8.0 RECOMMENDED SOLUTIONS

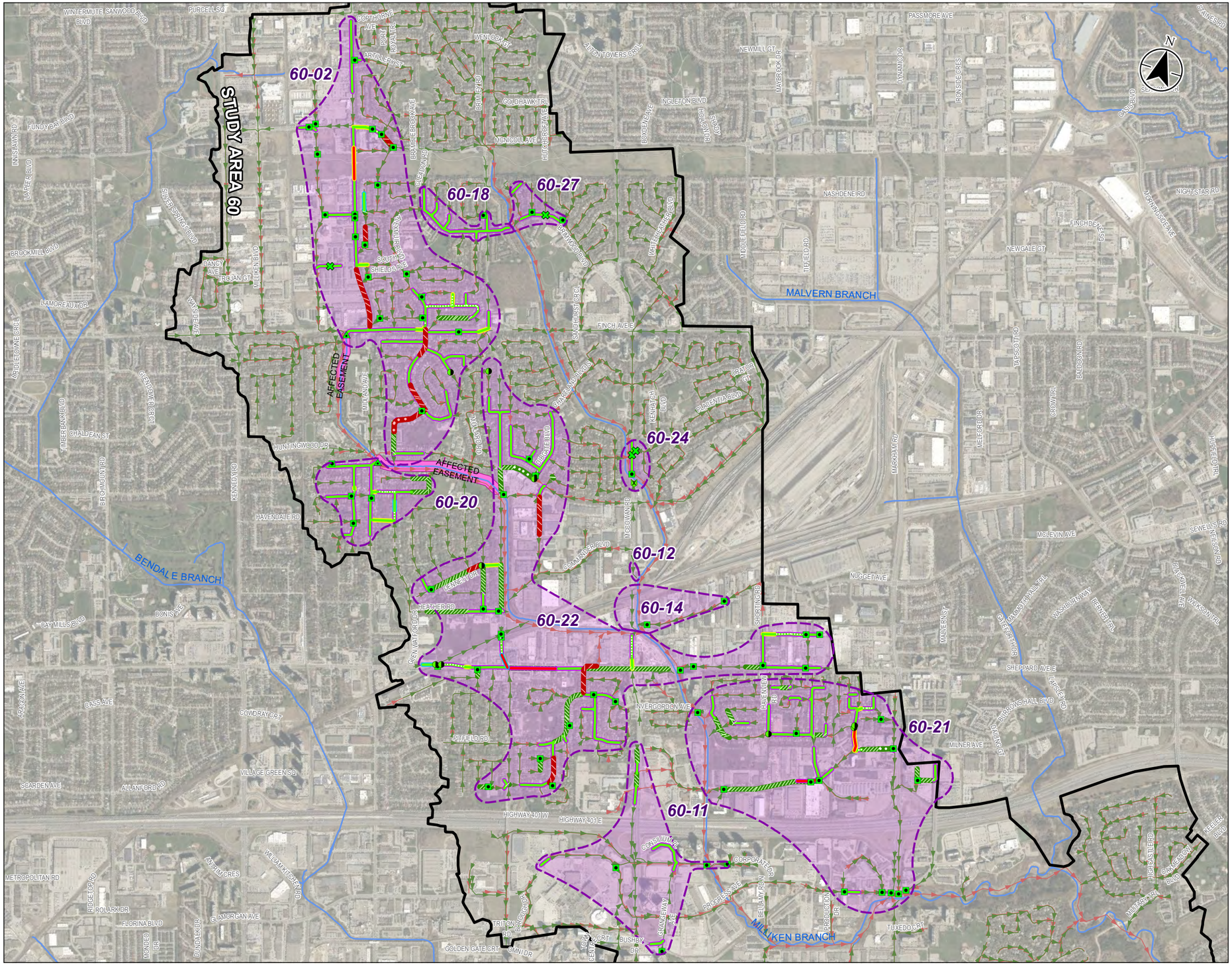
The recommended solution for each of the assignments discussed in this report meet the City's 100-yr design criteria for both subsurface HGL freeboard from surface (1.8 m), and surface depth (150 mm to 300 mm based on road classification), while minimizing the impact to the receiving watercourses and sewers. The sanitary collection system in this area achieves the 1.8 m freeboard criteria under the May 12, 2000, design storm (as measured at the Oriole RG) with the equivalent 3 L/s/ha wet weather flow generation rate.

Figure 8—1 presents the recommended integrated storm and sanitary solutions for the areas. A detailed SST, including the solution description, cost, and EA Schedule, can be found in **Appendix D.** A summary of the recommended solutions for each assignment are outlined below:

8.1.1 Recommended Solution for Assignment 60-02

Alternative 1 is the recommended solution for Assignment 60-02. This alternative utilizes conveyance upgrades, in-line storage, relief/diversion sewers, as well as an outfall upgrade on City property to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule B. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades;
- Provide sanitary in-line storage on:
    - Crockamhill Dr with a realignment;
    - Chartland Blvd S;
    - McNicoll Ave;
    - Haven Hill Sq;
    - Midland Ave (between South Shields Ave and Finch Ave E);
- Divert sanitary flows along Midland Ave, north of the HEPC, south towards Kilcullen Castle Gt to avoid upgrades through HEPC;
- Realign sanitary and storm sewers along Midland Ave to disconnect dual manhole;
- Redirect storm flows west on McNicoll Ave towards Midland Ave to avoid HEPC pipe upgrades, continuing south on Midland Ave to avoid easement upgrades;
- Redirect storm flows west on South Shields Ave to Midland Ave, and south on Alexmuir Blvd from Dunmall Dr towards Finch Ave E, to avoid easement pipe upgrades;
- Provide storm in-line storage on:
    - McNicoll Ave upstream of HEPC;
    - Valdor Dr upstream of easement;
    - Bushmills Sq upstream of easement;
    - Crookamhill Dr just north of Huntingwood Dr;
- Realign sewers on northern stretch of Bushmills Sq south of sanitary to avoid conflicts;
- Redirect flows west on Finch Ave E from Brimley Rd and realign sewers along Finch Ave E north into the ROW; and,
    - Outfall upgrade on City property south of Finch Ave E.



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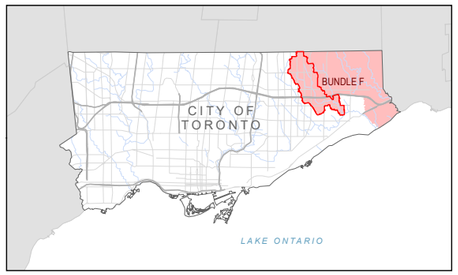

Project Location
City of Toronto

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Prepared by KDB on 2023-07-28

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE F - STUDY AREA 60

Figure No.
8.1

Title
Recommended Solutions

8.1.2 Recommended Solution for Assignment 60-11

Alternative 2 is the recommended solution for Assignment 60-11. This alternative utilizes increased inlet capacity, conveyance upgrades, and in-line storage to avoid upgrades under Highway 401 to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- In-line storm storage on McCowan Rd to avoid upgrades under Highway 401;
- Storm sewer conveyance upgrades along Progress Ave, Consilium Pl, and Bushby Dr; and,
- Increased storm inlet capacity on Progress Ave, Consilium Pl, Corporate Dr, and Bushby Dr.

8.1.3 Recommended Solution for Assignment 60-12

Alternative 2 is the recommended solution for Assignment 60-12. This alternative is to do nothing. A summary of this alternative solution is outlined below:

- Do Nothing;
- Only a single HGL infraction exists at the bottom of a steep slope near the outfall, thus it is considered a low flood risk.

8.1.4 Recommended Solution for Assignment 60-14

Alternative 3 is the recommended solution for Assignment 60-14. This alternative utilizes increased inlet capacity to mitigate surface and basement flood risk, and a “do nothing” approach on McCowan Rd due to low perceived risk and few benefitting properties. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- A “Do Nothing” alternative for sewers on McCowan Rd due to low perceived risk and few benefitting properties; and,
- Increased storm inlet capacity on Nugget Ave.

8.1.5 Recommended Solution for Assignment 60-18

Alternative 3 is the recommended solution for Assignment 60-18. This alternative is a hybrid alternative of Alternatives 1 and 2 and utilizes conveyance upgrades, similar to Alternative 1 except without upgrading the pipe immediately upstream of the outfall or the outfall itself, to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades as per Alternative 1; and,
- Realign storm and sanitary sewers to achieve required hydraulic separation.

8.1.6 Recommended Solution for Assignment 60-20

Alternative 1 is the recommended solution for Assignment 60-20. This alternative utilizes conveyance upgrades, sewer/flow redirection, in-line storage, and an outfall upgrade on City property to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule B. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades;
- Redirect storm flow from Stubbswood Sq and Glen Watford Dr west towards Midland Ave;
- New storm sewers on Havendale Rd between Glen Watford Dr and Midland Ave;
- Provide in-line storm storage on Stubbswood Sq upstream of easement;
- Realign and redirect storm sewers on Scotland Rd north from Stainforth Dr towards Emmeline Cres;
- Outfall upgrade in City-owned property; and,
- Realign sanitary and storm sewers to achieve required hydraulic separation.

8.1.7 Recommended Solution for Assignment 60-21

Alternative 2 is the recommended solution for Assignment 60-21. This alternative utilizes increased inlet capacity, conveyance upgrades, flow redirection, and in-line storage to avoid an outfall upgrade to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades along Milner Ave, Crown Acres Crt, Forest Crt, Scunthrope Rd, Pennybrook Ln, Spring Forest Sq, Prince William Crt, Wyper Sq, Havenview Rd, Carlingwood Crt, Glenstroke Dr, Invergordan Ave, Massie St, Plum Brook Cr, Mid-Dominion Acres, and Progress Ave;
- Redirect storm flows west on Crown Acres Crt to Scunthrope Rd to avoid private property;
- Redirect storm flows south along Scunthrope Rd to Milner Ave and east to Markham Rd* Redirect flows from Havenview Rd east along Invergordan Ave;
- Provide in-line storm storage on Kentish Cres and Invergordan Ave upstream of private property and easement with outfall, respectively, on Carlingwood Crt and Invergordan Ave upstream of private properties, and on Milner Ave between Scunthrope Rd and Markham Rd and between Mid-Dominion Acres and the outfall to avoid outfall upgrade;
- Disconnect sanitary flow to Invergordan Ave and divert flow south along Scunthrope Rd to Milner Ave; and,
- Sanitary conveyance upgrades along Milner Ave west of Executive Crt.

8.1.8 Recommended Solution for Assignment 60-22

Alternative 2 is the recommended solution for Assignment 60-22. This alternative utilizes increased inlet capacity, conveyance upgrades, flow redirection, and additional in-line storage to avoid outfall upgrades and to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades along Leeswood Cres, Chartland Blvd S, Brimley Rd, Dibgate Blvd, Idehill Cres, Broomfield Dr, Commander Blvd, McGriskin Rd, Sheppard Ave E, Shorting Rd, McCowan Rd, Pitfield Rd, Charterhouse Rd, Brownspring Rd, Terryhill Cres, Cleethorpes Blvd, Keyworth Trl, Gritanni Ln, Dennet Dr, Marydon Cres, Shilton Rd, and Heather Rd;
- Provide storm in-line storage on Hoseyhill Cres upsteam of easement; on Dibgate Blvd, Huntingwood Dr and Brimley Rd to avoid the outfall upgrade; on Sheppard Ave E just west of Shorting Rd; on Harrisfarm Gt just south of Sheppard Ave E; on Rubic Cres across Brimley Rd near Gritanni Ln; on Redbud Cres upstream of easements and private property; on Pitfield Rd between Terryhill Cres and Brownspring Rd; cascading in-line storage along Sheppard Ave E between Brimley Rd and the outfall; on Dennet Dr west of Shilton Rd, on Heather Rd west of Shilton Rd; on Shilton Rd north of Frances Cres; and on Brimley Rd north of Heather Rd;
- Redirect storm flows west from Dibgate Blvd on Huntingwood Dr to Brimley Rd, on McGriskin Rd west to Shorting Rd to avoid private property, on Sheppard Ave E and Brimley Rd towards outfall on Sheppard Ave E to avoid sewers within CPR property, on McCowan Rd south to Sheppard Ave E to avoid outfall upgrades, and on Dennet Dr east to Brimley Rd;
- Sanitary conveyance upgrades on Sheppard Ave E east of Brimley Rd; and,
- Provide in-line storage for sanitary system on Terryhill Cres, Brownspring Rd, Sheppard Ave E, Dennet Dr, and on Commander Blvd.

8.1.9 Recommended Solution for Assignment 60-24

Alternative 3 is the recommended solution for Assignment 60-24. This alternative utilizes conveyance upgrades, inlet restriction by catchbasin removal, overland flow re-routing, and no outfall upgrades to mitigate surface and basement flood risk. Due to the proposed overland flow re-routing work, this alternative is Schedule B. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades upstream of northern outfall;
- Catchbasins at intersection of Kenhatch Blvd and McCowan Rd removed;
- Decrease storm inlet capacity by removing catchbasins upstream of southern outfall; and,
- Remove curb and provide overland flow route to watercourse.

8.1.10 Recommended Solution for Assignment 60-27

Alternative 3 is the recommended solution for Assignment 60-27. This alternative utilizes adjusted inlet capacity and conveyance upgrades. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- Storm conveyance upgrades along Brimwood Blvd (between Macklingate Crt and Amanda Dr) and Melva Cres;
- Increased storm inlet capacity on Melva Cres and Wellpark Blvd at Brimwood Blvd; and
- Remove CBs on Brimwood Blvd at Amanda Dr.

8.2 OPINION OF PROBABLE COSTS

The opinion of probable costs based on version 4.1 of the City's CET for the recommended flood solutions in each of the 10 assignments are summarized below. This cost covers the total anticipated construction cost, includes 30% contingency and is exclusive of HST. Details regarding the cost estimate are provided in **Section 7.3**, and the recommended solution cost estimate sheets for each of the assignments are provided in **Appendix E**.

The opinion of probable costs for the recommended flood solution for each assignment are as follows:

- Assignment 60-02 flood solution cost is $96,985,256;
- Assignment 60-11 flood solution cost is $4,987,790;
- Assignment 60-12 flood solution cost is $0;
- Assignment 60-14 flood solution cost is $113,315;
- Assignment 60-18 flood solution cost is $10,489,537;
- Assignment 60-20 flood solution cost is $24,810,088;
- Assignment 60-21 flood solution cost is $73,051,132;
- Assignment 60-22 flood solution cost is $206,363,597;
- Assignment 60-24 flood solution cost is $1,683,244; and
- Assignment 60-27 flood solution cost is $3,143,155;

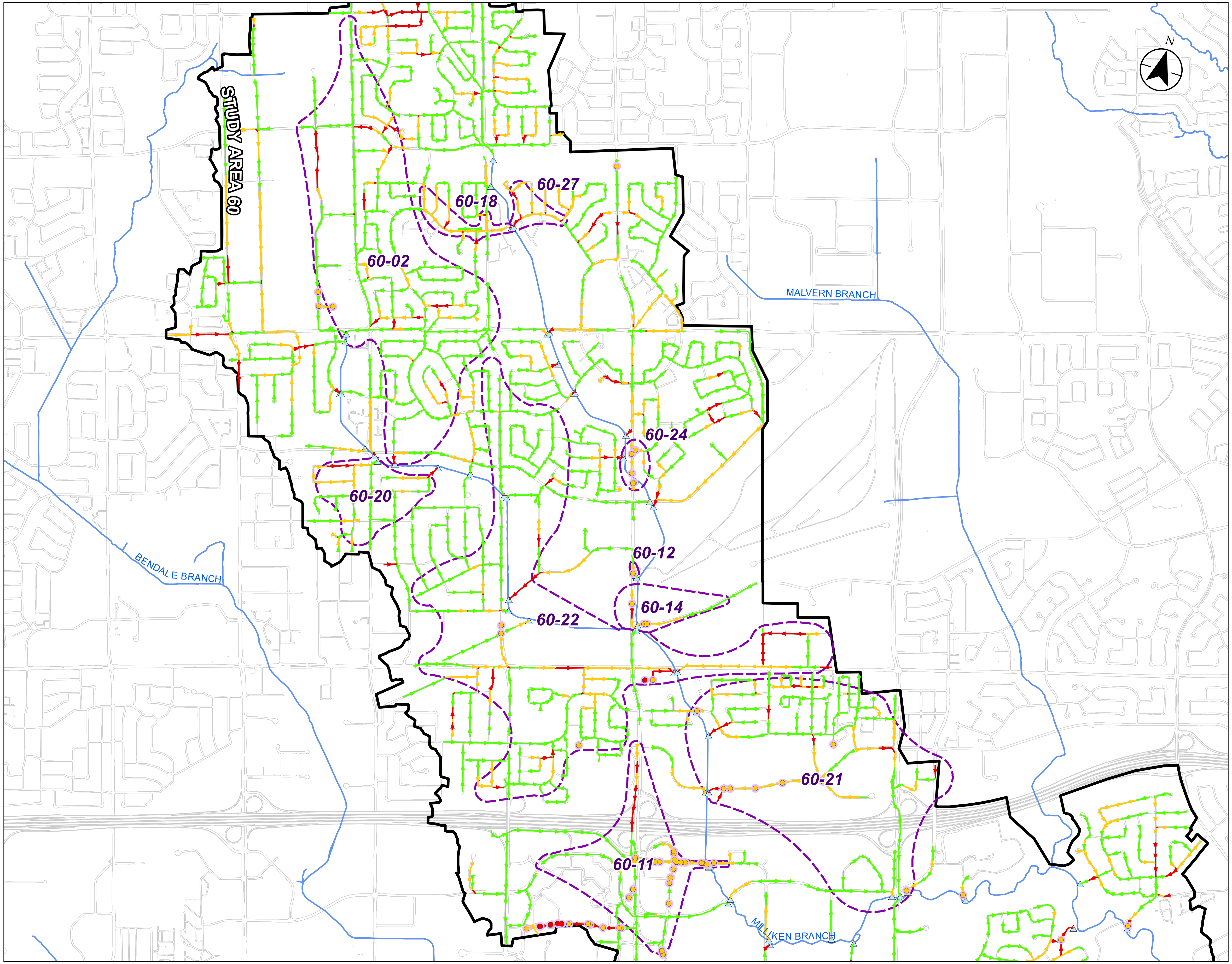
8.3 PERFORMANCE OF RECOMMENDED ALTERNATIVE AND SOLUTION EXEMPTIONS

The model results of the proposed solution for the 100-yr storm minor system, 100-yr storm major system, and May 12, 2000 sanitary system are presented in **Figure 8**—3, and **Figure 8**—4, respectively. The results are summarized below:

- The storm sewer and sanitary pipes within the ROW meet the HGL depth criteria where properties are connected to the sewer, except where shallow sewers within 1.8 m of the surface exist, as is the case in all assignment areas except 60-27. Here, the water level in the sewers is maintained below the crown of the pipe and less than the existing condition HGL.
- Overland flow depth is maintained within the street ROW per established criteria for varying road classifications.

While every attempt was made to meet the surface depth, HGL, sewer design, conflict clearance, and shallow pipe criteria throughout the Proposed Solution, there remain a few locations where explicit adherence to all criteria was not possible, nor always required due to limited flood risk to existing or potential future private properties, or because the HGL infraction occurs along the trunk sewer that is outside the purview of this study or is incurred by assumed TRCA water level boundary conditions. A list of the nodes and overland link depths along with supporting rationale for the exemption status is provided in **Appendix C** of the **Attachment #3 – TM3**.

The modelled performance of the recommended solution for each of the 10 assignments are summarized in **Section 8.3.1** to **Section 8.3.10** below.



Stantec

Legend

- Study Area
- Assignment Area
- Storm Outfall

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)
- Meets Exceedance Criteria

Pipe Surcharge State

- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 500 1,000 m

1:25,000 (At original document size of 11x17)

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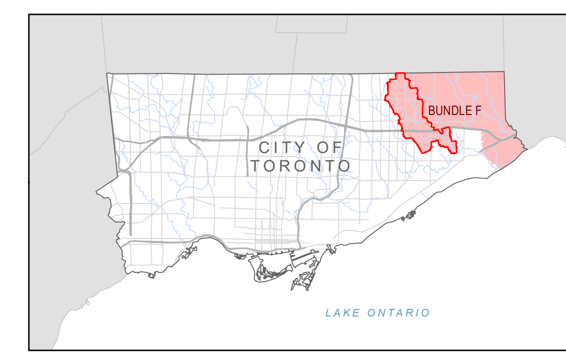


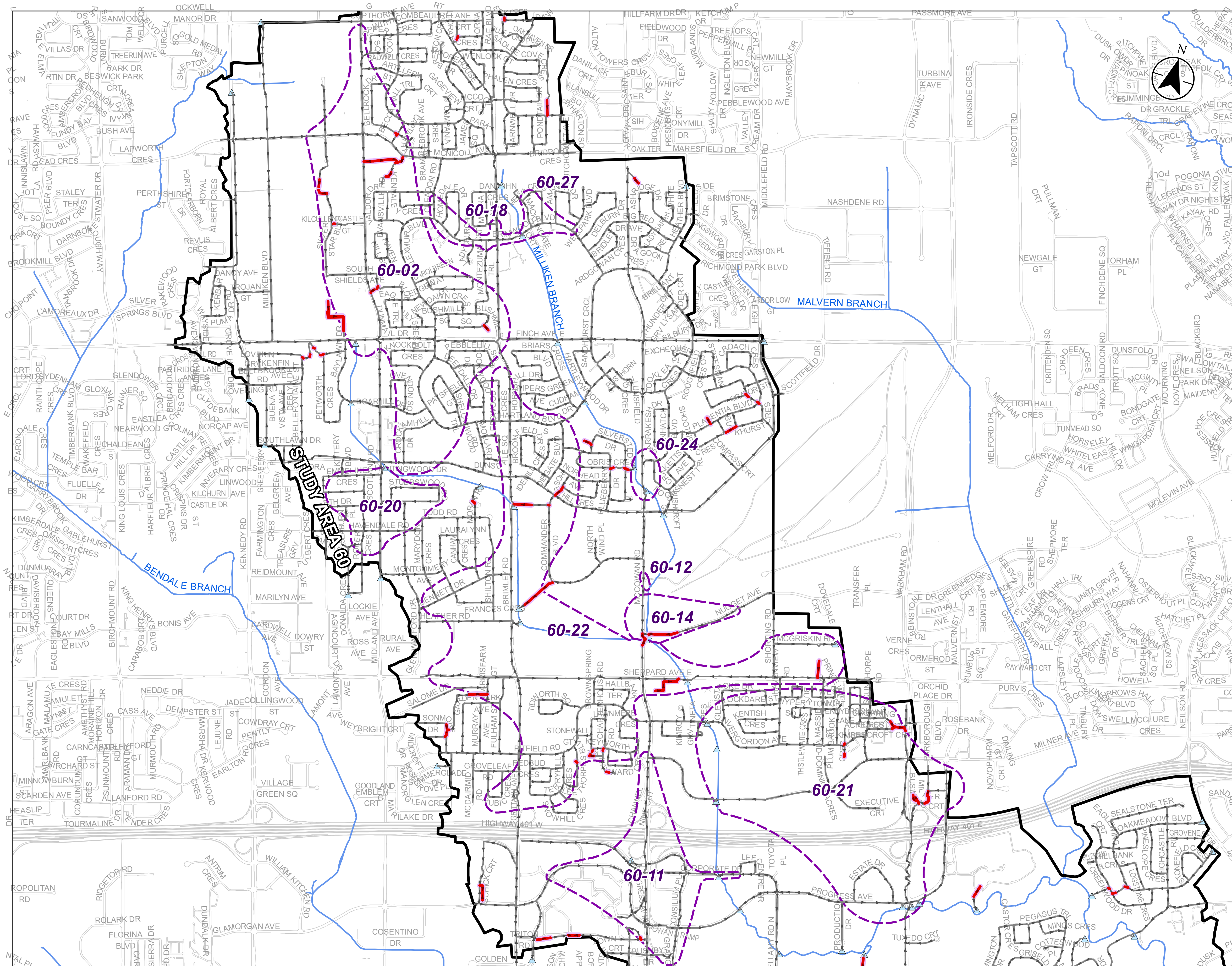
Project Location
City of Toronto

165660138 REVA
Prepared by KDB on 2023-07-28

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE F - STUDY AREA 60

Figure No.
8.2

Title
Proposed Storm System Results (100-yr)



Stantec

Legend

- Study Area
- Assignment Area
- Major System Outfall

Overland Depth

- Exceeds Maximum Allowable Depth
- Below Maximum Allowable Depth
- Meets Exemption Criteria

0 500 1,000 m

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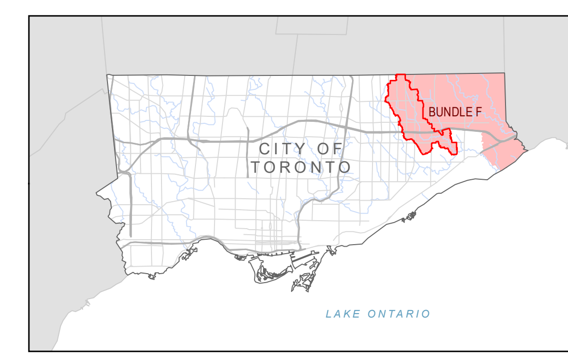

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CITY OF TORONTO

BASEMENT FLOODING CAPACITY STUDIES

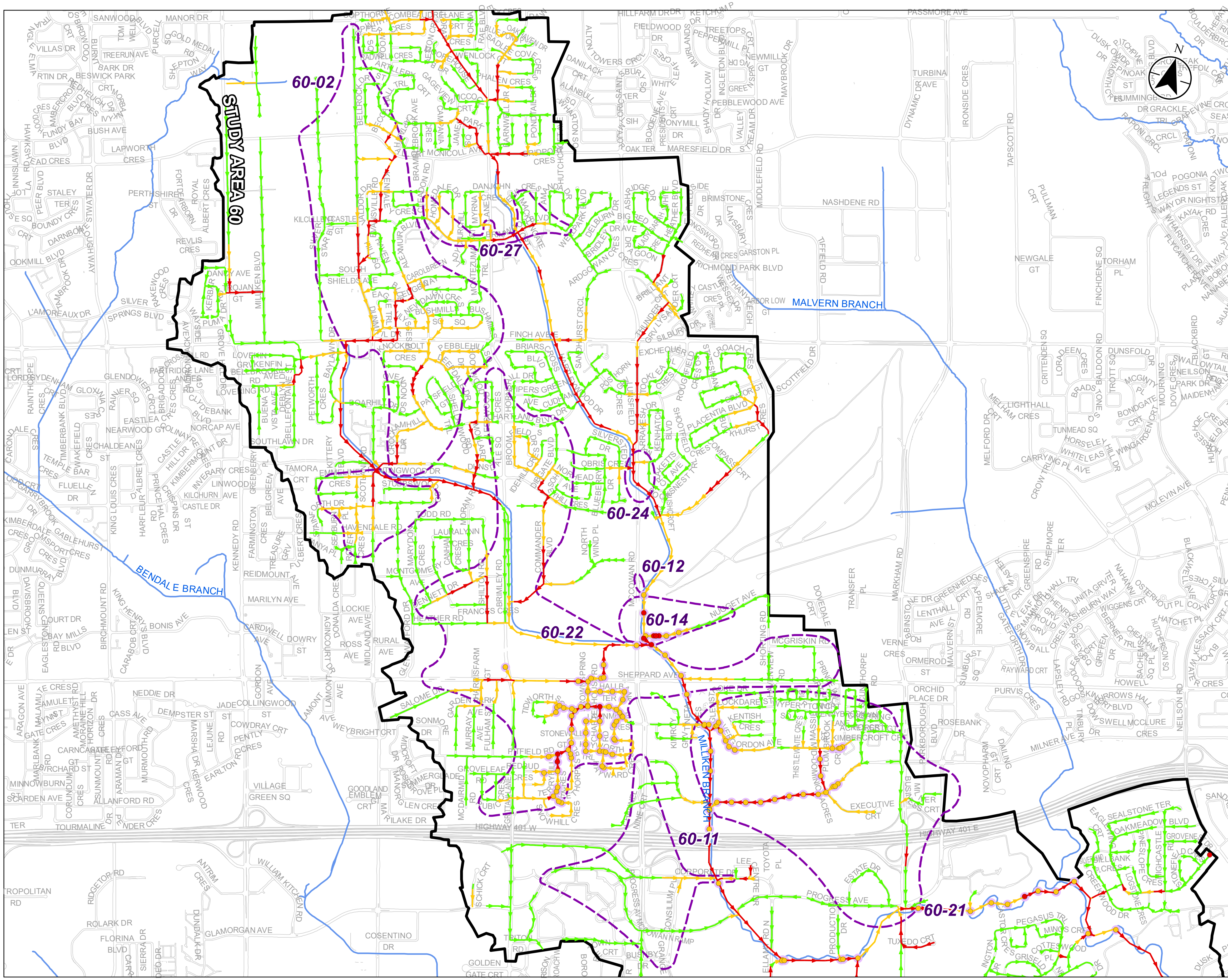
BUNDLE F - STUDY AREA 60

Figure No.

8.3

Title

Proposed Major Overland System Results (100-yr)



Stantec

Legend

- Study Area
- Assignment Area

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)
- Sealed MH
- Meets Exemption Criteria

Pipe Surcharge State

- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 500 1,000 m

1:25,000 (At original document size of 11x17)

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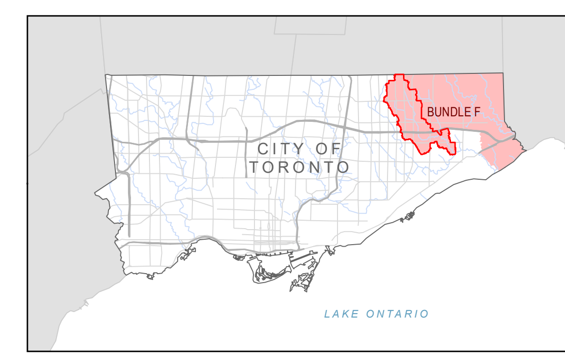

Project Location: City of Toronto

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Client/Project

CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE F - STUDY AREA 60

Figure No.

8.4

Title

Proposed Sanitary System Results (May 12, 2000)

8.3.1 Modelled Performance for Assignment 60-02

- HGL issues resolved through conveyance capacity upgrades, flow diversion, and an outfall upgrade;
- HGLs have been reduced from baseline where issues remain (within ICI areas with no basements);
- Conveyance capacity upgrades result in an overall peak flow increase to existing storm outfalls of 0.38 m3/s during minor storm events and an overall peak flow increase of 7.25 m3/s during the 100yr storm; and,
- 100-year level-of-service is met with shallow pipe and boundary condition limitations.

8.3.2 Modelled Performance for Assignment 60-11

- HGL issues on McCowan Rd resolved through conveyance upgrades and in-line storage;
- HGL issues remain on Corporate Dr due to boundary condition and on Consilium Pl due to shallow pipes;
- HGLs have been reduced from baseline where issues remain (observed only when boundary conditions are applied, or on shallow sewers);
- Conveyance upgrades result in an increase in outflows to East Highland Creek (Markham Branch) by 0.11 m3/s in the minor storm event and 1.91 m3/s in the major storm event; and,
- 100-year level-of-service is met with shallow pipe and boundary condition limitations.

8.3.3 Modelled Performance for Assignment 60-12

- No solutions proposed. One HGL infraction remains on McCowan Rd in ICI area (low perceived risk, few benefitting properties).

8.3.4 Modelled Performance for Assignment 60-14

- HGL issue remains on McCowan Rd at upstream end due to pipe capacity constraints (no proposed pipe solutions);
- HGL issues also remain on Nugget Ave due to increased inlet capacity, shallow existing pipes, and outfall;
- HGLs have been reduced from baseline where issues remain (on McCowan Ave, issues observed even without boundary condition influence; on Nugget Ave, issues observed only when boundary conditions are applied);
- Limited overall peak flow increase to existing storm outfalls of 0.02 m3/s was observed during minor storm events, and an overall peak flow decrease of 0.71 m3/s was observed during the 100yr storm;
- 100yr level-of-service on Nugget Ave with shallow pipe and boundary condition limitations; and,
- Overland exceedances remain regardless of boundary condition influence (30 – 50 cm overland depths on McCowan Rd and Nugget Ave, respectively).

8.3.5 Modelled Performance for Assignment 60-18

- HGL issues resolved with conveyance capacity upgrades;

- HGLs have been reduced from baseline where issues remain (observed only when boundary conditions are applied, or on shallow sewers);
- There is an overall increase in outflows to East Highland Creek (Markham Branch) by 0.01 m3/s in minor storm events and 0.97 m3/s major storm events; and
- 100-year level-of-service is met with shallow pipe and boundary condition limitations.

8.3.6 Modelled Performance for Assignment 60-20

- HGL issues resolved with conveyance capacity upgrades, sewer/flow redirection, and outfall upgrade;
- HGLs have been reduced from baseline where issues remain (observed only when boundary conditions are applied, or on shallow sewers);
- Overall outflows to East Highland Creek (Markham Branch) remain as per existing conditions in minor events, and overall outflows increase by 1.79 m3/s in major events; and,
- 100-year level-of-service is met with shallow pipe and boundary condition limitations.

8.3.7 Modelled Performance for Assignment 60-21

- Most HGL issues resolved through conveyance upgrades, redirection and in-line storage;
- HGL issues remain on Milner Ave, Executive Crt, and Invergordan Ave just west of Glenstroke Dr just upstream of outfall to East Highland Creek (Markham Branch) due to boundary conditions and shallow sewers, and in rear yard south of Invergordan Ave (private property);
- HGLs have been reduced from baseline where issues remain (observed only when boundary conditions are applied, on shallow sewers, and in private property);
- There is a decrease in outflows to East Highland Creek (Markham Branch) by 0.21 m3/s in minor events and an increase in outflows by 2.17 m3/s in major; and,
- 100-year level-of-service is met with shallow pipe and boundary condition limitations.

8.3.8 Modelled Performance for Assignment 60-22

- Most HGL issues resolved through conveyance upgrades, redirection and in-line storage;
- HGL issues remain on Brimley Rd north of the CPR line due to shallow sewers, in the rear yards off of Lawnmere Cres due to shallow sewers, and in the private property southeast of the McCowan Rd and Sheppard Ave E intersection due to private property constraints;
- HGLs have been reduced from baseline where issues remain (observed only on shallow sewers, and in private property);
- There is a decrease in outflows to East Highland Creek (Markham Branch) by 1.38 m3/s in minor events and by 39.67 m3/s in major events; and,
- 100-year level-of-service is met with shallow pipe and boundary condition limitations.

8.3.9 Modelled Performance for Assignment 60-24

- Local HGL reduced with conveyance capacity upgrades and inflow reduction/restriction;
- HGLs have been reduced from baseline where issues remain (observed only when boundary conditions are applied, or on shallow sewers);

- There is an overall decrease in outflows to East Highland Creek (Markham Branch) by 0.09 m3/s in the minor storm event and by 0.33 m3/s in the major storm events;
- 100-year level-of-service is met with shallow pipe and boundary condition limitations; and,
- Remaining overland exceedance resolved.

8.3.10 Modelled Performance for Assignment 60-27

- HGL issue on Melva Cres resolved through conveyance upgrades; and,
- No change to overall peak flow observed during minor storm events and an overall peak flow increase of 0.17 m3/s was observed during the major storm events.

8.4 HYDRAULIC IMPACT DOWNSTREAM

The overall 100-yr outflow with solutions has been maintained or reduced to less than baseline conditions with the implementation of proposed sewer modifications throughout the assignment area and the addition of in-line storage.

For the storm drainage system, under existing conditions, trapped overland flow paths and sewer conveyance bottlenecks provide a level of flow restriction to receiving watercourses. Relieving many of these bottlenecks and providing conveyance for the trapped overland flow paths will increase the peak flow to these watercourses. Conversely, storage elements for the storm drainage system as well as downspout disconnection will work to decrease impacts to the receiving watercourses from the sewer outfalls. The comparison of storm results of the 2 and 100-yr design storms between existing (Ex.) and proposed (Pr.) conditions is presented in **Table 8-1** for outfalls within the 10 EA Assignments for Area 60.

Table 8-1: Storm Outfall Performance

Outfall	2-year Storm						100-year Storm					
	Maximum Flow (m^3/s)				Maximum Velocity (m/s)		Maximum Flow (m^3/s)				Maximum Velocity (m/s)	
	Ex.	Pr.	Dif.	%	Ex.	Pr.	Ex.	Pr.	Dif.	%	Ex.	Pr.
To East Highland Creek Markham Branch												
Assignment 60-02												
OF5056222382	3.08	2.75	-0.33	-10.65	2.73	2.65	6.64	8.62	1.98	29.80	4.04	5.15
OF5125621842	2.67	3.01	0.34	12.76	2.57	2.69	10.30	11.52	1.21	11.79	3.78	4.00
OF5125821848	5.58	5.96	0.37	6.58	3.67	3.36	12.62	16.68	4.06	32.12	5.23	4.64
Assignment 60-02 2-yr Net Change (m^3/s)			0.38	Assignment 60-02 100-yr Net Change (m^3/s)					7.25			
Assignment 60-11												
OF4852625212	4.02	4.13	0.11	2.75	3.84	3.88	12.27	13.37	1.10	10.22	5.33	5.54
OF4870325026	2.02	1.95	-0.06	-3.14	2.56	2.54	7.73	7.76	0.03	0.42	3.82	3.82

Outfall	2-year Storm						100-year Storm					
	Maximum Flow (m^3/s)				Maximum Velocity (m/s)		Maximum Flow (m^3/s)				Maximum Velocity (m/s)	
	Ex.	Pr.	Dif.	%	Ex.	Pr.	Ex.	Pr.	Dif.	%	Ex.	Pr.
OF4871025033	0.49	0.55	0.06	11.95	2.15	2.23	1.28	1.91	0.63	49.55	2.86	3.24
Assignment 60-11 2-yr Net Change (m^3/s)			0.11				Assignment 60-11 100-yr Net Change (m^3/s)		1.76			
Assignment 60-12												
OF5032124058	0.23	0.23	0.00	0.02	3.22	3.22	0.65	0.65	0.00	0.03	4.50	4.50
Assignment 60-12 2-yr Net Change (m^3/s)			0.00				Assignment 60-12 100-yr Net Change (m^3/s)		0.00			
Assignment 60-14												
OF5001124145	0.63	0.63	0.00	-0.02	2.01	2.01	2.21	2.17	-0.03	-1.55	3.66	3.61
OF5003324150	1.06	1.08	0.02	1.73	1.92	1.93	4.23	3.55	-0.68	-16.07	3.12	2.89
Assignment 60-14 2-yr Net Change (m^3/s)			0.02				Assignment 60-14 100-yr Net Change (m^3/s)		-0.71			
Assignment 60-18												
OF5221022652	1.98	1.98	0.01	0.37	2.71	2.72	5.19	6.16	0.97	18.69	3.88	4.54
Assignment 60-18 2-yr Net Change (m^3/s)			0.01				Assignment 60-18 100-yr Net Change (m^3/s)		0.97			
Assignment 60-20												
OF5061922648	0.67	0.53	-0.14	-21.16	2.00	1.84	1.61	1.37	-0.23	-14.38	3.17	2.84
OF5054722272	1.80	1.94	0.14	7.58	2.46	2.20	4.04	6.06	2.02	50.11	3.78	3.28
Assignment 60-20 2-yr Net Change (m^3/s)			0.00				Assignment 60-20 100-yr Net Change (m^3/s)		1.79			
Assignment 60-21												
OF4854725216	0.47	0.44	-0.03	-6.45	2.59	2.55	1.03	1.43	0.40	38.45	3.32	3.68
OF4886526192	1.30	1.44	0.14	10.76	3.22	3.32	3.80	5.77	1.97	51.88	4.49	4.92
OF4888326242	2.17	2.34	0.17	8.01	3.48	3.45	6.06	6.93	0.87	14.43	4.80	4.92
OF4892226271	0.53	0.53	0.00	0.26	1.89	1.90	2.10	2.19	0.09	4.49	5.01	5.23
OF4915024887	3.85	3.62	-0.23	-6.09	2.74	2.48	11.61	11.51	-0.10	-0.87	4.02	4.00
OF4961524669	0.00	0.00	0.00	0.00	0.48	0.48	0.01	0.01	0.00	0.00	0.65	0.65
OF4949224780	1.30	1.04	-0.26	-20.32	2.31	2.17	3.45	2.39	-1.06	-30.63	4.20	3.10

Outfall	2-year Storm						100-year Storm					
	Maximum Flow (m^3/s)				Maximum Velocity (m/s)		Maximum Flow (m^3/s)				Maximum Velocity (m/s)	
	Ex.	Pr.	Dif.	%	Ex.	Pr.	Ex.	Pr.	Dif.	%	Ex.	Pr.
OF4962024646	0.48	0.48	0.00	0.00	2.04	2.04	0.86	0.86	0.00	0.00	2.35	2.35
Assignment 60-21 2-yr Net Change (m^3/s)			-0.21	Assignment 60-21 100-yr Net Change (m^3/s)					2.17			
Assignment 60-22												
OF4981624464	6.45	6.66	0.21	3.23	3.17	3.19	15.97	18.03	2.06	12.91	4.52	4.90
OF4982224471	1.91	2.09	0.18	9.45	3.81	3.87	6.02	7.51	1.49	24.68	5.15	5.54
OF4988223340	2.70	2.09	-0.61	-22.80	2.91	2.72	6.14	5.72	-0.42	-6.82	3.83	3.66
OF4999924148	0.23	0.00	-0.23	-100.00	1.81	0.00	0.58	0.08	-0.50	-85.51	3.87	1.22
OF5056323121	1.60	0.64	-0.96	-59.97	2.29	1.80	4.74	2.50	-2.24	-47.30	3.64	2.65
OF5057123101	0.66	1.40	0.74	111.54	3.69	4.94	1.27	3.61	2.34	184.59	4.77	7.12
OF4986323484	0.86	0.16	-0.70	-81.05	2.22	1.27	1.26	0.44	-0.82	-64.89	2.68	1.73
Assignment 60-22 2-yr Net Change (m^3/s)			-1.37	Assignment 60-22 100-yr Net Change (m^3/s)					1.91			
Assignment 60-24												
CN7418	0.39	0.41	0.02	4.39	1.71	1.74	1.19	1.26	0.07	6.07	2.89	3.02
OF5090523870	0.17	0.07	-0.10	-61.20	2.33	1.80	0.70	0.30	-0.40	-57.44	6.64	2.83
Assignment 60-24 2-yr Net Change (m^3/s)			-0.08	Assignment 60-24 100-yr Net Change (m^3/s)					-0.33			
Assignment 60-27												
OF5221922660	1.09	1.09	0.00	0.00	2.07	2.07	2.96	3.14	0.17	5.87	3.09	3.19
Assignment 60-27 2-yr Net Change (m^3/s)			0.00	Assignment 60-27 100-yr Net Change (m^3/s)					0.17			
Total 2-yr Net Change (m^3/s)			-1.15	Total 100-yr Net Change (m^3/s)					14.98			
Ex. = Existing Conditions; Pref. = Proposed Solution Conditions; Dif. = Difference from Proposed to Existing												

Under the 2-yr storm, the velocity change is generally minimal for most outfalls. However, within assignments 60-21 and 60-24 there are significant decreases in velocities during the 100-yr storm event at OF4949224780 (Assignment 60-21) and OF5090523870 (Assignment 60-24). Within assignment 60-02 there is an increase of velocity at OF5056222382 during the 100-yr storm event.

During the 100-yr design there are multiple locations where the flow at the outfalls has significantly increased or decreased due to a diversion of flow away from capacity restricted outfalls to another along the same branch of Highland Creek. One of these examples of where flow was redistributed is in Assignment 60-20, between OF5061922648 and OF5054722272.

This results in the overall outflow to East Highland Creek (Markham Branch) remaining as per existing conditions during the 2-yr storm event, and the overall flow increases during the 100-yr storm event by 1.79 m^3/s.

The upgrades within the recommended solution for Assignment 60-21 partially re-direct storm flows from their existing sewershed to an adjacent one. The most significant diversion with respect to creek chainage within Assignment 60-21 diverts flow from OF4915024887 to OF4888326242, located over 2 km downstream. The overall outflows to East Highland Creek (Markham Branch) decrease during the 2-yr storm events by 0.21 m^3/s and increase by 2.17 m^3/s during the 100-yr storm events.

Assignment 60-22 has a total of seven outfalls, three of which have a minimal velocity change. Three outfalls within this assignment, OF4986323484, OF5056323121, and OF4999924148, experience a significant decrease in velocity in both the 2-yr and 100-yr storm events, and one outfall, OF5057123101, experiences significant increases in velocity during the 2-yr and 100-yr storm events. Also, at OF5057123101 the flow has increased by 0.74 m^3/s (112%) during the 2-yr storm event due to increased inlet capacity added upstream. While this represents a significant increase in flow as a percentage, it aligns with the inlet capacity changes required to solve overland flooding at these locations during the 100-yr event. Overall, within Assignment 60-22 there is a decrease in outflows to East Highland Creek (Markham Branch) during the 2-yr storm events of 1.38 m^3/s and an increase in outflows during the 100-yr storm events of 1.91 m^3/s.

- Within Assignments 60-02, 60-11, 60-18, and 60-24 the overall flow to outfalls in East Highland Creek (Markham Branch) increase in both the 2-yr and 100-yr storm events. The overall peak flow to the outfalls within Assignments 60-14 increases by 0.02 m3/s during the 2-yr storm event and decreases by 0.71 m3/s during the 100-yr storm event. Within Assignment 60-27, the peak outfall decreases by 0.08 m3/s during 2-yr storm event and increases by 0.17 m3/s during the 100-yr storm event.
- All 10 assignments have an overall net decrease to East Highland Creek (Markham Branch) of 1.15 m3/s during the 2-yr storm events and an overall net increase of 14.98 m3/s during the 100-yr storm events.

The TRCA has expressed in past projects that the potential for flow increases to the creek due to improved efficiency of the storm remedial measures should not be considered to alter the existing floodplain since the contributing drainage area remains the same with only a redistribution of major and minor system flows under the extreme event. Low point storage and pipe capacity restrictions are not considered when calculating flood flows and flood line mapping for watercourses, since flood lines are generated using a macro-level watershed modelling technique which does not consider the conveyance and storage of the urban drainage system. Without accounting for these flow attenuations, flows used in the HEC-RAS models to determine the design flood levels in the watercourse could be more conservative than those generated in the BFPP detailed InfoWorks models.

Therefore, in general, neither increased sewer conveyance nor the presence of upstream storage is expected to negatively impact the watercourse substantially in terms of flood risk; however, the TRCA has identified concerns with Highland Creek's sensitivity to erosion. A monitoring plan may be required to observe and address erosion issues at the three above-identified locations. Refer to **Section 8.5.10** for mitigation considerations of potential impacts to watercourses.

The resulting peak flows found in the table above can be used by the TRCA to evaluate the influence of the proposed change on non-flood situations in their HEC-RAS model, recognizing the limitations of comparing hydrologic runoff generation methods between the subwatershed and local sewershed scales, and the differing rainfall duration/distribution. TRCA consultation materials and responses are included in **Attachment #3 – TM3**.

Area 60 has five (5) connections to the external minor system storm drainage network in Area 31, and 17 to Area 59. Overland flow drains into Areas 31 at nine (9) locations, Area 59 at 13 locations, Area 63 at 17 locations, and to Markham at two (2) locations, however none of the 100-yr outflows in proposed conditions exceed those under baseline conditions.

8.5 CONSIDERATIONS FOR PRELIMINARY DESIGN AND IMPLEMENTATION

The implementation of recommended solutions must consider potential constructability concerns, approvals, and effects on urban green space, cultural heritage, community, and aquatic and terrestrial systems, as discussed in **Section 7.4**. These aspects were evaluated for the Area 60 Schedule B assignments and documented in **Appendix C**. **Section 8.5.1** to **Section 8.5.9** highlight these considerations for each assignment. Assignment 60-12 is a Do Nothing solution and is therefore not listed in the sections below.

Furthermore, the sequencing of construction from downstream to upstream shall be considered during preliminary and detailed design given the scale of the assignment.

Considerations for agency impacts and future approvals are discussed in **Section 8.5.10**.

8.5.1 Considerations for Assignment 60-02:

- There is adequate space within the ROW for the recommended upgrades and in-line storage;
- Existing outfall structure may also need to be replaced to incorporate new outfall;
- Sanitary and storm sewer realignment required to achieve separation between dual systems;
- Outfall and conveyance capacity upgrades result in an overall peak flow increase to existing storm outfalls during minor and major storm events;
- Tree removal may be required for open cut construction within the ROW;
- Additional tree/shrub removal is likely required for the work surrounding the outfall;
- Greater environmental disturbance at watercourse due to outfall upgrades; and
- Mitigation measures to be provided at the preliminary design stage for 3315 Midland Ave (George L'Amoreaux) as this address is listed as a City Heritage Property and is within 50 m of proposed work.

8.5.2 Considerations for Assignment 60-11:

- There is adequate space within the ROW for the recommended upgrades and in-line storage;
- Upsizing storm sewers results in an increase in peak outflows to East Highland Creek (Markham Branch) during all storm events;
- Tree removal may be required for open cut construction within the ROW;
- 520 Progress Ave (Scott House) is a designated heritage property within Assignment 60-11. However, it does not reside within 50 m of the proposed works. Mitigation measures for vibration are required during construction if construction activities are to occur within 50 m of property and temporary fencing around the property is required during construction; and
- No crossing conflicts occur with the recommended solutions based on available information at the time of the Study and EA.

8.5.3 Considerations for Assignment 60-14:

- There is adequate space within the ROW for the additional inlet capacity work;
- Tree removal may be required for open cut construction within the ROW;
- Increasing the inlet capacity on Nugget Ave with no conveyance solutions along McCowan Rd results in a decrease in peak outflows to East Highland Creek (Markham Branch) during the 100yr storm event due to the excessive surface ponding; and
- 2050 McCowan Rd (Hugh Elliot House) is a designated heritage property just north of the 60-14 Assignment area. Mitigation measures for vibration is required during construction if construction activities are to occur within 50 m of property. Temporary fencing around the property is required during construction.

8.5.4 Considerations for Assignment 60-18:

- There is adequate space within the ROW for the recommended upgrades and in-line storage;
- Sanitary and storm sewer realignment required to achieve separation between dual systems;
- Tree removal may be required for open cut construction within the ROW; and
- Increase in outflows to East Highland Creek (Markham Branch) in minor and major events.

8.5.5 Considerations for Assignment 60-20:

- There is adequate space within the ROW for the recommended upgrades and in-line storage;
- Sanitary and storm sewer realignment required to achieve separation between dual systems;
- Tree removal may be required for open cut construction within the ROW;
- Additional tree/shrub removal is likely required for the work surrounding the outfall;
- Additional approvals/coordination required with TRCA for outfall upgrades and work within the affected easement;
- Overall outflows to East Highland Creek (Markham Branch) remain as per existing conditions in minor events, and the overall outflows increase in major events; and
- Greater environmental disturbance at watercourse due to outfall upgrades.

8.5.6 Considerations for Assignment 60-21:

- There is adequate space within the ROW for the recommended upgrades and in-line storage;
- Conveyance upgrades and in-line storage results in a decrease in peak outflows to East Highland Creek (Markham Branch) during minor events and an increase in peak outflows during major storm events;
- Tree removal may be required for open cut construction within the ROW; and
- No crossing conflicts occur with the recommended solutions based on available information at the time of the Study and EA.

8.5.7 Considerations for Assignment 60-22:

- There is adequate space within the ROW for the recommended upgrades and in-line storage;
- Conveyance upgrades and in-line storage results in decrease in peak outflows to East Highland Creek (Markham Branch) during minor events and an increase in peak outflows during major storm events;
- Tree removal may be required for open cut construction within the ROW;
- 33 Murray Ave (Harris-White House) and 2569 Midland Ave (Knox United Church) are designated heritage properties within/near the 60-22 Assignment area. Mitigation measures for vibration required during construction if construction activities are to occur within 50 m of property. Temporary fencing around the property required during construction; and
- No crossing conflicts occur with the recommended solutions based on available information at the time of the Study and EA.

8.5.8 Considerations for Assignment 60-24:

- There is adequate space within the ROW for the recommended upgrades and in-line storage;
- Consultation with TRCA required to confirm solution schedule due to overland regrading;
- Consultation with Transportation group required to confirm allowable gradient of overland flow route given presence of sidewalk;
- Conveyance upgrades result in an overall decrease in outflows to East Highland Creek (Markham Branch) in both minor and major events;
- Erosion protection to be provided on downslope to watercourse at overland flow discharge location;
- Tree removal may be required for open cut construction within the ROW; and
- No crossing conflicts occur with the recommended solutions based on available information at the time of the Study and EA.

8.5.9 Considerations for Assignment 60-27:

- There is adequate space within the ROW for the recommended upgrades and in-line storage;
- Sanitary and storm sewer realignment required to achieve separation between dual systems;
- Upsizing storm sewers results in an increase in peak outflows to East Highland Creek (Markham Branch);
- Tree removal may be required for open cut construction within the ROW;

- 44 Macklingate Crt (Macklin "Forest Home") is a designated heritage property within the Assignment 60-27 area.
  However, it does not reside within 50 m of the proposed works. Mitigation measures for vibration is required during construction if construction activities are to occur within 50 m of property. Temporary fencing around the property is required during construction; and
- No crossing conflicts occur with the recommended solutions based on available information at the time of the Study and EA.

8.5.10 Mitigation of Potential Impacts, Agency Concerns and Approvals

The potential environmental and social impacts associated with the preferred alternative are related to the construction, implementation, and long-term usage of the remedial measures. The impacts, their potential sources, and methods of mitigation, including agency consultation requirements, are identified below.

The following mitigation measures of potential impacts shall be reviewed and refined during the preliminary and detailed design stages for the assignments:

- Habitat and trees
  - Vegetation removal is to occur outside of the breeding bird season of April to August
  - If stockpiles of gravel and sand are required during the active turtle season (April to October), install turtle exclusion fencing around stockpiles prior
  - Implement erosion and sediment control mitigation measures
  - Spill Prevention and Contingency Plan to be developed prior to construction
  - Prepare tree removal and protection plans, along with tree protection barriers and signage where required
  - Prepare tree compensation plans for tree removals
  - Any damaged trees will be pruned through the implementation of proper arboricultural techniques, under supervision of a certified arborist
  - On-site inspection during construction
- Sediment and watercourse protection
  - Prior to the installation of a new outfall, determine increase in outlet velocities and flows and design energy dissipation measures as required to prevent erosion
  - Consider flow path and outlet orientation with existing bank and potential for bank hardening to prevent erosion
- Construction measures
  - Complete Traffic Management Plan
  - Use of Best Management Practices for dust control and vibration monitoring during construction
  - Use of low noise equipment during construction, where possible
  - Notify impacted property owners prior to construction
  - Maintain access to fronting properties

Three of the assignments have additional considerations to note for preliminary and detailed design as follows:

- The recommended solution for Assignment 60-02 includes a new outfall upgrade within an existing easement. During the preliminary and detailed design phases, flow dissipation measures will be required at the outfall upgrade to mitigate sediment and erosion impacts once detailed subsurface and topographic surveys are completed. In addition, some tree removal may be required at the outfall location.
- The recommended solution for Assignment 60-20 includes a new outfall upgrade within an existing easement. During the preliminary and detailed design phases, flow dissipation measures will be required at the outfall upgrade to mitigate sediment and erosion impacts once detailed subsurface and topographic surveys are completed. In addition, some tree removal may be required at the outfall location.
- The recommended solution for Assignment 60-24 requires additional consultation with the TRCA due to the proposed overland regarding, and consultation with the City's Transportation Services group to confirm the allowable gradient of overland flow route given the presence of a sidewalk.

For storm outfalls with significant flow increases, required mitigation for stream protection should be identified during detailed design, including but not limited to energy dissipation measures, reinforced wing walls, riprap, re-orientation of the storm outfall to be parallel with the flow direction of the watercourse, and aquatic habitat protection. The costs for such potential mitigation measures has been incorporated at a high-level into the line item for supply and installation of the upgraded outfall. During preliminary and detailed design, the cost estimates shall provide a breakdown of such measures as the design alignment will be better informed by field investigations, such as subsurface, topographic, and arboricultural surveys.

Further consultation will also be required with the TRCA and City of Toronto Parks, Forestry and Recreation division required for the proposed upgrades that extend beyond the ROW. Per Ontario Regulation 166/06, an Application for Development, Interference with Wetlands and Alteration to Shorelines and Watercourses with the TRCA will need to be submitted and approved prior to construction for assignments with outfall upgrades.

Based on the TRCA's feedback on the Area 60 EA PIE, the following should be considered during preliminary and detailed design:

- Efforts should be taken to demonstrate impact avoidance to the valley system.
- Ecological enhancement opportunities for disturbed areas based on the works proposed.
- At the permitting stage, to improve understanding on outfall site conditions and expedite the review process, picture evidence with a discussion on existing and proposed headwall and creek conditions would be useful to provide.

In addition, the TRCA noted that the following studies or projects are in progress that overlap or are adjacent to the proposed extents for the assignments discussed in this Project File report:

- Metrolinx Scarborough Subway Extension – Sheppard East Station, Sheppard Avenue East / McCowan Road / Nugget Avenue.

- Metrolinx – Culvert replacement of two culverts at McCowan Road/Nugget Avenue.
- TRCA and the City of Toronto – Highland Creek Markham Branch (Corporate Drive) Flood Remediation Environmental Assessment Study, southeast of Highway 401 and Ellesmere Road. Further information is available at: https://trca.ca/conservation/green-infrastructure/highland-creek-markham-branch-mcea/.
- Metrolinx, Finch-Kennedy SmartTrack GO Station – storm sewer and outfall to be replaced on Finch Avenue, west of Midland Avenue.

During the preliminary design stage, the assignments should be reviewed for updates and/or coordination with the aforementioned stakeholders.

9.0 CONCLUSIONS

The following conclusions can be drawn from the completion of this EA Study:

- Through the initial Study Phase completed for Area 60, several capacity issues were identified. Based on the review and interpretation of available background data, field investigations and resident input, the main causes of basement and surface flooding can be attributed to the following factors:
    - Sanitary trunk sewer aligned with major watercourses, offering potential for infiltration;
    - Elevated baseflows in the sanitary sewer taking up flow capacity;
    - Rural lot drainage and flow paths on private property;
    - Sewers not sized to handle high flows during extreme events;
    - Shallow sewers with less potential for freeboard from basements;
    - Insufficient overland flow drainage and ponding at low points; and
    - Large industrial-commercial-institutional sector with high imperviousness ratios;
- Alternative flood risk reduction solutions were identified at the Study Area-scale based on hydraulic connectivity (i.e., Assignments), and initially evaluated at a high-level including agency consultation to select the preferred solutions that would fall within the ROW. Through this process, 10 assignments were identified as potentially having greater environmental and social impacts due to solutions involving outfall upgrades, work around Highway 401, and overland flow re-routing. These solutions triggered an EA review and proceeded to completion of the Schedule B EA process with additional agency/public consultation, alternative solution review/refinement, and evaluation, as documented in this Project File.
- Through the EA process, an additional flood solution alternative was developed for each assignment (Alternative 3). All three alternatives were evaluated based on social, economic, environmental and constructability criteria using a scoring method. For each of the assignments the recommended alternative is listed below:
    - Alternative 1 was selected as the recommended solution for Assignment 60-02;
    - Alternative 2 was selected as the recommended solution for Assignment 60-11;
    - Alternative 2 was selected as the recommended solution for Assignment 60-12;
    - Alternative 3 was selected as the recommended solution for Assignment 60-14;
    - Alternative 3 was selected as the recommended solution for Assignment 60-18;
    - Alternative 1 was selected as the recommended solution for Assignment 60-20;
    - Alternative 2 was selected as the recommended solution for Assignment 60-21;
    - Alternative 2 was selected as the recommended solution for Assignment 60-22;
    - Alternative 3 was selected as the recommended solution for Assignment 60-24; and
    - Alternative 3 was selected as the recommended solution for Assignment 60-27.
- From the recommended alternative selection process, only three (3) of the 10 assignments are considered Schedule B undertakings. These assignments are as follows:
    - Assignment 60-02 – Work outside of the ROW for an outfall upgrade;
    - Assignment 60-20 – Work outside of the ROW for an outfall upgrade; and

  - Assignment 60-24 – Work requiring regrading of the overland subject to additional consultation with TRCA and the City's Transportation Services group to confirm allowable gradient of overland flow.

- One assignment, Assignment 60-12, was selected as a Do Nothing solution (Alternative 2) due to very limited flood risk.
- With the implementation of the recommended flood remedial measures, the storm drainage system can convey both the major and minor systems during the 100-year design storm within the City surface depth and HGL criteria with limitations stemming from downstream watercourse levels only. Similarly, with the proposed flood remedial measures, the sanitary drainage system can convey the May 12, 2000, event.
- With the implementation of the recommended solutions for each of the 10 EA assignments there is an overall net decrease to East Highland Creek (Markham Branch) of 1.15 m3/s during the 2-yr storm events and an overall net increase of 14.98 m3/s during the 100-yr storm events. In addition, below is a summary of the hydraulic performances at an assignment level;

  - Under the 2-yr storm, the velocity change is generally minimal for most outfalls. However, within assignments 60-21 and 60-24 there are significant decreases in velocities during the 100-yr storm event at OF4949224780 (Assignment 60-21) and OF5090523870 (Assignment 60-24). Within Assignment 60-02 there is an increase of velocity at OF5056222382 during the 100-yr storm event.
  - During the 100-yr design there are multiple locations where the flow at the outfalls has significantly increased or decreased due to a diversion of flow away from capacity restricted outfalls to another along the same branch of Highland Creek. One of these examples of where flow was redistributed is in Assignment 60-20, between OF5061922648 and OF5054722272. This results in the overall outflow to East Highland Creek (Markham Branch) remaining as per existing conditions during the 2-yr storm event, and the overall flow increases during the 100-yr storm event by 1.79 m3/s.
  - The upgrades within the recommended solution for Assignment 60-21 partially re-direct storm flows from their existing sewershed to an adjacent one. The most significant diversion with respect to creek chainage within Assignment 60-21 diverts flow from OF4915024887 to OF4888326242, located over 2 km downstream. The overall outflows to East Highland Creek (Markham Branch) decrease during the 2-yr storm events by 0.21 m3/s and increase by 2.17 m3/s during the 100-yr storm events.
  - Assignment 60-22 has a total of seven outfalls, three of which have a minimal velocity change. Three outfalls within this assignment, OF4986323484, OF5056323121, and OF4999924148, experience a significant decrease in velocity in both the 2-yr and 100-yr storm events, and one outfall, OF5057123101, experiences significant increases in velocity during the 2-yr and 100-yr storm events. Also, at OF5057123101 the flow has increased by 0.74 m3/s (112%) during the 2-yr storm event due to increased inlet capacity added upstream. While this represents a significant increase in flow as a percentage, it aligns with the inlet capacity changes required to solve overland flooding at these locations during the 100-yr event.

Overall, within Assignment 60-22 there is a decrease in outflows to East Highland Creek (Markham Branch) during the 2-yr storm events of 1.38 m3/s and an increase in outflows during the 100-yr storm events of 1.91 m3/s.

- Within Assignments 60-02, 60-11, 60-18, and 60-24 the overall flow to outfalls in East Highland Creek (Markham Branch) increase in both the 2-yr and 100-yr storm events. The overall peak flow to the outfalls within Assignments 60-14 increases by 0.02 m3/s during the 2-yr storm event and decreases by 0.71 m3/s during the 100-yr storm event. Within Assignment 60-27, the peak outfall decreases by 0.08 m3/s during 2-yr storm event and increases by 0.17 m3/s during the 100-yr storm event.

- The recommended improvement for the assignments work to help address the flooding problem, listed below in 2020 Canadian dollars, net to the City:
    - Assignment 60-02 estimated at a total construction cost of $96.9 million;
    - Assignment 60-11 estimated at a total construction cost of $5.0 million;
    - Assignment 60-12 estimated at a total construction cost of $0;
    - Assignment 60-14 estimated at a total construction cost of $113 thousand;
    - Assignment 60-18 estimated at a total construction cost of $10.5 million;
    - Assignment 60-20 estimated at a total construction cost of $24.8 million;
    - Assignment 60-21 estimated at a total construction cost of $73.1 million;
    - Assignment 60-22 estimated at a total construction cost of $206.4 million;
    - Assignment 60-24 estimated at a total construction cost of $1.7 million; and
    - Assignment 60-27 estimated at a total construction cost of $3.1 million;
- Based on the Stage 1 Archaeology Assessment, there is no further work required for Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-21, 60-22, 60-24 and 60-27. However, should the work extents change beyond the recommended solution footprint as proposed in this Project File, further Stage 1 archaeology assessment may be required.
- Based on the Stage 1 Assessment, a Stage 2 archaeology assessment is recommended for Assignment 60-20. The Stage 2 assessment shall be undertaken once the assignment progresses to the preliminary design stage.
- Protected properties and places of cultural heritage value or interest have been identified within the Assignment boundaries. As such, additional assessment and/or monitoring should be completed as described in this report.
- The Municipal Class EA Master Planning process (Phases 1 and 2) has been fulfilled through public consultation including one public information event, agency consultation, and the submission of this Project File document.

It is recommended that the Assignments proceed to preliminary design, subject to City prioritization, additional agency consultation, and commence with implementation as Capital budgeting allows.

Appendix A ADDITIONAL CONSULTATION MATERIAL

Appendix B ARCHAEOLOGY AND CULTURAL HERITAGE REPORTS

Appendix C EVALUATION MATRIX

Appendix D RECOMMENDED SOLUTION SUMMARY TABLE AND BOUNDARY CONDITIONS

Appendix E ASSIGNMENT COST ESTIMATE SHEETS