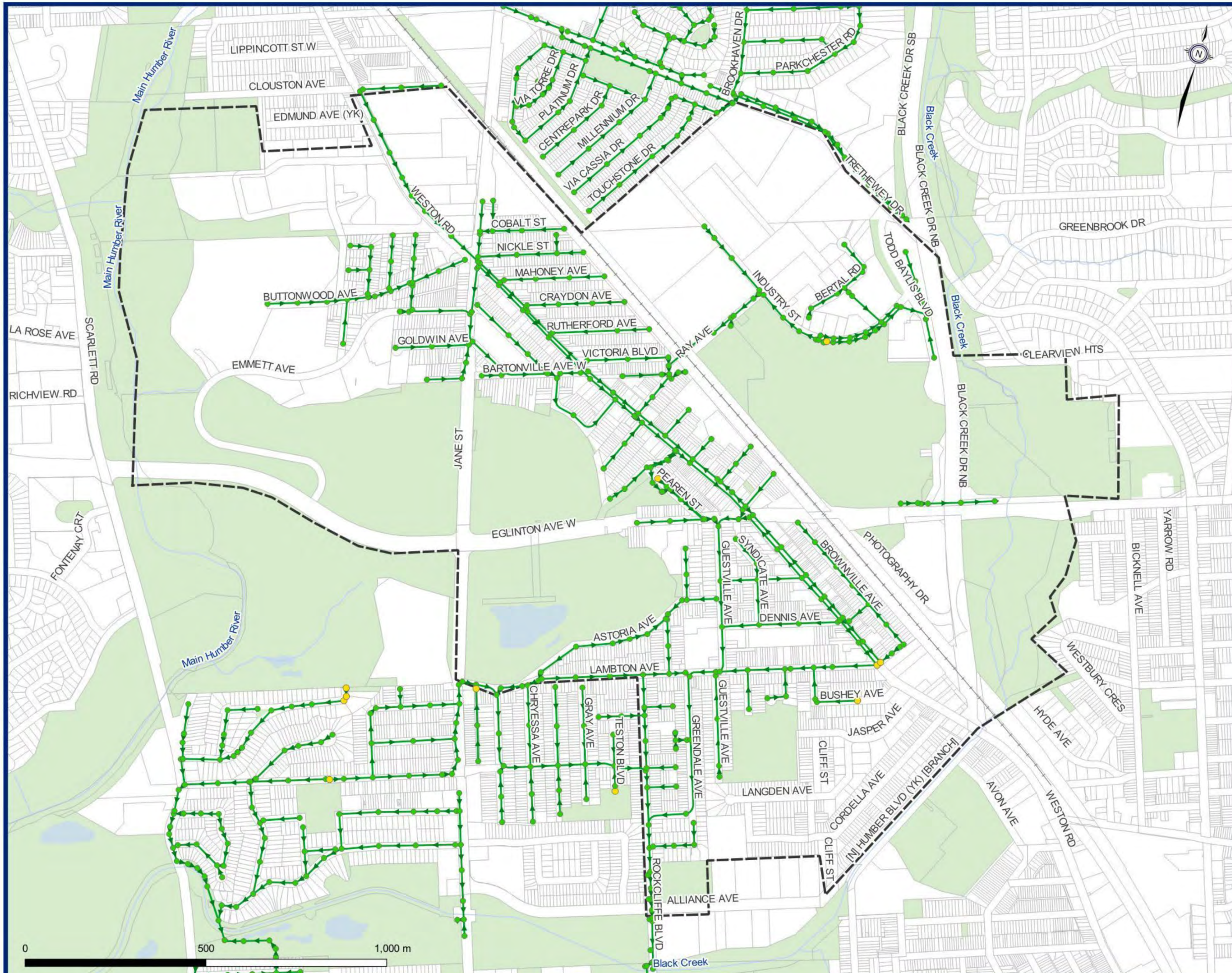
The future sewer system analysis will focus on comparing the results of the Pre-Growth scenarios and Post-Growth scenarios (with additional growth within Mount Dennis Study Area) in order to confirm if the preferred sewer upgrade projects in the Basement Flooding Study can accommodate the additional growth within Mount Dennis Study Area. Sewer profile showing system performance issues under existing conditions will be presented in order to show the impact of preferred sewer upgrade projects.

It should be noted that the following future sewer system performance analysis were assessed with free outfall condition in order to review the impact of additional sanitary flow from Mount Dennis Study Area.

Once the growth analysis had been completed, simulations were run using provided level files for the downstream conditions in the Black Creek Sanitary Trunk Sewer (BCSTS) for the May 12th, 2000 Historic Event and the 1 in 100-year return period design storm. The results from these simulations showed that there is no capacity in the downstream trunk sewer (BCSTS) under the conditions provided; this should be considered when evaluating opportunities for growth.

5.4.1 Dry Weather Flow Analysis (Sanitary and Combined)

Under dry weather flow conditions, both Pre-Growth and Post Growth sanitary and combined system model results show no constraints, as presented in **Figure 8** and **Figure 9**.



TORONTO

Mount Dennis Planning Framework

Depth to Water Level

- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State

- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features

- Property Parcels
- Mount Dennis Study Area

Environmental Features

- Watercourses
- Waterbodies
- Green Space

*Pre-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, without additional Mount Dennis Study Area growth.

Figure 8
Pre-Growth Scenario
Sanitary & Combined System
Modelling Results - Dry Weather Flow Condition

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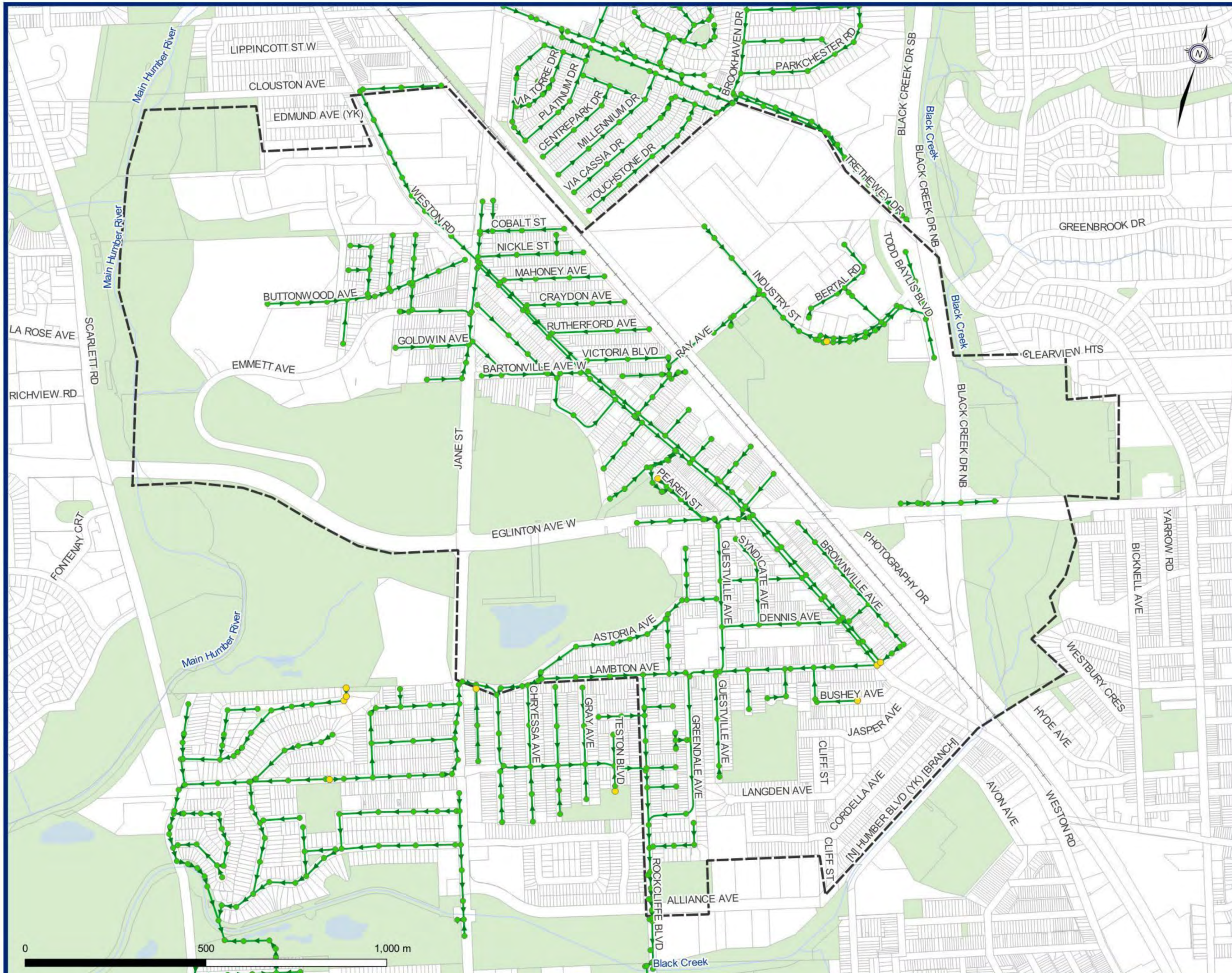
Mount Dennis Planning Framework



Depth to Water Level
- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State
- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

*Post-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, with additional Mount Dennis Study Area growth.

Figure 9
Post-Growth Scenario
Sanitary & Combined System
Modelling Results - Dry Weather Flow Condition

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5.4.2 5-Year 6-Hour Chicago Design Storm Analysis (Sanitary and Combined)

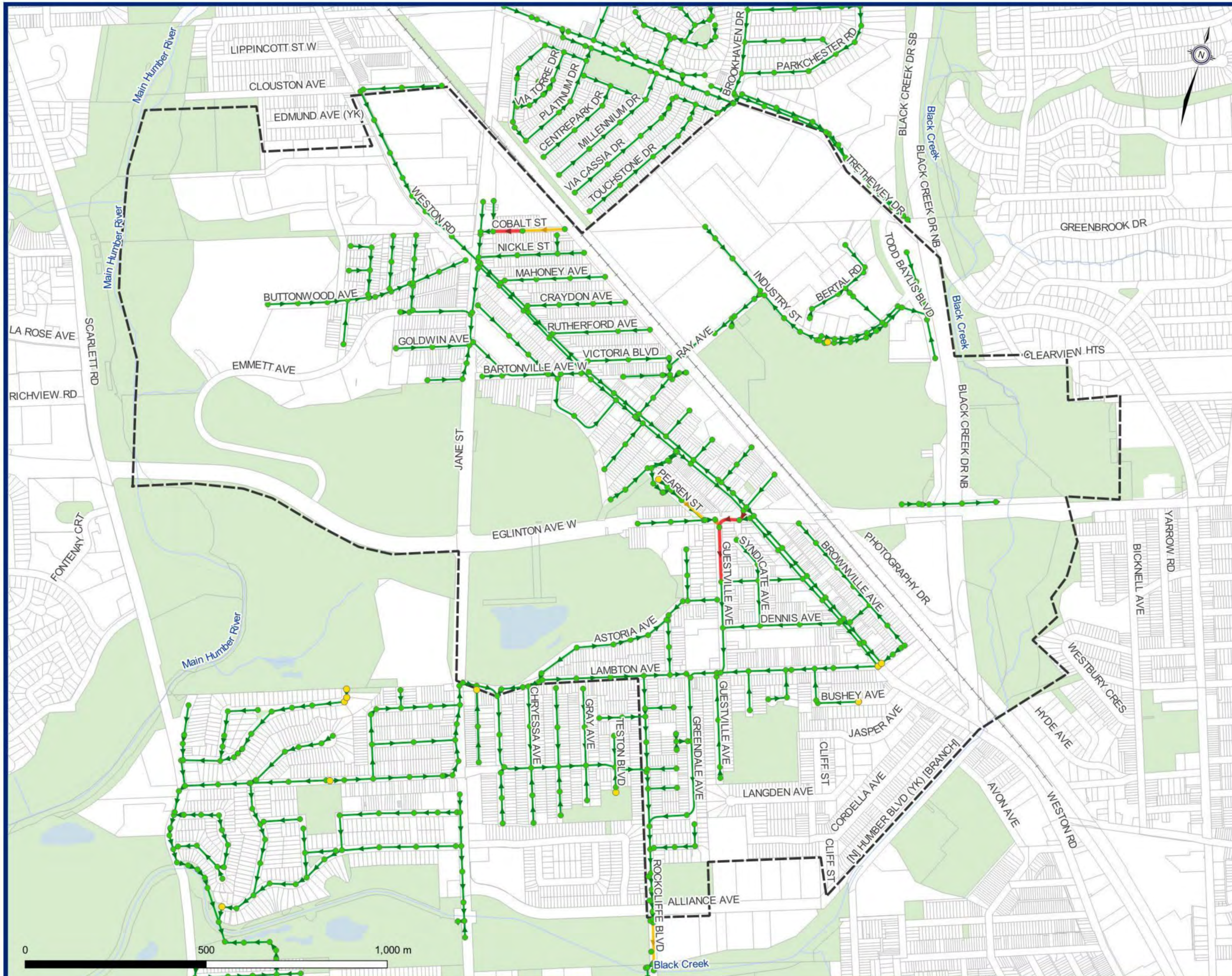
Under 1 in 5-year Chicago Design Storm conditions, there is one additional sewer segment (MH3829305504.1) surcharging in the Post-Growth sanitary and combined system model results compared to Pre-Growth scenario. The additional surcharging sewer is a 450mm combined sewer on Eglinton Avenue West between Pearen Street and Weston Road. The sewer profile in **Figure 10** shows this surcharging is a result of backwater from the downstream restriction along Guestville Avenue. **Table 10** presented modelling results of manholes and sewers in the profile under all scenarios.

Pre-Growth and Post Growth system performance map are presented in **Figure 11** and **Figure 12**.

Figure 10 – Sewer Profiles showing Surcharge State along Eglinton Avenue West and Downstream (5-Year 6-Hour Chicago Design Storm)

Table 10 – Results for Sanitary and Combined System (5-Year 6-Hour Chicago Design Storm) for Sewer Profiles along Eglinton Avenue West and Downstream

Figure 10	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3834905392.1	1	1	1
	MH3829305504.1	1	0.97	1
	MH3830205531.1	1	1	1
	MH3828405547.1	2	2	2
Maximum Downstream Flow (L/s)	MH3834905392.1	-43.92	-5.67	-6
	MH3829305504.1	-100.13	36.46	38.11
	MH3830205531.1	-105.94	33.34	35.43
	MH3828405547.1	662.76	642.3	649.37
Maximum Velocity (m/s)	MH3834905392.1	-0.59	-0.11	-0.11
	MH3829305504.1	0.93	0.94	0.95
	MH3830205531.1	-0.62	0.21	0.21
	MH3828405547.1	1.77	1.79	1.79
HGL (m)	MH3834905392	118.87	118.25	118.25
	MH3829305504	118.90	118.20	118.22
	MH3830205531	118.90	118.19	118.22
	MH3828405547	118.90	118.19	118.22
	MH3814005592	118.68	117.62	117.64
Depth to Ground (m)	MH3834905392	5.36	5.98	5.98
	MH3829305504	5.16	5.87	5.84
	MH3830205531	4.96	5.66	5.63
	MH3828405547	5.24	5.95	5.92
	MH3814005592	5.01	6.06	6.04



TORONTO

Mount Dennis Planning Framework

Depth to Water Level

- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State

- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features

- Property Parcels
- Mount Dennis Study Area

Environmental Features

- Watercourses
- Waterbodies
- Green Space

*Pre-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, without additional Mount Dennis Study Area growth.

Figure 11

Pre-Growth Scenario
Sanitary & Combined System

Modelling Results - 5-year Chicago Design Storm

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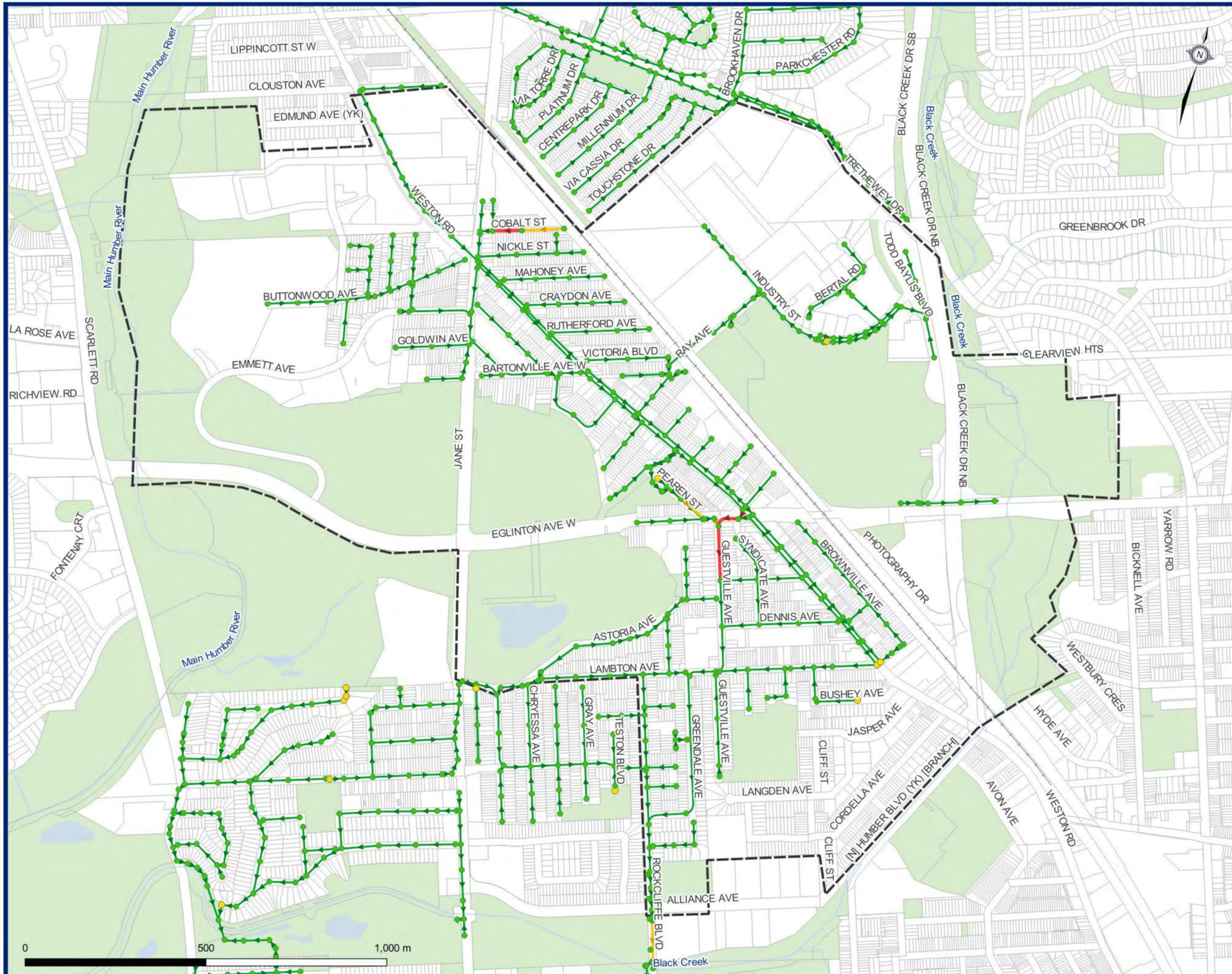

TORONTO

Mount Dennis Planning Framework

Depth to Water Level

- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State

- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features

- Property Parcels
- Mount Dennis Study Area

Environmental Features

- Watercourses
- Waterbodies
- Green Space

*Post-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, with additional Mount Dennis Study Area growth.

Figure 12

Post-Growth Scenario
Sanitary & Combined System

Modelling Results - 5-year Chicago Design Storm

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Under existing conditions, there is significant surcharging south of Eglinton Avenue. Surcharging by flow starts just north of Eglinton Avenue on Weston Road and continues south along Guestville Avenue, onto Greendale Avenue, to the trunk sewer on Rockcliffe Boulevard. **Figure 13** and **Figure 14** show the surcharging under existing conditions were largely mitigated by the preferred sewer upgrade projects. However, there are still a few sewer segments showing capacity issues. The additional flow from Mount Dennis Study Area has marginal impact on the overall system performance.

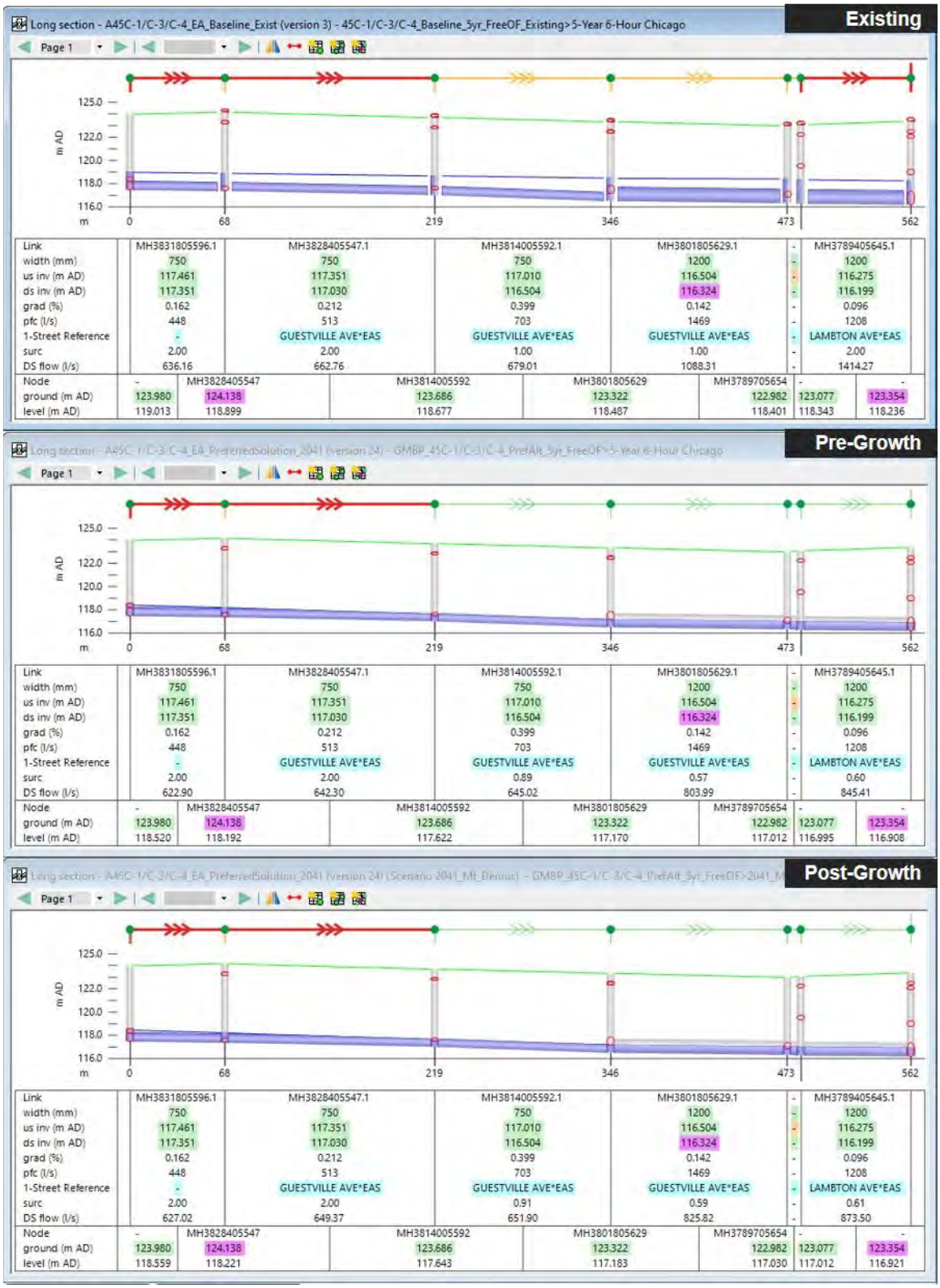

Figure 13 – Sewer Profiles from Weston Road to Greendale Avenue (1 in 5-year Design Storm)

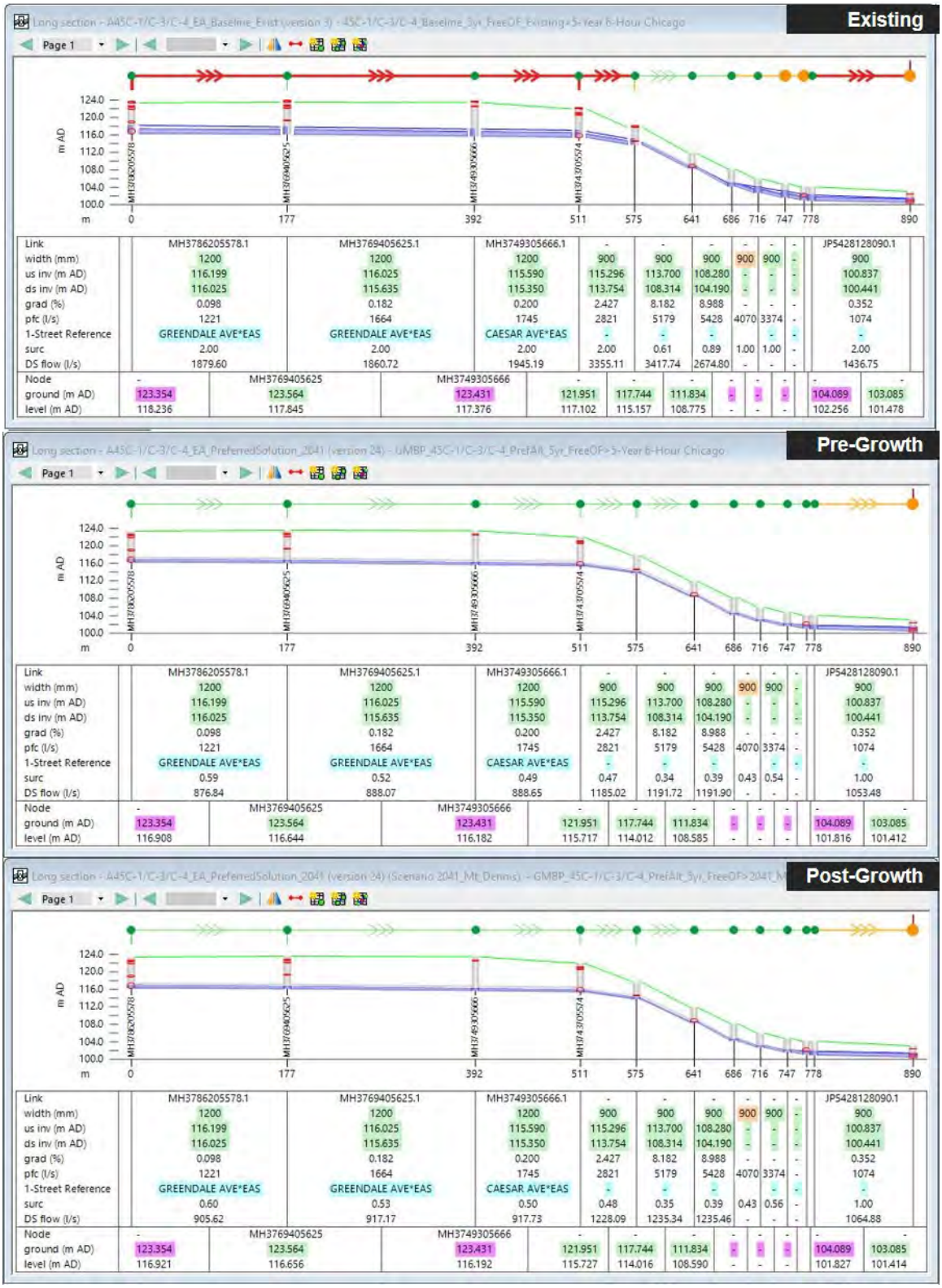

Figure 14 – Sewer Profiles from Greendale Avenue to Rockcliffe Boulevard (1 in 5-year Design Storm)

Table 11 and **Table 12** presented modelling results of manholes and sewers in the profiles under all scenarios.

Table 11 – Results for Sanitary and Combined System (5-Year 6-Hour Chicago Design Storm) for Sewer Profiles from Weston Road to Greendale Avenue

Figure 13	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3831805596.1	2	2	2
	MH3828405547.1	2	2	2
	MH3814005592.1	1	0.89	0.91
	MH3801805629.1	1	0.57	0.59
	MH3789705654.1	1	0.6	0.61
	MH3789405645.1	2	0.6	0.61
Maximum Downstream Flow (L/s)	MH3831805596.1	636.16	622.90	627.02
	MH3828405547.1	662.76	642.30	649.37
	MH3814005592.1	679.01	645.02	651.90
	MH3801805629.1	1,088.31	803.99	825.82
	MH3789705654.1	1,334.37	836.72	864.47
	MH3789405645.1	1,414.27	845.41	873.50
Maximum Velocity (m/s)	MH3831805596.1	1.38	1.36	1.37
	MH3828405547.1	1.77	1.79	1.79
	MH3814005592.1	1.57	1.59	1.58
	MH3801805629.1	1.16	1.20	1.21
	MH3789705654.1	1.15	1.18	1.19
	MH3789405645.1	1.24	1.22	1.23
HGL (m)	MH3831805596	119.01	118.52	118.56
	MH3828405547	118.90	118.19	118.22
	MH3814005592	118.68	117.62	117.64
	MH3801805629	118.49	117.17	117.18
	MH3789705654	118.40	117.01	117.03
	MH3789405645	118.34	117.00	117.01
Depth to Ground (m)	MH3831805596	4.967	5.46	5.421
	MH3828405547	5.239	5.946	5.917
	MH3814005592	5.009	6.064	6.043
	MH3801805629	4.835	6.152	6.139
	MH3789705654	4.581	5.97	5.952
	MH3789405645	4.734	6.082	6.065

Table 12 – Results for Sanitary and Combined System (5-Year 6-Hour Chicago Design Storm) for Sewer Profiles from Greendale Avenue to Rockcliffe Boulevard

Figure 14	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3786205578.1	2	0.59	0.6
	MH3769405625.1	2	0.52	0.53
	MH3749305666.1	2	0.49	0.5
	MH3743705574.1	2	0.47	0.48
	MH3737605593.1	0.61	0.34	0.35
	MH3731305612.2	0.89	0.39	0.39
	JP5428128110.1	1	0.43	0.43
	JP5428128111.1	1	0.54	0.56
	JP5428128112.1	1	0.93	0.95
	MH3719105650.2	1	1	1
	JP5428128090.1	2	1	1
Maximum Downstream Flow (L/s)	MH3786205578.1	1,879.60	876.84	905.62
	MH3769405625.1	1,860.72	888.07	917.17
	MH3749305666.1	1,945.19	888.65	917.73
	MH3743705574.1	3,355.11	1,185.02	1,228.09
	MH3737605593.1	3,417.74	1,191.72	1,235.34
	MH3731305612.2	2,674.80	1,191.90	1,235.46
	JP5428128110.1	2,673.50	1,191.92	1,235.43
	JP5428128111.1	2,673.15	1,191.88	1,235.26
	JP5428128112.1	2,672.91	1,191.91	1,234.99
	MH3719105650.2	1,436.56	1,053.33	1,064.71
	JP5428128090.1	1,436.75	1,053.48	1,064.88
Maximum Velocity (m/s)	MH3786205578.1	1.75	1.49	1.51
	MH3769405625.1	2.00	1.77	1.79
	MH3749305666.1	2.61	1.93	1.95
	MH3743705574.1	5.68	4.08	4.10
	MH3737605593.1	8.50	6.15	6.24
	MH3731305612.2	6.09	5.27	5.30
	JP5428128110.1	5.04	4.60	4.68
	JP5428128111.1	3.98	3.57	3.59
	JP5428128112.1	4.00	2.12	2.11
	MH3719105650.2	2.15	1.60	1.62
	JP5428128090.1	2.17	1.60	1.62
HGL (m)	MH3786205578	118.24	116.91	116.92
	MH3769405625	117.85	116.64	116.66
	MH3749305666	117.38	116.18	116.19
	MH3743705574	117.10	115.72	115.73
	MH3737605593	115.16	114.01	114.02

Figure 14	Model ID	Existing	Pre-Growth	Post-Growth
	MH3731305612	108.78	108.59	108.59
	JP5428128110	104.98	104.54	104.55
	JP5428128111	104.13	103.05	103.06
	JP5428128112	103.20	102.09	102.10
	MH3719105650	102.39	101.87	101.88
	JP5428128090	102.26	101.82	101.83
	MH3707405683	101.48	101.41	101.41
	MH3743705574	117.10	115.72	115.73
	MH3737605593	115.16	114.01	114.02
Depth to Ground (m)	MH3786205578	5.118	6.446	6.433
	MH3769405625	5.719	6.92	6.908
	MH3749305666	6.055	7.249	7.239
	MH3743705574	4.849	6.234	6.224
	MH3737605593	2.587	3.732	3.728
	MH3731305612	3.059	3.249	3.244
	JP5428128110	3.179	3.622	3.614
	JP5428128111	1.824	2.899	2.894
	JP5428128112	1.613	2.726	2.709
	MH3719105650	1.644	2.169	2.156
	JP5428128090	1.833	2.273	2.262
	MH3707405683	1.607	1.673	1.671
	MH3743705574	4.849	6.234	6.224
	MH3737605593	2.587	3.732	3.728

5.4.3 5-Year 6-Hour Chicago Design Storm Analysis (Storm)

Under 1 in 5-year Chicago Design Storm conditions, there is no additional surcharging conditions presented in the Post-Growth storm system model results compared to Pre-Growth model results, as presented in **Figure 15 and Figure 16**.

Under existing conditions, there are pockets of surcharging across the catchment. Key storm sewers that surcharge includes Eglinton Avenue west of Jane Street, as well as Ray Avenue and Industry Street down to Black Creek Drive. **Figure 17** and **Figure 18** show examples where primary storm sewer surcharging under existing conditions were mitigated by the preferred sewer upgrade projects, and the additional flow from Mount Dennis Study Area has marginal impact on the overall system performance. **Table 13** and **Table 14** presents modelling results of manholes and sewers in the profiles under all scenarios.

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Mount Dennis Planning Framework

Depth to Water Level
- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State
- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

*Pre-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, without additional Mount Dennis Study Area growth.

Figure 15

Pre-Growth Scenario
Storm System

Modelling Results - 5-year Chicago Design Storm

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November, 2021
719006-WW-003
Projection EPSG:26917

0 500 1,000 m

Mount Dennis Planning Framework

Depth to Water Level
- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State
- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

*Post-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, with additional Mount Dennis Study Area growth.

Figure 16
Post-Growth Scenario
Storm System
Modelling Results - 5-year Chicago Design Storm

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November, 2021
719006-WW-002
Projection EPSG:26917

0 500 1,000 m

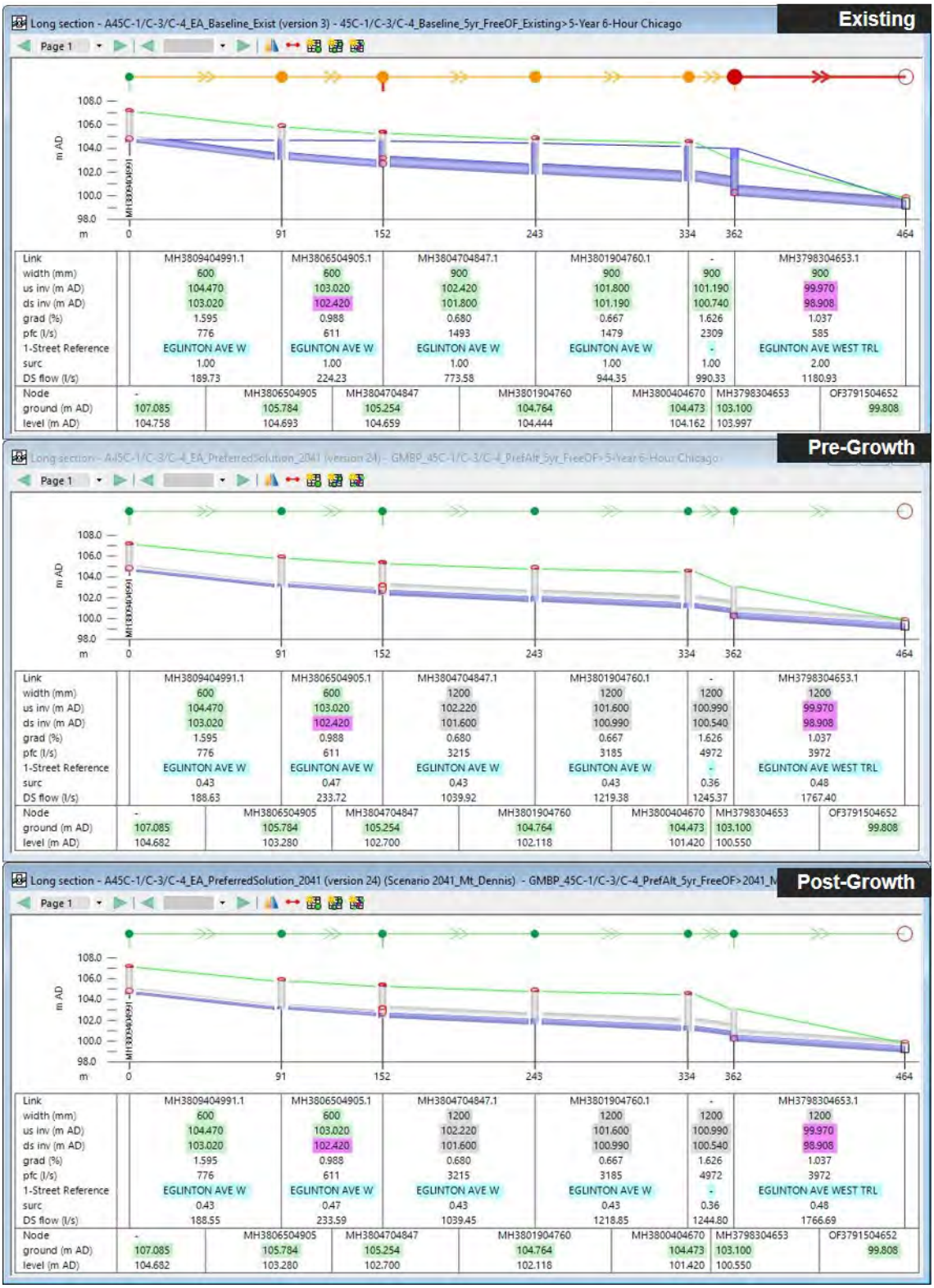


Figure 17 – Sewer Profiles along Eglinton Avenue (1 in 5-year Design Storm)

Figure 18 – Sewer Profiles along Industry Street (1 in 5-year Design Storm)

Table 13 – Results for Storm System (5-Year 6-Hour Chicago Design Storm) for Sewer Profiles along Eglinton Avenue

Figure 17	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3809404991.1	1	0.43	0.43
	MH3806504905.1	1	0.47	0.47
	MH3804704847.1	1	0.43	0.43
	MH3801904760.1	1	0.43	0.43
	MH3800404670.1	1	0.36	0.36
	MH3798304653.1	2	0.48	0.48
Maximum Downstream Flow (L/s)	MH3809404991.1	189.73	188.63	188.55
	MH3806504905.1	224.23	233.72	233.59
	MH3804704847.1	773.58	1,039.92	1,039.45
	MH3801904760.1	944.35	1,219.38	1,218.85
	MH3800404670.1	990.33	1,245.37	1,244.80
	MH3798304653.1	1,180.93	1,767.40	1,766.69
Maximum Velocity (m/s)	MH3809404991.1	1.56	1.60	1.60
	MH3806504905.1	0.86	1.98	1.98
	MH3804704847.1	2.09	2.23	2.23
	MH3801904760.1	2.32	2.62	2.61
	MH3800404670.1	2.88	3.45	3.45
	MH3798304653.1	2.41	3.26	3.26
HGL (m)	MH3809404991	104.76	104.68	104.68
	MH3806504905	104.69	103.28	103.28
	MH3804704847	104.66	102.70	102.70
	MH3801904760	104.44	102.12	102.12
	MH3800404670	104.16	101.42	101.42
	MH3798304653	104.00	100.55	100.55
Depth to Ground (m)	MH3809404991	2.327	2.403	2.403
	MH3806504905	1.091	2.504	2.504
	MH3804704847	0.595	2.554	2.554
	MH3801904760	0.32	2.646	2.646
	MH3800404670	0.311	3.053	3.053
	MH3798304653	-0.897	2.55	2.55

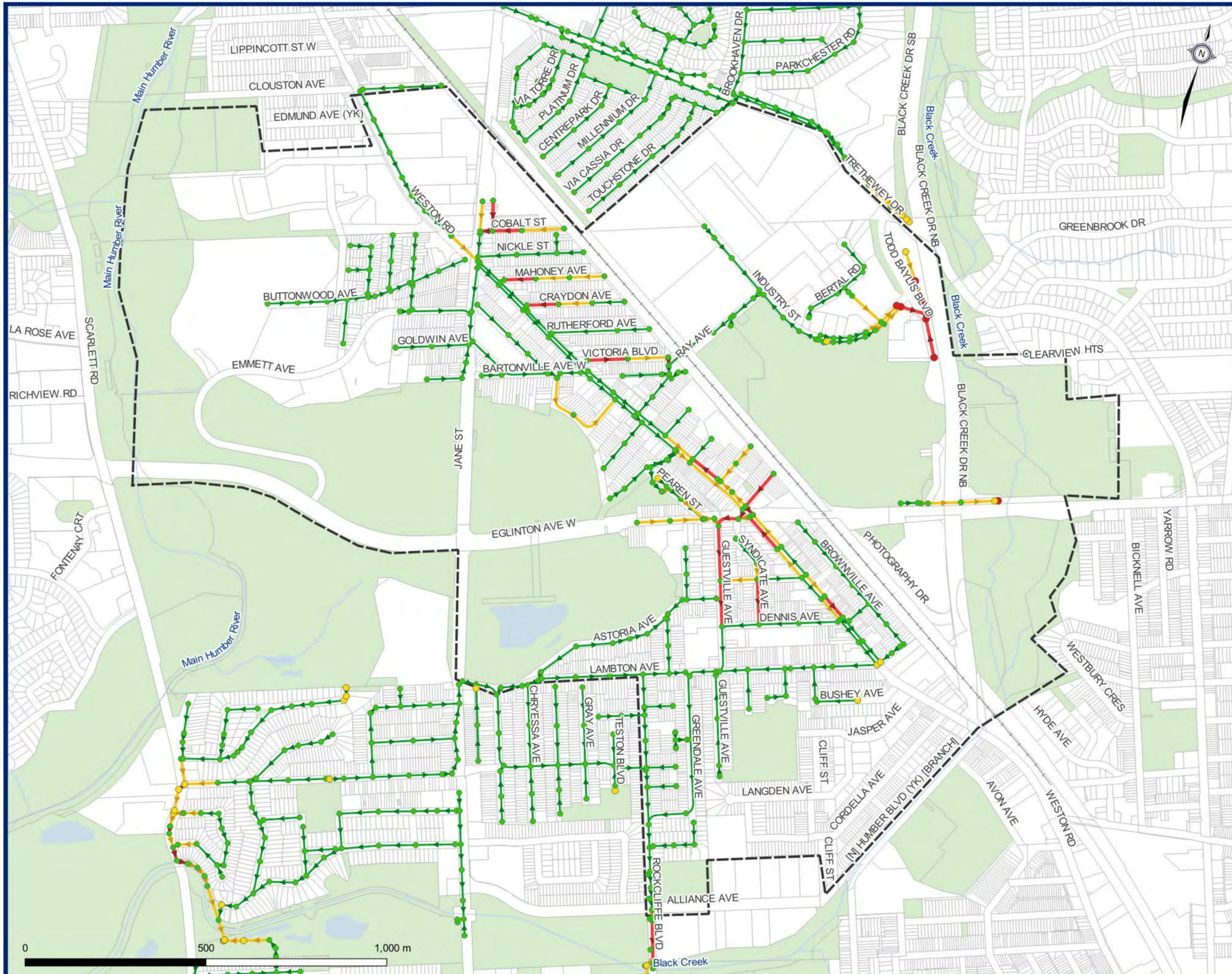
Table 14 – Results for Storm System (5-Year 6-Hour Chicago Design Storm) for Sewer Profiles along Industry Street

Figure 18	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3888605598.1	1	0.51	0.51
	MH3886705660.1	1	0.51	0.51
	MH3887005721.1	2	0.37	0.37
	MH3888405763.1	1	0.37	0.37
	MH3890905801.1	1	0.47	0.47
	MH3894805835.1	1	0.49	0.49
	MH3900205864.A	1	0.49	0.49
Maximum Downstream Flow (L/s)	MH3888605598.1	2,158.50	2,069.97	2,069.04
	MH3886705660.1	2,166.84	2,082.53	2,081.60
	MH3887005721.1	2,182.66	2,095.57	2,094.64
	MH3888405763.1	2,933.34	2,099.33	2,098.42
	MH3890905801.1	2,430.13	2,121.79	2,120.84
	MH3894805835.1	2,390.19	2,282.76	2,281.90
	MH3900205864.A	2,391.30	2,284.46	2,283.56
Maximum Velocity (m/s)	MH3888605598.1	2.61	2.82	2.82
	MH3886705660.1	2.53	2.82	2.82
	MH3887005721.1	3.69	4.40	4.40
	MH3888405763.1	11.49	4.41	4.41
	MH3890905801.1	5.91	3.18	3.18
	MH3894805835.1	3.71	3.24	3.24
	MH3900205864.A	2.43	3.25	3.24
HGL (m)	MH3888605598	117.34	115.19	115.19
	MH3886705660	117.06	114.79	114.79
	MH3887005721	116.77	114.15	114.15
	MH3888405763	115.78	112.80	112.80
	MH3890905801	115.15	110.07	110.07
	MH3894805835	111.18	109.66	109.66
	MH3900205864	109.68	109.14	109.14
	MH3900105955	109.04	108.16	108.16
Depth to Ground (m)	MH3888605598	6.912	9.058	9.058
	MH3886705660	6.743	9.012	9.012
	MH3887005721	5.711	8.332	8.332
	MH3888405763	3.852	6.83	6.83
	MH3890905801	1.712	6.787	6.787
	MH3894805835	2.366	3.887	3.887
	MH3900205864	1.891	2.431	2.431
	MH3900105955	1.632	2.51	2.51

5.4.4 100-Year 6-Hour Chicago Design Storm Analysis (Sanitary and Combined)

Under 1 in 100-year Chicago Design Storm conditions, there is one additional manhole (MH3846405657) with high HGL (HGL less than 1.8m below ground) in the Post-Growth sanitary and combined system model results compared to Pre-Growth scenario. This manhole is on Hollis Street near the railway. The sewer profile in **Figure 21** shows this high HGL condition is a result of limited capacity of the 300mm combined sewer on Hollis Street and downstream restriction along Guestville Avenue. **Table 15** presented modelling results of manholes and sewers in the profiles under all scenarios.

Pre-Growth and Post Growth system performance map are presented in **Figure 19** and **Figure 20**.



TORONTO

Mount Dennis Planning Framework

Depth to Water Level

- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State

- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features

- Property Parcels
- Mount Dennis Study Area

Environmental Features

- Watercourses
- Waterbodies
- Green Space

*Pre-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, without additional Mount Dennis Study Area growth.

Figure 19

Pre-Growth Scenario
Sanitary & Combined System
Modelling Results - 100-year Chicago Design Storm

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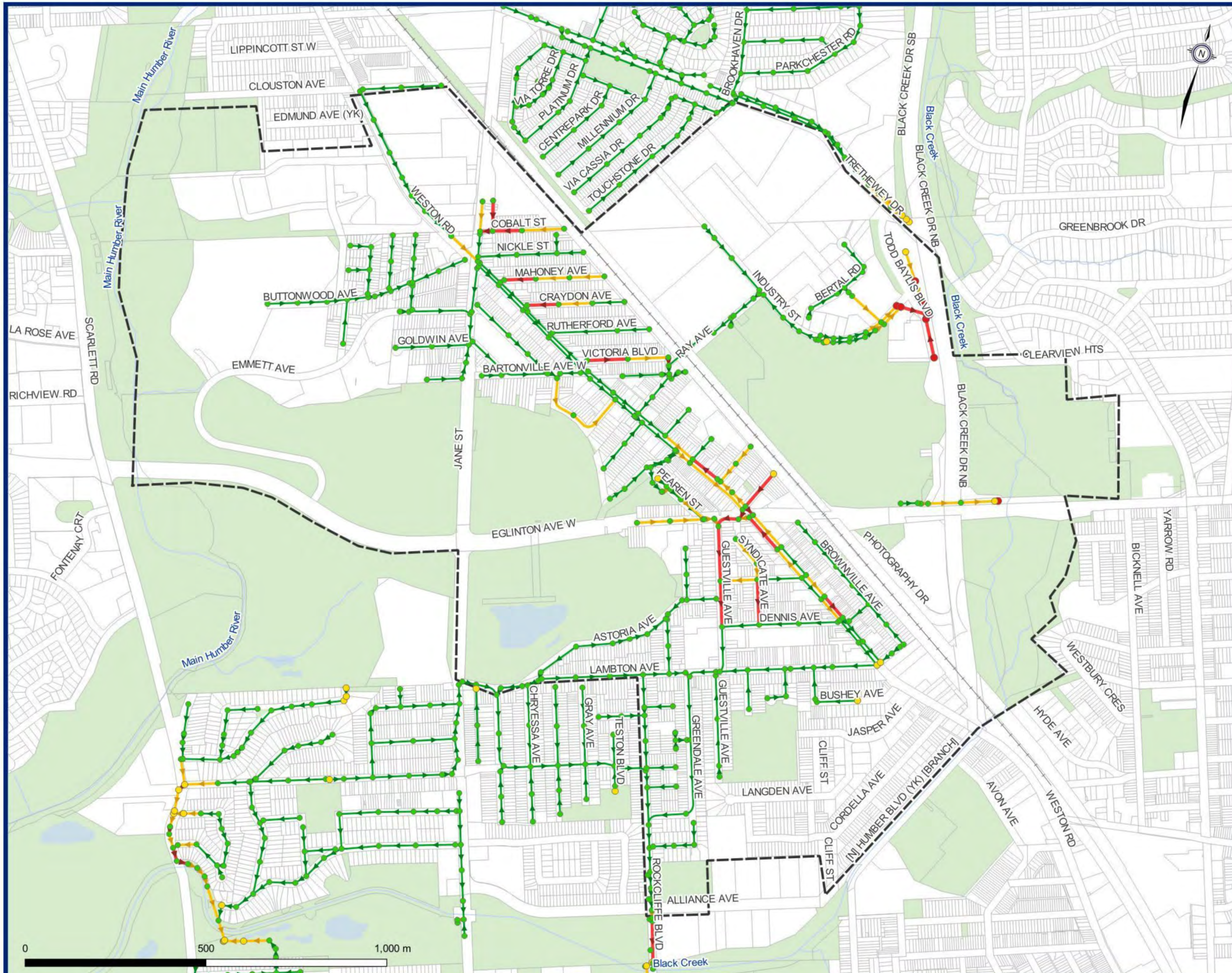

TORONTO

Mount Dennis Planning Framework

Depth to Water Level
- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State
- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

*Post-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, with additional Mount Dennis Study Area growth.

Figure 20
Post-Growth Scenario
Sanitary & Combined System
Modelling Results - 100-year Chicago Design Storm

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November, 2021
719006-WW-002
Projection EPSG:26917

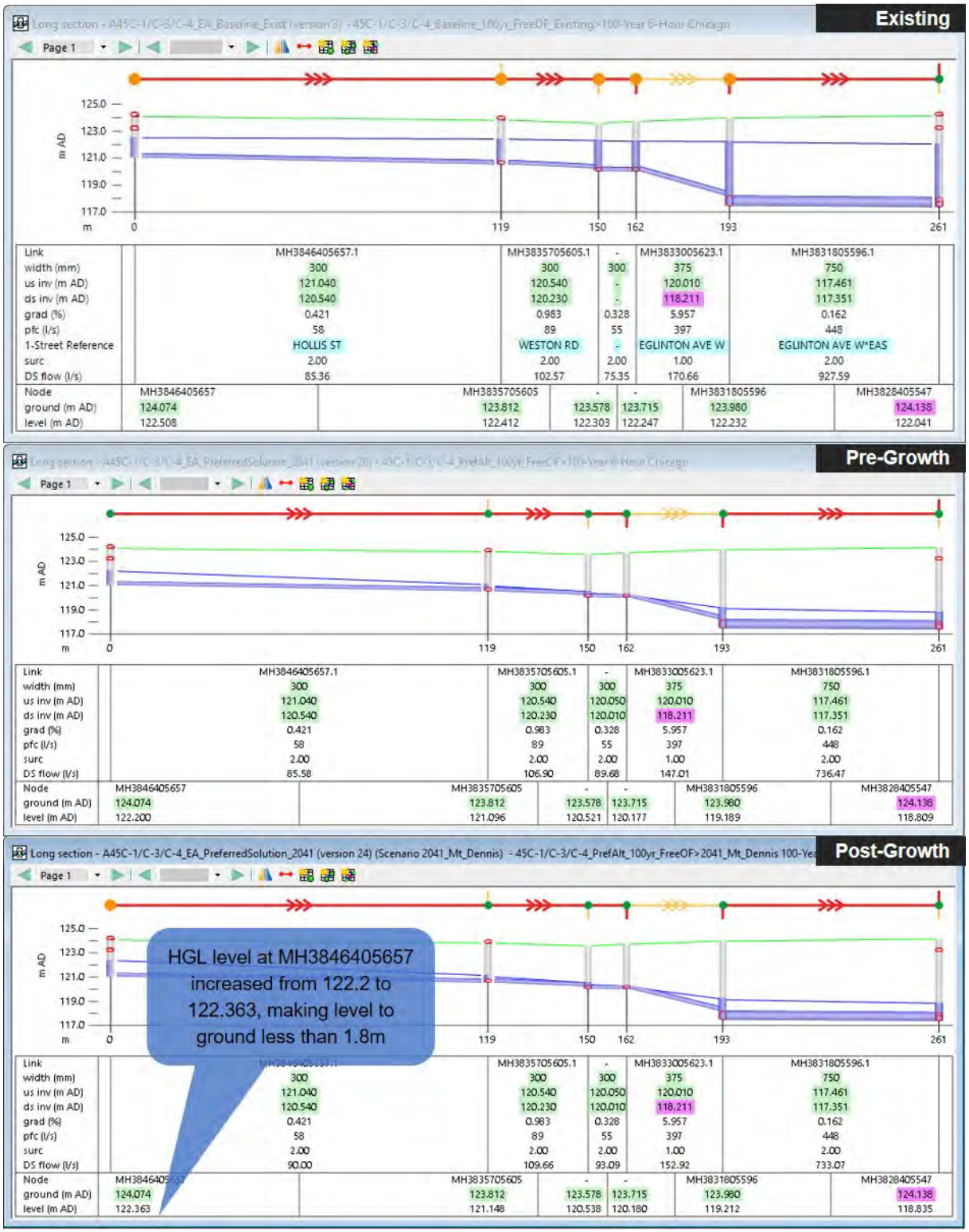

Figure 21 – Pre-Growth and Post-Growth Sewer Profiles showing HGL along Hollis Street and Downstream (100-Year 6-Hour Chicago Design Storm)

Table 15 – Results for Sanitary and Combined System (100-Year 6-Hour Chicago Design Storm) for Sewer Profiles along Hollis Street and Downstream

Figure 21	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3846405657.1	2	2	2
	MH3835705605.1	2	2	2
	MH3833905631.2	2	2	2
	MH3833005623.1	1	1	1
	MH3831805596.1	2	2	2
Maximum Downstream Flow (L/s)	MH3846405657.1	85.58	90.00	85.58
	MH3835705605.1	106.90	109.66	106.90
	MH3833905631.2	89.68	93.09	89.68
	MH3833005623.1	147.01	152.92	147.01
	MH3831805596.1	736.47	733.07	736.47
Maximum Velocity (m/s)	MH3846405657.1	1.25	1.25	1.27
	MH3835705605.1	1.64	1.68	1.68
	MH3833905631.2	1.39	1.52	1.55
	MH3833005623.1	2.99	3.17	3.19
	MH3831805596.1	1.87	1.58	1.57
HGL (m)	MH3846405657	122.51	122.20	122.36
	MH3835705605	122.41	121.10	121.15
	MH3833905631	122.30	120.52	120.54
	MH3833005623	122.25	120.18	120.18
	MH3831805596	122.23	119.19	119.21
	MH3828405547	122.04	118.81	118.84
Depth to Ground (m)	MH3846405657	1.566	1.874	1.711
	MH3835705605	1.4	2.716	2.664
	MH3833905631	1.275	3.057	3.04
	MH3833005623	1.468	3.538	3.535
	MH3831805596	1.748	4.791	4.768
	MH3828405547	2.097	5.329	5.303

Under existing conditions, there is significant surcharging south of Eglinton Avenue. Surcharging by flow starts just north of Eglinton Avenue on Weston Road and continues south along Guestville Avenue, onto Greendale Avenue, to the trunk sewer on Rockcliffe Boulevard. In addition to the surcharged sewers, there are a number of locations showing a risk of basement flooding (less than 1.8 m below cover) or flooding. **Figure 22** and **Figure 23** show the surcharging under existing conditions were significantly mitigated by the preferred sewer upgrade projects, and the additional flow from Mount Dennis Study Area has marginal impact on the overall system performance.

Table 16 and **Table 17** presented modelling results of manholes and sewers in the profiles under all scenarios.

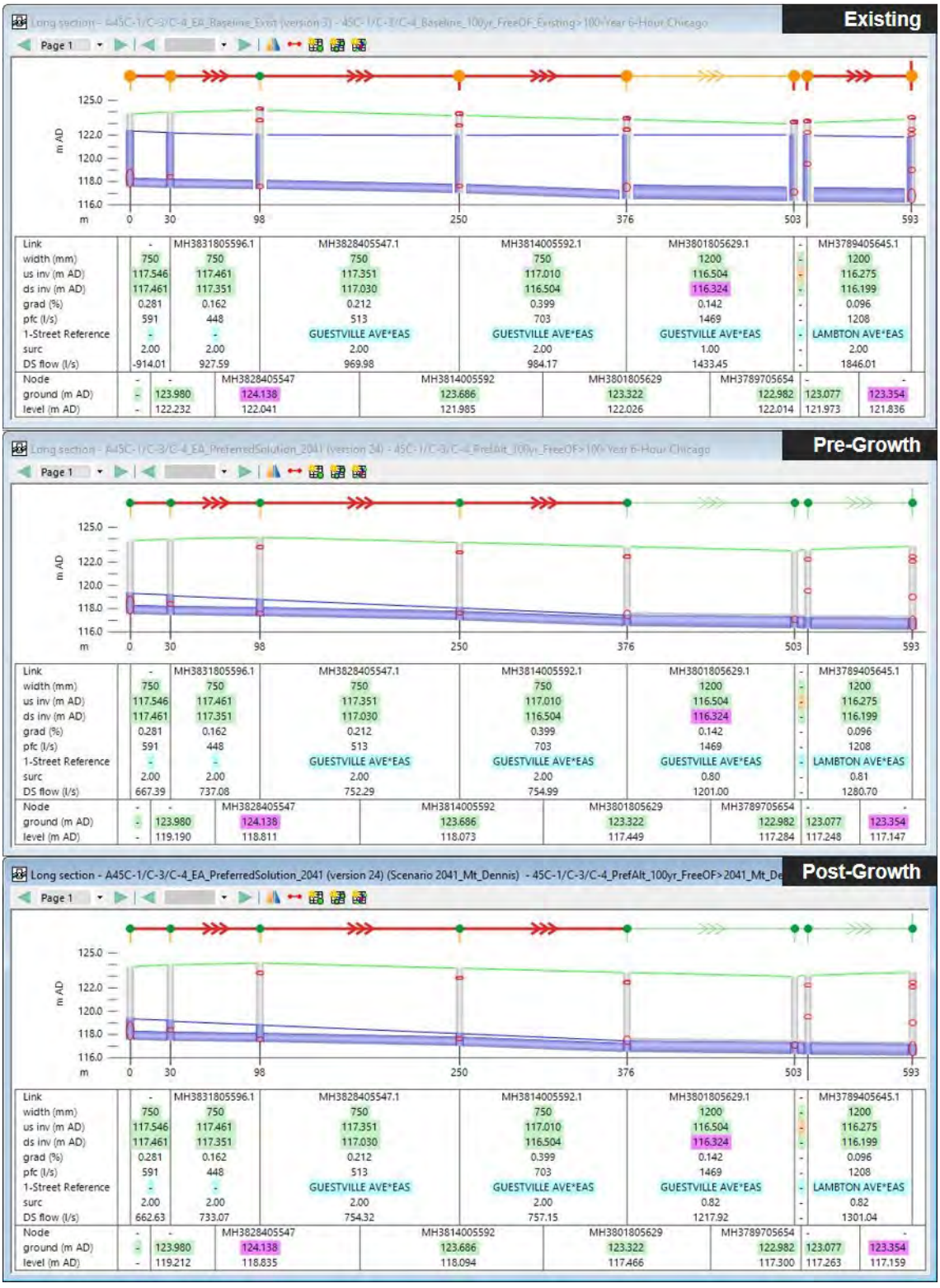

Figure 22 – Sewer Profiles from Weston Road to Greendale Avenue (1 in 100-year Design Storm)

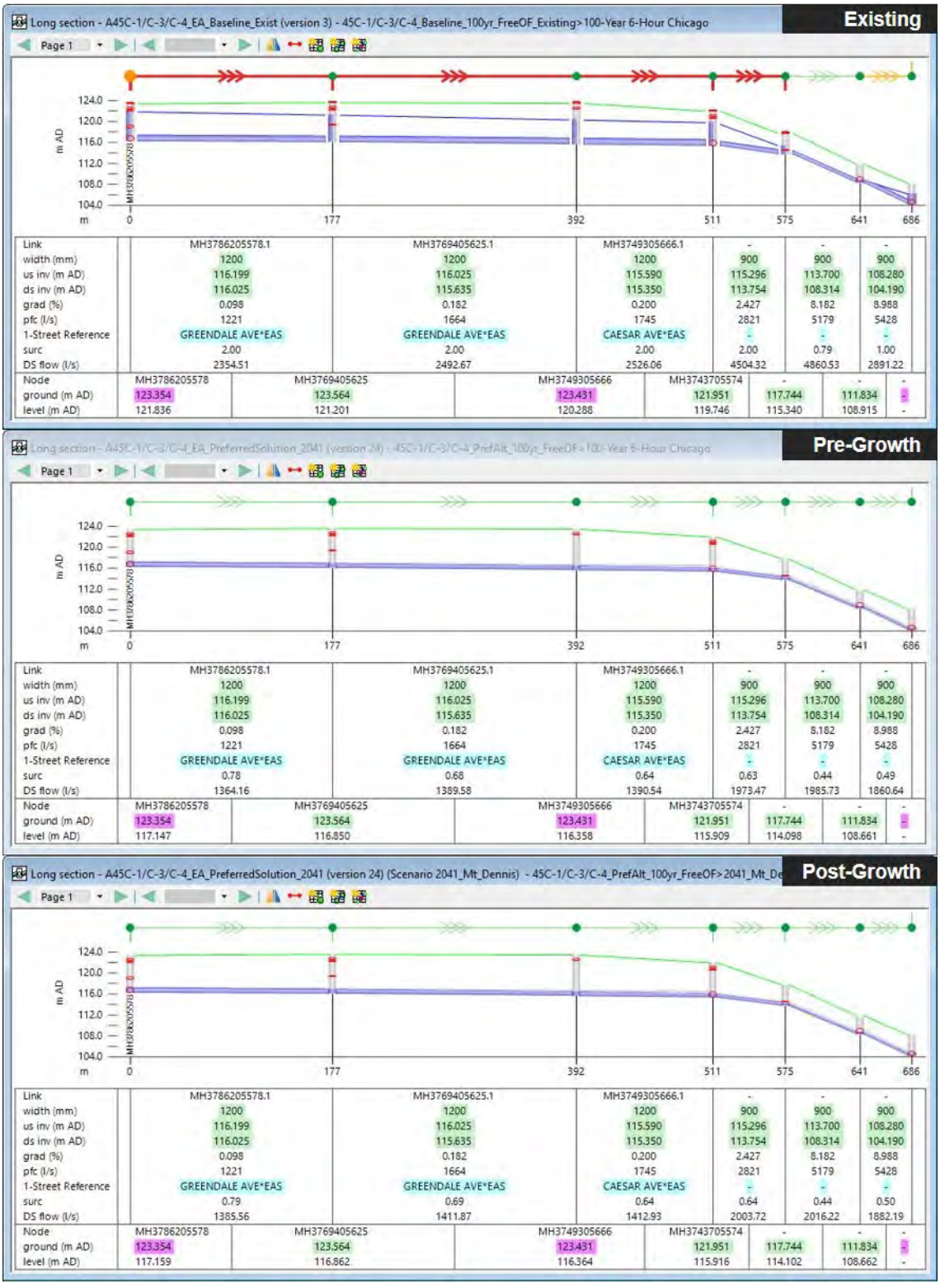

Figure 23 – Sewer Profiles from Greendale Avenue to Rockcliffe Boulevard (1 in 100-year Design Storm)

Table 16 – Results for Sanitary and Combined System (100-Year 6-Hour Chicago Design Storm) for Sewer Profiles from Weston Road to Greendale Avenue

Figure 22	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3834605600.1	2	2	2
	MH3831805596.1	2	2	2
	MH3828405547.1	2	2	2
	MH3814005592.1	2	2	2
	MH3801805629.1	1	0.8	0.82
	MH3789705654.1	1	0.81	0.82
	MH3789405645.1	2	0.81	0.82
Maximum Downstream Flow (L/s)	MH3834605600.1	667.52	662.63	667.52
	MH3831805596.1	736.47	733.07	736.47
	MH3828405547.1	752.12	754.32	752.12
	MH3814005592.1	754.79	757.15	754.79
	MH3801805629.1	1,200.32	1,217.92	1,200.32
	MH3789705654.1	1,263.30	1,284.01	1,263.30
	MH3789405645.1	1,279.96	1,301.04	1,279.96
Maximum Velocity (m/s)	MH3834605600.1	-1.89	1.42	1.41
	MH3831805596.1	1.87	1.58	1.57
	MH3828405547.1	2.01	1.80	1.79
	MH3814005592.1	2.07	1.64	1.65
	MH3801805629.1	1.19	1.24	1.24
	MH3789705654.1	1.47	1.30	1.30
	MH3789405645.1	1.53	1.34	1.34
HGL (m)	MH3834605600	122.39	119.36	119.38
	MH3831805596	122.23	119.19	119.21
	MH3828405547	122.04	118.81	118.84
	MH3814005592	121.99	118.07	118.09
	MH3801805629	122.03	117.45	117.47
	MH3789705654	122.01	117.28	117.30
	MH3789405645	121.97	117.25	117.26
Depth to Ground (m)	MH3834605600	1.44	4.47	4.45
	MH3831805596	1.75	4.79	4.77
	MH3828405547	2.10	5.33	5.30
	MH3814005592	1.70	5.61	5.59
	MH3801805629	1.30	5.87	5.86
	MH3789705654	0.97	5.70	5.68
	MH3789405645	1.10	5.83	5.81

Table 17- Results for Sanitary and Combined System (100-Year 6-Hour Chicago Design Storm) for Sewer Profiles from Greendale Avenue to Rockcliffe Boulevard

Figure 23	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3786205578.1	2	0.78	0.79
	MH3769405625.1	2	0.68	0.69
	MH3749305666.1	2	0.63	0.64
	MH3743705574.1	2	0.63	0.64
	MH3737605593.1	0.79	0.44	0.44
	MH3731305612.2	1	0.49	0.5
Maximum Downstream Flow (L/s)	MH3786205578.1	1,363.31	1,385.56	1,363.31
	MH3769405625.1	1,388.53	1,411.87	1,388.53
	MH3749305666.1	1,389.41	1,412.93	1,389.41
	MH3743705574.1	1,971.40	2,003.72	1,971.40
	MH3737605593.1	1,983.66	2,016.22	1,983.66
	MH3731305612.2	1,859.19	1,882.19	1,859.19
Maximum Velocity (m/s)	MH3786205578.1	1.89	1.66	1.67
	MH3769405625.1	2.10	1.95	1.96
	MH3749305666.1	2.62	2.24	2.26
	MH3743705574.1	6.81	4.64	4.68
	MH3737605593.1	9.09	7.37	7.41
	MH3731305612.2	6.10	5.96	5.99
HGL (m)	MH3786205578	121.84	117.15	117.16
	MH3834605600	122.39	119.36	119.38
	MH3831805596	122.23	119.19	119.21
	MH3828405547	122.04	118.81	118.84
	MH3814005592	121.99	118.07	118.09
	MH3801805629	122.03	117.45	117.47
	MH3789705654	122.01	117.28	117.30
	MH3789405645	121.97	117.25	117.26
	MH3786205578	121.84	117.15	117.16
Depth to Ground (m)	MH3786205578	1.52	6.21	6.19
	MH3834605600	1.52	6.21	6.19
	MH3831805596	2.36	6.71	6.70
	MH3828405547	3.14	7.07	7.07
	MH3814005592	2.21	6.04	6.04
	MH3801805629	2.40	3.65	3.64
	MH3789705654	2.92	3.17	3.17
	MH3789405645	2.04	3.53	3.52
	MH3786205578	1.52	6.21	6.19

5.4.5 100-Year 6-Hour Chicago Design Storm Analysis (Storm)

Under 1 in 100-year Chicago Design Storm conditions, there are no additional manholes with high HGL issues in the Post-Growth storm system model results compared to Pre-Growth model results, as presented in **Figure 24** and **Figure 25**.

Under existing conditions, the 100-year storm on the stormwater system caused extensive surcharge conditions and a number of locations showing risk of basement flooding (less than 1.8 m below cover) or flooding across the catchment area. Primary storm sewers surcharging includes Eglinton Avenue west of Jane Street, as well as Ray Avenue and Industry Street to Black Creek Drive.

Figure 26 and **Figure 27** show examples of primary storm sewers surchargings and high HGL issues under existing conditions were mostly mitigated by the preferred sewer upgrade projects with only a few manholes still showing risk of basement flooding, and the additional flow from Mount Dennis Study Area has marginal impact on the overall system performance. **Table 18** and **Table 19** presented modelling results of manholes and sewers in the profiles under all scenarios.

TORONTO

Mount Dennis Planning Framework

Depth to Water Level
- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State
- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

*Pre-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, without additional Mount Dennis Study Area growth.

Figure 24
Pre-Growth Scenario
Storm System
Modelling Results - 100-year Chicago Design Storm

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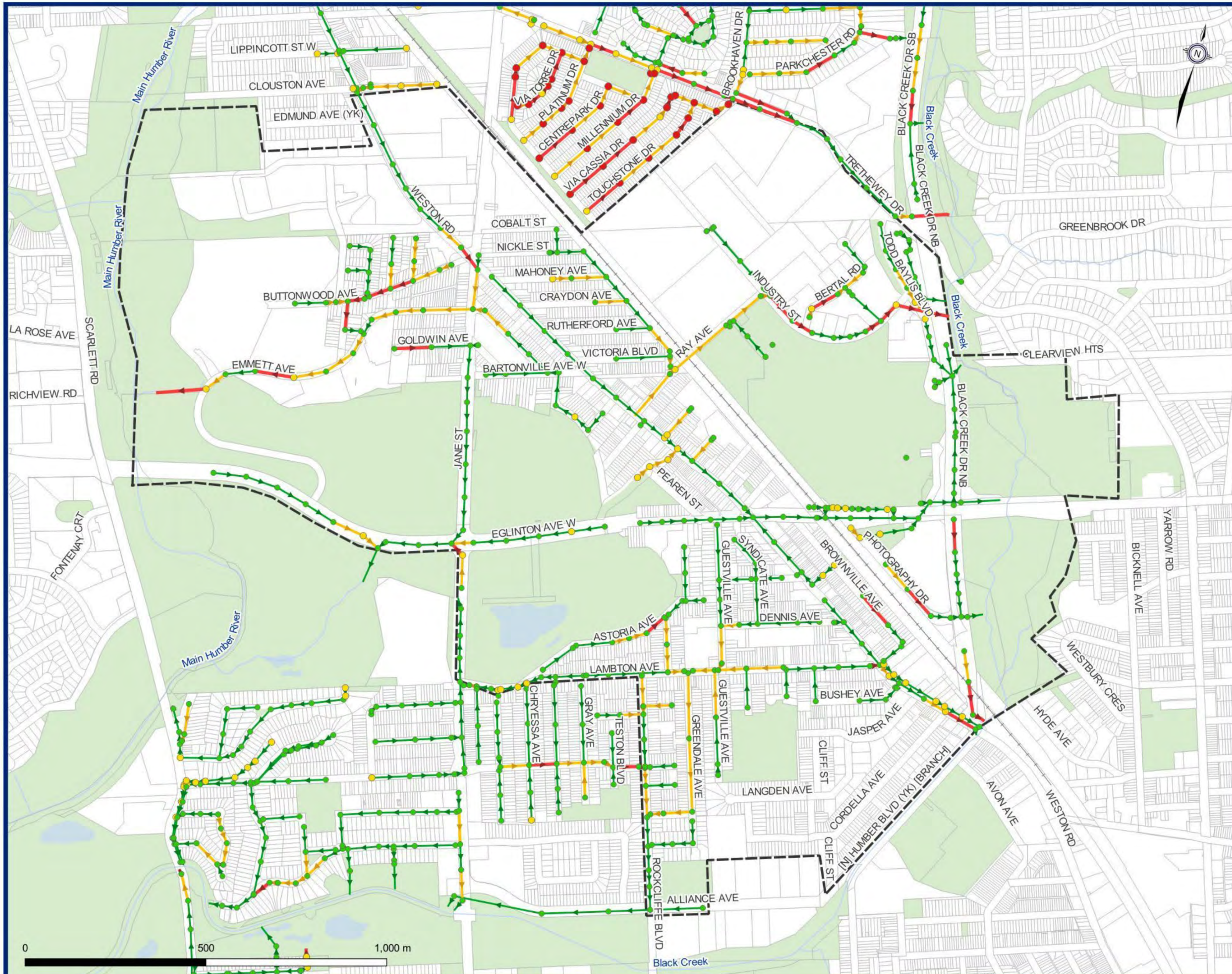
November, 2021
719006-WW-003
Projection EPSG:26917

0 500 1,000 m



TORONTO

Mount Dennis Planning Framework

Depth to Water Level

- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State

- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features

- Property Parcels
- Mount Dennis Study Area

Environmental Features

- Watercourses
- Waterbodies
- Green Space

*Post-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, with additional Mount Dennis Study Area growth.

Figure 25

Post-Growth Scenario
Storm System

Modelling Results - 100-year Chicago Design Storm

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November, 2021
719006-WW-002
Projection EPSG:26917

Figure 26 – Sewer Profiles from Eglinton Avenue to Godwin Avenue (1 in 100-year Design Storm)

Figure 27 – Sewer Profiles along Ray Avenue (1 in 100-year Design Storm)

Table 18 – Results for Storm System (100-Year 6-Hour Chicago Design Storm) for Sewer Profiles from Eglinton Avenue to Godwin Avenue

Figure 26	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3859004756.1	2	0.53	0.53
	MH3850204771.1	2	0.52	0.52
	MH3843604787.1	2	0.47	0.47
	MH3835804808.1	2	0.5	0.5
	MH3826904828.1	1	0.48	0.48
	MH3818004849.1	2	0.78	0.78
	MH3809204868.1	2	0.7	0.7
	MH3804704847.1	1	0.68	0.68
	MH3801904760.1	1	0.66	0.66
	MH3800404670.1	1	0.51	0.51
Maximum Downstream Flow (L/s)	MH3859004756.1	316.24	670.07	670.03
	MH3850204771.1	348.86	784.27	784.20
	MH3843604787.1	399.35	889.18	889.11
	MH3835804808.1	509.26	1,065.53	1,065.43
	MH3826904828.1	499.34	1,141.95	1,141.84
	MH3818004849.1	672.30	1,341.82	1,341.67
	MH3809204868.1	705.71	1,421.51	1,421.35
	MH3804704847.1	1,118.32	2,266.75	2,266.58
	MH3801904760.1	1,134.78	2,448.85	2,448.69
	MH3800404670.1	1,171.86	2,532.92	2,532.76
Maximum Velocity (m/s)	MH3859004756.1	1.77	2.84	2.84
	MH3850204771.1	2.80	3.37	3.37
	MH3843604787.1	2.63	4.34	4.34
	MH3835804808.1	2.46	4.86	4.86
	MH3826904828.1	2.20	4.51	4.51
	MH3818004849.1	2.12	2.18	2.18
	MH3809204868.1	2.39	2.56	2.56
	MH3804704847.1	2.16	2.76	2.76
	MH3801904760.1	2.36	3.12	3.12
	MH3800404670.1	2.90	4.32	4.32
HGL (m)	MH3859004756	123.79	120.37	120.37
	MH3850204771	122.48	118.87	118.87
	MH3843604787	119.79	116.56	116.56
	MH3835804808	115.78	112.43	112.43
	MH3826904828	111.20	107.21	107.21
	MH3818004849	106.78	103.94	103.94
	MH3809204868	105.74	103.47	103.47
	MH3804704847	105.40	103.08	103.08
	MH3801904760	104.97	102.42	102.42
	MH3800404670	104.58	101.66	101.66

Figure 26	Model ID	Existing	Pre-Growth	Post-Growth
	MH3798304653	104.37	100.84	100.84
Depth to Ground (m)	MH3859004756	-0.12	3.30	3.30
	MH3850204771	-0.11	3.49	3.49
	MH3843604787	-0.11	3.13	3.13
	MH3835804808	-0.02	3.32	3.32
	MH3826904828	-0.14	3.85	3.85
	MH3818004849	-0.05	2.79	2.79
	MH3809204868	-0.46	1.81	1.81
	MH3804704847	-0.15	2.18	2.18
	MH3801904760	-0.20	2.35	2.35
	MH3800404670	-0.11	2.81	2.81
	MH3798304653	-1.27	2.26	2.26

Table 19 – Results for Storm System (100-Year 6-Hour Chicago Design Storm) for Sewer Profiles along Ray Avenue

Figure 27	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3851905245.2	2	1	1
	MH3865605309.1	2	1	1
	MH3867205320.1	2	1	1
	MH3882605425.1	2	1	1
	MH3883805433.1	2	1	1
	MH3892905496.1	1	1	1
Maximum Downstream Flow (L/s)	MH3851905245.2	-2,106.97	1,079.21	1,103.38
	MH3865605309.1	-2,077.36	1,128.86	1,152.05
	MH3867205320.1	2,183.32	3,311.98	3,311.67
	MH3882605425.1	2,324.98	3,268.59	3,268.19
	MH3883805433.1	2,714.99	3,391.10	3,403.36
	MH3892905496.1	2,719.87	3,424.46	3,436.47
Maximum Velocity (m/s)	MH3851905245.2	-2.61	2.20	2.20
	MH3865605309.1	-3.48	3.06	3.02
	MH3867205320.1	2.36	3.09	3.09
	MH3882605425.1	2.51	3.06	3.06
	MH3883805433.1	2.98	2.83	2.83
	MH3892905496.1	3.00	2.59	2.58
HGL (m)	MH3851905245	122.46	119.43	119.45
	MH3865605309	122.29	119.36	119.39
	MH3867205320	122.24	119.34	119.37
	MH3882605425	121.79	118.49	118.51
	MH3883805433	121.74	118.38	118.40
	MH3892905496	121.30	117.84	117.86
	MH3893705521	121.08	117.48	117.49
Depth to Ground (m)	MH3851905245	1.53	4.55	4.53
	MH3865605309	-0.09	2.84	2.81
	MH3867205320	-1.14	1.76	1.73
	MH3882605425	2.59	5.89	5.87
	MH3883805433	2.69	6.05	6.03
	MH3892905496	3.63	7.08	7.07
	MH3893705521	3.67	7.28	7.26

5.4.6 May 12th, 2000 Historic Rainfall Event Analysis (Sanitary and Combined)

Under the historic rainfall event on May 12th, 2000, there are no additional manholes with high HGL issues in the Post-Growth storm system model results compared to Pre-Growth model results, as presented in **Figure 28** and **Figure 29**.

Under existing conditions, the primary location for surcharging by flow starts just north of Eglinton Avenue on Weston Road and continues south along Guestville Avenue, onto Greendale Avenue and eventually to the trunk sewer on Rockcliffe Boulevard. **Figure 30** and **Figure 31** show the surcharging under existing conditions were mitigated by the preferred sewer upgrade projects, and the additional flow from Mount Dennis Study Area has marginal impact on the overall system performance. **Table 20** and **Table 21** presented modelling results of manholes and sewers in the profiles under all scenarios.

TORONTO

Mount Dennis Planning Framework

Depth to Water Level
- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State
- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

*Pre-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, without additional Mount Dennis Study Area growth.

Figure 28

Pre-Growth Scenario
Sanitary & Combined System

Modelling Results - May 12, 2000 Storm

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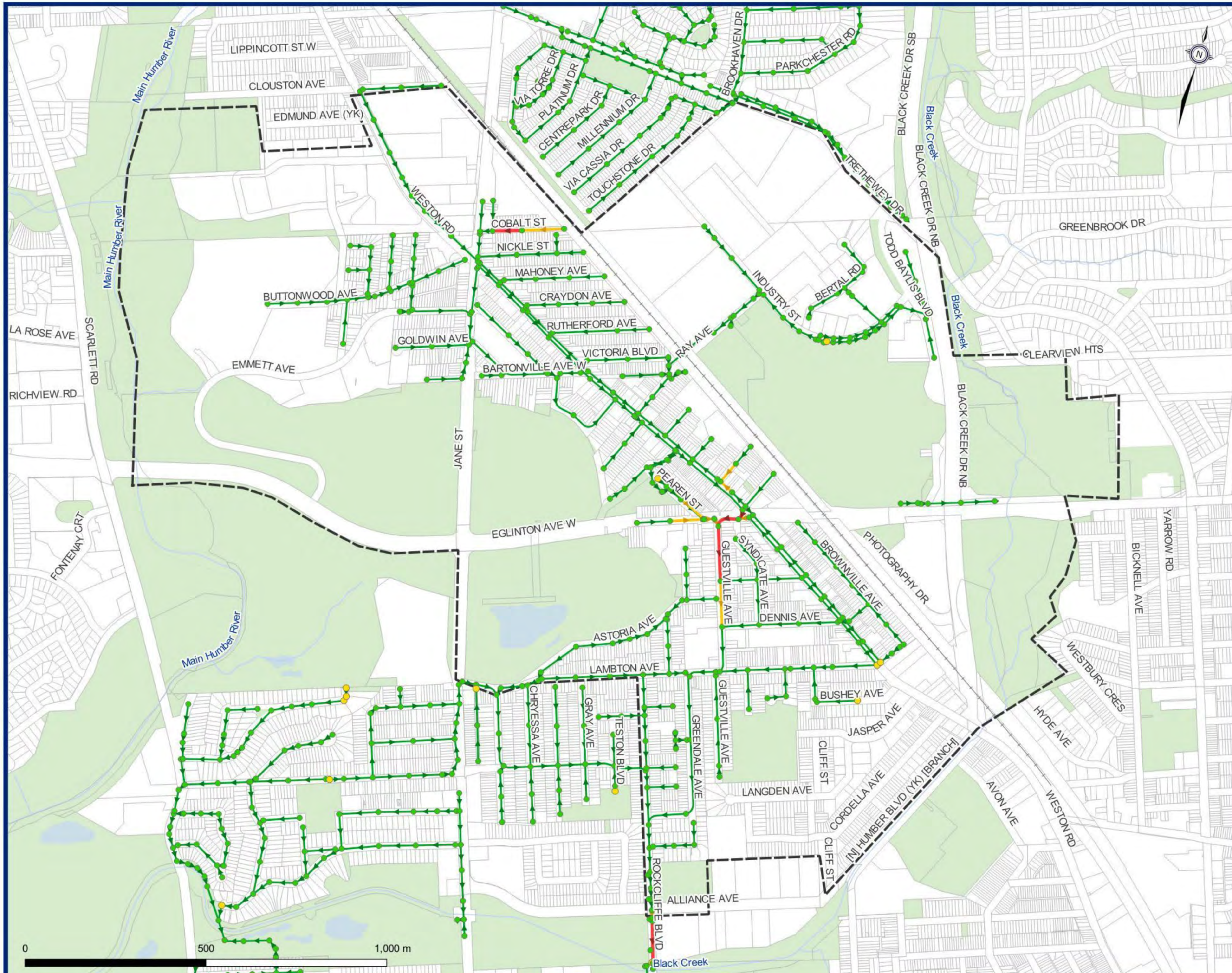
November, 2021
719006-WW-003
Projection EPSG:26917

0 500 1,000 m



TORONTO

Mount Dennis Planning Framework

Depth to Water Level

- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State

- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features

- Property Parcels
- Mount Dennis Study Area

Environmental Features

- Watercourses
- Waterbodies
- Green Space

*Post-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, with additional Mount Dennis Study Area growth.

Figure 29

Post-Growth Scenario Sanitary & Combined System

Modelling Results - May 12, 2000 Storm

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November, 2021
719006-WW-002
Projection EPSG:26917

Figure 30 – Sewer Profiles from Weston Road to Greendale Avenue (May 12th, 2000 Event)

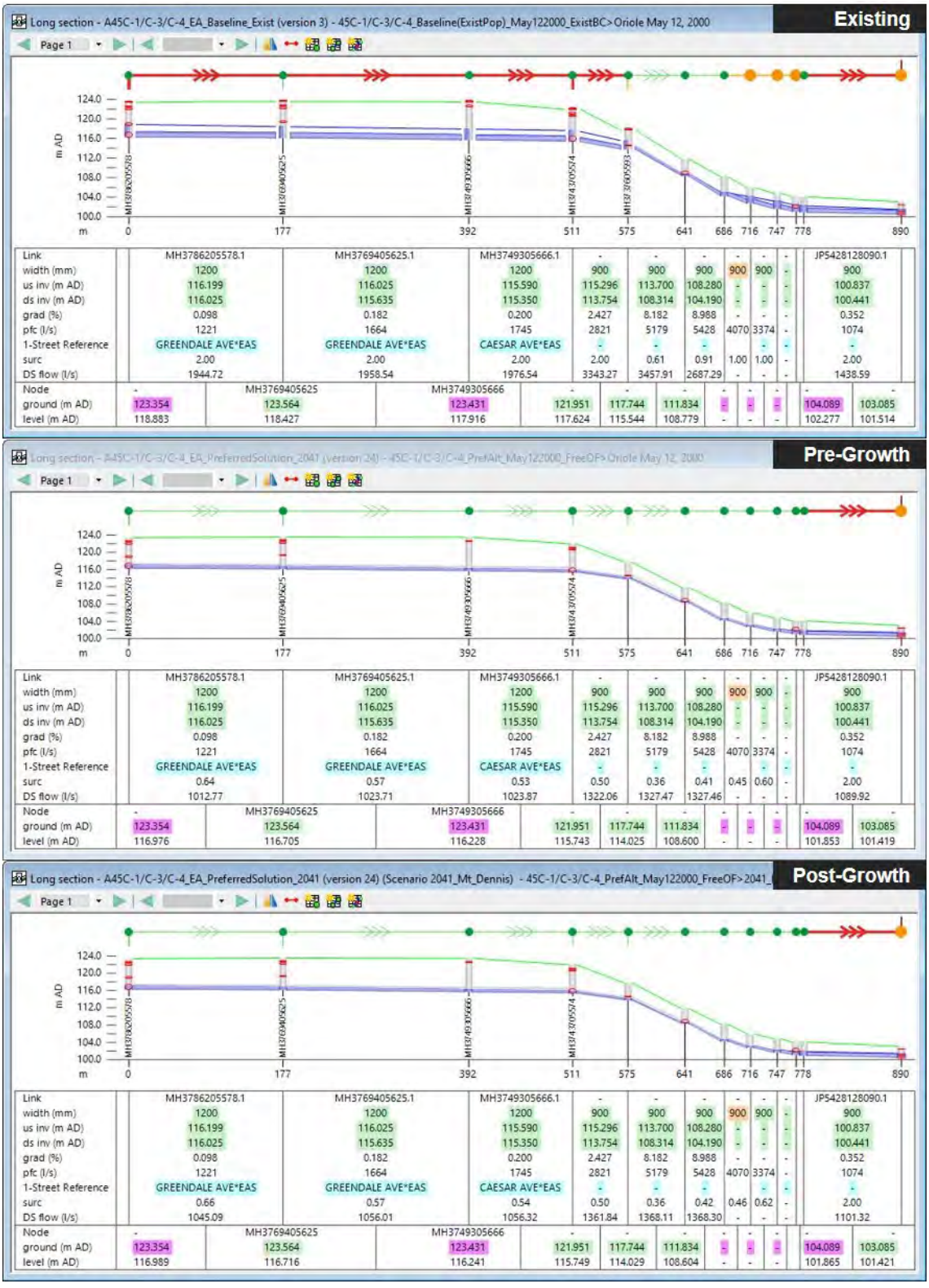

Figure 31 – Sewer Profiles from Greendale Avenue to Rockcliffe Boulevard (May 12th, 2000 Event)

Table 20 – Results for Sanitary and Combined System (May 12th, 2000 Historic Event) for Sewer Profiles from Weston Road to Greendale Avenue

Figure 30	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3843305426.1	1	0.87	0.89
	MH3834605600.1	2	2	2
	MH3831805596.1	2	2	2
	MH3828405547.1	2	2	2
	MH3814005592.1	1	0.98	1
	MH3801805629.1	1	0.64	0.65
	MH3789705654.1	1	0.66	0.67
	MH3789405645.1	2	0.66	0.67
Maximum Downstream Flow (L/s)	MH3843305426.1	633.46	624.59	627.01
	MH3834605600.1	634.16	624.18	627.22
	MH3831805596.1	654.84	650.24	656.42
	MH3828405547.1	677.30	666.09	673.74
	MH3814005592.1	690.62	668.70	676.50
	MH3801805629.1	1,162.62	909.02	934.71
	MH3789705654.1	1,379.83	958.96	988.90
	MH3789405645.1	1,464.02	968.50	998.97
Maximum Velocity (m/s)	MH3843305426.1	0.77	0.76	0.76
	MH3834605600.1	1.36	1.35	1.35
	MH3831805596.1	1.42	1.41	1.43
	MH3828405547.1	1.80	1.79	1.79
	MH3814005592.1	1.59	1.58	1.57
	MH3801805629.1	1.20	1.21	1.22
	MH3789705654.1	1.18	1.22	1.23
	MH3789405645.1	1.27	1.25	1.27
HGL (m)	MH3843305426	119.40	118.86	118.90
	MH3834605600	119.40	118.85	118.89
	MH3831805596	119.38	118.66	118.70
	MH3828405547	119.33	118.30	118.33
	MH3814005592	119.24	117.70	117.73
	MH3801805629	119.16	117.24	117.26
	MH3789705654	119.06	117.09	117.10
	MH3789405645	119.01	117.06	117.08
Depth to Ground (m)	MH3843305426	3.86	4.40	4.36
	MH3834605600	4.43	4.98	4.94
	MH3831805596	4.60	5.32	5.28
	MH3828405547	4.81	5.84	5.81
	MH3814005592	4.45	5.98	5.96
	MH3801805629	4.17	6.09	6.07
	MH3789705654	3.93	5.90	5.88
	MH3789405645	4.07	6.01	6.00
	MH3786205578	4.47	6.38	6.36

Table 21 – Results for Sanitary and Combined System (May 12th, 2000 Historic Event) for Sewer Profiles from Greendale Avenue to Rockcliffe Boulevard

Figure 31	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3786205578.1	2	0.64	0.66
	MH3769405625.1	2	0.57	0.57
	MH3749305666.1	2	0.53	0.54
	MH3743705574.1	2	0.5	0.5
	MH3737605593.1	0.61	0.36	0.36
	MH3731305612.2	0.91	0.41	0.42
	JP5428128110.1	1	0.45	0.46
	JP5428128111.1	1	0.6	0.62
	JP5428128112.1	1	0.98	1
	MH3719105650.2	1	1	1
	JP5428128090.1	2	2	2
Maximum Downstream Flow (L/s)	MH3786205578.1	1,944.72	1,012.77	1,045.09
	MH3769405625.1	1,958.54	1,023.71	1,056.01
	MH3749305666.1	1,976.54	1,023.87	1,056.32
	MH3743705574.1	3,343.27	1,322.06	1,361.84
	MH3737605593.1	3,457.91	1,327.47	1,368.11
	MH3731305612.2	2,687.29	1,327.46	1,368.30
	JP5428128110.1	2,687.34	1,327.26	1,368.53
	JP5428128111.1	2,687.38	1,326.73	1,368.72
	JP5428128112.1	2,687.39	1,326.96	1,368.73
	MH3719105650.2	1,438.54	1,089.73	1,101.18
	JP5428128090.1	1,438.59	1,089.92	1,101.32
Maximum Velocity (m/s)	MH3786205578.1	1.74	1.53	1.55
	MH3769405625.1	2.06	1.84	1.85
	MH3749305666.1	2.53	2.02	2.04
	MH3743705574.1	5.35	4.20	4.27
	MH3737605593.1	8.52	6.46	6.55
	MH3731305612.2	6.09	5.38	5.43
	JP5428128110.1	5.03	4.79	4.80
	JP5428128111.1	4.00	3.60	3.61
	JP5428128112.1	4.02	2.38	2.27
	MH3719105650.2	2.15	1.65	1.67
	JP5428128090.1	2.18	1.90	1.67
HGL (m)	MH3786205578	118.88	116.98	116.99
	MH3769405625	118.43	116.70	116.72
	MH3749305666	117.92	116.23	116.24
	MH3743705574	117.62	115.74	115.75
	MH3737605593	115.54	114.03	114.03
	MH3731305612	108.78	108.60	108.60
	JP5428128110	105.00	104.56	104.57

Figure 31	Model ID	Existing	Pre-Growth	Post-Growth
	JP5428128111	104.16	103.07	103.08
	JP5428128112	103.22	102.13	102.15
	MH3719105650	102.41	101.91	101.92
	JP5428128090	102.28	101.85	101.87
	MH3707405683	101.51	101.42	101.42
Depth to Ground (m)	MH3769405625	5.14	6.86	6.85
	MH3749305666	5.52	7.20	7.19
	MH3743705574	4.33	6.21	6.20
	MH3737605593	2.20	3.72	3.72
	MH3731305612	3.06	3.23	3.23
	JP5428128110	3.16	3.60	3.59
	JP5428128111	1.79	2.88	2.87
	JP5428128112	1.59	2.68	2.66
	MH3719105650	1.63	2.13	2.11
	JP5428128090	1.81	2.24	2.22
	MH3707405683	1.57	1.67	1.66

5.4.7 May 12th, 2000 Historic Rainfall Event Analysis (Storm)

Under the historic rainfall event on May 12th, 2000, there are no additional manholes with high HGL issues in the Post-Growth storm system model results compared to Pre-Growth model results, as presented in **Figure 32** and **Figure 33**.

Under existing conditions, the 100-year storm on the stormwater system caused surcharge conditions and a number of locations showing risk of basement flooding (less than 1.8 m below cover) or flooding. Primary storm sewers surcharging include Eglinton Avenue west of Jane Street, as well as Ray Avenue and Industry Street to Black Creek Drive. **Figure 34** and **Figure 35** show examples of primary storm sewers surcharging under existing conditions were mitigated by the preferred sewer upgrade projects, and the additional flow from Mount Dennis Study Area has marginal impact on the overall system performance. **Table 22** and **Table 23** presented modelling results of manholes and sewers in the profiles under all scenarios.

TORONTO

Mount Dennis Planning Framework

Depth to Water Level
- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State
- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

*Pre-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, without additional Mount Dennis Study Area growth.

Figure 32

Pre-Growth Scenario Storm System

Modelling Results - May 12, 2000 Storm

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November, 2021
719006-WW-003
Projection EPSG:26917

0 500 1,000 m

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TORONTO

Mount Dennis Planning Framework

Depth to Water Level
- Above Surface
- 0 - 1.8m
- > 1.8m

Sewer Surcharge State
- No Surcharge (Surcharge State <1)
- Surcharged by Depth (Surcharge State = 1)
- Surcharged by Flow (Surcharge State = 2)

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

*Post-Growth Scenario is the received A45 model with 2041 projection and preferred sewer upgrade projects, with additional Mount Dennis Study Area growth.

Figure 33

Post-Growth Scenario Storm System

Modelling Results - May 12, 2000 Storm

BluePlan ENGINEERING

November, 2021
719006-WW-002
Projection EPSG:26917

0 500 1,000 m

Figure 34 – Sewer Profiles along Eglinton Avenue (May 12th, 2000 Event)

Figure 35 – Sewer Profiles along Industry Street (May 12th, 2000 Event)

Table 22 – Results for Storm System (May 12th, 2000 Historic Event) for Sewer Profiles along Eglinton Avenue

Figure 34	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3809404991.1	1	0.45	0.45
	MH3806504905.1	1	0.5	0.5
	MH3804704847.1	1	0.45	0.45
	MH3801904760.1	1	0.45	0.45
	MH3800404670.1	1	0.37	0.37
	MH3798304653.1	2	0.5	0.5
Maximum Downstream Flow (L/s)	MH3809404991.1	193.22	199.56	199.56
	MH3806504905.1	197.22	250.12	249.97
	MH3804704847.1	836.68	1,128.01	1,127.53
	MH3801904760.1	1,018.57	1,306.13	1,305.62
	MH3800404670.1	1,067.33	1,342.95	1,342.47
	MH3798304653.1	-1,076.59	1,913.37	1,912.92
Maximum Velocity (m/s)	MH3809404991.1	1.56	1.63	1.63
	MH3806504905.1	0.83	1.99	1.99
	MH3804704847.1	1.96	2.31	2.31
	MH3801904760.1	1.94	2.68	2.68
	MH3800404670.1	1.99	3.57	3.57
	MH3798304653.1	-1.60	3.38	3.38
HGL (m)	MH3809404991	105.17	104.69	104.69
	MH3806504905	105.09	103.30	103.29
	MH3804704847	105.02	102.92	102.72
	MH3801904760	104.77	102.34	102.14
	MH3800404670	104.45	101.63	101.43
	MH3798304653	104.26	100.94	100.57
	OF3791504652	100.68	0.00	0.00
Depth to Ground (m)	MH3809404991	1.92	2.40	2.40
	MH3806504905	0.69	2.49	2.49
	MH3804704847	0.23	2.33	2.53
	MH3801904760	-0.01	2.43	2.63
	MH3800404670	0.03	2.84	3.04
	MH3798304653	-1.16	2.16	2.53
	OF3791504652	-0.87	99.81	99.81

Table 23 – Results for Storm System (May 12th, 2000 Historic Event) for Sewer Profiles along Industry Street

Figure 35	Model ID	Existing	Pre-Growth	Post-Growth
Maximum Surcharge State	MH3893705521.1	2	0.56	0.56
	MH3888605598.1	1	0.56	0.56
	MH3886705660.1	1	0.56	0.56
	MH3887005721.1	2	0.4	0.4
	MH3888405763.1	1	0.4	0.4
	MH3890905801.1	1	0.53	0.52
	MH3894805835.1	1	0.54	0.54
	MH3900205864.1	1	0.54	0.54
Maximum Downstream Flow (L/s)	MH3893705521.1	2,348.03	2,319.62	2,318.17
	MH3888605598.1	2,276.28	2,371.47	2,369.76
	MH3886705660.1	2,300.29	2,381.73	2,379.70
	MH3887005721.1	2,321.08	2,400.42	2,399.10
	MH3888405763.1	2,387.16	2,410.52	2,409.03
	MH3890905801.1	2,452.50	2,441.74	2,440.12
	MH3894805835.1	2,594.29	2,651.87	2,650.39
	MH3900205864.1	2,594.33	2,646.69	2,644.98
Maximum Velocity (m/s)	MH3893705521.1	2.48	2.84	2.84
	MH3888605598.1	2.57	2.87	2.86
	MH3886705660.1	2.49	2.87	2.87
	MH3887005721.1	4.30	4.53	4.53
	MH3888405763.1	4.89	4.54	4.54
	MH3890905801.1	20.03	3.27	3.27
	MH3894805835.1	3.77	3.38	3.38
	MH3900205864.1	-3.70	3.38	3.38
HGL (m)	MH3893705521	117.94	115.85	115.85
	MH3888605598	117.63	115.27	115.27
	MH3886705660	117.29	114.87	114.87
	MH3887005721	116.95	114.19	114.19
	MH3888405763	115.88	112.84	112.84
	MH3890905801	114.77	110.13	110.13
	MH3894805835	112.54	109.73	109.73
	MH3900205864	110.67	109.21	109.21
	MH3900105955	109.98	108.23	108.23
Depth to Ground (m)	MH3893705521	6.81	8.90	8.90
	MH3888605598	6.62	8.98	8.98
	MH3886705660	6.51	8.93	8.93
	MH3887005721	5.53	8.29	8.29
	MH3888405763	3.75	6.79	6.79
	MH3890905801	2.09	6.73	6.73
	MH3894805835	1.01	3.82	3.82
	MH3900205864	0.90	2.37	2.37
	MH3900105955	0.69	2.44	2.44

5.4.8 Sensitivity Analysis Utilizing Per Capita Rate of 450 L/cap/d

The above analysis was completed based on the per capita rate of 240 L/cap/d for growth population as outlined in **Section 5.1.2.2** of City of Toronto InfoWorks Basement Flooding Model Guideline. The Guideline also notes utilizing a higher per capita rate of 450 L/cap/d for growth population, which is used when confirming the size of the preferred alternatives of the solution development stage. **Table 24** compares the projected flows utilizing two different per capita rates.

Table 24 – Projected Flows Utilizing Different Per Capita Rates

Per Capita Rate	Projected ADWF (L/s)	Projected PDWF (L/s)
240 L/cap/d	61.0	94.0
450 L/cap/d	114.3	170.9

The Post-Growth system performance with two different per capita rates were assessed for the identical storm conditions as future sewer system analysis. Also, the sensitivity analysis was assessed with free outfall condition in order to review the impact of additional sanitary flow from Mount Dennis Study Area.

Demand Conditions:

- Post-Growth scenario
- A45 model with 2041 projection and preferred sewer upgrade projects, plus additional growth utilizing criteria of 240 L/cap/d within Mount Dennis Study Area
- Post-Growth Sensitivity scenario
- A45 model with 2041 projection and preferred sewer upgrade projects, plus additional growth utilizing criteria of 450 L/cap/d within Mount Dennis Study Area

Storm Conditions:

- Dry weather flow
- 5-Year 6-Hour Chicago
- 100-Year 6-Hour Chicago
- Oriole May 12, 2000 (historic event)

Overall, the system performance in the Post-Growth Sensitivity scenario is the same as the Post-Growth scenario except a few additional surcharging combined sewers due to existing system constraints under 1 in 5-year Chicago Design Storm conditions. The additional flow from Mount Dennis Study Area has marginal impact on the overall system performance. The sensitivity analysis confirmed that the preferred solution capital program from the Basement Flooding Study is well-designed and could solve the majority of system performance issues under both existing conditions and future growth.

Dry Weather Flow Analysis

Under dry weather flow conditions, there are no additional sewers surcharging in the Post-Growth Sensitivity scenario compared to Post-Growth scenario. Both sanitary & combined and storm system model results show on constraints.

100-Year 6-Hour Chicago Design Storm Analysis

Under 1 in 100-year Chicago Design Storm conditions, there are no additional manholes with high HGL in the Post-Growth Sensitivity scenario compared to Post-Growth scenario.

May 12th, 2000 Historic Rainfall Event

Under the historic rainfall event on May 12th, 2000, there are no additional manholes with high HGL in the Post-Growth Sensitivity scenario compared to Post-Growth scenario.

5-Year 6-Hour Chicago Design Storm Analysis

Under 1 in 5-year Chicago Design Storm conditions, there are additional surcharging conditions in the Post-Growth Sensitivity scenario compared to Post-Growth scenario.

Under 1 in 5-year Chicago Design Storm conditions, one additional surcharging sewer (JP5428128090.1) is a 900mm combined sewer on Rockcliffe Boulevard from Alliance Avenue to the Black Creek. The sewer profile in **Figure 36** shows this sewer segment has low gradient (0.352%). Thus, the surcharge state could change easily in this sewer segment even with small amount of increased flow.

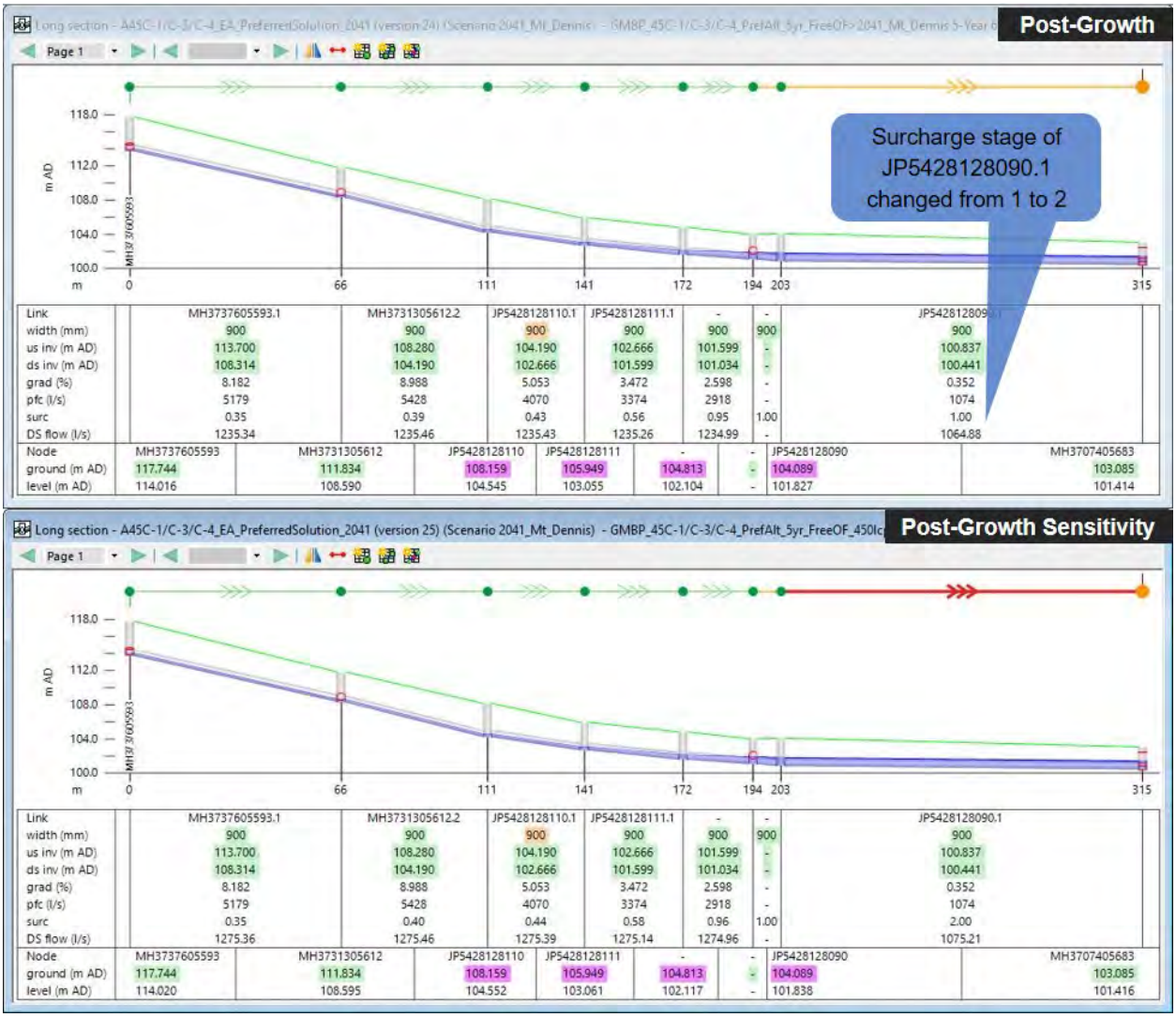

Figure 36 – Post-Growth and Post-Growth Sensitivity Sewer Profiles showing Surcharge State along Rockcliffe Boulevard (5-Year 6-Hour Chicago Design Storm)

Under 1 in 5-year Chicago Design Storm conditions, another additional surcharging sewer (MH3833005623.1) is a 375mm combined sewer on Eglinton Avenue West from Weston Road to Guestville Avenue. The sewer profile in **Figure 37** shows this back-water condition is a result of limited capacity of the downstream 750mm combined sewer.

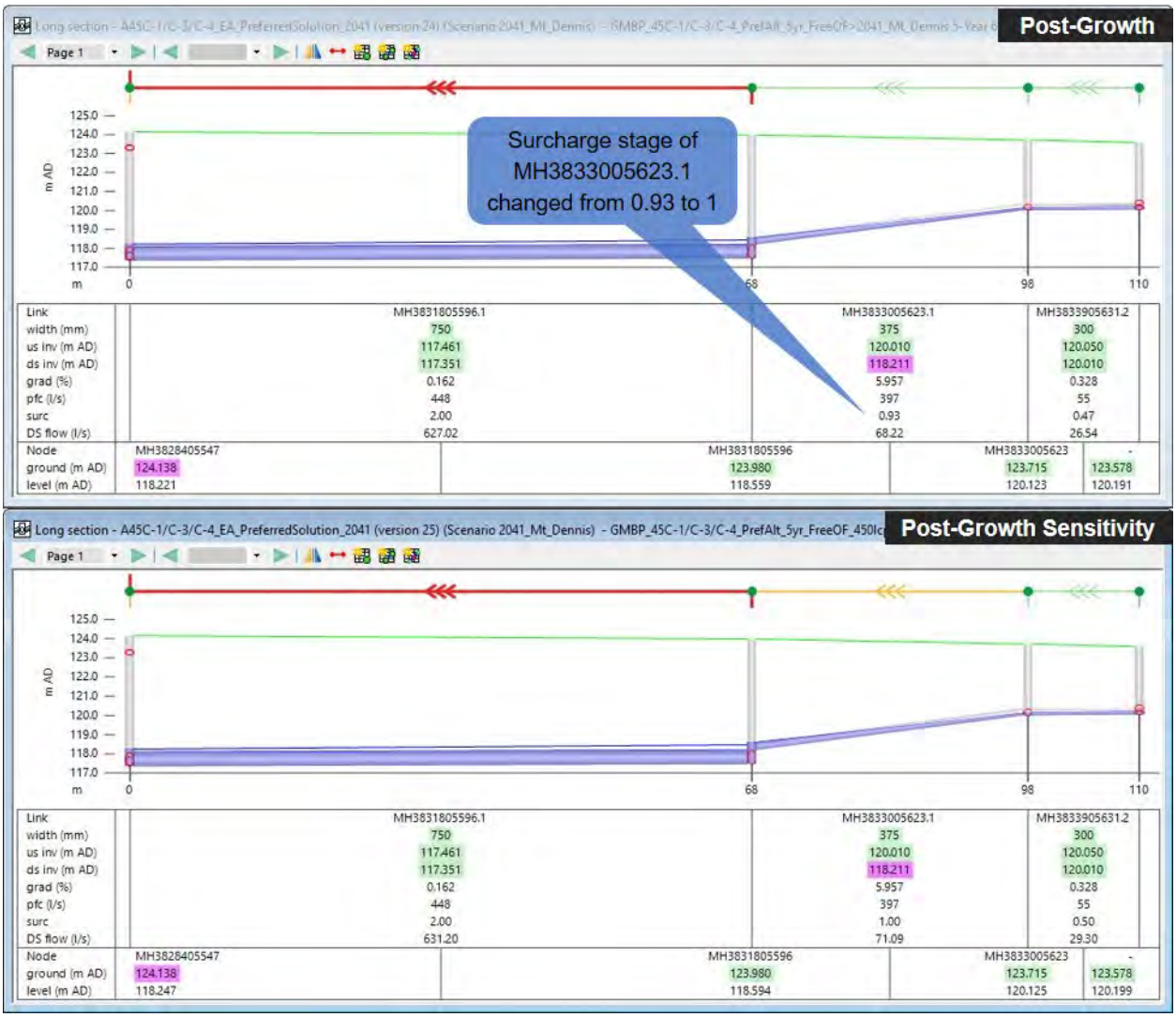

Figure 37 – Post-Growth and Post-Growth Sensitivity Sewer Profiles showing Surcharge State along Eglinton Avenue West (5-Year 6-Hour Chicago Design Storm)

Under 1 in 5-year Chicago Design Storm conditions, another additional surcharging sewer (MH3826405414.1) is a 375mm combined sewer on Eglinton Avenue West from Pearen Park to Pearen Street. The sewer profile in **Figure 38** shows this back-water condition is also a result of limited capacity of the downstream 750mm combined sewer.

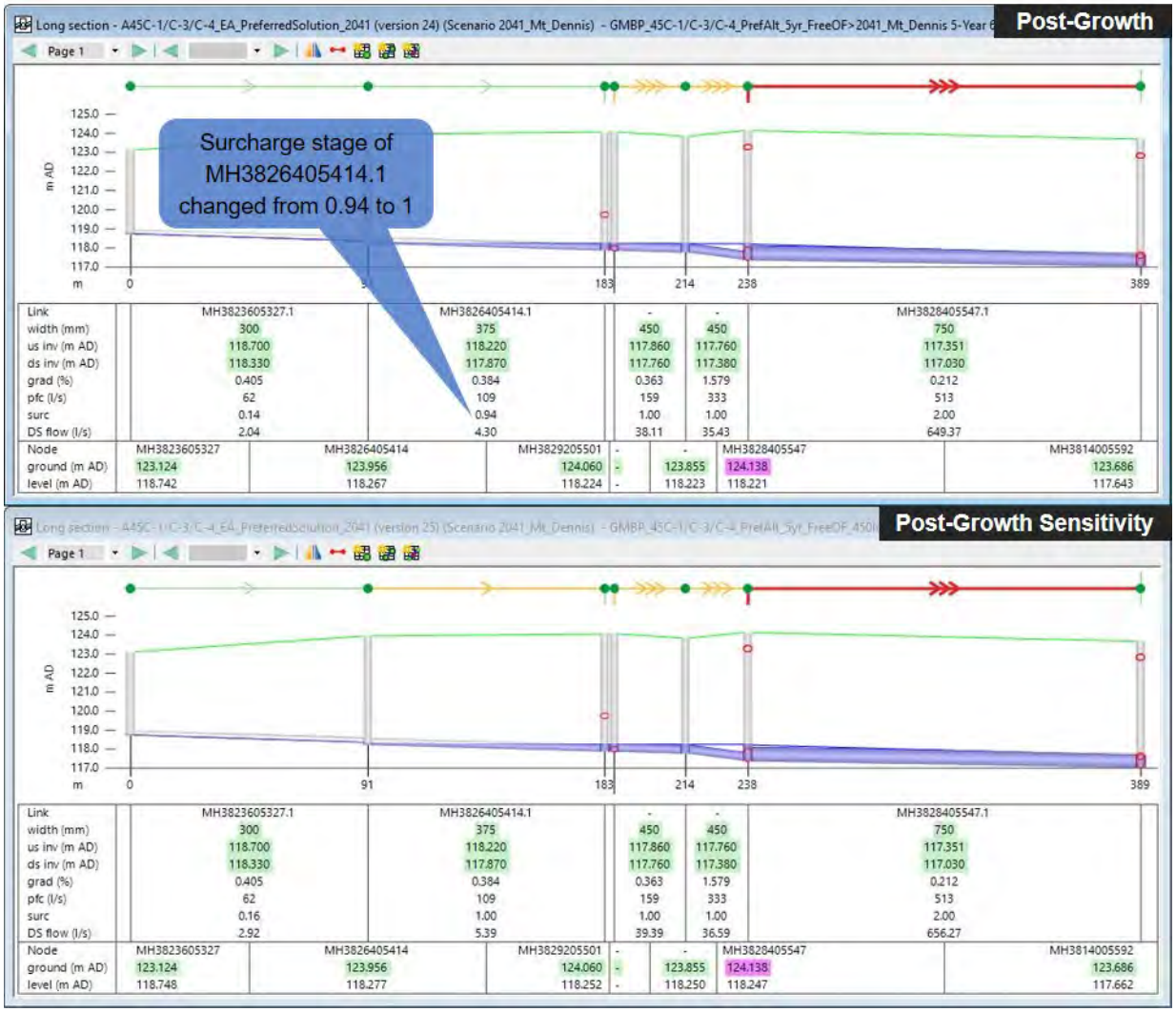

Figure 38 – Post-Growth and Post-Growth Sensitivity Sewer Profiles showing Surcharge State along Eglinton Avenue West (5-Year 6-Hour Chicago Design Storm)

5.5 Wastewater, Stormwater and Combined System Opportunities and Constraints

In general, the overall system with the preferred solution has sufficient capacity to convey existing and future peak wet weather flows. However, the combined system and storm system are showing some surcharge issues even under Pre-Growth scenario. **Figure 39** highlights some of the key opportunities and constraints in the Study Area.

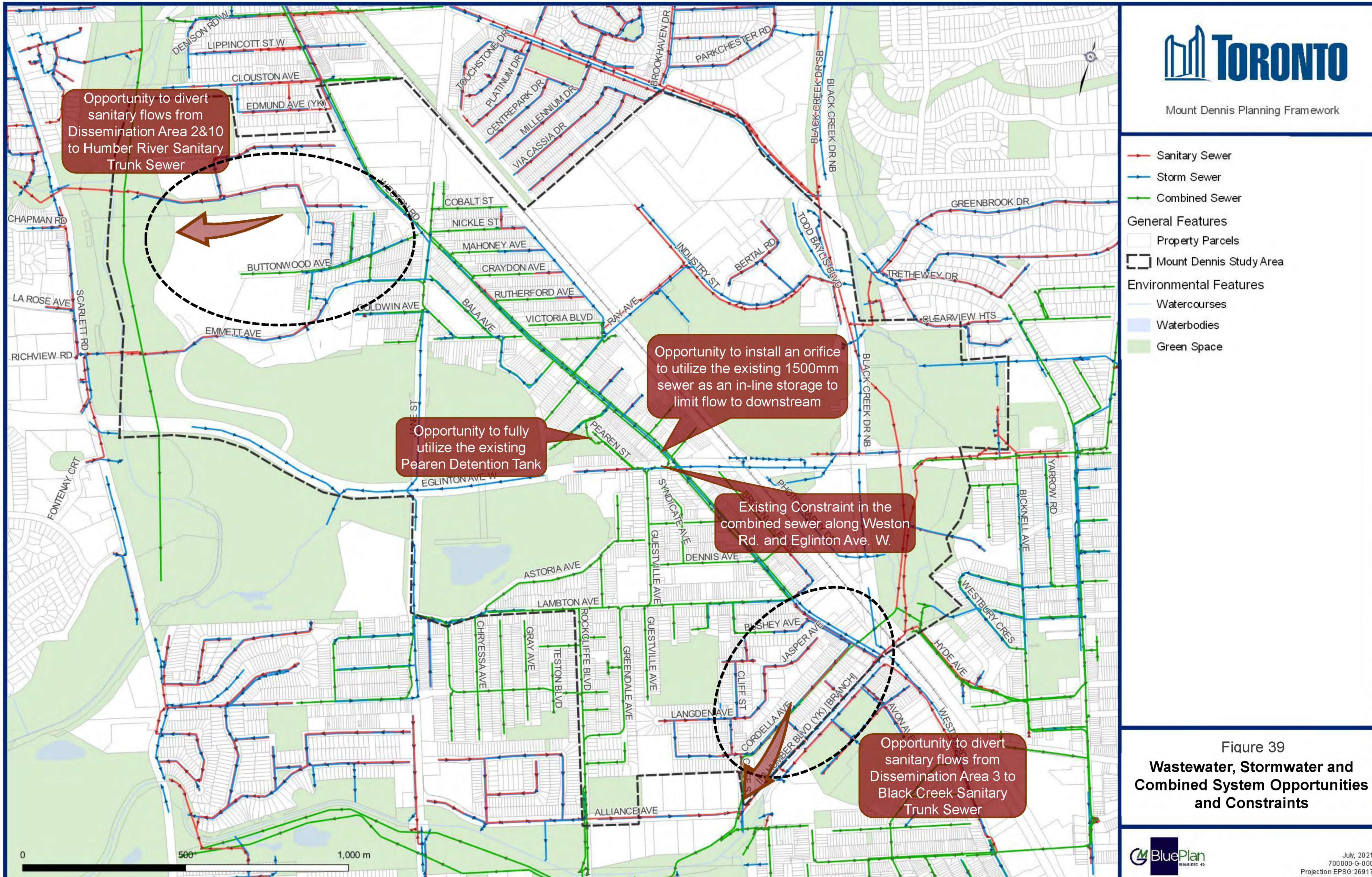

Figure 39
Wastewater, Stormwater and Combined System Opportunities and Constraints

Figure 40 shows an existing constraint in the combined sewer along Weston Road near Eglinton Avenue West. The existing 1500mm sewer flows into a 750mm sewer with S-bend, creating a bottleneck with local surcharging.

Figure 40 – Local Sanitary & Combined System at Weston Road and Eglinton Avenue West

There is an opportunity to fully utilize the in-line storage (Pearen Detention Tank) along Pearen Street to allow more flows into the 1050mm combined sewer from the flow split of Weston Road and Glenvalley Drive. The Pearen Detention Tank has a 100mm orifice plate to limit flow out of Detention Tank and avoid downstream surcharging along Guestville Avenue.

Further, there is also an opportunity to install a flow control at the most downstream segment of the existing 1500mm combined sewer along Weston Road to utilize inline storage more effectively and avoid downstream surcharging along Guestville Avenue.

In addition, **Figure 41** shows an opportunity to divert sanitary flows from Dissemination Area 2 and Dissemination Area 10 to the 1650mm Humber River Sanitary Trunk Sewer in the west. **Figure 42** shows an opportunity to divert sanitary flows from Dissemination Area 3 to the 1350mm Black Creek Sanitary Trunk Sewer in the southwest. It should be noted that these opportunities are dependant on the remaining capacity of Humber River Sanitary Trunk Sewer and Black Creek Sanitary Trunk Sewer; assessment of capacity of these trunk sewers is outside of the scope of this analysis.

Figure 41 – Local Sanitary & Combined System for Dissemination Area 2, 9 and 10

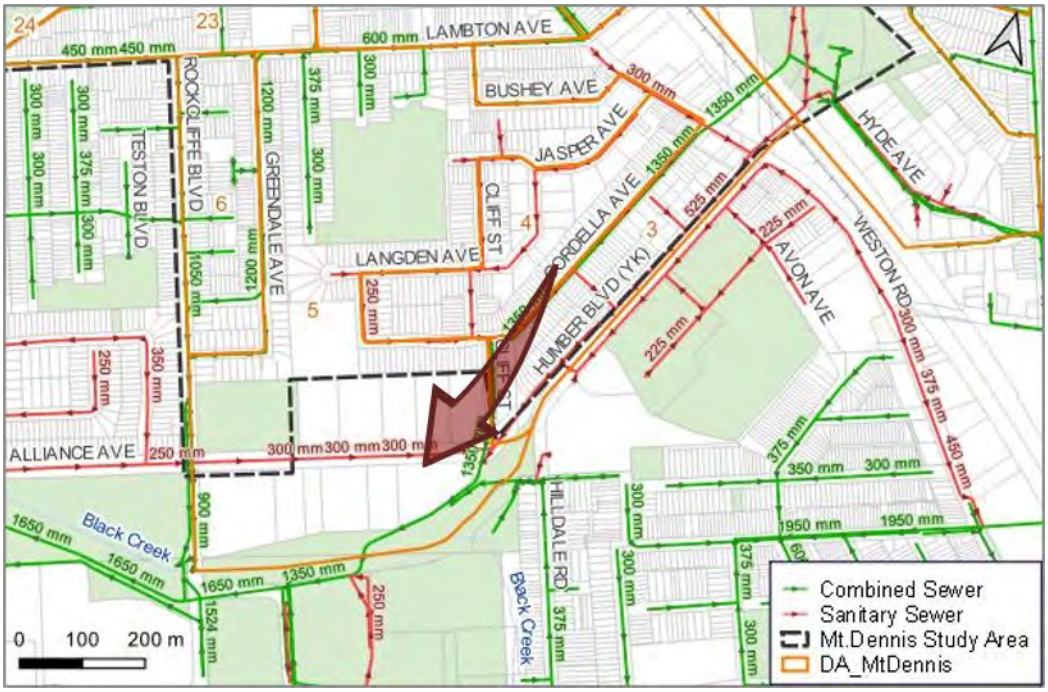

Figure 42 – Local Sanitary & Combined System for Dissemination Area 3 and 4

5.6 Wastewater, Stormwater and Combined Systems Servicing Strategy

In general, the preferred solution capital program from the Basement Flooding Study is well-designed and solves the majority of system performance issues under existing conditions.

Although the Mount Dennis Area is projected to experience significant intensification growth, this growth is spread out amongst several sub-catchments and relatively large sanitary and combined sewers. The main driver for capacity constraints within this area is the rain events in the combined system; the increase in dry weather flow from population and employment growth is relatively minor in comparison to the overall wet weather flow. As such, the existing sewer network, combined with upgrades from the preferred Basement Flooding Study capital upgrades generally provide adequate capacity to service the projected Mount Dennis growth.

The Wastewater, Stormwater and Combined Systems servicing strategy for Mount Dennis Study Area consists of the following, shown in **Figure 43**:

- Continue sewer separation within Study Area to limit the amount of combined flow going into the Black Creek Sanitary Trunk Sewer.
- Storm sewer upgrades including high-capacity inlets and new in-line storage pipe at local level to mitigate local surcharging issues, and storm sewer upgrades subtrunk level (Weston Road, Janes Street, Ray Avenue, and Industry Street) to increase conveyance capacity of storm system.
- Low impact development (LIDs) implementation along corridors with re-development to assist with Wet Weather Flow (WWF) reduction in sanitary, storm and combined sewer systems

5.7 Capital Program

As mentioned in **Section 5.1.4** , the recommended improvement projects (preferred solution capital program) and conceptual level cost estimates are detailed in the Basement Flooding Study. **Table 25** summarized the conceptual level cost for the capital program by categories.

Table 25 – Wastewater, Stormwater and Combined System Upgrades and Conceptual Level Costs

Capital Program Category	Conceptual-Level Cost Estimate
New Storm Sewer Installation	$ 77.8 M
Storm Sewer Upgrades	$ 42.5 M
Storm Sewer Upgrades with In-Line Storage	$ 1.2 M
Total	**$121.5M**

Mount Dennis Planning Framework

Replace existing storm sewer on Nickle St. leading to Ray Ave. to increase conveyance capacity

Replace existing storm sewer on Ray Ave. and Industrial St. to increase conveyance capacity

Replace existing storm sewer on Bala Ave. to increase conveyance capacity

Replace existing storm sewer on Jane St. to increase conveyance capacity and outfall improvement

Low impact development (LIDs) implementation along corridors with re-development to assist with Wet Weather Flow (WWF) reduction in sanitary, storm and combined sewer systems

- Sewer separation within combined area south of Eglinton Ave
- New storm sewers catch basins and high-capacity inlets

New storage tank and storm sewer outfall

0 250 500 m

Sanitary Sewer
Storm Sewer
Combined Sewer

Proposed Storm Upgrades
- In-line Storage
- New Sewer
- Relief Sewer
- Reverse Direction
- Sewer Upgrade

General Features
- Property Parcel
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

*NOTE: Comprehensive storm sewer upgrades, combined sewer upgrades and sewer separation plan throughout Mount Dennis Study Area outlined in *"Basement Flooding Remediation and Water Quality Improvements Master Plan Class EA – Area 45"* by IBI Group, July 2016. Infrastructure upgrades to service growth within the Mount Dennis Study Area are consistent with the findings from the Basement Flooding EA.

Figure 43

Wastewater, Stormwater, and Combined System Servicing Strategy

BluePlan Engineering

November, 2021
719006-WW-002
Projection EPSG:26917

6. SUMMARY

6.1 Water System

The Mount Dennis water system was evaluated based on the City's existing PD3 water model which was updated based on study area watermains and billing data received as well as locally calibrated through hydrant testing.

The baseline system performance under existing conditions is summarized as follows:

- Pressures within the local Mount Dennis study area typically exceed 70 psi with high pressures >100 psi within the south study area, south of Jasper Avenue under both an ADD and peak hour scenario
- Fire flow within the study area exceed 200 L/s along the trunk watermain on Weston Avenue with lower fire flows between 50-75 L/s experienced along Brownville Avenue and a dead end watermains resulting in 61% of evaluated hydrants having a fire flow deficiency
- High headlosses exceeding 5 m/1000 m are experienced along Clouston Avenue, Goldwin Avenue, and Pinehill Crescent
- Velocities are maintained below the 2.0 m/s criteria throughout the local study area

The system performance under future growth conditions is summarized as follows:

- Pressures within the local Mount Dennis study area typically exceed 70 psi with high pressures >100 psi within the south study area, south of Jasper Avenue under both an ADD and peak hour scenario
- Fire flows along Weston Avenue are decreased from existing conditions below 200 L/s due to the high demands along the corridor, resulting in a substantial decrease in fire flows less than 100 L/s west of Weston Road and north of Eglinton Road with 61% of evaluated hydrants having a fire flow deficiency
- High headlosses exceeding 5 m/1000 m are experienced along Clouston Avenue, Oxford Drive, Denarda Street, Goldwin Avenue, Pinehill Crescent, Keelesdale Road, and at the dead end on Emmett Avenue
- Velocities are maintained below the 2.0 m/s criteria throughout the local study area

To address future capacity constraints, watermain upgrades, replacement, and additional watermain/connections are recommended, shown in Figure 5. The total estimated cost for the water system upgrades to service the Mount Dennis growth is approximately **$21.5M**. Further cost reduction may be possible through the rehabilitation of identified watermains rather than the full replacement.

6.2 Sanitary, Combined, and Stormwater System

The future sewer system analysis compared the results of Pre-Growth scenario and Post-Growth scenarios (with additional growth within Mount Dennis Study Area) in order to confirm if the preferred sewer upgrade projects in the Basement Flooding Study can accommodate the additional growth within Mount Dennis Study Area.

It should be noted that all future sewer system performance analysis were assessed with free outfall condition in order to review the impact of additional sanitary flow from Mount Dennis Study Area. Once the growth analysis had been completed, simulations were run using provided level files for the downstream conditions in the Black Creek Sanitary Trunk Sewer (BCSTS) for the May 12th, 2000 Historic Event and the 1 in 100-year return period design storm. The results from these simulations showed that there is no capacity in the downstream trunk sewer under the conditions provided and this should be considered when evaluating opportunities for growth.

In general, the preferred solution capital program from the Basement Flooding Study is well-designed and could solve the majority of system performance issues under both existing conditions and future growth. The additional flow from Mount Dennis Study Area has marginal impact on the overall system performance:

- Under dry weather flow conditions, both Pre-Growth and Post Growth system model results show no constraints.
- Under 1 in 5-year Chicago Design Storm conditions, there is one additional sewer segment (MH3829305504.1) surcharging in the Post-Growth sanitary and combined system model results compared to Pre-Growth scenario. There is no additional surcharging in the Post-Growth storm system model results compared to Pre-Growth model results.
- Under 1 in 100-year Chicago Design Storm conditions, there is one additional manhole (MH3846405657) with high HGL (HGL less than 1.8m below ground) in the Post-Growth sanitary and combined system model results compared to Pre-Growth scenario. There is no additional manhole with high HGL in the Post-Growth storm system model results compared to Pre-Growth model results.
- Under the historic rainfall event on May 12th, 2000, there is no additional manhole with high HGL in the Post-Growth model results compared to Pre-Growth model results.
- In addition, the City has suggested a sensitivity analysis utilizing a higher per capita rate of 450 L/cap/d for growth population. The system performance in the Post-Growth Sensitivity scenario is the same as the Post-Growth scenario except a few additional surcharging combined sewers due to existing system constraints under 1 in 5-year Chicago Design Storm conditions.
- The recommended upgrades are shown in **Figure 43**.

The total projected cost for system upgrades from the Basement Flooding Study (which will also service the Mount Dennis Growth is approximately: **$121.6M**

APPENDIX A:
SYSTEM PERFORMANCE TABLES AND MAPS AND FUS CALCULATIONS FOR WATER SYSTEM

TORONTO

Mount Dennis Planning Framework

ADD Maximum Pressure
- 80 - 90 psi
- 90 - 100 psi
- 100 - 110 psi
- 110 - 120 psi
- > 120 psi
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

0 250 500 m

Figure A1

Existing Water System

Modelling Results
Average Day Demand (ADD) Scenario

BluePlan

November, 2021
700000-G-000
Projection EPSG:26917

Document Path: W:\GTA\7\19000\19006 Mount Dennis Planning Framework Study\5 Work in Progress\GIS and Databases\719006-W-001-Existing Water System.qgz

TORONTO

Mount Dennis Planning Framework

P HD Minimum Pressure
- 70 - 80 psi
- 80 - 90 psi
- 90 - 100 psi
- 100 - 110 psi
- 110 - 120 psi
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

0 250 500 m

Figure A2

Existing Water System

Modelling Results
Maximum Day Demand (MDD) Scenario

BluePlan

November, 2021
700000-G-000
Projection EPSG:26917

TORONTO

Mount Dennis Planning Framework

Available Fire Flow
- 80 - 90 psi
- 90 - 100 psi
- 100 - 110 psi
- 110 - 120 psi
- > 120 psi
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

0 250 500 m

Figure A3

Existing Water System

Modelling Results
Maximum Day Demand plus Fire Flow Scenario

BluePlan

November, 2021
700000-G-000
Projection EPSG:26917

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Mount Dennis Planning Framework

Max Headlosses
- 0.0 - 2.0 m/km
- 2.0 - 5.0 m/km
- 5.0 - 10.0 m/km
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

0 250 500 m

Figure A4

Existing Water System

Modelling Results
Maximum Day Demand (MDD) Scenario

BluePlan

November, 2021
700000-G-000
Projection EPSG:26917

TORONTO

Mount Dennis Planning Framework

ADD Maximum Pressure
- 80 - 90 psi
- 90 - 100 psi
- 100 - 110 psi
- 110 - 120 psi
- > 120 psi
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

Figure A5

Future Water System

Modelling Results
Average Day Demand (ADD) Scenario

BluePlan ENGINEERING

November, 2021
719006-W-002
Projection EPSG:26917

0 250 500 m

TORONTO

Mount Dennis Planning Framework

PHD Minimum Pressure
- 70 - 80 psi
- 80 - 90 psi
- 90 - 100 psi
- 100 - 110 psi
- 110 - 120 psi
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

Figure A6

Future Water System

Modelling Results
Maximum Day Demand (MDD) Scenario

0 250 500 m

BluePlan ENGINEERS

December, 2021
719006-W-002
Projection EPSG:26917

Document Path: W:\GTA\719006\719006 Mount Dennis Planning Framework Study\5 Work in Progress\GIS and Database\719006-HydroCAD\Future Water System.mxd

TORONTO

Mount Dennis Planning Framework

Available Fire Flow
- 50 - 75 L/s
- 75 - 100 L/s
- 100 - 150 L/s
- 150 - 200 L/s
- 200 - 250 L/s

Distribution Watermain

Transmission Watermain

General Features

Property Parcels

Mount Dennis Study Area

Environmental Features

Watercourses

Waterbodies

Green Space

0 250 500 m

Figure A7

Future Water System

Modelling Results

Maximum Day Demand plus Fire Flow Scenario

BluePlan

November, 2021

700000-G-000

Projection EPSG:26917

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TORONTO

Mount Dennis Planning Framework

Max Headlosses
- 0-2 m/km
- 2-5 m/km
- 5-10 m/km
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

0 250 500 m

Figure A8

Future Water System

Modelling Results
Maximum Day Demand Scenario

BluePlan

November, 2021
700000-G-000
Projection EPSG:26917

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TORONTO

Mount Dennis Planning Framework

ADD Maximum Pressure
- 80 - 90 psi
- 90 - 100 psi
- 100 - 110 psi
- 110 - 120 psi
- > 120 psi
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

Figure A9

Future Upgraded Water System

Modelling Results
Average Day Demand (ADD) Scenario

BluePlan ENGINEERING

December, 2021
719006-W-002
Projection EPSG:26917

0 250 500 m

TORONTO

Mount Dennis Planning Framework

PHD Minimum Pressure
- 70 - 80 psi
- 80 - 90 psi
- 90 - 100 psi
- 100 - 110 psi
- 110 - 120 psi
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

Figure A10

Future Upgraded Water System

Modelling Results
Maximum Day Demand (MDD) Scenario

0 250 500 m

BluePlan ENGINEERING

December, 2021
719006-W-002
Projection EPSG:26917

TORONTO

Mount Dennis Planning Framework

Available Fire Flow
- 50 - 75 L/s
- 75 - 100 L/s
- 100 - 150 L/s
- 150 - 200 L/s
- 200 - 250 L/s
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

Figure A11

Future Upgraded Water System

Modelling Results

Maximum Day Demand plus Fire Flow Scenario

BluePlan

December, 2021
700000-G-000
Projection EPSG:26917

0 250 500 m

TORONTO

Mount Dennis Planning Framework

Max Headlosses
- 0-2 m/km
- 2-5 m/km
- 5-10 m/km
- Distribution Watermain
- Transmission Watermain

General Features
- Property Parcels
- Mount Dennis Study Area

Environmental Features
- Watercourses
- Waterbodies
- Green Space

Figure A12

Future Upgraded Water System

Modelling Results
Maximum Day Demand Scenario

BluePlan

December, 2021
700000-G-000
Projection EPSG:26917

0 250 500 m

ID	ADD - Maximum Pressures (psi)			Peak Hour - Minimum Pressures (psi)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
WJ1092	106	106	108	99	97	98
WJ53850	121	121	124	115	112	114
WJ53832	121	121	123	114	112	113
WJ1093	112	112	114	105	103	104
WJ53853	120	120	123	114	111	113
WJ1175	121	122	124	115	112	114
WJ19215	121	122	124	115	112	114
WJ53834	120	120	123	114	111	113
WJ53837	117	117	119	110	108	109
WJ1174	121	121	123	114	112	113
WJ1095	117	117	119	110	108	109
WJ1098	116	117	119	110	108	109
WJ1099	109	110	112	103	101	102
WJ1181	99	100	102	92	92	92
WJ53843	121	121	123	115	112	113
WJ53828	121	122	124	115	112	114
WJ16302	121	121	123	114	112	113
WJ1103	93	93	95	86	84	86
WJ54405	120	120	122	113	111	112
WJ53979	118	118	121	112	109	111
WJ53978	118	118	120	111	108	110
WJ1102	95	96	97	89	86	88
WJ53934	120	120	122	113	110	112
WJ53933	119	119	121	112	110	111
WJ53936	118	118	120	112	109	111
WJ53935	119	119	121	112	110	111
WJ53839	121	121	123	114	112	113
WJ53846	122	122	124	115	112	114
WJ53937	113	113	116	107	104	106
WJ1101	98	98	100	91	89	91
WJ1100	99	99	101	92	90	91
WJ1090	93	93	95	86	84	85
WJ1088	94	94	96	87	84	86
WJ665	107	107	109	101	99	100
WJ666	102	102	104	95	94	95
WJ24954	102	102	104	95	94	95
WJ659	93	93	95	87	86	86
WJ24955	102	102	104	95	94	95

ID	ADD - Maximum Pressures (psi)			Peak Hour - Minimum Pressures (psi)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
WJ603	108	109	111	102	102	102
WJ604	108	109	111	102	102	103
WJ609	110	111	113	104	104	104
WJ608	110	111	113	104	104	104
WJ607	110	111	113	104	104	104
WJ611	111	112	114	105	105	105
WJ687	88	89	90	82	81	82
WJ570	88	89	90	82	81	82
WJ568	88	88	90	82	81	81
WJ575	90	90	92	83	83	83
WJ597	89	89	91	82	81	82
WJ592	89	89	91	83	81	82
WJ577	91	91	93	84	84	84
WJ591	90	89	91	83	82	83
WJ590	90	89	91	83	82	83
WJ578	91	91	93	85	84	84
WJ579	92	92	93	85	84	85
WJ620	89	89	90	82	81	82
WJ580	92	92	93	85	84	85
WJ619	89	89	91	82	81	82
WJ582	93	93	94	86	85	86
WJ618	89	89	91	82	81	82
WJ581	90	90	92	84	82	83
WJ617	90	90	92	83	82	83
WJ616	91	91	93	85	84	85
WJ615	91	91	93	84	84	85
WJ602	92	92	94	85	84	85
WJ613	91	91	93	85	84	85
WJ614	91	91	93	84	84	84
WJ601	106	106	108	99	99	100
WJ715	90	90	92	84	83	83
WJ692	89	89	90	82	81	82
WJ571	90	90	91	83	83	83
WJ572	90	90	92	83	83	83
WJ704	89	89	90	82	81	82
WJ705	89	89	90	82	81	82
WJ6954	90	90	91	83	82	83
WJ26375	90	90	91	83	82	83

ID	ADD - Maximum Pressures (psi)			Peak Hour - Minimum Pressures (psi)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
WJ703	89	89	91	82	82	82
WJ26376	90	90	91	83	82	83
WJ26394	90	90	91	83	82	83
WJ712	90	90	92	83	83	83
WJ713	91	91	92	84	83	84
WJ714	91	90	92	84	83	84
WJ5915	90	90	91	83	82	83
WJ573	90	90	91	83	82	83
WJ716	91	91	93	84	84	84
WJ718	92	92	93	85	84	85
WJ702	89	89	91	82	81	82
WJ598	90	90	91	83	82	83
WJ600	89	89	91	82	81	82
WJ599	89	89	90	82	81	82
WJ574	91	91	92	84	83	84
WJ576	91	91	93	84	83	84
WJ731	89	89	91	82	82	82
WJ733	90	90	91	83	83	83
WJ732	90	90	91	83	83	83
WJ722	90	90	91	83	82	83
WJ730	91	91	92	84	83	84
WJ729	91	91	92	84	83	84
WJ723	90	90	91	83	82	83
WJ6985	90	90	92	83	83	83
WJ727	90	91	92	84	83	84
WJ726	91	91	92	84	83	84
WJ725	90	90	92	83	83	83
WJ724	90	90	91	83	83	83
WJ700	90	90	91	83	82	83
WJ701	90	90	91	83	83	83
WJ711	90	90	91	83	82	83
WJ699	89	90	91	83	82	83
WJ698	90	90	92	83	83	83
WJ1719	89	90	91	83	82	83
WJ697	97	97	98	90	89	90
WJ707	89	90	91	83	82	83
WJ710	89	89	90	82	82	82
WJ708	89	89	90	82	82	82

ID	ADD - Maximum Pressures (psi)			Peak Hour - Minimum Pressures (psi)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
WJ26374	89	89	90	82	82	82
WJ696	99	99	100	92	92	92
WJ693	89	89	90	82	81	82
WJ690	97	97	99	90	90	90
WJ689	89	89	90	82	81	82
WJ691	89	89	91	83	82	83
WJ15846	88	89	90	82	81	82
WJ1119	92	92	94	86	83	85
WJ1122	92	92	94	86	83	85
WJ1121	92	92	94	86	83	85
WJ681	93	93	95	86	84	85
WJ1116	92	92	94	86	83	85
WJ678	92	92	94	85	83	84
WJ677	92	92	94	85	83	84
WJ55889	92	92	93	85	83	84
WJ676	92	92	94	86	83	85
WJ672	93	93	95	86	84	85
WJ56947	92	93	94	86	84	85
WJ673	93	93	95	86	84	85
WJ675	92	92	94	86	84	85
WJ684	91	91	92	84	82	83
WJ682	91	91	92	84	82	83
WJ6126	92	92	94	85	84	85
WJ680	93	93	95	87	85	86
WJ670	92	92	94	86	84	85
WJ671	93	93	94	86	84	85
WJ669	92	92	94	85	83	85
WJ679	93	93	95	86	85	86
WJ586	93	93	95	86	85	86
WJ26255	92	92	94	85	83	85
WJ587	92	92	94	85	84	85
WJ585	91	91	93	85	83	84
WJ588	92	92	93	85	83	84
WJ589	90	90	92	84	82	83
WJ594	90	90	92	84	83	83
WJ26254	93	93	95	86	84	86
WJ593	90	90	92	83	82	83
WJ736	112	112	114	105	106	105

ID	ADD - Maximum Pressures (psi)			Peak Hour - Minimum Pressures (psi)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
WJ735	109	109	111	102	102	102
WJ737	90	90	92	83	83	83
WJ738	90	90	91	83	83	83
WJ739	90	90	91	83	83	83
WJ740	90	90	91	83	83	83
WJ728	91	91	93	84	84	84
WJ721	91	92	93	83	82	85
WJ720	90	90	91	82	81	83
WJ734	94	93	95	87	86	86
WJ596	92	92	94	85	84	85
WJ595	91	91	92	84	83	84
WJ685	122	123	124	115	114	115
WJ771	101	102	103	94	93	94
WJ1130	99	100	101	92	91	92
WJ1129	98	99	100	91	90	91
WJ1128	95	95	97	88	86	87
WJ1127	93	93	95	86	84	86
WJ1126	93	93	95	86	84	85
WJ1125	93	93	95	86	84	85
WJ1124	92	93	94	86	84	85
WJ1109	93	93	95	86	84	85
WJ1143	93	94	95	87	85	86
WJ1144	94	94	96	87	85	86
WJ1120	92	92	94	86	83	85
WJ1123	93	93	95	86	84	86
WJ1110	93	93	95	86	84	85
WJ1145	97	97	99	90	88	90
WJ1146	97	97	99	90	88	90
WJ1157	94	94	96	87	85	86
WJ1108	94	94	96	87	85	86
WJ1156	93	93	95	86	84	85
WJ1155	93	93	95	86	84	85
WJ1117	93	93	95	86	84	85
WJ1154	94	94	96	87	85	86
WJ1118	93	93	95	86	84	85
WJ1153	93	93	95	86	84	86
WJ1158	93	93	95	86	84	85
WJ1111	93	93	95	86	84	86

ID	ADD - Maximum Pressures (psi)			Peak Hour - Minimum Pressures (psi)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
WJ1107	94	94	96	87	85	86
WJ15356	97	97	99	90	88	89
WJ1106	94	94	96	87	85	86
WJ15345	96	96	98	89	87	88
WJ15350	96	96	98	89	87	88
WJ1115	93	93	95	86	84	85
WJ1114	93	93	95	86	84	85
WJ1105	94	94	96	87	85	86
WJ1165	93	93	95	86	84	86
WJ1112	93	93	95	86	84	85
WJ1159	94	94	95	87	85	86
WJ15339	97	97	99	90	88	89
WJ1160	93	93	95	86	84	85
WJ1104	93	93	95	86	84	85
WJ53840	119	119	121	113	110	111
WJ1089	92	92	94	86	83	85
WJ1147	94	94	96	87	85	86
WJ1148	94	94	96	87	85	86
WJ1149	100	101	102	93	91	92
WJ1152	93	93	95	86	84	85
WJ1247	119	120	122	112	110	111
WJ1151	93	94	95	87	84	86
WJ53929	119	119	121	112	110	111
272-02-W	87	88	89	81	80	81
272-04	116	117	118	110	109	110
272-07-BR	91	92	93	84	83	84
272-09-E	90	91	92	83	83	83
272-09-W	90	92	92	83	83	83
280-01-BR	120	121	121	112	112	112
280-04-BR	123	123	124	115	114	115
MU_J55	118	119	119	110	109	110

ID	MDD+Fire Flow (L/s) – Available Flow (L/s)		
	2016	2041	2041+Upgrade
HY10	86	85	358
HY1028	195	194	431
HY1029	177	175	385
HY1030	159	158	315
HY1031	147	146	287
HY1033	126	125	194
HY1035	139	138	262
HY1037	153	152	304
HY1039	158	157	229
HY1041	116	115	150
HY1042	116	115	135
HY1046	135	133	198
HY1047	136	135	202
HY1048	156	154	450
HY1053	58	53	146
HY1054	64	58	136
HY1064	148	147	203
HY1065	200	198	512
HY1067	109	109	126
HY1073	199	198	485
HY11	134	133	531
HY112	88	87	131
HY114	68	68	92
HY115	159	157	410
HY116	166	164	446
HY118	170	169	464
HY119	172	171	495
HY12	129	128	472
HY123	174	172	577
HY1284	155	153	292
HY1289	157	155	302
HY129	126	125	394
HY13	146	145	387
HY133	203	201	666
HY135	75	74	120
HY137	49	48	90
HY139	123	122	465
HY140	116	115	416
HY142	104	103	405

ID	MDD+Fire Flow (L/s) – Available Flow (L/s)		
	2016	2041	2041+Upgrade
HY145	168	166	662
HY146	139	138	194
HY147	164	163	591
HY157	167	165	718
HY1581	182	181	530
HY1585	145	143	218
HY1586	129	128	180
HY1587	131	130	185
HY1589	151	149	301
HY1590	148	147	296
HY1592	176	175	398
HY1593	180	179	449
HY1594	191	189	544
HY1595	184	183	408
HY160	189	187	392
HY162	93	92	221
HY16277	57	55	107
HY163	84	83	194
HY167	95	95	225
HY168	187	186	407
HY169	202	200	462
HY170	113	112	136
HY172	122	121	152
HY18291	97	97	517
HY18292	129	128	486
HY1892	160	159	240
HY1934	161	160	370
HY1936	154	153	325
HY1964	151	150	597
HY20036	145	144	251
HY2016	101	100	496
HY203	175	174	398
HY204	203	201	626
HY205	179	178	352
HY206	116	115	140
HY207	194	192	372
HY208	213	212	574
HY209	213	211	556
HY211	53	50	194

ID	MDD+Fire Flow (L/s) – Available Flow (L/s)		
	2016	2041	2041+Upgrade
HY212	161	159	441
HY213	167	165	398
HY214	213	211	574
HY217	196	194	385
HY218	177	175	579
HY2188	171	170	527
HY22	191	190	489
HY220	168	166	411
HY221	178	176	346
HY2215	117	116	357
HY222	210	208	553
HY223	175	173	570
HY224	182	180	387
HY2240	59	58	134
HY225	169	167	715
HY226	166	165	636
HY2266	171	169	734
HY227	165	164	690
HY228	177	175	595
HY2282	148	146	523
HY229	167	166	738
HY23	55	55	244
HY230	209	207	487
HY2314	169	167	478
HY2331	114	113	187
HY2350	84	83	159
HY2351	51	50	101
HY2372	220	218	605
HY24	74	74	326
HY2438	166	167	465
HY25	83	82	330
HY3297	72	71	553
HY3300	84	83	593
HY3318	78	77	433
HY3352	138	137	489
HY3356	162	161	425
HY3359	140	139	206
HY3362	135	134	183
HY3366	141	140	190

ID	MDD+Fire Flow (L/s) – Available Flow (L/s)		
	2016	2041	2041+Upgrade
HY3370	136	135	214
HY3372	133	132	171
HY3375	138	137	183
HY3381	191	189	516
HY3384	140	138	186
HY3386	125	124	178
HY3388	157	155	227
HY3390	118	117	520
HY3393	100	99	416
HY3395	153	152	376
HY3399	129	127	191
HY3401	125	124	179
HY3404	141	140	231
HY3406	167	165	705
HY3410	129	127	366
HY3413	130	128	191
HY3415	142	140	232
HY3416	170	169	634
HY3420	171	170	582
HY3423	67	66	129
HY3426	86	85	207
HY3428	87	86	205
HY3430	120	119	314
HY3432	170	168	269
HY3436	95	94	224
HY3439	77	76	175
HY3444	77	76	169
HY3451	88	87	203
HY3454	107	105	250
HY3457	104	102	391
HY3460	168	166	602
HY3461	167	165	556
HY3463	53	52	116
HY3466	94	93	213
HY3471	54	53	119
HY3476	121	120	205
HY3480	78	76	150
HY3483	70	67	127
HY3485	203	201	525

ID	MDD+Fire Flow (L/s) – Available Flow (L/s)		
	2016	2041	2041+Upgrade
HY3487	148	147	365
HY3489	291	280	520
HY3492	217	211	391
HY3494	181	181	660
HY3611	166	167	461
HY3614	169	170	532
HY377	149	148	256
HY378	141	140	220
HY379	141	140	219
HY380	153	151	269
HY499	150	148	274
HY501	138	136	231
HY503	115	113	172
HY505	149	147	269
HY507	154	152	291
HY508	157	155	309
HY514	145	143	247
HY517	157	155	303
HY518	171	169	530
HY519	159	157	355
HY520	145	143	241
HY521	152	150	285
HY522	75	66	132
HY626	210	208	364
HY72	90	89	226
HY7352	102	99	399
HY74	123	121	425
HY76	107	106	481
HY760	196	195	439
HY7788	143	142	182
HY7789	151	149	271
HY7790	153	151	281
HY7942	164	163	401
HY8	195	194	705
HY826	133	132	194
HY828	101	100	121
HY829	81	80	90
HY830	133	131	162
HY8501	165	163	446

ID	MDD+Fire Flow (L/s) – Available Flow (L/s)		
	2016	2041	2041+Upgrade
HY8503	169	167	320
HY8509	89	88	225
HY8533	142	141	197
HY9	128	127	490
HY919	168	166	245
HY9396	207	206	345

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN12438_01	0.18	0.29	0.32	0.17	0.41	0.59
LN12438_02	0.21	0.3	0.33	0.22	0.43	0.62
LN12438_03	0.2	0.3	0.32	0.2	0.42	0.61
LN12438_04	0.2	0.3	0.32	0.2	0.42	0.61
LN12438_05	0.19	0.29	0.32	0.18	0.41	0.59
LN12438_06	0.18	0.29	0.32	0.17	0.41	0.59
LN12412_01	0.04	0.07	0.07	0.02	0.05	0.05
LN12412_02	0	0	0	0	0	0
LN12412_03	0.01	0.02	0.02	0	0	0
LN12412_04	0.03	0.05	0.05	0.01	0.03	0.03
LN54079	0.01	0.01	0.01	0	0	0
LN54037_01	0	0.06	0.05	0	0.04	0.03
LN54037_02	0.03	0.08	0.06	0.01	0.07	0.04
LN54037_03	0.02	0.07	0.05	0	0.05	0.04
LN54080_01	0.02	0.05	0.06	0	0.03	0.04
LN54080_02	0.04	0.05	0.07	0.01	0.03	0.06
LN54080_03	0.03	0.04	0.07	0.01	0.02	0.05
LN12311_01	0.02	0.06	0.06	0.01	0.07	0.06
LN12311_02	0.03	0.05	0.08	0.02	0.05	0.11
LN54082	0.05	0.14	0.13	0.03	0.18	0.16
LN54081	0.02	0.1	0.1	0.01	0.1	0.09
LN12329_01	0.02	0.11	0.09	0	0.18	0.14
LN12329_02	0.01	0.12	0.09	0	0.2	0.15
LN54083	0.01	0.07	0.05	0	0.05	0.03
LN54084_01	0.04	0.08	0.1	0.02	0.06	0.11
LN54084_02	0.05	0.09	0.11	0.02	0.07	0.12
LN54084_03	0.04	0.08	0.11	0.02	0.06	0.11
LN54045	0.01	0.12	0.09	0	0.12	0.09
LN54047	0.04	0.2	0.11	0.02	0.35	0.15
LN54049_01	0.12	0.18	0.09	0.13	0.27	0.11
LN54049_02	0.14	0.22	0.2	0.19	0.39	0.42
LN54049_03	0.14	0.2	0.1	0.17	0.34	0.14
LN54048	0.1	0.14	0.25	0.09	0.16	0.61
LN15636_01	0.08	0.12	0.24	0.07	0.15	0.63
LN15636_02	0.09	0.13	0.25	0.09	0.16	0.65
LN12322_01	0.18	0.25	0.26	0.16	0.31	0.42
LN12322_02	0.18	0.26	0.27	0.16	0.32	0.43
LN12322_03	0.18	0.26	0.27	0.16	0.33	0.44

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN54055	0.05	0.11	0.09	0.02	0.11	0.08
LN54056_01	0.11	0.18	0.17	0.11	0.27	0.32
LN54056_02	0.12	0.2	0.18	0.13	0.32	0.35
LN12319	0.05	0.12	0.11	0.05	0.24	0.21
LN12321_01	0.19	0.29	0.27	0.18	0.4	0.43
LN12321_02	0.19	0.3	0.27	0.18	0.42	0.44
LN4047285	0	0.02	0.02	0	0.02	0.02
LN12121	0.06	0.12	0.09	0.18	0.57	0.45
LN12117_01	0.21	0.33	0.28	0.22	0.5	0.5
LN12117_02	0.21	0.34	0.29	0.22	0.52	0.52
LN8779	0.12	0.23	0.22	0.15	0.53	0.19
LN13166_01	0.12	0.22	0.2	0.14	0.48	0.15
LN13166_02	0.12	0.22	0.21	0.15	0.49	0.15
LN13176_01	0.14	0.26	0.24	0.19	0.64	0.25
LN13176_02	0.13	0.25	0.23	0.17	0.58	0.21
LN54117_01	0.05	0.08	0.11	0.02	0.06	0.1
LN54117_02	0.05	0.09	0.11	0.03	0.07	0.11
LN54058	0.06	0.11	0.08	0.04	0.11	0.08
LN54057_01	0.07	0.13	0.18	0.04	0.16	0.32
LN54057_02	0.09	0.16	0.2	0.07	0.23	0.38
LN54057_03	0.08	0.15	0.2	0.06	0.2	0.36
LN54142_01	0.1	0.18	0.18	0.09	0.27	0.29
LN54142_02	0.1	0.18	0.18	0.1	0.28	0.3
LN54142_03	0.11	0.2	0.19	0.11	0.34	0.33
LN54142_04	0.1	0.19	0.18	0.1	0.3	0.31
LN1083_01	0.33	0.55	0.51	2.5	6.46	1.83
LN1083_02	0.33	0.55	0.51	2.5	6.46	1.83
LN13173_01	0.19	0.29	0.27	1.47	3.06	1.15
LN13173_02	0.19	0.29	0.26	1.46	3.03	1.14
LN16560	0.18	0.27	0.26	1.32	2.77	1.03
LN13049_01	0.3	0.47	0.43	2.04	4.71	1.53
LN13049_02	0.3	0.47	0.43	2.04	4.71	1.53
LN12453_01	0.05	0.11	0.09	0.04	0.21	0.19
LN12453_02	0.06	0.13	0.1	0.07	0.26	0.24
LN12453_03	0.05	0.12	0.09	0.05	0.23	0.22
LN13048	0.34	0.54	0.49	2.66	6.06	1.7
LN11996	0.13	0.19	0.31	0.43	0.92	0.71
LN1078	0.11	0.2	0.31	0.33	0.97	0.67

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN11774_01	0.03	0.06	0.09	0.01	0.03	0.1
LN11774_02	0.04	0.07	0.1	0.01	0.04	0.11
LN11774_03	0.03	0.07	0.09	0.01	0.04	0.1
LN1076	0.09	0.22	0.33	0.23	1.17	0.74
LN11787	0.08	0.19	0.3	0.16	0.86	0.63
LN1070	0.07	0.15	0.27	0.13	0.58	0.52
LN13855_01	0.05	0.29	0.18	0.18	4.15	0.31
LN13855_02	0.04	0.18	0.08	0.08	1.62	0.08
LN13855_03	0.01	0.06	0.02	0	0.21	0
LN13855_04	0.02	0.06	0.05	0.04	0.25	0.03
LN13855_05	0.05	0.19	0.12	0.13	1.86	0.15
LN1068_01	0.03	0.08	0.18	0.03	0.18	0.23
LN1068_02	0.03	0.08	0.18	0.03	0.18	0.23
LN1571_01	0.01	0.61	0.05	0	2.52	0.01
LN1571_02	0	0	0.61	0	0	2.78
LN1571_03	0	0	0.27	0	0	0.33
LN21680	0.26	0.61	0.55	0.52	2.52	0.86
LN12497_01	0.26	0.61	0.55	0.52	2.52	0.86
LN12497_02	0.26	0.61	0.7	0.42	2.04	1.36
LN12497_03	0.26	0.61	0.7	0.52	2.52	1.36
LN21681_01	0	0	0	0	0	0
LN21681_02	0	0	0	0	0	0
LN11823_01	0.01	0.05	0.11	0.01	0.08	0.12
LN11823_02	0.01	0.05	0.11	0.01	0.08	0.12
LN1036_01	0.08	0.13	0.12	0.07	0.19	0.18
LN1036_02	0.07	0.12	0.11	0.06	0.16	0.16
LN11917_01	0.1	0.14	0.12	0.1	0.2	0.17
LN11917_02	0.08	0.09	0.08	0.07	0.08	0.09
LN1032	0.19	0.25	0.21	0.36	0.61	0.45
LN11811_01	0.15	0.27	0.21	0.24	0.67	0.47
LN11811_02	0.16	0.33	0.26	0.27	0.97	0.7
LN16939	0	0	0	0	0	0
LN15411	0.02	0.09	0.06	0.01	0.16	0.01
LN11821	0.05	0.23	0.11	0.03	0.57	0.11
LN1053_01	0.03	0.12	0.17	0.02	0.39	0.07
LN1053_02	0.03	0.12	0.17	0.02	0.39	0.07
LN1048	0.03	0.14	0.25	0.02	0.5	0.4
LN1591_01	0.07	0.17	0.28	0.13	0.76	0.27

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN1591_02	0.07	0.17	0.28	0.13	0.76	0.27
LN1591_03	0.07	0.17	0.28	0.13	0.76	0.27
LN11852	0.14	0.2	0.19	0.22	0.38	0.41
LN11829_01	0.02	0.13	0.19	0.04	1.01	0.46
LN11829_02	0.04	0.21	0.26	0.13	2.23	0.85
LN11829_03	0.06	0.27	0.32	0.22	3.58	1.25
LN1622_01	0.28	0.38	0.43	3.86	6.51	2.29
LN1622_02	0.28	0.4	0.46	3.89	7.45	2.53
LN1636_01	0.15	0.3	0.41	1.14	4.32	1.84
LN1636_02	0.14	0.27	0.38	1.11	3.59	1.6
LN11840	0.08	0.25	0.37	0.2	1.52	0.46
LN4908	0.04	0.08	0.11	0.04	0.17	0.27
LN1684	0.34	0.48	0.61	2.58	4.96	1.64
LN4914	0.46	0.82	0.55	1.29	3.75	0.85
LN11846	0.01	0.11	0.11	0.01	0.69	0.17
LN1694_01	0.33	0.44	0.58	2.52	4.16	1.48
LN1694_02	0.33	0.42	0.57	2.52	3.87	1.41
LN13858_01	0.26	0.46	0.55	0.51	1.48	0.85
LN13858_02	0.26	0.46	0.55	0.51	1.48	0.85
LN13858_03	0.26	0.46	0.55	0.51	1.48	0.85
LN11879_01	0	0	0	0	0	0
LN11879_02	0.01	0.11	0.11	0.01	0.68	0.16
LN11722_01	0.12	0.18	0.22	0.22	0.51	0.79
LN11722_02	0.13	0.2	0.24	0.25	0.58	0.87
LN11722_03	0.14	0.22	0.26	0.31	0.69	1.01
LN54115	0.04	0.06	0.09	0.02	0.04	0.08
LN54116	0	0.01	0.01	0	0	0
LN11746_01	0.01	0.01	0.01	0	0	0
LN11746_02	0	0	0	0	0	0
LN822_01	0.12	0.35	0.3	0.1	0.76	0.5
LN822_02	0.11	0.35	0.3	0.1	0.75	0.5
LN823_01	0.09	0.32	0.28	0.06	0.65	0.43
LN823_02	0.09	0.32	0.28	0.06	0.65	0.43
LN11692_01	0.09	0.11	0.1	0.13	0.19	0.16
LN11692_02	0.07	0.1	0.09	0.09	0.16	0.13
LN11755_01	0.01	0.03	0.03	0	0.01	0.01
LN11755_02	0.01	0.01	0.01	0	0	0
LN11755_03	0.01	0.01	0.01	0.01	0.01	0.01

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN11728	0.06	0.29	0.25	0.03	0.55	0.32
LN11764_01	0.03	0.1	0.07	0.02	0.16	0.15
LN11764_02	0.04	0.11	0.08	0.03	0.19	0.17
LN15659	0	0	0	0	0	0
LN827	0.05	0.28	0.23	0.02	0.51	0.29
LN15664	0.01	0.21	0.17	0	0.29	0.16
LN11739_01	0.16	0.3	0.24	0.28	0.81	0.6
LN11739_02	0.15	0.29	0.22	0.23	0.79	0.54
LN15671	0.03	0.16	0.18	0.01	0.12	0.15
LN16933_01	0.02	0.1	0.1	0	0.07	0.09
LN16933_02	0.02	0.1	0.09	0	0.07	0.09
LN15651	0.01	0.06	0.06	0	0.01	0.02
LN833_01	0.02	0.09	0.09	0.01	0.06	0.1
LN833_02	0.03	0.08	0.09	0.01	0.05	0.1
LN11767_01	0.04	0.08	0.1	0.01	0.05	0.12
LN11767_02	0.04	0.08	0.1	0.01	0.05	0.13
LN1011	0.21	0.4	0.32	0.62	2.12	1.36
LN11926_01	0.02	0.08	0.08	0.01	0.07	0.06
LN11926_02	0.03	0.03	0.03	0.02	0.01	0.01
LN11926_03	0.03	0.04	0.04	0.01	0.02	0.02
LN1021	0.13	0.18	0.13	0.18	0.33	0.22
LN11930_01	0.05	0.1	0.09	0.03	0.1	0.1
LN11930_02	0.04	0.06	0.06	0.02	0.04	0.05
LN11933_01	0.09	0.12	0.11	0.08	0.16	0.16
LN11933_02	0.14	0.27	0.24	0.2	0.68	0.6
LN11933_03	0.11	0.19	0.17	0.13	0.35	0.33
LN11898_01	0.13	0.1	0.07	0.25	0.17	0.12
LN11898_02	0.13	0.12	0.08	0.27	0.22	0.13
LN11890_01	0.33	0.49	0.32	1.14	2.4	1.14
LN11890_02	0.33	0.48	0.31	1.12	2.28	1.05
LN11901_01	0	0.09	0.1	0	0.08	0.09
LN11901_02	0	0.08	0.09	0	0.07	0.08
LN11906_01	0.09	0.09	0.06	0.08	0.09	0.05
LN11906_02	0.09	0.1	0.07	0.09	0.11	0.07
LN16932	0.1	0.21	0.2	0.16	0.66	0.6
LN501_01	0.1	0.11	0.16	0.16	0.19	0.46
LN501_02	0.1	0.11	0.16	0.16	0.19	0.46
LN11667	0.01	0.02	0.02	0	0	0

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN11651_01	0.07	0.13	0.15	0.09	0.28	0.35
LN11651_02	0.09	0.15	0.17	0.13	0.36	0.44
LN498	0.17	0.34	0.34	0.43	1.57	1.62
LN496_01	0.15	0.32	0.32	0.37	1.38	1.43
LN496_02	0.16	0.32	0.33	0.38	1.42	1.47
LN11646	0.01	0.01	0.01	0	0	0
LN12407	0.02	0.03	0.03	0.01	0.01	0.01
LN12426_01	0.12	0.27	0.27	0.24	1.01	1.06
LN12426_02	0.13	0.28	0.28	0.26	1.07	1.12
LN12423	0.02	0.06	0.05	0.01	0.06	0.03
LN12340	0.1	0.21	0.23	0.12	0.48	0.61
LN12380_01	0.13	0.29	0.33	0.21	0.87	1.21
LN12380_02	0.14	0.3	0.34	0.23	0.94	1.28
LN12419_01	0.05	0.1	0.12	0.03	0.13	0.2
LN12419_02	0.06	0.13	0.15	0.05	0.19	0.27
LN12419_03	0.05	0.11	0.13	0.04	0.15	0.22
LN12410_01	0.06	0.12	0.13	0.07	0.23	0.32
LN12410_02	0.06	0.12	0.14	0.07	0.21	0.36
LN12410_03	0.08	0.12	0.16	0.1	0.24	0.45
LN1851	0.18	0.17	0.11	0.6	0.52	0.23
LN11206_01	0.05	0.4	0.21	0.02	0.79	0.21
LN11206_02	0.06	0.41	0.23	0.02	0.84	0.25
LN11206_03	0.05	0.4	0.22	0.02	0.8	0.23
LN11206_04	0.07	0.42	0.24	0.03	0.89	0.28
LN11206_05	0.07	0.42	0.24	0.03	0.89	0.28
LN11206_06	0.06	0.42	0.24	0.02	0.88	0.27
LN11206_07	0.06	0.42	0.23	0.02	0.87	0.26
LN4029467_01	0.21	0.29	0.33	0.9	1.53	2.04
LN4029467_02	0.21	0.29	0.33	0.9	1.53	2.04
LN10962	0.2	0.2	0.13	0.72	0.67	0.32
LN11291	0.25	0.32	0.37	1.37	2.12	2.84
LN11297	0.11	0.14	0.16	0.29	0.45	0.6
LN1863	0.14	0.18	0.21	0.49	0.75	1.01
LN11307_01	0.26	0.32	0.39	1.46	2.18	3.18
LN11307_02	0.26	0.32	0.39	1.46	2.18	3.18
LN11307_03	0.26	0.32	0.39	1.46	2.18	3.18
LN11307_04	0.25	0.32	0.37	1.37	2.13	2.85
LN11328_01	0.33	0.75	0.61	0.59	2.78	1.84

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN11328_02	0.32	0.75	0.6	0.59	2.77	1.83
LN11368_01	0.01	0.03	0.03	0	0.02	0.02
LN11368_02	0.01	0.09	0.09	0	0.09	0.09
LN11368_03	0.06	0.16	0.16	0.04	0.27	0.27
LN11368_04	0.01	0.06	0.06	0	0.04	0.04
LN11368_05	0.09	0.22	0.22	0.09	0.46	0.46
LN11374_01	0.35	0.77	0.62	0.68	2.9	1.94
LN11374_02	0.35	0.77	0.62	0.68	2.9	1.94
LN11375	0.04	0.09	0.09	0.06	0.19	0.19
LN11377	0.38	0.78	0.64	2.97	11.2	7.54
LN11389_01	0.38	0.78	0.64	0.66	2.49	1.68
LN11389_02	0.39	0.79	0.65	0.67	2.52	1.71
LN11389_03	0.38	0.79	0.65	0.66	2.51	1.7
LN11389_04	0.38	0.78	0.64	0.66	2.5	1.68
LN11472_01	0	0	0	0	0	0
LN11472_02	0	0	0	0	0	0
LN2038	0	0	0	0	0	0
LN11419	0.01	0.03	0.03	0	0.01	0.01
LN11414	0.39	0.8	0.66	0.69	2.6	1.78
LN2036_01	0.02	0.07	0.07	0.03	0.23	0.23
LN2036_02	0	0	0	0	0	0
LN2036_03	0.02	0.07	0.07	0.04	0.23	0.23
LN2035	0.39	0.8	0.66	3.12	11.77	1.78
LN11058_01	0.44	0.56	0.46	3.38	5.25	3.45
LN11058_02	0.44	0.56	0.46	3.38	5.25	3.45
LN1785_01	0.01	0.04	0.04	0	0.09	0.02
LN1785_02	0	0.02	0.02	0	0.02	0.02
LN15700_01	0.39	0.73	0.68	0.52	1.64	1.33
LN15700_02	0.39	0.73	0.68	0.52	1.64	1.33
LN15700_03	0.39	0.73	0.68	0.52	1.64	1.33
LN16934	0.75	1.24	1.11	5.38	13.85	10.57
LN11193_01	0.1	0.12	0.15	0.57	0.77	0.34
LN11193_02	0.09	0.1	0.14	0.5	0.55	0.28
LN11193_03	0.08	0.08	0.12	0.39	0.38	0.22
LN11193_04	0.07	0.06	0.11	0.31	0.24	0.17
LN1737	0	0	0	0	0	0
LN11039_01	0.1	0.07	0.12	0.61	0.34	0.21
LN11039_02	0.1	0.08	0.13	0.62	0.41	0.23

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN11033_01	0.08	0.05	0.11	0.41	0.15	0.13
LN11033_02	0.1	0.07	0.11	0.59	0.28	0.18
LN11033_03	0.09	0.05	0.1	0.52	0.19	0.15
LN820	0.18	0.42	0.36	0.23	1.08	0.7
LN1746	0.27	0.17	0.37	1.68	0.76	0.63
LN55988_01	0.1	0.11	0.14	0.64	0.66	0.29
LN55988_02	0.11	0.13	0.17	0.68	0.98	0.39
LN1743	0.25	0.17	0.35	1.46	0.76	0.59
LN11683_01	0.15	0.38	0.33	0.16	0.9	0.6
LN11683_02	0.15	0.38	0.32	0.15	0.86	0.58
LN11683_03	0.15	0.38	0.33	0.16	0.88	0.59
LN11875_01	0.19	0.22	0.26	1.85	2.36	0.89
LN11875_02	0.2	0.24	0.28	1.97	2.95	1.02
LN11045_01	0.07	0.06	0.15	0.33	0.21	0.22
LN11045_02	0.07	0.07	0.12	0.35	0.32	0.14
LN1612_01	0.08	0.18	0.18	0.36	1.59	0.41
LN1612_02	0.08	0.15	0.15	0.33	1.14	0.3
LN1612_03	0.01	0.06	0.06	0	0.24	0.06
LN1612_04	0	0.03	0.03	0	0.07	0.07
LN11024	0.27	0.24	0.37	1.76	1.4	0.63
LN1712_01	0.26	0.25	0.37	1.58	1.48	0.64
LN1712_02	0.26	0.27	0.38	1.6	1.66	0.69
LN1709_01	0.33	0.38	0.53	2.44	3.25	1.26
LN1709_02	0.32	0.36	0.51	2.37	2.94	1.18
LN23562_01	0.25	0.47	0.27	3.31	10.36	0.68
LN23562_02	0.25	0.37	0.22	3.19	6.67	0.47
LN11679	0.12	0.14	0.19	0.22	0.3	0.62
LN1604	0.03	0.14	0.16	0.01	0.24	0.28
LN11868	0.08	0.16	0.34	0.35	1.38	1.3
LN3185	0	0	0	0	0	0
LN11056_01	0.42	0.86	0.76	1.08	3.97	2.86
LN11056_02	0.42	0.86	0.76	1.08	3.97	2.86
LN612	0.35	0.72	0.62	0.74	2.86	1.98
LN11093	0.29	0.62	0.54	0.55	2.21	1.48
LN816	0.26	0.56	0.47	0.42	1.8	1.17
LN12402_01	0.21	0.46	0.39	0.3	1.27	0.82
LN12402_02	0.21	0.46	0.39	0.3	1.27	0.82
LN11021_01	0.13	0.3	0.16	0.93	4.61	0.25

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN11021_02	0.13	0.38	0.21	1.02	7.1	0.39
LN11021_03	0.14	0.46	0.25	1.07	9.94	0.55
LN2350	0.32	0.39	0.29	1.66	2.44	0.43
LN2351_01	0.24	0.32	0.26	3.12	5.1	0.33
LN2351_02	0.25	0.32	0.26	3.19	5.29	0.6
LN23561	0.1	0.07	0.14	0.1	0.06	0.2
LN1772_01	0.19	0.11	0.3	0.88	0.32	0.44
LN1772_02	0.19	0.12	0.3	0.88	0.35	0.44
LN11190_01	0.3	0.27	0.22	0.82	0.66	0.47
LN11190_02	0.31	0.29	0.24	0.87	0.75	0.55
LN1782_01	0.08	0.09	0.11	0.37	0.45	0.18
LN1782_02	0.07	0.08	0.1	0.33	0.36	0.15
LN11164_01	0.06	0.08	0.11	0.25	0.4	0.19
LN11164_02	0.04	0.12	0.15	0.12	0.83	0.32
LN1774	0.16	0.15	0.26	0.68	0.58	0.34
LN11176_01	0.08	0.07	0.08	0.36	0.3	0.07
LN11176_02	0.08	0.08	0.09	0.41	0.4	0.08
LN1778_01	0.16	0.17	0.28	1.42	1.66	0.99
LN1778_02	0.16	0.17	0.27	1.41	1.53	0.95
LN11195_01	0.11	0.14	0.2	0.72	1.11	0.51
LN11195_02	0.11	0.13	0.19	0.69	0.99	0.47
LN2345	0.07	0.15	0.26	0.34	1.31	3.28
LN11203	0.19	0.24	0.33	0.91	1.33	0.53
LN11099_01	0.1	0.11	0.1	0.61	0.67	0.1
LN11099_02	0.1	0.11	0.11	0.63	0.71	0.11
LN1825	0.16	0.2	0.28	0.68	0.95	0.39
LN1828	0	0.08	0.08	0	0.34	0.09
LN1824_01	0.17	0.18	0.27	0.72	0.79	0.36
LN1824_02	0.17	0.17	0.27	0.71	0.76	0.35
LN11199_01	0.06	0.06	0.03	0.08	0.08	0.02
LN11199_02	0.05	0.12	0.08	0.05	0.29	0.14
LN11199_03	0.06	0.09	0.05	0.07	0.15	0.05
LN10952	0.29	0.21	0.17	0.79	0.44	0.29
LN11112_01	0.08	0.09	0.14	0.35	0.49	0.21
LN11112_02	0.07	0.08	0.14	0.3	0.41	0.21
LN11153_01	0.01	0.04	0.08	0.01	0.12	0.07
LN11153_02	0.01	0.05	0.09	0.01	0.2	0.08
LN11124	0.09	0.09	0.1	0.47	0.53	0.09

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN11120	0.33	0.35	0.12	1.71	1.91	0.22
LN11143_01	0.16	0.16	0.26	0.67	0.68	0.33
LN11143_02	0.16	0.16	0.26	0.66	0.66	0.33
LN10979_01	0.02	0.01	0.01	0.01	0	0
LN10979_02	0.02	0.02	0.03	0.01	0.01	0.02
LN10979_03	0.01	0.05	0.05	0	0.06	0.06
LN10979_04	0.01	0.08	0.08	0	0.13	0.13
LN11123	0.05	0.21	0.28	0.2	2.3	0.48
LN10986	0.23	0.21	0.15	0.91	0.79	0.4
LN1819	0.16	0.16	0.23	0.66	0.62	0.26
LN10820	0.03	0.05	0.04	0.02	0.04	0.05
LN23702	0.18	0.18	0.17	0.61	0.59	0.3
LN2284	0.18	0.17	0.4	0.89	0.8	0.74
LN10830_01	0.05	0.05	0.03	0.05	0.05	0.02
LN10830_02	0.04	0.04	0.04	0.03	0.04	0.04
LN10830_03	0.02	0.04	0.07	0.01	0.03	0.09
LN6549	0.05	0.09	0.17	0.06	0.16	0.18
LN10863_01	0.11	0.11	0.22	0.75	0.73	0.3
LN10863_02	0.12	0.12	0.22	0.82	0.83	0.3
LN23708	0.16	0.2	0.3	0.27	0.42	0.98
LN23707	0.03	0.03	0.03	0.01	0.01	0.01
LN10868_01	0.16	0.15	0.21	0.61	0.54	0.23
LN10868_02	0.16	0.15	0.21	0.61	0.55	0.23
LN4495_01	0.03	0.05	0.03	0.03	0.06	0.01
LN4495_02	0.03	0.05	0.03	0.02	0.06	0.01
LN4494	0.03	0.05	0.05	0.08	0.16	0.12
LN1857_01	0.08	0.07	0.06	0.13	0.09	0.09
LN1857_02	0.08	0.06	0.06	0.12	0.08	0.08
LN1857_03	0.06	0.05	0.06	0.09	0.06	0.07
LN10890_01	0.04	0.04	0.02	0.04	0.03	0.01
LN10890_02	0.04	0.03	0.03	0.03	0.03	0.02
LN10890_03	0.02	0.03	0.05	0.01	0.02	0.05
LN10890_04	0.01	0.04	0.07	0	0.04	0.1
LN1822_01	0.16	0.15	0.22	0.63	0.56	0.24
LN1822_02	0.16	0.15	0.22	0.62	0.54	0.24
LN11137_01	0.02	0.02	0.01	0.01	0.01	0.01
LN11137_02	0.01	0.01	0.02	0.01	0	0.01
LN11137_03	0	0.03	0.05	0	0.02	0.05

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN11137_04	0.02	0.06	0.08	0.01	0.07	0.12
LN10829	0.08	0.07	0.07	0.14	0.1	0.1
LN1856	0	0	0	0	0	0
LN10839_01	0.14	0.13	0.09	0.37	0.32	0.17
LN10839_02	0.14	0.13	0.09	0.35	0.3	0.16
LN10529	0.01	0.12	0.18	0	0.2	1.03
LN16320	0.06	0.26	0.18	0.09	1.29	0.09
LN10769_01	0.37	0.4	0.2	6.05	6.74	0.26
LN10769_02	0.37	0.4	0.2	6.03	6.69	0.26
LN10769_03	0.27	0.27	0.25	3.37	3.22	0.38
LN10769_04	0.27	0.27	0.25	3.37	3.22	0.38
LN10769_05	0.37	0.39	0.2	6.03	6.38	0.26
LN10769_06	0.27	0.27	0.25	3.37	3.22	0.38
LN10569	0.07	0.16	0.45	0.34	1.39	4.03
LN16321_01	0.05	0.27	0.24	0.05	1.38	0.23
LN16321_02	0.05	0.27	0.43	0.05	1.38	0.92
LN2234_01	0	0.01	0.78	0	0	2.93
LN2234_02	0	0.01	0.78	0	0	2.93
LN2249	0.11	0.17	0.37	0.2	0.46	2.39
LN10747_01	0.11	0.16	0.43	0.21	0.45	3.28
LN10747_02	0.09	0.14	0.41	0.16	0.38	3.1
LN10747_03	0.11	0.16	0.43	0.21	0.45	3.28
LN10747_04	0.19	0.26	0.12	0.66	1.15	0.41
LN10747_05	0.19	0.26	0.12	0.64	1.12	0.42
LN10747_06	0.08	0.1	0.22	0.13	0.18	1.11
LN11070_01	0.25	0.34	0.2	3.26	5.81	0.37
LN11070_02	0.24	0.33	0.19	3.06	5.39	0.35
LN11070_03	0.11	0.15	0.09	0.75	1.29	0.09
LN11026_01	0.01	0.09	0.09	0.01	0.51	0.13
LN11026_02	0	0	0	0	0	0
LN11026_03	0	0.04	0.04	0	0.13	0.03
LN2356_01	0.3	0.42	0.23	4.7	8.43	0.5
LN2356_02	0.3	0.41	0.41	4.65	8.25	8.25
LN11091_01	0.2	0.27	0.15	2.09	3.89	0.21
LN11091_02	0.21	0.29	0.16	2.36	4.45	0.24
LN10732	0.04	0.05	0.05	0.03	0.04	0.05
LN10726_01	0.02	0.02	0.1	0.02	0.02	0.11
LN10726_02	0.02	0.02	0.1	0.02	0.02	0.12

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN10721	0.04	0.04	0.02	0.03	0.04	0.01
LN10710	0.11	0.16	0.33	0.22	0.49	2.08
LN2259	0.13	0.19	0.33	0.32	0.6	2.16
LN2260_01	0	0	0	0	0	0
LN2260_02	0	0	0	0	0	0
LN10700	0.05	0.03	0.08	0.13	0.05	0.09
LN10694	0.05	0.03	0.15	0.18	0.07	1.48
LN10683	0.12	0.18	0.29	0.27	0.57	1.75
LN11127_01	0.01	0.02	0.02	0	0.01	0.01
LN11127_02	0	0.01	0.01	0	0	0
LN11127_03	0	0	0	0	0	0
LN11025_01	0.04	0.15	0.26	0.01	0.12	0.35
LN11025_02	0.04	0.15	0.25	0.01	0.12	0.35
LN11025_03	0.04	0.15	0.25	0.01	0.12	0.35
LN2270	0.09	0.11	0.09	0.15	0.24	0.17
LN10662	0.06	0.12	0.08	0.25	0.84	0.52
LN6610	0.05	0.1	0.17	0.12	0.45	1.35
LN10752	0.2	0.24	0.08	0.67	0.98	0.21
LN6611	0.05	0.11	0.17	0.05	0.23	0.59
LN10629_01	0.05	0.08	0.08	0.19	0.37	0.07
LN10629_02	0.05	0.08	0.07	0.2	0.39	0.07
LN10629_03	0.05	0.08	0.08	0.19	0.37	0.07
LN10654	0.03	0.16	0.06	0.08	1.51	0.03
LN2272	0.09	0.11	0.07	0.22	0.33	0.15
LN2301	0.1	0.12	0.05	0.18	0.26	0.07
LN11050	0.03	0.05	0.05	0.01	0.03	0.03
LN2336	0	0	0	0	0	0
LN11057_01	0	0.01	0.01	0	0	0
LN11057_02	0.01	0.01	0.01	0	0	0
LN11069	0	0.01	0.01	0	0	0
LN2291	0.14	0.15	0.12	0.35	0.4	0.28
LN10645	0.1	0.11	0.04	0.24	0.31	0.07
LN11095_01	0.02	0.05	0.04	0.02	0.18	0.03
LN11095_02	0.03	0.05	0.03	0.08	0.15	0.01
LN11095_03	0.02	0.04	0.03	0.03	0.1	0.02
LN11095_04	0.02	0.04	0.02	0.04	0.1	0.01
LN2276_01	0.07	0.09	0.12	0.31	0.51	0.18
LN2276_02	0.06	0.08	0.12	0.24	0.39	0.19

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN11063_01	0	0	0	0	0	0
LN11063_02	0.01	0.02	0.02	0	0.01	0.01
LN11063_03	0	0.01	0.01	0	0	0
LN2334	0	0	0	0	0	0
LN10998_01	0.02	0.04	0.08	0	0.01	0.04
LN10998_02	0.02	0.04	0.08	0	0.01	0.04
LN10998_03	0.03	0.08	0.04	0.01	0.04	0.01
LN10998_04	0.01	0.03	0.07	0	0.01	0.04
LN10998_05	0.03	0.07	0.04	0.01	0.03	0.01
LN10998_06	0.01	0.03	0.07	0	0.01	0.03
LN10998_07	0.02	0.06	0.05	0	0.02	0.02
LN10998_08	0.02	0.04	0.06	0	0.01	0.02
LN11117_01	0.06	0.11	0.04	0.02	0.06	0.01
LN11117_02	0.08	0.13	0.03	0.04	0.09	0.01
LN11117_03	0.08	0.13	0.03	0.04	0.09	0.01
LN2320_01	0.04	0.12	0.25	0.01	0.08	0.33
LN2320_02	0.04	0.12	0.25	0.01	0.08	0.34
LN10615	0.04	0.07	0.13	0.04	0.15	0.5
LN2281_01	0.17	0.17	0.23	0.77	0.75	0.26
LN2281_02	0.17	0.17	0.23	0.77	0.75	0.26
LN6548	0.05	0.09	0.17	0.19	0.53	0.18
LN2280	0.16	0.15	0.15	0.65	0.63	0.08
LN23701	0.19	0.18	0.36	0.93	0.78	0.64
LN10825_01	0.07	0.06	0.16	0.34	0.22	0.18
LN10825_02	0.07	0.06	0.37	0.34	0.22	1.27
LN23706	0.07	0.08	0.09	0.02	0.03	0.05
LN10610_01	0.12	0.16	0.27	0.39	0.61	0.38
LN10610_02	0.12	0.16	0.27	0.39	0.61	0.38
LN11011_01	0.03	0.1	0.15	0.01	0.06	0.13
LN11011_02	0.01	0.08	0.16	0	0.03	0.15
LN10817	0.11	0.1	0.18	0.66	0.62	0.2
LN10604_01	0.04	0.07	0.25	0.03	0.11	0.35
LN10604_02	0.04	0.07	0.25	0.03	0.11	0.35
LN10604_03	0.04	0.07	0.25	0.03	0.11	0.35
LN10604_04	0.04	0.07	0.25	0.03	0.11	0.35
LN10975_01	0.07	0.21	0.17	0.03	0.21	0.18
LN10975_02	0.07	0.19	0.18	0.03	0.19	0.19
LN10519_02	0.05	0.14	0.17	0.05	0.31	0.53

ID	PHD - Maximum Velocities (m/s)			PHD - Maximum Headlosses (m/1000 m)		
	2016	2041	2041+ Upgrade	2016	2041	2041+ Upgrades
LN10798	0.18	0.18	0.17	1.42	1.38	0.3
LN1860_01	0	0	0	0	0	0
LN1860_02	0	0	0	0	0	0
272-02-04	0.28	0.59	0.54	0.1	0.4	0.34
272-04-07	0.28	0.59	0.54	0.1	0.4	0.34
272-07-09	0.28	0.59	0.54	0.1	0.4	0.34
272-09-00	0.28	0.59	0.54	0.1	0.4	0.34
272-09D	0.28	0.59	0.54	0.11	0.43	0.36
272-09U	0.28	0.59	0.54	0.11	0.43	0.36
280-01-04	0.17	0.52	0.48	0.04	0.33	0.28
280-04-06	0.17	0.52	0.48	0.04	0.33	0.28
LN11782_1	0	0	0	0	0	0
MU_P138	0.04	0.18	0.04	0.08	1.62	0.01
MU_P139	0.02	0.13	0.19	0.04	1	0.46
MU_P147	0.05	0.23	0.2	0.03	0.56	0.46
MU_P287_WMR	0.03	0.05	0.05	0.01	0.03	0.03
MU_P288_WMR	0.03	0.04	0.04	0.01	0.02	0.02
MU_P289_WMR	0.02	0.03	0.03	0.01	0.01	0.01
MU_P290_WMR	0	0.01	0.01	0	0	0
MU_P542_WMR	0.17	0.37	0.32	0.23	0.94	0.64
MU_P543_WMR	0.17	0.36	0.31	0.21	0.89	0.61
MU_P544_WMR	0.15	0.35	0.29	0.17	0.81	0.52
MU_P545_WMR	0.14	0.33	0.28	0.15	0.77	0.49
MU_P546_WMR	0.14	0.33	0.28	0.15	0.75	0.48

FUS Fire Flow Calculation - Single/Semi Family Residential						
	Estimate 1		Estimate 2		Estimate 3	
Total Floor Area without basement (m2)	200		200		200	
1. Construction	Wood Frame	1.5	Wood Frame	1.5	Wood Frame	1.5
	5000		5000		5000	
2. Occupancy	Limited-Combustible	-15%	Limited-Combustible	-15%	Limited-Combustible	-15%
	4250		4250		4250	
3. Sprinkler System	None	0%	None	0%	None	0%
	0		0		0	
4. Exposure Charge	3.1 - 10 m	20%	0 - 3 m	25%	0 - 3 m	25%
	10.1 - 20 m	15%	30.1 - 45 m	5%	> 45 m	0%
	0 - 3 m	25%	0 - 3 m	25%	0 - 3 m	25%
	30.1 - 45 m	5%	30.1 - 45 m	5%	20.1 - 30 m	10%
	65%		60%		60%	
	2763		2550		2550	
Required Fire Flow (L/min)	7000		7000		7000	
Required Fire Flow (L/s)	**117**		**117**		**117**	

FUS Fire Flow Calculation - Medium/Townhouse Residential and Commercial						
	Estimate 1		**Estimate 2**		**Estimate 3**	
Total Floor Area without basement (m2)	4,800		970		1,740	
1. Construction	Ordinary	1	Ordinary	1	Ordinary	1
	15000		7000		9000	
2. Occupancy	Combustible	0%	Combustible	0%	Limited-Combustible	-15%
	15000		7000		7650	
3. Sprinkler System	Standard Water Supply	-40%	None	0%	None	0%
	-6000		0		0	
4. Exposure Charge	> 45 m	0%	0 - 3 m	25%	0 - 3 m	25%
	> 45 m	0%	20.1 - 30 m	10%	30.1 - 45 m	5%
	> 45 m	0%	0 - 3 m	25%	0 - 3 m	25%
	> 45 m	0%	20.1 - 30 m	10%	30.1 - 45 m	5%
	0%		70%		60%	
	0		4900		4590	
Required Fire Flow (L/min)	9000		12000		12000	
Required Fire Flow (L/s)	**150**		**200**		**200**	

FUS Fire Flow Calculation - High Rise/Apartment Residential and Industrial						
	Estimate 1		**Estimate 2**		**Estimate 3**	
Total Floor Area without basement (m2)	48,000		20,160		25,200	
1. Construction	Non-Combustible	0.8	Non-Combustible	0.8	Non-Combustible	0.8
	39000		25000		28000	
2. Occupancy	Limited-Combustible	-15%	Free Burning	15%	Limited-Combustible	-15%
	33150		28750		23800	
3. Sprinkler System	Standard Water Supply	-40%	Fully Supervised	-50%	Standard Water Supply	-40%
	-13260		-14375		-9520	
4. Exposure Charge	20.1 - 30 m	10%	30.1 - 45 m	5%	20.1 - 30 m	10%
	> 45 m	0%	> 45 m	0%	> 45 m	0%
	30.1 - 45 m	5%	> 45 m	0%	30.1 - 45 m	5%
	20.1 - 30 m	10%	> 45 m	0%	20.1 - 30 m	10%
	25%		5%		25%	
	8288		1438		5950	
Required Fire Flow (L/min)	28000		16000		20000	
Required Fire Flow (L/s)	**467**		**267**		**333**	