CITY OF TORONTO

BLACK CREEK SANITARY DRAINAGE AREA SERVICING IMPROVEMENTS CLASS EA STUDY

ENVIRONMENTAL STUDY REPORT

WSP Jacobs

TABLE OF CONTENTS

TABLES

FIGURES

GLOSSARY OF TERMS

TERM	DESCRIPTION
City	City of Toronto
CTS	combined trunk sewer
DWF	dry weather flow
EA	environmental assessment
EPB	earth-pressure balance
I and I	inflow and infiltration
km	kilometre(s)
l/c/d	litre(s) per capita per day
l/s/ha	Litre(s) per second per hectare
m	metre(s)
m^3	cubic metre(s)
MECP	Ontario Ministry of the Environment, Conservation and Parks
mm	millimeter(s)
STS	sanitary trunk sewer
WWF	wet weather flow
WWTP	wastewater treatment plant

ES-1.0 EXECUTIVE SUMMARY

ES-1.1 BACKGROUND

The Black Creek Sanitary Trunk Sewer (STS) is a 15-kilometre (km) long trunk sewer that drains to the Humber STS and ultimately conveys sewage to the Humber Wastewater Treatment Plant (WWTP). Through this Municipal Class Environmental Assessment (EA), the following issues related to the Black Creek STS were identified within the Black Creek STS drainage area:

- Black Creek STS's capacity to accommodate future growth
- Surcharge level in the existing Black Creek STS during wet weather flow events
- Combined sewer overflow (CSO) to the Black Creek watercourse
- Excessive inflow and infiltration (I and I) and wet weather flow to the trunk sewers

As well, during certain extreme storm events, the Black Creek STS has experienced capacity issues, which have contributed to surface and basement flooding because the Black Creek STS has surcharged. During some storms, CSOs discharge into the Black Creek watercourse from the Hillary and Mt. Dennis combined trunk sewers (CTSs), which flow into the Black Creek STS, and the Rockcliffe CTS that flows into the Humber STS. Over the next few decades, the population within the Black Creek STS drainage area is expected to increase significantly, which will result in capacity constraints along the trunk sewer.

To address these issues, the Black Creek STS was assessed and evaluated in accordance with the Schedule C of the Municipal Class EA process. The study area includes the contributing areas to the Black Creek STS, Hillary CTS, Mt. Dennis CTS, St. Clair CTS, and Rockcliffe CTS.

ES-1.2 PURPOSE OF THIS MUNICIPAL CLASS EA

The purpose of the Black Creek Sanitary Drainage Area Servicing Improvements Class EA is to assess capacity issues with the Black Creek STS system, identify solutions, and develop a plan to achieve the following objectives:

- Reduce surcharge levels in the Black Creek STS during wet weather events.
- Reduce combined sewer overflow discharges to the Black Creek watercourse.
- Reduce I and I to the Black Creek STS.
- Accommodate flows for the projected 2041 population and employment growth and beyond.

Figure ES1 shows the EA study area.

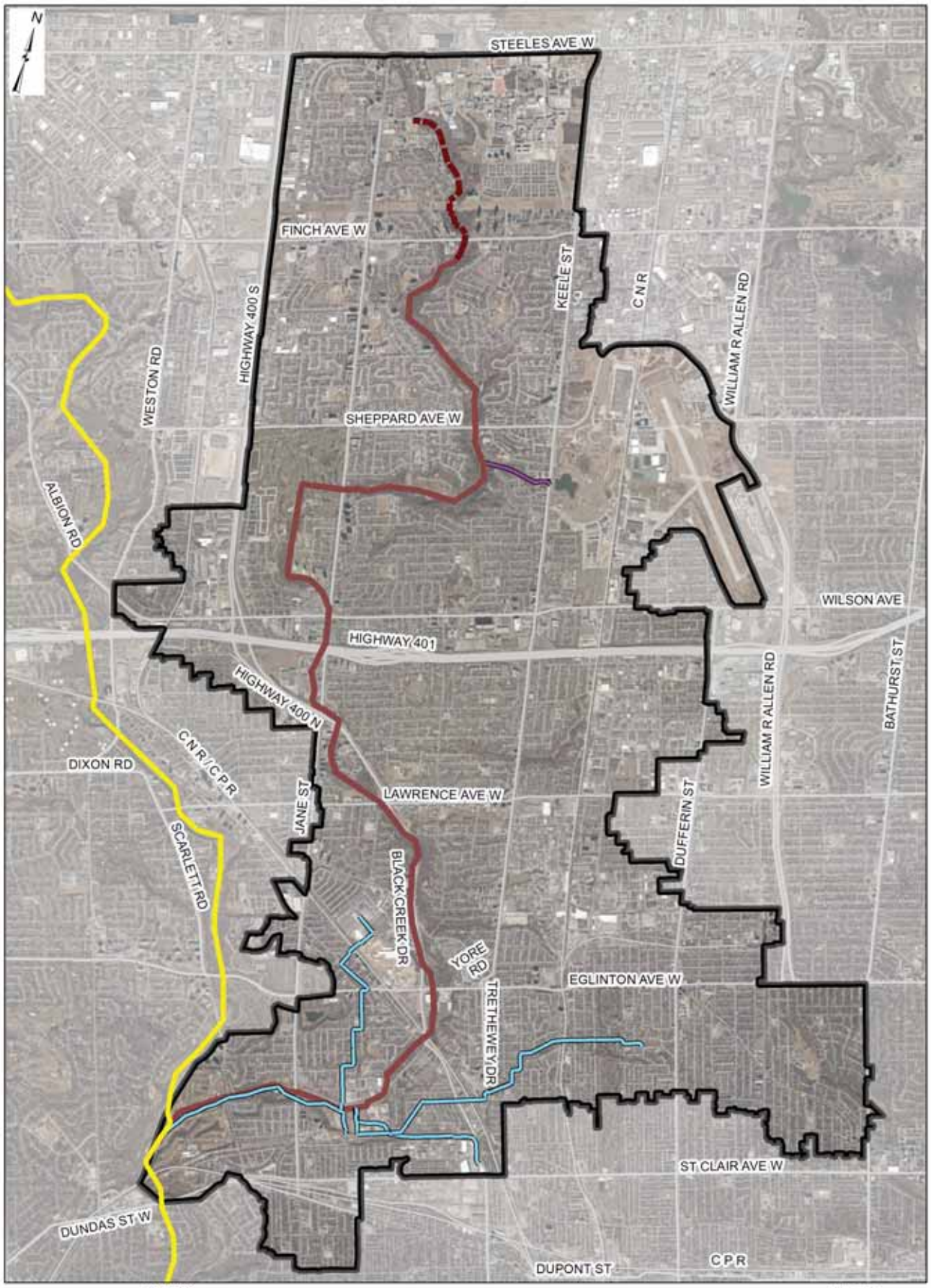


Figure ES1
Study Area
City of Toronto
Toronto, Ontario
December 2020

WSP/Jacobs

ES-1.3 LEVEL OF SERVICE CRITERIA

Service level criteria were developed to evaluate the existing sewer system and to develop proposed alternative solutions. These criteria were refined as the project progressed through various phases.

ES-1.3.1 PHASES 1 AND 2

TRUNK SEWERS

- Provide capacity for the projected 2041 population and employment.
- Without surcharge, provide conveyance for the 2041 projected peak sanitary flows based on a sanitary flow rate of 240 litres per capita per day (L/c/d) plus a design I and I allowance of 0.26 litres per second per hectare (L/s/ha).
- Provide conveyance and storage of I and I that results from wet weather flows (WWFs) of up to a 5-year design storm without causing or contributing to flooding in the local system or surficial flooding along the Black Creek STS.
- Provide emergency overflow from the Black Creek STS to the Black Creek watercourse, as needed, to reduce the risk of basement flooding and surface flooding for storms beyond the 5-year design storm.

CSO CONTROL

- Meet CSO control objectives of the Ontario Ministry of the Environment, Conservation and Parks' (MECP's) Procedure F-5-5, which includes capturing and treating all dry weather flow (DWF)plus 90 percent of the volume resulting from wet weather flow that is above the dry weather flow for an average year, during a seven-month period commencing within 15 days of the First of April. The City of Toronto (City) uses 1991 as the typical rainfall year for wet weather flow control assessment.
- Additional CSO outfalls are not allowed.
- CSO volumes may not be increased above the existing levels at each CSO outfall, except where the increase is due to the elimination of upstream CSO outfalls.
- The total CSO volume system wide must not be increased.

ADDITIONAL OPERATIONAL CRITERIA

- Flow from the Black Creek watercourse should not back up into the trunk system.
- The total peak flow from the Black Creek trunk sewer system under WWF conditions to the wastewater collection system downstream, including the Humber STS and the Humber WWTP, should not be increased from the existing condition. The existing peak flow under WWF conditions is determined using the existing conditions model.
- For storm events exceeding the 5-year design storm, the maximum peak flow from the Black Creek trunk sewer system that can be conveyed to the Humber STS after improvements to the existing Black Creek STS is approximately 5 cubic metres per second and will not have adverse impacts on the Humber STS and the Humber WWTP operations.

ES-1.3.2 PHASE 3

The City adopted a greater level of service for Phase 3 and for the development of the final conceptual design to provide further protection to the Black Creek watercourse and sewershed. The design level of service used for Phase 3 is the same as the level of service from Phases 1 and 2, with the following modifications and additions (Table ES-1):

Table ES-1 Differences in Design Level of Service between Phase 2 and Phase 3

CATEGORY	PHASE 2 LEVEL OF SERVICE	PHASE 3 LEVEL OF SERVICE
Sewers (Black Creek STS and New Relief Sewers)	Without surcharge, provide conveyance for the 2041 projected peak sanitary flows based on a sanitary flow rate of **240 L/c/d** plus a design I and I allowance of 0.26 L/s/ha.	Without surcharge **and with pipes less than 80 percent full**, provide conveyance for the 2041 projected peak sanitary flows based on a design sanitary flow rate of **450 L/c/d** [a] plus the design I and I allowance of 0.26 L/s/ha.
Sewers (Black Creek STS and New Relief Sewers)	Not Applicable	Upgrades and new infrastructure shall accommodate I and I from the 1-year design storm in the study area without surcharging the pipes.
Sewers (Black Creek STS and New Relief Sewers)	Not Applicable	The system should be designed to substantially reduce the impact of the Black Creek STS on the local sewers for storms above a 5-year design storm to reduce the contribution of the Black Creek STS to basement flooding and street flooding.
CSO Control	Meet CSO control objectives of MECP's Procedure F-5-5, which includes capturing and treating all DWF plus 90 percent of the volume resulting from WWF that exceeds the DWF for an average year, during a 7-month period commencing within 15 days of April 1.	Meet CSO control objectives from the MECP's Procedure F-5-5 and, in addition, achieve one or fewer CSOs at all CSO points for the 1991 average year to meet the goals for the 2003 Wet Weather Flow Master Plan.

Notes:

[a] Note that 450 L/c/d is not the projected future wastewater generation rate, but a design flow rate that includes a safety factor for new designs with a life span longer than the planning horizon.

ES-1.4 ASSESSMENT OF EXISTING TRUNK SEWER CAPACITY

The model simulations for the existing (2011) conditions revealed several issues with the Black Creek STS. Although the system performs to a satisfactory degree under DWF conditions, WWFs entering the Black Creek STS from the Hillary CTS and Mt. Dennis CTS are higher than the City's design allowance. Additionally, bottlenecks at the downstream section of the Black Creek STS occur beginning with the 3-month design storm event. The level of service gradually worsens as storms increase in magnitude, and the Black Creek STS is almost completely surcharged in the 1-year and 2-year events. In the 5-year and 10-year events, the Black Creek STS is completely surcharged.

In the 6-month event and larger events, the depth to water level (freeboard) worsens significantly in the upstream section of the Black Creek STS near Highway 401. This is mostly attributed to high I and I at this location and the build up of sediment.

CSOs into the environment do not meet the F-5-5 Procedure requirements for the study area. The largest CSO volume is from the Hillary CTS outfall near Rockcliffe Court, contributing close to 60 percent of the total CSO volume into Black Creek watercourse from the study area. The most frequent CSO location is the Rockcliffe CTS outfall near Rockcliffe Boulevard Bridge with 44 overflows in a typical year.

ES-1.4.1 PHASE 2

In Phase 2 of the EA, a long list of potential measures was developed and screened based on their feasibility for solving the identified problem. I and I and WWF control measures were considered to help manage flows to meet the study objectives. Based on those considerations, an alternative that considered I and I and Wet Weather Flow Control Measures was established and assessed (referred to as Alternative 1).

In addition to Alternative 1, further conveyance and storage measures are required to provide additional capacity and reduce water levels in the Black Creek STS during wet weather events and prevent surcharging, as well as to control CSOs to meet MECP Procedure F-5-5 objectives.

One measure to provide additional capacity includes twinning the existing Black Creek STS. A long list of potential routes was developed and reviewed based on the constructability and effectiveness of the routes. The long list of potential routes was screened and from the screening process three routes were determined to be feasible:

1 Route 1 – Keele Street – (north of) St. Clair Avenue
2 Route 5 – Keele Street – Lawrence Avenue – Jane Street – (north of) St. Clair Avenue
3 Route 9 – Finch Avenue and Sheppard Avenue – Jane Street – (north of) St. Clair Avenue (with additional sewer along Keele Street and Lawrence Avenue)

Another measure to provide additional capacity consists of adding storage tanks, and a long list of potential offline storage locations was developed. Storage locations for each alternative were selected using an iterative modelling approach to meet the Black Creek STS's performance objectives, which include reducing the risks of basement flooding in the local sewers due to the Black Creek STS surcharging. As a result, the tank locations were different for each alternative solution.

A short list of alternative solutions was then identified, as follows:

- Alternative 1: Wet Weather Flow Management
- Alternative 2: Keele Street
- Alternative 3: Keele/Jane Street
- Alternative 4: Satellite Storages

Alternative 1 considered I and I reductions along the Black Creek STS, and sewer separation in the combined sewer system areas, including:

- Implementing the Fairbank-Silverthorn STS project
- Installing backwater valves at five CSO outfall locations
- Replacing perforated sanitary manhole covers
- Reducing WWF to the Black Creek STS; for example, by controlling of flows from the combined trunk sewers during wet weather flow conditions, and preventing discharge from Hyde Tank when the hydraulic grade line in Black Creek STS is high

The effectiveness of Alternative 1 at meeting the design criteria was assessed using the sanitary sewer system hydraulic model. The results indicated that additional measures are required to achieve the study objectives in the form of relief sanitary trunk sewers and CSO control.

Alternatives 2, 3, and 4 include all the I and I and WWF flow reduction measures that were identified in Alternative 1. For Alternative 2, the Black Creek Relief STS is routed along Keele Street to St. Clair Avenue. Alternative 2 also includes a 2,500-cubic metres (m^3) sanitary relief tank near the intersection of Jane Street and Troutbrooke Drive. The Black Creek Relief STS for Alternative 3 is along Finch Avenue to Jane Street, and then south on Jane Street to St. Clair Avenue. A second relief sewer is included along

Keele Street to Lawrence Street, and connects to the main relief sewer on Jane Street in Alternative 3. Alternative 4 includes three offline relief tanks, as well as approximately 188 cubic metres (m^3) of inline storage. A relief sewer along Keele Street from Sheppard Avenue West to Lawrence Avenue West is also included in Alternative 4. Alternatives 2, 3, and 4 also all include emergency overflows.

For CSO control, Alternatives 2, 3, and 4 include the measures in Alternative 1, in addition to additional measures. These measures include inline storage along existing Keele Street sewers and two CSO storage tanks: one at Alliance Avenue and another at Rockcliffe Court.

The effectiveness of Alternatives 2, 3, and 4 at meeting the design criteria was assessed using the hydraulic model, and the results indicate these alternatives satisfy the design level of service criteria.

Alternatives 2, 3, and 4 were evaluated using natural environment criteria, socio-cultural environment criteria, technical considerations, and economic considerations. A performance scale was developed, consisting of a score from 1 to 3, with 1 as the lowest score and three as the highest, to evaluate how each alternative performs related to each criterion. The sum of each category was normalized to a possible score out of 10 points, resulting in each category being equally weighted. The maximum total alternative score is 40 points. Alternative 2 scored highest overall, with a score of 32.9. Alternatives 3 and 4 scored similar to each other, with total scores of 27.4 and 26.5, respectively. Therefore, Alternative 2 was selected as the recommended alternative.

ES-1.4.2 PHASE 3

During Phase 3 of the EA, the design level of service was enhanced from Phase 2 to provide for a greater level of service for the conceptual design. Modifications to the design level of service included increasing the 2041 projected peak sanitary flow rate to from 240 L/c/d to 450 L/c/d to account for growth beyond the projections and designing the new infrastructure to accommodate I&I from the 1-year design storm without surcharging pipes.

Design concepts were developed for the preferred alternative from Phase 2 for the following categories:

- Black Creek Sanitary Relief Trunk Sewer (Keele Street Relief Sewer)
- Black Creek STS Relief at Jane Street
- CSO Controls

ES-1.5 DESCRIPTION OF SANITARY RELIEF TRUNK AND DIVERSION CONCEPT OPTIONS (KEELE STREET RELIEF SEWER)

Three alternative design concept options were developed for the construction of the new Black Creek relief trunk sewer along the Keele Street corridor:

- Alternative Design Concept Option 1: Constructing a deep 3000-millimetre (mm)-diameter relief trunk sewer using an earth-pressure balance (EPB) tunnel-boring machine.
- Alternative Design Concept Option 2: Construction using microtunnelling to Highway 401 and an EPBtunnel-boring machine from Highway 401 to the Humber STS.
- Alternative Design Concept Option 3: Combining-microtunnelling, rock tunnel boring, and EPB tunneling.

Option 1 would consist of a 3000-mm-diameter relief trunk through its entire length (approximately 16 km). It would be constructed using an EPB tunnel-boring machine at depths ranging from about 79 m in the northern section to about 14 m in the southern section, where it would connect with the Humber STS.

For Option 2, the relief trunk sewer diameter would range from 1500- to 3000-mm-diameter through its length (approximately 16 km). The relief trunk sewer would be constructed using microtunnelling from the northern connection at the Black Creek STS, south to the intersection of Keele Street and Wilson Avenue, while EPB tunnelling would be used for the remaining length.

The relief trunk sewer diameter in Option 3 would range from 1500- to 3000-mm-diameter through its length (approximately 16 km), and three different tunneling methods are proposed, as follows.

1 Microtunnelling is proposed in the 1500-mm-diameter section running south-east along Murray Ross Parkway to the Hydro Corridor north of Finch Avenue. It then proceeds along the Hydro Corridor to Sentinel Road, south along Sentinel Road to Stilecroft Drive, east to Keele Street, then south along Keele Street to slightly north of the Maryport Trunk Relief Sewer.
2 Rock tunnelling is proposed for the section of sewer extending south from the Maryport Trunk Relief Sewer along Keele Street to the intersection of Irving Road and Keele Street.
3 EPB tunnelling through soft soil conditions will be used to construct the remainder of the trunk sewer, which will be 3000-mm-diameter.

ES-1.6 DESCRIPTION OF BLACK CREEK STS RELIEF AT JANE STREET DESIGN CONCEPT OPTIONS

Three alternative design concept options were developed to relieve surcharge in the Black Creek STS in the neighbourhood of the Black Creek STS and Jane Street. These include:

- Jane Street Option 1: A sanitary sewer relief storage tank at Downsview Dells Park (this was Alternative 2 in Phase 2)
- Jane Street Option 2:Aa relief tunnel running south along Jane Street and east along Downsview Avenue
- Jane Street Option 3: A relief tunnel running south along Jane Street and east along Wilson Avenue

Jane Street Option 1 includes a proposed storage tank (2,650 m^3) located northeast of Jane Street and Troutbrooke Drive in Downsview Dells Park. The tank would be 30 m wide by 20 m long, with a storage depth of 4.42 m. The construction depth would be approximately 6.62 m, assuming 1.8 m of cover over the tank. The tank and the associated piping would be installed via open-cut construction.

Jane Street Option 2 would divert flows from the Black Creek STS at Jane Street to an 1800-mm-diameter relief sewer. The sewer would run approximately 1.6 km south along Jane Street and approximately 2.3 km east along Downsview Avenue, and would connect to the Keele Street Relief Sewer. A second diversion would divert flow from the Black Creek STS at Downsview Avenue to the relief sewer. This would further relieve surcharging within the Black Creek STS and eliminate the need for the emergency sanitary sewer overflows near that location for storm events up to the 100-year storm.

Jane Street Option 3 would divert flows from the Black Creek STS at Jane Street to an 1800 mm diameter relief sewer. The relief sewer would run approximately 1.3 km south along Jane Street, 2.2 km east along Wilson Avenue, and connect to the Keele Street Relief Sewer. A second diversion would divert flows from the Black Creek STS to the relief sewer at the corner of Jane Street and Wilson Avenue. This would further relieve surcharging within the Black Creek STS in that area and eliminate the need for an emergency sanitary sewer overflow for storm events between the 5-year and 100-year storms.

ES-1.7 DESCRIPTION OF COMBINED SEWER OVERFLOW STORAGE CONCEPT OPTIONS

Three alternative design concepts were developed for the construction of the CSO storage facilities. These were based on a detailed review of the location of the existing CSO outfalls, the location of flow control structures, and the available space to accommodate the required storage facilities. All alternatives were developed to achieve the one-CSO-per-year design level of service criterion.

CSO Option 1 is the same as it was in Phase 2, and includes two proposed storage tanks: one CSO tank at Alliance Avenue and one CSO tank at Rockcliffe Court. The proposed Alliance CSO Tank volume is 6,600 m³ and the proposed Rockcliffe Tank volume is 35,500 m³. The Alliance CSO Tank is designed to collect CSOs from the three overflows along the Mt. Dennis STS (CSOs 6, 7, and 8). The Rockcliffe CSO Tank would control the CSO overflows from the Hillary CTS (CSO 3) and the Rockcliffe CTS (CSO 4). The two tanks would drain to separate trunk sewers: the Alliance CSO Tank would drain to the Black Creek STS and the Rockcliffe CSO Tank would drain to the new relief sewer. Note, another study recently proposed a stormwater storage facility at the Alliance Tank site, and the implementation of this option could restrict the use of the site for that purpose.

CSO Option 2 includes one CSO tank (39,000 m^3) at Rockcliffe Court (the same location as in Option 1) and a 3,000-mm-diameter, 462-m-long, storage tunnel (3,200 m^3) along Rockcliffe Boulevard. The Rockcliffe CSO Tank would control the CSO overflows from the Rockcliffe CTS and the Hillary CTS in the same manner as in Option 1. The CSO flows collected from the three overflows along the Mt. Dennis CTS (CSOs 6, 7, and 8) would be diverted into the proposed storage tunnel. The storage tunnel and Rockcliffe CSO Tank in this option would both drain to the new relief sewer. The tunnel and tank would also be hydraulically connected to each other to allow more effective use of the total storage.

CSO Option 3 is based on CSO overflows being diverted to a storage tunnel of 5-m-diameter and 2 km long (volume 39,250 m^3), parallel to the Keele relief trunk along the Hydro-One Corridor. However, due to the limited space available in many parts of the alignment and the presence of transmission mains, the construction of this additional 5-m-diameter tunnel is not feasible.

ES-1.8 EVALUATION OF DESIGN CONCEPTS

The evaluation criteria applied to assess the alternative solutions in Phase 2 of the Class EA process were modified to better support the process requirements for Phase 3 of the Municipal Class EA, which consists of assessing alternative design concepts for the preferred solution selected in Phase 2. The evaluation followed the same methodology as Phase 2 of the Municipal Class EA. The criteria were grouped into four main categories:

1 Natural environment
2 Socio-cultural environment
3 Technical environment
4 Economic environment

A performance scale consisting of a score from 1 to 3, where 1 was the worst score and 3 was the best, was developed to evaluate how each alternative performs related to each criterion. The sum of each category was normalized to a possible score out of 10 points resulting in each category being equally weighted. The maximum total alternative score is 40 points.

For the sanitary relief trunk design concept, Option 3 (microtunnelling, rock tunnelling, and EPB) was the highest-scoring option and is the recommended tunneling option. However, it was noted that there was a lack of geotechnical information associated with the northern end of the proposed alignment and that

additional geotechnical information would be needed in future design stages. If conditions are discovered through geotechnical investigations that render Option 3 infeasible, Option 1 remains a viable alternative.

For the Black Creek STS relief at Jane Street design concept, Jane Street Option 3 (the Jane Street-to-Wilson Street tunnel) was the highest -coring option and is the recommended option, pending the results of geotechnical investigations to be conducted in future design stages.

For the CSO storage design concept, CSO Option 2 was the highest-scoring option by a small margin, and is the recommended option. This option does not present the land use conflicts noted for Option 1; however, Option 1 could also be considered for implementation, if desired, given how close the scores are if potential land use conflicts associated with Option 1 are able to be avoided.

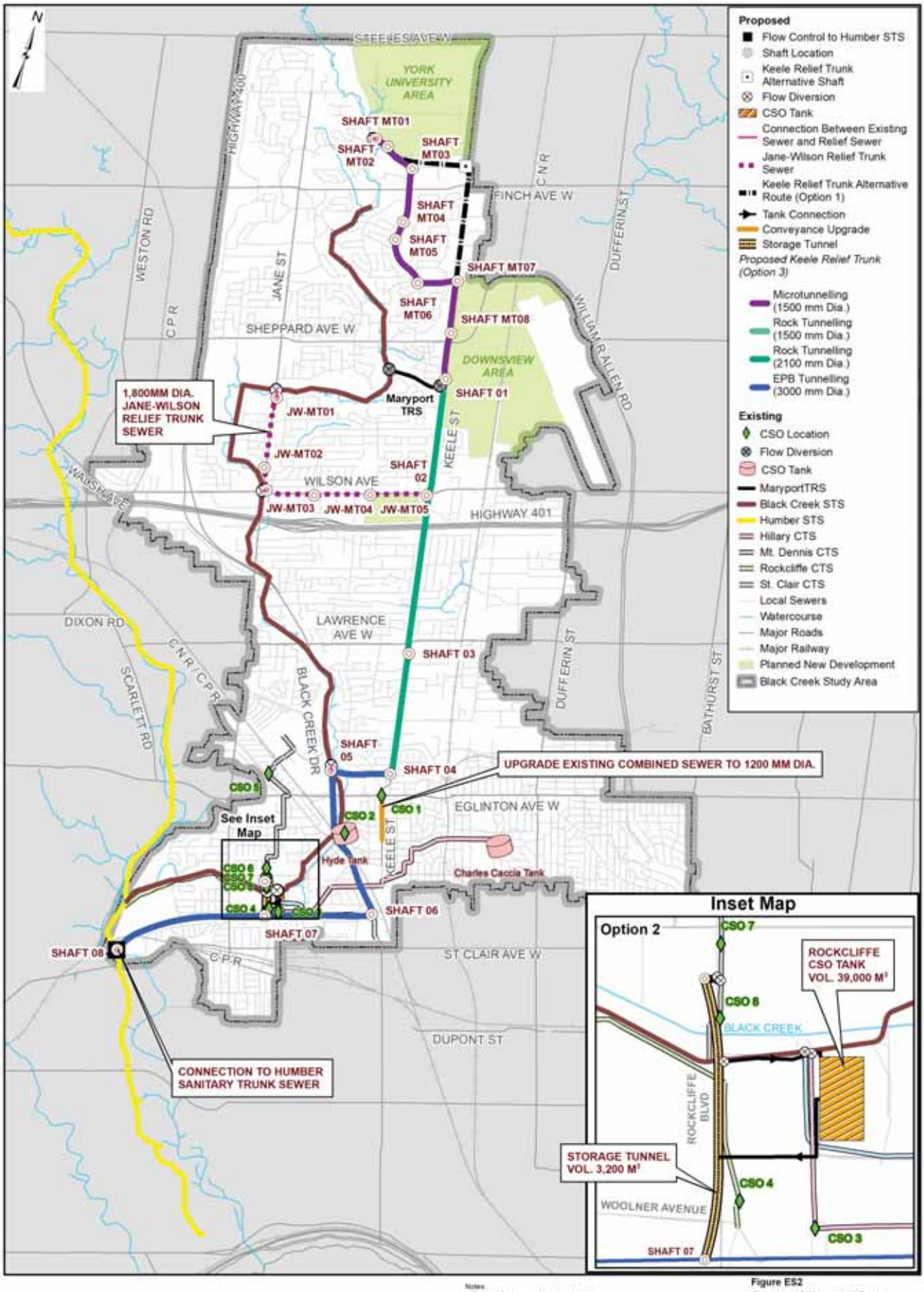
ES-1.9 CONCEPTUAL DESIGN

ES-1.9.1 OVERALL DESIGN CONCEPT

The design concept is a combination of the highest-scoring major design features, as follows:

- Sanitary Relief Trunk Option 3 (Keele Street Relief Trunk Sewer Alignment Option 3)
- Black Creek STS Relief at Jane Street Option 3 (the Jane Street-to-Wilson Street tunnel
- CSO Option 2 (Storage Tunnel and Rockckliffe Tank)

Figure ES2 provides an overview of the conceptual design



Notes:
1. Existing features are represented as provided to Jacobs in GIS layers. Jacobs takes no responsibility for the accuracy of the existing data.

Figure ES2
Overview of Conceptual Design
City of Toronto
Toronto, Ontario
December 2020

WSP/Jacobs

ES-1.9.2 ADDITIONAL DESIGN ELEMENTS

Several elements from Phase 2 were also incorporated into the final design concept, including:

- I and I reductions along the Black Creek STS
- Control of wet weather flow from the CTSs
- Sewer separation in the combined areas
- Wet weather flow reductions to the combined sewer system based on the following:
    - Construction of the Fairbank-Silverthorn Storm Trunk Sewer
    - Prevention of discharge from Hyde Tank when the HGL in the Black Creek STS is high
- Connection of new developments in the Downsview Area to the Keele Relief Sewer

As part of Phase 3 conceptual design, an upgrade to the existing sewer from the flow control structure at the intersection of Keele Street and Eglinton Avenue to Juliet Crescent was reviewed, and it is proposed to upgrade the combined sewer to a 1200 mm diameter sewer over a distance of approximately 592 m to achieve one CSO per year or less.

As part of conceptual design, the emergency sanitary sewer overflows from Phase 2 were also reviewed. The review indicated the overflows would not operate by gravity and pumping would be required to transfer water from the sewers to the Black Creek watercourse. Further hydraulic modelling for the design concept in Phase 3 also indicated the Phase 2 emergency sanitary sewer overflows would not be required to reduce the risk of basement flooding due to surcharging in the Black Creek STS. Therefore, emergency sanitary sewer overflows from Phase 2 are not included in the final design concept.

Additionally, flows to the Humber STS from the Keele Relief Sewer will be limited based on the flows in the Black Creek STS. The flows for the Black Creek STS will be monitored. A proposed sluice gate in Shaft 08 will have controls to allow the timing and rate of flows from the Keele Street Relief Sewer to be restricted, so the maximum combined flow to the Humber STS from the existing Black Creek STS and Keele Relief Sewer will not exceed 5 cubic metres per second and will not have adverse impacts on the Humber STS or the Humber WWTP operations.

ES-1.10 PERFORMANCE OF THE DESIGN CONCEPT

The hydraulic model was updated to reflect the conceptual design, and the design's performance was assessed.

The results confirm that the system conveys flows from the projected 2041 populations under design conditions (450 L/c/d + 0.26 L/s/ha) and can meet the level of service criteria of no surcharge and of conveying these flows while at less than 80 percent full flow capacity in the Black Creek STS. The only exception to this was a small section in the southern portion of the Black Creek STS, where the modelled flow is greater than 80 percent of the pipe's full flow capacity due to a short section of existing sewer pipe with a relatively flat slope compared to upstream and downstream pipes; however, no surcharging occurs in this section under the design conditions.

The new infrastructure (the Keele Street Relief Sewer and the Jane-Wilson Relief Sewer) can accommodate the 1-year design storm in the study area without surcharging, except for the lower portion of the Keele Relief Sewer and a small portion north of Sheppard Avenue. The lower portion of the Keele Relief Sewer surcharges under the 1-year storm due to backwater effects from the Humber STS, and not due to capacity issues in the new infrastructure. The water levels in the Humber STS are a boundary condition for this study, and there are no connections between the Keele Relief Sewer and other local sewers in this area. As a result, the surcharging noted in the lower portion of the Keele Relief Sewer under the 1-year storm does not impact local sewers. In the residential areas connected to Black Creek

STS just north of Sheppard Avenue, there were limited flooding complaints during major historical storms. Modelling also indicates the Black Creek STS does not contribute to basement or surficial flooding in these local areas. Therefore, the surcharging under the 1-year storm in these two limited areas was not considered as contravening the design level of service.

The results indicated a substantial improvement in the overall surcharge state compared to existing conditions for all design storms. Under the 5-year storm, water levels in the Black Creek STS and the new Keele Street Relief Sewer were modelled as being below ground surface, and there was no overflow or surficial flooding from either sewer system.

For impacts to local sewers, the results indicated there was a substantial reduction in the local sewer areas impacted by water levels in the Black Creek STS. For the 100-year storm, only two nodes were identified in impacted developed areas where there was slightly less than 1.8 m of freeboard and where the reduced freeboard may have been due to the influence of the Black Creek STS. There was an increase in the water level in CTSs near the connection with the Black Creek STS, because flow restricting orifices had been installed. However, in all cases, there was more than 1 m of freeboard maintained under the 100-year storm along the impacted CTSs, and there are no service connections to the combined trunk sewers in the impacted locations. Overall, the results were taken to indicate that:

- Up to and under the 5-year storm, the conceptual design can provide conveyance and storage of I and I from WWF without causing, or contributing to, flooding in the local system.
- Emergency overflows would not be required to reduce the risk of basement flooding and STS overflow to streets and roads due to surcharging in the Black Creek STS for storms beyond the 5-year design storm.
- For all storms, including storms beyond the 5-year storm, the conceptual design substantially reduces the impact of the Black Creek STS on local sewers.

The results for the performance under historical storms indicated that, overall, the amount of surcharging in the Black Creek STS and the impact of the Black Creek STS on the local sewers will greatly decrease after the conceptual design is implemented. Sections of the Hillary, Mt Dennis, and St. Clair CTSs would be impacted by the installation of a flow-restricting orifice to reduce flows going to the Black Creek STS. The impact varies, depending on the historical storm event; however, the areas with the greatest impact would not be in developed areas, and it is anticipated that there would be no building structures negatively impacted by the orifice installation. It is recommended that this be confirmed at future design stages.

The discharge to Humber STS was also evaluated. The combined peak flow from the Black Creek STS and the Keele Street Relief Sewer to the Humber STS were less than 5 cubic metres per second for all events, per the design criteria. However, under the conceptual design, the total volume of water conveyed to the Humber STS and the downstream Humber WWTP increased over existing conditions, both due to population growth between 2011 and 2041, and additional wet weather storage provided in the system. The maximum allowable peak flows to the Humber STS and the timing of when stored WWFs are released should be reviewed and optimized during future design stages to minimize or eliminate potential impacts to the Humber STS and the downstream WWTP from this additional volume of water.

The CSO control of the preferred design concept was evaluated. The results indicated the MECP's Procedure F-5-5 criteria for percent of WWF captured and the performance criterion of less than or equal to one CSO per year are both met.

Inflows and outflows to major structures, peak flows, and flow control structures were also assessed for the preferred design concept.

ES-1.11 DESIGN AND CONSTRUCTION CONSIDERATIONS

Sixteen shafts are required to implement the Keele Street Relief Sewer and five shafts are required to implement the Jane-Wilson Relief Sewer. Five diversions and one connection are also required in the preferred solution:

- Diversion to Black Creek STS north of Finch Avenue
- Diversion of Maryport TRS
- Diversion of Black Creek STS at Black Creek Drive
- Diversion of Black Creek STS on Jane Street North of Troutbrooke Drive
- Diversion of Black Creek STS at Jane and Wilson Streets
- Connection to the Humber STS

The storage tunnel along Rockcliffe Boulevard will have a storage volume of approximately 3,200 m^3 and the tunnel will receive flows from existing CSOs 6, 7, and 8. The tunnel will drain by gravity to the Keele Street Relief Sewer, and a sluice gate will be provided at the end of the storage tunnel to control outflow to the relief sewer. The sluice gate will be closed during storm events and opened when flows in the relief sewer decrease after the storm event. When the storage tunnel is filled, excess flows will overflow to the Black Creek watercourse via the two existing CSO outlet pipes corresponding to existing CSO 8 and CSO 6.

The Rockcliffe Court CSO Tank volume is 39,000 m^3. The Rockcliffe Tank will capture CSO flows from the Hillary CTS (CSO 3) and Rockcliffe CTS (CSO 4). A high-level diversion will also be installed on both the Hillary and St Clair CTSs at the point where they connect to the Black Creek STS. This diversion will help control surcharging in these systems that results from limiting flows to the Black Creek STS during WWF. When the tank is filled during WWF, excess flows will overflow to the Black Creek watercourse via the existing CSO 3 and 4 outfall pipes. The Rockcliffe Tank will drain by gravity to the new relief sewer at Shaft 07 (Keele Street Relief Sewer Alignment Option 3) via a 1800-mm-diameter outflow pipe that is connected to the 3000-mm-diameter storage tunnel along Rockcliffe Boulevard. The sluice gate at the end of the storage tunnel controls outflows from both of the storage tunnel and the Rockcliffe Tank to the new relief sewer.

Conceptual cost estimates were summed for the preferred Keele Street Relief Sewer design concept (Alignment Option 3), Jane Street relief concept (Option 3 – Jane-Wilson Relief Sewer), and CSO control option (CSO Option 2), and conveyance upgrade to provide an estimate of the total conceptual capital and operations and maintenance costs for the design. The total lifecycle cost is $558,000,000.

ES-1.12 IMPLEMENTATION PLAN

A four-phase implementation plan is proposed for the project:

1. *Phase 0: Sewer upgrade on Keele Street*

This phase can be conducted separately from the main sewer works in Phases 1 to 3, and elements can be built at any time. This phase only impacts the overflows from CSO 1.

2. *Phase 1:*

    - Contract 1: Relief Sewer from Humber STS to Shaft 04 (EPB Tunnelling) and CSO Storage Tunnel
    - Contract 2: CSO Storage

By the completion of phase one, the existing Black Creek STS will be relieved at the connection to the new relief sewer at Black Creek Drive and CSO control will be installed. This is a critical portion of the project, and will reduce both surcharging in the Black Creek STS south of the connection point and CSOs to Black Creek from the Hillary CTS, Mt. Dennis CTS, St. Clair CTS, and Rockcliffe CTS. Once the CSO storage facilities are built, the existing combined trunk sewer flow control regulators at connections of Hillary CTS, St. Clair CTS, and Mount Dennis CTS to Black Creek STS can be modified.

3. *Phase 2*

   - Contract 1: Keele Street Relief Sewer from Shaft 04 to Shaft 01 (Rock Tunnelling)
   - Contract 2: Jane-Wilson Relief Sewer

By the completion of phase two of the implementation plan, the section of the tunnel south of Maryport Avenue will be in operation, and the Black Creek STS south of the Maryport connection will be relieved. A connection stub will be included to connect the Phase 3 works.

4. *Phase 3*

   - Contract 1: Keele Street Relief Sewer from Shaft 01 to Shaft MT01 (Microtunnelling)

By the completion of phase three of implementation plan, the entire Black Creek sewer system will be in operation.

Assuming a construction start as early as the fall of 2023, it is projected that site investigations would proceed in third quarter, 2020, and all phases would be complete in first quarter, 2031.

ES-1.13 PUBLIC CONSULATION

To meet the needs of the consultation process, the City held three drop-in sessions including Public Information Centres and Public Information Events at three different phases throughout the study. Additionally, the project team consulted with provincial ministries and agencies and First Nations and Métis Communities.