Appendix 'A'

Pollution Prevention and Control Plan

Phase 3 Report

Executive Summary

Introduction

The City of London (City) initiated a Pollution Prevention and Control Plan (PPCP) in 2012 as part of its ongoing efforts to improve the performance of the City's sanitary and storm sewer infrastructure. The PPCP is aimed at reducing sewer system overflows (SSOs) and wastewater treatment plant (WWTP) and pumping station (PS) bypasses that are discharged into receiving streams during extreme wet weather events.

A PPCP is a master planning level tool that provides the City with project implementation and capital planning guidance for the next 20 years and beyond. The PPCP is based on a defined set of goals and objectives that are aligned with the objectives of the City, the Ministry of the Environment and Climate Change (MOECC), the Upper Thames River Conservation Authority (UTRCA), First Nations, and local stakeholders to maximize the benefits of the PPCP implementation strategy within the opportunities and constraints of the City's fiscal planning process.

This PPCP is being undertaken in accordance with the Environmental Assessment guidelines outlined in the Municipal Engineers Association (MEA) *Municipal Class Environmental Assessment (EA)* document (as amended in 2015), for Master Plans (MPs). MPs are long-range plans that examine the current and future requirements of a given infrastructure system using EA planning principles. The master planning process allows a municipality to identify the need for specific projects under a broad planning framework.

The PPCP consisted of three phases. The general study area for the PPCP is shown in **Figure ES-1**. This report provides the context for the efforts previously completed in Phase One and Phase Two, and details the recent efforts completed in Phase Three, including the evaluation and selection of preferred SSO and bypass mitigation measures.

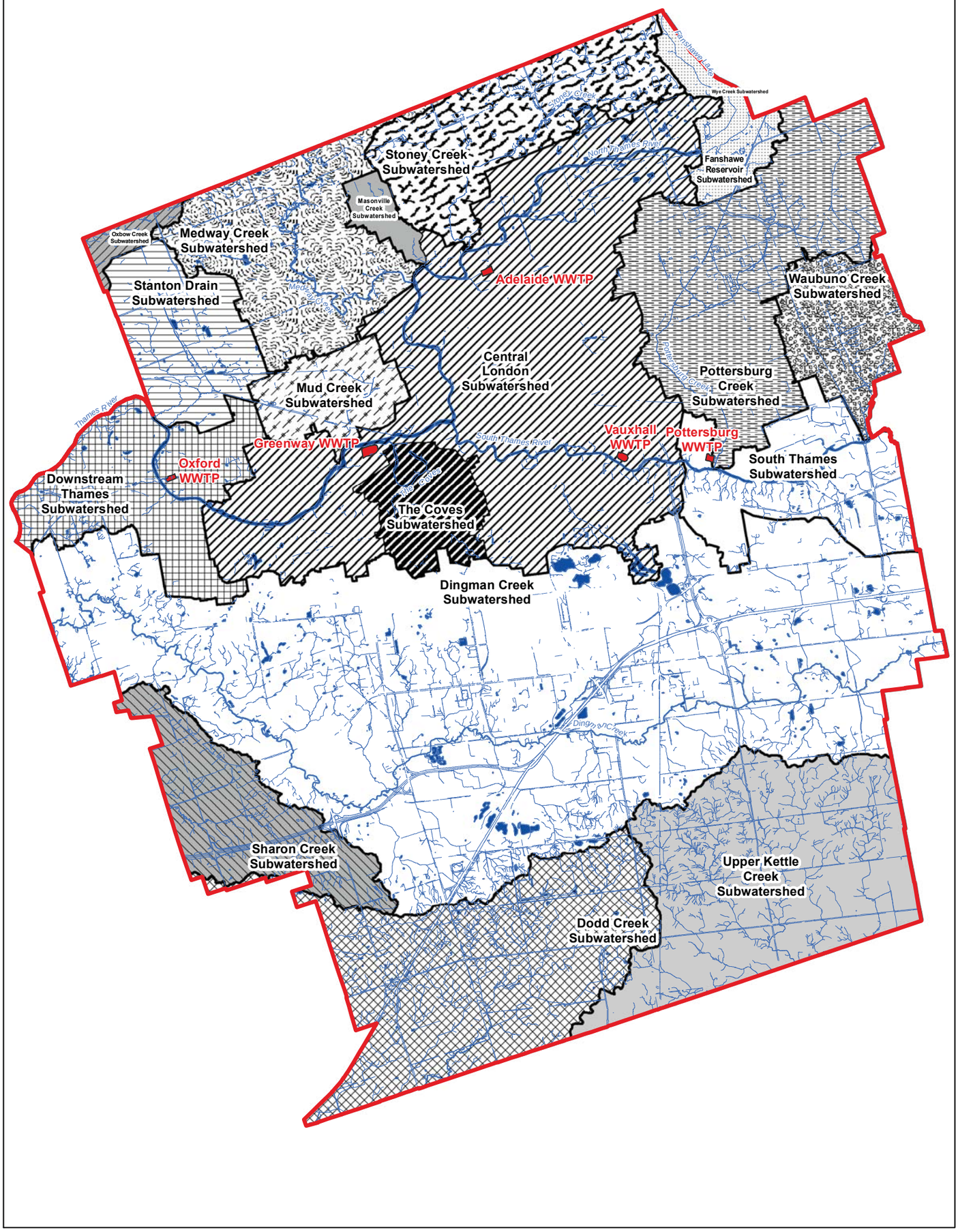
Background

The City's first sewer collection systems were built in the 1850s and some are still in service today. Over the years, the City has grown through annexations of former municipalities and has assumed responsibility for approximately 2,750 kilometers (km) of sanitary, storm, and combined sewers. The City's sanitary sewer system is comprised of five main sewersheds (Pottersburg, Vauxhall, Greenway, Adelaide, and Oxford).

Originally, SSOs and other bypasses that exist in the system were built to protect homes from basement flooding caused by the inflow and infiltration of excessive amounts of stormwater. At the time, discharge from these SSOs and bypasses was directed to receiving water bodies to alleviate flooding impacts.

The primary objective of this PPCP is therefore to develop and implement a plan to achieve a long-term solution that will limit the volume and frequency of occurrence of untreated wastewater discharges to the receiving streams from various SSOs and bypasses throughout the City, while maintaining an acceptable level of service and protection against basement flooding. This plan follows the principles outlined in the MOECC's Procedure F-5-5.

Procedure F-5-5 outlines the minimum treatment requirements for municipal and private combined and partially separated sewer systems. The primary goals of the Procedure are to eliminate the occurrence of dry weather SSOs and to minimize the potential for impacts on human health and aquatic life.



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City of London Boundary

Receiving Stream

Wastewater Treatment Plants

Waterbody

Figure ES-1

PPCP Study Area and Subwatersheds

London Pollution Prevention and Control Plan

City of London, London, Ontario

Study Implementation

SSO Characterization

A program to identify and document SSOs and identify their discharge points has been completed by the City. In all, a total of 149 SSO locations within the conveyance system and 45 corresponding discharge points to receiving streams were identified during Phase One of the PPCP. There are also five wastewater treatment plants (WWTPs) and 38 wastewater pumping stations of which 29 have bypasses that may discharge directly to receiving streams during extreme wet weather events.

Phase Two included twelve modelling assignments, which were conducted in two rounds in 2015 and 2016. The modelling assignments were completed to determine the discharge frequency and overflow volume of each SSO during various rainfall events. The modelling assignments were carried out using InfoWorks CS and InfoWorks ICM.

The primary receiving stream for the City SSOs and bypasses is the Thames River. Other receiving streams include Dingman Creek, Medway Creek, Pottersburg Creek, and the Coves. The areas modelled in Phase Two are shown in **Figure ES-2**. The eleven SSOs that have been removed since the beginning of the PPCP have not been shown.

Receiving Water Characterization

Two primary types of water quality monitoring programs were carried out for Phase Two of the PPCP. These include water chemistry studies and benthic macro invertebrate studies. Water chemistry constituents are generally selected for sampling and analysis using a list of conventional parameters. Benthic macro invertebrate sampling and analysis using BioMAP indices indicates the long-term water quality at the sampling location because the health of the macro invertebrate population is impacted as the macro invertebrates mature in the stream environment. The characteristics of the Thames River, Pottersburg Creek, and the Coves receiving environments, based on the BioMAP sampling results, are shown in **Figure ES-3**. The characteristics of the Dingman Creek receiving environment based on the BioMAP sampling results are shown in **Figure ES-4**.

Priority SSOs and PSs for Mitigation

Using the BioMAP water quality characterization of the reach that each SSO discharges into, a list of priority SSOs was created. SSOs which discharged into an impaired reach were included in the list of priority SSOs. The overflow volume at each SSO for the typical year (2010) was also considered to generate an additional priority list of SSOs. The modelling assignments were reviewed to identify SSOs which overflow 1,000 m^3 or more during the typical year, and these SSOs formed the basis for this additional priority list. The two priority SSO lists were combined and certain priority SSOs were grouped, based on whether a change made at one SSO could impact the overflow volume at another.

The SSO's level of compliance with Procedure F-5-5 was also considered and the majority of the SSOs that were not in compliance with Procedure F-5-5 were included in the priority list. Of the SSOs that were not on the priority list, there were three that did not comply with Procedure F-5-5 and two in which compliance could not be calculated. However, these five SSOs have a relatively low overflow volume (below 280 m^3) during the typical year and were not considered priority SSOs.

PSs and WWTPs were prioritized based on the water quality of the overflow receiving stream and monitored annual bypass volumes during the typical year from April 1 to October 31, 2010. Since 2010 is the City's typical year used in the typical year simulations for determining SSO overflow volumes for all of the modelling assignments, it is appropriate to prioritize the PSs and WWTPs using the 2010 monitored data. PSs and WWTPs that recorded a bypass during 2010 to a receiving stream with a water quality of impaired or transitional using BioMAP results, or had a bypass volume of 1,000 m^3 or greater were identified as priority PSs and WWTPs. The exception to this is the Dingman PS, which although it did not overflow during 2010 it discharges to the BioMAP impaired Dingman Creek. Due to the large number of BioMAP impaired sampling results in Dingman Creek, the Dingman PS was classified as a priority PS. The Southland PS, which was commissioned in early 2018, was also listed as a priority PS since any bypasses will discharge to Dingman Creek.

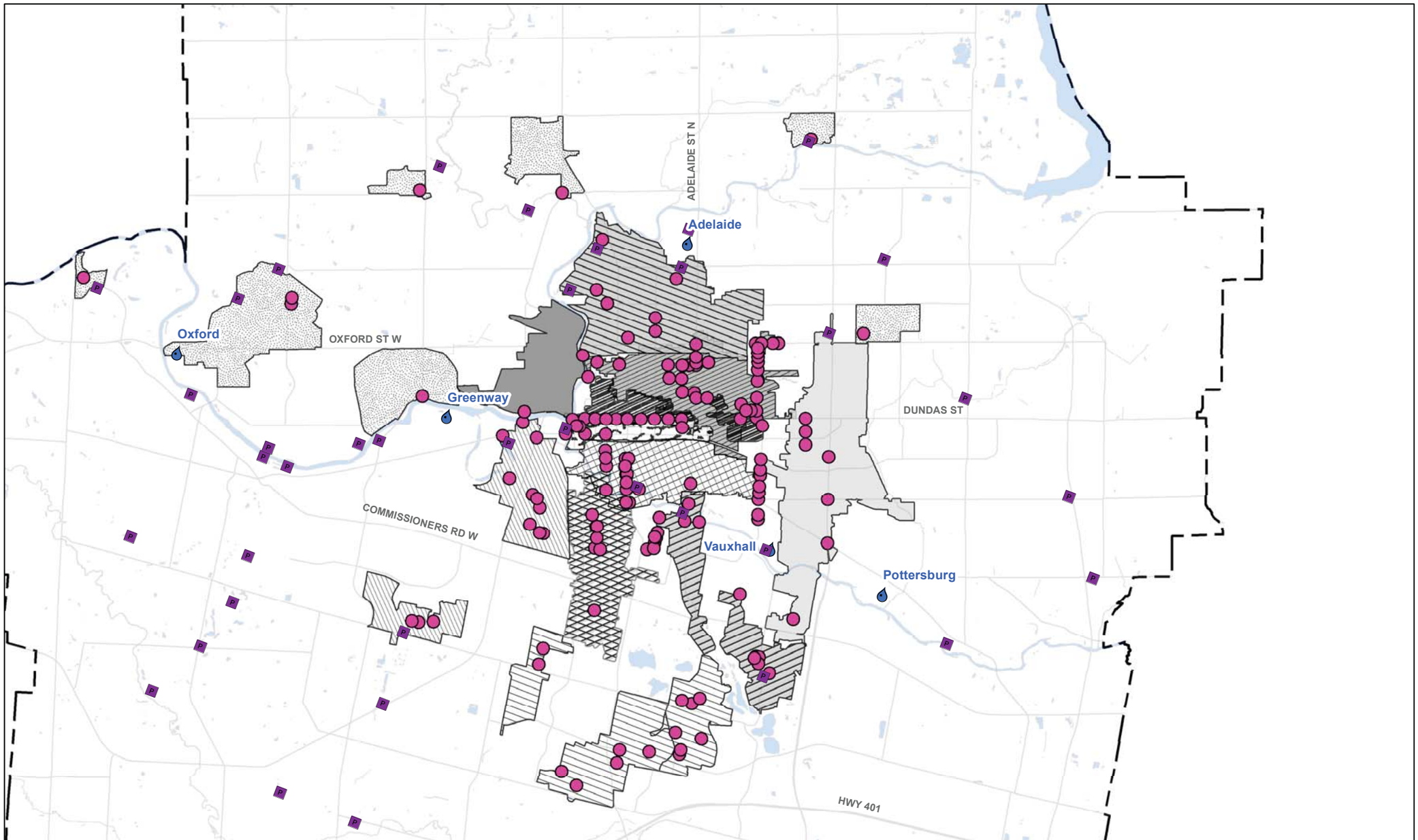

Figure ES-2
Modelling Assignment Locations with all SSO Locations
London Pollution Prevention and Control Plan
City of London

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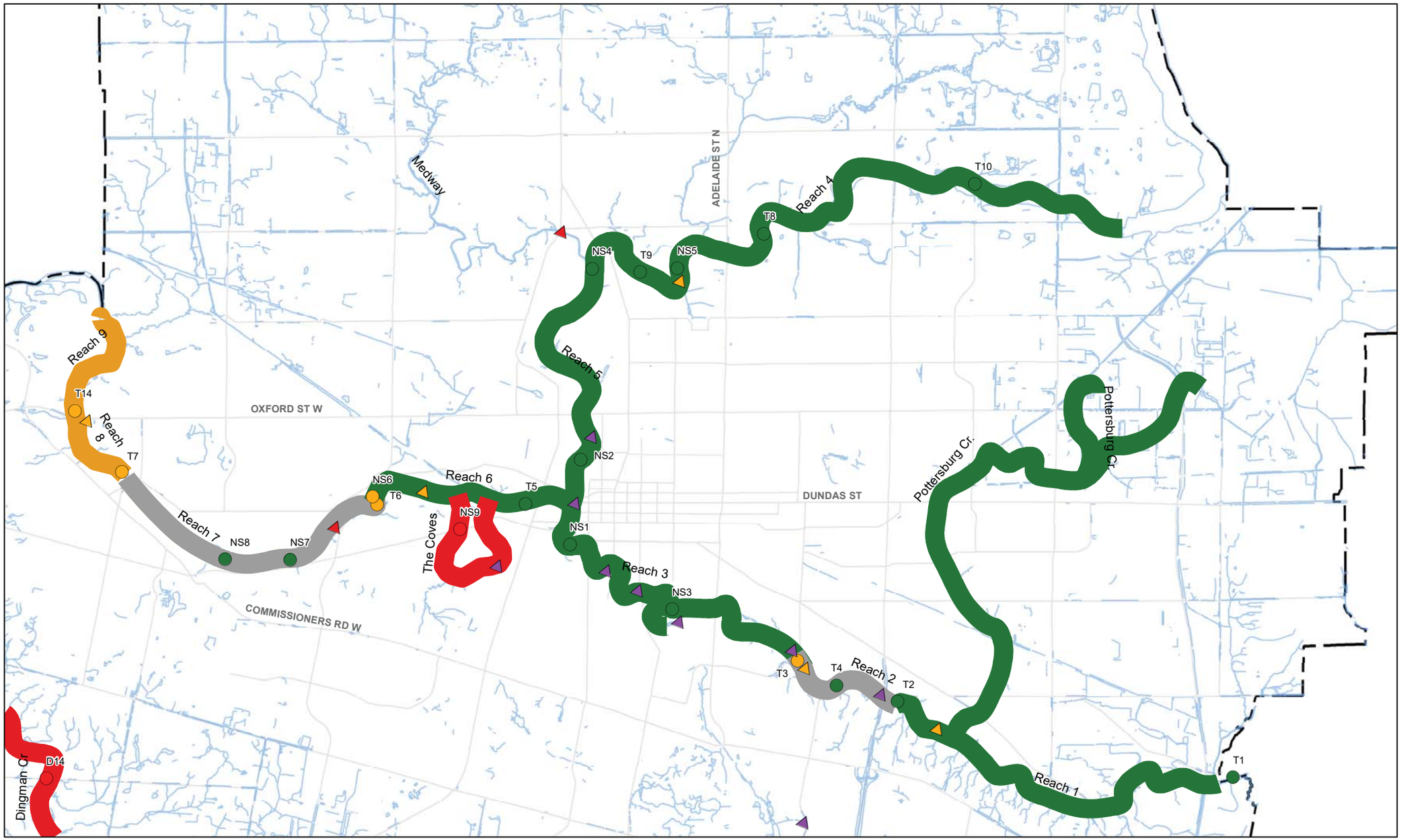

Figure ES -3
Thames River Reaches and Water Quality Rating -North
London Pollution Prevention and Control Plan
City of London

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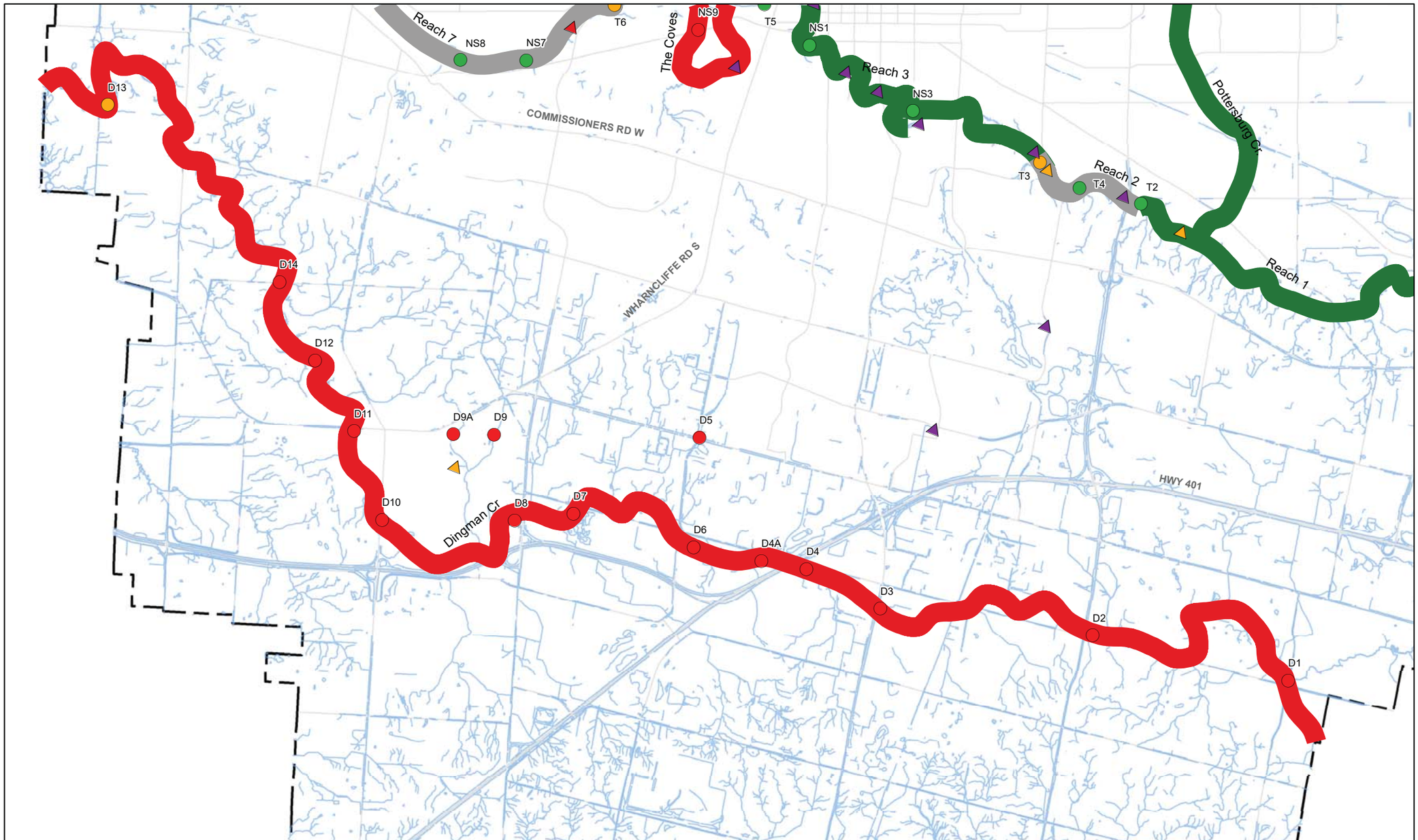

Figure ES-4
Thames River Reaches and Water Quality Rating -South
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As each WWTP undergoes a plant upgrade or expansion in the City, specific consideration is given to meet the intent of Procedure F-5-5 through these upgrades and through wet weather operating strategies. The WWTPs were not further considered as part of the PPCP due to the uniqueness of these facilities. The priority SSOs that were considered as part of the PPCP include SSOs in the sanitary sewer conveyance system and at PSs only. The remaining SSOs will continue to be monitored by the City and addressed in the future through capital infrastructure projects, and as the PPCP is reviewed and updated.

The priority PSs were grouped and combined with the list of priority SSOs. This combined list is shown in **Table ES-1** and illustrated in **Figure ES-5**.

Table ES-1. Priority SSOs and PSs

Group ID.	SSO ID	Group Description	Typical Year Overflow Volume (m^3)	BioMAP WQ Rating	Complies with F-5-5 90% Capture Rate (Y/N)
A	SW-01	King/River, York/Ridout	40,251	Unimpaired	N
A	CW-04		2,709	Unimpaired	Y
B	SP-45	Cathcart/ Devonshire	146	Impaired	Y
B	SW-03		5	Impaired	Y
C	PM-02	Pall Mall Relief System	10,332	Unimpaired	N
C	PM-09		7,752	Unimpaired	N
C	SD-05		2,531	Unimpaired	Y
C	PM-03		1,397	Unimpaired	Y
D	SD-01	Cavendish	10,070	Unimpaired	Y
E	CP-09	Edward/Tecumseh	325	Impaired	Y
F	SN-05	Evergreen/ Riverview	3,337	Unimpaired	N
G	N/A	Berkshire PS	4,667	Unimpaired - Transitional	N/A
H	N/A	Medway PS	1,198	Unimpaired	N/A
I	N/A	Sunninghill PS	863	Unimpaired- Transitional	N/A
J	N/A	Hunt Club PS	343	Transitional	N/A
K	N/A	Dingman PS	0	Impaired	N/A
I	N/A	Southland PS *	N/A	Impaired	N/A

* PS commissioned in early 2018

Alternative Mitigation Strategies

One of the objectives of Phase Two of the PPCP was to identify feasible alternatives to mitigate or eliminate SSOs and PS by-passes. The ultimate objective is to improve the water quality of the receiving streams. SSO best management practices and alternatives were grouped into three main categories:

- **Source Controls –** Water use methods such as water conservation or lot level methods that remove, capture or reduce the flow of stormwater and groundwater that may be directed to the sanitary or combined sewers by means of municipal programs and policies.
- **Conveyance Controls –** Methods of storing, slowing and/or staggering the flow of excessive amounts of stormwater that has been directed to the sewer system during wet weather events. Conveyance controls can address site specific issues or can be included in system wide maintenance programs.
- **End-of-Pipe Controls –** These controls occur at the end of a flow conveyance system or outfall. They often include some form of water treatment or physical separation.

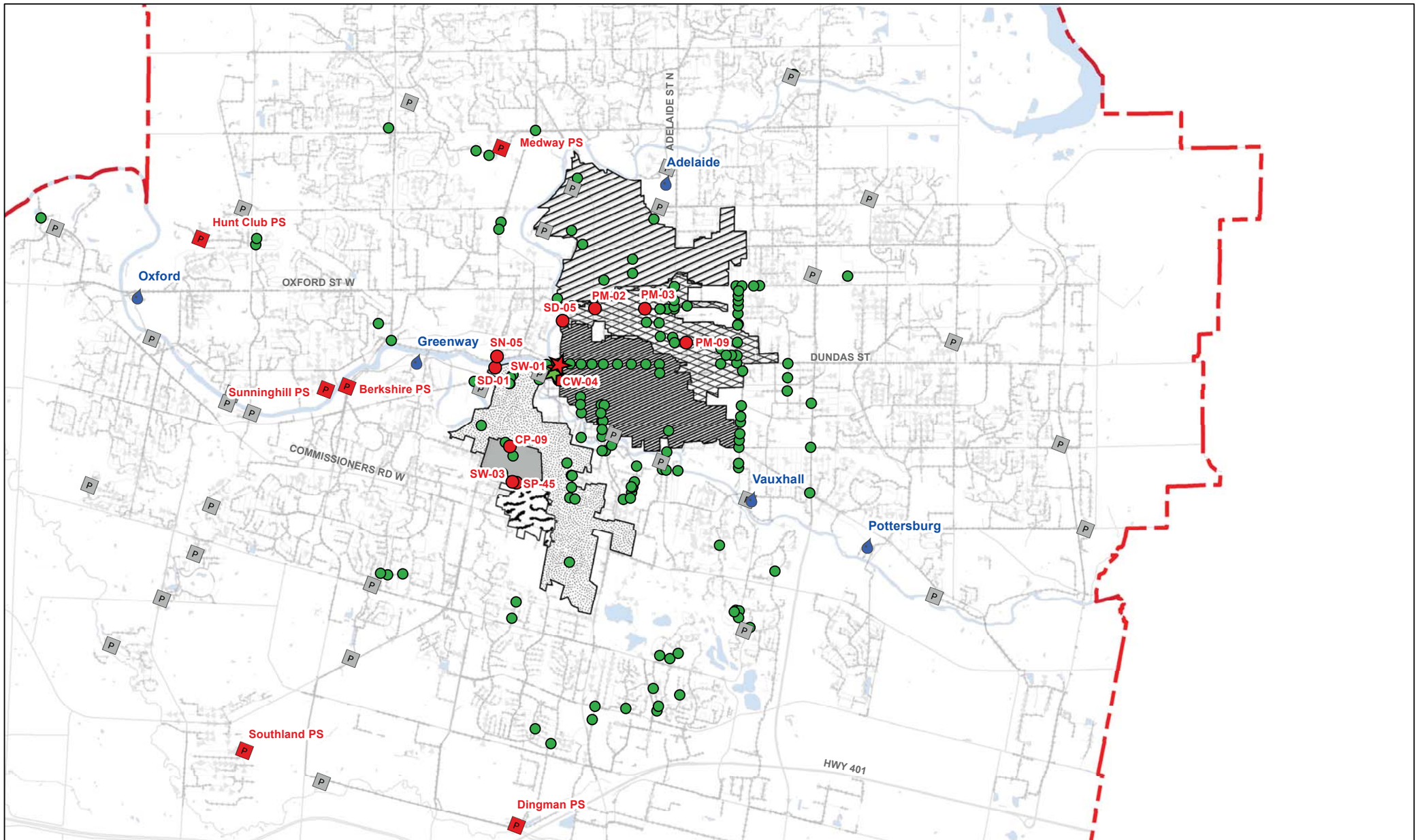

Figure ES-5
Prioritized SSO and PS Locations
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City of London

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A long list of SSO and PS bypass mitigation alternatives was created from the categories outlined above to identify feasible alternatives to mitigate or eliminate the overflow volumes at priority SSOs and PSs with the ultimate goal of improving the receiver water quality. The long list of alternatives was screened to a short list of alternatives based on the characteristics of the sanitary sewer system and the anticipated effectiveness in controlling SSO.

Alternative Evaluation

In Phase Three of the PPCP, the short list of alternatives for priority SSOs and PSs were evaluated further using technical, environmental, social, planning, and economic criteria to identify the preferred solution for mitigating or eliminating discharges.

The City's planned construction of the new Cavendish Trunk and the proposed Horton/Wharncliffe Sewer Realignment directly impact the overflow volumes in Group D (SD-01) and Group F (SN-05). Due to the likely reduction in SSO overflow volumes that would be seen at SD-01 and SN-05, it is recommended that the overflow volumes at these SSOs are monitored after completion of these infrastructure projects.

Group A and Group C are hydraulically linked since Group A is downstream of Group C and the alternatives for each of these SSO groups were simulated together to determine if a Group A alternative impacts Group C and vice versa. The recommended alternative for Group A includes seven phases of sewer separation that are already planned in the downtown core, removing the stormwater flows that can directly enter the sanitary system at MC-02 and DS-01, and upsizing the 900 mm diameter pipe along King St. and Becher St. to a 1200 mm diameter pipe. For Group C, simulation results indicate that a reduction of inflow and infiltration (I&I) by 50 percent in combination with increasing the SSO control elevations along the Pall Mall Trunk would eliminate overflow volumes. It is recommended that an I&I feasibility study be conducted in the Pall Mall catchment to determine if there is need to upsize the Pall Mall sanitary trunk sewer.

It is recommended that the Group B catchment area be targeted for weeping tile disconnection from the sanitary system. Simulation results indicated that weeping tile disconnection at a 60 percent participation rate eliminates the overflow volume during the typical year for the Group B SSOs.

Similar to Group C, the simulation results indicated that an I&I reduction of 50 percent, upstream and downstream of CP-09, in Group E would eliminate the overflow volume at this SSO. An I&I feasibility study is recommended for the Group E catchment area before upsizing the pipes downstream of CP-09.

Three of the six priority pumping stations have separate infrastructure projects and/or studies that have recently been completed or are planned, and are expected to reduce bypass volumes. A planned adjustment at the Westmount PS would reduce flows reaching the Berkshire PS. Flows to the Hunt Club PS were recently reduced by redirecting flow to the Hyde Park PS, and there is an EA being completed outside of the PPCP for the Dingman PS to determine the preferred solution for this station to handle increased flows. It is recommended that bypass volumes at these PSs are monitored after these initiatives are implemented. Similarly, Southland PS was commissioned in early 2018, and flow monitoring will assess bypass volume and frequency results at the PS.

For the remaining two PSs, Medway PS and Sunninghill PS, it was recommended that their catchment areas be targeted for weeping tile disconnection from the sanitary system. A large portion of the homes in these two catchment areas are assumed to have weeping tile connections, and a targeted weeping tile program has the potential to substantially reduce the I&I reaching the Medway PS and the Sunninghill PS.

Recommendations and Implementation Plan

The recommended projects to mitigate SSOs were prioritized based on their potential to reduce contaminant loading to the receiving streams, fiscal constraints, and opportunities for integration with planned infrastructure projects. **Table ES-2** and **Figure ES-6** summarize the recommended implementation plan. The implementation timeframes are represented as short-term (1-5 years), medium-term (5-10 years), and long-term (10-20 years). Sewer separation within the City is also presented in **Table ES-2** as this work coincides with wet weather flow reduction in the sanitary system presented in this PPCP. Please note that **Table ES-2** does not include facility upgrades for PSs.

It is recommended that the City continue to implement their policies and procedures for source control for managing stormwater before it enters downstream infrastructure. It is also recommended that updates to the system hydraulic models are made as infrastructure projects are completed so that the overflow and bypass volumes can be reassessed through subsequent updates to the PPCP.

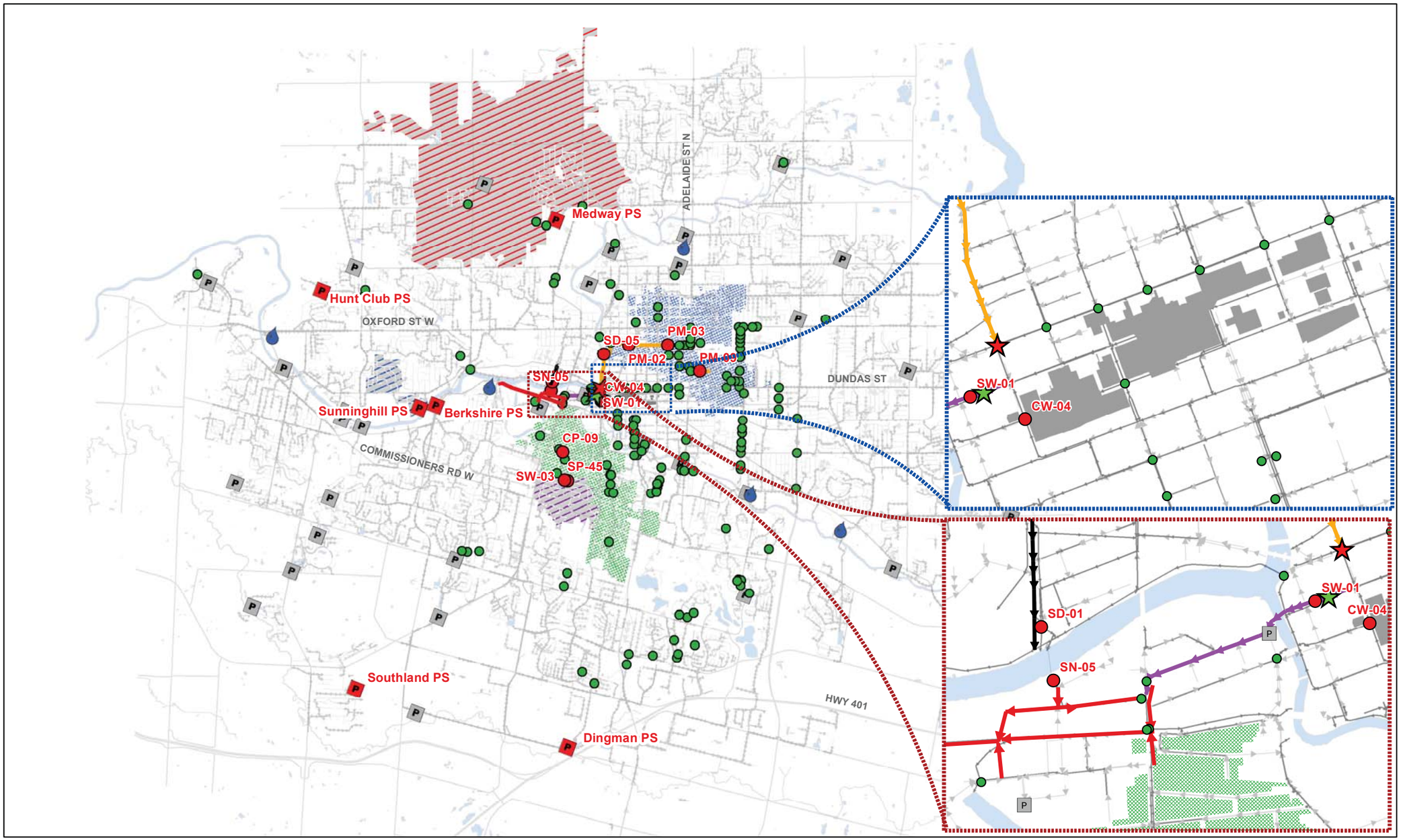

Figure ES-6
Preferred Alternatives for Priority SSO Groupings
London Pollution Prevention and Control Plan
City of London

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Table ES-2. Recommended Implementation Plan

Project Implementation Number	Group ID.	Group Description	Recommendation	SSO(s) Impacts	Infrastructure/Construction Cost Estimate	Engineering Cost Estimate	Considerations	Implementation Timeframe
S1	N/A	N/A	Egerton Street sewer separation (from Dundas Street to 75 m north of Brydges Street, King Street from Egerton St to Kellogg Lane) and King Street (from Egerton Street to Kellogg Lane)	N/A	$5,799,999 [a]	-	This planned project will help reduce the wet weather flows in the sanitary system in the Vauxhall sewershed.	Short-Term Phase 1 - 2018
S2	Group A	King/Thames, York/ Ridout and Richmond	Storm Sewer Separation Phase 1 (River to Talbot Street, and Talbot Street south to CN rail tracks) to Phase 2 (Talbot Street to Clarence Street, and Talbot Street from York Street to King Street)	SW-01, CW-04	$15,050,500 [a,d]	$ 1,441,000 [d]	This project will help reduce the wet weather flows in the Group A catchment area. Remaining phases of downtown sewer separation are recommended in subsequent years, depending on budget availability etc.	Short-Term Phase 1 - 2018 Phase 2 - 2019
S3	Group A and C	King/Thames, York/ Ridout and Richmond and Pall Mall Relief System	Storm sewer disconnection at MC-02 and DS-01	SW-01, CW-04, PM-02, PM-09, SD-05, PM-03	$4,000	-	Verify no PDCs remain upstream of storm sewers.	Short-Term
S4	Group A and C	King/Thames, York/ Ridout and Richmond and Pall Mall Relief System	Conduct an I&I reduction analysis to determine feasibility of reducing the I&I by 50 percent in the PM-02, PM-03, and PM-09 catchment areas	SW-01, CW-04, PM-02, PM-09, SD-05, PM-03	-	$150,000	This should be carried out to determine feasibility and effectiveness on I& reduction, to determine if there is need to increase the Pall Mall trunk sanitary sewer size.	Short-Term

Project Implementation Number	Group ID.	Group Description	Recommendation	SSO(s) Impacts	Infrastructure/Construction Cost Estimate	Engineering Cost Estimate	Considerations	Implementation Timeframe
S5	Group D	Cavendish	Construct the new proposed Cavendish Trunk. Monitor the overflow volume at SD-01 after completion of the construction of the new Cavendish Trunk to reassess this SSO	SD-01	$2,695,350 [a]	$10,000 (flow monitoring)	Phase 1 of the Cavendish trunk is planned for construction in 2018. SD-01 has a relatively large overflow volume during the typical year.	Short-Term
S6	Group E	Edward/Tecumseh	That an I&I study to identify the sources of I&I and determine the feasibility of removing the I&I be conducted before any infrastructure upgrades are implemented for CP-09	CP-09	-	$150,000	This study should be initiated in 2018 of 2019 to determine the potential for I&I reduction in this catchment area.	Short-Term
S7	Group B	Cathcart/ Devonshire	Implement a targeted weeping tile disconnection program to achieve a 60 percent participation rate, which corresponds to 250 homes in the Group B catchment area	SP-45, SW-03	$1,275,000	-	Requires home owner participation	Short-Term
M1	N/A	N/A	Storm Sewer Separation for the City's combined sewer areas (that are not included in S1, S2 M2, and L1). This includes approximately 17 km of combined sewer replacement (through complete infrastructure renewal and road reconstruction). [b]	N/A	$108,800,000 [c]	$16,300,000 [e]	The planned sewer separation projects will help reduce wet weather flow within the City's sanitary system. Please refer to the Canada-Ontario Lake Erie Action Plan for phosphorus reduction for further details.	Medium- Term
M2	Group A	King/Thames, York/ Ridout and Richmond	Storm Sewer Separation Phase 3 (Richmond Street – York Street to	SW-01, CW-04	$42,000,000 [d]	$5,300,000 [e]	This project will help reduce the wet weather flows in the	Medium-Term

Project Implementation Number	Group ID.	Group Description	Recommendation	SSO(s) Impacts	Infrastructure/Construction Cost Estimate	Engineering Cost Estimate	Considerations	Implementation Timeframe
			Dundas Street), Phase 4 (King Street Phase 1 – Richmond Street to Wellington Street), Phase 5 (Clarence Street – York Street to Dundas Street; York Street – Clarence Street to Wellington Street), and Phase 6 (Wellington Street – Dundas Street to King Street; King Street – Wellington Street to Colborne Street)				Group A catchment area. Remaining phases of downtown sewer separation are recommended in subsequent years, depending budget availability etc.	
M3	Group F	Evergreen/ Riverview	Implement the proposed Horton/Wharncliffe Sewer Realignment infrastructure upgrades. Monitor the overflow volume at SN-05 after completion of the construction of the new proposed Horton/Wharncliffe Sewer Realignment to reassess this SSO	SN-05	$5,100,000 [f]	$10,000 (flow monitoring) $765,000 [e]	Needs to be implemented before Group A and Group C pipe capacity upgrades, but implemented after some wet weather flow reduction is achieved upstream so that flows to the Greenway WWTP are not substantially increased.	Medium-Term
M4	Group H	Medway PS	Implement a targeted weeping tile disconnection program in the Group H catchment area.	N/A	$17,243,100 [g]		Requires home owner participation.	Medium-Term
M5	Group I	Sunninghill PS	Implement a targeted weeping tile disconnection program in the Group I catchment area.	N/A	$1,907,400 [g]		Requires home owner participation.	Medium-Term

Project Implementation Number	Group ID.	Group Description	Recommendation	SSO(s) Impacts	Infrastructure/Construction Cost Estimate	Engineering Cost Estimate	Considerations	Implementation Timeframe
L1	Group A	King/Thames, York/ Ridout and Richmond	Storm Sewer Separation Phase 7 (York Street – Wellington Street to Colborne Street)	SW-01, CW-04	$10,440,000 [d]	$1,310,000 [e]	This project will help reduce the wet weather flows in the Group A catchment area.	Long-Term
L2	Group A and C	King/Thames, York/ Ridout and Richmond and Pall Mall Relief System	Upsizing the 900-mm-diameter pipe from the intersection of King St. and Ridout St. to Wharncliffe Rd. and Becher St. to a 1,200-mm-diameter pipe. Increase SW-01 invert elevation to pipe obvert.	SW-01, CW-04, PM-02, PM-09, SD-05, PM-03	$6,204,000 [h]	$930,600 [e]	This is a requirement to reduce discharges and has a major impact on SSO volumes and frequency. The pipe capacity increases at Wharncliffe/ Horton need to be implemented first. To avoid excessive construction in the downtown core, this should not be implemented until the sewer separation projects are complete.	Long-Term
L3	Group A and C	King/Thames, York/ Ridout and Richmond and Pall Mall Relief System	Complete I&I removal projects and then increase the SSO control elevations along the Pall Mall trunk sewer to reduce the potential for overflow	SW-01, CW-04, PM-02, PM-09, SD-05, PM-03	N/A [i]		This is a preferred approach to improve capacity and reduce SSOs than increasing the Pall Mall sewer pipe size. SSO elevations should not be increased until after upsizing the 900-mm-diameter pipe from the intersection of King St. and Ridout St. to Wharncliffe Rd. and Becher St. to a 1,200-mm-diameter pipe.	Long-Term (if required)

Project Implementation Number	Group ID.	Group Description	Recommendation	SSO(s) Impacts	Infrastructure/Construction Cost Estimate	Engineering Cost Estimate	Considerations	Implementation Timeframe
L4	Group A and C	King/Thames, York/ Ridout and Richmond and Pall Mall Relief System	Replace the Pall Mall trunk sewer with a 900-mm-diameter pipe from Elizabeth St. and Queens Ave. to Dundas St. and then increase the SSO control elevations along Pall Mall trunk to reduce the potential for overflow	SW-01, CW-04, PM-02, PM-09, SD-05, PM-03	$24,066,000	$3,609,900 [e]	This option should only be implemented if sufficient I&I reduction cannot be achieved (based on the I&I study). This work should not be completed until after upsizing the 900-mm-diameter pipe, from the intersection of King St. and Ridout St. to Wharncliffe Rd. and Becher St. to a 1,200-mm-diameter pipe.	Long-Term (if required)
L5	Group E	Edward/Tecumseh	Complete I&I removal projects.	CP-09	N/A [i]		Relatively low overflow volume. This is a preferred approach to improve capacity and reduce SSOs than increasing pipe sizes.	Long-Term (if required)
L6	Group E	Edward/Tecumseh	Upsize the sewers downstream of CP-09 to Wharncliffe and Horton.	CP-09	$11,741,300	$1,761,195 [e]	Relatively low overflow volume. This option should only be implemented if sufficient I&I reduction cannot be achieved (based on the I&I study).	Long-Term (if required)

[a] Cost based on tendered value

[b] Source: City of London (2017)

[c] Cost based on a unit cost, with the assumption that the average cost of this full road reconstruction (watermain, sewer and selected utility upgrade/replacement) is equivalent to installing 900 mm diameter sewers at 5 m depth.

[d] Source: AECOM (2017)

[e] Cost assumed from 15% of construction cost

[f] Source: R.V. Anderson Associates Limited (2016)

[g] Cost based on the assumption that 100% of the homes with weeping tile connections in the catchment area will participate in disconnecting weeping tiles from the sanitary system.

[h] Assuming bridge work on the King Street Pedestrian Bridge is not required

[i] Cost of reducing I&I to be determined during I&I reduction feasibility study