8. WET WEATHER FLOW MANAGEMENT STRATEGY

8.1 OVERVIEW

As presented in Section 5.7, the preferred solution for management of wet weather flows is to maximize the level of treatment of these flows by conveyance to the Woodward Avenue WWTP, up to the maximum treatment capacity of 1,300 ML/d. The detailed preferred strategy includes the following components:

- Expand secondary treatment at Woodward Avenue WWTP to provide a peak capacity of 1,000 ML/d and expand primary treatment to provide a peak capacity of 1,300 ML/d
- Upgrade raw wastewater pumping at the Woodward Avenue WWTP to provide reliable pumping capacity of 1,700 ML/d, a flow rate equivalent to the capacity of the trunk sewers that feed the plant
- Upgrading the collection system to convey flows to the Woodward Avenue WWTP so that the full treatment capacity may be utilized (i.e., there will be no collection system bypassing when the plant is not operating at capacity).

Optimization of the system operation is also required to maximize the use of the existing system so that there are no bypasses when the Woodward Avenue WWTP has capacity remaining.

With implementation of the above recommendations, the City will achieve goals on a system-wide basis for wet weather flow capture and treatment, with more than 90% of the wet weather flow receiving treatment in an average rainfall year. However, while overall system goals would be achieved, upgrades to reduce CSO events at specific sensitive locations are required, specifically:

- Cootes Paradise
- Sherman Inlet
- Windermere Basin.

Furthermore, local area upgrades are required in areas with local capacity limitations where basement flooding events have been experience. These system upgrades will require a separate program of investigations and remediation, considered to be outside the scope of this Class EA study.

The following sections present conceptual design alternatives for system optimization, and for achieving local controls for the three sensitive areas evaluated, the evaluation of these alternatives, and rationale for selection of a preferred design concept.
8.2 SYSTEM OPTIMIZATION

8.2.1 Description of Existing System

The collection system in Hamilton consists of a network of pipes that collect sanitary wastewater and convey this wastewater to deep sewers, referred to as interceptors. Three interceptors (Western, Red Hill and Eastern) carry flow to the raw wastewater pumping station at the Woodward Avenue WWTP site. In the older portions of the City, sewer pipes were also designed to collect runoff from stormwater and snow melt. During these ‘wet weather’ events, flows in the collection system can increase significantly. If all of this flow were allowed into the deep trunk sewers, there would be a risk of flooding the wastewater pumping station, and wastewater backing up in the interceptor, potentially causing problems such as basement flooding. To prevent these occurrences, a number of flow control or regulating structures, such as weirs and gates, have been installed to divert a portion of flow away from the interceptors. At some locations, where CSO storage tanks have been installed, a portion of wet weather flow is diverted to the tanks, and returned back to the system during dry weather for treatment. At others, wet weather flows are diverted through CSO outfalls directly to Hamilton Harbour.

Collection system modelling completed to support this Class EA study showed that for the existing system, during some wet weather periods, even when there is capacity in the Woodward Avenue WWTP, flow is being diverted either to tanks or CSO outfalls. This is because the control structures are static and their settings may not be optimized. The best performance could only be realized if the control structures could be adjusted (referred to as “real time control” or RTC) based on how much capacity remained in the interceptor and at the plant for each particular event, to maximize the use of that capacity under a range of conditions such as storm intensity, and where in the City the storm is occurring.

8.2.2 Description of Alternatives

In general terms, there is only one alternative design concept to system optimization, that is a program of operational changes, control structure setting adjustments and automation of control structures and CSO tank pumps to facilitate maximum use of the Woodward Avenue WWTP capacity, and allow no overflows to the receiving water if plant capacity is available. This strategy provides the maximum available level of treatment to the wet weather flows generated within the City.

8.2.3 Preferred Design Concept

The City has already initiated the implementation of the preferred design concept for a system optimization and real time control (RTC) program, outside the scope of this Class EA study. That program will involve the following scope of work:

♦ Complete field investigations to validate the City’s combined trunk sewer “Modeling of Urban Sewer” (MOUSE) model in terms of current control structure configurations and settings

♦ Identify and evaluate strategies for optimizing the combined trunk system operation, with a goal of fully utilizing available CSO tank storage and planned
Woodward Avenue WWTP capacity before any system bypassing, and achieving local control goals, based on modification of flow control structures and real time control (RTC) (local manual and/or automated)

- Design and implement the preferred optimization and RTC strategy
- Initiate a data monitoring and reporting strategy, and use on-going results for further refinement and enhancement.

8.3 COOTES PARADISE

8.3.1 Description of Existing System

The combined sewer system discharges during storm events to Cootes Paradise through four CSOs, namely, Main-King CSO, Royal CSO, Ewen CSO and Sterling CSO.

The City has adopted a policy of controlling all CSO discharges to Cootes Paradise, with the exception of a maximum of one CSO event in an average rainfall year. The City has already constructed a CSO tank at the Main-King CSO, and recently completed construction at the Royal CSO. There are currently plans to install another tank at the Ewen CSO, which would leave the Sterling CSO as the only uncontrolled discharge point to Cootes Paradise.

8.3.2 Criteria and Constraints

Modelling results indicate that four to 11 discharge events would occur at the Sterling CSO in an average year\(^1\) with no upgrades to the system at this point. As such, CSO control measures are required to meet the City’s CSO discharge policy at this location.

A new CSO storage tank was considered for the Sterling CSO; however, a review of the land uses in the area showed that there is no adequately sized site that could accommodate the new tank. It was also determined through system modelling that the downstream Main-King storage tank has adequate capacity for Sterling CSOs, and therefore, use of this capacity was readily identified as a preferred design concept. In order to reduce the frequency of CSO events at the Sterling overflow, the Sterling CSC regulator structure simply requires adjustment, which will direct more flow downstream.

Through the system analysis, it was identified that there are hydraulic bottlenecks in the system upstream of the Main-King CSO storage tank. The existing 750 mm gravity sewer, which is installed under Provincial Highway 403, has a theoretical capacity of 680 L/s. However, the actual conveyance capacity is limited to 400 L/s before surcharging occurs. The upstream trunk sewer has a conveyance capacity of approximately 7,100 L/s and the downstream trunk sewer has a conveyance capacity of approximately 2,200 L/s. The existing 750 mm gravity sewer crossing Highway 403 results in a hydraulic bottleneck.

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\(^1\) An average year refers to: the long term average of flow based on using simulation of at least twenty years of rainfall data; and/or a year in which the rainfall pattern (e.g. intensity, volume and frequency) is consistent with the long-term mean of the area; and/or a year in which the runoff pattern resulting from the rainfall (e.g. rate, volume and frequency) is consistent with the long-term mean of the area.
This bottleneck prevents the total quantity of dry-weather sanitary flows from the upstream catchment areas from entering the Western Interceptor to be conveyed to the Woodward Avenue WWTP for treatment. Dry weather flows in excess of the Interceptor capacity under Highway 403 are diverted to the Main-King CSO tank, which effectively reduces the available volume within the tank to store wet weather flows. The total minimum conveyance capacity required to service the Sterling and the Main-King catchment areas and avoid using the CSO storage tank during dry weather is 800 L/s.

Therefore, to reduce discharges at the Sterling CSO outfall and optimize the use of available wet weather storage in Cootes Paradise, an evaluation of alternatives to achieve the required conveyance capacity in the Main-King catchment area was undertaken and is described in the following sections.

### 8.3.3 Description of Alternatives

Table 18 presents alternatives evaluated for alleviating the hydraulic bottleneck, so that flow does not enter the Main-King CSO tank during dry weather.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-1</td>
<td>Provide a secondary dry-weather conveyance sewer under Highway 403.</td>
<td>This alternative involves eliminating the hydraulic restriction at Highway 403 with a new twinned 750 mm gravity sewer under the highway. The proposed sewer could have a capacity of 1,100 L/s, increasing the total through flow capacity under Hwy 403 to 1,500 L/s.</td>
</tr>
<tr>
<td>M-2</td>
<td>Increase the dry-weather conveyance under Highway 403.</td>
<td>This alternative involves installation of a 600 mm diameter steel liner (pipe) within the existing 750 mm gravity trunk sewer under Highway 403, making the existing gravity trunk sewer conveyance suitable for pressurized pumped flows, and construction of a new 800 L/s sewage pumping station to convey the peak dry-weather flows through the 600 mm steel lined trunk sewer.</td>
</tr>
<tr>
<td>M-3</td>
<td>Construction of a dedicated dry-weather sewage pumping station.</td>
<td>This alternative would require construction of a new 400 L/s pumping station upstream of the CSO tank to convey dry-weather flows exceeding the existing 400 L/s capacity of the 750 mm diameter gravity sewer under Highway 403. The pumping station will increase the dry-weather through flow to the downstream trunk sewer. Flows into this new pumping station exceeding 400 L/s will overflow to the Main-King CSO Tank through the existing infrastructure.</td>
</tr>
</tbody>
</table>

### 8.3.4 Evaluation of Alternatives and Selection of Preferred

A detailed evaluation matrix for the Main-King CSO (Cootes Paradise) options is provided in Appendix 5.

A series of meetings were held with the Ministry of Transportation (MTO) to discuss the various alternatives and options for a possible new gravity sewer or forcemain under Highway 403. MTO identified the requirements and stipulations for any construction impacting the provincial route. These discussions further assisted the City in selecting a
preferred alternative for the Main-King catchment area. Relevant correspondence with the MTO is included in Appendix 9.

Option M-3 was selected as the preferred solution for the Main-King catchment area for the following reasons:

- There is very little risk involved with this option since construction on the existing CSO storage tank site will be relatively straightforward and any operations and maintenance work for the new pumping station will also be relatively straightforward.

- Other alternatives involve risk with construction impacting Highway 403 that will require permits from the MTO and could impact project costs and schedule.

- This alternative utilizes available capacity in the Main-King storage tank for flows from the Sterling catchment area.

- Meets all criteria at lowest capital and life-cycle costs.

8.3.5 Preferred Design Concept

The preliminary design concept for managing CSOs to Cootes Paradise is based on the adjustment of the Sterling CSO weir, which is required to be raised to allow an additional 400 L/s of wet-weather flow to be conveyed toward the Main-King catchment area. The existing 750 mm diameter gravity conveyance under Highway 403 will remain unchanged. Dry weather flows exceeding the existing 400 L/s capacity of the 750 mm diameter gravity sewer will be intercepted and diverted towards the Main-King CSO Tank. A new 400 L/s pumping station upstream of the CSO tank is proposed to be constructed to increase the dry-weather through flow to the downstream trunk sewer. Flows into this new pumping station exceeding 400 L/s will overflow to the Main-King CSO tank through the existing infrastructure. Any overflow of the tank will be conveyed to the existing outfall.

This alternative meets the minimum proposed conveyance required at the Main-King catchment area of 800 L/s. The capacity of the existing 750 mm gravity sewer across Highway 403 would remain at 400 L/s, while the proposed pumping station at the Main-King CSO tank site would be designed to convey an additional 400 L/s, increasing the total conveyance capacity to the required 800 L/s.

Figure 13 shows the site plan of the Main-King CSO tank site with the proposed combined pumping station.
8.4 SHERMAN INLET

8.4.1 Description of Existing System
The current combined sewer system discharges during storm events to Sherman Inlet through the Birch CSO.

The City has adopted a policy of controlling all CSO discharges to Sherman Inlet in an average rainfall year. Only the uncontrolled Birch CSO discharges at this location.

8.4.2 Criteria and Constraints
Modelling results indicate that 26 to 32 discharge events would occur at the Birch CSO in an average year\(^1\). As such, CSO control measures are required to meet the City’s CSO discharge policy at this location.

8.4.3 Description of Alternatives
Table 19 presents alternatives evaluated for the Birch CSO (Sherman Inlet).

<table>
<thead>
<tr>
<th>Table 19 Birch CSO Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Option</strong></td>
</tr>
<tr>
<td>B-1</td>
</tr>
<tr>
<td>B-2</td>
</tr>
<tr>
<td>B-3</td>
</tr>
<tr>
<td>B-4</td>
</tr>
</tbody>
</table>

8.4.4 Evaluation of Alternatives and Selection of Preferred
A detailed evaluation matrix for the Birch CSO (Sherman Inlet) options is provided in Appendix 5. Option B-4 was selected as the preferred solution, for the following reasons:

✦ City staff are familiar with the operation of pumping stations and operations and maintenance work for the new pumping station will be relatively straightforward.

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\(^1\) An average year refers to: the long term average of flow based on using simulation of at least twenty years of rainfall data; and/or a year in which the rainfall pattern (e.g. intensity, volume and frequency) is consistent with the long-term mean of the area; and/or a year in which the runoff pattern resulting from the rainfall (e.g. rate, volume and frequency) is consistent with the long-term mean of the area.
The proposed pumping station has the smallest footprint of all alternatives considered, and the Hamilton Port Authority, which owns the land on which the pumping station is proposed, are in general agreement with locating a pumping station here.

- Meets all criteria at lowest capital and life-cycle costs.

### 8.4.5 Preferred Design Concept

The proposed Birch Avenue pumping station site plan is presented in Figure 14. This pumping station will be designed to divert the flow from the Birch Avenue CSO outfall to the Wentworth CSO. The flow is proposed to be redirected from the Birch Avenue CSO sewer to the proposed pumping station, where it will be conveyed to the Wentworth CSO sewer.

The pumping station will be located on lands owned by the Hamilton Port Authority (HPA). Through consultation with the HPA, the City was able to modify the original proposed design for the pumping station to reach a design that was satisfactory to all parties and features parking spaces to allow access to the planned naturalized area and trails surrounding the Sherman Inlet. Relevant correspondence with the HPA is included in Appendix 9. HPA has requested additional correspondence during the detailed design phase of the pumping station to ensure that all factors are addressed.

The pumping station will be designed with a firm capacity of 2,400 L/s based on three duty pumps and one standby pump. The wet well is proposed to be divided into two cells to allow maintenance to be carried out easily by isolating each cell. The dry pit will accommodate the four wet well/dry pit submersible pumps, including the associated valves, fittings and pipes. The above grade portion of the pumping station will accommodate a standby diesel generator (if required), motor control centre (MCC) and control panels.

The conceptual site plan for the station has spatial requirements of approximately 35 m by 40 m. This includes required set back allowances, access and, as requested by the HPA, 5 parking spaces for access to the waterfront trail at the Sherman Inlet location. The required space for the pumping station was also minimized at the request of the HPA. A temporary construction easement of 35 m by 20 m will be required for the duration of construction.
8.5 WINDERMERE BASIN

8.5.1 Description of Existing System

The combined sewer system discharges during storm events to Windermere Basin through the Parkdale CSO.

The City has adopted a policy of controlling all CSO discharges to Windermere Basin in a typical rainfall year. Only the uncontrolled Parkdale CSO discharges at this location.

8.5.2 Criteria and Constraints

Modelling results indicate that 5 to 7 discharge events would occur at the Parkdale CSO in an average year\(^1\). As such, CSO control measures are required to meet the City’s CSO discharge policy at this location.

8.5.3 Description of Alternatives

Table 20 presents alternatives evaluated for the Parkdale CSO (Windermere Basin).

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-1</td>
<td>Install a storage tank at Parkdale CSO.</td>
<td>Construction of a CSO storage tank with a capacity of 5,000 m(^3). This alternative would require the identification and purchase of land sufficiently sized for a storage tank, as the City does not currently own any land to accommodate a tank of this size in the vicinity of the Parkdale CSO.</td>
</tr>
<tr>
<td>P-2</td>
<td>Capture CSO flows at the Parkdale CSO and pump to the Dunn CSO.</td>
<td>This alternative involves construction of a pumping station just upstream of the Parkdale CSO to pump flows to the Dunn CSO during storm events.</td>
</tr>
<tr>
<td>P-3</td>
<td>Extension of the Proposed 3.0m diameter storage tunnel to the Parkdale CSO at a length of 700 m.</td>
<td>Increase the downstream conveyance capacity of the system between Parkdale CSO and Woodward Avenue WWTP. This entails construction of a 700 m length of pipe with a 3.0 m diameter.</td>
</tr>
<tr>
<td>P-4</td>
<td>Weir adjustment and real-time control (RTC) to avoid overflow discharges at Parkdale CSO.</td>
<td>Implement a real-time control (RTC) system to continually adjust the levels of existing regulator gates and storage facilities according to changing rainfall and flow conditions in order to maximize the use of storage capacity available and minimize overflow volumes during each storm event.</td>
</tr>
</tbody>
</table>

8.5.4 Evaluation of Alternatives and Selection of Preferred

A detailed evaluation matrix for the Parkdale CSO (Windermere Basin) options is provided in Appendix 5. Option P-4 was selected as the preferred solution, for the following reasons:

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\(^1\) An average year refers to: the long term average of flow based on using simulation of at least twenty years of rainfall data; and/or a year in which the rainfall pattern (e.g. intensity, volume and frequency) is consistent with the long-term mean of the area; and/or a year in which the runoff pattern resulting from the rainfall (e.g. rate, volume and frequency) is consistent with the long-term mean of the area.
♦ A real-time control (RTC) system continually adjusts the levels of existing regulator gates and storage facilities according to changing rainfall and flow conditions, which will maximize the use of storage capacity available and minimize overflow volumes during each storm event.

♦ RTC requires no land or construction and therefore has no impact on the environment due to construction.

♦ The proximity of the Parkdale CSO to the Woodward Avenue WWTP reduces the complexity of RTC operation for City staff.

♦ Meets all criteria at lowest capital and life-cycle costs.

8.6 COST OF PREFERRED COLLECTION SYSTEM DESIGN CONCEPTS

Table 20 presents a summary of preferred design concepts and capital costs of the preferred collection system design concepts for wet weather flow control.

<table>
<thead>
<tr>
<th>Table 21</th>
<th>Preferred Collection System Design Concepts and Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Concept</td>
<td>Capital Cost</td>
</tr>
<tr>
<td>Collection system optimization and real time control (RTC), including upgrades at the Parkdale CSO to prevent overflows when the plant is not at capacity.</td>
<td>$10,500,000</td>
</tr>
<tr>
<td>Sterling flow diversion and Main-King Tank Pumping Station</td>
<td>$4,400,000</td>
</tr>
<tr>
<td>Birch Avenue CSO Pumping Station</td>
<td>$6,800,000</td>
</tr>
<tr>
<td>Total Collection System Preferred Design Concept</td>
<td>$21,700,000</td>
</tr>
</tbody>
</table>

Note:
1. Includes allowance for engineering, contingency, bonding and inflation.