Toronto Basement Flooding Capacity Studies – Bundle F Study Area 60: EA Project File

Project File

October 6, 2023

Prepared for:

City of Toronto

Prepared by:

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TORONTO BASEMENT FLOODING CAPACITY STUDIES – BUNDLE F STUDY AREA 60: EA PROJECT FILE

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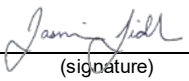
Prepared by 
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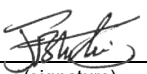
Prepared by 
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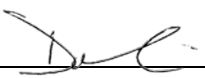
Reviewed by 
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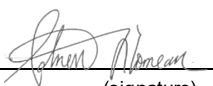
Approved by 
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Abbreviations

1D	1-Dimensional
2D	2-Dimensional
AA	Archaeological Assessment
ASD	Assignment Scoping Document
BFPP	Basement Flooding Protection Program
CB	Catchbasin
CCTV	Closed-Circuit Television
CET	City's Cost Estimating Tool
CHR	Cultural Heritage Report
CSO	Combined Sewer Overflow
CSR	Customer Service Record
DEM	Digital Elevation Model
DWF	Dry Weather Flow
EA	Environmental Assessment
ESA	Environmentally Significant Area
ESR	Environmental Study Report
Ex.	Existing
FSIP	Field Survey and Investigation Program
GIS	Geographic Information System
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HGL	Hydraulic Grade Line
ICI	Industrial-Commercial-Institutional
MEA	Municipal Engineers Association

MECP	Ministry of the Environment, Conservation and Parks
MH	Maintenance Hole
OF	Outfall
PIE	Public Information Event
PKDBS	Project Knowledge Database Structure
Pr.	Proposed
QA/QC	Quality Assurance and Quality Control
RG	Rain Gauge
ROW	Right-of-Way
SASP	Site and Area Specific Policy
SPA	Special Policy Area
SST	Solution Summary Table
TM	Technical Memorandum
TRCA	Toronto and Region Conservation Authority
TWAG	Toronto Water Asset Geodatabase

Executive Summary

The Basement Flooding Protection Program (BFPP) Capacity Assessment Studies Project for Study Areas 46 to 61 and 63 to 67 seeks to characterize drainage system capacity and develop solutions to reduce the risk of basement and surface flooding within the remaining BFPP Study Areas in the City. The study areas have been grouped together in six Bundles across the City; Stantec Consulting Ltd. (Stantec) is undertaking the Bundle D and Bundle F assignments.

The study was carried out to assess the sanitary and storm drainage systems to identify the potential factors, mechanisms and impacts of surface and basement flooding and to develop comprehensive flooding remediation plans that best meet the target level-of-service criteria of the City under 2041 growth conditions. Based on guidance from the City, the basement flooding protection level has been set to the equivalent of the May 12, 2000, storm event for the sanitary system and the 100-year design storm for the combined/storm minor and major systems.

The City has embarked on a new approach in an effort to meet this objective, incorporating lessons-learned and feedback from previous projects. The overall approach includes two distinct, yet integrated, phases of the project: the initial Study Phase, and the Preliminary Design Phase. The objective of this effort is to reduce the risk of future basement and surface flooding resulting from shortfalls in the capacity of the municipal drainage systems. In other words, the focus of flood remediation efforts is on publicly derived sources, such as back-up of City sewer systems, or surface flooding emanating from the public right-of-way (ROW).

The primary focus from the Study Phase was on the development of Schedule A/A+ assignments where feasible, recognizing there may be a need for additional Schedule B and/or C Environmental Assessment (EA) activities for more involved solutions negatively affecting the social or natural environments. From the Study Phase, 10 assignments were identified to be Schedule B undertakings due to their involvement with outfall upgrades, work around Highway 401, and overland flow re-routing.

SCOPE OF STUDY

The focus of this EA is on Area 60 within Bundle F, with the geographic context of the entire Study Area 60 presented in. This EA Project File reviews the assessments completed through the Study Phase for Area 60 with focus on Schedule B Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27, with further elaboration on activities completed after the Study Phase to satisfy the Schedule B EA requirements for the assignments.

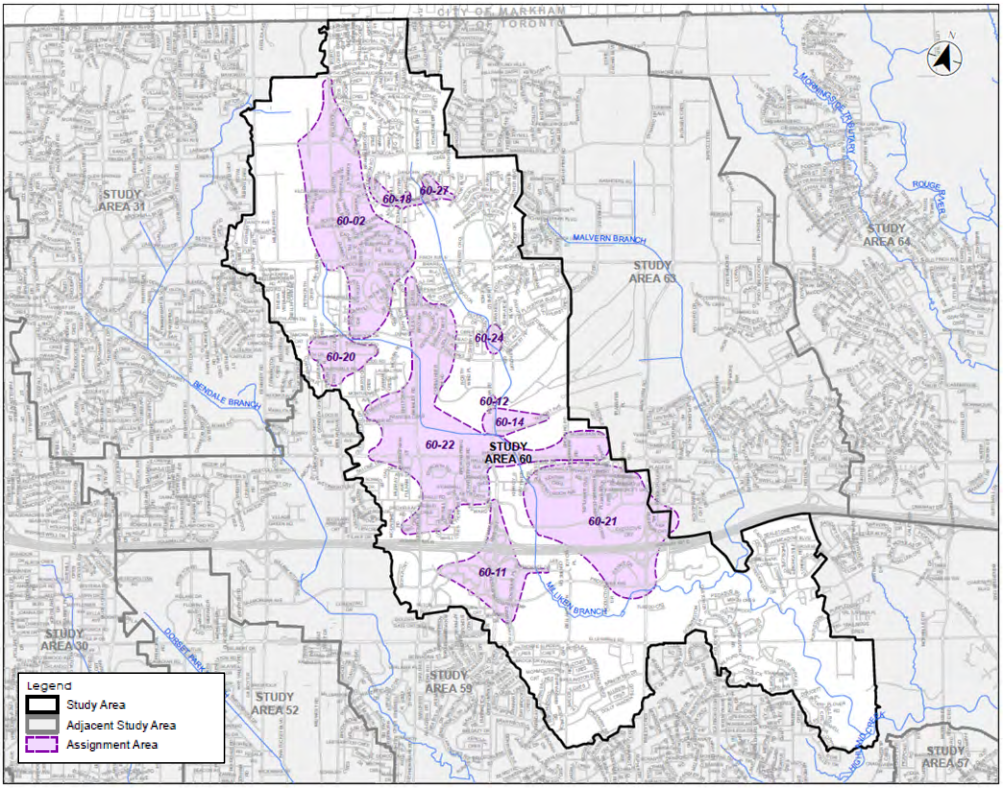
The study was carried out to assess the sanitary and storm drainage systems to identify the potential factors, mechanisms and impacts of surface and basement flooding and to develop comprehensive flooding remediation plans that best meet the target level-of-service criteria of the City. To achieve this scope, the study included the following tasks:

- Municipal Class EA project Phase 1 activities, including agency consultation and community questionnaire.

- Comprehensive review of background data and available information to confirm existing field conditions, supplemented as required with additional field investigations.
- Identification and prioritization of the factors contributing to basement and surface flooding including interaction of the storm, sanitary and overland systems.
- Development of a Geographic Information System (GIS)-based topographical model to help define the major system surface drainage patterns and identify and quantify low lying or other problematic areas.
- Development of sanitary and storm drainage system hydrologic and hydraulic modeling tools.
- Confirmation and identification of potential basement flooding areas.
- Evaluation of various flood remediation measures and development of comprehensive cost-effective flood remediation plans to achieve the targeted hydraulic performance under future projected population.
- Where alternative flood remediation measures were developed, an assessment was completed based on hydraulic, environmental, and socio-economic factors to determine the recommended flood solution.
- Development of opinions of probable costs, implementation sequencing, and mitigation measures.

ASSIGNMENT AREA CHARACTERISTICS

Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27 are located within Study Area 60. Generally, the assignments are bounded by Ellesmere Rd to the south, Steeles Ave to the north, Kennedy Rd to the west, and Malvern St to the east.



ES.1 Area 60 EA Assignments

Assessment of Existing Conditions

The majority of reported flooding issues are private-side related, and not chronic issues resulting from surface drainage or collection system capacity. The relatively few flood complaints can be attributed to long-standing collection system and stormwater management practices in Scarborough, which include having foundation drains not connected to the sanitary sewer, implementation of the dual drainage principle in urban design since the 1970s, and consideration of the HGL in the design of storm sewer systems.

Field investigation and inspection were conducted to identify the specific characteristics of the study area and its drainage systems. An assessment was undertaken of the existing natural and built environments, as well as a review of available data sources and any previous studies. Historical flooding records and the public questionnaire results show that flooding incidents have occurred throughout the entire study area, but there are areas where flooding is clustered at numerous properties which may indicate temporary inadequacy of the sewer systems and/or surface drainage systems as opposed to site-specific issues.

An integrated hydrologic-hydraulic simulation model of the storm and sanitary network was developed, calibrated to flow monitoring data, and validated against historic flood records.

The overall background review, field investigations, public consultation and hydraulic modelling analysis revealed that the storm drainage system in the assignment area does operates well with almost 70% of pipes indicating over 100-yr level of service.

The resulting model was used as a tool to assess the hydraulic performance of the existing drainage systems, identify their current performance level, determine potential causes of deficiencies, and develop remedial measures for the basement and surface flooding issues resulting from public drainage system performance. In general, the major system standards in Scarborough have resulted in a resilient overland system for conveying flows to SWM facilities and the East Highland Creek tributaries. Surface depth exceedances are also observed in low points on local roads, where ponding is directed from the arterial/collector roadways into the local low points to reduce depths and promote safe vehicular passage on major arteries. These locations often coincide with overtaxed minor systems, limiting the amount of flow that can be removed from the surface.

Collectively, these factors contribute to episodes of surface and/or basement flooding from the public system under extreme rainfall events that exceed the original design capacity. Additionally, private side drainage issues such as poor lot grading, blocked laterals, reverse-driveways, etc., can also contribute to individual property flooding.

STUDY PROCESS AND CONSULTATION

The framework of the project approach and Study phase followed the guidelines of the Municipal Class EA document disseminated by the Ontario MEA (2000, amended 2007, 2011 and 2015). By following these guidelines, the Study satisfied the requirements of the Ontario Environmental Assessment Act through completion of Phase 1 of the Class EA process and set the framework to undertake Phase 2 activities for projects identified as Schedule B or C.

From the Study phase, 10 assignments were identified as a Schedule B undertaking where the following additional review and consultation measures were taken:

- Detailed alternative review, including development of an additional Alternative 3 solution;
- Public consultation; and
- Advancement in consultation with agency stakeholders.

This Project File document is intended as a summary report, documenting Phase 1 and 2 of the Class EA. A Notice of Completion is submitted to review agencies and the public to allow for comment and input on this Project File for at least 30 calendar days from date of notice. Subject to comments received and the receipt of the necessary approvals, the City of Toronto intends to continue with the preliminary/detailed design and construction of the flood remediation measures to mitigate the risk of basement and surface flooding in Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27.

Agency and Public Consultation

Consultation with agency stakeholders and the public was conducted with the following components:

- Notice of Commencement was issued September 15, 2022, online and in the September 22 and 29 Scarborough Mirror newspaper editions
- A public questionnaire was issued in Fall 2020 to addresses within the study area to help identify public-side flooding concerns.
- A Notice of Consultation was issued by Canada Post to all properties in the study area to advise of consultation opportunities. Due to the Covid-19 pandemic, the City posted public consultation materials online from December 27, 2022, to January 27, 2023, on a dedicated City webpage, including presentation materials with information pertaining to the study, EA process, existing conditions, and alternatives and the preferred solution for the ten assignments.
- Through the Study Phase, the following groups were engaged with feedback provided and incorporated: Mississauga's of the Credit First Nation, Toronto Parks, Forestry and Recreation, Toronto Water – Operations, Toronto Water – Stream Restoration Unit, Toronto Transportation Services, and Toronto and Region Conservation Authority (TRCA)
- Throughout the EA Phase, the following agency stakeholders were engaged with feedback provided and incorporated: TRCA, Bell, Rogers, Hydro One, Toronto Hydro, and Trans-Northern Pipelines

DEVELOPMENT AND EVALUATION OF ALTERNATIVES

The baseline conditions represented the starting point from which solutions were required. Baseline conditions are represented by the design storm results, incorporating projected 2041 population on the sanitary model and an assumed 75% Downspout Disconnection for the storm model reflecting the intentions of the Wet Weather Flow Management Master Plan for new development to control onsite stormwater discharges to better than pre-development conditions under large storms.

There are several storm sewersheds based on physical outfall location to watercourses or boundary conditions with adjacent Study Areas, and a number of sanitary subsewersheds connecting to the trunk. Within each sewershed, Problem Areas were defined based on the criteria infractions of the baseline

condition models and became the initial basis for presentation and communication regarding solutions. These Problem Areas were in some cases compiled into Solution IDs when the problem areas and/or solutions were close in proximity or connected. Through the solutions development process and in planning for construction and solution implementation, these Solution IDs were then compiled into Assignments based on hydraulic connectivity.

The approach to solution development was premised on the principle of conveyance within the municipal ROW as a first iteration, to maximize the number of solutions that fall within the Municipal Class EA Schedule A or A+ categorization. Where the initial solutions were constrained by unfavourable requirements, fell outside of the ROW, or may lead to Schedule B/C implications, alternative solutions were reviewed and assessed. Alternatives were evaluated based on fourteen (14) criteria. Each criterion was ranked either high, medium, or low impact with a corresponding score of 1,2, or 3 respectively. A "low" ranking represents the lowest impact and most desirable, while a "high" ranking represents the highest impact and least desirable. Once each criterion was evaluated, the score from all criteria was totaled. Based on the total score, the most preferred alternative was the highest scored alternative and was selected for the Assignment ID.

Summary of Alternatives

Based on the performance of the storm and sanitary drainage system model, flood remedial measures were conceptually designed in the hydraulic model. Four alternatives were developed for Assignment 60-24, two alternatives were developed for Assignment 60-12, and for the remaining 8 EA assignments, three alternatives were developed to relieve flooding and improve the storm and sanitary system while meeting the City's guidelines. In general, the alternatives incorporate elements of inlet capacity and conveyance upgrades, in-line storage, relief/diversion sewers, outfall upgrades, and park storage to mitigate surface and basement flood risk for the identified Schedule B assignments.

RECOMMENDED SOLUTIONS

The recommended solution for each of the EA assignments is presented in **Figure ES.2**. A summary of the recommended solution for each of the assignments is outlined below.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

Based on the Stage 1 Assessment, there is no further work required for Assignments 60-02, 60-11, 60-12, 60-18, 60-21, 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.

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.

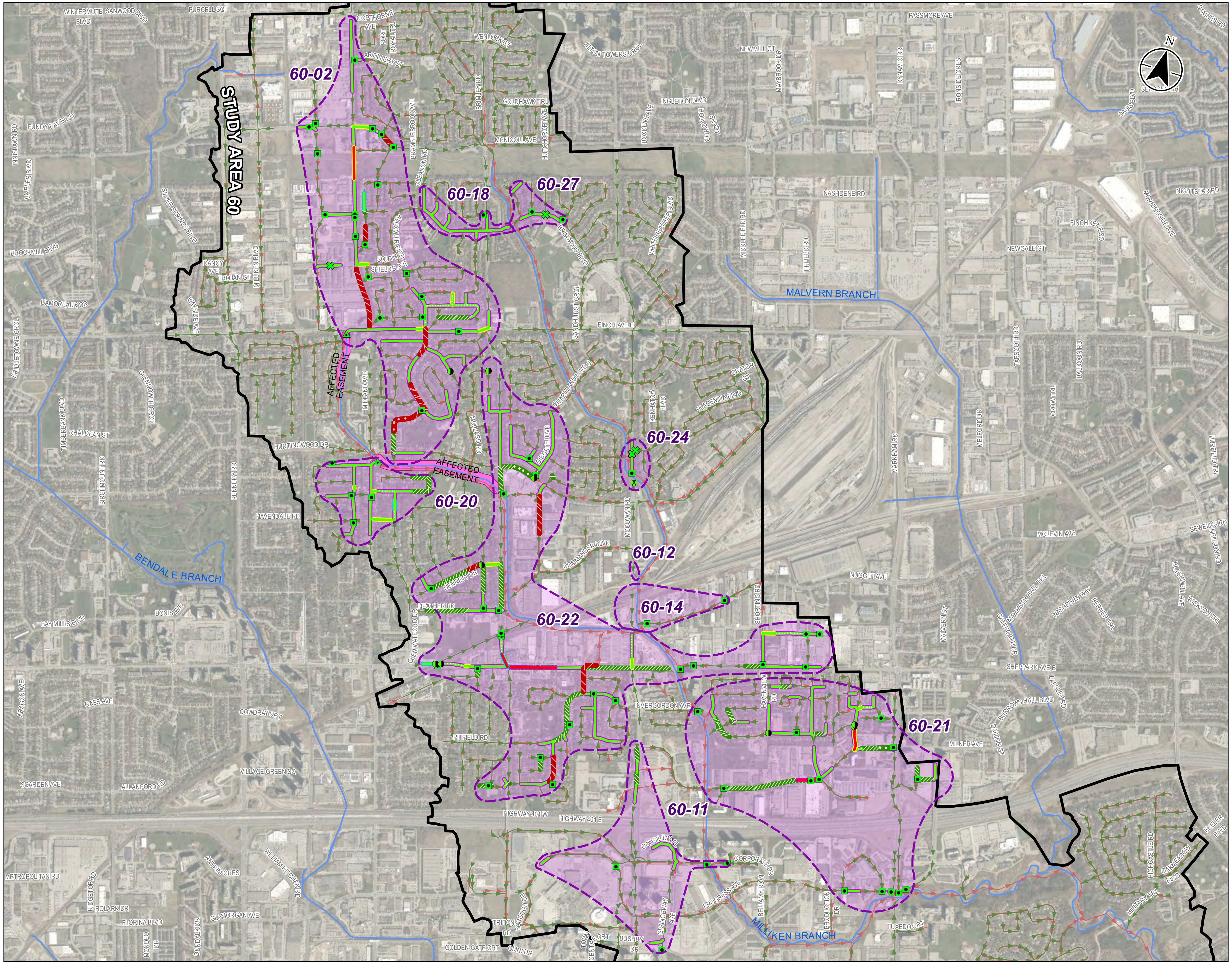
- The upgrades within the recommended solution for Assignment 60-21 partially re-direct storm flows from their existing sewershed to an adjacent one. The most significant diversion, with respect to creek chainage, within Assignment 60-21 diverts flow from OF4915024887 to OF4888326242, located over 2 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 outfall, 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.

The recommended solutions are provided in **Figure 1—1** Schedule B Assignments within Study Area 60 and **Figure ES. 2:** Recommended Solutions for Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-22, 60-24, and 60-27. 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.



Stantec

Legend

- Study Area
- Assignment Area
- Storm Sewer
- Sanitary Sewer

Proposed Storm Solutions

- Increase Inlet Capacity
- Increase Inlet Capacity, Isolate MH
- Isolate MH
- Remove CBs
- Remove CBs, Depress Curb
- Upgrade Outfall
- New
- Realign
- Replace
- Upgrade
- Realign and Upgrade
- Inline Storage
- Realign and Inline Storage

Proposed Sanitary Solutions

- New
- Replace
- Upgrade
- Inline Storage
- Realign and Inline Storage
- Affected Easement

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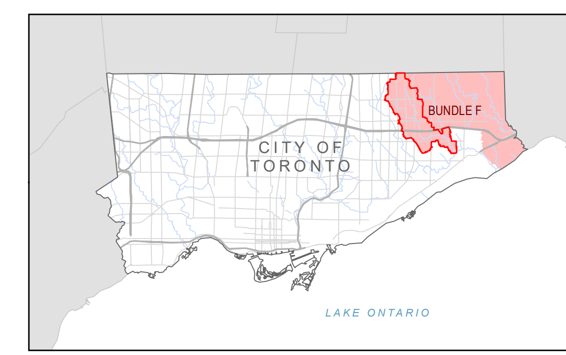
Notes

1. Coordinate System: NAD 1983 CSRS MTM 10
2. Contains information licensed under Toronto Water Asset Mapping User Agreement.
3. Contains information made available under the Toronto and Region Conservation Authority Open Data Licence v 1.0, Open Government Licence – Toronto, and Open Government Licence – Ontario.



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.
ES.2

Title
Recommended Solutions

1.0 INTRODUCTION

The Basement Flooding Protection Program (BFPP) Capacity Assessment Studies Project for Study Areas 46 to 61 and 63 to 67 seeks to characterize drainage system capacity and develop solutions to reduce the risk of basement and surface flooding within the remaining BFPP Study Areas in the City. The study areas have been grouped together in six Bundles across the City; Stantec Consulting Ltd. (Stantec) is undertaking the Bundle D and Bundle F assignments. The focus of this Environmental Assessment (EA) is Area 60, which includes Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27, with the geographic context of the entire Bundle F area presented in **Figure 1**—1.

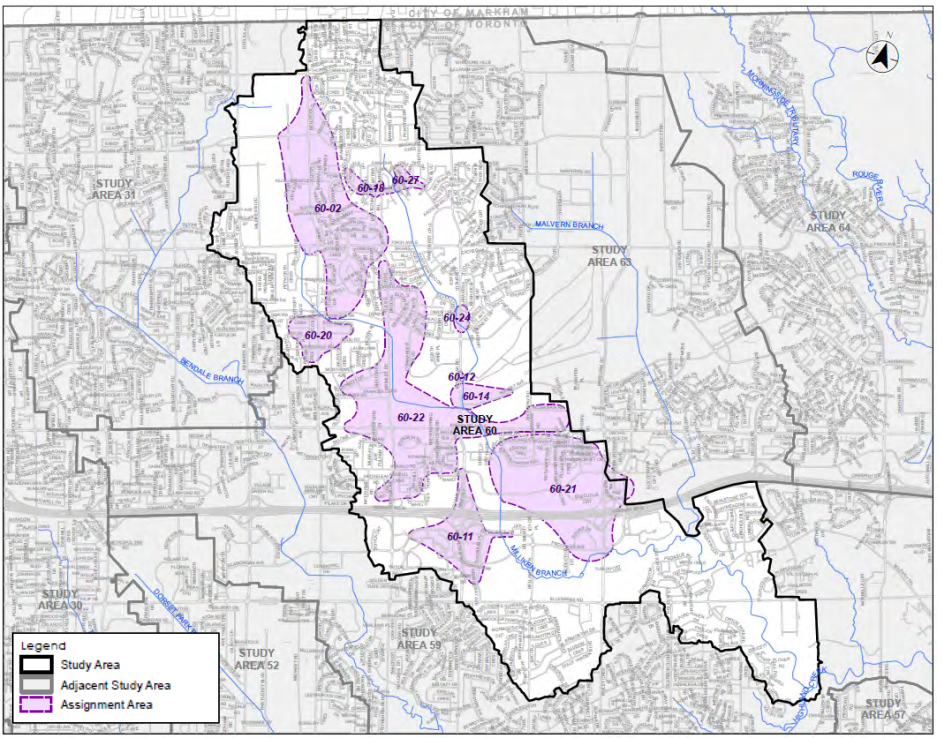


Figure 1—1: Schedule B Assignments within Study Area 60

This EA Project File reviews the assessments completed through the Study Phase for Area 60 with focus on the Schedule B Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27, with further elaboration on activities completed to satisfy the Schedule B EA requirements for the assignment.

2.0 STUDY OVERVIEW

This section reviews the approach and scope of the Capacity Assessment Study completed for Study Area 60. The elements from this Study provide the basis for the EA, with focus on Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27.

2.1 PROJECT OBJECTIVES AND APPROACH

The City has embarked on a new approach in an effort to meet this objective, incorporating lessons-learned and feedback from previous projects. The overall approach is demonstrated in **Figure 2**—1, indicating two (2) distinct, yet integrated, phases of the project: the initial Study Phase, and the Preliminary Design Phase. The objective of this effort is to reduce the risk of future basement and surface flooding resulting from shortfalls in the capacity of the municipal drainage systems. In other words, the focus of flood remediation efforts is on publicly derived sources, such as back-up of City sewer systems, or surface flooding emanating from the public right-of-way (ROW).

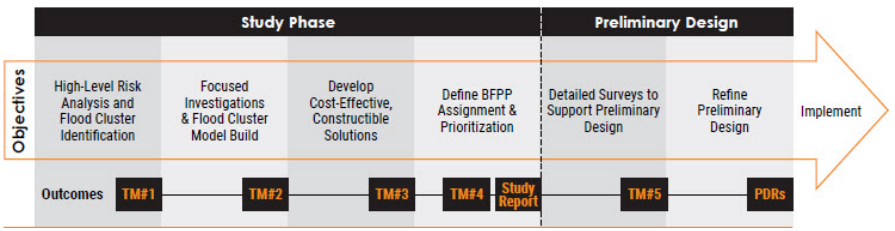


Figure 2—1: Overall Project Approach

The project was supported by a series of four (4) Technical Memoranda (TM) which detail the analysis, findings, and recommendations at the following key stages:

- TM1 – Preliminary Assessment and Flood Cluster Identification (Attachment 1)
- TM2 – Hydrologic and Hydraulic Modelling and Assessment (Attachment 2)
- TM3 – Recommended Solutions Development (Attachment 3)
- TM4 – Assignment Scope Development and Prioritization

The primary focus from the Study Phase was on the development of Schedule A/A+ assignments where feasible, recognizing there may be a need for additional Schedule B and/or C EA activities for more involved solutions negatively affecting the social or natural environments. Select Schedule A/A+ assignments may then proceed to Preliminary Design in consultation with the City. The overall workflow for the Study and Preliminary Design Phases are presented in **Figure 2**—2.

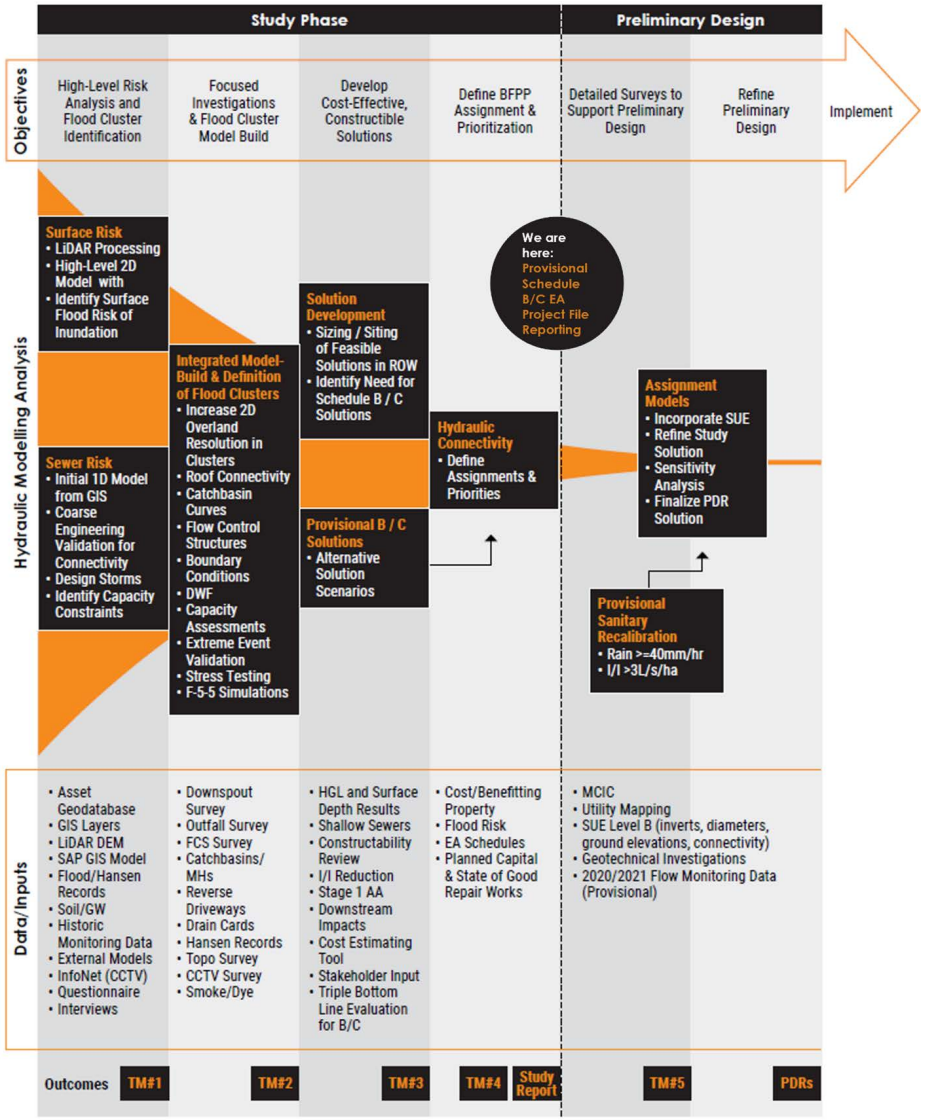


Figure 2—2: Overall Project Workflow

Following the solution development components through TMs 3&4 with summary in the Study Report, 35 assignments were identified, 25 of which were considered Schedule A/A+, while 10 assignments were identified as a Schedule B undertaking and are therefore the focus of this EA report. The Assignments identified within the Study Area are shown in **Figure 2**—3. Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27 are considered Schedule B undertakings.

The TMs and Study Report from the Study Phase form the basis of the material used to create this Project File EA report. Each study report was prepared in accordance with Phase 1 of the Municipal Engineers Association's (MEA's) Municipal Class EA Process (October 2000, as amended in 2007, 2011 & 2015).

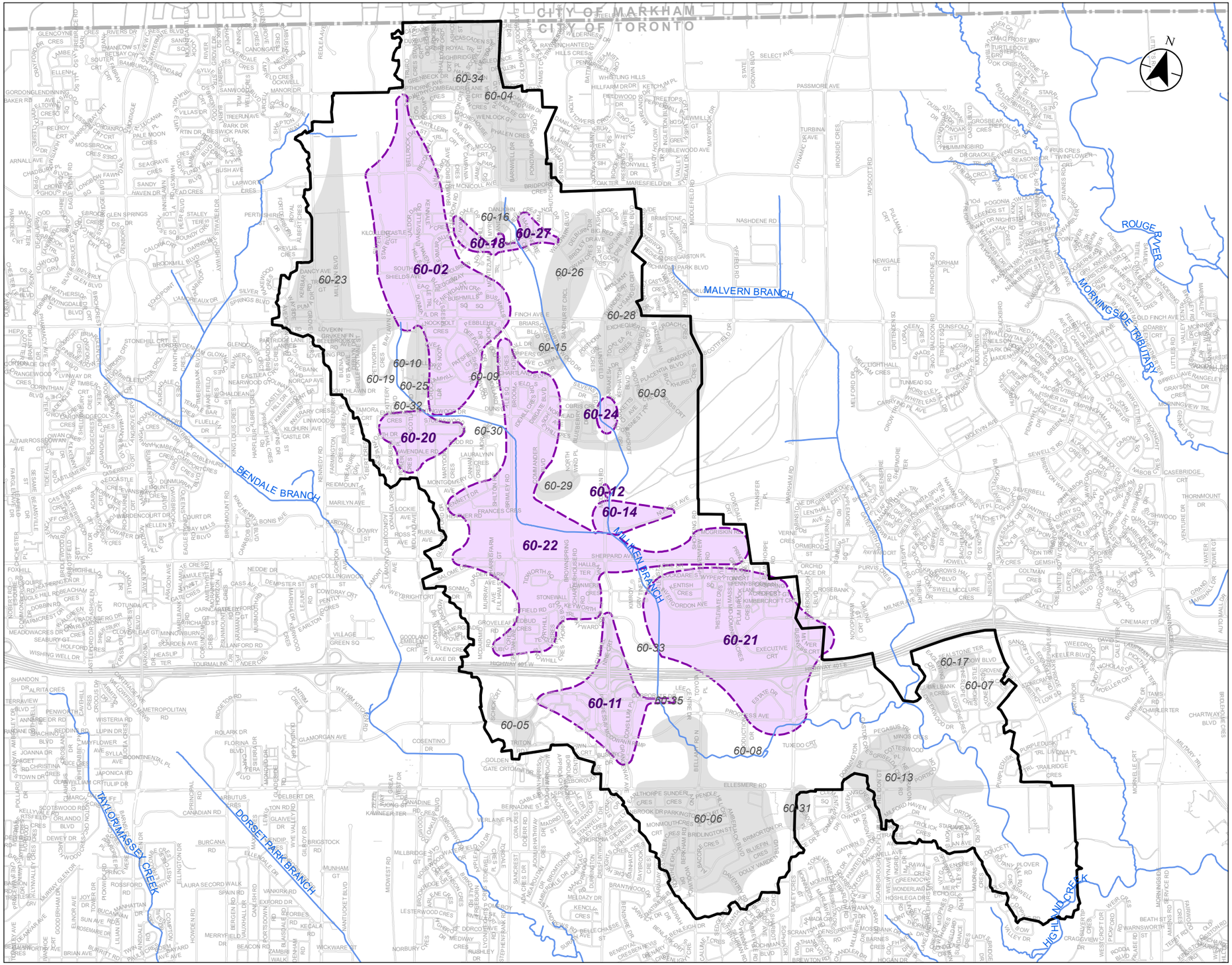
The study report for Area 60 summarizes TM1 to TM4. A brief synopsis of each TM is provided in the following sub-sections. TMs 1-3 are included as attachments to this Project File Report.

2.1.1 Overview of TM1

TM1, developed in Stage 1 of this capacity study, outlined the initial desktop data collection and review process, including the definition of initial high-level, risk-based 2-dimensional (2D) surface and 1-dimensional (1D) sewer models (InfoWorks ICM v.10.0.4) to help define initial capacity restrictions in the drainage systems. Through data overlay and interpretation, focus areas were defined based on data uncertainty and/or elevated risk of surface/basement flooding that were then subject to a Field Survey and Investigation Program (FSIP). The primary objective of the FSIP was to collect additional desktop and field information to help reduce the amount of uncertainty in priority areas of the hydraulic model and study area. The program was undertaken through four components including Additional Desktop Review, Field Survey (Inventory) of Physical Building/Topographic Features, Flow Control Structure Inspections, and Flow Monitoring Plan. The FSIP was a staged process undertaken in parallel activities with Stage 2 (TM2).

2.1.2 Overview of TM2

Based on the high-level analysis and definition of areas at risk from Stage 1 (documented in TM1), Stage 2 involved detailed validation of the Stage 1 model in identified focus areas. TM2 documented the FSIP data collection process and findings; advanced the Stage 1 High-Level model with more detail in the areas of focus as defined by the Stage 1 sub-cluster assessment; incorporated the storm drainage topographic subcatchments and 1D overland network, including FSIP survey data; refined the sanitary model with dry weather flow (DWF) parameters based on available flow monitoring data; established the existing condition storm and sanitary collection system performance, cross-referencing against available historic customer service records reports of non-private side flooding; interpreted the potential contributing factors to capacity issues, based on the hydraulic model performance against TM1 data; and, provided recommendations for suitability of the storm/combined drainage and sanitary models for proceeding to solution development, and whether any additional field work was warranted.



Stantec

Legend
- Study Area
- Schedule B Assignment Area
- Other Assignment Area

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Notes
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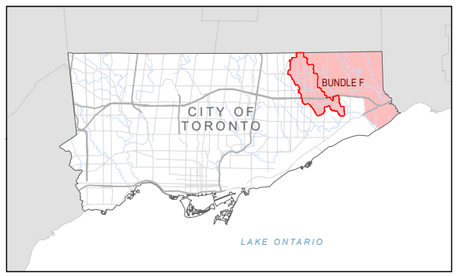


Project Location
City of Toronto

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.
2.3

Title
Study Area 60 Assignments

2.1.3 Overview of TM3

TM3 presents the development and evaluation of various measures for surface and basement flooding remediation completed in Stage 3 of this capacity study. TM3 includes a review of the design criteria, constraints, and approach to solution development; the definition of Problem Areas based on modelled system results; the development of solutions to mitigate modelled capacity constraints in the surface and subsurface system; cost estimation using version 4.1 of the City's Cost Estimating Tool (CET); desktop evaluation of solution constructability; initial assessment of the EA Schedule; list of basement flooding criteria exempted nodes/links and corresponding rationale; initial evaluation of Closed-Circuit Television (CCTV) survey status and potential needs to inform the approach to collecting additional data before the Preliminary Design; and, sets the stage for TM4 prioritization and definition of Preliminary Design Assignments.

The results of this TM provide the basis for the TM3 activities of establishing which projects require additional evaluation under the EA Process, and which Schedule A/A+ projects can be prioritized for advancement to the Preliminary Design stage.

Completion of draft TM3 informed the development of draft TM4, and in turn the draft TM4 elements of grouping Solutions into Assignments and factoring in the cost/benefitting property have been incorporated into the final TM3. Final TM3 and final TM4 are therefore completely integrated.

2.1.4 Overview of TM4

While integrated with TM3, TM4 documents the constructability details and cost per benefitting properties for all considered alternatives. The selected preferred alternative solutions are grouped into assignments based on connectivity and evaluated for eligibility with respect to the cost per benefitting property threshold. Recommended solutions are then compiled in Assignment Scoping Documents (ASDs). ASDs provide a visual overview of the proposed work and area, includes details on the components within the assignment, and outlines constructability considerations and any additional City Capital Works that are part of the scope going forward. As part of TM4, the proposed assignments are also prioritized for implementation based on key criteria that rationalizes the impact, cost, complexity, and capital coordination of each undertaking. In essence, TM4 presents the scope of flooding solution assignments for advancement to the preliminary design stage or identifies where further Phase 2 EA review is required for Schedule B/C assignments. Results of TM4 indicated that 10 assignments are considered Schedule B undertakings due to their involvement with outfall upgrades, work around Highway 401, and overland flow re-routing.

2.2 SCOPE OF STUDY

The study was carried out to assess the sanitary and storm drainage systems to identify the potential factors, mechanisms and impacts of surface and basement flooding and to develop comprehensive flooding remediation plans that best meet the target level-of-service criteria of the City. To achieve this scope, the study included the following tasks:

- Municipal Class EA project Phase 1 activities, including agency consultation and community questionnaire.
- Comprehensive review of background data and available information to confirm existing field conditions, supplemented as required with additional field investigations.
- Identification and prioritization of the factors contributing to basement and surface flooding including interaction of the storm, sanitary and overland systems.
- Development of a Geographic Information System (GIS)-based topographical model to help define the major system surface drainage patterns and identify and quantify low lying or other problematic areas.
- Development of sanitary and storm drainage system hydrologic and hydraulic modeling tools.
- Confirmation and identification of potential basement flooding areas.
- Evaluation of various flood remediation measures and development of comprehensive cost-effective flood remediation plans to achieve the targeted hydraulic performance under future projected population.
- Where alternative flood remediation measures were developed, an assessment was completed based on hydraulic, environmental, and socio-economic factors to determine the recommended flood solution.
- Development of opinions of probable costs, implementation sequencing, and mitigation measures.

2.3 DESCRIPTION OF THE STUDY AREA AND ASSIGNMENT

As shown in **Figure 1**—1, Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27 are located throughout the Area 60 study area. Generally, the assignments are bounded by Ellesmere Rd to the south, Steeles Ave to the north, Kennedy Rd to the west, and Malvern St to the east.

3.0 THE ENVIRONMENTAL ASSESSMENT PROCESS

The Study Phase for Area 60 followed the Ontario Municipal Class EA process which has resulted in the submission of this Project File Report for Area 60, with focus on Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27. The Ontario Class EA process, Study phase consultation and EA phase consultation is discussed herein.

3.1 ONTARIO ENVIRONMENTAL ASSESSMENT ACT

The planning of major municipal projects or activities (e.g., an upgrade or expansion of an existing water, wastewater, or stormwater servicing area) is subject to the Ontario Environmental Assessment Act, R.S.O. 1990 (EA Act). The EA Act requires the proponent (in this case, the City) to complete a Municipal Class EA, for a basement and surface flooding infrastructure master planning exercise. Environmental impacts that the proposed undertaking may have must be identified, and mitigation measures outlined. The EA Act defines the environment in terms of physical, natural, social, and cultural aspects. The following provides more information on the planning process that governs this undertaking.

3.1.1 Municipal Class Environmental Assessment Process

The Municipal Class EA process was developed by the Municipal Engineers Association (MEA) as an alternative method to Individual EAs for recurring municipal projects that are similar in nature, usually limited in scale, and with a predictable range of environmental effects that are responsive to mitigating measures.

The Class EA procedure does not require application for additional approvals under the EA Act, provided the proponent has complied with the necessary requirements and procedures. These requirements and procedures include a full description of the project, consideration of alternatives, and identification of the impacts resulting from their initiation and continuance. The Class EA process also requires the proponent to inform and consult with the public and concerned agencies.

Projects are classified in four categories under the Municipal Class EA process:

Schedule A Projects: These projects are limited in scale and will result in minimal impact on the environment and consist of normal or emergency maintenance and operational issues. The projects are normally pre-approved and may proceed without following the entire EA planning procedure, such as normal or emergency operational and maintenance activities.

Schedule A+ Projects: These pre-approved projects are limited in scale and will result in minimal impact on the environment; however, the public must be advised prior to project implementation.

Schedule B Projects: When the nature of the project dictates that there is a potential for adverse environmental impact, the proponent is required to follow a process of evaluating alternative solutions to the undertaking which includes mandatory contacts with directly affected public and relevant review

agencies, in order to factor in their concerns in the process. Projects defined under this classification must be documented in the form of a Project File and be filed for review by the public and review agencies.

Schedule C Projects: Under the Schedule C classification, there is a potential for significant environmental impacts; therefore, the project must proceed under the full planning evaluation and documentation procedure defined in the Class EA document. Projects defined under this classification must be documented in the form of an Environmental Study Report (ESR) and filed for review by the public and review agencies.

Agreements made or commitments given by the proponent to affected review agencies or the public during the course of the screening process must be followed through and implemented; otherwise, the proponent is in contravention of the EA Act, and may be subject to a penalty.

The EA process in Ontario follows a logical decision-making process and incorporates all aspects of:

- Identification of the problem or need for the project (Phase 1);
- A thorough evaluation of the planning options or alternative solutions to the problem based on defined screening criteria (Phase 2, the last phase for Schedule B projects);
- An assessment of design alternatives (pre-design for Schedule B projects, or Phase 3 for Schedule C projects);
- The completion of documentation for the public record (Project File for Schedule B projects or Phase 4 – ESR for Schedule C projects); and
- The implementation of the project including design with appropriate monitoring during construction (Phase 5).

All projects proceed to Phase 5 once they have been approved. The Class EA guideline document provides a detailed description of the phases and schedule requirements.

3.2 PROJECT EA APPROACH

The framework of the project approach and Study phase followed the guidelines of the Municipal Class EA document disseminated by the Ontario MEA (2000, amended 2007, 2011 & 2015). By following these guidelines, the Study satisfied the requirements of the Ontario Environmental Assessment Act through completion of Phase 1 of the Class EA process and set the framework to undertake Phase 2 activities for projects identified as Schedule B or C.

From the Study phase, Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27 were identified as Schedule B undertakings where the following additional review and consultation measures were taken:

- Detailed alternative review, including development of additional Alternative 3 solution;
- Public consultation; and
- Advancement in consultation with agency stakeholders.

The above measures are discussed in the following sections of this Project File Report.

3.3 STUDY PHASE

Consultation documentation from the Study Phase is provided in Appendix D of **Attachment #3 - TM3**. The following sub-sections discuss the consultation performed during this phase.

3.3.1 Public Consultation

During the Study phase, the public was notified of the study via the City's website and a mailout seeking public input via online questionnaire regarding their flooding experiences.

A public questionnaire was issued in Fall 2020 to addresses within the study area to help identify public-side flooding concerns. A list of addresses where questionnaire responses may be helpful in identifying public-side flooding concerns was compiled and provided to the City for distribution in the fall of 2020 (refer to Section 2.3.5 of **Attachment #2 – TM#2** for further details).

A total of 323 questionnaires were sent to residents within Area 60 with 29 respondents. Of the 29 respondents, 14 indicated they had experienced flooding, with nine (9) indicating a potential storm source, two (2) indicating a possible sanitary source, and three (3) indicating an undetermined source. There was no other public consultation during the Study Phase.

3.3.2 Agency and Indigenous Communities Consultation

The following stakeholders were engaged through the Study Phase:

- Chippewas of Rama First Nation, Chippewas of Scugog Island First Nation, Beausoleil, Curve Lake First Nation, Hiawatha First Nation, Mississaugas of Scugog Island First Nation, Alderville First Nation, Six Nations of the Grand River, and Huron-Wendat for issuance of Stage 1 Archaeological Assessment
    - No comments received
- Mississauga's of the Credit First Nation
    - Received July 7, 2021, through archaeology assessment correspondence
    - Received July 14, 2022, through archaeology assessment correspondence and incorporated into assessment documentation (see Section 4.4.3).
- Toronto Parks, Forestry & Recreation
    - Workshop #1: held May 20, 2021
- Toronto Water – Operations
    - Workshop #1: held May 20, 2021
- Toronto Transportation Services
    - Workshop #1: held May 20, 2021
- Toronto Water – Stream Restoration Unit

  - Workshop #3: held September 21, 2021

- Toronto and Region Conservation Authority (TRCA)
  - Workshop #2: held June 22, 2021, with TRCA
  - Area 60 Proposed Solutions Memo Review: August 11, 2021
  - Bundle F Pre-Consultation Meeting and Package for Schedule A/A+ or Schedule B assignments within TRCA regulated limits: May 25, 2022 (no meeting was held however presentation materials were provided to the TRCA)

3.4 EA PHASE

Following the Study Phase, additional consultation was undertaken through the EA phase, as documented herein.

3.4.1 Public Consultation

Following the Study Phase, the following public consultation was undertaken:

- Notice of Commencement
  - Issued September 15, 2022, online and in the September 22 and 29 Scarborough Mirror newspaper editions.
- Public Consultation Event #1
  - A Notice of Consultation was issued by Canada Post to all properties in the study area to advise of consultation opportunities. Commenting period was held between December 27, 2022, to January 27, 2023.
  - Consultation material, consisting of a presentation, was posted on the City's dedicated webpage, and included information pertaining to the study, EA process, existing conditions for Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27, and alternatives and the preferred solution for the assignments. The presentation materials are provided in **Appendix A**.
  - A summary of public consultation for the EAs under Bundles D & F of the BFPP, is provided in **Appendix A**. The following comments were received:
  - One (1) resident inquired about catchbasin debris clearing. The resident was directed to 311 services.

3.4.2 Agency and Indigenous Communities Consultation

The following agency stakeholders were engaged through the EA Phase (see **Appendix A**):

- TRCA
  - The TRCA provided comments on the information presented in PIE#1 on March 13, 2023. The City provided responses on June 1, 2023. The comments and responses are provided in Appendix A.
- HydroOne – Provided a general letter noting assets are present in the area.

- Rogers Communications (Telecon) – Provided map to the City of their plants within the Area 60 assignment areas.
- Toronto Hydro – Provided a general letter for clearances. No asset data provided.
- Trans-Northern Pipelines – Provided a letter stating that there are assets in the Study Area; however, there are no concerns with the planned study. TransCanada Pipelines would like a copy of the final Project File report for their understanding.
- Association Conseil des écoles catholiques du Centre-Est, Bell Canada, Canada Lands Corporation, Canadian Pacific Rail, Enbridge Gas, Environment Canada, Great Lakes and Corporate Affairs, Enwave Energy Corporation, Greater Toronto Airport Authority, Imperial Oil, Metrolinx, Ministry of Advanced Education, Skills & Training, Ministry of Colleges and Universities, Ministry of Economic Development, Job Creation and Trade, Ministry of Education Ministry of Energy, Northern Development and Mines, Ministry of Environment, Conservation and Parks, Ministry of Heritage, Sport, Tourism and Cultural Industries, Ministry of Municipal Affairs and Housing, Ministry of Transportation, Ontario Power Generation, Ontario Provincial Police, Sun-Canadian Pipe Line Company Ltd., TELUS, Toronto Catholic District School Board, Toronto District School Board, Toronto Fire Services, Toronto Hydro, Toronto Paramedic Services, Toronto Police Services, Toronto Public Health, Videotron Ltd., Zoya Group, and Zayo
    - No comments received
- Chippewas of Rama First Nation, Chippewas of Scugog Island First Nation, Beausoleil, Curve Lake First Nation, Hiawatha First Nation, Mississaugas of Scugog Island First Nation, Mississauga's of the Credit First Nation, Alderville First Nation, Six Nations of the Grand River, and Huron-Wendat for issuance of Notice of Commencement and Notice of Public Consultation.
    - No comments received
    - Two agencies were contacted regarding solutions on private property. See **Appendix A** for the correspondence log.

3.4.3 Notice Of Completion

The filing of this Project File and the issuance of the Notice of Completion fulfill the requirements for Phases 1 and 2 of the Class EA process. Subject to comments received and the receipt of the necessary approvals, the City of Toronto intends to continue with the preliminary/detailed design and construction of the flood remediation measures to mitigate the risk of basement and surface flooding in Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27.

4.0 EXISTING CONDITIONS

Information pertaining to the existing drainage systems, boundary conditions, socio-economic environment, and physical and natural heritage for Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27 and the surrounding Area 60 are discussed in the following sections.

4.1 DRAINAGE SYSTEMS

The following sections describe the sanitary, storm and overland drainage systems.

4.1.1 Sanitary Sewer System

As illustrated in **Figure 4**—1, local sanitary sewer systems within Study Area 60 discharge into the two sanitary sewer trunks that flow north-to-south across the study area. From the north, the trunks follow different East Highland Creek tributaries, converging into one trunk sewer just upstream of Sheppard Ave E, which then crosses Highway 401 eventually discharging into Study Area 59. There is approximately 155 km of sanitary sewer within Area 60, with pipe diameters ranging from 150 mm to 1200 mm. The sanitary sewers date between 1950 and the 2010s, with the majority dating back to the 1970s and 1980s. Based on historic criteria, there is potential for foundation drains in the areas constructed pre-1970 to be connected to the sanitary system, while the remainder are likely all directed to the storm sewer, with consideration for 100-yr HGL freeboard in the design.

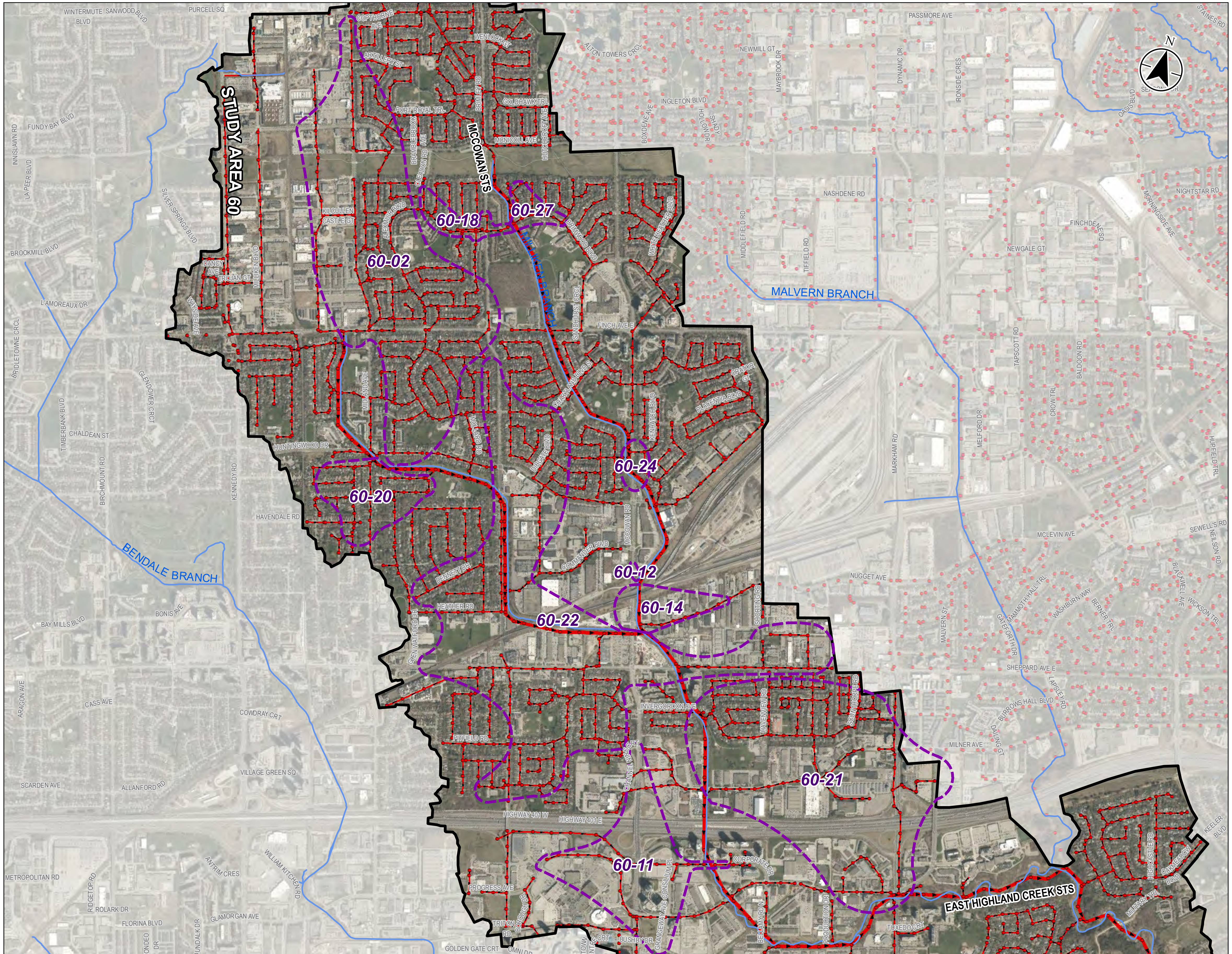
There are also 85 perforated MHs found in the sanitary system and 68 on the dual system in Area 60; 53 of which are located within overland low points. A total of 361 dual MHs were also identified, which were all determined to have no hydraulic cross-connection to the storm system. There are no municipal sewerage pumping stations in Study Area 60.

Refer to **Attachment #1 - TM1** for further detail pertaining to the existing sanitary sewer system.

4.1.2 Storm Sewer System

The storm sewer system, shown in **Figure 4**—2, consists of smaller networks discharging to East Highland Creek and its tributaries, and includes 63 storm outfall structures. There is approximately 162 km of storm sewer within Area 60, with circular pipe sizes ranging from 200 mm to 2700 mm in diameter and rectangular pipes ranging from 2400H x 3350W mm to 2743H x 4876W mm in size. Similar to the sanitary system, the storm sewers date between 1970 and the 2010s, with the majority installed within the 1970s and 1980s. The storm system also consists of one stormwater storage pipe on Wyper Sq (south of Sheppard Ave E, east of Havenview Rd), and one orifice structure at the intersection of Brilliant Ct and Sandhurst Crcl (east of McCowan Rd). There are also four stormwater management (SWM) facilities within Study Area 60, all of which are dry ponds.

Attachment #1 - TM1 provides additional detail on the storm sewer system.



Stantec

Legend

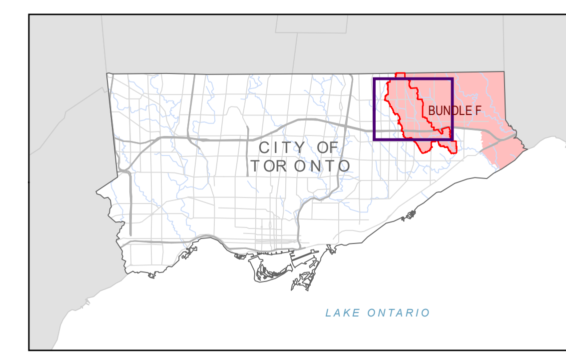
- Study Area
- Assignment Area
- Sanitary Manhole
- Local Sanitary Sewer (< 600 mm)
- Local Trunk Sewer (≥ 600 mm)

0 100 200 m

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

Notes

1. Coordinate System: NAD 1983 CSRS MTM 10
2. Contains information licensed under Toronto Water Asset Mapping User Agreement.
3. Contains information made available under the Toronto and Region Conservation Authority Open Data Licence v 1.0, Open Government Licence – Toronto, and Open Government Licence – Ontario.



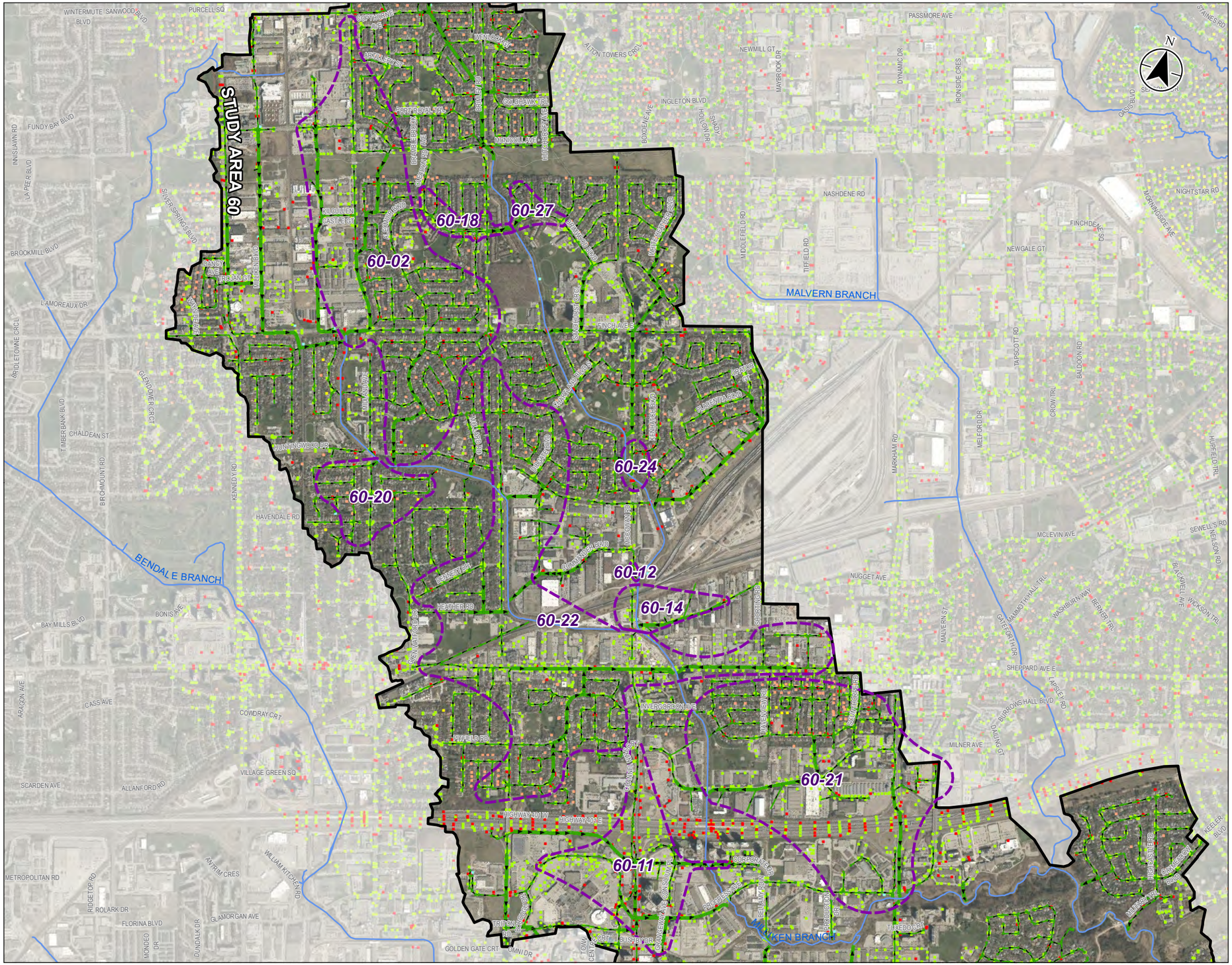
Project Location
City of Toronto

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.
4.1

Title
Existing Sanitary Sewer System



Stantec

Legend

- Study Area
- Assignment Area
- Manhole
- Catchbasin
- Double Catchbasin
- Private Catchbasin
- Rear Yard Catchbasin
- Other Inlet
- Local Sewer (< 1200 mm)
- Trunk Sewer (≥ 1200 mm)

Notes

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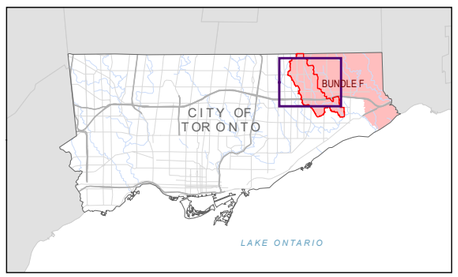

Project Location
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165660138 REVA
Prepared by KDB on 2023-07-28

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

Figure No.
4.2

Title
Existing Storm Sewer System

4.1.3 Overland Flow System

The overland/major flow system comprises the network of streets and natural flow paths that can temporarily store and convey runoff during a high-intensity storm and may influence the flow entering the storm and sanitary sewer systems. This surface flow accumulates at low points causing ponding. The major storm boundary was established based on topographic drainage derived from the digital elevation model (DEM) data along with field survey results regarding low points and downspout connectivity.

As per Scarborough practice post 1970, the major overland system has been considered as the former borough developed, with the majority of main watercourses remaining as open channels for relief above sewer capacity. The resulting storm sewersheds are relatively small with good access to major system relief in most locations. **Figure 4**—3 shows the existing overland flow system.

4.2 BOUNDARY CONDITIONS

A component of the hydraulic model is the establishment of boundary conditions for inflows or levels entering or exiting the study area. The boundary conditions applied to the storm, sanitary and overland systems were originally derived in Stage 1 and updated in Stages 2 and 3 as required. Conditions representing adjacent study areas were taken from external models completed by others, while those that represent transitions between study areas that reside within Bundle F (Areas 60 and 64 in this case), were generated based on the capacity study models. Watercourse level boundaries for the storm system were applied from provided TRCA HEC-RAS assuming the 5-yr levels applied to the storm outfalls for all design events. The boundary condition levels applied to the final recommended alternative solutions 100-yr (storm and overland systems) and May 12, 2000 (sanitary system) models in Stage 3 are presented in **Appendix D** of this report and **Table 2-3** of **Attachment #3 – TM3**.

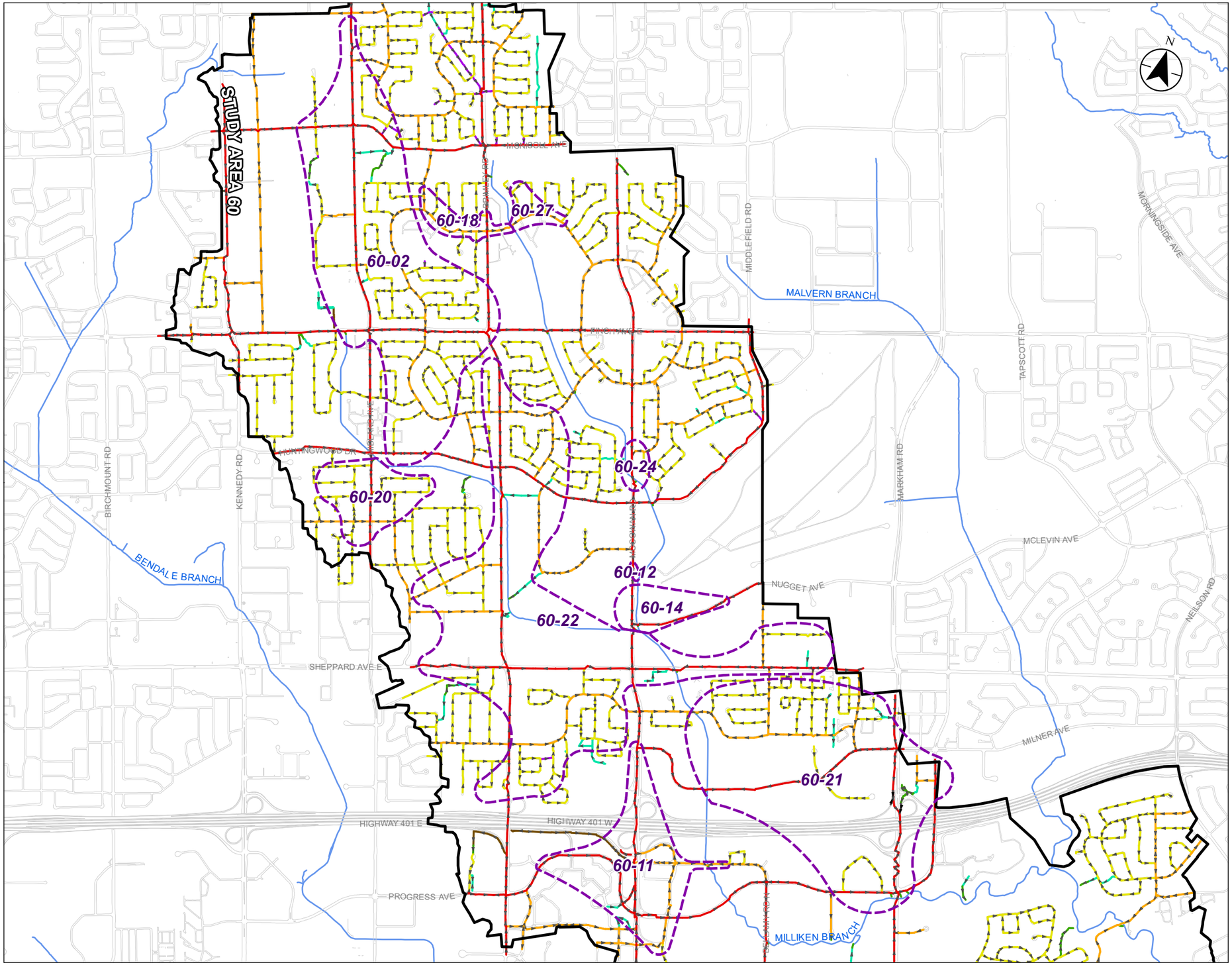
4.3 SOCIO-ECONOMIC ENVIRONMENT

The following sections discuss the land use and potential growth for the assignment area.

4.3.1 Land Use Classification

Study Area 60 can be characterized as a mix of residential and industrial-commercial-institutional (ICI) land use classification. Residential neighborhoods are concentrated around Midland Ave, Brimley Rd, and Finch Ave, along with Sheppard Ave and smaller clusters south of the Highway 401. ICI areas comprise just over a quarter of the study area, the largest commercial area being the Scarborough Town Center and neighbouring retail properties. There are also four industrial clusters distributed throughout. The Canadian Pacific Railway Yard is categorized as Vacant and Utility / Transportation, along with two open-space utility corridors.

See **Figure 2.1** and **Table 2.1** in **Attachment #1 – TM1**.



Stantec

Legend

- Study Area
- Assignment Area

Modelled Overland Conduit Type

- Highway
- Arterial Road
- Collector Road
- Local Road
- Rural Cross-Section
- City Pathway
- Park / Open Space
- Private Property
- Ditch
- Creek

0 250 500 m

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

Notes

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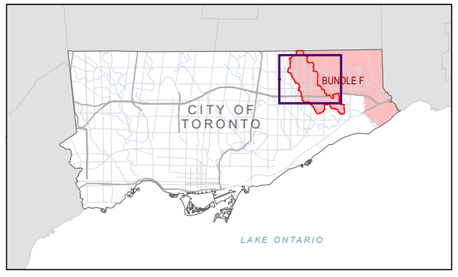

Project Location
City of Toronto

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.
4.3

Title
Existing Overland Flow System

4.3.2 Population and Water Use

Water consumption records were provided per address point on an annual basis for 2018. Populations were also provided as part of the City's Planning Datasets and were used as the basis of the existing conditions sanitary model.

4.4 PHYSICAL AND NATURAL HERITAGE ENVIRONMENT

The following sections discuss the key topographical, hydrogeological, and environmentally significant features within the assignment area. In addition, historical or archaeological potential within the assignment limits are discussed herein.

4.4.1 Topography and Hydrogeology

The Study Area topography was demonstrated in **Figure 2.8** of **Attachment #1 - TM1**, with drainage generally flowing north to south across the study area to Highland Creek. **Figure 3.1** of **Attachment #1 - TM1** also helps to depict a more micro-level definition of the topography within the study area, illustrating detailed flow paths and depressions within the ground surface.

A hydrogeological assessment of the study area's soil and groundwater conditions is also detailed in **Attachment #1 - TM1**, based on information from the City's borehole database, water well records from the Ministry of Environment, Conservation and Parks (MECP), and publications produced by consultants and other government agencies. Key findings suggest that the shallow subsurface throughout much of the study area is characterized as fine-textured soils (silt and clay) which extend from existing grades to depths of approximately 10 m, along with pockets of coarse-textured soils (sand and gravel) encountered near ground surface in the central and southeastern portions of the study area.

In the northwestern portion of the study area, the inferred depth to water table is greater than 6 m relative to ground surface. Throughout the remainder of the study area (i.e., south of Sheppard Ave East), the inferred depth to water table is less than 6 m relative to ground surface. Based strictly on hydrogeological data (i.e., soil composition and depth to water table), the relative risk for groundwater migration to the sewer system would be low in the northern portion of the study area; and low to moderate in the southern portion of the study area.

Given the hydrogeological conditions, it is reasonable to assume that the experienced flooding is not likely attributable to excessive groundwater seepage into the sewer network.

4.4.2 Environmentally Significant Areas and Special Policy Areas

Environmentally Significant Areas (ESA) are the areas of land or water within the natural heritage system that have special characteristics defined in Policy 13 of the City of Toronto Official Plan (June 2006, updated March 2022). They are particularly sensitive and require additional protection to preserve their environmentally significant qualities.

A map showing the environmentally significant areas is included in the Toronto Official Plan (Map 12A): https://www.toronto.ca/wp-content/uploads/2019/06/987b-cp-official-plan-Map-12A_ESAs_AODA.pdf. There are no environmentally significant areas within the 10 Schedule B assignments in Area 60.

A map showing the Special Policy Areas (SPA) is also included in the Toronto Official Plan (Map 10) available at the following web link: https://www.toronto.ca/wp-content/uploads/2017/11/9048-cp-official-plan-Map-10_Special-Policy-Areas_AODA.pdf. Based on the information outlined in the map, there is no SPA affecting any of the 10 Schedule B assignments in Area 60.

Further to the above, there are three (3) Site and Area Specific Policies (SASP) identified in the study area that are adjacent to the proposed Schedule B assignments (Map 30 and 33) (https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/official-plan/chapter-7-site-and-area-specific-policies/):

- SASP #130. West side of Markham Road, south of Milner Avenue: Senior citizen's housing and ancillary facilities, including recreational and convenience commercial facilities, are permitted. (Map 33, Assignment 60-21)
- SASP #262. Lands along Midland Avenue and Brimley Road, south of Finch Avenue to Highway 401; McCowan Road, south of Huntingwood Drive to Highway 41; and Huntingwood Drive, east of CN Railway to McCowan Road: Only detached dwellings and semi-detached dwellings are permitted. (Map 30, Assignments 60-20 and 60-22)
- SASP #263. Lands along Midland Avenue and Brimley Road, north of Finch Avenue; the south side of Steeles Avenue, McCowan Road, north of Huntingwood Drive; and the west side of Middlefield Road: Only detached dwellings, semi-detached dwellings and street townhouses are permitted. (Map 30, Assignments 60-24)

Proposed work for Assignments 60-20, 60-21, 60-22, and 60-24 overlap these areas as indicated. During the preliminary design stage for the listed assignments, additional coordination will be required.

4.4.3 Natural Heritage and Archaeological Potential

The natural heritage system consists of all the native land cover in an area. A healthy environment depends on maintaining a network of areas in which the protection, restoration and enhancement of natural features and functions has high priority to help maintain the biodiversity of native plants and animals. Natural heritage system planning needs to be integrated with other municipal land use planning objectives and form a part of the City's building decisions.

The consideration of cultural heritage is a requirement of the MEA Class EA process and the revised 2014 Provincial Policy Statement. In this process, the cultural environment, including built heritage resources and cultural heritage landscapes as well as archaeological resources, is considered as one in a series of environmental factors when undertaking an MEA Class EA. Therefore, a desktop review for the area was reviewed for the presence of protected heritage properties, indicating that there are some protected properties and places of cultural heritage value or interest within the study area boundary.

This information was referenced during solution development as proposed solutions within or near these properties requires additional assessment to be completed during the detailed design phase to identify, evaluate, assess the impacts, and provide recommendations to mitigate the effects of the undertaking on cultural heritage resources including built heritage and cultural heritage landscapes.

The desktop review of the City of Toronto's Heritage Register is provided in **Figure 5.3** of **Attachment #3 – TM3**, cross-referenced against the proposed solutions. Part IV Designations refer to properties recognized of cultural heritage value or interest, and Listed Properties refer to those where further evaluation of the property will take place if there is an intent to impact or demolish the property. The *Heritage Overview – Basement Flooding Protection Program, Bundle F: Study Area 60* was undertaken to identify recognized heritage resources within the Bundle F Study Area 60. Below is an overview of the heritage potential for the 10 Schedule B assignments within Area 60.

- Assignment 60-02:
    - Based on consultation with the appropriate regulatory bodies, desktop data collection, and a site visit, Assignment 60-02 was determined to contain one identified heritage resources (3315 Midland Avenue). Accordingly, when a preliminary design is determined for Assignment 60-02, a Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment (CHR) should be carried out for the Assignment Area. The CHR will establish the existing conditions of Assignment 60-02 and confirm the presence of additional potential heritage resources. The CHR should be carried out by a qualified heritage professional who is a professional member of the Canadian Association of Heritage Professionals.
- Assignment 60-11:
    - Based on consultation with the appropriate regulatory bodies, desktop data collection, and a site visit, Assignment 60-11 was determined to contain one identified heritage resources (520 Progress Avenue). Accordingly, when a preliminary design is determined for Assignment 60-11, a Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment (CHR) should be carried out for Assignment Area. The CHR will establish the existing conditions of Assignment 60-11 and confirm the presence of additional potential heritage resources. The CHR should be carried out by a qualified heritage professional who is a professional member of the Canadian Association of Heritage Professionals.
- Assignment 60-14:
    - Based on consultation with the appropriate regulatory bodies, desktop data collection, and a site visit, Assignment 60-14 was determined to contain one identified heritage resources (2050 McCowan Road). Accordingly, when a preliminary design is determined for Assignment 60-14, a Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment (CHR) should be carried out for the Assignment Area. The CHR will establish the existing conditions of Assignment 60-14 and confirm the presence of additional potential heritage resources. The CHR should be carried out by a qualified heritage professional who is a professional member of the Canadian Association of Heritage Professionals.

- Assignment 60-18:
    - Based on consultation with the appropriate regulatory bodies, desktop data collection, and a site visit, Assignment 60-18 was determined not to contain any identified heritage resources, however based on topographic mapping and the presence of buildings that are 40 or more years old, a Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment (CHR) should be carried out for the Assignment Area when a preliminary design is determined. The CHR will establish the existing conditions of Assignment 60-18 and confirm the presence of additional potential heritage resources. The CHR should be carried out by a qualified heritage professional who is a professional member of the Canadian Association of Heritage Professionals.
- Assignment 60-20:
    - Based on consultation with the appropriate regulatory bodies, desktop data collection, and a site visit, Assignment 60-20 was determined not to contain any identified heritage resources, however based on topographic mapping and the presence of buildings that are 40 or more years old, a Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment (CHR) should be carried out for the Assignment Area when a preliminary design is determined. The CHR will establish the existing conditions of Assignment 60-20 and confirm the presence of additional potential heritage resources. The CHR should be carried out by a qualified heritage professional who is a professional member of the Canadian Association of Heritage Professionals.
- Assignment 60-21:
    - Based on consultation with the appropriate regulatory bodies, desktop data collection, and a site visit, Assignment 60-21 was determined not to contain any identified heritage resources, however based on topographic mapping and the presence of buildings that are 40 or more years old, a Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment (CHR) should be carried out for the Assignment Area when a preliminary design is determined. The CHR will establish the existing conditions of Assignment 60-21 and confirm the presence of additional potential heritage resources. The CHR should be carried out by a qualified heritage professional who is a professional member of the Canadian Association of Heritage Professionals.
- Assignment 60-22:
    - Based on consultation with the appropriate regulatory bodies, desktop data collection, and a site visit, Assignment 60-22 was determined not to contain any identified heritage resources, however based on topographic mapping and the presence of buildings that are 40 or more years old, a Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment (CHR) should be carried out for the Assignment Area when a preliminary design is determined. The CHR will establish the existing conditions of Assignment 60-22 and confirm the presence of additional potential heritage resources. The CHR should be carried out by a qualified

heritage professional who is a professional member of the Canadian Association of Heritage Professionals.

- Assignment 60-24:
    - Based on consultation with the appropriate regulatory bodies, desktop data collection, and a site visit, Assignment 60-24 was determined not to contain any identified heritage resources. No additional cultural heritage studies are recommended for Assignment 60-24.
- Assignment 60-27:
    - Based on consultation with the appropriate regulatory bodies, desktop data collection, and a site visit, Assignment 60-27 was determined to contain one identified heritage resources (44 Macklingate Court). Accordingly, when a preliminary design is determined for Assignment 60-27, a Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment (CHR) should be carried out for the Assignment Area. The CHR will establish the existing conditions of Assignment 60-27 and confirm the presence of additional potential heritage resources. The CHR should be carried out by a qualified heritage professional who is a professional member of the Canadian Association of Heritage Professionals.

Similarly, the City's Archaeological Master Plan identifies areas that may potentially contain archeological resources. As a first step for these areas, a desktop review was completed to identify potential for a Stage 1 Archaeological Assessment (AA), which is required to determine the possible nature and significance of any archeological resources that may be present. A Stage 1 assessment involves a review of geographical and historical land use for the proposed development area. Mapping from the Toronto Ontario Genealogical Society and records from the Ministry of Heritage, Sport, Tourism and Culture Industries for known archaeological sites were reviewed, which also includes known cemetery locations. This information was referenced during solution development as solutions should generally avoid these cemeteries by 10 m, and if contained within the ROW, should be located on the far side of the ROW from the cemetery. Areas of potential for Aboriginal and Euro-Canadian archaeological remains generally include land adjacent to current and historical watercourses, parks, grassed areas, or other non-paved, undisturbed land. Any solutions that impact these areas may require a Stage 2 AA which involves a shovel test pit survey under the field supervision of a licensed archaeologist prior to any construction activities. The desktop review of the City of Toronto's Heritage Register for Archaeological potential is presented in **Figure 5.3** of **Attachment #3 – TM3**, cross-referenced against the proposed solutions.

The Stage 1 Archaeological Assessment: Basement Flooding Capacity Assessments Bundle F was undertaken to identify archaeology potential for the proposed solution extents within the Bundle F study areas.

Based on the Stage 1 Assessment, there is no further work required for Assignments 60-02, 60-11, 60-12, 60-18, 60-22, 60-24 and 60-27. However, should the solution extents deviate from the recommended alternative presented in Section 8.0, further Stage 1 archaeology assessment may be required.

Based on the Stage 1 Assessment, a Stage 2 archaeology assessment is recommended for Alternative 1 of Assignments 60-14, 60-20, and 60-21.

However, the recommended alternative for Assignments 60-14 and 60-21 as outlined in Section 8.0 do not require further works. The Stage 2 assessment for Assignment 60-20 shall be undertaken once the assignment progresses to the preliminary design stage.

The full Stage 1 Archaeological and Cultural Heritage reports complete with field photos and review are provided in Appendix B. The Stage 1 Archaeological report was shared with indigenous communities and any comments received are also provided in Appendix B.

5.0 DATA COLLECTION AND FIELD SURVEY

Data collection provides the foundation for the assessment and analysis of the sewer and drainage systems. Data provided by the City included physical information about the service area and sewer systems, as well as historical information related to development practices, by-laws, topography, hydrogeology, operations and maintenance, and basement flooding reports. A summary of the data collected and reviewed is below, and more details are provided in **Attachment #1 – TM1**.

A Project Knowledge Database Structure (PKDBS) was established in coordination with Toronto Water, to facilitate the management, maintenance, and exchange of information throughout the course of the project. The PKDBS was submitted to the City following the completion of the Area 60 Study Report and will be updated to include files from the EA phase, including this Project File report.

5.1 DATA COLLECTION

The data collected to complete the Study and EA for Area 60 are documented herein.

5.1.1 Summary of Supporting Information

The background information used to understand and describe the physical characteristics of the study area was generally available via reports or in a format suitable for viewing in GIS and included the following:

- Physical sewer network data including MHs, CBs (CB), and pipes (to develop detailed hydraulic model and assess existing and proposed infrastructure performance)
- Sewer Asset Planning DWF InfoWorks model
- Historical flow monitoring and precipitation data (to assess existing system performance in dry and wet weather and provide context for sanitary DWF parameters)
- Land use classification and impervious layers (to determine hydrologic properties of the area)
- 2011-2016 equivalent population data (for model dry weather input)
- Projected 2041 Population Projections (to verify that the proposed sanitary solutions will be effective with future population growth)
- Water consumption records (to estimate wastewater flows and distribute census population data)
- Aerial photographs (to identify structures and classify land use)
- DEM and topographic data (to delineate drainage areas)
- Current and historical sewer design criteria and sewer use by-law
- Historical surface and basement flooding reports, including Customer Service Records (CSR) from Hansen (to validate hydraulic modeling tool)
- Historical operations and maintenance reports
- CCTV inspections and smoke/dye test results
- Natural surface water drainage information
- Local drainage and sewer system improvements
- Geotechnical reports for groundwater and soil conditions

- Highway 401 drainage drawings from Ministry of Transportation
- Floodplain mapping and GIS layers from TRCA
- Consultation with City operations staff
- Various previous studies

The available CSR data since 2003 are widespread, however, records are primarily related to service connection blockage and not well correlated with historic rain or clear indicators of public-side capacity issues (back-up, MH overflow, CB overflow).

5.1.2 Data Gap Identification and Correction

In Stage 1, there was a degree of uncertainty in the Toronto Water Asset Geodatabase (TWAG) sewer asset data that was used to develop the storm and sanitary collection systems. The major uncertainty was with regards to the roof connectivity, given the number of downspout disconnection exemptions and mixed information from available drain plans. Address point data from the FSIP (see **Section 5.2** below) was used to update the roof connectivity assumptions of Stage 1, which covered almost all residential roofs; however, this information was limited to curb-view access.

5.2 FIELD SURVEY AND INVESTIGATION PROGRAM

During Stage 1, focus areas were defined where additional desktop information review and field investigation was required to help reduce the amount of uncertainty in priority areas of the hydraulic model and study area. The FSIP was undertaken in a staged manner as follows:

1. Additional Desktop Review
2. Field Survey (Inventory) of Physical Building/Topographic Features
3. Additional Data Collection
4. Flow Monitoring Plan

These processes were completed in parallel, with two iterations of the FSIP. The first FSIP included additional desktop review, which entailed review of select record drawings, and existing CCTV/Panaramo reviews for bifurcation or dual MHs. The field data that was collected during the initial field surveys is summarized in **Section 5.2.1**.

5.2.1 Initial Field Surveys

The base scope of field investigations included visible roof downspout connections, reverse sloped driveways, flat sloped (poor drainage) properties, surface topography including street low points and spill locations, CB grate types and locations, storm sewer s, and perforated MH lids. These investigations were undertaken from the public ROW, with no private property access, and were focused on areas of uncertainty and/or identified Flood Clusters, such that the total coverage area was no more than 50% of the Bundle F area. Infrastructure Intelligence Services Inc was subcontracted to complete the field activities.

Using a hand-held tablet with pre-populated field forms tied to the Address shapefile, field crews input data digitally for ease of daily QA/QC and mapping of progress/findings. Roof connectivity, reverse driveways and lot drainage were surveyed to verify and update assumptions made to inform the model build.

A critical contributor to overloading a sewer system is low point water accumulation, in terms of having sufficient inlets to be able to accept the flow and potential for spill to adjacent properties. Additionally, CB efficiency has the potential to impact expected capture rate, independent of location, and with the proposed change to the CB head-discharge curves to allow more water in at lower heads, having an accurate inventory of the CBs is increasingly important. Therefore, the same inventory area for roof connectivity was allocated for the CB survey, and key low points were flagged for enhanced inspection regarding potential spill points. CB inspections were undertaken with a Global Positioning System - enabled tablet device with +/- 3.0 m or better x-y accuracy, and included surveys of CBs (e.g., quantity, cover type) and MH covers (e.g., presence of perforated lids) including location. The City's TWAG databases (i.e., CB and MH layers) were augmented/updated by the findings of this survey.

All modelled outfalls were inspected to update/augment the existing TRCA data, which was focused on outfall condition and impact on the watercourse. Information collected using tablet field forms included: configuration and condition, shape, size, dimensions, flow conditions on the day of the survey, relative invert depth to the ground surface level, and discharge conditions (free flow outfall, partially/totally submerged). Within the 10 Schedule B assignments there were 30 outfalls investigated as summarized below:

- Within Assignment 60-02: 3 outfalls were investigated;
- Within Assignment 60-11: 3 outfalls were investigated;
- Within Assignment 60-12: 1 outfall was investigated;
- Within Assignment 60-14: 2 outfalls were investigated;
- Within Assignment 60-18: 1 outfall was investigated;
- Within Assignment 60-20: 2 outfalls were investigated;
- Within Assignment 60-21: 8 outfalls were investigated;
- Within Assignment 60-22: 7 outfalls were investigated;
- Within Assignment 60-24: 2 outfalls were investigated; and
- Within Assignment 60-27: 1 outfall was investigated.

Photographs, including views looking upstream and downstream, were geo-tagged with captions and are included as part of the PKDBS.

5.2.2 Additional Field Surveys

The second iteration of the FSIP was to complete inspections of existing flow control structures in the study area. Combined sewer overflow (CSO) structures, Dual MHs and bifurcation nodes are flow control structures, as they offer the potential for flow distribution between the various sewer systems that can affect the performance of the hydraulic model flow distribution.

Therefore, in sensitive areas, inspections were undertaken to confirm existence of the flow control, and where significant or complex controls exist, to quantify (by measurement) the characteristic dimensions of any identified cross-connection for use in the hydraulic model. The flow control structure investigations were split into two types of inspections: Level 1 confined space entries and high-level camera inspections.

- The Level 1 inspections involved entering MHs to identify the potential for cross-connection between adjoining sewer systems, recording physical dimensions of the structure and overflow components (weir/orifice/opening height, width, length, type, plates, etc.), and providing a sketch and photos/video of the configuration with qualitative interpretation of the structure operation. A total of 23 locations within Study Area 60 were surveyed for Level 1 inspections with all findings and documentation provided as part of the PKDBS. Level 1 inspections were completed within the following Schedule B assignment areas:
- Assignment 60-02, 3 inspections;
- Assignment 60-21, 1 inspection; and
- Assignment 60-22, 2 inspections.

The intent of the high-level camera chamber inspections was to collect information about dual and bifurcation MHs that have not been surveyed by the City. The inspection was intended to confirm the hydraulic connection for the dual manholes, and the orientation of the inverts, bulk-heading, and the flow paths for the bifurcation manholes so that they could be modelled accordingly. The high-level camera inspections were completed for 191 dual MHs within Study Area 60. All findings and documentation are provided as part of the PKDBS. High-level camera inspections were completed within the following Schedule B assignment areas:

- Assignment 60-02, 4 high-level inspections;
- Assignment 60-18, 1 inspection;
- Assignment 60-20, 10 inspections;
- Assignment 60-21, 5 inspections; and
- Assignment 60-22, 17 inspections.

5.3 RAINFALL AND FLOW MONITORING

The review of historic rainfall and flow monitoring data, and the 2-year rainfall and flow monitoring program conducted through the Study Phase is discussed herein.

5.3.1 Historic Rainfall and Flow Monitoring Data

Limited historic flow monitoring data was available from 2019, with nine (9) sites (4 trunk, 5 local) evaluated in TM1, indicating no significant rainfall events (all less than 2-yr) and typical per capita rates. The results were used to help identify the areas of interest for additional field survey and investigation and influenced the selection of hydrologic modelling parameters in Stage 2.

5.3.2 Rainfall and Flow Monitoring Program

To supplement the available flow monitoring data, a 2020/2021 flow monitoring plan was proposed for the sanitary and storm system, with the objective of providing DWF input into the sanitary model parameters and in hopes of capturing an extreme storm event for potential calibration where a minimum intensity of 40 mm within one hour is required. SCG Flowmetrix was subcontracted to provide flow and rainfall monitoring and data management services for the study.

Flow monitors were installed in 16 sites (11 sanitary and 5 storm) within Area 60 from May 1, 2020, to October 31, 2021. The flow monitoring data was subject to review per the provisional TM5 which summarized the data collected. Rain events that were recorded within the study area did not trigger the intensity threshold of 40 mm within one hour for model calibration and most events were less than a 2-yr storm.

Flow monitors were installed within the following Schedule B assignments in Area 60:

- Within Assignment 60-02, 1 sanitary flow monitor was installed; and
- Within Assignment 60-21, 2 sanitary and 1 storm flow monitors were installed.

5.4 ADDITIONAL SCOPE AND CCTV REVIEW

To define the complete scope of each Assignment, the City's State of Good Repair for Capital Projects (rehabilitation/replacement) and 5-yr Capital Plan for watermain projects and green infrastructure were overlain with the proposed Assignments. Where the City works geographically aligned with the defined basement flooding Assignments, this scope of work was added to the Assignment. The following assignments have potential Capital Works coordination per the information provided by the City:

- Assignment 60-02
    - Watermain Cathodic Protection, 2022, Deepdale Dr and Pebblehill Sq
- Assignment 60-18
    - Watermain replacement, 2023, Brimley Rd (Brimwood Blvd to Danjohn Cres)
- Assignment 60-21
    - Watermain Cathodic Protection, 2022, Invergordon Ave, Milner Ave, Scunthorpe Rd
- Assignment 60-22
    - Local sanitary spot repair, Timing Unknown, Sheppard Ave E
    - Local sanitary sewer replacement, Timing Unknown, Sheppard Ave E

Capital coordination should be confirmed with known timelines of the BF work during the preliminary design stage.

A CCTV review for the proposed Assignments was completed 200 m downstream of proposed upgrades to determine potential remediation needs to be completed in the Assignment scope. Areas where CCTV data was not available was recommended for investigation during the preliminary design stage.

A summary of the CCTV review for each assignment requiring action is provided in **Table 5-1**.

Table 5-1: CCTV Per Assignment

Assignment	*Length of Pipe to be Replaced Based on CCTV Score ≥ 4 (m)		Length of CCTV to be Completed (m)		Downstream Remedial Works to be Completed with Assignment		Total Length of Downstream Sewers Reviewed (m)	
	Storm	Sanitary	Storm	Sanitary	Storm	Sanitary	Storm	Sanitary
60-02	117	207	-	81	Yes - Heavy Cleaning	Yes - Heavy Cleaning, Flushing	2,097	1,348
60-11	-	n/a	90	n/a	Yes - Heavy Cleaning	n/a	960	n/a
60-12	No downstream sewers, assignment terminates at outfall							
60-14	No downstream sewers, assignment terminates at outfall							
60-18	No downstream sewers, assignment terminates at outfall							
60-20	-	n/a	209	n/a	No	n/a	209	n/a
60-21	-	-	975	-	No	Yes - Heavy Cleaning, Flushing	1,159	491
60-22	-	145	335	197	Yes - Flushing	Yes - Heavy Cleaning, Flushing	958	1,189
60-24	No downstream sewers, assignment terminates at outfall							
60-27	-	n/a	-	n/a	No	n/a	184	n/a
Total	117	207	1,609	278	n/a	n/a	5,567	3,028

Thus, the total length of pipe that was required to be reviewed for the Schedule B Assignments are 7,176 m of storm and 3,306 m of sanitary. However, CCTV information was only available from City records for 5,567 m of storm and 3,028 m of sanitary, which was reviewed by Stantec. The remaining amount of 1,609 m of storm and 278 m of sanitary are to be surveyed during preliminary design.

6.0 ASSESSMENT OF EXISTING CONDITIONS

The following sections outline the Study Phase assessment of the provided data, the hydrologic and hydraulic model development, the basement flooding criteria used in the systems assessments, and the existing conditions systems performance results.

6.1 HYDROLOGIC AND HYDRAULIC MODEL DEVELOPMENT

Two stages of model development were completed; Stage 1 and Stage 2. The Stage 1 model development targeted a risk-based capacity assessment identifying high-level areas at risk (referred to as modelled Flood Clusters), while Stage 2 sought to confirm and update the details within these areas of focus and improve the model confidence throughout. The Stage 1 and Stage 2 model build, and existing conditions results are documented in the **Attachment #1 - TM1** and **Attachment #2 - TM2**, respectively.

6.1.1 High-Level Risk-Based Models

The Stage 1 analysis was broken up into two main components; the major overland system 2D model build, and the minor sewer system 1D model build. The objective of these initial models was to provide a 'first-cut' representation of the surface and subsurface drainage conditions at a macro-level, and gain an understanding of the system complexity, uncertainties, and initial model results from which to assess the sensitivity to capacity restrictions. Together with other physical and anecdotal characteristics, the model results supported the identification of additional field survey and investigation requirements with the ultimate objective of improving the confidence in the model build and representation of flood risk. **Figure 6.11** in **Attachment #1 - TM1** illustrates the areas defined as high-risk, or modelled Flood Clusters, which were targeted for field surveys and detailed model validation in Stage 2.

6.1.2 Detailed Models in Focused Area

Stage 2 integrated the field survey findings identified based on Stage 1 results, including roof downspout connectivity, dual MH connectivity, perforated MH locations, inlet/CB information, reverse driveways, and outfall structures. Available record drawings (as-built and/or as-designed) were used to validate minor system details in areas identified as high-risk, or to confirm severe uncertainties identified in Stage 1. A 1D dual drainage modelling approach was adopted in Stage 2 to define the major system, integrating findings from the 2D Stage 1 overland results, and surveyed low points. Overall confidence in the model was improved through the Stage 2 model validation and updates.

6.2 BASEMENT FLOODING CRITERIA

The City's Basement Flooding criteria are summarized as follows:

- Design storms for use is assessing system performance:
- Storm and Combined Drainage System: 100-yr 6-hr Chicago design storm per the City Model Guidelines

- Sanitary System: equivalent to the May 12, 2000, storm as gauged at the City's Oriole Yard (Station 102) located at Sheppard Ave and Leslie St. 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.
- The maximum HGL in the sanitary and storm sewer (minor) system shall be maintained below basement elevations (assumed 1.8 m below ground elevation at centerline of road) during the respective system design storms. Measured from model node for simplicity.
- No net increase in peak wet weather flow to the combined or sanitary trunk sewers.
- Sewer Overflows:
- Flow frequency and volume capture at CSO cannot increase to the environment from existing conditions, using the annual MECP Procedure F-5-5 methodology for the "Typical Year" rain events. Discharge during extreme events (>10-yr) remains acceptable if the F-5-5 "Typical Year" combined sewer overflow criteria are met.
- Abandonment of overflow preferred, considering resulting flood risk. Raising of overflow levels to reduce spill also considered. Abandonment of overflow or lowering overflow weir levels to relief overflows for extreme rain events (>10-yr) may be considered.
- For shallow storm sewers with obvert less than 1.8 m below ground surface, there shall be no surcharge and the proposed HGL must be lower than or equal in elevation to existing conditions.
- For shallow sanitary sewers with obvert less than 1.8 m below ground surface, the proposed HGL must be lower than pipe centerline.
- Avoid increases to the peak flow discharges into existing external systems. Where unavoidable, consultation with City and adjacent Study Area team may be required.
- Within road underpasses, the minor system shall be sized to convey the 25-yr storm under free flow conditions and may be exempt from HGL freeboard criteria if no property connections exist.
- The overland flow (major) system depth on local streets shall be maintained within the ROW or not be above 150 mm over the crown of the road, equating to 235 mm for most local roads with paved 8.5 to 9.0 m widths. Where reverse driveways are present, depth on local streets shall not exceed 150 mm over the gutter. Local roads with no curbs or ditches have been set to 150 mm. Ditches and simulated overland flow paths outside the ROW have generally been set to 300 mm. On collector and arterial roads, the depth as measured from the gutter varies based on width of paved area which is estimated based on number of lanes and 2% crossfall. Rural road cross-sections are variable, dependent on local topographic conditions. Arterial roads allow depth to the crown of road, while collectors allow an additional 100 mm above the crown. Table 6-1 presents the resulting depth exceedance criteria as referenced from road gutter:

Table 6-1: Road Depth Exceedances

Number of Lanes in ROW	Local Roads	Collector Roads	Arterials Roads
Less Than 4 Lanes	235 mm	235 mm	235 mm
4 Lanes (14 m paved width)	N/A	240 mm	140 mm
5 Lanes (17.5 m paved width)	N/A	275 mm	175 mm
6 Lanes (21 m paved width)	N/A	300 mm	210 mm
7 Lanes (24.5 m paved width)	N/A	300 mm	245 mm

Number of Lanes in ROW	Local Roads	Collector Roads	Arterials Roads
8 Lanes (28 m paved width)	N/A	300 mm	280 mm
Depth relative to gutter, based on road width and 2% crossfall. Maximum depth 300 mm to not exceed 150 mm over crown. If reverse driveway present, max depth is 150 mm.			

Overland flow depths and velocity must be considered for public safety, as outlined in **Table 6-2**:

Table 6-2: Permissible Depths for Submerged Objects

Water Velocity (m/s)	Permissible Depth (m)
2.0	0.21
3.0	0.09
Based on a 20-kg child and a concrete-lined channel	

6.3 SUMMARY OF SYSTEM PERFORMANCE FOR STUDY AREA 60

The majority of reported flooding issues are private-side related, and not chronic issues resulting from surface drainage or collection system capacity. The relatively few flood complaints can be attributed to long-standing collection system and stormwater management practices in Scarborough, which include having foundation drains not connected to the sanitary sewer, implementation of the dual drainage principle in urban design since the 1970s, and consideration of the HGL in the design of storm sewer systems.

6.3.1 Minor System (Storm and Sanitary)

The lower intensity historic storms of July 8, 2013, and May 12, 2000, did not result in widespread flood complaints and the system as simulated did not match the majority of the 17 flood complaints, some of which are located in Assignments 60-02, 60-11, 60-21, 60-20 and 60-22, with surcharge and HGL infractions predominantly observed at the downstream end of the storm systems or along shallow pipes. The August 19, 2005, storm reflects the intensity of the storm as measured by the northern rain gauges, which over-estimates the peak intensity uniformly across the assignment areas in the northern portion of Area 60, resulting in widespread capacity issues. Clusters of historic flood records generally align with areas experiencing modelled HGL and surcharge issues. However, areas of modelled risk exceed those defined by flooding records, which suggests the model is conservative based on the rainfall. The vintage of the areas primarily affected is pre-1980, when stormwater management practices were not commonly implemented, and therefore a lower level of service would be expected (which is demonstrated in the Sewer Performance and Utilization Levels). These results suggest the overall system performance in these assignment areas has moderate resilience to high-intensity events.

From an existing conditions Storm Sewer Utilization Level perspective, the storm drainage system operates well with almost 70% of pipes indicating over 100-yr level of service.

Storm sewer performance levels are lower at the downstream ends of most storm systems as expected; and in some pipes along the upstream ends of arterial/collector roads due to localized capacity constraints such as in 60-02, 60-11, 60-21 and 60-22.

The HGL results echo these findings but are further exacerbated by the presence of shallow storm sewers and reverse driveways in many of the older residential areas throughout all of the assignment areas (with just 40% over 100-yr level of service), presenting storm sewer improvement opportunities in most residential areas within the study area.

Refer to Figure 3.18 and Figure 3.19 in **Attachment #2 – TM2,** for the existing conditions minor storm sewer system performance results.

Future population projections indicate a 20% increase in population distributed throughout the study area, thus resulting in only a minor influence on system capacity.

The sanitary system when stressed under the conservative 3 L/s/ha approach, only marginally matches the low intensity May 12, 2000, event but results in over-estimation of flooding relative to complaints in the largest August 19, 2005, event.

The resulting existing conditions Sanitary Sewer Utilization Level reveals the local sanitary sewers are indicating high performance levels upwards of the 100-yr event, while the sanitary trunk indicates surcharge under frequent events (2 to 5-yr) along most of its northern length, through 60-18, 60-24 and 60-27, up to Markham Rd. Some sanitary subtrunk connections also indicate frequent surcharge towards the connection with the sanitary trunk, such as in 60-21 and 60-22.

The Sanitary Sewer Improvement Opportunities indicate that surcharge does not always reflect flood risk, with the HGL infractions generally exceeding the 25-yr, except in the Bellamy Rd/Ellesmere Rd (outside of assignment areas), Chartland Blvd S at Crockamhill Dr (A60-02), and southwest of Sheppard Ave E and McCowan Rd areas (A60-22), which all correspond with historic flood complaints. A few other points along the trunk are indicated but are associated with the creek valley land and not direct connection to properties but do influence local connections. The 5-yr storm further expands the 2-yr issues, and introduces a new area southwest of Sheppard Ave E and McCowan Rd (A60-22), where there is a history of flood complaints, and the Finch / Midland / McNicoll area (A60-02), and the upper trunk northwest of Brimley Rd. Beyond these major pockets, the local system is fairly robust to wet weather events.

When applied to the design May 12, 2000, event with future population, a reasonable measure of flooding results that generally corresponds with the main flood complaints.

Details of the sanitary system performance analysis are provided in **Attachment #2 – TM2**. The boundary conditions applied for the sanitary system assessment are described in Section 4.1.7 of TM2. Refer to Figure 4.11 and Figure 4.12 for the existing conditions sanitary sewer surcharge and hydraulic grade line performance, respectively.

6.3.2 Overland System

The existing conditions overland drainage system, while generally showing a large degree of capacity to convey large events, does exhibit some issues on minor collector roads, where maximum allowable depths are generally lower, triggering exceedances in more frequent events; in some instances, as low as the 2-year.

In general, the major system standards in Scarborough have resulted in a resilient overland system for conveying flows to SWM facilities and the East Highland Creek tributaries. Surface depth exceedances are also observed in low points on local roads, where ponding is directed from the arterial/collector roadways into the local low points to reduce depths and promote safe vehicular passage on major arteries, such as Chartrand Blvd S at Crockamhill Dr (A60-02), McCowan Rd at Nugget Ave (A60-14), Brimley Rd at Danjohn Cres (A60-18), Milner Ave at Executive Crt (A60-21), and Brimley Rd at Heather Rd (A60-22). These locations often coincide with overtaxed minor systems, limiting the amount of flow that can be removed from the surface.

Refer to Figure 3.2 **Attachment #3 – TM3** for the major overland system performance results.