CSO Master Plan

Baltimore District Plan

August 2019

City of Winnipeg

JACOBS

CSO Master Plan

Project No: 470010CH
Document Title: Baltimore District Plan
Revision: 04
Date: August 18, 2019
Client Name: City of Winnipeg
Project Manager: John Berry
Author: Danny Tinker
File Name: Baltimore_Plan_Final_CO1MP_08182019_Tracked

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	06/2018	DRAFT for City Comment	DT	ES/SG	
1	02/15/2019	DRAFT 2 for City Review	DT	SG/MF	MF
2	06/2019	Final Draft Submission	DT	MF	MF
3	07/2019	Revised Final Draft Submission	DT/MF	MF	MF
4	08/18/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Baltimore District

1.1 District Description

Baltimore district is located towards the southern limit of the combined sewer (CS) area and is included within the South End Sewage Treatment Plant (SEWPCC) catchment area. Baltimore is bounded by Daly Street to the west, Glasgow Avenue to the north and the Red River to the east and south. Figure 06 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan control options.

Osborne Street (Highway 62) is a regional road that passes through Baltimore district; this turns into Dunkirk Drive after the St. Vital Bridge, which crosses over the Red River, in the Mager district to the south. The northern portion of Osborne Street abuts the Jessie district and goes underneath the Southwest Transit Corridor. Baltimore district also contains the eastern end of Jubilee Avenue, which is a high traffic route that connects Pembina Highway and Osborne Street. The Southwest Rapid Transitway (SWRT) briefly enters and exits the district in the northwest.

The land usage is categorized as mainly residential (over 50 percent), with the remainder of developed land identified as commercial along Osborne Street. Non-residential use in the area includes the Riverview Health Centre, located in the northeastern section of the district, and part of the Winnipeg Transit Fort Rouge Garage located on Brandon Avenue.

The only available green space is that which borders the Red River, running along the edge of the district and can be seen in the overhead view in Figure 06.

1.2 Development Potential

There is limited land area available for new development within Baltimore district. No significant developments that would impact the CSO Master Plan are planned or expected.

One area within the Baltimore combined sewer district has been identified as a Major Redevelopment Site, the Fort Rouge Yards. This site includes the lands immediately east of the Fort Rouge rail lines, and the Bus Rapid Transit corridor. This Major Redevelopment Site is considered underused and will be prioritized to be developed into a higher density, mixed-use community.

1.3 Existing Sewer System

The Baltimore district has an approximate area of 200 ha[1] based on the district boundary. There is approximately 3 percent of the district by area (7 ha) which has been partially separated. .

The CS system includes a flood pump station (FPS), CS lift station (LS), one combined CS / flood pump station (FPS) outfall, and four storm relief sewer (SRS) outfalls. All domestic wastewater and CS flow collected in Baltimore district are routed to Baltimore Road, where the CS, LS, FPS and outfall are located.

The CS collected throughout the district flows into the main 1350 mm by 1800 mm sewer trunk that leads to the CS LS, FPS and outfall located at the eastern end of Baltimore Street. The Baltimore interceptor sewer extends from Cockburn district along Rosedale Avenue to Osborne Street and then connects to Baltimore Road from Osborne Street.

---

[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.

During dry weather flow (DWF), flow is diverted by the primary weir to the Baltimore CS LS and pumped through the Baltimore force main that runs parallel to Churchill Drive and then across the Red River via river crossing that runs parallel to the St. Vital Bridge, then tying into a gravity sewer flowing to the Mager CS LS. The Mager LS pumps to the south end interceptor system, which flows by gravity to the South End Sewage Treatment Plant (SEWPCC). During wet weather flow (WWF), any flow that exceeds the diversion capacity of the primary weir is discharged into the Baltimore outfall, where it is discharged to the Red River by gravity. 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 and when gravity discharge through the outfall is not possible, the excess flow is pumped by the Baltimore FPS through the CS outfall to the Red River.

An SRS system was designed and installed throughout the Baltimore district to increase the level of basement flood protection by diverting flow to existing pipes with sufficient capacity or directly to the Red River. Baltimore has four SRS outfalls, each located along the edge of the Red River. Eccles West and Eccles East are positioned for the northeastern section of Baltimore, Hay for the northwestern section, and Osborne for the southern section of the district to relieve the system during WWF surcharge. In these areas, high point off-take pipe interconnections divert WWF from the CS system to the SRS system that directs flow either to an SRS outfall or back to the Baltimore CS outfall. Sluice and flap gates are also installed on the SRS outfall to prevent back-up of the Red River into the SRS system under high river level conditions.

The five outfalls to the Red River are as follows:

- ID05 (S-MA60013599) – Baltimore CS Outfall
- ID02 (S-MA70006325) – Osborne SRS Outfall
- ID07 (S-MA70022370) – Eccles East SRS Outfall
- ID08 (S-MA70006655) – Eccles West SRS Outfall
- ID09 (S-MA70005806) – Hay SRS Outfall

1.3.1 District-to-District Interconnections

There are four district-to-district interconnections between Baltimore and the neighboring Cockburn district. The Baltimore force main transfers flow across the Red River to Mager district. The force main crosses the Red River parallel to the St. Vital Bridge. Interconnections include gravity and pumped flow from one district to the other. Each interconnection is listed in the following subsections:

1.3.1.1 Interceptor Connections – Upstream Of Primary Weir

Cockburn

- The Cockburn CS LS discharges into the Baltimore Interceptor, a gravity sewer beginning at Cockburn Street and Rosedale Avenue that flows through the Baltimore district to the Baltimore CS LS. This interceptor also receives the CS collected from the Baltimore district.
  - Rosedale Avenue at Baltimore District Boundary invert – 228.28 m (S-MA60012254)

1.3.1.2 Interceptor Connections – Downstream Of Primary Weir

Baltimore

- The 450 mm Baltimore LS force main flows under pressure into Mager district at Kingston Row and Edinburgh Street:
  - Dunkirk Avenue force main at connection point to Mager CS – 226.56 m (S-MA50017754)

1.3.1.3 District Interconnections

Cockburn

<u>CS to CS</u>

- High Point Manholes (flow is directed into both districts from these manholes):
  - Montague Avenue and Nassau Street South – 228.88 m References Both Districts (S-MH60010528)
  - McNaughton Avenue and Nassau Street South – 228.82 m References Both Districts (S-MH60010544)
  - Churchill Drive – 229.71 m References Both Districts (S-MH60010728)

A district interconnection schematic is included as **Error! Not a valid bookmark self-reference.**. The drawing illustrates the collection areas, interconnections, pumping systems, and discharge points for the existing district.

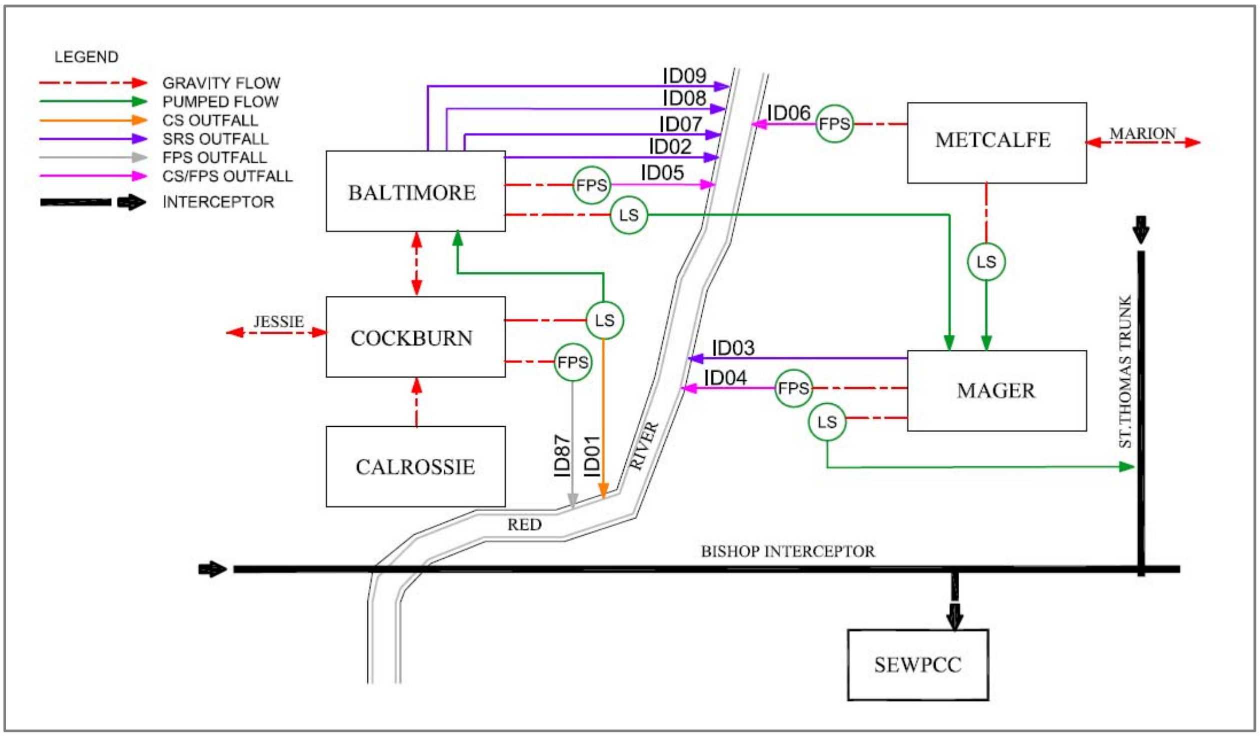


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 06 and are listed in **Error! Reference source not found.**.

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Combined Sewer Outfall (ID05)	S-RE60006416.1	S-MA60013599	1800 mm	Circular Invert: 222.74 m
Flood Pumping Outfall (ID05)	S-RE60006416.1	S-MA60013599	1800 mm	Circular Invert: 222.74 m

Other Overflows	N/A	N/A	N/A	
Main Trunk	S-CG00000778.1	S-MA70016827	1350 x 1800 mm	Invert: 223.16 m
SRS Outfalls (ID02, ID07, ID08, ID09)	324X0000064.1 S-CO70010585.1 S-CS00000430.1 S-CS00000442.1	S-MA70006325 S-MA70022370 S-MA70006655 S-MA70005806	1600 mm 750 mm 1200 mm 1600 mm	Invert: 221.34 m Invert: 223.03 m Invert: 221.89 m Invert: 221.47 m
SRS Interconnections	N/A	N/A	N/A	39 SRS - CS
Main Trunk Flap Gate	S-CG00001040.1	S-CG00001040	1525 mm	Invert: 223.48 m
Main Trunk Sluice Gate	S-TE70028161.1	S-CG00001040	1500 x 1500 mm	Invert: 223.48 m
Off-Take	S-MH60011694.1	S-MA70007637	750 mm	
Dry Well	N/A	N/A	N/A	
CS Lift Station Total Capacity	N/A	N/A	0.340 m^3/s	2 x 0.170 m^3/s
Lift Station ADWF	N/A	N/A	0.0408 m^3/s	
Lift Station Force Main	S-BE70018613.1	S-MA70051065	450 mm	To Mager district gravity system
Flood Pump Station Total Capacity	N/A	N/A	Min – 2.06 m^3/s Max – 2.60 m^3/s	Min – 2 x 0.47 m^3/s, 1.11 m^3/s Max – 0.55 m^3/s, 0.58 m^3/s, 1.46 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.343 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 1-1. Critical elevation reference points are identified on the district overview and detailed maps.

Table 1-1. Critical Elevations

Reference Point	Item	Elevation (m)[a]
1	Normal Summer River Level	Baltimore – 223.74 Eccles – 223.74 Hay – 223.74 Osborne – 223.75
2	Trunk Invert at Off-Take	223.16
3	Top of Weir	223.51
4	Relief Outfall Invert at Flap Gate	Osborne SRS – 222.21 Eccles West SRS– 222.53 Eccles East SRS – 223.40 Hay – 221.69
5	Low Relief Interconnection (S-MH70002869)	225.21
6	Sewer District Low Interconnection (Cockburn)	228.82
7	Low Basement	227.17

Table 1-1. Critical Elevations

Reference Point	Item	Elevation (m)[a]
8	Flood Protection Level (Baltimore)	230.01

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

A storm water management study (I.D. Engineering, 1993) was completed for Baltimore district in 1993. The study described the potential of implementing relief alternatives, and recommended alternatives to meet the 5-year and 10-year design level of service for basement flooding. Table 1-2 provides a summary of the district status in terms of data capture and study.

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 Baltimore CS District was included as part of this program. Instruments installed at each of the 39 primary CSO outfall locations have a combination of inflow and overflow level meters and flap gate inclinometers, if available.

Table 1-2. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
Baltimore	1993	Future Work-	2013	SRS system operational	N/A

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Baltimore district. This consists of monthly site visits in confined entry spaces to ensure 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 Baltimore sewer district are listed in Table 1-3. The proposed CSO control projects will include latent storage, in-line storage via a control gate, and floatables management via screening. Program opportunities including green infrastructure (GI) and real time control (RTC) will also be included as applicable.

Table 1-3. 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 and SRS systems are suitable for use of latent and in-line storage. These options will take advantage of the existing CS and SRS pipe networks for additional storage volume. The assessment completed as part of Phase 3 indicated that only the SRS system at Eccles would be suitable for implementation of latent storage system.

All primary overflow locations are to be screened 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 any undesirable floatables in the wastewater. 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. Screens will be installed only at the Baltimore CS outfall located on Baltimore Street.

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.

1.6.2 Latent Storage

There are four SRS outfalls located in the Baltimore district and latent storage is proposed as a control option at only the Eccles West SRS Outfall. The latent storage level in the system is controlled by river level, and the resulting backpressure of the river level on the SRS outfall flap gate, as explained in Part 3C. The latent storage design criteria are identified in Table 1-4. The storage volumes indicated in design criteria table below are based on the NSWL river conditions for the 1992 representative year.

Table 1-4. Latent Storage Conceptual Design Criteria (Eccles West SRS)

Item	Elevation/Dimension	Comment
Invert Elevation	222.53 m	
NSWL	223.74 m	
Trunk Diameter	1200 mm	
Design Depth in Trunk	1210 mm	Eccles Latent storage is located from the Eccles West SRS flap gate
Maximum Storage Volume	317 m^3	Eccles twin SRS
Force Main	100 mm	Pipe diameter
Flap Gate Control	N/A	Flap Gate Control measures not required to provide level of latent storage required. NSWL alone provides sufficient backpressure.
Lift Station	Included	Off-line wet well
Nominal Dewatering Rate	0.01 m^3/s	Based on 24-hour emptying requirement
RTC Operational Rate	TBD	Future RTC / dewatering review on performance

Note:

TBD – To be determined
RTC = real time control
Latent storage at Hay SRS and Osborne not cost effective and not taken forward for latent storage control option

The addition of a latent storage pump station (LSPS) and force main that connects back to the CS system will be required for latent storage. A conceptual layout location of the LSPS and force main for the Eccles West SRS is shown in Figures 06-02. The LSPS will be installed near the existing gate chamber to avoid interference with nearby residential lands and disruption to existing sewers. The LSPS will transfer stored latent volume back into the CS system. The LSPS will operate to dewater the SRS system in preparation for the next runoff event, the requirement for the system to be ready for the next event within a 24-hour period after completion of the previous event. The proposed route for the latent force main along the ROW in Eccles Street already has three existing pipes, however, the existing SRS pipe within the west boulevard and the CS pipe in the eastern side of the street should have sufficient space that would allow a shallow force main pipe to be installed along the western edge of the street. The alternative potential location for force main discharge re-entry into the CS system at manhole ID S-MH60007438 could be achieved, although the existing CS sewer levels in this area indicate this pipe would include a negative gradient pipe. Further assessment of this would be recommended during the preliminary and detailed design of these recommendations.

As described in the standard details in Part 3C, wet well sizing will be determined based on the final pump selection, operation and dewatering capacity required. The interconnecting piping between the new gate chambers and the LSPS will be sized to provide sufficient flow to the pumps while all pumps are operating. Flap gate control was not deemed necessary for this control option. Flap gate control may be considered if additional storage is required or if the river level regularly drops below the SRS flap gate elevation. The SRS flap gate control is described further in the standard details in Part 3C.

1.6.3 In-Line Storage

In-line storage has been proposed as a CSO control option for the Baltimore district. The 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 to provide an overall higher volume capture. The control gate will also provide hydraulic head for screening operations as an additional benefit.

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 in-line storage are listed in Table 1-5.

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

Item	Elevation/Dimension	Comment
Invert Elevation	223.16 m	Pipe invert upstream of primary weir
Trunk Diameter	1350 x 1800 mm	
Gate Height	0.7 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	224.16 m	
Bypass Weir Height	224.06 m	
Maximum Storage Volume	400 m^3	
Nominal Dewatering Rate	0.340 m^3/s	Based on existing CS LS capacity
RTC Operational Rate	TBD	Future RTC / dewatering review on performance

Note:
TBD – to be determined

The proposed control gate will cause combined sewage to back-up in the collection system to the extent shown on Figure 06. Based on the available capacity of the sewers, the in-line storage will exist within nearby SRS and interceptor that run parallel to each other on Baltimore Road and the extent of the in-line storage and volume is related to the elevation of the bypass 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 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.

Figure 06-01 provides an overview of the conceptual location and configuration of the control gate, bypass weir, and screening chambers. The proposed control gate will be installed in a new chamber within the existing trunk sewer alignment near the existing CS LS and FPS. The dimensions of the chamber will be approximately 5.5 m in length and 3 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. The existing sewer configuration, including the 1350 mm by 1800 mm sewer trunk, may have to be modified to accommodate the new chamber. Further optimization of the gate chamber size may be provided if a decision is made not to include screening. Further optimization of the gate chamber size may be provided if a decision is made not to include screening. The existing sewer configuration may require the construction of an additional off-take pipe to be completed, if the future detailed design establishes that the proposed gate chamber cannot encompass the existing primary weir chamber. This will allow CS flows captured by the proposed control gate to be diverted to the Baltimore CS LS, ensuring that the system performs as per the existing conditions. The existing primary weir would remain in place to allow flow diversion to continue when the control gate is in its lowered position. The work required for the control gate construction is located within a residential street with minor disruptions expected.

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 CS LS rehabilitation or replacement project.

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. Additionally, for RTC, an initial estimate of two times the nominal dewatering rate has been selected. This allows individual districts to be dewatered within 12 hours, rather than within 24 hours. It 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 impact of the RTC/future dewatering arrangement will be necessary to review the downstream impacts (i.e., on Mager district).

1.6.4 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. Off-line screens will be proposed 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	224.16 m	
Bypass Weir Crest	224.06 m	
Normal Summer River Level	223.73 m	
Maximum Screen Head	0.33 m	

Peak Screening Rate	0.87 m^3/s	
Screen Size	1.5 m wide x 1 m high	Modelled Screen Size

The proposed side bypass overflow weir and screening chamber will be located adjacent to the proposed control gate and existing CS trunk, as shown on Figure 06-01. The screens will operate with the control gate in the raised position. A side bypass weir upstream of the gate will direct the flow 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 to the CS LS for routing to the SEWPCC for removal.

The dimensions for the screen chamber to accommodate influent from the side weir, the screen area, and the routing of the discharge p*i*ping downstream of the gate are 5 m in length and 3.5 m in width. The existing sewer configuration, including the 1350 mm by 1800 mm sewer trunk, may have to be modified to accommodate the new chamber.

1.6.5 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 will be reviewed to identify the most applicable GI controls.

Baltimore has been classified as a high GI potential district. The land usage is categorized as mainly residential, with the remainder of developed land identified as commercial along Osborne Street. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, and rain gardens. There are a few flat roof commercial buildings in the north end of the district which make an ideal location for green roofs. The higher area of greenspace in Baltimore district is suitable for biorientation garden projects.

1.6.6 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 may require the addition of a new chamber and a moving gate at the outfall. Lower velocities in the sewer may create additional debris deposition and require more frequent cleaning. Additional system monitoring, and level controls will be installed which will require regular scheduled maintenance. The control gate on the CS trunk would control the upstream levels for operation of the screens.

The latent storage will take advantage of the SRS infrastructure already in place; therefore, minimal additional maintenance will be required for the sewers. The proposed LSPS will require regular maintenance that would depend on the frequency of LSPS operation.

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. Additional maintenance for the pumps will be required at regular intervals in line with typical lift station maintenance and after significant screening events.

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)[1]	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	221	221	7,124	41	N/A
2037 Master Plan – Control Option 1	221	221	7,124	41	IS, SC, Lat St

Note:

IS = In-line Storage
SC = Screening

Lat St = Latent Storage

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 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. This 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, Table 1-8also 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	Master Plan			
	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [b]
Baseline (2013)	69,611	72,575	-	26	0.296 m^3/s
Latent & In-Line Storage	60,144 [a]	66,599	5,976	21	0.435 m^3/s
Control Option 1	**60,144**	**66,599**	**5,976**	**21**	**0.435 m^3/s**

[a] Latent storage and in-line storage were not simulated independently during the Preliminary Proposal assessment
[b] 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

<table>
<tr><th>Control Option</th><th>2014
Preliminary Proposal
Capital Cost</th><th>2019
CSO Master Plan
Capital Cost</th><th>2019 Annual Operations and Maintenance Cost</th><th>2019
Total Operations and Maintenance Cost
(Over 35-year period)</th></tr>
<tr><td>Latent Storage</td><td>$4,760,000</td><td>$1,480,000</td><td>$55,000</td><td>$1,190,000</td></tr>
<tr><td>In-line Control Gate</td><td rowspan="2">N/A [a]</td><td>$2,360,000 [b]</td><td>$42,000</td><td>$900,000</td></tr>
<tr><td>Screening</td><td>$2,850,000 [c]</td><td>$52,000</td><td>$1,120,000</td></tr>
<tr><td>Subtotal</td><td>$4,760,000</td><td>$6,690,000</td><td>$149,000</td><td>$3,210,000</td></tr>
<tr><td>Opportunities</td><td>N/A</td><td>$670,000</td><td>$15,000</td><td>$320,000</td></tr>
<tr><td>District Total</td><td>$4,760,000</td><td>$7,360,000</td><td>$164,000</td><td>$3,530,000</td></tr>
</table>

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for this control gate and screening work found to be $2,620,000 in 2014 dollars

b Costs associated with any revision to existing off-take, as required, to accommodate the control gate location and allow the intercepted CS flow to reach the existing Baltimore CS LS are not included.

[c] Cost for bespoke screenings return/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 cost 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, based on an assumed value of 3 percent per for construction inflation.

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 Options	Latent Storage	PP had four latent storage control locations recommended; MP has one latent storage control location recommended.	Eccles West SRS Outfall
	Control Gate	A control gate was not included in the Preliminary Proposal estimate	Added for the MP to further reduce overflows
	Screening	Screening was not included in the Preliminary Proposal estimate	Added in conjunction with the Control Gate
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 another higher-level performance target. For the purposes of this CSO Master Plan, the future performance target is 98 percent capture for the representative year measured on a system-wide basis. This target will permit the number of overflows and percent capture to vary by district to meet 98 percent capture. Table 1-11 provides a description of how the regulatory target adjustment could be met by building off the proposed work identified for Control Option 1.

Overall the Baltimore district would be classified as low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture in the representative year future performance target. Increased volume capture from the review of the latent storage arrangements during a future modelling assessment could achieve additional flow capture, primarily via the implementation of either construction of additional interconnections between the CS and SRS systems for the Hay and Osborne systems or the reassessment of the performance of existing weir connections through survey confirmation work. Increases in the height of the control gate providing temporarily increased interception rates could be pursued and increase the in-line storage performance, so long as this does not impact the existing level of basement flooding protection. Off-line storage elements such as an underground tank or storage tunnel with associated dewatering pump infrastructure could also be utilized to provide additional volume capture. Finally the focused use of green infrastructure at key locations would also be utilized to provide 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	• Increased Latent Storage • Increased In-line Storage • Off-line storage (Tank/Tunnel) • Increased use of GI

The control options selected for the Baltimore district has 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 assessed based on a system wide basis. The listed migration options would be assessed as potential individual or combined solutions to achieve the percent capture target.

The cost for upgrading to meet 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

Risk Number	Risk 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	R	-	-	-	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
6	Sewer Condition	R	R	-	-	-	-	-	-
7	Sewer Conflicts	R	R	-	-	-	-	-	-
8	Program Cost	O	O	-	-	-	-	-	O

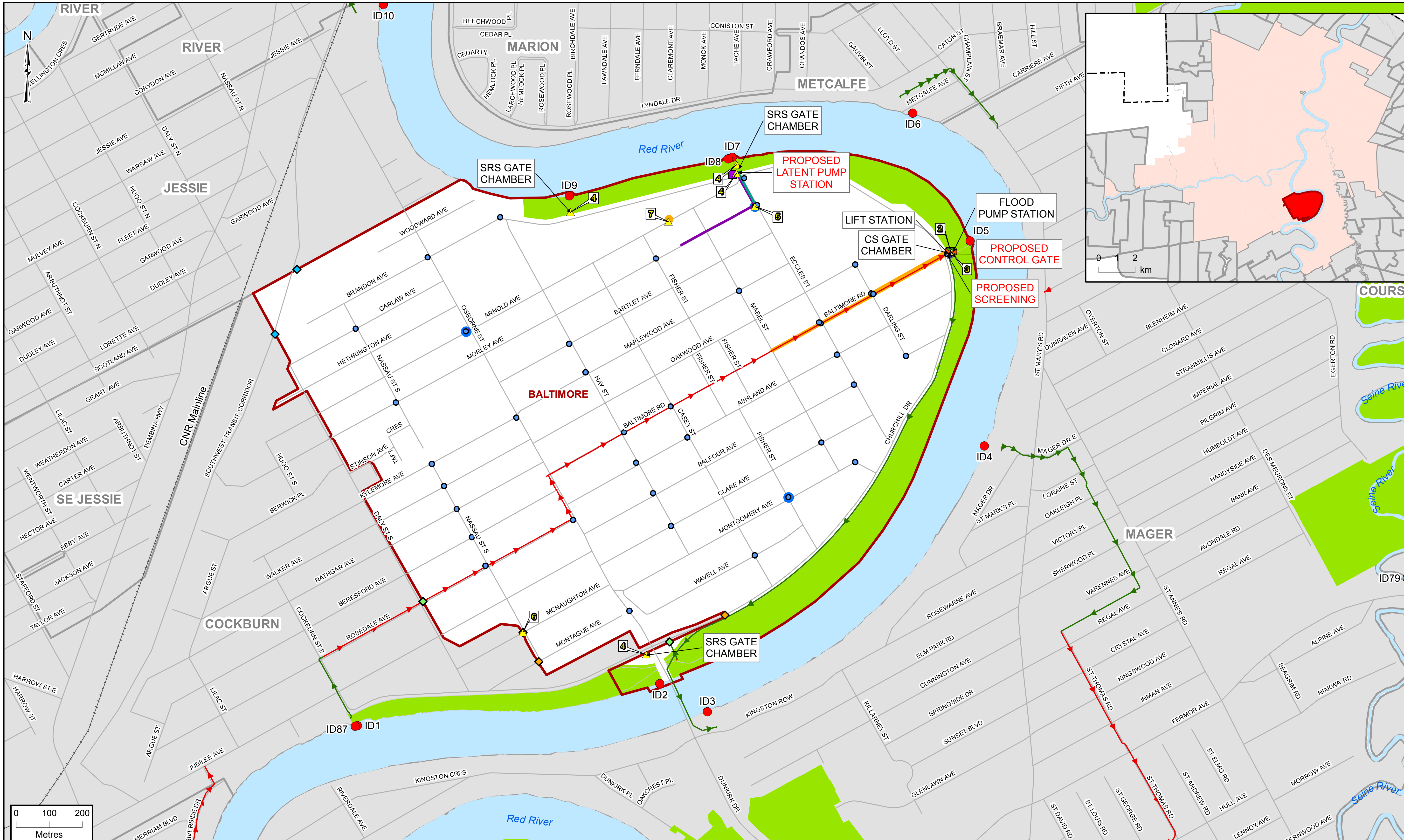
Table 1-12. Control Option 1 Significant Risks and Opportunities

Risk Number	Risk 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
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	R	-	-	-	-	O	O	-
12	Operations and Maintenance	R	R	-	-	-	R	O	R
13	Volume Capture Performance	O	O	-	-	-	O	O	-
14	Treatment	R	R	-	-	-	O	O	R

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

1.12 References

I.D. Engineering Canada INC. 1993. *Baltimore Combined Sewer District Sewer Relief Study*. Prepared for the City of Winnipeg, Waterworks, Waste and Disposal Department. November.



LEGEND

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

Inter-System Connection
- SRS - CS

District Boundary Crossing
- CS
- LDS
- WWS

- Interceptor Sewer
- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

- Proposed Control Gate
- Proposed SRS Latent Storage Pump
- Latent Storage Limit
- Latent Force Main
- Extent of In-line Storage

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

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

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 06
District Overview Map
Sewer District: Baltimore
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\BALTIMORE\BALTIMORE_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 7:43:51 AM

LEGEND

- Primary Weir
- Critical Elevation
- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate
- Pump Location
- Force Main

Sewer By Type
- CS
- LDS
- SRS
- WWS

Control Structure Type
- Gate Chamber

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

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 06-01
Control Gate and Screening
Sewer District: Baltimore
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\BALTIMORE\BALTIMORE_DISTRICT_DETAIL_BALTIMORERD.MXD SBEGG1 7/29/2019 7:45:10 AM

LEGEND

Critical Elevation	Flap Gate	Sewer By Type	Control Structure Type	Land Parcel
CSO Outfall	Sluice Gate	CS	Gate Chamber	
Manhole		SRS		
		WWS		

CSO MASTER PLAN
PROPOSED SOLUTIONS

Proposed Latent Force Main
Latent Pump

ALL PROPOSED SOLUTIONS
SHOWN IN RED TEXT

JACOBS

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

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 06-02
Latent SRS Control
Sewer District: Baltimore
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\BALTIMORE\BALTIMORE_DISTRICT_DETAIL_ECCLESST.MXD SBEGG1 6/25/2019 1:48:59 PM