CSO Master Plan

Hart District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Hart District Plan
Revision:	03
Date:	August 22, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	Hart_Plan_Final_CO1MP_08192019

Jacobs Engineering Group Inc.

1301 Kenaston Boulevard
Winnipeg, MB R3P 2P2
Canada
www.jacobs.com

Document History and Status

Revision	Date	Description	By	Review	Approved
0	10/05/2018	DRAFT for City Comment	AK, DT	SG	
1	02/15/2019	DRAFT 2 for City Review	JT	MF	MF
2	6/20/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

JACOBS

Contents

Tables

Figure

1. Hart District

1.1 District Description

The Hart district is located in the northeastern sector of the combined sewer (CS) area along the eastern edge of the Red River, south of the Munroe district and west of the Roland district. Hart is approximately bounded by the Red River to the south and west, Gateway Road to the east, and Harbison Avenue West to the north.

The majority of Hart is mixed residential with smaller areas of commercial and industrial land use. Residential areas are mainly single-family with some two-family and multi-family along Watt Street and Stadacona Street. Manufacturing and commercial areas are located along Henderson Highway, Watt Street, and Stadacona Street. Approximately 45 ha of the district is classified as greenspace. Greenspace areas include Elmwood Winter Park, Chalmers Park, and Ernie O'Dowda Park; and various school parks, playgrounds, and community areas throughout the district. The Elmwood Cemetery makes up a large area in the southwestern part of the district.

This district is located in proximity to downtown and has many transportation routes. Regional roads in the district include Henderson Highway and Watt Street in the north-south direction and Nairn Avenue, Talbot Avenue, Midwinter Avenue, Hespler Avenue, and Johnson Avenue in the east-west direction. The Harry Lazeranko Bridge on Hespler Avenue and both the Disraeli (Henderson Highway) and Louise Bridges (Stadacona Street) cross the Red River into St Johns and Syndicate districts, respectively.

1.2 Development

A portion of Nairn Avenue and Henderson Highway are located within the Hart District. These streets are identified as a Regional Mixed Use Corridors as part of the OurWinnipeg future development plans. As such, focused intensification along Nairn Avenue and Henderson Highway is to be promoted in the future.

Nairn Avenue, Watt Street, and a portion of Stradacona Street within the Hart District have been identified as part of the potential routes for the Eastern Corridor of Winnipeg's Bus Rapid Transit. The work along these streets could result in additional development in the area. This could also present an opportunity to coordinate sewer separation works alongside the transit corridor development, providing further sewer separation within the Hart District. This would reduce the extent of the Control Options listed in this plan required.

1.3 Existing Sewer System

Hart district encompasses an area of 222 ha[1] based on the district boundary and includes a CS system and a storm relief sewer (SRS) system. This district includes 15 percent (33 ha) identified as land drainage sewer (LDS) separated. There are no separation-ready areas identified.

The CS system includes a diversion structure, flood pump station (FPS), CS lift station (LS), CS outfall, and outfall gate chamber within the FPS. The CS systems drain towards the pump stations and Hart CS outfall located at the western end of Hart Avenue at the Red River. Sewage is either diverted to the SPS and pumped across the Red River and connects to the Main Interceptor within the St. Johns district, or overflows the primary weir and flows through the FPS wet well and into the CS outfall into the Red River.

A single CS trunk collects flow from most of the district and directs flow to the primary weir near Hart Avenue. The main 1625 mm by 2060 mm CS trunk extends from the primary weir east along Hart Avenue. Multiple collector pipes in the eastern and centre areas of Hart district flow into the CSmain

[1] City of Winnipeg GIS information relied upon for area statistics. The GIS records may vary slightly from the city representation in the InfoWorks sewer model. Therefore, minor discrepancies in the area values reported in Section 1.3 Existing Sewer System, and in Section 1.8 Performance Estimate may occur

along Henderson Highway. The Henderson Highway CS main then flows to tie into the main trunk sewer on Hart Avenue.

The SRS system includes various interconnections to the CS system. The southeastern portion of the district east of Stadacona Street and south of Chalmers Avenue is serviced by a complete SRS system including connected catch basins and an outfall to the Red River. This portion of the SRS connects downstream of the gate chamber that services the Roland district CS system and shares this outfall with the SRS and CS from the Roland district. As the Hart SRS ties into the outfall downstream of the gate chamber, there is no flap gate or positive gate to provide protection against high river levels. The remainder of the SRS pipe in the district west of Stadacona and north of Chalmers Avenue provides extra capacity during high flow events, such that the CS system can overflow into the SRS. When CS capacity is regained, the SRS drains back into the Hart CS system. Most catch basins, aside from the southeastern SRS area, are still connected to the CS system.

During dry weather flow (DWF), the SRS is not required; sanitary sewage flows to the diversion chamber and is diverted by the primary weir to a 450 mm off-take pipe, where it flows by gravity to an adjacent CS LS to be pumped through a force main river crossing. The river crossing flows into the St. John's district and discharges by gravity into the Main Interceptor, which eventually flows by gravity to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF) events, any flows that exceed the diversion capacity overtop the primary weir and are discharged to the Red River via the outfall structure. Sluice and flap gates are installed on the CS outfall to prevent back-up of the Red River into the CS system under high river level conditions. Under these high river level conditions gravity discharge is not possible, and excess flow is pumped by the Hart FPS to an alternate outfall flow path, which allows it to by-pass the flap and sluice gates and be discharged directly to the river via the same outfall.

There is one (shared CS and SRS) outfall to the Red River as follows:

- ID27 (S-MA70043042) – Hart CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Hart and the surrounding districts. Each interconnection is shown on Figure 17 and shows locations where gravity flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

St John's

- Two 300 mm force mains carry flow from the Hart SPS across the Red River to the St. John's district:
  - Invert at manhole in St. John's district east of Main Street – 227.72 m (S-MH70028727)

1.3.1.2 District Interconnections

Mission

<u>CS to CS</u>

- CS flows through a 600 mm CS off-take secondary interceptor pipe south by gravity on Archibald Street from Hart district into Mission district. This is CS intercepted from the Roland district. This CS then flows into the Montcalm CS LS and is pumped via force main river crossing into the Syndicate district. There is no interaction with the Hart CS system.
  - Invert at Hart district boundary 223.56 m (S-MA50018054)

Roland

CS to CS

- A 1625 by 2060 mm CS flows west by gravity on Elmwood Road at Watt Street from Roland district into Hart district to enter the Roland CS outfall. There is no interaction with the Hart CS system.
  - Invert at Hart district boundary 223.52 m (S-MA40011002)

SRS to SRS

- A 2900 mm SRS flows southwest by gravity crossing Elmwood Road from Roland district into Hart district. This trunk connects into the same gate chamber and outfall as the Watt Street SRS; there is no interaction with the Hart SRS system upstream of the gate chamber.
  - Invert at Hart district boundary 222.27 m (S-MA40011025)

A district interconnection schematic is included as Figure 1-1. The drawing illustrates the collection areas, interconnections, flow controls, pumping systems, and discharge points for the existing system.

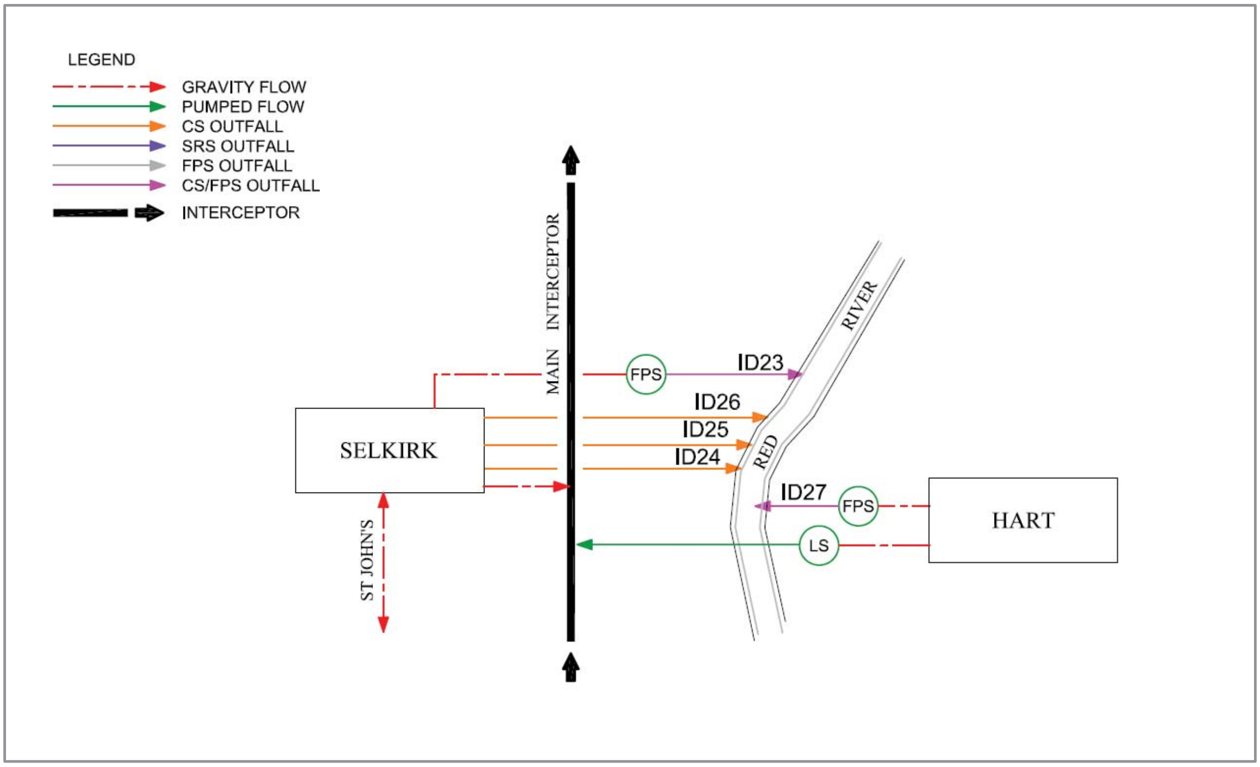

Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 17 and listed in Table 1-1.

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Combined Sewer Outfall (ID27)	S-AC70016714.1	S-MA70043042	2550 mm, Invert: 222.02 m	Red River (SAP_E-34 has 2400 mm)

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Flood Pumping Outfall (ID27)	S-AC70016714.1	S-MA70043042	2550 mm, Invert: 222.02 m	Red River (SAP_E-34 has 2400 mm)
Main Trunk	S-TE40000965.1	S-MA70016456	2850 mm Invert: 222.76 m	Main CS that flows west on Hart Avenue (SAP_E-34 has 2850 x 2160 mm)
SRS Outfalls	N/A	N/A	N/A	SRS outfall from Hart shared with primary CS outfall from Roland district.
SRS Interconnections	N/A	N/A	N/A	52 SRS - CS
Main Trunk Flap Gate	S-TE70026133.1	S-CG00001075	2400 mm	Invert: 223.14 m
Main Trunk Sluice Gate	S-CG00001075.1	S-CG00001076	2400 x 2400 mm	Invert: 222.87 m
Off-Take	S-MH70006540.1	S-MA70016455	450 mm	Diverts DWF to lift stations for treatment Invert: 222.76 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.114 m^3/s	2 x 0.057 m^3/s
ADWF	N/A	N/A	0.029 m^3/s	
Lift Station Force Main	S-MH70028728.2	S-MA70062904	300 mm	Pumped for treatment at NEWPCC Invert: 226.46 m
	S-MH70028728.1	S-MA70062904	300 mm	Pumped for treatment at NEWPCC Invert: 226.46 m
Flood Pump Station Total Capacity	N/A	N/A	1.83 m^3/s	2 x 0.53 m^3/s 1 x 0.77 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.124 m^3/s	

Notes:

ADWF = average dry-weather flow
GIS = geographic information system
ID = identification

N/A = not applicable

The critical system elevations for the existing system relevant to the development of the CSO control options are listed in Table 1-2. Critical elevation reference points are identified on the district overview and detailed maps.

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
1	Normal Summer River Level	Hart – 223.683
2	Trunk Invert at Off-Take To Lift Station	222.76
3	Top of Weir	223.08
4	Relief Outfall Invert at Flap Gate	N/A

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
5	Low Relief Interconnection (S-TE40000965)	223.46
6	Sewer District Interconnection (Roland)	222.52
7	Low Basement	226.65
8	Flood Protection Level (Hart)	229.32

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

Table 1-3 provides a summary of the district status in terms of data capture and study. The most recent study completed in Roland was the *Munroe, Roland, Hart Combined Sewer Study* (Wardrop, 1985). The study's purpose was to develop sewer relief options to reduce surcharge levels and relieve basement flooding. No other studies have been completed on the district sewer system since that time.

Between 2009 and 2015, the City invested $12 million in the CSO Outfall Monitoring Program. The program was initiated to permanently install instruments in the primary CSO outfalls. The outfall from the Hart Combined Sewer District was included as part of this program. Instruments installed at each of the 39 primary CSO outfall locations has a combination of inflow and overflow level meters and flap gate inclinometers if available.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
17 – Hart	1985	Future Work	2013	Study Complete	N/A

Source: Report *Munroe, Roland, Hart Combined Sewer Study*, 1985

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Hart district. This consists of monthly site visits in confined entry spaces to verify that physical readings concur with displayed transmitted readings and replacing desiccants where necessary.

1.6 Control Option 1 Projects

1.6.1 Project Selection

The proposed projects selected to meet Control Option 1 – 85 Percent Capture in a Representative Year for the Hart sewer district are listed in Table 1-4. The proposed CSO control projects will include in-line storage via a control gate, and floatable management via screening. Program opportunities including green infrastructure (GI) and real time control (RTC) will also be included as applicable.

Table 1-4. District Control Option

Control Limit	Latent Storage	Flap Gate Control	Gravity Flow Control	Control Gate	In-line Storage	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year	-	-	-	✓	✓	-	-	-	✓	✓	✓

Notes:

- = not included
✓ = included

The existing CS system is suitable for use as in-line storage. This control options will take advantage of the existing CS pipe networks for additional storage volume. Existing DWF from the collection system will remain the same, and overall district operations will remain the same. The district has a large CS trunk and capacity available to operate as storage.

All primary overflow locations are to be screen under the current CSO control plan. Installation of a control gate will be required for the screen operation, and it will provide the mechanism for capture of the in-line storage. Floatable control will be necessary to capture floatables in the sewage. Floatables will be captured with all implemented control options to some extent, but screening may be added as required to reach the desired level of capture.

Complete sewer separation was also assessed for the Hart district, given the extent of separation which has occurred to date and the access to the Red River from multiple points within the district. The system wide assessment however did not find complete sewer separation to be necessary to achieve the 85 percent capture performance target. Complete sewer separation in this instance was found to not be cost effective to achieve the necessary percent capture.

GI and RTC will be applied within each district on a system-wide basis with consideration of the entire CS area. The level of implementation for each district will be determined through evaluations completed through district level preliminary design.

1.6.1 In-Line Storage

In-line storage has been proposed as a CSO control for the Hart district. In-line storage will require the installation of a control gate at the CS outfall. The gate will increase the storage level in the existing CS and provide an overall higher volume capture. The existing SPS will provide the dewatering for the in-line storage.

A standard design was assumed for the control gate, as described in Part 3C. A standard approach was used for conceptual gate sizing by assuming it to be the lesser of the height of half of the site-specific trunk diameter or the maximum height of the gate available. The design criteria for the in-line storage are listed in Table 1-5.

Table 1-5. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	222.76 m	N/A
Trunk Diameter	2850 mm	N/A

Table 1-5. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Gate Height	1.21 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	224.28 m	N/A
Maximum Storage Volume	2027 m^3	N/A
Nominal Dewatering Rate	0.114 m^3/s	Based on existing CS LS capacity
RTC Operational Rate	TBD	Future RTC / dewatering review on performance, potentially based on 2 times nominal rate

Note:
RTC = Real Time Control
TBD = to be determined

The proposed control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 17. The extent of the in-line storage and volume is related to the top elevation of the bypass side weir. The level of the top of the bypass side weir and adjacent control gate level are determined in relation to the critical performance levels in the system for basement flooding protection: when the system level increases above the bypass weir crest and proceeds above the top of the control gate during high flow events, , the control gate drops out of the way. At this point, the district will only provide its original interception capacity via the primary weir for the district, and all excess CS would flow over the weir and discharge to the river. After the sewer levels in the system drops back below the bypass side weir critical performance level, the control gate moves back to its original position to capture the receding limb of the WWF event. The CS LS will continue with its current operation while the control gate is in either position, with all DWF being diverted to the CS LS and pumped. The CS LS will further dewater the in-line storage provided during a WWF event as downstream capacity becomes available.

The physical requirements for the off-take and station sizing for a modification to pumping capacity have not been considered in detail, but they will be required in the future as part of an RTC program or lift station rehabilitation or replacement project.

Figure 17-01 provides an overview of the conceptual location and configuration of the control gate and screening chambers. The control gate will be installed in a new chamber within the trunk sewer alignment upstream of the FPS and CS LS. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 6 m in length and 4 m in width. The existing pipe configuration, including the weir and off-take, will have to be modified to allow the installation of the in-line gate and screening chambers. The outfall easement is constricted which may add difficulty to construction in this location. Residential homes are located directly adjacent to the existing gate chamber and easement.

The nominal rate for dewatering is set at the existing CS LS capacity. This allows dewatering through the existing interceptor system within 24 hours following the runoff event, allowing it to recover in time for a subsequent event. The future RTC upgrades will provide the ability to capture and treat more volume for localized storms by using the excess interceptor capacity where the runoff is less. Further assessment of the actual impact of the future RTC/dewatering arrangement will be necessary to review the downstream impacts.

1.6.2 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens will be designed to maintain the current level of basement flooding protection.

The type and size of screens depend on the specific station configuration and the head available for operation. A standard design was assumed for screening and is described in Part 3C. The design criteria for screening, with an in-line control gate implemented, are listed in Table 1-6.

Table 1-6. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.28 m	
Bypass Weir Crest	224.18 m	
NSWL	223.68 m	
Maximum Screen Head	0.50 m	
Peak Screening Rate	0.52 m^3/s	
Screen Size	1.5 m wide x 1 m high	Modelled Screen Size

The side overflow weir and screening chamber will be located adjacent to the existing combined trunk sewer, as shown on Figure 17-01. The screens will operate once levels within the sewer surpass the in-line control elevation. A side weir upstream of the control gate will direct the overflow to the screens located in the new screening chamber, with screened flow discharged to the downstream side of the gate to the river. The screening chamber will include screenings pumps with a discharge returning the screened material back to Hart CS LS and on to NEWPCC for removal. The provision of screening pumps is dependent on final level assessment within the existing infrastructure and the Hart trunk is likely to require pumped screenings return. This will be confined during the future assessment stage.

The dimensions for the screen chamber to accommodate influent from the side weir, the screen area, and the routing of discharge downstream of the gate are 3.5 m in length and 3 m in width.

1.6.3 Green Infrastructure

The approach to GI is described in Section 5.2.1 of Part 2 of the CSO Master Plan. Opportunities for the application of GI will be evaluated and applied with any projects completed in the district. Opportunistic GI will be evaluated for the entire district during any preliminary design completed. The land use, topography and soil classification for the district was reviewed to identify the most applicable GI controls.

Hart has been classified as a high GI potential district. Land use in Hart is mixed residential with smaller areas of commercial and industrial land use. Residential areas are mainly single-family with some two-family and multi-family along Watt Street and Stadacona Street. Manufacturing and commercial areas are located along Henderson Highway. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, and rain gardens. The flat roof commercial buildings along Henderson Highway make would be an ideal location for green roofs. There is also a higher area of greenspace in Hart district which could be used for rain garden projects.

1.6.4 Real Time Control

The approach to RTC is described in Section 5.2.2 of Part 2 of the CSO Master Plan. The application of RTC will be evaluated and applied on a district by district basis through the CSO Master Plan projects with long term consideration for implementation on a system wide basis.

1.7 System Operations and Maintenance

System operations and maintenance (O&M) changes will be required to address the proposed control options. This section identifies general O&M requirements for each control option proposed for the district. More specific details on the assumptions used for quantifying the O&M requirements are described in Part 3C of the CSO Master Plan.

In-line storage will impact the existing sewer and will require the addition of a new chamber and a moving gate at the outfall. In-line storage dewatering will be controlled with the existing Clifton CS LS, which will require more frequent and longer duration pump run times. Lower velocities will occur in the CS trunk in the vicinity of the control gate due to lower pass forward flows, and may create additional debris deposition requiring cleaning. Additional system monitoring, and level controls will be installed, which will require regular scheduled maintenance.

Floatable control with outfall screening will require the addition of another chamber with screening equipment installed. The chamber will be installed adjacent to the control gate chamber and will operate in conjunction with it. Screening operation will occur during WWF events that surpass the in-line storage control level. WWF will be directed from the main CS trunk, over the side weir in the control gate chamber and through the screens to discharge into the river. The screens will operate intermittently during wet weather events and will likely require operations review and maintenance after each event. The frequency of a screened event will correlate to the number overflows identified for the district. Having the screenings pumped back to the interceptor system via a small LS and force main will be required. The screenings return will require O&M inspection after each event to assess the performance of the return pump system.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. An individual model was created to represent the sewer system baseline as represented in the year 2013 and a second model was created for the CSO Master Plan evaluation purposes, with all the control options recommended for the district to meet Control Option 1 implemented in the year 2037. A summary of relevant model data is provided in Table 1-7.

Table 1-7. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	193	193	9,488	68	N/A
2037 Master Plan – Control Option 1	193	193	9,488	68	IS, SC

Notes:

Total area is based on the model subcatchment boundaries for the district.
IS = In-line Storage
SC = Screening

No change to the future population was completed as from a wastewater generation perspective from the update to the 2013 Baseline Model to the 2037 Master Plan Model. The population generating all future wastewater will be the same due to Clause 8 of Environment Act Licence 3042 being in effect for the CS district.

City of Winnipeg hydraulic model relied upon for area statistics. The hydraulic model representation may vary slightly from the City of Winnipeg GIS Records. Therefore, minor discrepancies in the area values reported in Section 1.3 Existing Sewer System, and in Section 1.8 Performance Estimate may occur.

The performance results listed in Table 1-8 are for the hydraulic model simulations using the year-round 1992 representative year. The table lists the results for the Baseline, for each individual control option, and for the proposed CSO Master Plan - Control Option 1. The Baseline and Control Option 1 performance numbers represent the comparison between the existing system and the proposed control options. The table also includes overflow volumes specific to each individual control option; these are listed to provide an indication of benefit gained only and are independent volume reductions.

Table 1-8. Performance Summary – Control Option 1

Control Option	Preliminary Proposal Annual Overflow Volume (m^3)	Master Plan Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [a]
Baseline (2013)	202,990	202,745	-	21	0.090 m^3/s
In-Line Storage	158,187	165,575	37,170	20	0.127 m^3/s
Control Option 1	**158,187**	165,575	37,170	**20**	**0.127 m^3/s**

[a] Pass forward flows assessed on the 1-year design rainfall event

The percent capture performance measure is not included in Table 1-8, as it is applicable to the entire CS system and not for each district individually.

1.9 Cost Estimates

Cost estimates were prepared during the development of the Preliminary Proposal and have been updated for the CSO Master Plan. The CSO Master Plan cost estimates have been prepared for each control option, with overall program costs summarized and described in Section 3.4 of Part 3A. The cost estimate for each control option relevant to the district as determined in the Preliminary Proposal and updated for the CSO Master Plan are identified in Table 1-9. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-9. Cost Estimates – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance Cost (Over 35-year period)
In-Line Storage	$7,740,000 [a]	$2,950,000 [b]	$47,000	$1,010,000
Screening		$2,330,000 [c]	$54,000	$1,150,000
Subtotal	**$7,740,000**	**$5,280,000**	**$101,000**	**$2,160,000**
Opportunities	N/A	$530,000	$10,000	$220,000
District Total	**$7,7400,000**	**$5,810,000**	**$111,000**	**$2,380,000**

[a] Control Gate and screening costed together as part of the Preliminary Proposal costing.

[b] Cost associated with new off-take construction, as required, to accommodate control gate location and allow intercepted CS flow to reach existing Clifton LS not included

[c] Cost for bespoke screenings return pump/force main not included in Master Plan as will depend on selection of screen and type of screening return system selected

The estimates include changes to the control option selection since the Preliminary Proposal, updated construction costs, and the addition of GI opportunities. The calculations for the CSO Master Plan cost estimate includes the following:

- Capital costs and O&M costs are reported in terms of present value.
- A fixed allowance of 10 percent has been included for GI, with no additional costs for RTC. This has been listed as part of the Opportunities costs.
- The Preliminary Proposal capital cost is in 2014-dollar values.

- The CSO Master Plan capital cost is based on the control options presented in this plan and in 2019-dollar values.
- The 2019 Total Annual Operations and Maintenance (over 35-year period) cost component is the present value costs of each annual O&M cost under the assumption that each control option was initiated in 2019.
- The 2019 Annual Operations and Maintenance Costs were based on the estimated additional O&M costs annually for each control option in 2019 dollars.
- Future costs will be inflated to the year of construction.

Cost estimates were prepared during the development of the Preliminary Proposal and updated for Phase 3 during the CSO Master plan development. The differences identified between the Preliminary Proposal and the CSO Master Plan are accounting for the progression from an initial estimate used to compare a series of control options, to an estimate focusing on a specific level of control for each district. Any significant differences between the Preliminary Proposal and CSO Master Plan estimates are identified in Table 1-10.

Table 1-10. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Option	Control Gate	Preliminary Proposal estimate was based on a standard cost per district, which has been updated to a site-specific cost estimate.	Updates to costing estimates adopted for Master Plan costing
	Screening	Preliminary Proposal estimate was based on a standard cost per district, which has been updated to a site-specific cost estimate.	Updates to costing estimates adopted for Master Plan costing
Opportunities	A fixed allowance of 10 percent has been included for program opportunities	Preliminary Proposal estimate did not include a cost for GI opportunities	
Lifecycle Cost	The lifecycle costs have been adjusted to 35 years	City of Winnipeg Asset Management Approach	
Cost escalation from 2014 to 2019	Capital Costs have been inflated to 2019 values based on an assumed value of 3 percent per for construction inflation.	Preliminary Proposal estimates were based on 2014-dollar values.	

1.10 Meeting Future Performance Targets

The regulatory process requires consideration for upgrading Control Option 1 to 98 percent capture for the representative year. This will still be on a system-wide basis and will permit the number of overflows and percent capture to vary by district to meet the 98 percent capture target. Table 1-11 provides a description of how the upgrade could be met by building off controls identified in Control Option 1.

Overall the Hart district would be classified as a high potential for implementation of complete sewer separation as a feasible approach to achieve the 98 percent capture future performance target in the representative year. . The non-separation measures recommended as part of this district engineering plan to meet Control Option 1, specifically in-line storage and floatables management via off-line screening, are therefore at risk of becoming redundant and unnecessary when the measures to achieve future performance targets are pursued. As a result, these measures should not be pursued until the requirements to meet future performance targets are more defined. Should it be confirmed that complete separation is the recommended solution to meet future performance targets, then complete separation will likely be pursued to address Control Option 1 instead of implementing the non-separation measures. This will be with the understanding that while initial complete separation is less cost-effective to meet Control Option 1, it is the most cost effective solution to meet the future performance target and removes the capital costs on short term temporary solutions. The focused use of green infrastructure at key locations would also provide additional volume capture benefits to meet future performance targets.

Table 1-11. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Sewer Separation • Increased use of GI

The control options selected for the Hart district have been aligned for the 85 percent capture performance target based on the system wide basis. The expandability of this district to meet the 98 percent capture would be restricted as proposals for Control Option No.1 do not match with the 98 percent target. This would involve the expansion of the SRS systems, although this would require connection of the existing catch basins in locations where SRS pipes have been installed and this will be required to be completed to achieve complete sewer separation of this district.

The cost for upgrading to an enhanced performance target depends on the summation of all changes made to control options in individual districts and has not been fully estimated at this stage of master planning. The Phase In approach is to be presented in detail in a second submission for 98 percent capture in a representative year, due on or before April 30, 2030.

1.11 Risks and Opportunities

The CSO Master Plan and implementation program are large and complex, with many risks having both negative and positive effects. The objective of this section is to identify significant risks and opportunities for each control option within a district.

The CSO Master Plan has considered risks and opportunities on a program and project delivery level, as described in Section 5 of Part 2 of the CSO Master Plan. A Risk And Opportunity Control Option Matrix covering the district control options has been developed and is included as Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-12.

Table 1-12. Control Option 1 Significant Risks and Opportunities

ID Number	Component	Latent Storage / Flap Gate Control	In-line Storage / Control Gate	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
1	Basement Flooding Protection	-	R	-	-	-	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-

Table 1-12. Control Option 1 Significant Risks and Opportunities

ID Number	Component	Latent Storage / Flap Gate Control	In-line Storage / Control Gate	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
6	Sewer Condition	-	R	-	-	-	-	-	-
7	Sewer Conflicts	-	R	-	-	-	-	-	-
8	Program Cost	-	O	-	-	-	-	-	O
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	-	O	O	-
12	Operations and Maintenance	-	R	-	-	-	R	O	R
13	Volume Capture Performance	-	O	-	-	-	O	O	-
14	Treatment	-	R	-	-	-	O	O	R

Risks and opportunities will require further review and actions at the time of project implementation.

1.12 References

Wardrop Engineering Consultants (Wardrop). 1985. *Munroe, Roland, Hart Combined Sewer Relief Study.* Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. June.

LEGEND

- Primary Weir
- Critical Elevation
- CSO Outfall
- Low CS Manhole
- Low SRS Connection

Inter-System Connection
- CS - WWS
- SRS - CS
- SRS - LDS

District Boundary Crossing
- CS
- SRS
- WWS

- Interceptor Sewer
- Force Main
- Street
- Railway
- District Boundary
- Watercourse
- Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

- Proposed Control Gate
- Extent of In-line Storage
- Sewer Separation - Complete

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

Notes:
1. Map data source - City of Winnipeg, 2013

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 17
District Overview Map
Sewer District: Hart
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE7\HART\HART_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 9:58:57 AM

LEGEND
Primary Weir
Critical Elevation
CSO Outfall
Manhole
Flap Gate
Sluice Gate
Pump Location
Force Main
Sewer By Type
CS
SRS
WWS
Pump Station Type
Flood Pump Station
Lift Station

CSO MASTER PLAN PROPOSED SOLUTIONS
Control Gate
Screening

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

Notes:
1. Map data source - City of Winnipeg, 2013

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 17-01
Control Gate and Screening
Sewer District: Hart
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE7\HART\HART_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 10:01:28 AM