



INFORMATION REPORT

TO:	Chair and Members Public Works Committee
COMMITTEE DATE:	August 10, 2022
SUBJECT/REPORT NO:	Flooding and Drainage Improvement Framework (PW22071) (City Wide)
WARD(S) AFFECTED:	City Wide
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COUNCIL DIRECTION

N/A

INFORMATION

Summary:

Staff in Hamilton Water (HW), along with a team of consulting engineers, and in consultation with other internal partner groups have developed the Flooding and Drainage Improvement Framework (FDIF), a roadmap that guides the City of Hamilton (City) toward improved drainage system performance to mitigate community flooding and Combined Sewer Overflows (CSO's). The completed assessment has recommended a significant capital investment and infrastructure program that carries an estimated 10-year cost of \$367M, 10-20-year cost of \$258M, and a 20+ year cost of \$404M, for a total program value exceeding \$1B.

OUR Vision: To be the best place to raise a child and age successfully.

OUR Mission: To provide high quality cost conscious public services that contribute to a healthy, safe and prosperous community, in a sustainable manner.

OUR Culture: Collective Ownership, Steadfast Integrity, Courageous Change, Sensational Service, Engaged Empowered Employees.

Recommended strategies are focussed on Managed Sewer Separation, an effort to build separated storm sewer infrastructure within the Combined Sewer System (CSS) where it does not currently exist today. In addition, it will be necessary to connect that new infrastructure to existing or new storm sewer outlets conveying flow to the natural environment and reducing inflow to the existing combined sewers. Beyond managed sewer separation, additional recommendations are made to provide support for increased levels of sewer system service to the community in the form of sewer rehabilitation, underground storage, major system conveyance improvements, inlet controls, green infrastructure, and private property measures. New trunk sewer opportunities have also been proposed as options to help increase City sewer capacity, initiatives that will carry additional costs not yet estimated.

An Environmental Assessment (EA) process will begin in 2023 to further explore the FDIF recommended approaches to sewer capacity challenges and refine the information needed to most effectively optimize plans and meet community expectations. In addition, local system studies will be needed to provide field level information that will guide local implementation details. This work will be done in distinct zones within the City and will include effective consultation with the public, partners, stakeholders, and also include Indigenous consultation. In relation to proposals potentially involving the Red Hill Valley, all applicable matters will be referred to the Joint Stewardship Board if and to the extent required by the Red Hill Valley suite of agreements, particularly the Joint Stewardship Agreement dated December 18, 2003 between the Haudenosaunee and Hamilton.

Finally, more work is necessary to develop a financing and implementation plan to support this significant initiative. HW plans to provide committee and Council with this additional information through a future recommendation report for consideration once these key program pieces have been developed. Additional background information is included in Report PW22071 to give a greater understanding of the work that has been completed to develop the strategic conclusions made to date under this FDIF.

Background:

The current City was formed in 2001 through the amalgamation of six (6) former municipalities and as such, the City's wastewater and stormwater networks are a complex collection of systems that were built over the course of 150 years under numerous design philosophies and standards, many pre-dating modern day criteria. Despite newer portions of the City's collection system being constructed with separated sanitary and storm pipes, many separated storm sewers continue to be connected to upstream portions of the combined sewer system (CSS) due to a lack of storm outlets to the environment, resulting in an unfinished solution, which continues to contribute to urban flooding under storm conditions.

Due to increased urbanization, growth intensification, and increases in the frequency and intensity of rainfall events due to climate change, the original design capacity of the City's legacy CSS has become strained, resulting in the CSS capacity being overloaded more frequently during higher volume rain events. These pressures, along with a lack of major overland flow routes have resulted in both overland and basement flooding issues throughout the CSS.

Over the past 60 years, in an effort to address the identified CSS capacity issues and environmental concerns relating to CSOs, the City has completed numerous and significant upgrades to the CSS. These measures, such as the construction of sewers and CSO tanks have resulted in reductions in CSOs to the environment; however, overflows to the environment still occur, and several areas within the City remain at risk of flooding during wet weather events.

In 2017, a Flooding and Drainage Master Servicing Study (FDMSS) was initiated by HW to identify flooding issues throughout the CSS area of the City and to propose a long-term program to mitigate these issues. The scope of the study included the development of a dual drainage system model for the CSS, various system modelling exercises, documentation of the analysis, identification of projects and programs for flooding mitigation, followed by the development of cost estimates.

By 2021, it was identified that the FDMSS study required the development of a higher-level framework that provided strategic conclusions. The new assignment, referred to as the FDIF, was intended to advance the work done in the previous assignment by providing a framework and implementation road map of recommended solutions to address both short and long-term urban flooding issues in the CSS area.

The FDIF did not duplicate the FDMSS analysis but organized the findings and identified areas where further study is warranted. The resulting FDIF report (completed in February 2022), provides HW with an initial strategy to budget and begin to implement specific works that will advance flooding mitigation measures in the CSS area. This work is a long-term initiative aimed at improving existing system performance and will feed into separate work under the ongoing Water, Wastewater and Stormwater Master Plan (W/WW/SW Master Plan) which is focussed on growth servicing.

Flooding and Drainage Improvement Framework:

The CSS area of the City is located mostly within lower Hamilton, bounded by Cootes Paradise to the west, the Red Hill Valley to the east, Hamilton Harbour to the north, and Mohawk Road to the south. A map of the CSS is attached as Appendix "A" to Report PW22071. The CSS includes 33 individual CSO outfalls (as defined in the FDIF) and nine CSO tanks; it is a complex network of sewers of various age and legacy design criteria.

For the FDIF study, the CSS was subdivided into 24 CSO catchments or sewersheds for higher level results mapping. To allow for more in-depth analysis and prioritization efforts, these 24 catchments were further subdivided into smaller areas of ~40-50 hectares, resulting in 108 subcatchment areas.

Each of the 108 subcatchments was assessed based on several key factors, using data available from the City and/or the FDMSS, including:

- Historic flooding
- Sewer age and condition
- Sewer depth
- Sewer capacity/performance (based on system modelling)
- Overland flow route capacity/performance (based on system modelling)
- Topography of the sewershed

Mapping was developed for each of the key factors, and a composite map was also developed that represents an overall priority ranking for the 108 subcatchment areas to guide program interventions. The composite map is attached as Appendix “B” to Report PW22071.

Level of Service:

FDIF work did consider community levels of service and it has been concluded that a uniform level of service across the CSS area is not a realistic objective. This is due to the physical variability of the system, including grading constraints (e.g. low-lying areas in the City), legacy construction based on outdated design standards, availability of outlets (current and future) or overland flow routes, and unknown conditions that are location specific (such as utility conflicts or the presence of basement connections).

Rather than apply a blanket level of service that would not be practically achievable, the FDIF references the following Risk Management Levels of Service that are performance based objective targets for the CSS that should be considered when planning system upgrades:

- Manage sewer flows such that the hydraulic grade line for the CSS remains below the residential basement flooding risk level (1.8m below ground surface) during a 5-year design wet weather event.
- Meet the Ministry of Environment Conservation and Park’s (MECP) Procedure F-5-5 criteria, which regulates CSO’s into the natural environment.
- Safely capture and convey the 100-year design storm within defined overland flow routes to a stormwater management facility or suitable outlet.

While these performance targets may not be achievable across the entire CSS, they will guide relative performance improvements moving forward, i.e. the program aims to generally improve level of service across the CSS. The Risk Management Levels of Service are currently being referenced within the ongoing W/WW/SW Master Plan. It is anticipated that these performance targets will continue to be carried forward until future, area-specific studies identify the need for changes. A potential result of further studies may be that Special Policy Area criteria may be required within particular sub-catchments.

Management Strategy:

After the completion of prioritization mapping based on existing conditions, management strategies were developed based on the Risk Management Levels of Service and the following overarching objectives:

- Short-term – minimize the frequency, severity, and extent of basement and surface flooding.
- Long-term – in addition to short-term objectives, minimize the frequency, duration, and total volume of CSOs; reduce stress on system capacity to support current and future communities; provide added system resilience for impacts of climate change.

The short-term strategy for achieving the objectives involves targeted sewer separation and the construction of storage infrastructure in areas identified by the analysis as high priority. The long-term strategy is a vision referred to as Managed Sewer Separation, meaning a planned effort to separate the CSS, system-wide, to the extent that is practically feasible or until the benefits no longer outweigh the cost. This strategy can be expected to influence the City's infrastructure capital program (within the Road Right of Way) in the future by adjusting existing road condition drivers to make way for sewer separation drivers. The impact and associated cost of this split will need to be further evaluated and discussed as part of future financing and implementation plans in terms of how that affects existing Asset Management strategies and decisions, currently applied in Hamilton.

Similar to Hamilton, other communities are also working to manage the impacts of legacy combined sewer designs. Examples of Ontario municipalities who have previously or are currently working to reduce and eliminate CSSs and CSOs using multi-faceted programs include the City of Toronto, the City of Ottawa, the City of Brantford, the City of London, the City of Kingston, and the City of St. Catharines.

Based on the above noted objectives, various solutions were evaluated for expected system performance improvements, consisting of:

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- System Level – three options for new, large diameter interceptor trunk sewers (two (2) combined, one (1) storm), which would require further study following the Class Environmental Assessment (EA) process and coordination with the W/WW/SW Master Plan.
- Local level – sewer separation, sewer rehabilitation, underground storage, major system conveyance improvements, new sewer outlets, inlet controls, green infrastructure, and private property measures.

It is noted that both the FDMSS and the FDIF acknowledge that although green infrastructure plays a role in achieving the program objectives, it is not the focus of the program recommendations. Implementation of green infrastructure within this program may reduce the impact of smaller, more frequent rain events by acting as a source control and improving water quality. However, green infrastructure interventions alone will not be able to address the Risk Management Levels of Service objective, given the magnitude of water volumes contributing to existing flooding and drainage issues.

The FDIF has recommended the development of specific green infrastructure policies; these recommended policies should be considered during the development of the City's Green Development Standards initiative, as well as any other synergistic policy developments.

Each of the identified 108 study subcatchments was assessed alongside the list of potential solutions. Several infrastructure options were then developed, bundled into the 24 larger sewersheds, and labelled as either: recommend/carry forward, further study, or screened out. The projects identified as recommend/carry forward and further study make up the studies and infrastructure works component of the proposed program.

FDIF Recommendations:

The FDIF recommends a program which involves studies, investigations, policy development, and infrastructure works for a 0 to 20+ year timeframe to maximize the system performance objective results. The program is summarized in Table 1 below:

Table 1

Category	Timeline			Total
	0-10 Years	10-20 Years	20+ Years	
Studies and Policy Development	\$5M			\$5M
Capital Works - Priority Area Projects (Recommended)	\$214M	\$93M		\$307M
Capital Works - Potential Projects (Further Study)	\$96M	\$146M		\$242M

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Capital Works - Managed Sewer Separation	\$52M	\$19M	\$404M	\$475M
Total	\$367M	\$258M	\$404M	\$1,029M

Detailed breakdowns of individual projects including project description, priority, estimated cost, and implementation timeframe are included in the FDIF report attached as Appendix “C” to Report PW22071. It is noted that the capital works estimates are subject to refinement based on the outcomes of the recommended studies at the onset of the program.

Currently, HW holds approximately \$2M in approved capital funds to support the initiation of studies recommended for the immediate or short-term. Additionally, up to \$90M in capital funds was included in the later years of the 2022 10-year Water, Wastewater and Storm Rate Capital Budget to facilitate implementation of capital works. Based on the FDIF findings, there is a budget gap of approximately \$275M.

The long-term program costs (10+ years) will be refined based on the results of the strategic Class EA studies recommended for short-term completion. These proposed Class EA studies are foundational for establishing future details of infrastructure works. It is proposed that in parallel to the short-term Class EA studies and finalization of the W/WW/SW Master Plan, that HW will begin working with internal partners (and where required industry experts) to formalize financing and intergovernmental relations strategies to support the FDIF recommendations.

Ongoing Flood Mitigation Works:

Outside of the recommended FDIF program, the City continues to support various flood reduction, mitigation or adaptation initiatives, that have and will continue to benefit the community including but not limited to:

- Ongoing development of Green Development Standards
- Requirements for backflow preventers for new buildings
- Protective Plumbing Program
- Requiring flood quantity controls from the 100-year to 2-year flows for redevelopment within the CSS area
- Reviewing and confirming existing Intensity-Duration-Frequency curves used for sewer design based on potential future climate impacts
- Local drainage improvement projects based on past studies and/or ongoing roads capital works (e.g. Ainslie Wood Neighbourhood Creek Separation EA)
- Restriction of permanent groundwater dewatering to the CSS.

These programs reflect activities already being undertaken in parallel to implementation of the FDIF.

Relevant Consultation:

As part of the FDIF, staff conducted workshops with internal City stakeholders, including the Planning and Economic Development and Public Works Department (Asset Management and Engineering Services). Public consultation was not completed as part of this study.

The key recommended projects for immediate or short-term implementation are noted to be strategic Municipal Class EA studies for segmented areas of the CSS, as described in Table 2. Public consultation will be pursued within these studies in accordance with the requirements of the Municipal Class EA process, which will include effective consultation with the public and with all partners, stakeholders, and will also include Indigenous consultation. In relation to proposals potentially involving the Red Hill Valley, all applicable matters will be referred to the Joint Stewardship Board if and to the extent required by the Red Hill Valley suite of agreements, particularly the Joint Stewardship Agreement dated December 18, 2003 between the Haudenosaunee and Hamilton.

Table 2

Recommended Study Name	Proposed Start Timeline
Ainslie Wood Neighbourhood Creek Separation EA	0-3 years (currently underway)
West End Sewer Separation Study and New Outfall EA (Chedoke Creek and Cootes Paradise)	0-3 years
Red Hill Sewer Separation Study and New Outfall EA	3-5 years
Hamilton Harbour Sewer Separation Study and New Outfall EA	3-5 years
Scoped Capacity Assessment of North Mountain Area	5-10 years
Interceptor Feasibility Study and EA (pending recommendations of the W/WW/SW Master Plan)	5-10 years

HW staff will be launching the next stages of work through an EA process in 2023 with existing budgeted funds, reaffirmed through the 2023 rate budget process. This work will be initiated in stages and begin in an area of the CSS that is not connected to the Red Hill Valley. This same approach will be followed for areas that may influence the Red Hill Valley, but on a timeline beyond 2023. This timeline provides staff with ample time to meet the City's obligations under Red Hill Valley suite of agreements, particularly the Joint Stewardship Agreement dated December 18, 2003 between the Haudenosaunee and Hamilton, both in advance of and during the eventual EA process.

Next Steps:

The FDIF recommends a set of high priority projects to be implemented within a 0 to 3-year timeframe, including general City adoption of the Managed Sewer Separation vision. Acknowledgement of this vision is key to establishing and committing to long-term capital budget requirements. Of the five (5) immediate initiatives recommended by the FDIF, the majority are ongoing or have been initiated in some manner, having been tied to previous commitments such as the MECP Chedoke Order:

- Ainslie Wood Neighbourhood Creek Separation EA
- West End Sewer Separation Study and New Outfall EA
- Update to All-Pipes Model for sanitary and combined area
- Update to Stormwater and Low Impact Development (LID) Policies
- Stormwater User Rate Study

Although some approved budget does exist to allow for initiation of short-term studies, most of the recommended capital program is not currently budgeted and will present budgetary pressures for the City. As a result, in parallel with completion of the initial Class EA studies, HW will be working with Corporate Finance and the City Manager's Office to develop a financing strategy and intergovernmental relations strategy to support the FDIF. The outcomes of this work are planned to be presented to Committee and Council for consideration at a future meeting with recommendations that are supported by the appropriate financial and implementation details.

Like all Master Plan level strategies, the FDIF report recommends that this framework be revisited at regular intervals in the future to ensure that works completed are continuing to meet short and long-term objectives, as well as the changing needs of a growing City.

APPENDICES AND SCHEDULES ATTACHED

Appendix "A" to Report PW22071 – Combined Sewer Service Area Map

Appendix "B" to Report PW22071 – Overall Prioritization Map

Appendix "C" to Report PW22071 – Flooding and Drainage Improvement Framework