CSO Master Plan

Alexander District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No: 470010CH
Document Title: Alexander District Plan
Revision: 03
Date: August 22, 2019
Client Name: City of Winnipeg
Project Manager: John Berry
Author: Scott Begg
File Name: Alexander_Plan_Final_CO1MP_08202019

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	08/30/2018	DRAFT for City Comment	DT	SG	
1	01/15/2019	DRAFT 2 for City Review	SB	MF	SG
2	06/2019	Final Draft Submission	DT	MF	MF
3	08/20/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Alexander District

1.1 District Description

Alexander district is located in the centre of the combined sewer (CS) area along the western edge of the Red River and north of Bannatyne district. Alexander is approximately bounded by Pacific Avenue and Elgin Avenue to the south, Xante Street and Trinity Street to the west, Higgins Avenue to the north, and the Red River to the east. The Canadian Pacific Railway (CPR) Mainline acts as the northern border crossing Main Street parallel with Higgins Avenue.

The land use within Alexander is distributed between industrial, multiple-use sector, and residential areas. General manufacturing exists north of Logan Avenue from Arlington Street to Stanley Street located next to the CPR Mainline. The residential sections include two-family and multi-family buildings and are located south of Logan Avenue, while the multiple-use sector is located in the eastern area of Alexander district. The National Microbiology Laboratory is the only institutional area in the district. China Town is included as part of the multiple-use sector and is located next to Main Street in the downtown area.

Main Street, Disraeli Freeway, Logan Avenue, Isabel Street, Sherbrook Street, and Arlington Street are regional transportation routes that pass through Alexander district. Greenspace within Alexander is limited due to the high residential and commercial density. Approximately 6 ha of the district is classified as greenspace. The more significant parcels of greenspace are identified as Central Community Centre, Pioneer Athletic Grounds, Dufferin Park, and a section of Fort Douglas Park on the riverbank.

1.2 Development

Alexander district includes a significant portion of the downtown area and the potential for redevelopment in the future is high. The OurWinnipeg development plan has prioritized the downtown for opportunities to create complete, mixed-use, higher density communities. Redevelopment within this area could impact the CS system and will be investigated on a case-by-case basis for potential impacts to the combined sewer overflow (CSO) Master Plan. All developments within the CS districts are mandated to offset any peak combined sewage discharge by adding localized storage and flow restrictions, in order to comply with Clause 8 of the Environment Act Licence 3042.

A portion of Main Street is located within the Alexander district. Portage Avenue is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Main Street is to be promoted in the future.

A portion of the South Point Douglas Lands Major Redevelopment Site is located within the Alexander district. This site includes the lands adjacent to the Assiniboine River north of the Waterfront neighborhood. This Major Redevelopment Site is considered underused and will be prioritized to be developed into a higher density, mixed-use community.

Main Street, Princess Street, King Street, and Higgins Avenue within the Alexander 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 separation within the Alexander district. This would reduce the extent of the Control Options listed in this plan required.

1.3 Existing Sewer System

Alexander district encompasses an area of 157 ha[1] based on the district boundary GIS information, and includes a CS system and a storm relief sewer (SRS) system. Included in this area is approximately 1 ha that contains a separate land drainage sewer (LDS) system and is partially separated, and approximately 2 ha that is considered separation ready.

The Alexander district does not contain an independent lift station (LS) to transport intercepted CS, instead all CS intercepted by the primary weir is conveyed to the Interceptor system entirely by gravity. The CS system includes a diversion chamber, flood pump station (FPS) and CS outfall gate chamber..). The Alexander FPS and CS outfall are located next to the Red River at the end of Galt Avenue and Waterfront Drive. The diversion chamber is set further north from the CS outfall at Galt Avenue and Lily Street, and redirects flow from the CS to the Main Interceptor on Main Street. The CS system drains towards the Alexander CS outfall, located at the eastern end of Galt Avenue, where combined sewage is intercepted or may be discharged into the Red River under high wet weather flow (WWF) conditions. There are two main sewer trunks that connect at the diversion chamber. Sewage from the area west of Main Street is collected in a 1500 mm sewer trunk that extends along Logan Avenue. A 450 mm CS trunk collects sewage from a small area south of Galt Avenue and east of Main Street. The two sewers converge at the Lily Street diversion chamber and connect into a 600 mm interceptor that connects to the Main Interceptor on Main Street.

During WWF events, the SRS system provides relief to the CS system in Alexander district. The SRS system that extends through Alexander includes multiple interconnects with the SRS network in the Bannatyne district, where it is ultimately discharged into the Red River at the McDermot SRS outfall on the eastern end of McDermot Avenue within the Bannatyne district. Note there are no dedicated SRS outfalls within the Alexander district. The SRS system is installed in specific sections west of Main Street and connects to the CSs via interconnections with a system of high overflow pipes and weirs. Most catchbasins are still connected to the CS system, so no partial separation utilizing these SRS pipes has been completed.

During dry weather flow (DWF), the SRS system is not required; sanitary sewage is intercepted by the primary weir at the CS outfall and into the Alexander diversion chamber, where it flows by gravity through the 600 mm interceptor pipe to the Main Interceptor sewer and eventually flows to the North End Sewage Treatment Plan (NEWPCC) for treatment.

During wet weather flow (WWF), any flow that exceeds the primary diversion weir capacity overtops the weir, and is discharged through the gate chamber to the Red River. Within the gate chamber a sluice gate is installed on the CS outfall, along with a flap gate to restrict back-up from the Red River into the CS system. When the river level is high the flap gate makes it so that gravity discharge of excess CS which has overtopped the primary weir is not possible. Under these conditions the excess flow is instead pumped by the Alexander flood pumping station (FPS) to discharge to the river at a point downstream of the flap gate.

The one outfall to the Red River (one CS) is as follows:

- ID19 (S-MA70021229) – Galt CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Alexander and the surrounding districts. Each interconnection is shown on Figure 01 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed as follows:

---

[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 mode. Therefore, minor discrepancies in the area values reported in Section 1.3 Existing Sewer System and in Section 1.8 Performance Estimate may occur.

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Syndicate

- The 1950 mm Main Interceptor pipe flows by gravity north on Main Street into Syndicate district to carry sewage to the NEWPCC for treatment:
  - Invert at Syndicate district boundary 221.11 m (S-MH20017375)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Bannatyne

- The 1950 mm Main Interceptor pipe flows by gravity north on Main Street into Alexander district to carry sewage to the NEWPCC for treatment:
  - Invert at Alexander district boundary 221.37 m (S-MH20017277)

1.3.1.3 District Interconnections

Aubrey

<u>CS to CS</u>

- A 375 mm CS flows east on Alexander Avenue from Alexander district into a 1450x1875 CS at the intersection of Alexander Avenue and Xante Street that enters Aubrey district:
  - Invert at Alexander district boundary 228.49 m (S-MH20017584)
- High point manhole:
  - Henry Avenue at Tecumseh Street – 229.96 m (S-MH20017866)
  - Logan Avenue – 228.77 m (S-MH20017639)
  - Pacific Avenue – 229.30 m (S-MH20017548)
  - Elgin Avenue – 229.49 m (S-MH20017513)

<u>SRS to SRS</u>

- An 1800 mm SRS flows east by gravity and a 375 mm SRS flows west on Alexander Avenue exit Alexander district and enter Aubrey district at the intersection of Alexander Avenue and Xante Street:
  - Invert at Alexander district boundary 224.43 m (S-MA20019577)
  - Invert at Aubrey district boundary 225.13 m (S-MH70028380)

Bannatyne

<u>CS to CS</u>

- A 375 mm CS flows northbound on Princess Street from Bannatyne district and connects to the CS system in Alexander district:
  - Invert at Bannatyne district boundary 227.44 m (S-MH20017220)
- High point CS manhole:
  - Arlington Street – 229.54 m (S-MH20016288)

<u>CS to SRS</u>

- A 450 mm CS flows by gravity north on Sherbrook Street. The manhole includes an interconnection to the Bannatyne SRS network with a 750 mm overflow SRS:
  - Invert at Bannatyne district boundary 227.67 m (S-MA70026573)

SRS to SRS

- A 450 mm SRS flows by gravity west on Ross Avenue to Tecumseh Street and connects to the SRS system in Alexander district:
  - Invert at Alexander district boundary 227.43 mm (S-MA70062533)
- A 525 mm SRS flows southbound by gravity from Alexander district into the Bannatyne district SRS network on Arlington Street:
  - Invert at Alexander district boundary 228.39 m (S-MH70028427)
- A 1200 mm SRS flows by gravity along Tecumseh Street and into Bannatyne district at the intersection of Tecumseh and Elgin Avenue, serving a section of Alexander district. It connects to the SRS system on William Avenue:
  - Invert at Alexander district boundary 227.03 m (S-MH70028468)
- A 1050 mm SRS flows southbound by gravity on Sherbrook Street, while a 450 mm SRS flows westbound on Ross Avenue. Both SRSs flow from Alexander district, into a manhole at the intersection of Sherbrook Street and Ross Avenue, and connect to the SRS system in Bannatyne district:
  - Invert at Bannatyne district boundary on Sherbrook Street 226.03 m (S-MH70028633)
  - Invert at Bannatyne district boundary on Ross Avenue 226.30 m (S-MA70062775)
- A 1050 mm SRS flowing southbound into Bannatyne by gravity on Isabel Street connects to the SRS network on William Avenue. The SRS interconnects with the CS system in Alexander district flowing south from Logan Avenue into Bannatyne Avenue:
  - Invert at Bannatyne district boundary 225.15 m (S-MH70032777)
- A 750 mm SRS flows from the SRS network in Alexander district into Bannatyne district by gravity on Ellen Street:
  - Invert at Bannatyne district boundary 224.90 m (S-MH70029529)
- A 750 mm SRS consisting of a weir overflows during high rainfall events at the corner of Princess Street and Rupert Avenue and flows by gravity eastbound on Rupert Avenue to connect to the SRS system in Bannatyne district:
  - Invert at Alexander district boundary 225.39 m (S-MH70045620) Weir height – 227.15 m
- A 900 mm SRS flows by gravity south on King Street from Alexander district and crosses into Bannatyne district at the intersection of King Street and Pacific Avenue:
  - Invert at Bannatyne district boundary 224.59 m (S-MH70045558)

LDS to LDS

- A 525 mm LDS serves the National Microbiology Laboratory between Alexander Avenue and William Avenue. The LDS flows by gravity into Bannatyne and connects to the SRS network in Bannatyne at the corner of Tecumseh Street and Elgin Avenue:
  - Invert at Bannatyne district boundary 229.33 m (S-MH70008110)
- A 450 mm LDS flows south into Bannatyne district at the intersection of Pacific Avenue and Waterfront Drive and is discharged to the main Bannatyne CS outfall:
  - Invert at Bannatyne district boundary on Waterfront Drive 225.92 m (S-MH70014314)

LDS to SRS

- A 300 mm LDS flows by gravity east into Bannatyne and connects to the SRS system in Bannatyne at the corner of Tecumseh Street and Elgin Avenue:
  - Invert at Bannatyne district boundary 230.10 m (S-MA70022800)

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

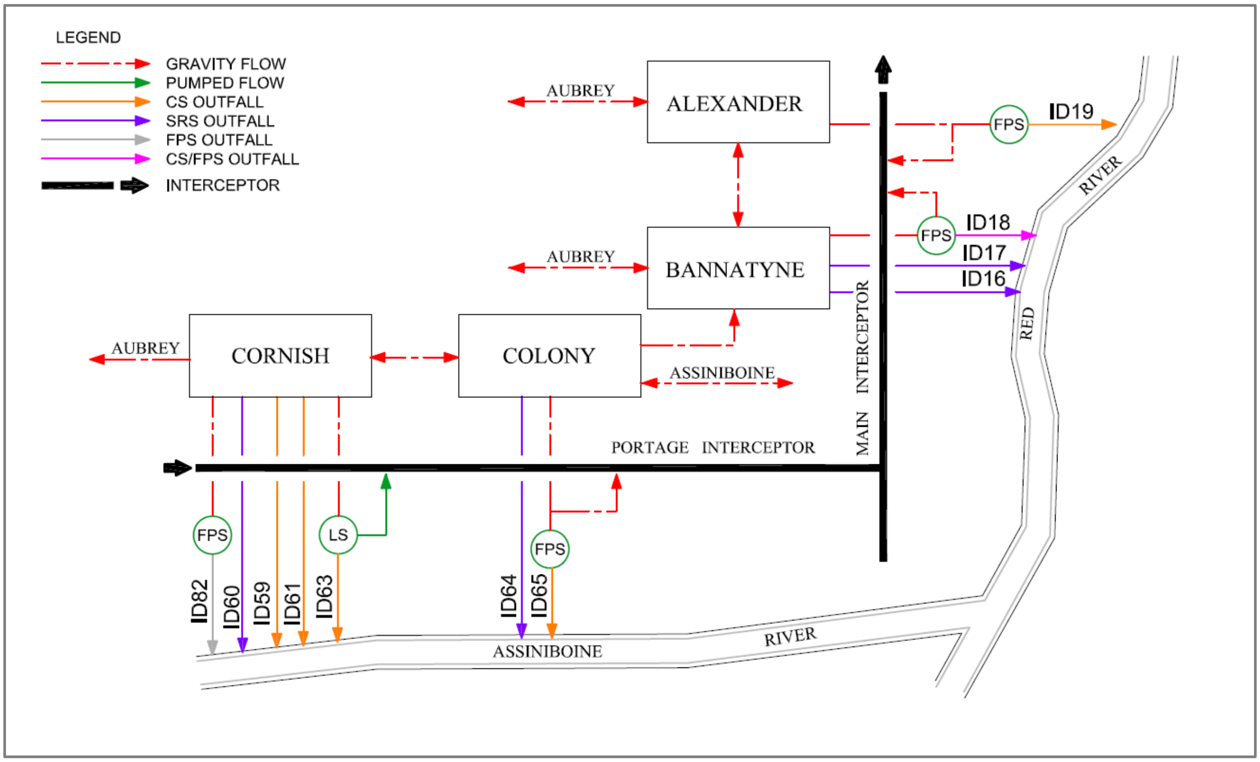


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 01 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 (ID19)	S-AC70009998.1	S-MA70021229	1500 mm	Red River Invert: 223.88 m
Flood Pumping Outfall (ID19)	S-AC70009998.1	S-MA70021229	1500 mm	Red River Invert: 223.88 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-MH20012121.1	S-MA70021213	1500 mm	Circular Invert: 224.03 m
SRS Outfalls	N/A	N/A	N/A	No dedicated SRS outfall in this district.
SRS Interconnections	N/A	N/A	N/A	36 SRS - CS
Main Trunk Flap Gate	S-AC70009987.1	S-CG00001074	1500 x 1500 mm	Flap gate size Invert: 224.37 m
Main Trunk Sluice Gate	ALEXANDER_GC.1	S-CG00001073	1500 x 1500 mm	Invert: 223.78 m
Off-Take	S-TE70007762.2	S-MA70016914	600 mm	Invert: 224.57 m
Dry Well	N/A	N/A	N/A	Diversion structure, no LS as part of outfall.

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Total Capacity	N/A	S-MA70016914 (1)	600 mm (1)	600 mm gravity pipe relied on for pass forward flow, capacity 0.5 m^3/s(2) (downstream 300mm sluice – capacity 0.35 m^3/s)
ADWF	N/A	N/A	0.0346 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	Diversion structure, no lift station force main as part of outfall.
Flood Pump Station Total Capacity	N/A	N/A	0.920 m^3/s	1 x 0.52 m^3/s 1 x 0.400 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.220 m^3/s	

Notes:

ADWF = average dry-weather flow
GIS = geographic information system
ID = identification
N/A = not applicable

(1) Gravity pipe replacing Lift Station as Alexander is a gravity discharge district

(2) Between diversion chamber and main interceptor sewer there is a modelled 300 mm sluice that needs to be investigated. The sluice further limits the pass forward flow to 0.35 m^3/s.

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	Alexander – 223.72
2	Trunk Invert at Off-Take	224.57 (diversion chamber)
3	Top of Weir	224.94
4	Relief Outfall Invert at Flap Gate	N/A
5	Relief Interconnection (S-MH70029532)	226.34
6	Sewer District Interconnection (Bannatyne)	221.37
7	Low Basement	228.60
8	Flood Protection Level (Alexander, Bannatyne)	229.78

[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 Bannatyne was the *Alexander and Bannatyne Combined Sewer Districts Sewer Relief and CSO Abatement Study* (AECOM, 2009). The study's purpose was to identify and recommend sewer relief and CSO abatement options for the Alexander and Bannatyne districts. Sewer relief projects completed as part of the basement flood relief program were last completed in 2010. An SRS latent storage pump system was installed near the McDermot SRS outfall in 2014 and has been undergoing operational evaluations since that time.

Between 2009 and 2015, the City invested $12 million in the CSO Outfall Monitoring Program. The program was initiated to permanently installing instruments in the primary CSO outfalls. The Galt outfall from the Alexander CS district was included as part of this program. Instruments installed at each of the thirty nine primary CSO outfall locations have 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
7 – Bannatyne	2009[a]	Future Work	2013	Study Complete	N/A

[a] = Sewer relief projects: Contracts 1B, 1A, 2A, 2B, 3A, 3B, 4, 5 & 8 completed associated with this study

1.5 Ongoing Investment Work

There are plans to replace the existing diversion structure for the Galt outfall at Lily Street and Galt Avenue. As part of this work, a new off-take pipe is to be constructed leading to the interceptor for the district. This work is anticipated to take place in the next five years.

There is ongoing maintenance and calibration of permanent instruments installed within the Galt primary outfall within the Alexander 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 Assiniboine district are listed in Table 1-4. The proposed CSO control projects will include gravity flow control, screening, and floatable management. 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	-	-	✓	-	✓ [a]	-	-	-	✓	✓	✓

Notes: [a] = screening only, existing high-level weir

- = not included

✓ = included

The existing CS system in the Alexander district has a high level primary weir already installed. Therefore in-line storage has not been recommended in this district.

A gravity flow controller is proposed on the CS system to allow the dewatering rate from the district back into the Main Street interceptor to be monitored.

Floatable control will be necessary to capture any undesirable floatables in the sewage. All primary overflow locations are to be screened under the current CSO control plan, installation of a screening chamber will be required for the screen operation, and the existing weir will provide the mechanism for continuing capture of the existing in-line storage. In the Alexander district, a high level weir is currently in operation and the screen will be situated downstream of this structure.

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 Gravity Flow Control

Alexander district does not include a lift station (LS) and discharges directly to the Main Interceptor by gravity. A flow control device will be required to control the diversion rate for future RTC and dewatering assessments. A standard flow control device was selected as described in Part 3C.

The flow controller will be installed at an optimal location downstream of the diversion chamber at the intersection of Galt Avenue and Lily Street. Figure 01-02 identifies a conceptual location for flow controller installation. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction. The diversion weir at the CS outfall may have to be adjusted to match the hydraulic performance of the flow controller.

A gravity flow controller has been included as a consideration in developing a fully optimized CS system as part of the City's long-term objective. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

1.6.3 Floatables Management

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

The type and size of screens depend on the LS and the hydraulic head available for operation. A standard design was assumed for screening and is described in Part 3C. The design criteria for screening, with gate control implemented, are listed in Table 1-5.

Table 1-5. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate (Existing Weir)	224.94 m	Existing Static Weir Level
Normal Summer Water Level	223.72 m	
Maximum Screen Head	1.22 m	
Peak Screening Rate	0.74 m^3/s	Bypass to be installed to match district first flush peak flow rate
Screen Size	1.5 m x 1.0 m	Modelled Screen Size

The proposed screening chamber would be located within the existing combined trunk sewer downstream of the primary weir, as shown on Figure 01-01. The screens would operate once levels within the sewer surpassed the existing primary weir elevation. The overflow will continue to be directed to the outfall, with the screens located in the new screening chamber, with screened flow discharged to the upstream side of the existing gate to the river. The screening chamber would include screening pumps with a discharge returning the screened material back to the interceptor and on to the NEWPCC for removal. This would require a force main to be installed along Galt Avenue from the FPs to the downstream side of the gravity flow controller. A bypass would also be installed to limit the overflow volume to be screened to match that of the other proposed screening units in the system. The dimensions for the screen chamber to accommodate influent from the existing overflow CS sewer, the screen area, and the routing of discharge piping 3.2 m in length and 3.1 m in width.

1.6.4 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 applicable GI controls.

Alexander has been classified as a low to medium GI potential district. Land use in Alexander is mix of residential, commercial, and institutional, the east end of the district is bounded by the Red River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

1.6.5 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.

The flow controller will require the installation of a chamber and flow control equipment. Monitoring and control instrumentation will be required. The flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required.

Floatable control with outfall screening will require the addition of another chamber with screening equipment installed. The chamber will be installed downstream of the primary weir. Screening operation will occur during WWF events that surpass the in-line storage control level. WWF would be directed from the main outfall trunk and directly 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 would 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 model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized in Table 1-6.

Table 1-6. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	157	157	3,212	74	N/A
2037 Master Plan – Control Option 1	157	157	3,212	74	SC

Notes:

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 1-7 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 1-7also 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 1-7. 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 [a]
Baseline (2013)	20,726	26,851	-	16	0.220 m^3/s
Control Option 1	**18,134**	**26,142**	**708**	**15**	**0.225 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 1-7, 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 1-8. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 to plus 100 percent.

Table 1-8. Cost Estimate – 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)
Screening	- [a]	$2,680,000 [c]	$30,000 [c]	$650,000
Gravity Flow Control	N/A [b]	$1,280,000	$35,000	$740,000
Subtotal	**N/A**	**$3,960,000**	**$65,000**	**$1,390,000**
Opportunities	N/A	$400,000	$6,000	$140,000
District Total	**N/A**	**$4,360,000**	**$71,000**	**$1,530,000**

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for this item of work found to be $600,000 in 2014 dollars

[b] Gravity Flow Control not included in the Preliminary Proposal

[c] Cost for bespoke screenings return pump 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.

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 1-9.

Table 1-9. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Screening	Screening was not included in the preliminary estimate	Added to the Master Plan
	Gravity Flow Control	A flow controller was not included in the preliminary estimate	Added for the Master Plan to further reduce overflows and optimize in-line storage provided.
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 1-10 provides a description of how the regulatory target adjustment could be met by building off the proposed work identified in Control Option 1.

Overall the Alexander district would be classified as a 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. Opportunistic separation of portions of the district may be achieve with synergies with other major infrastructure work to address future performance targets. To achieve additional future volume capture, an off-line storage element such as underground tank or storage tunnel with associated dewatering pump infrastructure would be proposed. In addition, green infrastructure could potentially be utilized in key locations to provide additional storage and increase capture volume as necessary.

Table 1-10. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Opportunistic Separation • Off-line Storage (Tank/Tunnel) • Increased use of GI

The control option for the Alexander district has been aligned to the primary outfalls being screened under the current CSO 85 percent capture control plan. The expandability of this district to meet the 98 percent capture would be assessed based on a system wide basis. The applicability of the listed migration options will be stepped than full district solutions.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-11.

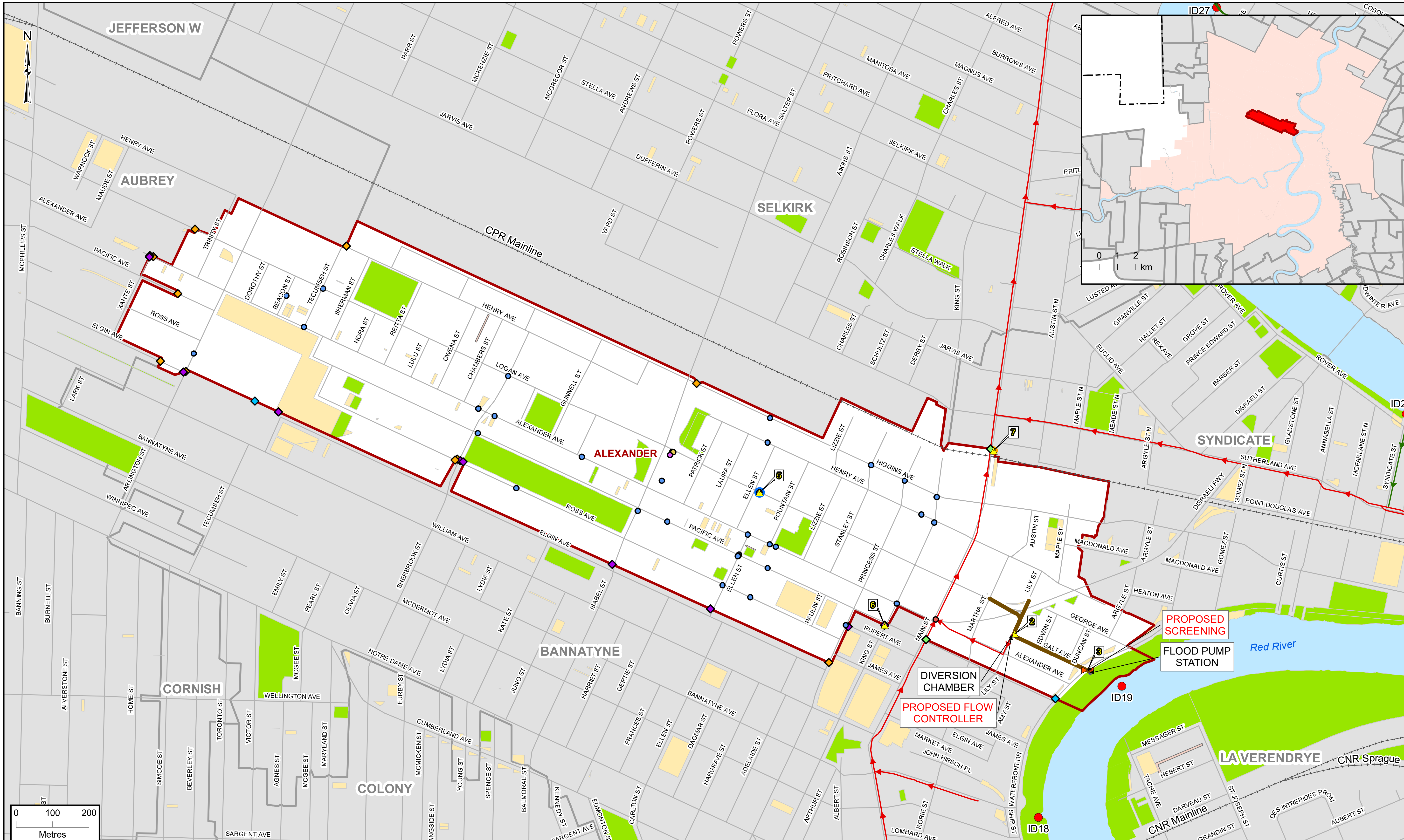
Table 1-11. Control Option 1 Significant Risks and Opportunities

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	-	-	-	-	-	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	-	-	-	-
8	Program Cost	-	-	-	-	-	-	-	O
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	-	O	O	-
12	Operations and Maintenance	-	-	-	-	-	R	O	R
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	-	O	O	R

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

1.12 References

AECOM. 2009. *Alexander and Bannatyne Combined Sewer Districts Sewer Relief and CSO Abatement Study*. Prepared for the City of Winnipeg. April.



LEGEND

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

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

District Boundary Crossing
- CS
- LDS
- SRS
- WWS

- Extent of Existing In-line Storage
- Interceptor Sewer
- Force Main
- Street
- Railway
- District Boundary
- Watercourse
- Greenspace
- City Owned Land

CSO MASTER PLAN PROPOSED SOLUTIONS
- Screening
- Flow Controller

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 01
District Overview Map
Sewer District: Alexander
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\ALEXANDER\ALEXANDER_DISTRICT_OVERVIEW_MAP.MXD DT072410 7/29/2019 9:02:53 AM

LEGEND

Primary Weir
CSO Outfall
Manhole
Flap Gate
Sluice Gate
Pump Location

Sewer By Type
CS
LDS
WWS

Pump Station Type
Flood Pump Station

CSO MASTER PLAN
PROPOSED SOLUTIONS
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 01-01
Screening
Sewer District: Alexander
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\ALEXANDER\ALEXANDER_DISTRICT_DETAIL_GALTAV.MXD SBEGG1 7/29/2019 9:01:10 AM

LEGEND

- Critical Elevation
- Manhole
- Sewer By Type
- CS
- Pump Station Type
- Diversion Chamber
- Land Parcel

CSO MASTER PLAN
PROPOSED SOLUTIONS
Flow Controller

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 01-02
Flow Controller
Sewer District: Alexander
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\ALEXANDER\ALEXANDER_DISTRICT_DETAIL_LILYST.MXD SBEGG1 6/20/2019 1:24:38 PM

CSO Master Plan

Armstrong District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No: 470010CH
Document Title: Armstrong District Plan
Revision: 03
Date: August 19, 2019
Client Name: City of Winnipeg
Project Manager: John Berry
Author: Jack Tinker
File Name: Armstrong_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	09/14/2018	Version 1 DRAFT	JT	SB, MF, SG	
1	02/15/2019	DRAFT 2 for City Review	JT	SG	MF
2	08/13/2019	Final Draft Submission	DT	MF	MF
3	18/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Armstrong District

1.1 District Description

Armstrong district is located in the northern section of the combined sewer (CS) area to the west of the Red River. The district is bounded by Leila Avenue and the Canadian Pacific Railway (CPR) Winnipeg Beach to the north, McPhillips Street to the west, King Sudbury Avenue to the south, and Main Street to the east.

Armstrong district primarily includes residential area with the majority being single-family residential. The residential area is mainly located east of Sinclair Street. This district also includes commercial areas including a section of the Garden City Shopping Centre adjacent to McPhillips Street.

The CPR Winnipeg Beach line passes through the southern end of Armstrong District. Salter Street, McGregor Street, McPhillips Street, and Main Street are regional transportation routes running north to south on either side of the district, with Partridge Avenue and Leila Avenue being regional routes running east to west. Armstrong district has approximately 24 ha of greenspace including Garden City Park, Margaret Park, and Vince Leah Park.

1.2 Development

A portion of Main Street is located within the Armstrong District. Main Street is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Main Street is to be promoted in the future.

One area within the Armstrong combined sewer district, the Garden City Shopping Centre at the intersection of McPhillips Street and Leila Avenue, has been identified as a Regional Mixed-Use Centre as part of OurWinnipeg. As such, focused intensification within this Mixed Used Centre is to be promoted in the future, with a particular focus on mixed use development.

1.3 Existing Sewer System

Armstrong district encompasses an approximate area of 151 hectares (ha)[1] based on the district boundary and includes a CS system and a storm relief sewer (SRS) system. This district does not include any areas that have separate land drainage sewer (LDS) systems or that could be considered separation ready.

The CS system includes a diversion structure and one CS outfall. All system flows collected are routed to the diversion structure located at the intersection of Main Street and Armstrong Avenue. A 2700 mm circular CS trunk collects combined sewage from all the areas west of Main Street within the Armstrong district. There is a 600 mm CS servicing the north part of the district between Main Street to Aikins Street.

During dry weather flow (DWF), sanitary sewage from the Armstrong district flows into the diversion chamber upstream of the CS outfall. Flows are diverted by the primary weir to a 600 mm secondary offtake pipe which reduces to 525 mm before it flows into the Main Interceptor and to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), flows that exceed the diversion capacity overtops the weir and is discharged into the river through the outfall. Sluice and flap gates are installed on the outfall to prevent river water from backing up into the CS system when the Red River levels are particularly high. However not only does the flap gate prevent river water intrusion, but it also prevents gravity discharge from the

[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.

Armstrong CS outfall. Under these conditions of high river level the excess flow is pumped by the Newton FPS to a point in the Armstrong CS Outfall downstream of the flap gate, where it can be discharged to the river by gravity. Temporary flood pumps are to be installed in the Armstrong district based on the flood manual high river level triggers to deal with situations such as this.

An interconnection with the Newton district is present near the diversion to allow flow from Armstrong to flow into Newton immediately upstream of the primary weir for the Armstrong district. This provides the operational ability to utilize the Newton flood pump station (FPS) to dewater Armstrong during WWF and high river level conditions when gravity discharge through the Armstrong CS outfall is not possible. This connect is kept closed and currently only used by operations for maintenance activities.

A portion of the separate sewer districts west of the Armstrong district are serviced by the Leila CS trunk sewer, and are ultimately intercepted by the Armstrong CS system This includes the entire Maples residential neighbourhood, and the Leila-McPhillips Triangle Shopping Centre/residential area. The LDS trunk sewers from these separate sewer districts connect directly to the Leila CS trunk at two locations. A 1350 mm diameter, 525 mm diameter, and 2700 mm diameter LDS sewer each connect at the intersection of Leila Avenue and Watson Street. A 1200 mm LDS sewer then connects at the intersection of McPhillips Street and Leila Avenue. A number of smaller diameter LDS systems connect into the CS trunk along Leila from the north. The wastewater from these separate sewer districts is conveyed to treatment via the Northwest Interceptor system.

The one outfall to the Red River (CS) is as follows:

- ID36 (S-MA00017633) – Armstrong CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Armstrong and the surrounding districts. Each interconnection is shown on Figure 2 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

Riverbend Park (Area 9 NW)

- The 2250 mm Main Interceptor pipe flows north by gravity on Main Street from the Armstrong district to the Riverbend Park) district:
  - Invert at Armstrong district boundary 215.85 m (S-MH00000791)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Newton

- The 2250 mm Interceptor pipe flows north by gravity on Main Street into the Armstrong district to the NEWPCC:
  - Invert at Newton district boundary 216.61 m (S-MA00000807)

1.3.1.3 District Interconnections

Maples (Area 3 [NW])

<u>LDS to CS</u>

- The 2700 mm LDS main sewer trunk flows by gravity east on Leila Avenue into the Armstrong district:
  - Invert at the Maples (Area 3 (NW)) district boundary 226.54 m (S-MA00002447)

Templeton (Area 6 (NW))

LDS to CS

- The 1500 mm LDS pipe flows south by gravity on Garden Park Drive into the Armstrong district:
  - Invert at the Armstrong district boundary 226.29 m (S-MA00001940)
- The 1350 mm LDS pipe flows south by gravity on Sinclair Street into the Armstrong district:
  - Invert at the Armstrong district boundary 226.22 m (S-MA70031211)
- The 1200 mm LDS pipe flows south by gravity on McGregor Street into the Armstrong district:
  - McGregor Street at Miravista Drive – 225.75 m (S-MH00001441)
- The 900 mm LDS pipe flows south by gravity on Diplomat Drive into the Armstrong district:
  - Invert at the Armstrong district boundary 225.85 m (S-MA00001592)
- The 525 mm LDS pipe flows south by gravity on Ambassador Row into the Armstrong district:
  - Invert at the Armstrong district boundary 226.54 m (S-MA00001635)
- The 450 mm LDS pipe flows south by gravity on Monsey Street into the Armstrong district:
  - Invert at the Armstrong district boundary 226.50 m (S-MA00001439)

Newton

CS to CS

- The 2700 mm CS main sewer trunk flows east on Armstrong Avenue out of the Armstrong district towards the Armstrong CS outfall located at the far end of Armstrong Avenue:
  - Invert at the Armstrong district boundary 223.58 m (S-MA00000802)
- The 1350 mm CS pipe diverts south onto Main Street into Newton district and connects to the Newton CS network (this connection is normally kept closed and only used for operational maintenance):
  - Invert at the Armstrong district boundary 225.03 m (S-MA00000789)
- The 600 mm CS pipe flows south by gravity on Main Street into the Armstrong district:
  - Invert at the Armstrong district boundary 224.64 m (S-MA00000784)
- The 450 mm CS pipe flows south by gravity on Main Street into the Armstrong district:
  - Invert at the Armstrong district boundary 225.55 m (S-MA00000779)
- The 450 mm CS pipe flows south by gravity on Main Street out of the Armstrong district:
  - Invert at the Armstrong district boundary 225.55 m (S-MA00000930)
- The 600 mm CS pipe flows east by gravity though Beeston Drive onto Main Street into the Newton district:
  - Invert at the Newton district boundary 225.67 m (S-MA00000869)

Jefferson East

CS to CS

- The 300 CS pipe flows south by gravity on Powers Street into the Armstrong district:
  - Invert at the Jefferson East district boundary 227.31 (S-MA00001541)

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.

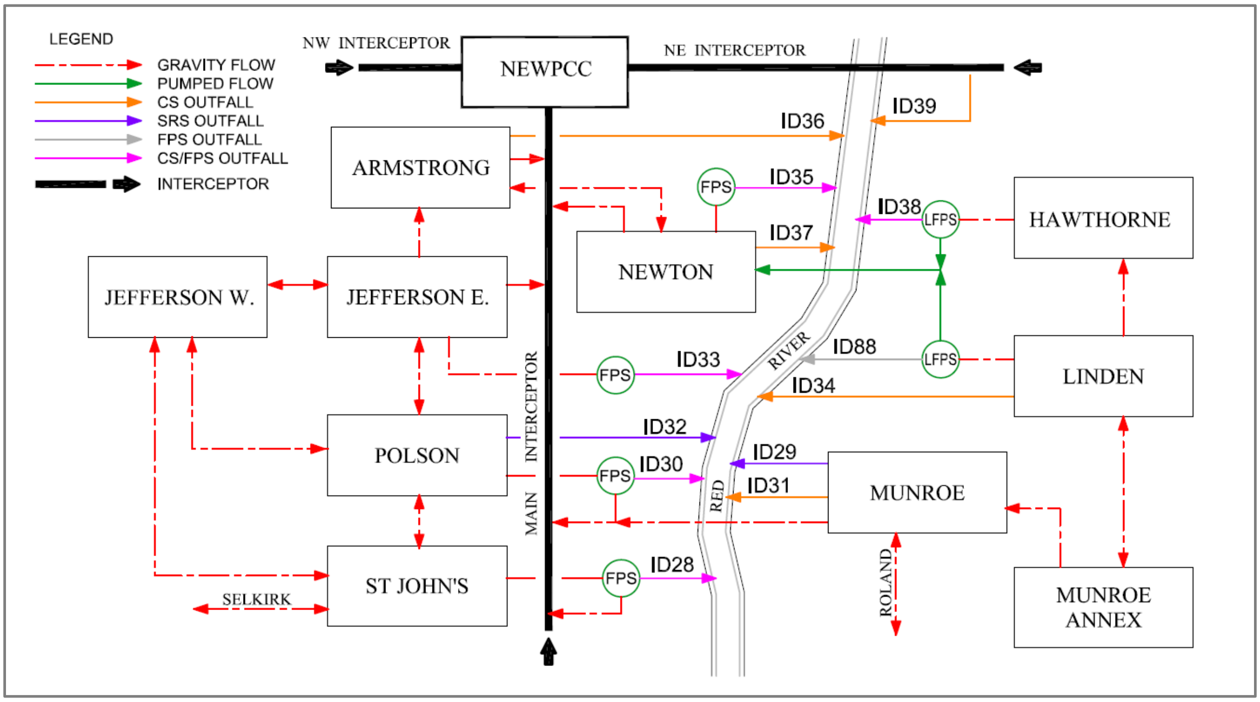


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 02 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 (ID36)	S-MH00002352.1	S-MA00017633	2700 mm	Red River Invert: 221.79 m
Flood Pumping Outfall	N/A	N/A	N/A	No Flood Pump Station in this district.
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-TE00000258	S-MA00000755	2700 mm	Main CS that flows east on Armstrong Avenue Circular Invert: 223.58 m
SRS Outfalls	N/A	N/A	N/A	No SRS within this district.
SRS Interconnections	N/A	N/A	N/A	No SRS within this district.
Main Trunk Flap Gate	S-CG00000773.1	S-CG00000773	1800 mm	Invert: 222.74 m Circular
Main Trunk Sluice Gate	S-CG00000772.1	S-CG00000772	1800 mm	Invert: 222.42 m Square
Off-Take / Diversion	S-MH00000681.2	S-MA70021108	600 mm	Invert: 223.58 m
Dry Well	N/A	N/A	N/A	No lift station within Armstrong.
Lift Station Total Capacity	N/A	S-MA70021108 (1)	600 mm (1)	0.57 m3/s (1)
ADWF	N/A	N/A	0.011 m^3/s	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Force Main	N/A	N/A	N/A	
Flood Pump Station Total Capacity	N/A	N/A	N/A	No Flood Pump Station in this district.
Pass Forward Flow – First Overflow	N/A	N/A	0.172 m^3/s	

Notes:

(1) – Gravity diversion pipe replacing Lift Station as Armstrong is a gravity discharge district

ADWF = average dry-weather flow
GIS = geographic information system
ID = identification
N/A = not applicable

The critical system elevations relevant to the development of the Combined Sewer Overflow (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	Armstrong – 223.65
2	Trunk Invert at Off-Take / Diversion	223.58
3	Top of Weir	223.98
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Interconnection (Newton)	225.03
7	Low Basement	228.24
8	Flood Protection Level (Armstrong)	228.78

[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 Armstrong was the *Sewer Relief Study: Armstrong Combined Sewer District Conceptual Report* (IDE, 1993). The study's purpose was to develop sewer relief options that provide a 5-year level of protection against basement flooding and to develop alternatives for reducing and eliminating pollutants from CSOs. No other CSO study or system design work has 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 Armstrong Combined Sewer 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
02 – Armstrong	1993	2016 Summer Flow Monitoring Campaign Completed	2013	Conceptual Study Completed	TBD

Note:
TBD = To Be Determined

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Armstrong 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 Armstrong sewer district are listed in Table 1-4. The proposed CSO control projects will include complete sewer separation. 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% Capture in a Representative Year	-	-	-	-	-	-	-	✓	✓	✓	-

Notes:

- = not included
✓ = included

Armstrong district has been identified as an early priority action for the CSO Master Plan. The upstream separate area LDS system connects directly into the CS trunk and contributes dramatically to the WWF received in the CS district. WWFs from these separated areas are utilizing capacity in the CS trunk for the Armstrong district. A complete sewer separation scheme which removes these LDS ties from the Armstrong CS system and instead directs them to a river outfall is proposed to deal with this issue. The existing CS main trunk is proposed to be an LDS pipe, which will outfall at the existing CS outfall. A new wastewater sewer (WWS) trunk along Leila and interconnecting WWS to service all properties is then proposed.

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 Sewer Separation

The complete sewer separation project for Armstrong district will provide immediate benefits to the CSO program when implemented. The work is recommended to include installation of a WWS system to collect sanitary sewage and foundation drainage. The new WWS system will include a trunk sewer along Leila Avenue connecting into the Main Interceptor, new secondary and lateral sewers and wastewater service reconnections to all properties. The existing CS trunk sewer is then recommended to be converted to an LDS sewer. Collected stormwater runoff from the separate sewer districts to the west of Armstrong, along with within the Armstrong district itself, will continue to be routed through the existing CS trunk sewer and ultimately to the Red River via the Armstrong CS outfall. At this point the diversion structure currently utilized for the Armstrong district could be decommissioned. The approximate area of sewer separation is shown on Figure 02.

The flows to be collected after the Armstrong complete separation will be as follows:

- DWF will be collected in the new WWS and will consist of sanitary sewage combined with foundation drainage.
- WWF will flow through the converted CS system to an outfall to the Red River.

This will result in a significant reduction in WWF directed to the main interceptor after the separation project is complete. The WWS separation project will eliminate overflows from the district.

It is proposed that future post construction flow monitoring of the district is completed to verify sewer system performance.

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 will be reviewed to identify the most applicable GI controls.

Armstrong has been classified as a high GI potential district. Land use in Armstrong is mostly single and double family residential with large areas of commercial land use. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, and rain gardens. The commercial areas in the west end of the district would be an ideal location for green roofs.

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.

Sewer separation will create additional sewer pipes to maintain, minimal operator involvement will be required to maintain the new WWS system and additional LDS elements. This will result in additional maintenance costs over the long term, but operational costs will be minimal. There will be continued maintenance of the system required for the management of WWF in the separated sanitary sewer system. There will be potential O&M reductions as a result of the decommissioning of the diversion structure and other components of the current CS outfall arrangement. These components will no longer be necessary once the CS outfall is converted to a dedicated LDS outfall.

It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the WWS system) extent within the Armstrong district.

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 model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added To Model
2013 Baseline	863	863	3,759	60	N/A
2037 Master Plan – Control Option 1	127	66	3,628	12	SEP

Notes:

SEP = separation

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-6, are for the hydraulic model simulations using the year-round 1992 representative year applied uniformly. 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 1-6. Performance Summary – Control Option 1

	Preliminary Proposal	Master Plan			
Control Option	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow
Baseline (2013)	710,537	749,622	-	23	0.172 m^3/s [b]
LDS Separation	0	N/A	N/A	N/A	N/A
WWS Separation	N/A [a]	0	749,622	0	0.345 m3/s [c]
Control Option 1	**0**	**0**	**749,622**	**0**	**0.345 m3/s** [c]

[a] LDS trunk not simulated independently during the Preliminary Proposal assessments including offline storage tank.

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

[c] Discharge into outfall pipe for 5-year design event but no overflow to river

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 relevant 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 1-7. The cost estimates are a Class 5 planning level estimate with a level of accuracy range of minus 50 percent to plus 100 percent.

Table 1-7. Cost Estimates – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost [b]	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance Cost (Over 35-year period) [b]
Sewer Separation	- [a]	$61,080,000	$57,000	$1,220,000
In-line Control Gate	$7,680,000	N/A	N/A	N/A
Screening		N/A	N/A	N/A
Off-line Storage Tank	$4,700,000	N/A	N/A	N/A
Tunnel	$75,200,000	N/A	N/A	N/A
Subtotal	**$87,580,000**	**$61,080,000**	**$57,000**	**$1,220,000**
Opportunities	$0	$6,110,000	$6,000	$120,000
District Total	**$87,580,000**	**$67,190,000**	**$63,000**	**$1,340,000**

[a] Tunnel storage taken as sewer separation of upstream district draining to Armstrong district

[b] WWS complete separation control option selected as part of Master Plan assessment

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 opportunities, with no additional costs for RTC (depending on future monitoring of post separation WWF impacts).
- 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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Sewer Separation	Added as a result of Master Plan assessment. Initial costs based LDS separation in conjunction with a long tunnel, subsequently changed to WWS separation.	
	Control Gate	Removed from Master Plan	No longer required with complete separation work.
	Screening	Removed from Master Plan	No longer required with complete separation work.
	Off-line Storage	Removed from Master Plan	No longer required with complete separation work.
	Tunnel	Removed from Master Plan	No longer required with complete separation work.
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 proposed complete separation of the Armstrong district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target. It is recommended to complete post separation modelling to confirm the target is fully achieved.

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 as part of the CSO Master Plan and is included as part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-9.

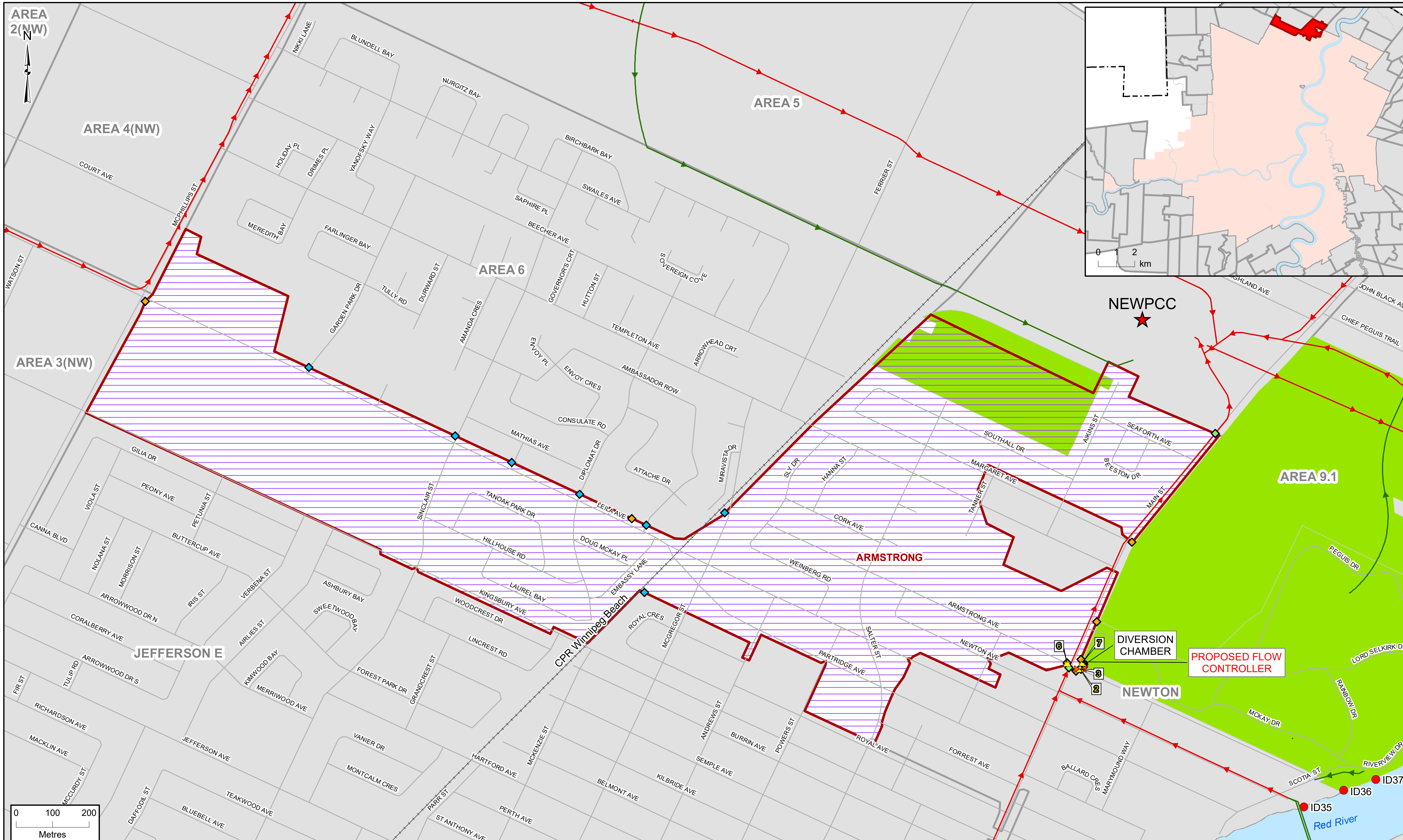
Table 1-9. Control Option 1 Significant Risks and Opportunities

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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

I.D. Engineering Canada Inc (IDE). 1993. *Sewer Relief Study: Armstrong Combined Sewer District Conceptual Report*. Prepared for the City of Winnipeg. September.



LEGEND

- Primary Weir
- Critical Elevation
- CSO Outfall
- Low CS Manhole
- Sewage Treatment Plant

Inter-System Connection
- CS - WWS

District Boundary Crossing
- CS
- LDS
- WWS

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

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Planning

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 02
District Overview Map
Sewer District: Armstrong
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\ARMSTRONG\ARMSTRONG_DISTRICT_OVERVIEW_MAP.MXD DT072410 7/29/2019 9:31:36 AM

LEGEND

Primary Weir
Critical Elevation
Manhole

Sewer By Type
CS
WWS

Pump Station Type
Diversion Chamber

CSO MASTER PLAN
PROPOSED SOLUTIONS
Flow Controller

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 02-01
Control Gate
Sewer District: Armstrong
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\ARMSTRONG\ARMSTRONG_DISTRICT_DETAIL_ARMSTRONGAVE.MXD SBEGG1 7/29/2019 9:30:19 AM

CSO Master Plan

Ash District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CS
Document Title:	Ash District Plan
Revision:	03
Date:	August 16, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Ash_Plan_R2_04232019_Markup

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	08/2018	Version 1 DRAFT	SG	ES	
1	02/15/2019	DRAFT 2 for City Review	SB	MF	SG
2	06/2019	Final Draft Submission	DT	MF	MF
3	08/16/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Ash District

1.1 District Description

Ash district is located towards the southwestern limit of the combined sewer (CS) area along the southern bank of the Assiniboine River. Ash is bounded by the Assiniboine River to the north; Cambridge Street to the east, Centennial Street North, Kenaston Boulevard, and Doncaster Street to the west; and Wilkes Avenue to the south. Ash district contains numerous major transportation routes that pass through the district including Kenaston Boulevard, Taylor Avenue, Grant Avenue, Corydon Avenue, and Academy Road. Kenaston Boulevard passes north-south through Ash and provides access across the Assiniboine River. The Midland rail line connects to the Canadian Pacific Railway Lariviere rail lines and passes through the center of the Ash district. Ash is surrounded by Jessie and Cockburn districts to the east, Lindenwoods East and West to the south, and Doncaster to the west.

Land use in Ash is mainly residential with the remainder being commercial use. The commercial businesses are found along the busier routes, including Corydon Avenue, Grant Avenue and Academy Avenue. The residential land is made up of single-family homes with multi-family and apartment complexes found in the southern section of Ash near Wilkes Avenue. Numerous schools and recreational areas are distributed around the district, with the Manitoba Youth Centre on Tuxedo Avenue and River Heights School and Community Centre occupying the most non-residential land use area. Approximately 53 ha of the district is classified as greenspace.

1.2 Development

A Route 90 Improvement Study is currently underway that will lead to a significant amount of construction and right of way adjustments along Route 90/Kenaston Boulevard. This work, which will impact both Doncaster and Ash districts, could impact the Combined Sewer Overflow (CSO) Master Plan. The Route 90 work is discussed further in Section 1.5.

The Waverley Underpass Project is currently ongoing at the time of writing and is anticipated to conclude in 2020. This work does not affect the CSO Master Plan.

1.3 Existing Sewer System

Ash district encompasses an area of 744 ha[1] based on the district boundary and includes both a combined sewer (CS), wastewater sewers (WWS), and a storm relief sewer (SRS) system. As shown in Figure 03, there is approximately 6 percent (45 ha) already separated and 1 percent (7 ha) of the district is considered separation ready.

The Ash CS system includes a flood pump station (FPS), CS lift station (LS), and a CS outfall gate chamber located adjacent to the Assiniboine River at Wellington Crescent and Ash Street, at the Ash CS outfall. Sewage flows collected in Ash converge to the 1720 mm by 2220 mm egg-shaped sewer trunk on Academy Road which connects to the main 2440 mm by 3150 mm egg-shaped sewer trunk on Ash Street. The CSs meet at the intersection of Ash Street and Wellington Crescent and flow to the CS outfall. CS is also received from the Doncaster and Tuxedo districts, with the intercepted CS from these districts discharging into the Ash CS system at the intersection of Willow Avenue and Doncaster Street.

The SRS predominately drains towards the Renfrew SRS outfall located adjacent to the Assiniboine River at Wellington Crescent and Renfrew Street. There are also areas of SRS constructed to provide localized relief, but which tie back into the existing CS system. Minor SRS work was completed surrounding

[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.

Wellington Crescent, ultimately discharging into a dedicated SRS outfall near Wellington Crescent and Academy Road.

During dry weather flow (DWF), the SRS system is not required; sanitary sewage is diverted by the primary weir at the Ash CS Outfall, through the 600 mm off-take pipe to the Ash CS LS, where it is pumped across the Assiniboine River to the Main Interceptor pipe in the Aubrey district and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), any flow in the CS system that exceeds the diversion capacity overtops the primary weir and is discharged to the river. A flap and sluice gate are in place on the CS outfall to prevent river water from flowing into the CS under high river level conditions. When the river level is high such as this, the flap back prevents gravity discharge of any excess CS which spills over the primary weir within this outfall pipe. In this case the excess flow is instead pumped by the Ash FPS to a dedicated FPS outfall where it is discharged by gravity into the river. This FPS outfall does not have a flap gate or positive gate. The FPS contains four pumps to accommodate the wet weather flow (WWF) response received by the district.

The SRS system provides relief to the CS system in Ash district during WWF events. The WWF is drained by gravity into the main SRS outfall on Renfrew Street or the smaller outfall near the western edge of Ash on Wellington Crescent. Two flap gates are located on the Renfrew outfall pipe to prevent river water from backing up into the Renfrew SRS under high river level conditions on the Assiniboine River. The Renfrew SRS outfall is also equipped with a positive gate for temporary dewatering purposes and to provide emergency protection to the SRS system from flooding during high river level conditions. SRSs are implemented throughout the district and connect to the CS via interconnections.

A small number of land drainage sewers (LDSs) exist in the northwestern part of the district. This section of LDS collects surface runoff and conveys it to a separate LDS outfall. South of the CPR Mainline the CS system has been separated with the wastewater sewer (WWS) connecting into the CS system north of the tracks.

The outfalls to the Assiniboine River are as follows:

ID55 (S-MA70033504) – Ash CS Outfall

ID51 (S-MA60006673) – Wellington SRS Outfall

ID53 (S-MA70024441) - Renfrew SRS Outfall

ID89 (S-MA70016005) – Ash FPS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Ash and the surrounding districts. Each interconnection is shown in Figure 03 and shows gravity and pumped flow from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Aubrey

- Dual 300 mm force main river crossing carries flow from the Ash LS across the Assiniboine River to the Aubrey district Man interceptor pipe and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.
  - Aubrey district south of Wolseley Avenue invert = 230.64 m (S-MH70006432)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Doncaster

- A 750 mm CS pipe under surcharged flow conditions in the Doncaster district flows by gravity southbound on Doncaster Street and connects into the CS system in Ash:
  - Willow Avenue and Doncaster Street invert = 226.37 m (S-MH60006151)

1.3.1.3 District Interconnections

Doncaster

<u>CS to CS</u>

- Common high point CS manhole:
  - Kenaston Boulevard and Corydon Avenue = 227.70 m (S-MH60006019)

Lindenwoods East (Area 3)

<u>WWS to WWS</u>

- A 250 mm WWS sanitary sewer flows into Ash district and crosses the district boundary at the intersection of Waverley Street and Victor Lewis Drive:
  - Waverley Street and Victor Lewis invert at Ash district boundary = 228.87 m

<u>LDS to LDS</u>

- A 375 mm LDS flows into Ash district at Wilkes Avenue and is discharged into a stormwater retention basin in Ash:
  - Wilkes Avenue near Waverley Street invert at Ash district boundary = 228.23 m
- A 375 mm LDS pipe from Area 3 flows northbound by gravity into Ash LDS system at Wilkes Avenue and Victor Lewis Drive:
  - Wilkes Avenue and Victor Lewis Drive invert at Ash district boundary = 228.95 m (S-MH70001787)
- Two LDS systems convey flow out of Ash district, cross the district boundary and discharge into a stormwater retention basin in Lindenwoods East:
  - Waverley Street and Victor Lewis Drive invert at Ash district boundary = 229.66 m

Lindenwoods West (Area 3.1)

<u>LDS to LDS</u>

- A 750 mm LDS system convey flow out of a small portion of Ash district, crosses the district boundary and discharges into a stormwater retention basin in Lindenwoods West:
  - Sterling Lyon Parkway and Brockville Street at Ash district boundary = 229.48 m
- A LDS siphon crosses from Lindenwoods West to Ash district, and then connects into the LDS system in Ash. This LDS system discharges either into a stormwater retention basin in Ash or the one in Lindenwoods West:
  - Wilkes Avenue and Paget Street invert at Ash district boundary = 230.24 m

Willow

LDS to LDS

- A 600 mm LDS overflow is located in Ash district and flows southbound by gravity into Willow district:
  - Fennell Street and Wilson Place invert at Willow district boundary = 231 m (S-MH60014575)

Jessie

CS to CS

- A 300 mm CS at Corydon Avenue and Cambridge Street flows eastbound by gravity into Jessie district. The manhole at the district boundary in Ash is also a high point:
  - Corydon Avenue and Cambridge Street invert at Jessie district boundary = 229.25 m (S-MH60010068)
  - Common high point CS manhole = 229.50 m

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

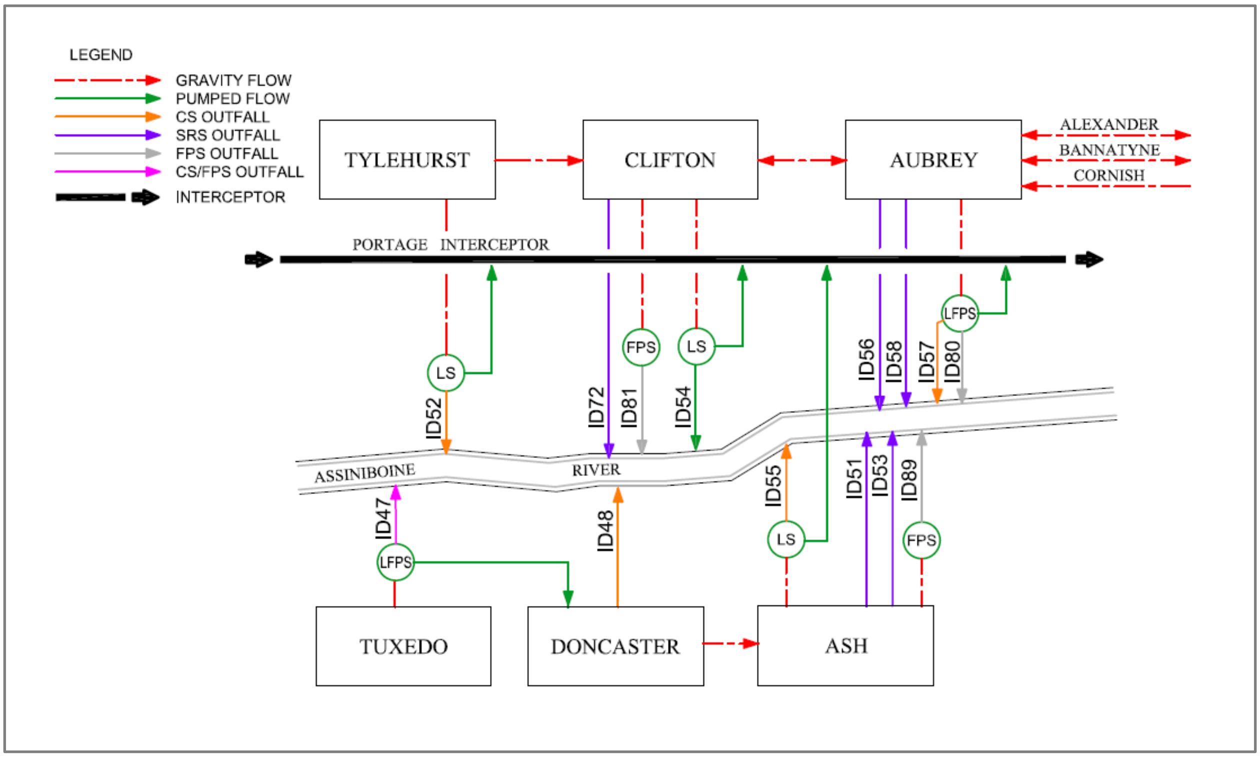


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 03 and are 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 (ID55)	S-MH70011795.1	S-MA70033504	3480 mm	Assiniboine River Invert: 222.98 m
Flood Pumping Outfall (ID81)	S-AC70007362.1	S-MA70016005	2100 mm	Assiniboine River Invert: 224.87 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-TE70007360.1	S-MA70016011	2440 x 3150 mm	Invert: 223.26 m
SRS Outfalls	S-CO70011421.1 S-MH60005292.1	S-MA70024441 S-MA60006673	2400 mm 300 mm	Assiniboine River Invert: 222.2 m Invert: 226.0 m
SRS Interconnections	N/A	N/A	N/A	30-SRS-CS Interconnections throughout district.
Main Trunk Flap Gate	S-MH70011794.1	S-CG00000743	2500 mm	Invert: 223.83 m
Main Trunk Sluice Gate	ASH_GC.1	S-CG00000744	1800 x 2100 mm	Invert: 223.47 m
Off-Take	S-TE70007363.1	S-MA70017767	600 mm	Invert: 223.47 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	S-TE70027396.2 S-TE70027398.1 S-TE70027395.2 (stand-by)	N/A	0.280 m^3/s	1 x 0.19 m^3/s max discharge 1 x 0.09 m^3/s (0.19 m^3/s max discharge) 1 x 0.00 m^3/s (0.19 m^3/s max discharge)
Lift Station ADWF	N/A	N/A	0.101 m^3/s	Ash district ADWF as 0.094 m^3/s
Lift Station Force Main	S-YY70021058.2	S-MA70044147	300 mm	2 x 300 mm
Flood Pump Station Total Capacity	N/A	N/A	5.24 m^3/s	3 x 1.42 m^3/s, 1 x 0.98 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.660 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	Ash – 223.85 Renfrew – 223.88 Wellington – 224.21
2	Trunk Invert at Off-Take	223.47
3	Top of Weir	224.03
4	Relief Outfall Invert	Renfrew - 222.48
5	Relief Interconnections (S-MH60006951)	224.97

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
6	Sewer District Interconnection (Doncaster Street and Tuxedo Avenue)	Invert at district boundary: 226.62
7	Low Basement	230.43
8	Flood Protection Level	230.30

[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 Ash was in 1981 with the Ash District Combined Sewer Relief (M.M. Dillon Ltd, 1981). This study discussed the upgrading of the Ash CS district to reduce surcharge levels and basement flooding.

Significant SRS construction was completed throughout Ash from 1979 - 1981 to relief the basement flooding risk in the district. This work included the construction of the dedicated SRS outfall at Wellington Crescent and Waverley Street to compliment the Renfrew SRS outfall constructed in the 1960s. Ultimately this Waverley outfall was converted do a dedicated LDS outfall providing partial separation to the Ash district.

In 2013 further SRS relief work was completed in the northwest corner of the Ash District to provide localized CS relief to properties on Wellington Crescent immediately east of Kenaston Boulevard. This work included the construction of the Wellington dedicated SRS outfall.

Starting in 2014, the City initiated a preliminary design study to focus on relief of the Waverley Street and Taylor Avenue. The Waverley Underpass Study provided a high level design for a grade separation of Waverley Street and the Canadian National Railway (CNR) that passes through Ash District. The objective of this study was to improve the transportation network within the area. The construction is currently underway with plans for the project to be completed in late 2019. The construction impacts the portions of the southeast Ash district: primarily along Waverley Street, from Grant Avenue to Wilkes Avenue and along Taylor Avenue. From Lindsay Street to Cambridge Street Improvements to the land drainage were proposed, mainly the separation of Taylor Avenue and Waverley Street, The area south of Taylor Avenue has already been previously separated as part of this work.

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 Ash 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
3 - Ash	1981	Future Work	2013	Planning Separation	N/A

Source: Report on Ash District Combined Sewer Relief, 1981

1.5 Ongoing Investment Work

Proposed investment work is being considered for Route 90 from Taylor Avenue to Ness Avenue, which will occur in both Doncaster and Ash. Kenaston Boulevard runs through the north section of Ash and, therefore, will affect the sewer systems in this district. The existing combined sewers will be evaluated for separation potential as part of the Route 90 Widening Project. Opportunistic separation will be incorporated where there is benefit. The separation costs may be reduced if separation work is planned as part of road reconstruction.

There is ongoing maintenance and calibration of permanent instruments installed within the Ash outfall. This consists of monthly site visits in confined entry spaces to verify that physical readings concur with displayed transmitted readings and replacing desiccants when 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 Ash sewer district are listed in Table 1-4. The proposed CSO control projects will include latent storage with flap gate control, partial separation, in-line storage via control gate floatables control 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 and SRS systems are suitable for use as in-line and latent storage. These proposed control options would take advantage of the existing CS and SRS pipe networks for additional storage volume. Existing DWF levels experienced within the collection system, and overall district operations would remain the same. Additional WWF during rainfall events however will be collected from the SRS and CS systems and forwarded to the NEWPCC for treatment.

Floatable control will be necessary to capture any 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 floatable capture level. Installation of a control gate will be required for the screen operation. The control gate installation will additionally provide the mechanism for capture of the additional in-line storage.

Partial separation has been proposed to be completed in conjunction with the Route 90 widening work and opportunistic additional separation would be beneficial at intersecting local roads. This is also part of the Doncaster district proposed control option work.

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 Sewer Separation

The partial sewer separation project for Ash will provide benefits to the CSO program when complete. The work includes installation of a new LDS trunk and collector sewers within the district as part of the Route 90 Widening Project. The existing CS trunks along Kenaston Boulevard will be separated into distinct storm and sanitary sewer systems, which will allow for sanitary sewage that contains untreated domestic, industrial, and commercial wastes to be separated from the storm runoff. A new LDS system would allow the storm runoff to be discharged into the Assiniboine River during rainfall events. The existing combined sewers would be retained for use as separate WWS to convey sanitary sewage through the Ash sewer system to the appropriate treatment plant. The approximate area of sewer separation is shown on Figure 03.

The flows to be collected after the Ash partial separation will be as follows:

- Dry weather flows will remain the same for Ash district with all DWF being diverted to the Ash CS LS and into Aubrey district.
- The Ash WWF response overall will be reduced as the section along Route 90 will consist of sanitary sewage combined with foundation drainage.

Partial sewer separation will provide a reduction of overflows when evaluated with the 1992 representative year. In addition to reducing the CSO volume, the benefits of the Ash partial separation include a reduction of the amount of flood pumping required at the Ash FPS. The complete sewer separation work proposed in this CSO Master Plan for the upstream districts of Doncaster and Tuxedo will also contribute to the reductions experienced in the Ash district, as the intercepted CS from each of these districts also contribute to the CS within the Ash district.

1.6.3 Latent Storage

Latent storage is proposed as a control option for the Ash district. The latent storage level in the system is controlled by the river level, and the resulting backpressure of the river level on the SRS outfall flap gate, as explained in Part 3C. However, the level of the Renfrew SRS outfall is only partially above the NSWL when modelled with the 1992 representative year. This only provides a modest benefit in terms of additional volume capture with latent storage at this location controlled only by the river level. Therefore, a mechanical gate control has been additionally recommended for this control option, to provide the additional latent storage volume. This will allow the SRS outfall flap gate to remain closed regardless of the river level conditions on the Assiniboine River. Details of the SRS flap gate control are provided in the standard details in Part 3C. The latent storage design criteria are identified in Table 1-5. The storage volumes indicated in Table 1-5are based on the river level conditions over the course of the 1992 representative year, with supplemental mechanical flap gate control provided as required.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	222.69 m	
NSWL	223.88 m	
Trunk Diameter	2400 mm	
Design Depth in Trunk	1190 mm	
Maximum Storage Volume	1779 m^3	
Force Main	150 mm	
Flap Gate Control	Yes	
Pump Station	Yes	
Nominal Dewatering Rate	0.03 m^3/s	Based on 24 hour emptying requirement

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
RTC Operational Rate	TBC	Future RTC/dewatering review on assessment

Notes:

NSWL – normal summer water level

RTC – Real Time Control

The addition of a pump and force main that connects back to the CS system will be required for latent storage. A conceptual layout for the latent storage pump station (LSPS) and force main is shown on Figure 03-02. The LSPS will be located adjacent to the existing gate chamber near Wellington Crescent. The LSPS will direct flows southwest to the nearby 300 mm CS sewer on Renfrew Street and into the manhole (S-MH70028046) on the south curb on Wellington Crescent and the back lane of Renfrew Street. This location for latent storage dewatering return was evaluated and capable of accommodating the returned pump flow and selected as appropriate. The pump station will operate to dewater the SRS system in preparation for the next runoff event, to meet the requirement for the system to be ready for the next event within a 24-hour period after completion of the previous event.

The LSPS would connect to the SRS outfall chamber and discharge back to the CS system once capacity allows. Figure 03 identifies the extent of the SRS system within Ash district that would be used for latent storage. The maximum storage level is directly related to the NSWL and the size and depth of the SRS system. Once the level in the CS system exceeds the in-line control gate (see Section 1.6.4), the mechanical flap gate control provided at the Renfrew SRS outfall will be deactivated. At this point the combined sewage within the SRS system will be discharged to the river, assuming river levels are sufficiently low to allow discharge. The Wellington SRS system located in the northwest corner of the Ash district was also evaluated. The Wellington SRS outfall pipe invert elevation was found to be consistently above the NSWL under the 1992 representative year. It therefore, does not contribute to the available latent storage in Ash utilizing the Renfrew SRS outfall.

The lowest interconnection between the combined sewer and relief pipe was found to be higher than the proposed latent and in-line storage control levels. This will allow the two systems would function independently to provide additional volume capture.

As described in the standard details in Part 3C wet well sizing within the LSPS will be determined based on the final pump selection, operation and dewatering capacity required. The interconnecting piping between the new gate chamber and the LSPS would be sized to provide sufficient flow to the pumps while all pumps are operating.

1.6.4 In-Line Storage

In-line storage has been proposed as a CSO control for the Ash 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 and provide additional hydraulic head for screening operations.

A standard design was assumed for the control gate, as described in Part 3C. The standard approach was initially 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 bypass weir and control gate levels were then subsequently assessed to a level below the existing FPS operational levels, as the half trunk diameter initial level assessment indicated that the FPS operated prior to the opening of the control gate. This would increase the operational run period of the FPS and is not considered beneficial to the control option.

The design criteria for in-line storage are listed in Table 1-6.

Table 1-6. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	223.30 m	
Trunk Diameter	2440 x 3150 mm	Egg-shaped
Gate Height	0.90 m	Flood pumping station assessment max operational level
Top of Gate Elevation	224.40 m	
Maximum Storage Volume	2000 m^3	
Nominal Dewatering Rate	0.28 m^3/s	Existing CS LS pump capacity
RTC Operational Rate	TBD	Future RTC/dewatering review on assessment

Note:
RTC = Real Time Control

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 03. 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 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 to 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 03-01 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 FPS. The dimensions of the chamber will be 5.1 m in length and 3.7 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. The proposed location is within the existing Ash CS LS and gate chamber layout and based on the available potential space. 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 Ash 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 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 FPS rehabilitation or replacement project.

The nominal rate for dewatering is already set at the existing CS LS pumping capacity. This allows dewatering through the existing interceptor system within 24 hours following a runoff event, allowing it to recover in time for a subsequent event. Future RTC / dewatering assessment will be necessary to define additional rates. This would provide some flexibility in the ability to increase the dewatering rate for spatial rainfall events. This would dewater the district more quickly, to capture and treat more volume for these localized storms by using the excess interceptor capacity where the runoff is less.

1.6.5 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The 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 gate control implemented, are listed in Table 1-7.

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.40 m	
Bypass Weir Crest	224.30 m	
Normal Summer Water Level	223.85 m	
Maximum Screen Head	0.69 m	
Peak Screening Rate	0.65 m^3/s	
Screen Size	1.5 m x 1.0 m	Modelled Screen Size

The proposed side overflow bypass weir and screening chamber will be located adjacent to the proposed control gate and existing CS trunk, as shown on Figure 03-01. The screens will operate with the control gate in its 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 side bypass weir height will be set to the critical performance level of the control gate. The screening chamber will include screenings pumps with a discharge returning the screened material to the LS for routing to the NEWPCC for removal.

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 3.2 m in length and 3.1 m in width. The existing sewer configuration may have to be modified to accommodate the new chamber.

1.6.6 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 applicable GI controls.

Ash has been classified as a medium GI potential district. Land use in Ash is mainly residential with a small amount of commercial, and the north end of the district is bounded by the Assiniboine River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

1.6.7 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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within separated part of the district may also receive insufficient flows with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district.

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.

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 and dewatering pumps will require regular maintenance that would depend on the frequency of operation. The flap control gate mechanisms will require maintenance inspections for continued assurance that the flap gate would open during WWF events, expected to be based on the number of overflows for the district.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-8.

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	818	818	21,358	24	N/A
2037 Master Plan – Control Option 1	818	774	21,258	23	IS, Lat St, SC, SEP, FGC

Notes:

IS = In-line StorageLat St = Latent Storage
SC = Screening
SEP = Separation

FGC – Flap Gate Control

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 1-9 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 1-9. 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 [c]
Baseline (2013)	356,385	341,484	-	27	0.660 m^3/s
Latent Storage	347,453 [a]	315,960 [b]	25,524	22	0.660 m^3/s
Latent & In-Line Storage		312,942 [b]	3,018	22	0.569 m^3/s
Latent (flap gate control), In-Line & Partial Separation	N/A [a]	258,264	54,678	22	0.617 m^3/s
Control Option 1	**355,500**	**258,264**	**83,220**	**22**	0.617 m^3/s

[a] Latent storage and in-line storage not simulated independently during the Preliminary Proposal assessment. Separation not included in PP

[b] Assessment completed with individual district models and full model impact overflows provided

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

The percent capture performance measure is not included in Table 1-9, 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 1-10. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-10. District Cost Estimate – 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 (Over 35-year period)
Latent Storage	N/A [a]	$2,590,000	$72,000	$1,550,000
Flap Gate Control	N/A [b]	$2,340,000	$33,000	$710,000
In-Line Storage	N/A [a]	$5,100,000 [d e]	$61,000	$1,320,000
Screens		$2,550,000 [f]	$55,000	$1,190,000
Partial Separation [c]	N/A [c]	$29,100,000	$17,000	$370,000
Subtotal	**N/A**	**$41,680,000**	**$238,000**	**$5,140,000**
Opportunities	N/A	$4,170,000	$24,000	$510,000
District Total	**N/A**	**$45,850,000**	**$262,000**	**$5,650,000**

[a] Latent Storage, Screening and In-Line Storage not included in the original Preliminary Proposal 2015 costing submission. Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for the Latent Storage item of work found to be $1,710,000 in 2014 dollars, Costs for the Screening and In-Line Storage items of work found to be $4,320,000 in 2014 dollars.

[b] Flap Gate Control not included in the Preliminary Proposal 2015 costing

[c] Costs for sewer separation may be shared with Public Works budget for the Route 90 widening. Sewer separation not originally proposed as proposed as part of Preliminary Proposal costing.

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

[e] Full control gate structure not needed at Renfrew SRS as existing chamber structure to be utilized for flap gate control. Cost revised after submission of preliminary CO1MP costs. Cost for this item found to be $2,760,000 in 2019 dollars.

[f] 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.

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 1-11.

Table 1-11. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	In-Line Storage	A control gate was not included in the Preliminary Proposal estimate.	Added for the MP to further reduce overflows
	Screening	Not included in the Preliminary Proposal estimate.	Added in conjunction with the Control Gate.
	Latent Storage	Not included in the Preliminary Proposal estimate.	Added for the MP to further reduce overflows
	Flap Gate Control	Not included in Preliminary Proposal estimate	Added for improvement to Master Plan options
	Partial Separation	Not included in the Preliminary Proposal estimate.	Added for the MP to further reduce overflows
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 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 1-12 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 Ash district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. However, opportunistic sewer separation within portions of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line-tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume.

Table 1-12. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Increased GI • Off-Line Storage (Tank/Tunnel) • Opportunistic Separation

The Ash district control options have been selected to align with the system wide basis to achieve the 85 percent capture performance target. The expandability of this district to meet the 98 percent capture future target would be achieved on a stepped approach from the system wide basis. The interaction with the upstream district control options implementation i.e. separation of Tuxedo and Doncaster, will also impact this district's performance.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-13.

Table 1-13. 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	-	-	O	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	R	R	-	-	-	-	-	-
7	Sewer Conflicts	R	R	-	-	R	-	-	-

Table 1-13. Control Option 1 Significant Risks and Opportunities

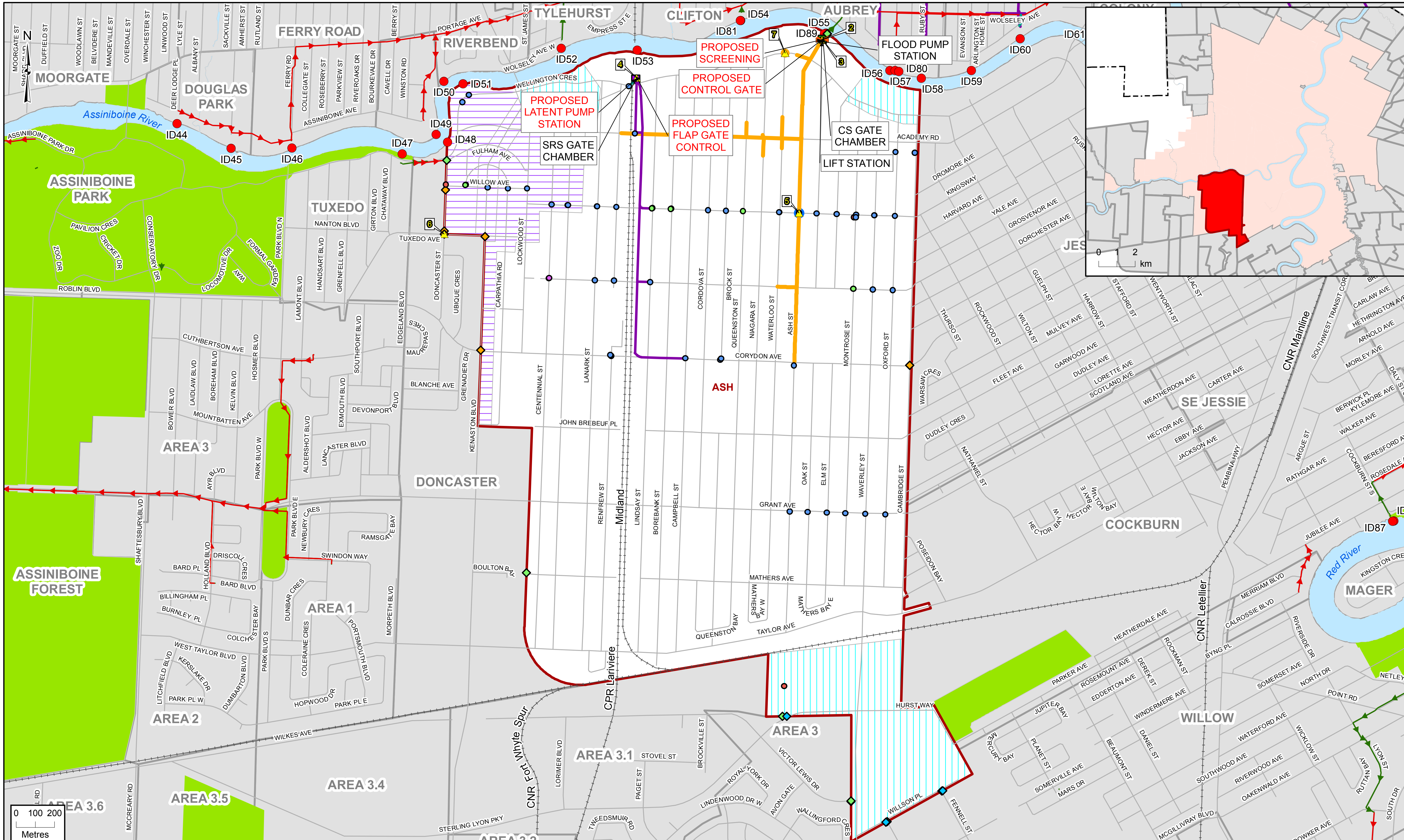
Risk Number	Risk Component	Latent Storage / Flap Gate Control	In-line Storage / Control Gate	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
8	Program Cost	**O**	**O**	**-**	**-**	**R**	**-**	**-**	**O**
9	Approvals and Permits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

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

1.12 References

City of Winnipeg. 2008. *Study Details, Route 90 Study*. Accessed July 10, 2018. http://www.winnipeg.ca/publicworks/construction/studies/route90-studyDetails.stm.

M.M. Dillon Ltd. 1981. *Ash District Combined Sewer Relief*. December.



LEGEND

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

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

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
- Extent of In-line Storage
- Latent Force Main
- Sewer Separation - Planning
- Sewer Separation - Complete

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 03
District Overview Map
Sewer District: Ash
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\ASH\ASH_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:08:05 AM

LEGEND

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

Sewer By Type
- CS
- 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

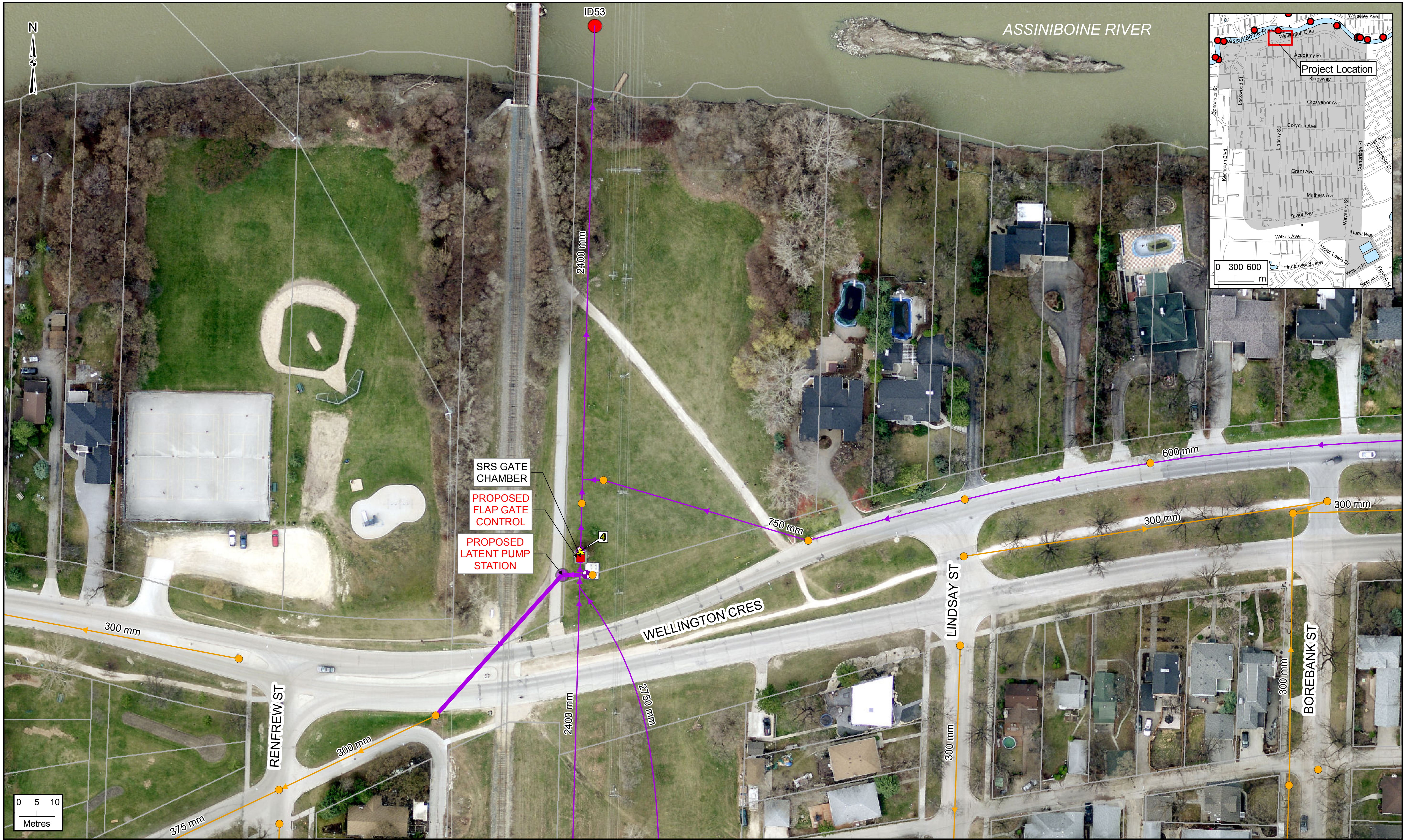
JACOBS

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

Winnipeg
THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 03-01
Control Gate and Screening
Sewer District: Ash
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\ASH\ASH_DISTRICT_DETAIL_ASHST.MXD SBEGG1 7/29/2019 8:07:17 AM



LEGEND

- Critical Elevation
- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate

Sewer By Type
- CS
- SRS

Control Structure Type
- Gate Chamber

- Land Parcel

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 03-02
Latent SRS Control
Sewer District: Ash
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\ASH\ASH_DISTRICT_DETAIL_RENFREWLATENT.MXD SBEGG1 6/24/2019 7:35:15 AM

CSO Master Plan

Assiniboine District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Assiniboine District Plan
Revision:	03
Date:	August 18, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	Assiniboine_Plan_Final_CO1MO_08182019

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	08/30/2018	DRAFT for City Comment	DT	SB / MF / SG	
1	02/15/2019	DRAFT 2 for City Review	JT	MF	SG
2	06/07/2019	Final Draft Submission	DT	MF	MF
3	08/18/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Assiniboine District

1.1 District Description

Assiniboine district is located in the centre of the combined sewer (CS) area north of the Assiniboine River. Assiniboine is approximately bounded by Osborne Street, Memorial Boulevard, and Vaughan Street to the west; Graham Avenue to the north; Garry Street and Main Street to the east; and the Assiniboine River to the south.

Land use within Assiniboine district is comprised mostly of the downtown living and multiple-use sectors. Broadway is the approximate dividing line between the two sectors with the downtown living sector to the south and the multiple-use sector to the north. This includes a mix of high-rise office buildings, commercial businesses, apartment blocks, and hotel complexes. A character sector is located in the west which includes the Manitoba Legislative Building and grounds. Overall, this district includes the majority of the downtown area and includes major buildings such as the RBC Winnipeg Convention Centre, City Place, and the Manitoba Courts.

All roadways in the downtown area are considered regional transportation routes. Aside from the Legislative grounds, greenspace is limited to Bonnycastle Park located south of Assiniboine Avenue along the Assiniboine River. Approximately 8 ha of the district is classified as greenspace.

1.2 Development

Assiniboine district includes a significant portion of the downtown area and the potential for redevelopment in the future is high. The OurWinnipeg development plan has prioritized the Downtown for opportunities to create complete, mixed-use, higher density communities. Redevelopment within this area could impact the combined sewer and would be investigated on a case-by-case basis for potential impacts to the combined sewer overflow (CSO) Master Plan. All developments within the CS districts are mandated to offset any peak combined sewage discharge by adding localized storage and flow restrictions, in order to comply with Clause 8 of the Environment Act Licence 3042.

1.3 Existing Sewer System

Assiniboine district encompasses an approximate area of 86 ha[1] based on the GIS district boundary information. The district includes a CS system and a storm relief sewer (SRS) system. This district does not include any areas that may be identified as land drainage sewer-separated or separation ready. The CS system drains toward the Assiniboine outfall, located at the corner of Assiniboine Avenue and Main Street where CS is diverted to the Main Interceptor.

Two main sewer trunks collect the sewage that flows to the Assiniboine primary CS outfall. A 1350 mm CS captures flow from the southeastern section of the Bannatyne district and a 1200 mm CS trunk sewer collects flow representing the Assiniboine district proper. The 1200 mm CS trunk sewer extends along Assiniboine Avenue with collector pipes along Carlton Street and Smith Street. The southeastern section of the Bannatyne district serviced by the Assiniboine primary outfall collects flow along Main Street south of Graham Avenue within the Bannatyne district boundary, and also includes a separate 600 mm CS that services the area of The Forks south of Graham Avenue. These two CSs connect into a 1350 mm CS trunk sewer which flows by gravity south towards the Assiniboine diversion chamber.

During dry weather flow (DWF), the SRS is not required, and sanitary sewage flows to the diversion chamber upstream of the Assiniboine CS outfall and is diverted by the primary weir to a 1120 mm interceptor pipe. From here the intercepted DWF flows by gravity north to the Main Interceptor and

[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.

eventually to the North End Sewage Treatment Plant (NEWPCC) for treatment. During wet weather flow (WWF), flow that exceeds the diversion capacity overtops the primary weir and is discharged to the river. Sluice and flap gates are installed on the Assiniboine CS outfall to prevent river water from backing up into the CS system. When the river level is high along the Assiniboine River, the flap gate remains closed and gravity discharge is not possible. In this situation the build-up of CS within the Assiniboine outfall is pumped by the Assiniboine flood pump station (FPS) through the Assiniboine CS outfall downstream of the flap gate, allowing it to discharge to the river.

As well during WWF events, an SRS system provides relief to the CS system in Assiniboine district. The SRS system extends throughout the district and has multiple interconnections with the CS system. Most catch basins are still connected to the CS system, so no partial separation has been completed utilizing this SRS system. Combined sewage relieved from the CS system and entering the SRS system is ultimately collected in a SRS trunk sewer running along Donald Street. This SRS trunk is drained by gravity to a dedicated SRS outfall at Donald Street and Assiniboine Avenue, immediately east of the Mid-Town Bridge. A sluice gate is located in the outfall pipe to prevent river water from backing up into the SRS system under high river level conditions along the Assiniboine River. A new flap gate is also planned to be constructed at this SRS outfall.

There are also two secondary CS outfalls within the Assiniboine district, which provide relieve to the CS in the district under WWF events and allow direct discharge to the Assiniboine River at different points, thereby relieving the system and reducing the possibility of basement flooding. The Kennedy CS outfall is located at Kennedy Street and Assiniboine Avenue, within the far upstream portion of the main trunk sewer for the Assiniboine district. If the WWF exceeds the capacity of this portion of the trunk sewer, then it will spill over a weir connecting to the Kennedy outfall and will overflow to the Assiniboine River. The Hargrave outfall is located immediately west of the Mid-Town Bridge. The secondary outfall is located within the main trunk sewer for the Assiniboine district, after it has received CS from approximately one-third of the district. If the WWF exceeds the capacity of this portion of the trunk sewer, it will spill over a weir connecting to the Hargrave outfall and will overflow to the Assiniboine River. Both sluice and flap gate protection are provided on both the Kennedy and Hargrave secondary outfall, to prevent river water from backing up into the CS system under high river level conditions along the Assiniboine River.

The four outfalls to the Assiniboine River (three CSs and one SRS) are as follows:

- ID71 (S-MA70008123) – Assiniboine CS Outfall
- ID68 (S-MA20014087) – Hargrave Secondary CS Outfall
- ID66 (S-MA70068974) – Kennedy Secondary CS Outfall
- ID69 (S-MA20014095) – Donald SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Assiniboine and the surrounding districts. Each interconnection is shown on Figure 04 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

Bannatyne

- The 1650 mm Main Interceptor pipe flows by gravity eastbound on Broadway from Assiniboine district into Bannatyne district:
  - Main Interceptor on Broadway Invert at District Boundary – 223.16 m (S-MH20012896)
- The 450 mm diversion CS from the Assiniboine CS outfall connects to the 1120 mm interceptor that flows by gravity north on Main Street to the Main Interceptor at Broadway into Bannatyne district:
  - Main Street – 224.28 m (S-MA70008109)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Colony

- The 1500 mm Main interceptor pipe flows by gravity eastbound on Broadway from Colony district into Assiniboine district:
  - Main Interceptor Along Broadway Avenue – Invert at District Boundary – 223.16 m (S-MH20012896)

1.3.1.3 District Interconnections

Colony

<u>CS to CS</u>

- High sewer overflow from Assiniboine district north into Colony district:
  - Carlton Street and Portage Avenue Overflow Invert – 229.11 m (S-MH20014164)

<u>SRS to SRS</u>

- A 1350 mm SRS extends into Colony district, servicing Portage Place Shopping Centre, and flows by gravity from Colony district southbound into Assiniboine district on Kennedy Street:
  - Kennedy Street Invert at District Boundary – 225.64 m (S-MA20015634)

<u>SRS to CS</u>

- A 1050 mm SRS flows diverts flow from the Colony CS system and flows by gravity southbound on Donald Street and connects to the SRS network in the Assiniboine district:
  - Portage Ave and Donald Street Overflow (Top of Overflow Weir) Into 1050 mm SRS – 228.09 m (S-MH20014250)
- A 450 mm overflow SRS diverts flow from the Colony CS system and flows by gravity into the Assiniboine SRS system along St. Mary Avenue:
  - St. Mary Avenue Overflow (Top of Overflow Weir) Into 450 mm SRS – 228.32 m (S-MH20013465)
- Three separate high sewer overflows SRS pipes connect at manhole at the intersection of Graham Avenue and Edmonton Street within Assiniboine district. A 450 mm SRS overflow pipe collects SRS from this manhole northbound on Edmonton Street into Colony district and connects to the CS system in Colony district:
  - Edmonton Street and Graham Avenue 450 mm Overflow Invert – 227.83 m (S-MA20015704)

Bannatyne

<u>CS to CS</u>

- A 1350 mm CS flowing by gravity connects to the diversion chamber at the Assiniboine CS outfall from servicing southeastern portion of Bannatyne district into Assiniboine district:
  - Main Street CS Pipe Invert at District Boundary – 225.75 m (S-MA70008114)

<u>SRS to CS</u>

- A 525 mm SRS diverts flow from Bannatyne CS System, and then flows by gravity westbound along Graham Avenue into the SRS system in Assiniboine district:
  - Graham Avenue and Garry Street SRS Overflow (Top of Overflow Weir) Into 525 SRS – 228.85 m (S-MH20014497)

- A 300 mm SRS diverts flow from Bannatyne CS System, and then flows by gravity southbound on Fort Street into the CS system in Assiniboine district:
  - York Avenue and Fort Street SRS Overflow (Top of Overflow Weir) Into 300 SRS – 229.31 m (S-MH20014456)
- A 300 mm diversion SRS with two overflow connections diverts flow from the Bannatyne CS System, and then flows by gravity south on Smith Street and connects to the Assiniboine SRS system at the intersection of Smith Street and Graham Avenue:
  - Smith Street and Graham Avenue SRS Overflow #1 (Top of Overflow Weir) Into 300 SRS – 228.67 m (S-MH20014271)
  - Smith Street and Graham Avenue SRS Overflow #2 (Top of Overflow Weir) Into 300 SRS – 229.08 m (S-MH20014178)

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

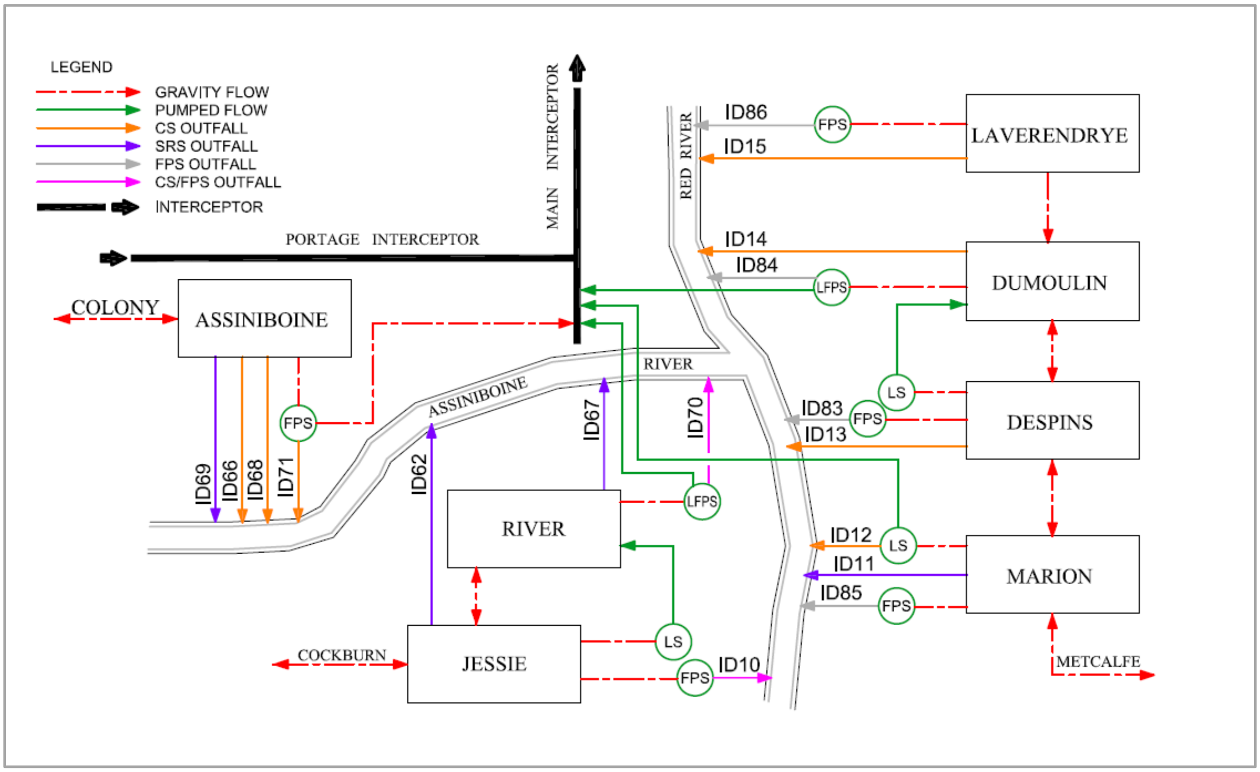


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 04 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 (ID71)	S-RE70003466.1	S-MA70008123	1400 mm	Assiniboine River Invert: 222.04 m
Flood Pumping Outfall (ID71)	S-RE70003466.1	S-MA70008123	1400 mm	Assiniboine River Invert: 222.04 m

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Other Overflows (ID66 & ID68)	S-AC70028554.1 S-AC20004773.1	S-MA70068974 S-MA20014087	750 mm 750 mm	Invert: 222.43 m Invert: 222.03 m
Main Trunk	S-MH20011932.1	S-MA70008096	1200 mm	Circular Invert: 225.83 m
SRS Outfalls (ID69)	S-CO70003060.1	S-MA20014095	1900 mm	Invert: 221.80 m
SRS Interconnections	N/A	N/A	N/A	41 SRS - CS
Main Trunk Flap Gate	S-AC70008475.1	S-CG00000720	1525 mm	Invert: 223.97 m
Main Trunk Sluice Gate	ASSINIBOINE_GC.1	S-CG00000721	1721 x 1721 mm	Invert: 223.70 m
Off-Take	ASSINIBOINE_WEIR.2	S-MA70008109	450 mm	Invert: 225.94 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	ASSINIBOINE_WEIR.2 (1)	S-MA70008109 (1)	450 mm (1)	1.236 m3/s (1)
ADWF	N/A	N/A	0.031 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	
Flood Pump Station Total Capacity	N/A	N/A	1.4 m^3/s	1 x 1.4 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.841 m^3/s	1-year design event

Notes:

ADWF = average dry-weather flow
GIS = geographic information system
ID = identification
N/A = not applicable

(1) – Gravity pipe replacing Lift Station as Assiniboine is a gravity discharge district

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[a]
1	Normal Summer River Level	Assiniboine – 223.828 Donald – 223.83 Hargrave – 223.831 Kennedy – 223.833
2	Trunk Invert at Off-Take	225.94
3	Top of Weir	226.41
4	Relief Outfall Invert at Flap Gate	Donald – 222.44
5	Low Relief Interconnection (S-MH20012805)	227.378
6	Sewer District Interconnection (Colony)	225.38
7	Low Basement	228.90
8	Flood Protection Level (Assiniboine)	229.91

[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 Assiniboine was the *Conceptual Design of Combined Sewer Relief for Assiniboine Sewer District* (Comeau, 1989). The study's purpose was to assess the level of protection against basement flooding and to provide appropriate methods for providing relief to the district. No other work has 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 Assiniboine 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
4 – Assiniboine	1989	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Assiniboine 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.

Upgrades to the Donald SRS outfall are under design at the time of writing, to be implemented in the near future. This work will include the addition of a flap gate to existing gate chamber at this outfall, which includes only a positive sluice gate at this time. This work will be critical to allow for latent storage implementation.

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 Assiniboine district are listed in Table 1-4. The proposed CSO control projects will include latent storage, and floatables 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 height of the existing weir is sufficient that it negates the need to add a control gate to provide in-line storage. The existing height of the weir provides an existing storage of 143 m^3. Since this district already has an existing high level weir, this has been taken as acceptable for basement flooding protection.

The existing SRS system is suitable for use as latent storage. These control options will take advantage of the existing SRS pipe network for additional storage volume.

The Assiniboine district discharges to the interceptor by gravity; therefore, a gravity flow controller is proposed on the CS system to optimize the dewatering rate from the district back into the Main Street interceptor.

Floatable control will be necessary to capture any undesirable 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 capture level.

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

Latent storage is proposed as a control option for Assiniboine district. The latent storage level in the system is controlled by the river level on the Assiniboine River, 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 1-5. The storage volumes indicated in Table 1-5 are based on the NSWL for the 1992 representative year.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	Donald – 222.44 m	Flap gate invert
NSWL	223.83 m	
Trunk Diameter	1950 mm	
Design Depth in Trunk	1390 mm	

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Maximum Storage Volume	420 m^3	
Force Main	150 mm	
Flap Gate Control	N/A	Flap gate control was established as not required for this work.
Lift Station	Yes	
Nominal Dewatering Rate	0.03 m^3/s	Based on 24 hour emptying requirement
RTC Operational Rate	TBD	Future RTC / dewatering review on performance

Note:

NSWL – normal summer water level RTC – Real Time Control

The addition of a pump and force main that connect to the CS system are necessary for the latent storage to be emptied. A conceptual layout for the latent storage pump station (LSPS) and force main is shown on Figure 04-02. The LSPS will be located to the east of the existing SRS outfall chamber to avoid interference with nearby residential lands and disruption to existing sewers. The latent force main will flow north and connect to the Assiniboine CS system and into the manhole (S-MH20012737) on Assiniboine Avenue.

The LSPS would connect to the SRS outfall chamber and discharge back to the CS system once capacity allows. This SRS outfall chamber is currently being upgraded to include a flap gate to allow latent storage to be utilized, see Section 1.5 above. Figure 04 identifies the extent of the SRS system within Assiniboine district that would be used for latent storage. The maximum storage level is directly related to the 1992 representative year NSWL and the size and depth of the SRS system. Once pressure from the level in the SRS exceeds the river level backpressure, the flap gate opens, and the combined sewage is discharged to the river.

As part of the evaluation of the latent storage volume using the continuous NSWL river conditions during the 1992 representative year, it was found that additional flap gate control will not be required to meet Control Option 1. In situations where non modelled assessments are to be completed, the actual river levels will be both lower and higher than the NSWL level at various points throughout an annual year. Where the level is below NSWL, the latent volume will be less than predicted during the MP assessment, while conversely when the level is above the NSWL, the latent volume will be more than predicted. The continuous assessment is seen as a conservative approach since the majority of the representative year rainfall events occur when the river levels are higher than the NSWL.

It should also be noted that the lowest interconnection between the combined sewer and SRS relief pipe network is higher than the proposed latent and existing in-line storage control levels, meaning that the two systems would function independently.

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 SRS gate chamber and the pump station would be sized to provide sufficient flow to the pumps while all pumps are operating.

1.6.3 Gravity Flow Control

Assiniboine district does not include a LS and discharges to the Main Interceptor by gravity, and only restricted by the off-take pipe flow capacity. A flow control device will be required to control and monitor this diversion rate for future RTC and dewatering assessments. A standard flow control device was selected as described in Part 3C.

The flow controller will include flow measurement and a gate to control the discharge flow rate. This has been taken as part of the City's future vision to develop a fully integrated CS system network and will be needed to review flows during spatial rainfall WWF scenarios. The CSO Master Plan assessment utilized a uniform rainfall event, and no further investigative work has been completed within the CSO Master Plan. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

The flow control would be installed at an optimal location on the connecting off-take sewer between the Main Interceptor and existing diversion chamber. Figure 04-01 identifies a conceptual location for flow controller installation. The location proposed would be constructed within the right of way of Main Street, a major arterial roadway. Additional modelling assessment would also be needed to reconfirm the flows within the off-take at this point, and to investigate if the existing off-take pipe may need to be resized as a result of this work. Survey work would be involved to confirm levels in area as part of model maintenance and improvement. The construction is expected to be significant from a traffic aspect due to the location proposed, although construction traffic will be of a short term nature, and will not require the same closures as that for construction of new sewers with separation projects. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction.

1.6.4 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials; in-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	226.42 m	Existing weir level
Bypass Weir Crest	N/A	In-line screening
NSWL	223.83 m	
Maximum Screen Head	2.59 m	
Peak Screening Rate	0.91 m^3/s	
Screen Size	1.5 m wide x 1 m high	Modelled Screen Size

The proposed screening chamber will be located in-line to the existing weir and existing CS trunk, as shown on Figure 04-01. The flow to the screens located in the new screening chamber, with screened flow discharged to the downstream side of the screening chamber to the river. The screening chamber will include screenings pumps with a discharge returning the screened material to the main interceptor for routing to the NEWPCC for removal.

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 was reviewed to identify the most applicable GI controls.

Assiniboine has been classified as a medium GI potential district. Land use in Assiniboine is downtown living and multiple-use sectors, the south end of the district is bounded by the Assiniboine River. This means the district would be an ideal location for bioswales, and green roofs. There are a few parking lot areas which would be ideal for paved porous pavement.

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 Systems 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.

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 operation. Additional system monitoring, and level controls will be installed which will require regular scheduled maintenance.

The gravity flow controller will require the installation of a chamber and flow control equipment. Monitoring and control instrumentation will be required. The gravity flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required, which are further elaborated in Part 3C of the CSO Master Plan.

Floatable control with outfall screening will require the addition of another chamber with screening equipment installed. Screening operation will occur during WWF events that surpass the existing in-line storage control level. WWF would be directed from the main outfall trunk, over the existing primary weir and through the screens to discharge into the river. The screens will operate intermittently during wet weather events based on actual overflows and will likely require operations review and maintenance after each event. The frequency of a screened event would correlate to the number overflows identified for the district. The collected screenings will be transferred back to the main trunk via a small bespoke pump station and force main. Additional maintenance for the screening pumps will be required at regular intervals and after 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 summarized in Table **1-**7.

Table 1-7. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added To Model
2013 Baseline	102	102	7,325	65	N/A
2037 Master Plan – Control Option 1	102	102	7,325	65	Lat St, SC,

Notes:

Table 1-7. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added To Model

Lat St = Latent 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. 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)	Master Plan Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [b]
Baseline (2013)	11,244	13,005	-	16	0.841 m^3/s
Latent Storage	9,734	11,549	1,457	11	0.653 m^3/s
Off-line Storage Tank	5,302 [a]	N/A	N/A	N/A	N/A
Control Option 1	**5,302 [a]**	**11,549**	**1,457**	**11**	**0.653 m^3/s**

[a] Preliminary Proposal included offline storage tank which was not proposed for the CO1MP assessment

[b] Pass forward flows assessed on the 1-year (Baseline) and 5-year (Latent & CO1) design rainfall events at main Assiniboine CS outfall. No overflow for 1-year event.

The selection of an off-line tank during the Preliminary Proposal has been reevaluated during the CSO Master Plan phase as not appropriate. It was found that the performance provided by the other more cost effective control options in all other CS districts achieved the 85 percent capture prior to the requirement for off-line storage tanks in specific districts. The updated cost considerations have also resulted in the removal of this solution from the Assiniboine district.

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 AACE 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 (Over 35-year period)
Latent Storage	$1,790,000	$2,580,000	$74,000	$1,600,000
Off-line Storage Tank	- [a]	N/A [c]	N/A	N/A
Screening	- [a]	$2,910,000 [d]	$34,000 [d]	$740,000
Gravity Flow Control	N/A [b]	$1,300,000	$34,000	$740,000
Subtotal	**$1,790,000**	**$6,790,000**	**$143,000**	**$3,080,000**
Opportunities	N/A	$680,000	$14,000	$310,000
District Total	**$1,790,000**	**$7,470,000**	**$158,000**	**$3,390,000**

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for Off-line storage item of work found to be $2,980,000 and Screening item of work found to be $450,000 both in 2014 dollars

[b] Gravity flow control not included in the Preliminary Proposal 2015 costing

[c] Off-line storage not taken forward as a Master Plan Control Option 1 solution.

[d] 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 alternative plans, 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.

Table 1-10. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Latent Storage	Unit cost updates	
	Screening	Screening was not included in the preliminary estimate	
	Removal Of Off-line Storage Tank	Off-line storage not taken forward as a Master Plan Control Option 1 solution, not considered cost effective to meet CO1 target.	
	Gravity Flow Control	A flow controller was not included in the preliminary estimate	Added for the Master Plan to optimize existing static in-line performance.
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, a future performance target of 98 percent capture for the representative year measured on a system-wide basis was evaluated. 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 Assiniboine 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. The increased volume capture via the inclusion of a flap gate on the latent storage infrastructure could potentially be achieved. In addition, green infrastructure and off-line storage tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume. Opportunistic separation of portions of the district may be achieved with synergies with other major infrastructure work to address 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 use of latent storage (Flap Gate Control) • Increased use of GI Off-line Storage (Tank/Tunnel) • Opportunistic Separation

The Assiniboine district control options have been aligned to the primary outfall being screened under the proposed 85 percent capture control plan. This may limit the expandability nature to achieve the 98 percent capture but would require to be based on the system wide assessment.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-12.

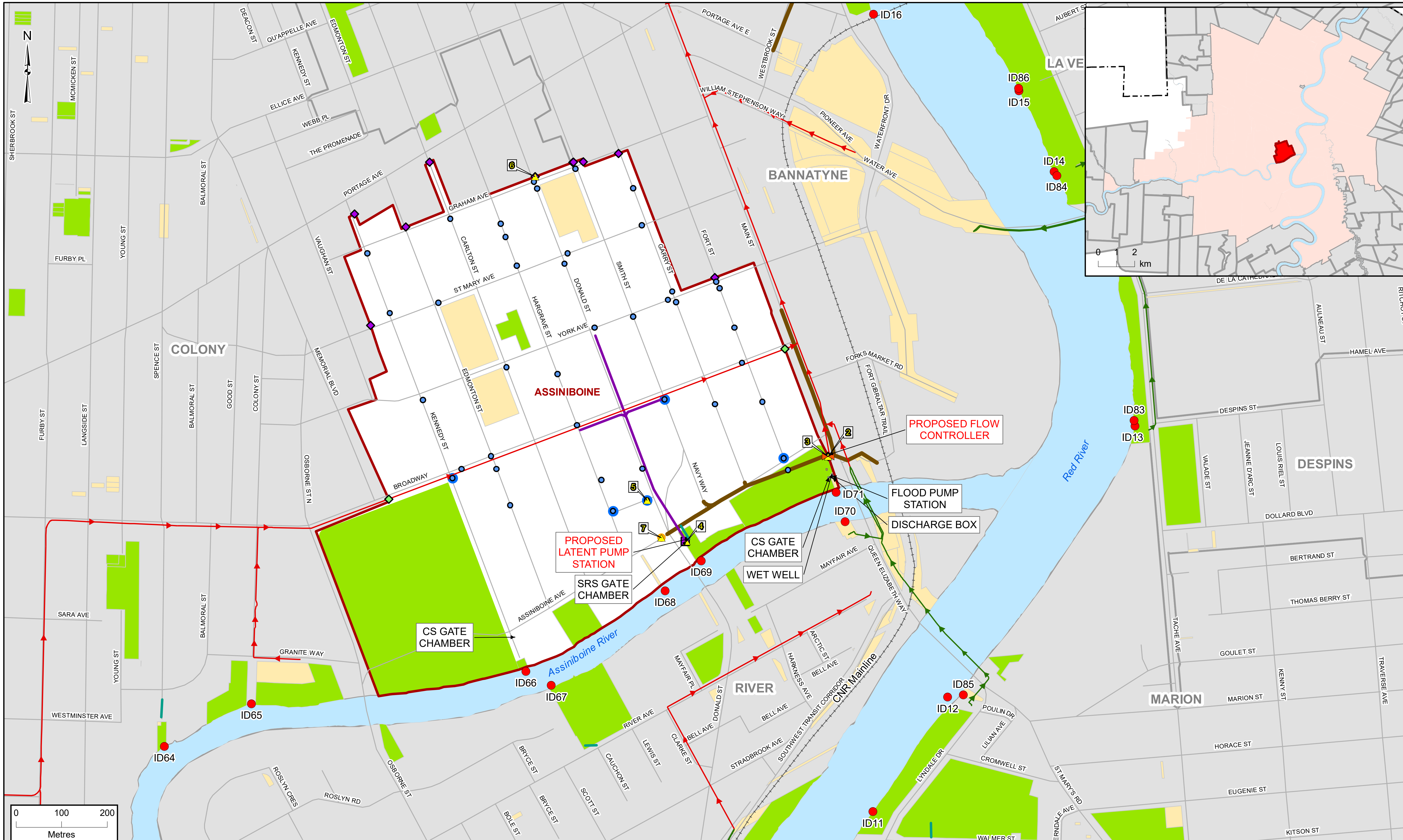
Table 1-12. Control Option 1 Significant Risks and Opportunities

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	-	-	-	-	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	-	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	-	-
6	Sewer Condition	R	-	-	-	-	-	-	-
7	Sewer Conflicts	R	-	-	-	-	-	-	-
8	Program Cost	-	-	-	-	-	-	-	O
9	Approvals and Permits	-	-	-	-	-	-	-	-
10	Land Acquisition	-	-	-	-	-	-	-	-
11	Technology Assumptions	R	-	-	-	-	O	O	-
12	Operations and Maintenance	R	-	-	-	-	R	O	R
13	Volume Capture Performance	O	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	-	-	O	R

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

1.12 References

Comeau, J.E. 1989. *Conceptual Design of Combined Sewer Relief for Assiniboine Sewer District*. Prepared for the Water and Waste Department.



LEGEND

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

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

District Boundary Crossing
- CS
- SRS
- WWS

- Extent of Existing In-line Storage
- Interceptor Sewer
- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace
- City Owned Land

CSO MASTER PLAN PROPOSED SOLUTIONS

- Proposed SRS Latent Storage Pump
- Latent Storage Limit
- Latent Force Main

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 04
District Overview Map
Sewer District: Assiniboine
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\ASSINIBOINE\ASSINIBOINE_DISTRICT_OVERVIEW_MAP.MXD DT072410 7/29/2019 9:05:38 AM

LEGEND

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

Sewer By Type

- CS
- WWS

Control Structure Type

- Gate Chamber

Pump Station Type

- Discharge Box
- Flood Pump Station
- Wet Well

CSO MASTER PLAN PROPOSED SOLUTIONS

- Screening
- Flow Controller

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 04-01
Flow Controller
Sewer District: Assiniboine
City of Winnipeg
Combined Sewer Overflow Master Plan

LEGEND

Critical Elevation
CSO Outfall
Manhole
Sluice Gate

Sewer By Type
CS
SRS

Control Structure Type
Gate Chamber

Land Parcel

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

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 04-02
Latent SRS Control
Sewer District: Assiniboine
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\ASSINIBOINE\ASSINIBOINE_DISTRICT_DETAIL_DONALDST.MXD SBEGG1 6/20/2019 1:19:18 PM

CSO Master Plan

Aubrey District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Aubrey District Plan
Revision:	04
Date:	August 16, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Danny Tinker
File Name:	Aubrey_Plan_Final_CO1MP_08162019

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	08/30/2018	Version 1 DRAFT	DT	SB / SG / MF	
1	02/15/2019	DRAFT 2 for City Review	MF	SG	MF
2	05/2019	Final Draft Submission	DT	MF	MF
3	06/2019	Revised Final Draft Submission	DT	MF	SG
4	08/16/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Aubrey District

1.1 District Description

Aubrey district is in the central portion of the combined sewer (CS) area north of the Assiniboine River. As a district, Aubrey has a unique configuration due to the northern section of Aubrey extending into Clifton district and separating Aubrey district. It is approximately bounded by the Canadian Pacific Railway (CPR) Winnipeg Yards to the north; Erin Street, Minto Street, and Goulding Street to the west; the Assiniboine River to the south; and Burnell Street and Arlington Street to the east. The section of Aubrey district that divides Clifton district is bordered by McCrossen Street to the west, Dublin Avenue and Notre Dame Avenue to the north, and Clifton Street to the east.

The land use within Aubrey district is distributed between primarily industrial and residential areas, as well as commercial businesses located along Portage Avenue and McPhillips Street. The northern area of Aubrey is primarily heavy manufacturing with the CPR Weston Shops and Yards, and the Pacific Industrial lands. The central and southern sections of Aubrey district include residential land consisting of single- and two-family homes and apartment buildings distributed throughout the district. The area of Notre Dame Avenue has mostly been developed as light and heavy industrial. Commercial corridors are located along the various east-west streets in the southern sections of Aubrey, including Ellice Avenue, Wellington Avenue, and Sargent Avenue, among others.

Many major transportation routes pass through the district: McPhillips Street, Logan Avenue, Notre Dame Avenue, Wall Street, Ellice Avenue, and Portage Avenue

Greenspace is limited in the Aubrey district, with small parks located within the residential areas. These parks include Stanley Knowles Park and Sargent Park. Notable non-residential buildings in the Aubrey district include the CPR Winnipeg Yard that spans the northern section, the Royal Canadian Mounted Police Winnipeg Office, and the McPhillips Station Casino.

1.2 Development

A portion of Portage Avenue is located within the Aubrey District. Portage Avenue is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

Aubrey district encompasses an area of approximately 537 ha[1] based on the GIS district boundary data. This includes an area of approximately 17 ha (3 percent of the district area) that is considered separation ready and approximately 16 ha (3 percent of the district area) of greenspace. There is no completed separation in the district.

The CS system includes a flood pump station (FPS), a CS lift station (LS) system and two independent storm relief sewer (SRS) systems. Four outfalls are in the district including one CS, one FPS and two SRS.

The CS system flows to the Aubrey outfall, located at the southern end of Aubrey Street. A single 2800 mm CS trunk sewer collects flow from most of the district. This trunk extends north along Aubrey Street to Portage Avenue. The section of the district north of Notre Dame Avenue is serviced by a 700 mm CS on Logan Avenue that connects to a 900 mm by 1200 mm egg-shaped CS on McPhillips Street. This, in turn, flows to a 1675 mm by 2150 mm egg-shaped trunk on Lipton Street that increases in size as it flows

[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.

south and into a 2050 mm by 2650 mm egg-shaped trunk on Aubrey Street which connects into the 2800 trunk sewer and towards the Aubrey outfall. This Lipton/Aubrey trunk sewer also receives combined sewage from the southern section of the district. Sewers along major roads such as Portage Avenue, Ellice Avenue, St Matthews Avenue, Sargent Avenue, Wellington Avenue, Notre Dame Avenue, and McPhillips Street act as collector pipes and feed into the Aubrey and Lipton Streets trunk sewers. A separate 300 mm CS, which collects sewage from Palmerston Avenue, connects to the trunk at the Aubrey outfall immediately upstream of the primary weir.

During dry weather flow (DWF), flow is diverted by the primary weir to the Aubrey CS LS and pumped to the interceptor sewer on Wolseley Avenue which flows by gravity to the NEWPCC for treatment. The Aubrey district receives the intercepted combined sewage flow from the Ash CS district, via a force main river crossing across the Assiniboine River. The flow from Ash CS lift station (LS) connects to the interceptor on Wolseley upstream of the Aubrey interceptor connection.

During wet weather flow (WWF), any flow that exceeds the diversion capacity overtops the primary weir and is discharged to the Assiniboine river. Sluice and flap gates are installed on the Aubrey CS outfall to prevent back-up of the Assiniboine River into the CS system under high river levels in the Assiniboine River. When the Assiniboine River levels are high during WWF events however, no gravity discharge is possible due to the flap gate installed on the CS outfall. Under these high river level conditions, the excess flow is pumped by the FPS, where it is routed to the dedicated FPS outfall to the river. The FPS outfall does not have a flap gate or sluice gate installed.

During WWF events as well, the SRS systems provide relief to the CS system in the Aubrey district. The SRS systems extend throughout Aubrey and have multiple interconnections with the CS system. Most catch basins are still connected to the CS system, so no partial separation has been completed. Combined sewage relieved from the CS system and entering the SRS system is routed to one of two SRS trunk sewers. The first SRS trunk sewer collecting SRS from the western portion of the district is located along Aubrey Street and is drained by gravity through the Aubrey SRS outfall to the Assiniboine River. The second SRS trunk sewer collecting SRS from the eastern portion of the district is located along McPhillips Street/Burnell Street/Lenore Street and flows by gravity through Ruby SRS outfall to the Assiniboine River.

The four outfalls to the Assiniboine River (one CS, two SRSs, and one FPS) are as follows:

- ID57 (S-MA70017579) – Aubrey CS Outfall
- ID82 (S-MA70017556) – Aubrey FPS Outfall
- ID56 (S-MA70017585) – Ruby SRS Outfall
- ID58 (S-MA70022480) – Aubrey SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Aubrey and the surrounding districts. Each interconnection is shown on Figure 05 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed in the following subsections.

1.3.1.1 Interceptor Connection – Downstream of Primary Weir

Cornish

- The 1200mm Main Interceptor, a gravity sewer discharges into the Cornish district from the Aubrey district and carries sewage to the NEWPCC for treatment:
  - Invert at the manhole S-MH20008231 in Portage Avenue. This gravity pipe flows through multiple districts, including Aubrey, and on to the NEWPCC.

1.3.1.2 Interceptor Connection – Upstream of Primary Weir

Ash

- Dual 300 mm force main river crossing carries flow from the Ash LS across the Assiniboine River to the Aubrey district Man interceptor pipe and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.
    - Aubrey district south of Wolseley Avenue invert each force main pipe = 230.64 m (S-MH70006432)

Clifton

- A 1050mm Main Interceptor sewer discharges via gravity into the Aubrey district from the Clifton district and carries sewage to the NEWPCC for treatment:
    - Portage Avenue – 226.68 m (S-TE70008265)

1.3.1.3 District Interconnections

Clifton

<u>CS to CS</u>

- High Point Manholes (flow is directed into both districts from these manholes):
    - Midland Street – 230.72 m (S-MH20010625)
    - Notre Dame Street – 230.28 m (S-MH20010674)
    - Wall Street (near Wall Street East) – 229.04 m (S-MH20009426) (also to SRS)
    - Wolseley Avenue – 230.22 m (S-MH70039558)
    - Pacific Avenue West and Quelch Street – 228.87 m (S-MH20011789)
    - Alexander Avenue and Quelch Street – 228.57 m (S-MH20010968)
    - Portage Avenue and Clifton Street – 227.24 m (S-MH20010003)
- A 750mm bifurcation pipe directs excess flow from the Clifton district to the Aubrey district at the intersection of Roy Avenue and Cecil Street :
    - Cecil Street – 227.88 m (S-MH20010899)
- A 750 mm bifurcation pips from Aubrey flows southbound on Quelch Street and excess flows connect to the CS system south in the Clifton district on Logan Avenue:
    - Logan Avenue – 227.03 m (S-MH20010965)

<u>CS to SRS</u>

- High Point Manhole(s):
    - Minto Street – 227.56 m (S-MH20008769)
    - Goulding Street – 229.9 m (S-MH20008710)
    - Goulding Street – 229.53 m (S-MH20008700)
    - Wolseley Avenue and Basswood Place – 229.65 m (S-MH70005332)
- A 450 mm SRS overflow pipe connects from the Aubrey district to the SRS system in Clifton district at Keewatin Street and Alexander Avenue:
    - Alexander Avenue –228.27 m (S-MH20011401)

- A 300 mm SRS overflow pipe connects into the SRS system in Clifton district to reduce sewage back-up of the CS network in Aubrey on Pacific Avenue West:
  - Pacific Avenue West – 227.84 m (S-MH20011392)
- A 300 mm diversion pipe provides relief to the CS on Sprague Street and flows from a high point manhole into the Clifton district flowing eastbound on Wolseley Avenue:
  - Wolseley Avenue –229.42 m (S-MH20010522)

SRS to CS

- A 600 mm SRS overflow pipe from Aubrey's CS system flows into Clifton district on Notre Dame Avenue near Clifton Street North:
  - Notre Dame Avenue – 227.91 m (S-MH20011679)
- A 375 mm SRS overflow pipe from Aubrey's CS system flows into Clifton district on Logan Avenue near Wiens Street and connects to the SRS along Logan Avenue:
  - Logan Avenue – 228.83 m (S-MH20011446)

SRS to SRS

- A 2700 mm SRS trunk conveys flow by gravity southbound on Midland Street from Aubrey district into Clifton district to Clifton's SRS outfall:
  - Midland Street– 225.53 m (S-TE20003059)
- A 2250 mm SRS trunk flows by gravity from northern Clifton into Aubrey district at the intersection of Notre Dame Avenue and Flint Street. It also connects to a SRS coming eastbound from Aubrey and then it connects the SRS that flows south on Midland Street:
  - Flint Street and Notre Dame Avenue –225.68 m (S-MH20011539)
- A 1650 mm SRS flows by gravity from northern Clifton collecting overflow from the CS system, into Aubrey district on Notre Dame Avenue. It then connects the SRS that flows south on Midland Street:
  - Notre Dame Avenue –227.22 m (S-MH20010742)
- A 1350 mm SRS flows by gravity from the Aubrey district into Clifton district along Quelch Street at Logan Avenue:
  - Logan Avenue – 226.91 m (S-MH20010964)
- A 1,350 mm SRS pipe flows by gravity from the Aubrey district into Clifton along Worth Street:
  - Worth Street – 226.94 m (S-TE20003936)

WWS to CS

- A 250 mm WWS pipe flows westbound from the Aubrey district on Pacific Avenue into the Clifton CS system:
  - Pacific Avenue – 227.92 m (S-MH20011757)

Alexander

CS to CS

- A 200 mm CS servicing a small area of Aubrey district flows by gravity to connect with the 750 mm CS that connects to the Alexander CS system in Alexander district at the corner of Alexander Avenue and Xante Street:
  - Alexander Avenue and Xante Street Invert at District Boundary – 228.41 m (S-MA20019569)
- High Point Manholes (flow is directed into both districts from these manholes):

- Henry Avenue and Tecumseh Street – 228.95 m References Alexander District, 229.96 m References Aubrey District (S-MH20017866)
- Logan Avenue and Trinity Street – 228.77 m References Alexander District, 226.94 m References Aubrey District (S-MH20017639)
- Pacific Avenue and Arlington Street – 229.3 m (S-MH20017548)
- Elgin Avenue and Arlington Street – 229.49 m (S-MH20017513)

LDS to SRS

- A 375 mm LDS services surface runoff from portion of Alexander district, and flows from Aubrey SRS by gravity westbound along Alexander Avenue and connects to the SRS system in the Aubrey district at the corner of Alexander Avenue and Xante Street:
  - Xante Street and Alexander Avenue Invert at District Boundary – 224.94 m (S-MA70062373)

Bannatyne

CS to CS

- A 300 mm CS pipe acts as overflow at Winnipeg Avenue and Arlington Street to relief CS system in Aubrey district, and then flows by gravity northbound along Arlington Street into the CS System in the Bannatyne District:
  - Winnipeg Avenue and Arlington Street CS Overflow Invert into 300 mm CS – 228.91 m (S-MH20016213)
- High point manhole:
  - William Avenue and Arlington Street – 229.77 m (S-MH20017498)
  - Bannatyne Avenue and Lark Street – 229.10 m (S-MH20016063)
  - McDermot Avenue and Arlington Street – 229.46 m (S-MH20016155)
  - Notre Dame Avenue and Arlington Street – 229.43 m (S-MH20016156)

SRS to CS

- A 1200 mm SRS relieving several blocks from Bannatyne district CS system flows by gravity southbound on Arlington Street into a manhole at Arlington Street and Winnipeg Avenue that connects with the Aubrey CS system.
  - Winnipeg Avenue and Arlington Street Invert at District Boundary – 226.63 m (S-MA70062569)

SRS to SRS

- A 300 mm SRS overflow pipe diverts flow from Aubrey district CS system at Notre Dame Avenue and Arlington Street, and then flows by gravity to connect into the 1350 mm SRS along Notre Dame Avenue and flows into Bannatyne district SRS system.
  - Notre Dame Avenue and Arlington SRS Overflow Invert into 300 SRS – 229.92 m (S-MH20016162)
- A 250 mm SRS overflow pipe diverts flow from Aubrey district CS system at high point CS manhole at Notre Dame Avenue and Arlington Street, and then flows by gravity to connect into the 1350 mm SRS along Notre Dame Avenue and flows into Bannatyne district SRS system.
  - Notre Dame Avenue and Arlington SRS Overflow Invert into 300 SRS – 229.53 m (S-MH20016156)
- A 1350 mm SRS overflow pipe diverts flow from Aubrey district CS system at Winnipeg Avenue and Arlington Street, and then flows by gravity to connect into the 1350 mm SRS along Notre Dame Avenue and flows into Bannatyne district SRS system.

- Winnipeg Avenue and Arlington SRS Overflow (Top of Overflow Weir) Into 1350 mm SRS – 228.12 m (S-MH70028506)

- A 300 mm SRS overflow pipe diverts flow from Aubrey district CS system at Notre Dame Avenue and Home Street, and then flows by gravity northbound along Home Street and flows into Bannatyne district SRS system.
  - Notre Dame Avenue and Home Street SRS Overflow Invert (Top of Overflow Weir) Into 300 mm SRS – 229.44 m (S-MH20016212)
- A 375 mm SRS overflow pipe diverts flow from Aubrey District CS system at Winnipeg Avenue near Tecumseh Street, and then flows eastbound on Winnipeg Avenue into the SRS system in the Bannatyne district.
  - Winnipeg Avenue and Tecumseh Street SRS Overflow (Top of Overflow Weir) Into 375 mm SRS – 228.99 m (S-MH70028288)

Cornish

CS to CS

- The 1200 mm Interceptor pipe along Wolseley flows by gravity carrying intercepted CS from the Cornish district and crosses into the Aubrey district on Wolseley Avenue:
  - Wolseley Avenue Interceptor Invert at District Boundary - 226.21 m (S-MA20013757)
- The 1200 mm Main Interceptor pipe along Wolseley flows by gravity carrying intercepted CS from the Douglas Park, Ferry Road, Riverbend, Parkside, Tylehurst, and Clifton districts and crosses into the Aubrey district on Wolseley Avenue:
  - Main Interceptor Along Wolseley Invert at District Boundary - 226.18 m (S-MA20013779)
- High Point Manholes (flow is directed into both districts from these manholes):
  - Portage Avenue and Burnell Street – 229.09 m (S-MH20013779)

SRS to SRS

- A 600 mm SRS divert flow from Aubrey CS System, and then flows by gravity eastbound on Wellington Avenue into the SRS System in the Cornish district:
  - Wellington Avenue and Home Street 600 mm SRS Overflow Invert – 227.55 m (S-MH20016115)

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

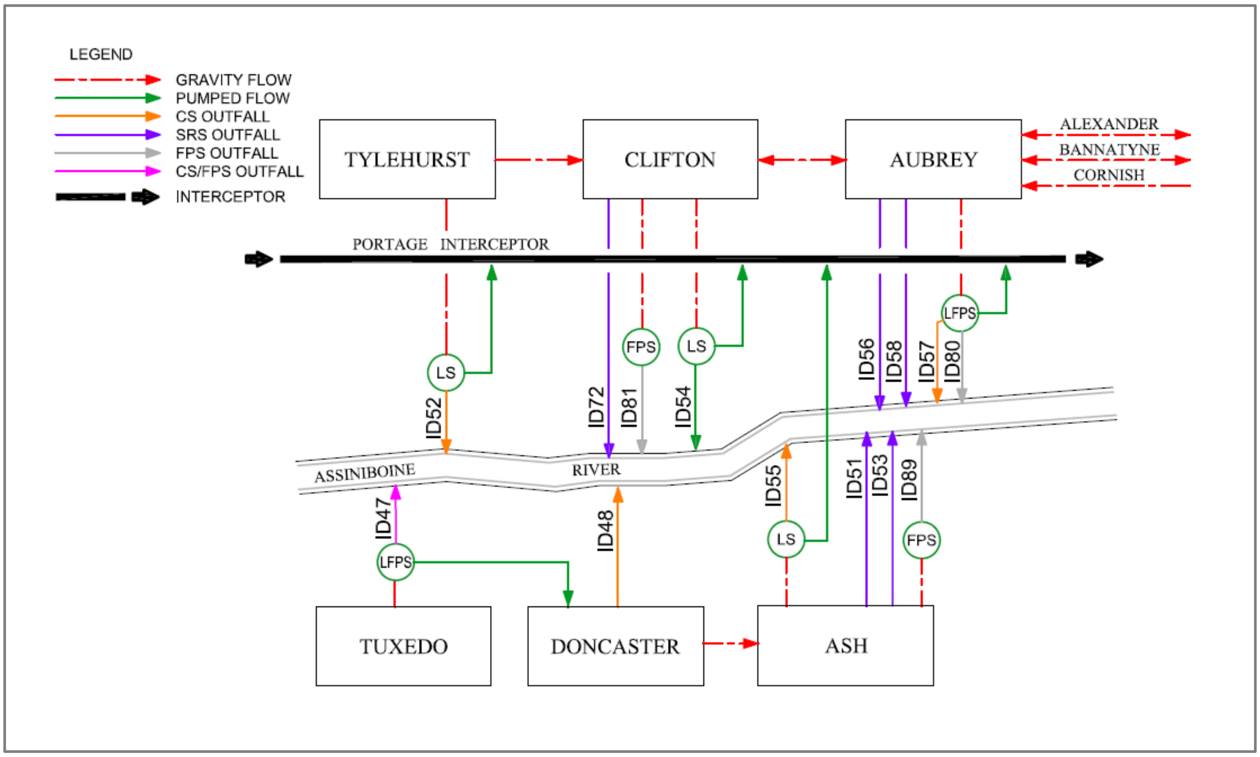


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 05 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 (ID57)	S-MH70006676.1	S-MA70017579	2850 mm	Assiniboine River Invert: 221.00 m
Flood Pumping Outfall (ID82)	S-AC70008105.1	S-MA70017556	2100 mm	Assiniboine River Invert: 224.81 m
Other Overflows	N/A	N/A	N/A	
Main Sewer Trunk	S-MH20012470.1	S-MA20013760	2800 mm	Circular Invert: 223.32 m
SRS Outfalls (ID56 & ID58)	S-CO70008120.1 S-CO70010647.1	S-MA70017585 S-MA70022480	2890 mm 2700 mm	Invert: 221.00 m Invert: 221.15 m
SRS Interconnections	N/A	N/A	N/A	101 SRS – CS
Main Trunk Flap Gate	S-TE70008067 Weir.1	S-CG00000724	2100 mm	Invert: 224.00 m
Main Trunk Sluice Gate	AUBREY_GC.1	S-CG00000725	1500 x 1500 mm	Invert: 223.61 m
Off-Take	S-TE70008067.2	S-MA70017460	600 mm	Circular Invert: 223.32 m
Dry Well	N/A	N/A	N/A	No dry well in lift station design.
Lift Station Total Capacity	N/A	N/A	0.44 m^3/s	1 x 0.235 m^3/s 1 x 0.205 m^3/s

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station ADWF	N/A	N/A	0.054 m^3/s	
Lift Station Force Main	S-TE70008096.1	S-MA70017546	600 mm	Invert: 229.17 m
Flood Pump Station Total Capacity	N/A	N/A	5.24 m^3/s	3 x 1.42 m^3/s 1 x 0.98 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.225 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	Aubrey – 223.85 Ruby – 223.85 Aubrey – 223.85
2	Trunk Invert at Off-Take	223.32
3	Top of Weir	224.48
4	Relief Outfall Invert at Flap Gate	Ruby – 221.46 Aubrey – 221.18
5	Low Relief Interconnection (S-MH20010140)	225.88
6	Sewer District Interconnection (Alexander)	224.94
7	Low Basement	230.59
8	Flood Protection Level (Aubrey)	230.22

[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 Aubrey was the 1986 Basement Flood Relief study (Girling, 1986). No other work has been completed or evaluated 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 Aubrey 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
5 – Aubrey	1986	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

The proposal for the replacement of the existing positive gates and gate chamber located on both SRS outfall pipes has been planned. A Request for Proposals (RFP) was issued in 2016 (Bid Opp. 125-2016), which required the replacement of the positive gate housed with individual buried chamber structures located on the Ruby SRS and the Aubrey SRS pipe. Two new gate chamber structures will have a new positive gate (with electric actuator) and flap gate installed within each structure. These will be located along the west property alignment of 980 Palmerston (Robert Steen Community Centre) for the Ruby SRS outfall and on Aubrey Street on the south side of Palmerston Avenue for the Aubrey SRS outfall.

Within each structure, there will also be provision for a permanently installed submersible pipe, located on the upstream side of the positive gate with discharge piping to the adjacent combined sewer. These have been developed by the City and have been issued as Bid Opportunities 865-2018 (Aubrey SRS) and 798-2016 (Ruby SRS).

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Aubrey 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 CSO Control Option 1 – 85 Percent Capture in a Representative Year for the Aubrey district are listed in Table 1-4. The proposed CSO control options will include in-line storage via control gate, latent storage and 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% Capture in a Representative Year	✓	-	-	✓	✓	-	-	-	✓	✓	✓

Notes:

- = not included
✓ = included

The existing CS and SRS systems are suitable for use as in-line and latent storage. These control options will take advantage of the existing CS pipe network for additional storage volume. Existing DWF from the collection system will remain the same, and overall district operations will remain the same. Additional CS to SRS interconnections are proposed to allow the WWF flows to enter both SRS systems to maximize the potential existing latent storage volumes. The full interaction between the district's CS and SRS system are recommended to be fully confirmed to validate these additional interconnections.

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 additionally it will provide the mechanism for capture of the in-line storage.

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

Latent storage is a suitable control option for Aubrey district. The latent storage level is controlled by the river level and the resulting backpressure of the river level on the Ruby and Aubrey SRS outfall flap gates, as explained in Part 3C. The storage volumes indicated in Table 1-5 are based on the river level conditions with the NSWL during the 1992 representative year at each specific outfall location. The latent storage design criteria are identified in Table 1-5.

As part of the initial evaluation, the hydraulic model indicated that no excess CS from the CS system would enter the Aubrey SRS system under the 1992 representative year conditions. This was the first of such occurrences when modelling potentially latent storage solutions. The Aubrey SRS however includes two independent, extensive SRS systems with dedicated outfalls, and therefore provides the opportunity to store large amounts of the wet weather flow received. This would further reduce the burden on the in-line storage utilizing the Aubrey CS system. that will each provide additional storage volume. In situations such as this, the typical latent storage upgrade of providing mechanical flap gate control will not provide sufficient performance improvements. The issue is primarily due to insufficient flows entering the SRS system.

The performance was found to be greatly improved by introducing additional CS-SRS interconnections to divert excess flow from the CS system into the SRS systems under the majority of 1992 representative year conditions. Therefore, to ensure that the potential volume capture available from these existing latent storage systems was optimized, additional interconnections between the CS system and both SRS were also proposed. The proposed interconnection locations were selected in order to divert flow from directly upstream of the CS LS, and can be seen on Figure 05-01 and Figure 05-02. The first interconnection to divert excess CS into the Aubrey SRS system connects from manhole S-MH20012470 and ties immediately upstream of the Aubrey SRS outfall gate chamber. The second interconnection to tie into the Ruby SRS system would also connect from manhole S-MH20012470 in the CS system and then tie immediately upstream of the Ruby SRS outfall gate chamber. The existing CS sewer pipe at the point of these proposed interconnections will have the largest flow within the Aubrey district and will ensure that the SRS systems would receive flow volume to optimize the use of the available latent storage. An investigation into the model assumptions and existing upstream CS to SRS interconnections will be necessary to confirm the extent of these new downstream interconnections and the volume of WWF entering both SRS systems.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	Ruby – 221.46 m Aubrey – 221.18 m	Flap Gate inverts
NSWL	Ruby – 223.85 m Aubrey – 223.851 m	
Trunk Diameter	Ruby – 2700 mm Aubrey – 2890 mm	

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Design Depth in Trunk	Ruby – 2390 mm Aubrey – 2671 mm	
Maximum Storage Volume	Ruby – 8,877 m^3 Aubrey – 7,969 m^3	Total Storage: 16,846 m^3
Force Main Diameter	Ruby – 225 mm Aubrey – 225 mm	
Flap Gate Control	Ruby – N/A Aubrey – N/A	
Lift Station	Ruby – Yes Aubrey – Yes	
Nominal Dewatering Rate	Ruby – 0.075 m^3/s Aubrey – 0.075 m^3/s	Based on 24-hour emptying requirement
RTC Operational Rate	Ruby – TBC Aubrey – TBC	Future RTC/ dewatering assessment. Possibly based on 2 times nominal rate

Notes:

NSWL = normal summer water level

RTC = Real Time Control

The addition of the two latent storage pump stations (LSPS) and force mains that connect back to the CS system are necessary for the latent storage to be emptied after each storm event. A conceptual layout for each LSPS and force main location is shown on Figure 05-01 and Figure 05-02. These layouts are based on the work undertaken by the City as part of Bid Opportunities for the Aubrey and Ruby SRS gate chamber work.

The Aubrey SRS LSPS, shown on Figure 05-01, would be located upstream of the existing SRS gate chamber close to the proposed CS screening and control gate. The force main will connect back to the main CS system upstream of the Aubrey LS. An interconnection between the CS and SRS system is proposed to ensure the full SRS latent storage is utilized. A 225 mm pipe would achieve this interconnection.

The Ruby SRS LSPS, shown on Figure 05-02, is proposed be located to the north of the Ruby gate chamber within the grounds of the Robert Steen Community Centre at the corner of Palmerston Avenue and Ruby Street. The force main will connect to the 300 mm CS at the manhole at the junction of Ruby Street and Palmerston Avenue (pipe capacity stated as 105 litres per second [L/s] and latent pumps at 75 L/s within Bid Opportunity 798-2016). If during the more detailed assessment it is noted that the pipe section is inadequate, the force main would connect to the next manhole downstream at the southern end of Lipton Street on Palmerston Avenue. Minor disruption to the access to the Robert Steen Community Centre is envisaged; the parallel streets of Lipton Street and Lenore Street will allow access to all locations during construction. An interconnection from the main CS system to the SRS pipe system is required to fully utilize the latent storage within the Ruby SRS system. A new 225 mm pipe would be constructed, connecting the main CS trunk in Aubrey Street to SRS pipe in Palmerston Avenue. Normal disruption along Palmerston Avenue would be encountered with trenchless pipe installation construction work. The presence of groundwater in close proximity to the river bank in this area has encountered in the past. All latent storage associated construction work will require an Ground Water Management Plan to be undertaken.

Both LSPSs will operate to empty the SRS after filling from a runoff event in preparation for the next runoff event. The Ruby SRS and Aubrey SRS outfalls will be upgraded with flap and sluice gates as part of a separate project. A single chamber will house the sluice gate, flap gate, and submersible wet well chamber.

The evaluation of the latent storage volume was completed using the continuous NSWL river conditions, and it was found that additional flap gate control will not be required to meet Control Option 1. In situations where non modelled assessments are to be completed, the actual river levels will be both lower and higher than the 1992 representative year NSWL level at various points throughout the year. Where the level is below NSWL, the latent volume will be less than predicted during the MP assessment, while conversely when the level is above the NSWL, the latent volume will be more than predicted. The continuous assessment is seen as a conservative approach since the majority of the representative year rainfall events occur when the river levels are higher than the NSWL.

1.6.3 In-line Storage

In-line storage has been proposed as a CSO control for Aubrey 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 to provide an overall higher volume capture and will provide additional hydraulic head for screening operations.

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 1-6.

Table 1-6. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	223.32 m	Downstream invert of pipe at weir
Trunk Diameter	2800 mm	
Gate Height	1.43 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	224.85 m	
Maximum Storage Volume	2,080 m^3	
Nominal Dewatering Rate	0.440 m^3/s	Based on existing CS LS pump rate
RTC Operational Rate	TBC	Future RTC/dewatering assessment to be undertaken

The proposed control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 05. 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 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 Aubrey 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 to the North Main Interceptor pipe on Wolseley Avenue. The CS LS will further dewater the in-line storage provided during a WWF event as downstream capacity becomes available.

Figure 05-01 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 trunk sewer alignment and be located north of the Aubrey outfall gate chamber. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5 m in length and 3.5 m in width. 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 Aubrey 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 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. This future RTC 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.

1.6.4 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 hydraulic 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 1-7.

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.85 m	
Bypass Weir Crest	224.75 m	
NSWL	223.85 m	
Maximum Screen Head	0.9 m	
Peak Screening Rate	0.85 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 existing combined trunk sewer, as shown on Figure 05-01. The screens will operate once levels within the sewer surpassed the bypass weir elevation. A side bypass weir upstream of the gate will direct the initial 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 may include screenings pumps with a discharge returning the screened material back to the interceptor and on to the NEWPCC for removal. The provision of screening pumps is dependent on final level assessment within the existing infrastructure and the Aubrey trunk has potential for gravity screenings return to occur. This will be confirmed during future assessment stage.

The dimensions for the screen chamber to accommodate influent from the side bypass weir, the screen area, and the routing of discharge downstream of the gate are 6 m in length and 2.5 m in width.. The screening chamber is expected to be located within a residential street with minor disruptions expected.

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.

Aubrey has been classified as a medium GI potential district. Land use in Aubrey is mostly single-family residential with smaller areas of commercial and industrial land use. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, and rain gardens. The industrial areas in the north end of the district would be an ideal location for green roofs.

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 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 CS LS which will require more frequent and longer duration pump run times. Lower velocities in the CS trunks 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 latent storage will take advantage of the SRS infrastructure already in place or under construction; therefore, minimal additional maintenance will need to be anticipated. The proposed latent LSPS at both locations will require regular maintenance that will depend on the frequency of operation. Operational issues have been experienced in the past with large inflow and infiltration flow occurring within the SRS surrounding the Ruby SRS outfall specifically. The proposed latent LSPS may address this issue and remove the additional O&M currently associated with this location.

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 would be directed from the main outfall 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 would 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

1.8.1 InfoWorks Model

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 of 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 1-8.

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added To Model
2013 Baseline	445	443	16,875	36	N/A
2037 Master Plan – Control Option 1	445	443	16,875	36	IS, Lat St, SC

Notes:

IS = In-line Storage
Lat St = Latent 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 1-9 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 number represent the comparison between the existing system and the proposed control options. Table 1-9 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 1-9. Performance Summary – Control Option 1

Control Option	Preliminary Proposal Annual Overflow Volume (m^3)	Master Plan Overflow Reduction (m^3)	Overflow Reduction (m^3)	Number Overflows	Pass Forward Flow at First Overflow [b]
Baseline (2013)	260,852	141,643	-	27	0.484 m^3/s
In-Line Storage	246,277 [a]	120,521	21,122	27	0.484 m^3/s
In-Line + Latent Storage		120,521	0	27	0.542 m^3/s
In-Line + Latent Storage with additional interconnections	N/A	81,709	38,812	14	0.542 m^3/s
Control Option 1	**246,277**	**81,709**	**59,934**	**14**	**0.542 m^3/s**

[a] Latent 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 1-9, 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 1-10. The cost estimates are Class 5 planning level estimates with a level of accuracy of minus 50 to plus 100 percent.

Table 1-10. 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 (Over 35-year period)
Latent Storage	$3,500,000	$5,560,000 [b]	$172,000	$3,710,000
In-Line Storage	-[a]	$2,920,000 [c]	$46,000	$990,000
Screening		$2,840,000 [d]	$51,000	$1,100,000
Subtotal	**$3,500,000**	**$11,470,000**	**$270,000**	**$5,800,000**
Opportunities	N/A	$1,150,000	$27,000	$580,000
District Total	**$3,500,000**	**$12,620,000**	**$297,000**	**$6,380,000**

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for this item of work found to be $3,980,000 in 2014 dollars

[b] Latent Storage capital cost includes the chambers, sluice and flap gate construction that has been assigned to Bid Opps 789-2016 (Ruby SRS) and 865-2018 (Aubrey SRS) work. Future capital cost will only include the latent pumps and force mains as well as the additional CS to SRS interconnection pipework. Cost for these items taken to reduce to $480,000 in 2019 dollars.

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

[d] 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:

- 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 on 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 1-11.

Table 1-11. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Latent Storage	Latent storage work currently underway by City of Winnipeg.	Original capital costs updated.
	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
	Latent Interconnections	Added as part of Master Plan	Based on modelling performance optimization.
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 Costs	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 1-12 provides a description of how the regulatory target adjustment could be met by building off proposed work identified in Control Option 1.

Overall the Aubrey district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. Increased volume capture from the latent storage arrangements already constructed as part of meeting Control Option 1 could be achieved by construction of flap gate control mechanisms. This would allow excess flow to be stored in the SRS system even under low river level conditions. Further increases in the control gate height, and in term level of volume capture could also be potentially completed in this district to meet future performance targets. 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, focused use of green infrastructure, and reliance on said green infrastructure to provide volume capture benefits could be utilized to meet future performance targets.

Table 1-12. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Increased use of GI • Increased use of latent storage (flap gate control) • Increased use of in-line storage • Off-line Storage (Tunnel/tank)

The control options selected for the Aubrey 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 through the potential additional development of the latent storage, via flap gate control. This would require the detailed investigation and performance of the interconnections between the CS and two SRS systems with 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 1-13.

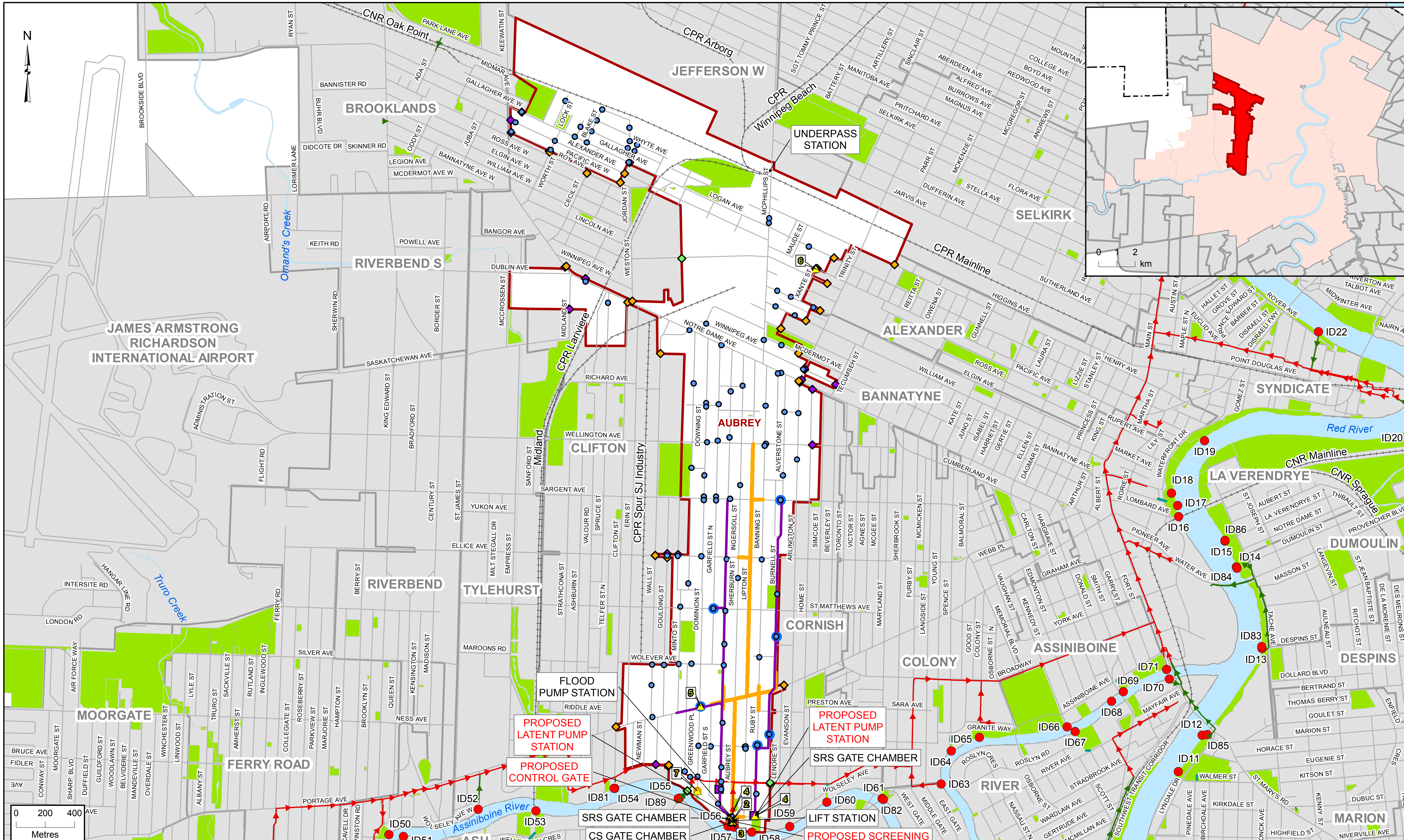
Table 1-13. Control Option 1 Significant Risks and Opportunities

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
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

Girling, R.M. 1986. *Basement Flooding Relief Program Review – 1986.*



LEGEND

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

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

District Boundary Crossing
- CS
- SRS
- 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
- Extent of In-line Storage
- Latent Force Main

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 05
District Overview Map
Sewer District: Aubrey
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\AUBREY\AUBREY_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 9:12:06 AM

LEGEND

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

Sewer By Type
CS
SRS
WWS

Control Structure Type
Gate Chamber

Pump Station Type
Flood Pump Station
Lift Station

CSO MASTER PLAN PROPOSED SOLUTIONS

Proposed Latent Force Main
CS-SRS Interconnection
Control Gate
Gate Chamber
Screening
Latent Pump

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 05-01
Control Gate and Screening - Latent SRS Control
Sewer District: Aubrey
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\AUBREY\AUBREY_DISTRICT_DETAIL_SHERBURN.MXD SBEGG1 7/29/2019 9:12:35 AM

LEGEND

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

Sewer By Type
- CS
- SRS
- WWS

Control Structure Type
- Gate Chamber

Pump Station Type
- Flood Pump Station
- Lift Station

CSO MASTER PLAN
PROPOSED SOLUTIONS

- Proposed Latent Force Main
- CS-SRS Interconnection
- Control Gate
- Gate Chamber
- Screening
- 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 05-02
Latent SRS Control
Sewer District: Aubrey
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\AUBREY\AUBREY_DISTRICT_DETAIL_RUBY.MXD SBEGG1 7/29/2019 9:09:58 AM

JACOBS®

CSO Master Plan

Baltimore District Plan

August 2019

City of Winnipeg

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

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 Figure 1-1. The drawing illustrates the collection areas, interconnections, pumping systems, and discharge points for the existing district.

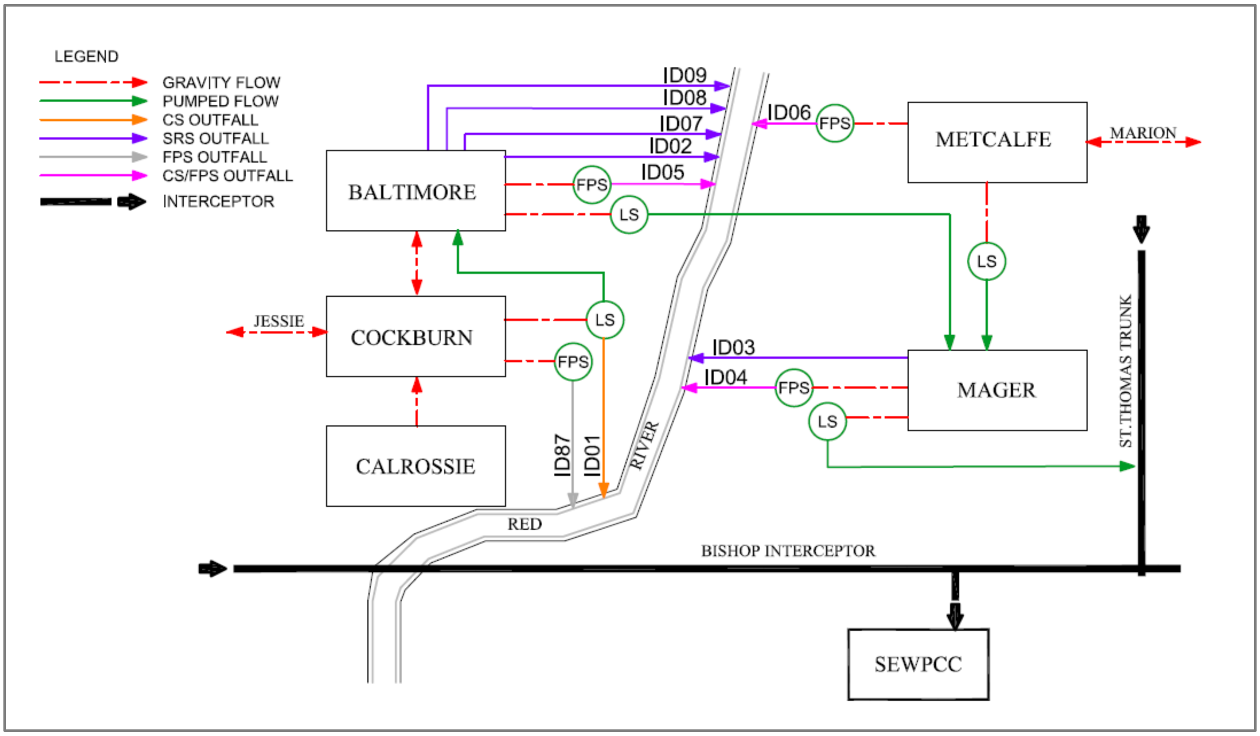


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 06 and are listed in Table 1-1.

Table 1-1. Sewer District Existing Asset Information

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 1-2. 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	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 1-2. 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 1-3 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 1-3. 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 1-4. 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 1-4. 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 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 1-5. The storage volumes indicated in design criteria table below are based on the NSWL river conditions for the 1992 representative year.

Table 1-5. 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

Table 1-5. Latent Storage Conceptual Design Criteria (Eccles West SRS)

Item	Elevation/Dimension	Comment
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 1-6.

Table 1-6. 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	

Table 1-6. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
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 1-7.

Table 1-7. 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 piping 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 1-8.

Table 1-8. 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 1-9 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 1-9 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 1-9. 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 1-9, 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 1-10. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-10. 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)
Latent Storage	$4,760,000	$1,480,000	$55,000	$1,190,000
In-line Control Gate	N/A [a]	$2,360,000 [b]	$42,000	$900,000
Screening		$2,850,000 [c]	$52,000	$1,120,000
Subtotal	**$4,760,000**	**$6,690,000**	**$149,000**	**$3,210,000**
Opportunities	N/A	$670,000	$15,000	$320,000
District Total	**$4,760,000**	**$7,360,000**	**$164,000**	**$3,530,000**

[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 1-11.

Table 1-11. 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 1-12 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 1-12. 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 1-13.

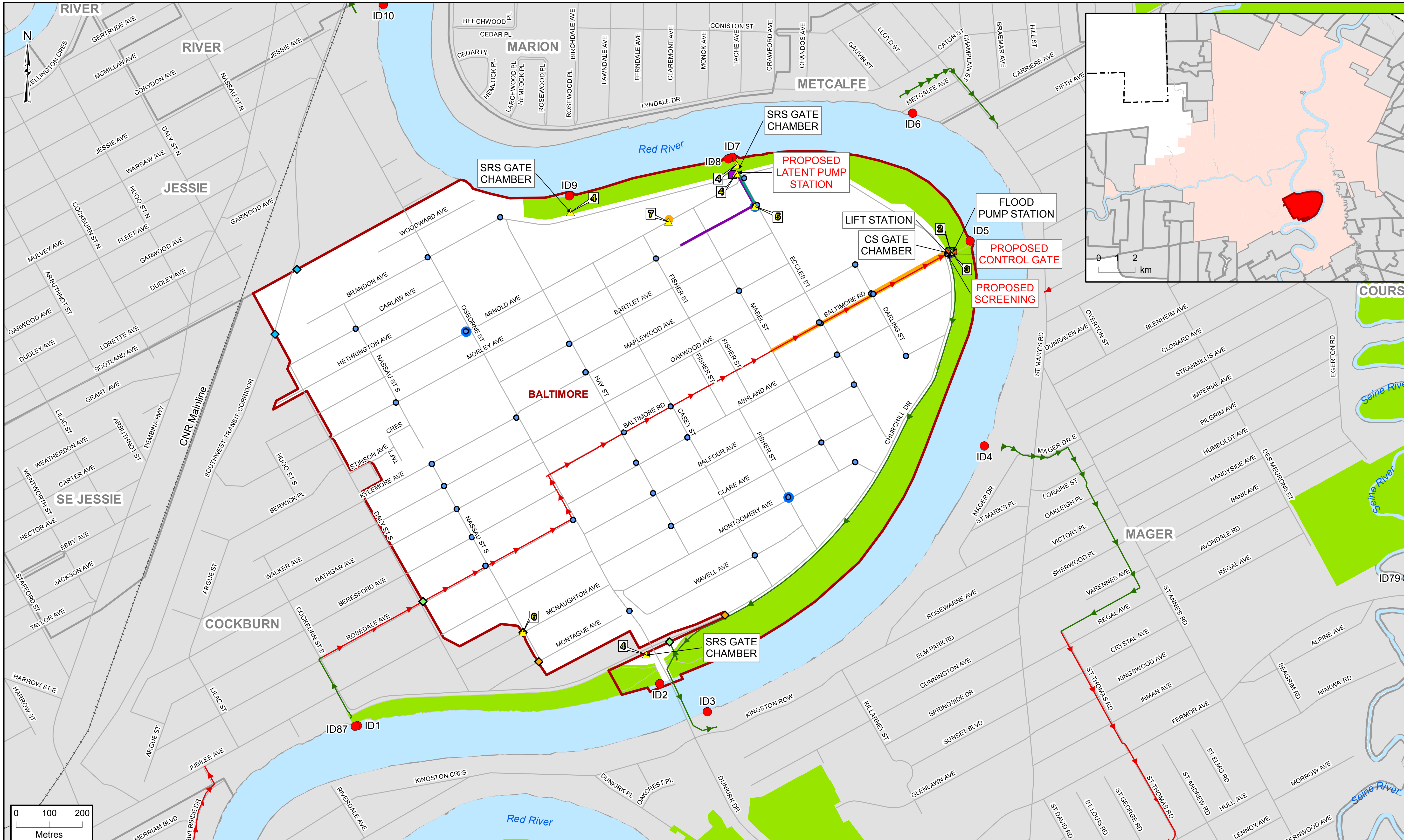
Table 1-13. Control Option 1 Significant Risks and Opportunities

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
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	Inter-System Connection	District Boundary Crossing	Interceptor Sewer	District Boundary
Critical Elevation	SRS - CS	CS	Force Main	Watercourse
Decommissioned Outfall		LDS	Street	Greenspace
CSO Outfall		WWS	Railway	
Low CS Manhole				
Low SRS Connection				

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

CSO Master Plan

Bannatyne District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Bannatyne District Plan
Revision:	03
Date:	August 19, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Danny Tinker
File Name:	Bannatyne_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	08/30/2018	DRAFT for City Comment	DT	SG	
1	15/02/2019	DRAFT 2 for City Review	MF	SG	MF
2	07/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Bannatyne District

1.1 District Description

Bannatyne district is in the centre of the combined sewer (CS) area at the intersection of the Assiniboine and Red Rivers. Bannatyne is bounded by Arlington Street to the west, Notre Dame Avenue,Portage Avenue, and the Red River to the south, Elgin Avenue and Pacific Avenue to the north, and the Red River to the east.

Bannatyne has a wide variety of land uses across the district. The downtown area along Portage Avenue and Main Street includes a high density, multiple-use sector. The area west of Isabel Street includes a mix of commercial, educational and institutional, and residential land, where the residential areas are a mix of two- and multi-family homes. Commercial businesses are mainly located along Notre Dame Avenue and Isabel Street. The Health Sciences Centre is a major institution within the district, and consists of the City of Winnipeg's largest hospital, and a number of educational buildings. The Exchange District is located east of Isabel Street and covers a portion of the Bannatyne district. The Forks is another significant section of Bannatyne and includes a large commercial area, museum, hotel, several small parks, and riverbank sections that cover the southeastern area of the district. Approximately 17 ha of the district is classified as greenspace.

Portage Avenue, Main Street, and Notre Dame Avenue are regional transportation routes that pass through the Bannatyne district, with Portage and Main being the center of the City of Winnipeg and the CS area. The Canadian National Railway Mainline, which passes through Bannatyne parallel to the southern end of Main Street, separates the multiple-use sector from The Forks.

1.2 Development

Bannatyne district includes a significant portion of the downtown area, and the potential for redevelopment in the future is high. The OurWinnipeg development plan has prioritized the downtown for opportunities to create complete, mixed-use, higher density communities. Redevelopment within this area could impact the CS and will be investigated on a case-by-case basis for potential impacts to the combined sewer overflow (CSO) Master Plan. All developments within the CS districts are mandated to offset any peak combined sewage discharge by adding localized storage and flow restrictions, in order to comply with Clause 8 of the Environment Act License 3042.

A portion of Portage Avenue and Main Street are located within Bannatyne district. These streets are identified as Regional Mixed Use Corridors as part of the Our Winnipeg future development plans. As such, focused intensification along Portage Avenue and Main Street is to be promoted in the future.

Main Street, Pioneer Avenue, Princess Street, King Street, Donald Street, Smith Street, and Graham Street within the Bannatyne 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 separation within the Bannatyne district. This would reduce the extent of the Control Options listed in this plan required.

1.3 Existing Sewer System

Bannatyne district covers an approximate land area of 257 ha[1] and includes a CS system, a storm relief sewer (SRS) system and a land drainage sewer (LDS) system. As shown in Figure 07, there is approximately 9 percent (23 ha) separated and 1 percent (3 ha) separation-ready areas.

[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.

The CS system drains towards the Bannatyne outfall, located at the eastern end of Bannatyne Avenue at the Red River. At the outfall, combined sewage is diverted to the Main Interceptor pipe or the Bannatyne flood pumping station (FPS), or it may be discharged directly into the Red River. Sewage primarily flows through the 1500 mm main CS sewer trunk that extends along Bannatyne Avenue and receives all combined sewage from Bannatyne district west of Main Street. This CS runs from Sherbrook Street to Main Street and ties into the Bannatyne outfall upstream of the primary weir for the district. The area west of Main Street is serviced by a 1500 mm CS trunk extending along Bannatyne Avenue that runs from Sherbrook Street to Main Street. Finally, a 1125 mm sewer services the area north of Bannatyne Avenue ties into the Bannatyne outfall upstream of the primary weir for the district. A 1300 mm to 1050 mm CS runs north on Main Street from Portage Avenue that connects to the 1125 mm CS, servicing areas in south Bannatyne district. Other existing CS major collector pipes run along major roads, such as Williams Avenue and Notre Dame Avenue that each flow toward the main CS trunk on Bannatyne Avenue east of Main Street.

During heavy rainfall events, the SRS system provides relief to the CS system in the Bannatyne district. Most catch basins are still connected into the CS system, so the SRS acts as an overflow conduit for the CS. The SRS system discharges directly to the Red River through the McDermot dedicated SRS outfall. The McDermot SRS outfall is located at the eastern end of McDermot Avenue. A flap gate and sluice gate installed along the outfall pipe prevents river water from backing up into the SRS system under high river level conditions. Latent storage pumps are located upstream of the flap gate. Where high river levels keep the flap gate closed, the pumps keep the SRS dewatered following wet weather events. The pumps discharge upstream of the Bannatyne weir but are prevented from dewatering in the event of high levels in Bannatyne. The SRS system is installed throughout the majority of the district and connects to the CSs via interconnections with high overflow pipes and weirs.

There are also separation-ready sewers along John Hirsh Place consisting of a sustainable urban drainage system utilizing Green Infrastructure (GI). The street’s drainage is diverted into underground soil storage cells which discharge back into the CS system on Bannatyne Avenue.

The area in the southeastern part of the district known as The Forks, contains a separate LDS system with two separate outfalls. These sewers discharge directly to the Red River and the Assiniboine River through separate LDS outfalls. A short segment of Waterfront Drive also has a separate LDS system, which connects = into the CS outfall on Bannatyne Avenue downstream of the primary weir.

The SRS does not receive dry weather flow (DWF); all DWF generated by the district is diverted by the primary weir within the main CS trunk, through a 1050 mm CS offtake pipe to flow by gravity back to the Main Interceptor on Main Street, and eventually on to the North End Sewage Treatment Plant (NEWPCC) for treatment. During wet weather flow (WWF), any flow that exceeds the diversion capacity overtops the primary weir in the Bannatyne CS outfall and is discharged through the gate chamber to the Red River. There is also a secondary CS outfall located at the eastern end of Lombard Avenue at the Red River. This secondary outfall is in place to relieve the CS system during WWF events, and discharges this excess CS directly to the Red River. Sluice gates are installed on both the Bannatyne and Lombard CS outfalls, with a flap gate on the Bannatyne CS outfall to restrict back-up from the Red River into the CS system under high river level conditions. When the river level is high such as this gravity discharge from the Bannatyne CS outfall is not possible. The excess flow under these conditions may be pumped by the Bannatyne FPS to reconnect to the CS outfall downstream of the flap gate, allowing gravity discharge to the river once more. Two weirs are located on either side of the FPS to restrict the DWF from entering the FPS.

The three outfalls to the Red River (two CSs and one SRS) are as follows:

- ID18 (S-MA70000991) – Bannatyne CS Outfall
- ID16 (S-MA70012338) – Lombard CS Outfall
- ID17 (S-MA20013332) – McDermot SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between the Bannatyne district and the surrounding districts. Each interconnection is shown on Figure 07. Interconnections include gravity and pumped flow from one district to another. The known district-to-district interconnections are identified as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Alexander

The 1950 mm Main Interceptor pipe flows by gravity north on Main Street into Alexander district to carry sewage to the NEWPCC for treatment:

- Invert at Alexander district boundary 221.76 m (S-TE20005752)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Assiniboine

The 1500 mm Main Interceptor pipe flows by gravity eastbound on Broadway from Assiniboine district into Bannatyne district:

- Invert at Bannatyne district boundary 224.28 m (S-TE70003462)

Despins

A 300 mm force main connects the Despins SPS to a 450-mm WWS in Bannatyne.

- River Crossing (S-MA70050831)

Dumoulin

A 300 mm force main connects the Dumoulin FPS / SPS to a 450-mm WWS in Bannatyne.

- River Crossing (S-MA70050829)

River

Two force mains, 600 mm and 500 mm, pump sewage across the Assiniboine River at Queen Elizabeth Way and Main Street:

- Invert at Queen Elizabeth Way in Bannatyne district, flowing from River district = 227.72 m (S-MH70001947)
- Invert at Queen Elizabeth Way in Bannatyne district, flowing from River district = 227.72 m (S-MH70001947)

1.3.1.3 District Interconnections

Cornish

<u>CS to CS</u>

A 1200 mm SRS flows by gravity into Cornish district from Bannatyne district on Wellington Avenue:

- Invert at Cornish district boundary 226.41 m (S-MA20018024)

A 300 mm CS flows by gravity west on Wellington Avenue and connects to the CS system in Cornish district:

- Invert at Bannatyne district boundary 229.48 m (S-MA20017998)

Assiniboine

<u>CS to CS</u>

A 1200 mm CS flowing by gravity connects to the diversion chamber at the Assiniboine CS outfall from Assiniboine district into Bannatyne district:

- Invert at Bannatyne district boundary on Main Street 225.83 m (S-MA70008096)

The 1350 mm CS flowing by gravity connects to the diversion chamber at the Assiniboine CS outfall from Bannatyne district into Assiniboine district:

- Invert at Bannatyne district boundary on Main Street 225.94 m (S-MA70016038)

- A 375 mm CS flows by gravity east on Broadway and connects to the CS system in Bannatyne district:
  - Invert at Bannatyne district boundary 226.35 m (S-MA20014317)

<u>SRS to SRS</u>

A 300 mm diversion SRS flows by gravity on Smith Street and connects to the Assiniboine SRS system at the intersection of Smith Street and Graham Avenue:

- Invert at Assiniboine district boundary 227.71 m (S-MA70087631)

A 525 mm SRS flows by gravity westbound into Assiniboine Avenue on Graham Avenue and connects to the SRS system in Assiniboine district:

- Invert at Assiniboine district boundary 227.50 m (S-MA20015767)

High sewer overflow:

- Smith Street and Graham Avenue – Invert at Bannatyne district boundary 229.08 m (S-MA70023072)
- Garry Street and Graham Avenue – Invert at Assiniboine district boundary 229.07 m (S-MA70001518)
- Fort Street and York Avenue – Invert at Bannatyne district boundary 229.31 m (S-MA20016068)

Aubrey

<u>CS to CS</u>

A CS flowing southbound on Lark Street flows by gravity into the manhole at the intersection of Lark Street and Bannatyne Avenue. From there, it is split into a 450 mm CS that flows eastbound on Bannatyne Avenue into Bannatyne district and a 375 mm CS that flows into Aubrey district:

- Bannatyne Avenue and Lark Avenue – 229.10 m (S-MH20016063)

A 300 mm CS flows by gravity southbound on Arlington Street from Bannatyne district into a manhole that connects with the Aubrey CS system at the intersection of Winnipeg Avenue and Arlington Street:

- Invert at Bannatyne district boundary 228.83 m (S-MA70062544)

A 1200 mm SRS flows by gravity southbound on Arlington Street from Bannatyne district into a manhole that connects with the Aubrey CS system at the intersection of Winnipeg Avenue and Arlington Street:

- Invert at Bannatyne district boundary 226.66 m (S-MA70062569)

A 1350 mm SRS flows into Bannatyne district from Aubrey receiving sewage from two high sewer overflows at the intersection of Notre Dame Avenue and Arlington Street:

- Invert at Aubrey district boundary 226.54 m (S-MA20018132)

A 375 mm SRS flows eastbound on Winnipeg Avenue in Aubrey district into the SRS system in Bannatyne district at the corner of Tecumseh Street and Winnipeg Avenue:

- Invert at Bannatyne district boundary 227.92 m (S-MA70062311)

High point manhole:

- William Avenue – 229.77 m (S-MH20017498)
- McDermot Avenue – 229.46 m (S-MH20016155)
- Notre Dame Avenue and Arlington Street – 229.43 m (S-MH20016156)

High sewer overflow:

- Notre Dame Avenue and Arlington Street – Invert at Bannatyne district boundary 229.92 m (S-MA20018078)
- Notre Dame Avenue and Arlington Street – Invert at Aubrey district boundary 229.53 m (S-MA20018082)
- Notre Dame Avenue and Home Street – Invert at Aubrey district boundary 229.44 m (S-MA20018115)

Alexander

CS to CS

A 375 mm CS flows northbound on Princess Street from Bannatyne district and connects to the CS system in Alexander district:

- Invert at Bannatyne district boundary 227.55 m (S-MA20019098)

A 450 mm CS flows by gravity north on Sherbrook Street. The manhole includes an interconnection to the Bannatyne SRS network with a 750 mm overflow SRS:

- Invert at Bannatyne district boundary 227.67 m (S-MA70026573)

A 450 mm SRS flows by gravity west on Ross Avenue to Tecumseh Street and connects to the SRS system in Alexander district:

- Invert at Alexander district boundary 227.43 mm (S-MA70062533)

A 1200 mm SRS flows by gravity along Tecumseh Street and into Bannatyne district at the intersection of Tecumseh Street and Elgin Avenue, serving a section of Alexander district. It connects to the SRS system on William Avenue:

- Invert at Alexander district boundary 227.03 m (S-MA70062503)

A 1050 mm SRS flows southbound by gravity on Sherbrook Street, while a 450 mm SRS flows westbound on Ross Avenue. Both SRSs flow from Alexander district, into a manhole at the intersection of Sherbrook Street and Ross Avenue and connect to the SRS system in Bannatyne district:

- Invert at Bannatyne district boundary on Sherbrook Street 226.03 m (S-MA70062761)
- Invert at Bannatyne district boundary on Ross Avenue 226.30 m (S-MA70062775)

A 1050 mm SRS flowing southbound into Bannatyne by gravity on Isabel Street connects to the SRS system on William Avenue. The SRS interconnects with the CS system in Alexander district flowing south from Logan Avenue into Bannatyne Avenue:

- Invert at Bannatyne district boundary 225.15 m (S-MA70069557)

A 900 mm SRS flows by gravity south on King Street from Alexander district and crosses into Bannatyne district at the intersection of King Street and Pacific Avenue:

- Invert at Bannatyne district boundary 224.42 m (S-MA70095935)

A 750 mm SRS flows from the SRS network in Alexander district into Bannatyne district by gravity on Ellen Street:

- Invert at Bannatyne district boundary 224.81 m (S-MA70066231)

- A CS flows north by gravity from Bannatyne district into the Alexander district CS system on Princess Street:
  - Invert at Bannatyne district boundary 227.55 m (S-MA20019098)

A 750 mm SRS consisting of a weir overflows during high rainfall events at the corner of Princess Street and Rupert Avenue and flows by gravity eastbound on Rupert Avenue to connect to the SRS system in Bannatyne district:

- Invert at Alexander district boundary 225.39 m (S-MA70096068) Weir height – 227.15 m

A 525 mm SRS flows southbound by gravity from Alexander district into the Bannatyne district SRS system on Arlington Street:

- Invert at Alexander district boundary 228.02 m (S-MA70062474)

High point CS manhole:

- Arlington Street – 229.54 m (S-MH20016288)

<u>LDS to CS</u>

A 525 mm LDS serves the National Microbiology Laboratory between Alexander Avenue and William Avenue. The LDS flows by gravity into Bannatyne and connects to the SRS network in Bannatyne at the corner of Tecumseh Street and Elgin Avenue:

- Invert at Bannatyne district boundary 229.23 m (S-MA70022812)

- A 300 mm LDS flows by gravity east into Bannatyne and connects to the SRS system in Bannatyne at the corner of Tecumseh Street and Elgin Avenue:
  - Invert at Bannatyne district boundary 230.10 m (S-MA70022800)

A 450 mm LDS flows south into Bannatyne district at the intersection of Pacific Avenue and Waterfront Drive and is discharged to the main Bannatyne CS outfall:

- Invert at Bannatyne district boundary on Waterfront Drive 225.63 m (S-MA70037381)

Colony

<u>CS to CS</u>

A 450 mm CS flowing by gravity eastbound on Portage Avenue connects to the CS system in Bannatyne district at the intersection of Portage Avenue and Smith Street:

- Invert at Bannatyne district boundary 227.94 m (S-MA20015831)

A 300 mm CS flowing by gravity east on Ellice Avenue at Kennedy Street connects to the CS system in Bannatyne district from Colony district:

- Invert at Colony district boundary 228.60 m (S-MA70014619)

High point CS manhole:

- Victor Street – 229.62 m (S-MH20015805)
- Agnes Street – 229.30 m (S-MH20014738)
- McGee Street – 229.65 m (S-MH20015026)
- Maryland Street – 229.24 m (S-MH20015031)
- Young Street – 229.10 m (S-MH20015264)
- Cumberland Avenue and Balmoral Street – 229.02 m (S-MH20015291)
- Kennedy Street – 226.69 m (S-MH20015216)
- Qu'Appelle Avenue – 228.97 m (S-MH70040622)
- Carlton Street – 228.32 m (S-MH20014246)
- Toronto Street – 229.72 m (S-MH20016007)

High sewer overflow:

- Hargrave Street – 229.02 m (S-MA20015844)

A 1200 mm SRS flowing by gravity south and a 450 mm overflow SRS flowing by gravity east in Colony district connect to 1200 mm SRS on Ellice Avenue at Kennedy Street into Bannatyne district:

- Invert at Bannatyne district boundary on Kennedy Street 226.14 m (S-MA20016684)
- Invert at Colony district boundary 228.60 m on Ellice Avenue (S-MA20016685)

A 375 mm SRS flowing by gravity north on Donald Street connects to the SRS network in Bannatyne district at the intersection of Ellice Avenue and Donald Street:

- Invert at Bannatyne district boundary 227.76 m (S-MA70087485)

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

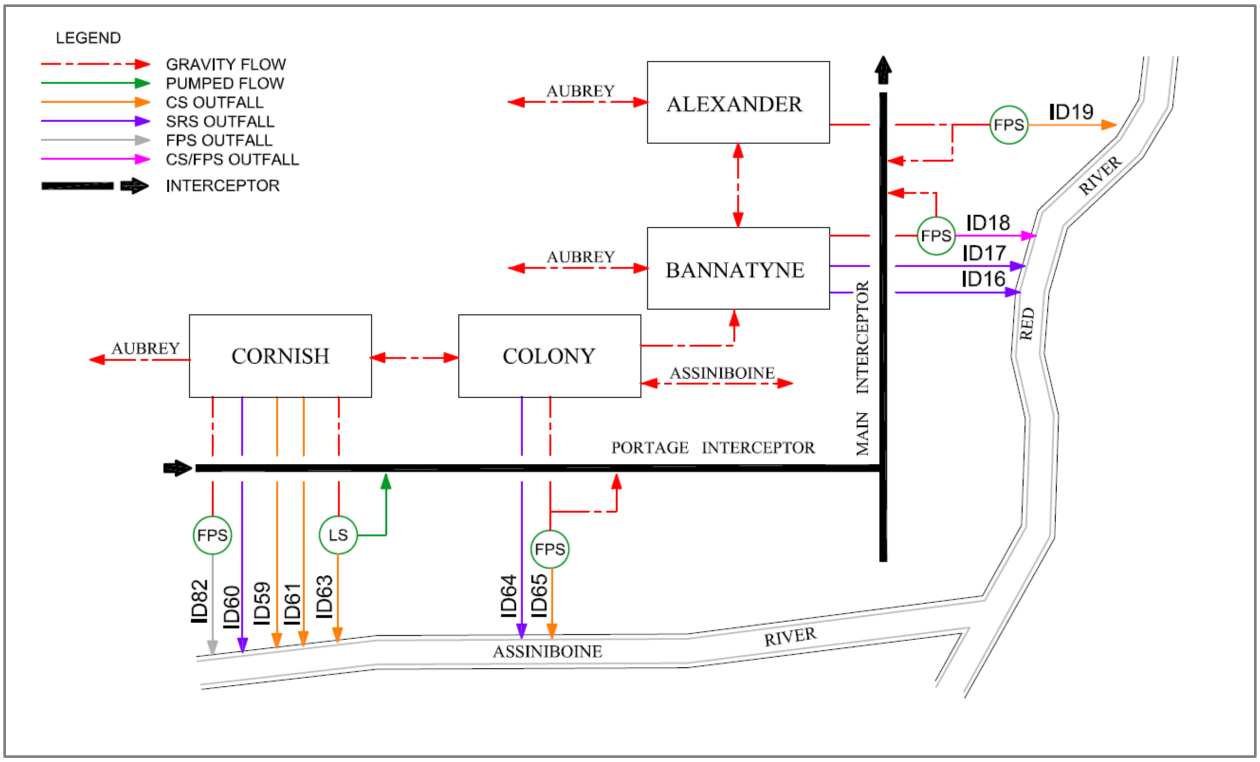


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 07 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 (ID18)	S-CO70000468.1	S-MA70000991	1100 x 1300 mm	Red River Invert: 222.10 m
Flood Pumping Outfall (ID18)	S-CO70000468.1	S-MA70000991	1100 x 1300 mm	Red River Invert: 222.10 m
Other Overflows (ID16)	S-MH70004946.1	S-MA70012338	900 mm	Red River Invert: 223.54 m
Main Trunk	S-TE70023567.1	S-MA70062289	1500 mm	Main CS that flows east on Bannatyne Avenue Circular

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
				Invert: 223.97 m
SRS Outfalls (ID17)	S-CO70010863.1	S-MA20013332	2700 mm	Invert: 221.29 m
SRS Interconnections	N/A	N/A	N/A	SRS - CS
Main Trunk Flap Gate	S-MH70006731.1	S-CG00000729	1525 mm	Invert: 223.81 m
Main Trunk Sluice Gate	S-CG00000728.1	S-CG00000728	1525 x 1525 mm	Invert: 223.57 m
Off-Take	N/A	S-MA70062293	N/A	Invert: 223.98 m
Dry Well	N/A	N/A	N/A	Diversion structure, no lift station force main as part of outfall.
Lift Station Total Capacity	N/A	S-MA70062266 (1)	1,050 mm (1)	2.59 m^3/s (1)
ADWF	N/A	N/A	0.0589 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	Diversion structure, no lift station force main as part of outfall.
Flood Pump Station Total Capacity	N/A	N/A	2.82 m^3/s	2 x 0.97 m^3/s 1 x 0.64 m^3/s 1 x 0.24 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.443 m^3/s	

Notes:

ADWF = average dry-weather flow
GIS = geographic information system
ID = identification
N/A = not applicable

(1) Gravity pipe replacing Lift Station as Bannatyne is a gravity discharge district

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	Bannatyne – 223.72 McDermot – 223.73 Lombard – 223.73
2	Trunk Invert at Off-Take	N/A
3	Top of Weir	225.70
4	Relief Outfall Invert at Flap Gate (New McDermot Flap Gate) Relief Outfall Invert at Lombard Overflow (Lombard weir)	McDermot – 221.49 Lombard – 226.43
5	Low Relief Interconnection (S-MH20014313)	227.07
6	Sewer District Interconnection (Alexander district – S-TE20005752))	221.76
7	Low Basement	228.60
8	Flood Protection Level (Bannatyne, Alexander)	229.79

[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 Bannatyne was the *Alexander and Bannatyne Combined Sewer Districts Sewer Relief and CSO Abatement Study* (AECOM, 2009). The study's purpose was to identify and recommend sewer relief and CSO abatement options for the Alexander and Bannatyne districts. Sewer relief projects completed as part of the ongoing basement flood relief program were last completed in 2010. A SRS latent storage pump system was installed near the McDermot SRS outfall in 2014. The pumps were initially activated to dewater in winter periods but have been operating in summer periods from 2017.

A Sustainable Urban Drainage System with GI elements was installed along John Hirsh Place in 2016. The drainage system consists of soil storage cells which filter, provide attenuation and storage of surface runoff.

The City undertook an extensive district summer flow monitoring campaign in 2016 to collect observed flow monitoring data for the purpose of calibration of the City hydraulic model.

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 Bannatyne CS district was included as part of this program. Instruments installed at each of the 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
7 – Bannatyne	2009	2016	2013	Complete	N/A

Source: Report on *Alexander and Bannatyne Combined Sewer Districts Sewer Relief and CSO Abatement Study*, 2009

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Bannatyne 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.

Specific to the McDermot SRS, an ongoing annual flow monitoring program (from 2019 to 2022), will be installed to assess the performance of the McDermot latent storage facility and the John Hirsh Place sustainable drainage system previously constructed.

1.6 Control Option 1 Projects

1.6.1 Project Selection

The Bannatyne district has latent storage, gravity control, and floatable control projects proposed to meet CSO Control Option 1. Table 1-4 provides an overview of the control options included in the 85 percent capture in a representative year option.

Table 1-4. District Control Option

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

Notes:

- = not included
✓ = included

The existing SRS systems are suitable for use as latent storage. These control options will take advantage of the existing SRS pipe network for additional storage volume. Existing DWF from the collection system will remain the same, and overall district operations will remain the same. The SRS proposed latest storage option has been installed by the City during the assessment of the Preliminary Proposal.

The existing CS system has a high level primary weir already installed and therefore no proposed in-line storage is noted at this district.

Bannatyne district discharges to the interceptor by gravity; therefore, it will also require a method of gravity flow control to optimize and control the discharge rate to the interceptor for future dewatering Real Time Controls (RTCs).

Floatable control will be necessary to capture any undesirable floatables in the sewage. Floatables will be captured with all implemented control options to some extent, but screening is currently proposed for floatable management. Screens would be installed on the primary outfall located on the eastern end of Bannatyne Avenue.

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

Latent storage is a suitable control option for the Bannatyne district for the utilizing the McDermot SRS system. Latent storage has been recently installed in the district at the McDermot SRS outfall and has been included as part of the CSO Master Plan performance evaluation. The latent storage level in the system is controlled by the 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 in which was utilized in the 2014 design are identified in Table 1-5. The storage volumes indicated in Table 1-5 are based on the NSWL river level conditions over the course of the 1992 representative year.

Table 1-5. Latent Storage Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	McDermot – 221.49 m	Flap Gate invert
NSWL	223.73 m	
Trunk Diameter	2700 mm	

Table 1-5. Latent Storage Design Criteria

Item	Elevation/Dimension	Comment
Design Depth in Trunk	2235 mm	
Maximum Storage Volume	4414 m^3	
Force Main	150 mm	
Flap Gate Control	N/A	
Lift Station	Yes	Within existing gate chamber
Nominal Dewatering Rate	0.050 m^3/s – proposed 0.032 m3/s (current rate installed in 2014)	Based on 24 hour emptying requirement between WWF events
RTC Operational Rate	TBD	Dependent on future RTC/dewatering control option assessment and recommendations

Note:
NSWL = normal summer water level
RTC = real time control

Latent storage is accessible and has lower risk than other storage types. In 2014, the City installed an in-line pump, removable weir, and interconnection to the 300-mm CS to pilot the SRS latent storage in this location. In order to facilitate an operational latent system, the existing McDermot latent pump station and interconnecting pipes will be operated and the monitoring program currently assessing the performance of the latent storage system will be reviewed at the completion of the monitoring collection period. This future review will allow the storage/dewatering pump capacity to ensure that the 24 hour emptying period is achieved by the current system. The operation of the submersible latent storage pump is dependent on the level meter at Bannatyne. If the level is greater than 225.4 m, the pump is switched off. When the level drops below 225.1 m at Bannatyne, the pump is allowed to operate. This arrangement is to ensure the dewatering pumps do not increase the volume or number of overflow events at the Bannatyne primary CS outfall.

As part of the CSO Master Plan, the details of the newly constructed outfall gate chamber and installation of the submersible pump and force main is shown on Figure 07-02. The submersible pump is located within the new gate chamber. The latent force main flows west and connect to the Bannatyne CS system on Ship Street, where it flows to the main Bannatyne CS outfall. The submersible pump empties the SRS system in preparation for the next runoff event based on the level meter at Bannatyne, as outlined previously.

The full details of the installed arrangement are covered in Bid Opportunity 912-2013.

1.6.3 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens would be proposed to maintain the current level of basement flooding protection. The existing arrangement at the Bannatyne CSO chamber has a high weir installed, and the standard arrangement of a side weir upstream of the existing weir would not work adequately in this location. The excess CS which overflows over the existing primary weir will be directed to the screens located in a new screening chamber, with screened flow discharged to the river.

The type and size of screens depend on the hydraulic head available for operation. A standard design was assumed for screening and is described in Part 3C. The design criteria for screening are listed in Table 1-6.

Table 1-6. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Weir	225.7 m	Existing Static Weir Level
NSWL	223.73 m	
Maximum Screen Head	1.97 m	
Peak Screening Rate	1.95 m^3/s	Bypass to be installed to match district first flush peak flow rate
Screen Size	3.1 m x 5.7 m	

The proposed screening chamber will be located adjacent to the existing combined trunk sewer, as shown on Figure 07-01. The screen would operate once levels within the sewer surpassed the existing primary weir elevation. The overflow will continue to be directed to the outfall, with the screen located in the new screening chamber, with screened flow discharged to the upstream side of the gate to the river. The screening chamber would include screenings pumps with the discharge returning the screened material to the main sewer pipe for routing back to the interceptor and on to the NEWPCC for removal. A bypass would also be installed to limit the overflow volume to be screening to match that of the other proposed screening units in the system.

The dimensions for the screen chamber to accommodate influent from the screen area, and the routing of discharge downstream of the gate are 5.7 m in length and 3.1 m in width.

1.6.4 Gravity Flow Control

Bannatyne district does not include a lift station (LS) and discharges directly to the Main Interceptor by gravity. A flow control device will be required to control and monitor the diversion rate for future RTC and dewatering assessment. A standard flow control device was selected as described in Part 3C.

The controller will include flow measurement and a gate to control the discharge flow rate. This has been taken as part of the City's future vision to develop a fully integrated CS system network and will be needed to review flows during spatial rainfall WWF scenarios. The CSO Master Plan assessment utilized a uniform rainfall event, and no further investigative work has been completed within the CSO Master Plan.

The flow control would be installed at an optimal location on the connecting sewer between the existing weir and the Main Interceptor pipe on Bannatyne Avenue. Figure 07-01 identifies a conceptual location for flow controller installation. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction. The diversion weir at the CS outfall may have to be adjusted to match the hydraulic performance of the flow controller.

A gravity flow controller has been included as a consideration in developing a fully optimized CS system as part of the City's long-term objectives. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

1.6.5 Green Infrastructure

The North East Exchange District has undergone green infrastructure improvements within Bannatyne District. The improvements include watermain renewal, widening and lining sidewalks with trees and enhanced lighting were completed on John Hirsch Place, Lily Street, and Pacific Avenue, and green infrastructure work was piloted concurrently with these street upgrades. The green infrastructure involved utilizing sub-surface bioretention soil storage systems. This system utilizes plantings to absorb stormwater being directed to storage areas beneath the road, while for severe wet weather events the soil strata partial cleans excess water prior to being collected by the existing combined sewers. This bioretention GI was primarily completed on John Hirsch Place. The City will monitor the performance of this bioretention system to determine the operational requirements and measurable benefits.

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 applicable GI controls.

Bannatyne has been classified as a medium GI potential district. Bannatyne district is a mix of commercial, educational and institutional, and residential land. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

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 Systems Operations and Maintenance

Systems 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.

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

The flow controller will require the installation of a chamber and flow control equipment. Monitoring and control instrumentation will be required. The flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required.

Floatable control with outfall screening will require the addition of another chamber with screening equipment installed. The chamber will be installed downstream of the primary weir. Screening operation will occur during WWF events that surpass the in-line storage control level. WWF would be directed from the main outfall trunk and directly 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 would 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 model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized 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 Mode
2013 Baseline	203	203	7,719	69	N/A
2037 Master Plan – Control Option 1	203	203	7,719	69	Lat St,

Notes:

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 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. 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 1-8 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	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 [a]
Baseline (2013)	159,421	148,170	-	19	0.460 m^3/s
Latent Storage [b]	157,789	115,571	32,599	14	0.470 m^3/s
Latent and Off-line Storage	76,689	N/A [c]	N/A [c]	N/A [c]	N/A [c]
Control Option 1	**76,689**	**115,571** [b]	**32,599**	**14**	**0.470 m^3/s**

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

[b] Latent storage pump and force main already installed within McDermot SRS system. Modelled as proposed pump capacity. Existing LSPS capacity to be assessed after monitoring collection period ended.

[c] Off-line storage originally recommended as part of Preliminary Proposal, but was not carried forward during the Master Plan assessment.

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 Class 5 planning level estimates with a level of accuracy of minus 50 to plus 100 percent.

Table 1-9. Cost Estimate – 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)
Latent Storage	$1,930,000	N/A [c]	N/A	N/A
Gravity Flow Control	N/A [a]	$1,300,000	$34,000	$740,000
Tunnel Storage	$6,480,000	N/A [d]	N/A	N/A
Screening	N/A [b]	$3,960,000 [e]	$50,000	$1,080,000
Off-line Storage	$15,040,000	N/A [d]	N/A	N/A
Subtotal	**$23,440,000**	**$5,260,000**	**$84,000**	**$1,820,000**
Opportunities	N/A	$530,000	$8,000	$180,000
District Total	**$23,440,000**	**$5,790,000**	**$92,000**	**$2,000,000**

Note:

[a] Gravity Flow Control not included in the Preliminary Proposal

[b] Screening solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for this item of work found to be $730,000 in 2014 dollars.

[c] McDermot SRS Latent Storage complete and operational in 2017. No additional cost allocated.

[d] Tunnel and Off-line Storage removed from Master Plan Control Options.

[e] 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 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.

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	Gravity Flow Control	A control gate was not included in the preliminary estimate	Control gate added to Master Plan Control Options
	Screening	Screening was not included in the preliminary estimate	Screening added to Master Plan Control Options
	Latent Storage	Preliminary estimate did not include latent storage work.	Latent storage work completed in 2014 fully operational in 2017
	Off-line Storage	Not included in the Master Plan Control Options	Removed during marginal analysis process in Master Plan development.
	Tunnel Storage	Not included in the Master Plan Control Options	Removed during marginal analysis process in Master Plan development.
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 Costs	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 in Control Option 1.

Overall the Bannatyne district would be classified as a 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. However, opportunistic separation of portions of the district may be achieved with synergies with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase captured volume.

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	• Opportunistic Sewer Separation • Increased use of GI • Off-Line Storage (Tank/Tunnel)

The control option for the Bannatyne district has been aligned to the primary outfalls being screened under the current CSO 85 percent capture control plan. The expandability of this district to meet the 98 percent capture would be based on the system wide basis. The applicability of the listed migration options will be stepped than full district solutions.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-12.

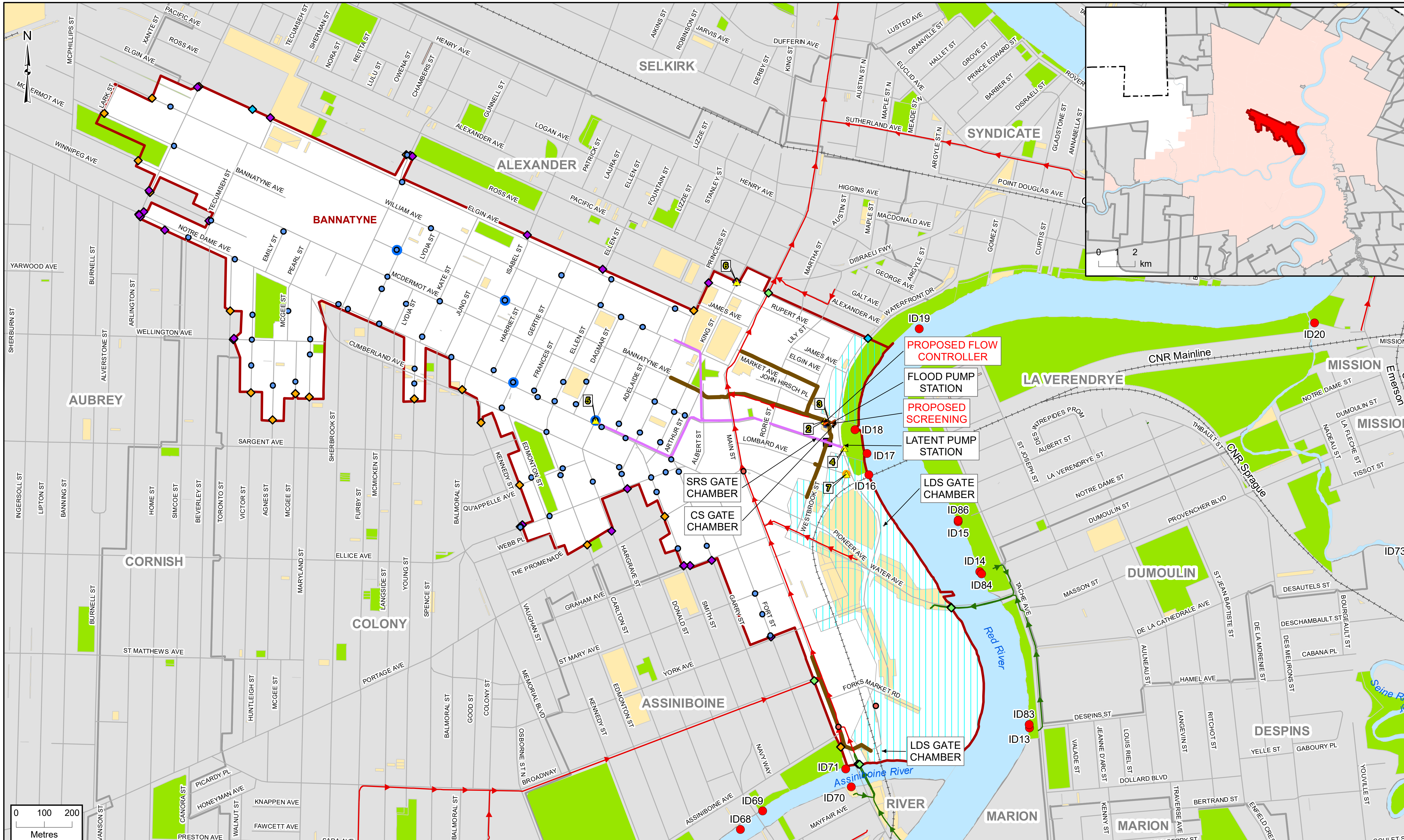
Table 1-12. Control Option 1 Significant Risks and Opportunities

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	-	-	-	-	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
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	R	-	-	-	-	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

AECOM. 2009. *Alexander and Bannatyne Combined Sewer Districts Sewer Relief and CSO Abatement Study*. Prepared for the City of Winnipeg. April.



LEGEND

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

Inter-System Connection

- CS - WWS
- SRS - CS

District Boundary Crossing

- CS
- LDS
- SRS
- WWS

- Existing Latent Storage Limit
- Extent of Existing In-line Storage
- Interceptor Sewer
- Force Main
- Street
- Railway
- District Boundary
- Watercourse
- Greenspace
- City Owned Land

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Complete

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 07
District Overview Map
Sewer District: Bannatyne
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\BANNATYNE\BANNATYNE_DISTRICT_OVERVIEW_MAP.MXD DT072410 7/29/2019 9:18:08 AM

LEGEND

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

Sewer By Type
- CS
- LDS
- SRS

Control Structure Type
- Gate Chamber

Pump Station Type
- Flood Pump Station

CSO MASTER PLAN
PROPOSED SOLUTIONS
- Screening
- Flow Controller

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

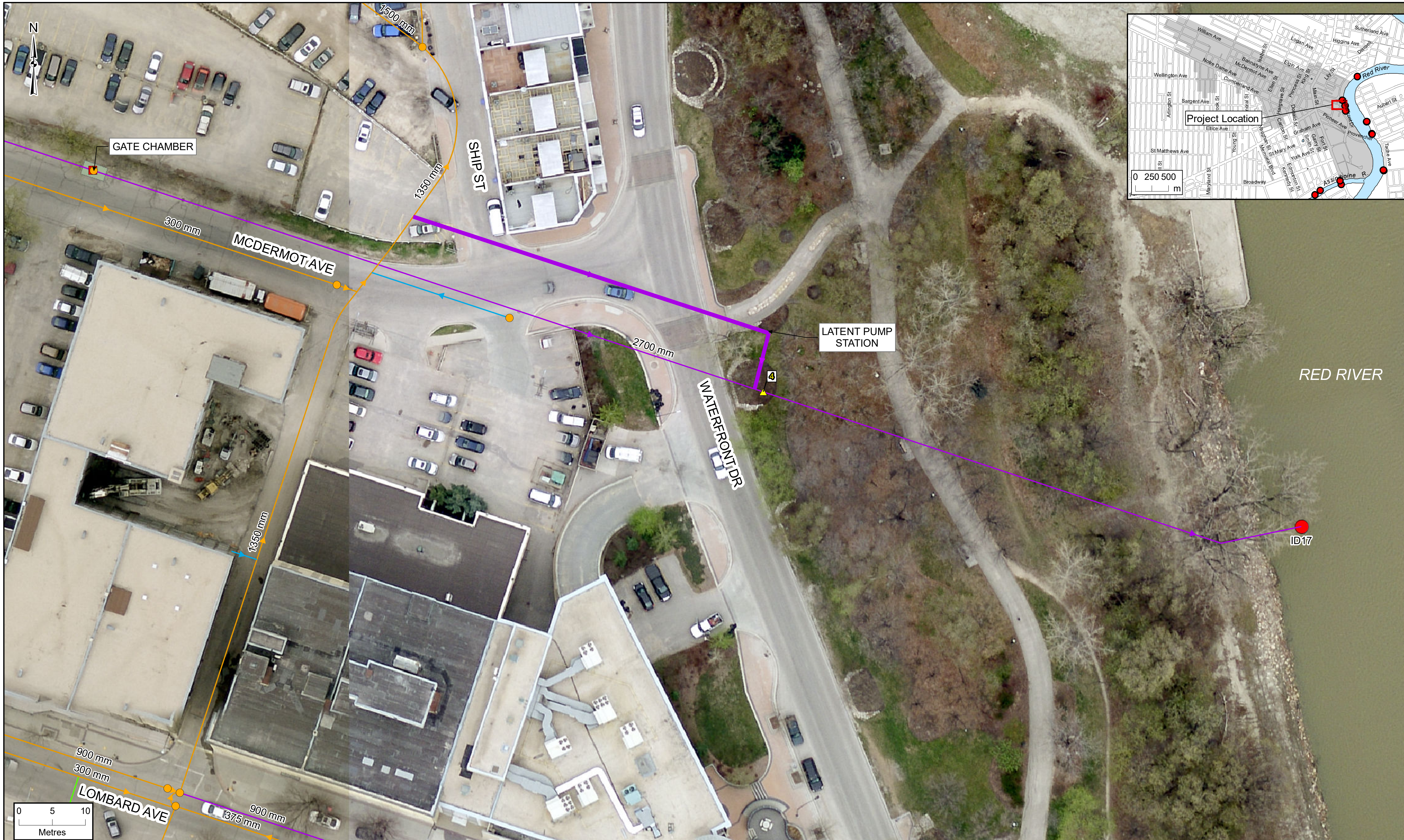
JACOBS

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

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 07-01
Screening and Flow Controller
Sewer District: Bannatyne
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\BANNATYNE\BANNATYNE_DISTRICT_DETAIL_WATERFRONT.MXD SBEGG1 7/29/2019 9:15:33 AM



LEGEND

Critical Elevation	**Sewer By Type**	**Control Structure Type**
CSO Outfall	CS	Gate Chamber
Manhole	LDS	
Sluice Gate	SRS	
	WWS	

CSO MASTER PLAN
PROPOSED SOLUTIONS

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 07-02
Latent SRS Control
Sewer District: Bannatyne
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\BANNATYNE\BANNATYNE_DISTRICT_DETAIL_MCDERMOT.MXD DT072410 8/15/2019 7:55:37 AM

CSO Master Plan

Clifton District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Clifton District Plan
Revision:	03
Date:	August 16, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Stephen Godon
File Name:	Clifton_Plan_Final_CO1MP_08162019

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	08/2018	Version 1 DRAFT	SG	ES	
1	02/15/2019	DRAFT 2 for City Review	SB	SG	MF
2	07/2019	Final Draft Submission	DT	MF	MF
3	08/16/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Clifton District

1.1 District Description

Clifton district is located towards the western edge of the combined sewer (CS) area. It stretches from Pacific Avenue West at the north to the Assiniboine River at the south. The most northern section of Clifton is split by Aubrey district. This section is bounded by Keewatin Street to the west, Pacific Avenue West to the north, Weston Street to the east, and Notre Dame Avenue to the south. The southern section of Clifton is bounded by the Midland Rail line to the west; Saskatchewan Avenue to the north; Downing, Goulding, and Clifton Streets to the east; and the Assiniboine River to the south. Omand's Creek runs north-south along the western side of the district boundary adjacent to the Tylehurst district and extends from Dublin Avenue to the Assiniboine River.

Many major transportation routes pass through the district. Ellice Avenue, Wellington Avenue, Sargent Avenue, Notre Dame Avenue, and Portage Avenue run horizontally through Clifton providing a corridor for small commercial businesses. Wall Street and Erin Street run parallel to each other providing access from Portage Avenue to Notre Dame Avenue. Clifton district also includes two rail lines:

- Canadian Pacific Railway (CPR) Lariviere
- CPR Spur SJ Industry

The Clifton area is primarily residential and industrial with an even distribution of general, light, and heavy manufacturing facilities located in the northern section of Clifton and along Erin and Wall Streets. Residential areas are located throughout the district and include mostly single- and two-family homes with a few apartment buildings. Approximately 30 ha of the district is classified as greenspace.

1.2 Development

A portion of Portage Avenue is located within the Clifton District. Portage Avenue is identified as a Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

Clifton district encompasses an area of 371 ha[1] and includes both a CS system and a storm relief sewer (SRS) system. As shown in Figure 08, there is no LDS already separated areas and 2 percent (7 ha) of the total district is considered separation ready.

The Clifton sewer system includes a flood pump station (FPS), CS lift station (LS), and a CS outfall gate chamber located adjacent to the Assiniboine River at Clifton Street and Wolseley Avenue. The sewage LS is located beside the flood pumping station (FPS) with an independent outfall to the river.

CS flows south through a 2970 by 2300 mm main egg-shaped trunk sewer that runs along Clifton Street. A 600 mm collector pipe collects sewage from four residential blocks south of Portage Avenue and ties into the Clifton trunk sewer immediately upstream of the Clifton CS outfall. CS from the northern section of Clifton district flows through the 1025 by 1325 mm egg-shaped trunk on Clifton Street and flows south towards the CS outfall. There is an extensive SRS pipe network in both the northern and southern sections of Clifton. The majority of these SRS pipes drain towards a dedicated SRS outfall at the southern end of Strathcona 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), the SRS is not utilized, and all sanitary sewage is diverted by the primary weir through the 500 mm off-take pipe to the Clifton CS LS, where it is pumped to the Portage interceptor pipe where it flows by gravity east along Wolseley Avenue and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), any flow that exceeds the diversion capacity of the primary weir then overtops the weir and is discharged to the river. Sluice and flap gates are installed on the Clifton CS outfall and are utilized to restrict back-up from the Assiniboine River into the CS system during high river level conditions. When the Assiniboine River level is high like this however gravity discharge is not possible due to the flap gate. The excess flow under these conditions is instead pumped by the Clifton FPS to discharge into a dedicated FPS outfall. There are no flap or sluice gates installed on this FPS outfall, and allows for gravity discharge to the river regardless of river level conditions.

During WWF as well, the SRS system provides relief to the CS system in the Clifton district by diverting CS into the SRS system via high point overflow connections between the CS and SRS systems. Portions of this SRS divert CS from the CS system at one point, but then ties back into the CS system at a point further downstream. The majority of SRS for the Clifton district flow by gravity to a dedicated SRS outfall on Strathcona Street. Flap and positive gates are installed on the Strathcona SRS outfall pipe to prevent river water from backing up into the Clifton SRS under river level conditions. The Strathcona SRS outfall discharges into Omand’s Creek.

The outfalls to for the Clifton District are as follows:

- ID54 (S-MA70008731) – Clifton CS Outfall
- ID81 (S-MA70042741) – Clifton FPS Outfall
- ID72 (S-MA20011477) – Clifton SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Clifton and the surrounding districts. Each interconnection is shown on Figure 08 and shows gravity and pumped flow from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Aubrey

- A 1200 mm WWS Main interceptor flows eastbound by gravity at the district boundary between Clifton and Aubrey and on to the North End Sewage Treatment Plant (NEWPCC) for treatment:
  - Invert at manhole on Wolseley Avenue at Clifton district boundary – 226.69 m (S-MA70017830)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Tylehurst

- A 600 mm WWS Main interceptor flows eastbound by gravity through the siphon at the district boundary between Clifton and Tylehurst and on to the North End Sewage Treatment Plant (NEWPCC) for treatment:
  - Invert at manhole on Portage Avenue at Clifton district boundary – 228.11 m (S-MH20009684)

1.3.1.3 District Interconnections

Tylehurst

<u>CS to CS</u>

- A 200 mm CS sewer from Tylehurst district into the Clifton CS system:
  - Sargent Avenue and Sanford Street – 228.92 m (S-MH20009103)

Aubrey

<u>CS to CS</u>

- High Point Manhole:
  - Midland Street – 230.72 m (S-MH20010625)
  - Notre Dame Street – 230.28 m (S-MH20010674)
  - Wall Street (near Wall Street East) – 229.04 m (S-MH20009426) (also to SRS)
  - Wolseley Avenue – 230.22 m (S-MH70039558)
  - Pacific Avenue West and Quelch Street – 228.87 m (S-MH20011789)
  - Alexander Avenue and Quelch Street – 228.57 m (S-MH20010968)
  - Portage Avenue and Clifton Street – 227.24 m (S-MH20010003)
- A 750 mm pipe directs excess flow from the Clifton district to the Aubrey district at the intersection of Roy Avenue and Cecil Street:
  - Cecil Street – 227.88 m (S-MH20010899)
- A 750 mm bifurcation pipe from Aubrey flows southbound on Quelch Street and excess flows connect to the CS system south in the Clifton district on Logan Avenue:
  - Logan Avenue – 227.03 m (S-MH20010965)

<u>CS to SRS</u>

- High Point Manholes:
  - Minto Street – 227.56 m (S-MH20008769)
  - Goulding Street – 229.9 m (S-MH20008710)
  - Goulding Street – 229.53 m (S-MH20008700)
  - Wolseley Avenue and Basswood Place – 229.65 m (S-MH70005332)
- A 450 mm SRS overflow pipe connects from the Aubrey district to the SRS system in Clifton district at Keewatin Street and Alexander Avenue:
  - Alexander Avenue – 228.27 m (S-MH20011401)
- A 300 mm SRS overflow pipe connects into the SRS system in Clifton district to reduce sewage back-up of the CS network in Aubrey on Pacific Avenue West:
  - Pacific Avenue West – 227.84 m (S-MH20011392)
- A 300 mm diversion pipe provides relief to the CS on Sprague Street and flows from a high point manhole into the Clifton district flowing eastbound on Wolseley Avenue:
  - Wolseley Avenue – 229.42 m (S-MH20010522)

<u>SRS to SRS</u>

- A 2700 mm SRS trunk conveys flow by gravity southbound on Midland Street from Aubrey district into Clifton district to Clifton's SRS outfall:
  - Midland Street – 225.53 m (S-TE20003059)
- A 2250 mm SRS trunk flows by gravity from northern Clifton into Aubrey district at the intersection of Notre Dame Avenue and Flint Street. It also connects to a SRS coming eastbound from Aubrey and then it connects to the SRS that flows south on Midland Street:
  - Flint Street and Notre Dame Avenue – 225.68 m (S-MH20011539)
- A 1650 mm SRS flows by gravity from northern Clifton collecting overflow from the CS system, into Aubrey district on Notre Dame Avenue. It then connects the SRS that flows south on Midland Street:
  - Notre Dame Avenue – 227.22 m (S-MH20010742)
- A 1350 mm SRS flows by gravity from the Aubrey district into Clifton district along Quelch Street at Logan Avenue:
  - Logan Avenue – 226.91 m (S-MH20010964)
- A 1350 mm SRS pipe flows by gravity from the Aubrey district into Clifton along Worth Street:
  - Worth Street – 226.94 m (S-TE20003936)

<u>SRS to CS</u>

- A 600 mm SRS overflow pipe from Aubrey's CS system flows into Clifton district on Notre Dame Avenue near Clifton Street North:
  - Notre Dame Avenue – 228.5 m (S-MH20011679)
- A 375 mm SRS overflow pipe from Aubrey's CS system flows into Clifton district on Logan Avenue near Wiens Street and connects to the SRS along Logan Avenue:
  - Logan Avenue – 228.83 m (S-MH20011446)

<u>WWS to CS</u>

- A 250 mm WWS pipe flows westbound from the Aubrey district on Pacific Avenue into the Clifton CS system:
  - Pacific Avenue – 227.92 m (S-MH20011757)

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

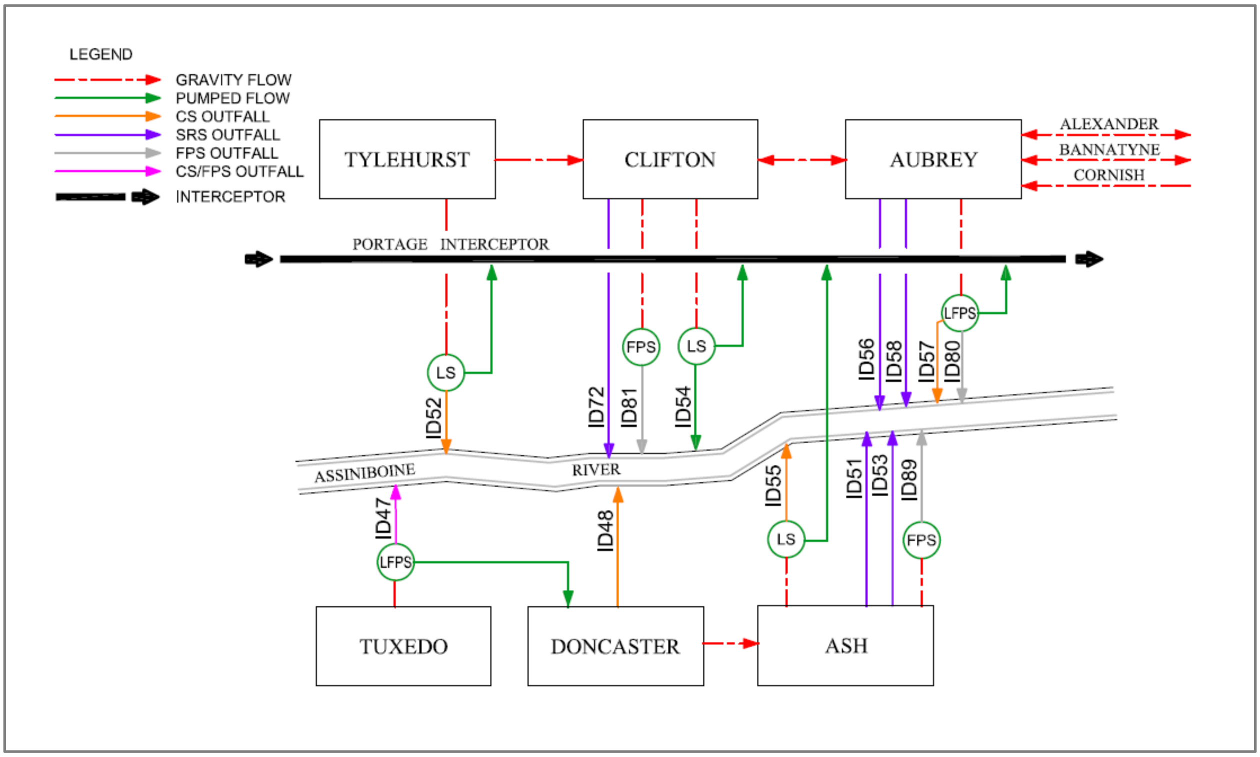


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 08 and are 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 (ID54)	CLIFTON_GC2.1	S-MA70008731	2500 mm	Circular Invert: 223.50 m
Flood Pumping Outfall (ID81)	S-AC70016634.1	S-MA70042741	2100 mm	Circular Invert: 224.75 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-CG00000937.1	S-MA70008732	2970 x 2300 mm	Egg-shaped Invert: 223.82 m
SRS Outfalls (ID72)	S-MH70004527.1	S-MA20011477	2700	Circular Invert: 223.68 m
SRS Interconnections	N/A	N/A	N/A	60 SRS-CS
Main Trunk Flap Gate	CLIFTON_WEIR.1	S-CG00000762	2100 mm	Invert: 224.05 m
Main Trunk Sluice Gate	CLIFTON_GC1.1	S-CG00000763	1800 x 2400 mm	Invert: 224.03 m
Off-Take	S-TE70008194.1	S-MA70017712	500 mm	Circular Invert: 223.80 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.250 m^3/s	1 x 0.150 m^3/s 1 x 0.100 m^3/s
Lift Station ADWF	N/A	N/A	0.066 m^3/s	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Force Main	S-AC70008191.1	S-MA70017710	300 mm	Invert: 226.65 m (Note downstream gravity Interceptor 1066 mm diameter with peak flow capacity of 0.791 m^3/s)
Flood Pump Station Total Capacity	N/A	N/A	5.64 m^3/s	4 x 1.41 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.456 m^3/s	

Note:
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	Clifton – 223.86 Strathcona – 223.86
2	Trunk Invert at Off-Take	223.80
3	Top of Weir	224.80
4	Relief Outfall Invert at Flap Gate	223.70
5	Low Relief SRS Interconnection (S-TE20003352)	225.2
6	Sewer District Interconnection (Aubrey)	225.35
7	Low Basement	229.97
8	Flood Protection Level	230.30

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

A summary of the previous work in the Clifton district has been included in Table 1-3, and provides a summary of the district status in terms of data capture and study. The most recent study completed in Clifton was in 1979 with the *Conceptual Design Report for the Clifton Combined Sewer Relief Project* (James F. Maclaren Limited, 1979). The purpose of the conceptual design was to examine various alternatives to provide sewer relief for Clifton district, as well as considering pollution control for CSOs to the Assiniboine River.

An extensive SRS system was constructed within the Clifton district, as well as covering the adjacent Aubrey and Tylehurst districts, over an approximate length of 14 km between 1979 and 2013 (the majority was constructed in 1981). The SRS system is classified as the Strathcona SRS discharging to the Assiniboine river via a 2700 mm diameter outfall pipe.

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 Clifton 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	Planned Completion
8 - Clifton	1979 - Conceptual	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Clifton 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 Clifton sewer district are listed in Table 1-4. The proposed CSO control projects will include in-line storage via control gate, floatable management via screening, and latent storage with flap gate control. 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% Capture in a Representative Year	✓	✓	-	✓	✓	-	-	-	✓	✓	✓

Notes:

- = not included
✓ = included

The existing CS system is suitable for use as in-line and latent storage. These control options would take advantage of the existing CS pipe network for additional storage volume. Existing DWF from the collection system would remain the same, and overall district operations would remain the same, although additional WWF will be collected from the SRS and transferred to the existing CS system and forwarded to the NEWPCC for treatment.

All primary overflow locations are to be screened under the current CSO control plan. The installation of a control gate at the primary CS outfall will be required for the screen operation. The control gate installation will also provide the mechanism for capture of additional in-line storage.

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

Latent storage is proposed as a control option for the Clifton district. The latent storage level is partially controlled by the resulting backpressure of the river level on the Strathcona SRS outfall flap gate. However, the level of the Strathcona SRS outfall is sufficiently above the river level that insufficient volume capture is achieved from the latent storage provided by the flap gate only. Therefore, flap gate control has been recommended with this control option, to provide the additional latent storage volume desired. The latent storage design criteria are identified in Table 1-5.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	223.70 m	
NSWL	223.86 m	
Trunk Diameter	2,700 mm	
Design Depth in Trunk	160 – 1740 mm	1.74 m for 1-year design event (depth varies with rainfall)
Maximum Storage Volume	23 - 6,740 m^3	Varies depending on rainfall, 6,740m^3 with 1-year design event. 23 m^3 provided with no flap control (single rainfall event modelled value)
Force Main	125 mm diameter	
Flap Gate Control	Yes	
Lift Station	Yes	
Nominal Dewatering Rate	0.040 m^3/s	Based on 24-hour emptying requirement between WWF events
RTC Operational Rate	TBD	Dependent on future RTC control option requirement and recommendation

Notes:

NSWL = normal summer water level
TBD = to be determined

The addition of a latent storage pump station (LSPS) and force main that connect to the CS system are necessary for the latent storage. The purpose of the LSPS is to 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. A conceptual layout for the LSPS and force main is shown on Figure 08-02. The pump station would be located to the east of the existing SRS outfall chamber within public land. The latent force main will route through city-owned land and connect to the interceptor sewer on Raglan Road and into the manhole (S-MH20010465). The pump station and force main construction would cause minimal disruption to local residents within the surrounding area.

As mentioned above, flap gate control for the SRS system is proposed to fully utilize the latent storage available in the SRS system. The operation of this flap control will be tied to the lowering of the control gate on the CS system. As soon as the control gate drops out of the way, resulting from the increasing level in the CS system to the critical elevation, the flap control allows full capacity outflow in the SRS system through the SRS outfall and flap gate. The actual levels in the SRS system at these times will vary depending on the rainfall characteristics.

Figure 08 identifies the extent of the SRS system within the Clifton district that would be used for latent storage. The extent shown on the figure is relative to the NSWL as the controlling elevation. The maximum storage level is related to the NSWL, flap gate control and the size and depth of the SRS system. Once the level in the SRS exceeds the river level or the control set point of the flap gate control, the flap gate opens, and the CS is discharged to the river. The lowest interconnection between the combined sewer and relief pipe is higher than the proposed latent and in-line storage control levels, as a result the additional storage contained within the two systems via in-line and latent storage would function independently.

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 chamber and the pump station would be sized to provide sufficient flow to the pumps while all pumps are operating. Th flap gate control function is also described in the standard details in Part 3C.

1.6.3 In-Line Storage

In-line storage has been proposed as a CSO control for the Clifton district. The in-line storage will require the installation of a control gate at the CS outfall. The control gate will primarily be use to maximize the available hydraulic head in the district CS system, such that screening can be effectively operated. The gate will also provide a minor increase in the storage level in the existing CS to provide an increase to the volume capture. Should screening no longer be required for floatables management in this district, ultimately the in-line storage arrangements recommended in this sub-section should not be pursued.

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 1-6.

Table 1-6. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	223.82 m	Downstream invert of pipe at weir
Trunk Diameter	2300 x 2970 mm	
Gate Height	0.59 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	225.40 m	
Bypass Weir Height	225.20 m	
Maximum Storage Volume	2,397 m^3	
Nominal Dewatering Rate	0.25 m^3/s	Based on existing sewage LS capacity
RTC Operational Rate	TBD	Future RTC / dewatering review on performance

The proposed control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 08. 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 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 to the Main Interceptor pipe on Wolseley Avenue. The CS LS will further dewater the in-line storage provided during a WWF event as downstream capacity becomes available.

Figure 08-01 provides an overview of the conceptual location and configuration of the control gate and screening chambers. The control gate would be installed in a new chamber within the trunk sewer alignment and located north of the CS LS. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5.0 m in length and 3.6 m in width. The existing sewer configuration including the construction of an additional off-take, and force main modifications may have to be completed accommodate the new control gate chamber. This will be confirmed in future design assessments. This construction will be within city owned land as this is adjacent to the existing FPS and CS LS structures. The construction is expected to be minimal from a traffic aspect due to the location proposed being located off of a residential street, although construction traffic will be present in the local street area.

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 FPS rehabilitation or replacement project.

The nominal rate for dewatering is already set at the existing pipe capacity as the district is a gravity discharge district. Any future considerations, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflows at this district. This future RTC control will provide the ability to capture and treat more volume for localized storms by using the excess interceptor capacity where the runoff is less.

1.6.4 Floatables Management

Proposed 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 hydraulic 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 1-7.

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	225.40 m	
Bypass Weir Crest	225.20 m	
NSWL	223.86 m	
Maximum Screen Head	1.34 m	
Peak Screening Rate	0.76 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 existing combined trunk sewer, as shown on Figure 08-01. The screens will operate once levels within the sewer surpass the bypass weir elevation. The side bypass weir upstream of the gate will direct initial 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 may include screenings pumps with a discharge returning the screened material to the LS for routing back to the interceptor and on to the NEWPCC for removal. The provision of screening pumps is dependent on final level assessment within the existing infrastructure and the Clifton trunk. This will be confirmed during future assessment stage.

The dimensions for the screen chamber to accommodate influent from the side bypass weir, the screen area, and the routing of discharge piping downstream of the gate are 3.6 m in length and 3.1 m in width. The location of the screen will provide minimal interference with local private residencies although possible disruption from construction processes is possible. All land utilized has been determined to City-owned, as per the current zoning boundary maps.

1.6.5 Green Infrastructure

The approach to GI is described in more detail 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 applicable GI controls.

Clifton has been classified as a medium GI potential district. Land use in Clifton is mainly industrial and residential, the south end of the district is bounded by the Assiniboine River. Bioswales and green roofs may be suitable to the industrial areas while cisterns/rain barrels, and rain garden bioretention are suitable for the residential areas. Parking lots located in commercial areas are ideal for paved porous pavement.

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 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.

The latent storage would take advantage of the SRS infrastructure already in place, therefore, minimal additional maintenance will need to be anticipated. The proposed latent LSPS will require regular maintenance that would depend on the frequency of operation. The flap control gate will require maintenance inspection for continued assurance that the flap gate would open during WWF events.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-8.

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	403	384	8,160	46	N/A
2037 Master Plan – Control Option 1	403	384	8,160	46	Lat St, FGC, IS, SC

Notes:

Lat St = Latent Storage

FC = Flap Gate Control
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 1-9 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 1-9 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 1-9. District 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 [c]
Baseline (2013)	153,921	114,875	-	41	0.456 m^3/s
In-line Storage	153,619 [a]	97,059 [b]	17,816	41	0.296 m^3/s
Latent Storage		113,932 [b]	943	15	0.296 m^3/s
Flap Gate Control		104,302 [b]	10,573	15	0.292 m^3/s
Control Option 1	**153,397**	**88,392**	**26,483**	**15**	**0.292 m^3/s**

[a] In-line and latent storage not modelled separately in the Preliminary Proposal assessment. Flap gate control not considered in PP assessment.

[b] Assessment completed with individual district models and reductions attributed to full model impact overflows provided

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

The selection of a flap gate control for the latent storage was not considered during the Preliminary Proposal, although further assessment of the level interaction between the SRS outfall and NSWL resulted in this being reconsidered during the CSO Master Plan phase.

The percent capture performance measure is not included in Table 1-9, 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 1-10. The cost estimates are a Class 5 planning level estimate with a level of accuracy of minus 50 to plus 100 percent.

Table 1-10. 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 (Over 35-year period)</th></tr>
<tr><td>Latent Storage</td><td rowspan="2">N/A [a]</td><td>$2,410,000</td><td>$87,000</td><td>$1,860,000</td></tr>
<tr><td>Latent Flap Gate Control</td><td>$2,420,000</td><td>$42,000</td><td>$900,000</td></tr>
<tr><td>In-line Storage</td><td rowspan="2">$7,740,000 [b]</td><td>$2,730,000 [c]</td><td>$42,000</td><td>$900,000</td></tr>
<tr><td>Screening</td><td>$2,730,000 [d]</td><td>$48,000</td><td>$1,040,000</td></tr>
<tr><td>Subtotal</td><td>$7,740,000</td><td>$10,290,000</td><td>$219,000</td><td>$4,700,000</td></tr>
<tr><td>Opportunities</td><td>N/A</td><td>$1,030,000</td><td>$22,000</td><td>$470,000</td></tr>
<tr><td>District Total</td><td>$7,740,000</td><td>$11,320,000</td><td>$241,000</td><td>$5,170,000</td></tr>
</table>

[a] Latent Storage and flap gate control not included in the Preliminary Proposal 2015 costing. Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for the Latent Storage item of work found to be $1,530,000 in 2014 dollars

[b] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for this item of work found to be $3,000,000 in 2014 dollars

[c] 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

[d] 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 Mast Plan cost estimate includes the following:

- Capital costs and O&M 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.

Cost estimates were prepared during the development of the Preliminary Proposal and updated for Phase 3 during the CSO Master Plan development. The difference 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 1-11 below.

Table 1-11. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Control Gate	Preliminary estimate was based on a standard cost per district, which has been updated to a site-specific cost estimate	The change may result in significant changes to individual districts, but balances over the entire CS area
	Screening	Preliminary estimate was based on a standard cost per district, which has been updated to a site-specific cost estimate	The change may result in significant changes to individual districts, but balance out over the entire CS area
	Latent Storage	Not included in the Preliminary Proposal cost submission, modelled as part of Preliminary Proposal refinements.	Add to Master Plan recommended solutions.
	Flap Gate Control	Not included in the Preliminary Proposal. Determined as necessary to fully take advantage of available latent storage.	Added in conjunction with Latent Storage
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 Costs	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 1-12 provides a description of how the target adjustment could be met by building off proposed work identified in Control Option 1.

Overall the Clifton district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to meet future performance targets. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume to meet future performance targets.

Table 1-12. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Opportunistic separation • Off-line storage (Tank/Tunnel) • Increased use of GI

The control options for the Clifton district has been aligned for the 85 percent capture performance target based on the system wide assessment. The expandability of the district to the future 98 percent capture target will be restricted depending on the interaction of the system wide performance.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-13.

Table 1-13. 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	-	-	O	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
6	Sewer Condition	R	R	-	-	-	-	-	-
7	Sewer Conflicts	R	R	-	-	-	-	-	-
8	Program Cost	O	O	-	-	-	-	-	O
9	Approvals and Permits	-	-	-	-	-	R	-	-

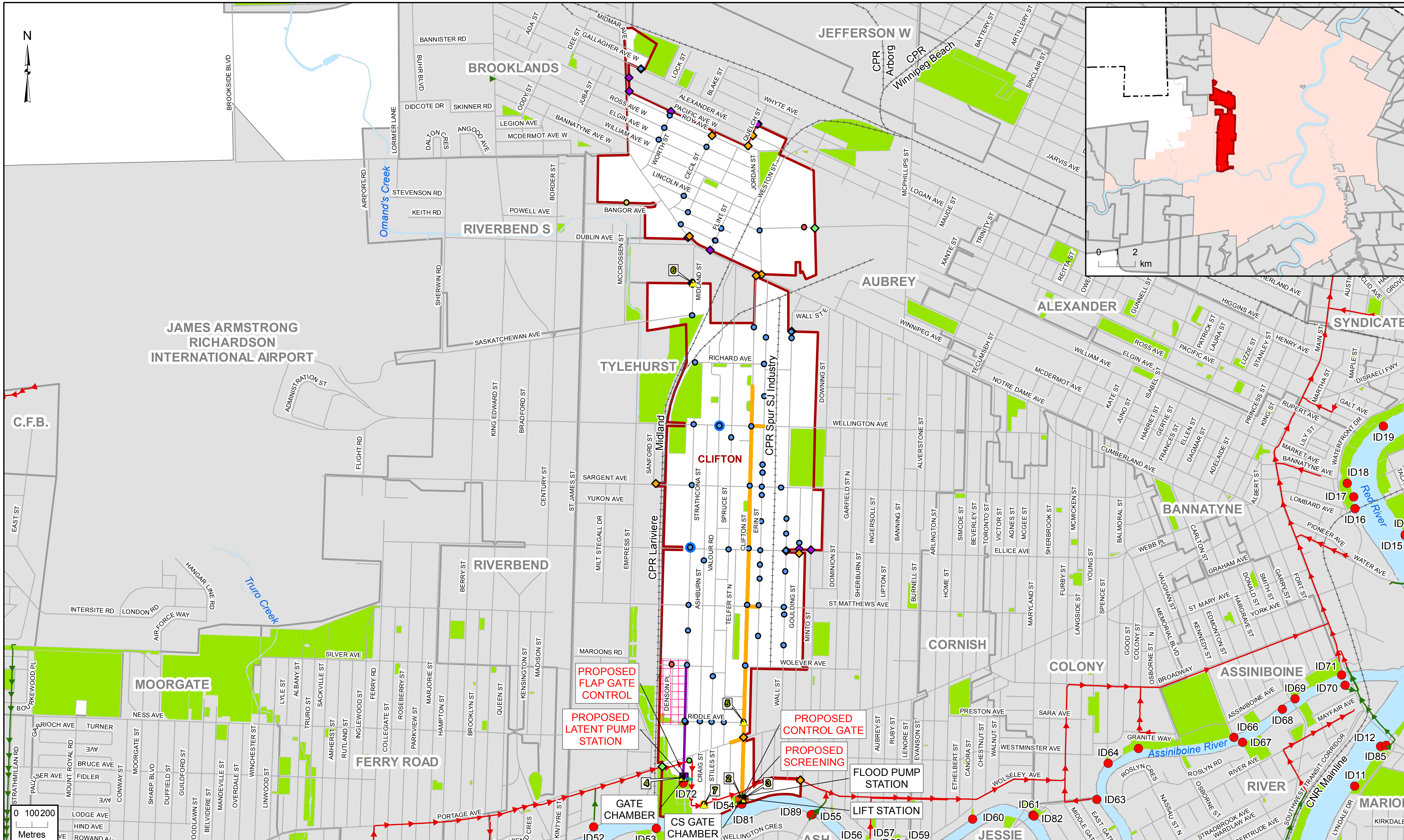
Table 1-13. Control Option 1 Significant Risks and Opportunities

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
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

James F. Maclaren Limited. 1979. *Conceptual Design Report for the Clifton Combined Sewer Relief Project*. Prepared for the City of Winnipeg Water and Waste Department. January.



LEGEND

Primary Weir	Inter-System Connection	District Boundary Crossing	Interceptor Sewer
Critical Elevation	CS - LDS	CS	Force Main
CSO Outfall	CS - WWS	SRS	Street
Low CS Manhole	SRS - CS	WWS	Railway
Low SRS Connection	SRS - WWS		

District Boundary
Watercourse
Green Space

CSO MASTER PLAN PROPOSED SOLUTIONS

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

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 08
District Overview Map
Sewer District: Clifton
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE4\CLIFTON\CLIFTON_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:48:42 AM

LEGEND

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

Sewer By Type
- CS
- 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 08-01
Control Gate and Screening
Sewer District: Clifton
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE4\CLIFTON\CLIFTON_DISTRICT_DETAIL_CLIFTONST.MXD SBEGG1 7/29/2019 8:47:42 AM

LEGEND

- Critical Elevation
- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate

Sewer By Type
- CS
- LDS
- SRS
- WWS

Control Structure Type
- Gate Chamber

- Land Parcel

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

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 08-02
Latent SRS Control
Sewer District: Clifton
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE4\CLIFTON\CLIFTON_DISTRICT_DETAIL_STRATHCONAST.MXD SBEGG1 6/24/2019 8:20:35 AM

CSO Master Plan

Cockburn and Calrossie Districts Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Cockburn and Calrossie Districts Plan
Revision:	04
Date:	August 18, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Stephen Godon
File Name:	Cockburn_Plan_Final_CO1MP_08182019

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	08/2018	DRAFT – Template Development	SG	ES	
1	11/2018	Version 1 DRAFT	SG	ES / JB / DT	
2	12/2018	Version 2 DRAFT	SG	ES / MF	
3	05/2019	Final Draft Submission	SG	MF	MF
4	08/18/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Cockburn and Calrossie Districts

1.1 District Description

The Cockburn and Calrossie sewer districts are located at the southern limit of the combined sewer area. Cockburn is bounded by Grant Avenue on the north, Daly Street on the east, Jubilee and Parker Avenues on the south, and Cambridge Street on the west. Calrossie is a small separated sewer district located south of Jubilee Avenue between Pembina Highway and the Red River, extending south to Calrossie Boulevard. Figure 09 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan control options.

The Canadian National Railway (CNR) Mainline and CNR Letellier rail lines run through Cockburn and split it into two distinct parts; in terms of the combined sewer (CS) area, these are subsequently referred to as Cockburn East and Cockburn West. Cockburn East includes the Lord Roberts area, which developed as residential in the early 1900s, while the residential portion of Cockburn West was developed between the 1940s and 1960s.

Pembina Highway is a major regional roadway that runs parallel to the rail lines in a north-south direction; it intersects with Grant Avenue and Taylor Avenue, which are major regional streets that extend from Pembina Highway to the west.

Cockburn East is primarily residential, except for the railway corridor that originally contained the Fort Rouge Yards. The railway yards are in the process of being abandoned and replaced with the Southwest Rapid Transitway (SWRT), a new bus rapid transit roadway.

A portion of Cockburn West between Grant Avenue and Taylor Avenue is primarily residential, with single-family residential areas and multi-family apartment buildings along Grant and Taylor Avenues. Grant Avenue includes Grant Park shopping centre, Grant Park School, and Pan Am Pool. Taylor Avenue includes two commercial developments: Grant Park Pavilions and Grant Park Festival. Approximately 22 ha of the district is classified as greenspace, which includes multiple parcels spread throughout the district.

Calrossie is primarily a single-family residential area with some commercial properties along Pembina Highway.

1.2 Development

A significant level of development is ongoing within the Cockburn district. This includes the Fort Rouge Yards, the Taylor Lands, and the Parker Lands. Each of these areas have designated as Major Redevelopment Sites as part of the Complete Communities direction strategy within OurWinnipeg. The lands adjacent to the SWRT along the former Fort Rouge Yards are in the process of being developed into multi-family residential housing. The area south of Taylor Avenue and west of Pembina Highway is actively under development, as follows:

- The second phase of the SWRT is being constructed from the underpass at Pembina Highway and Jubilee Avenue in a westward direction parallel to Parker Avenue, before turning south to the University of Manitoba.
- Large commercial developments are taking place on the Taylor and Parker Lands. The Taylor Lands development has been zoned for commercial development and is proceeding. High-density residential development has been proposed for Parker Lands. Both development areas will be served by the new land drainage sewer (LDS) system, which is being installed as part of the basement flooding relief.
- The Pembina-Jubilee underpass is being widened to a six-lane underpass. The current design includes use of a dry pond to temporarily store stormwater with gradual release back into the CS system.

A portion of Pembina Highway is located within the Cockburn and Calrossie Districts. Pembina Highway is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Pembina Highway is to be promoted in the future.

1.3 Existing Sewer System

The Cockburn district has an approximate area of 327[1] ha based on the district boundary. There is approximately 1 percent (4 ha) separated and no separation-ready areas. Separation work is ongoing with areas west and north of the rail line planned for LDS separation.

The Calrossie district has a drainage area of 16 ha and was originally a small CS district; it has since been completely separated through the addition of an LDS system. An LDS outfall is located in Toilers Memorial Park, near the intersection of Riverside Drive and Byng Place. In 2014, the LDS outfall was reconnected to the upstream side of the LDS gate chamber installed for the Cockburn West sewer separation project. The original CSs for Calrossie continue to discharge separate wastewater into the Cockburn CS system at the intersection of Jubilee Avenue and Riverside Drive.

The CS system includes a flood pump station (FPS), CS lift station (LS), one CS outfall, and one FPS outfall. All domestic wastewater and CS flows collected in Cockburn and Calrossie districts are routed to Cockburn Avenue, where the CS LS and outfall are located.

During dry weather flow (DWF), sewage flows are directed by the primary weir to the Cockburn CS LS and pumped to the Baltimore interceptor sewer. From Baltimore district, flows are pumped across the Red River to a gravity sewer flowing to the Mager CS LS. The Mager CS LS then 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 Cockburn outfall, where it flows 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 Cockburn CS outfall is not possible, the excess flow is pumped by the Cockburn FPS to a separate outfall adjacent to the CS outfall, where it will the discharge by gravity to the Red River. There are no sluice or flap gates on this FPS outfall.

The two CS outfalls to the Red River are as follows:

- ID1 (S-MA60012037) – Cockburn CS Outfall
- ID87 (S-MA60012037) – Cockburn FPS Outfall

1.3.1 District-to-District Interconnections

There are several sewer system interconnections between this district and the adjacent districts; see Figure 09. 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 – Downstream of Primary Weir

Baltimore

- The Cockburn CS LS discharges through a 250 mm force main 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.

---

[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.

1.3.1.2 District Interconnections

Calrossie

WWS to CS

- A 200 mm WWS pipe from Calrossie flows into the Cockburn CS system at the intersection of Jubilee Avenue and Riverside Drive. (S-MH60010185)

Jessie

CS to CS

- High Point Manhole (flow is directed into both districts from this manhole)
  - Ebby Avenue and Wentworth Street – 228.93 m (S-MH60010140)
- A 300 mm CS sewer acts as an overflow pipe from the Cockburn CS system into the Jessie CS system.
  - Jackson Avenue and Stafford Avenue – 229.29 m (S-MH60010066)

LDS to LDS

- A 1350 mm LDS trunk conveys flow from the Fort Rouge Yards development area within Cockburn to an LDS outfall discharging to the Red River and located in the Jessie sewer district.

Baltimore

CS to CS

- High Point Manholes (flow is directed into both districts from these manholes)
  - Montague Avenue and Nassau Street South – 228.83 m (S-MH60010528)
  - McNaughton Avenue and Nassau Street South – 228.82 m (S-MH60010544)
  - Churchill Drive – 229.71 m (S-MH60010728)

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

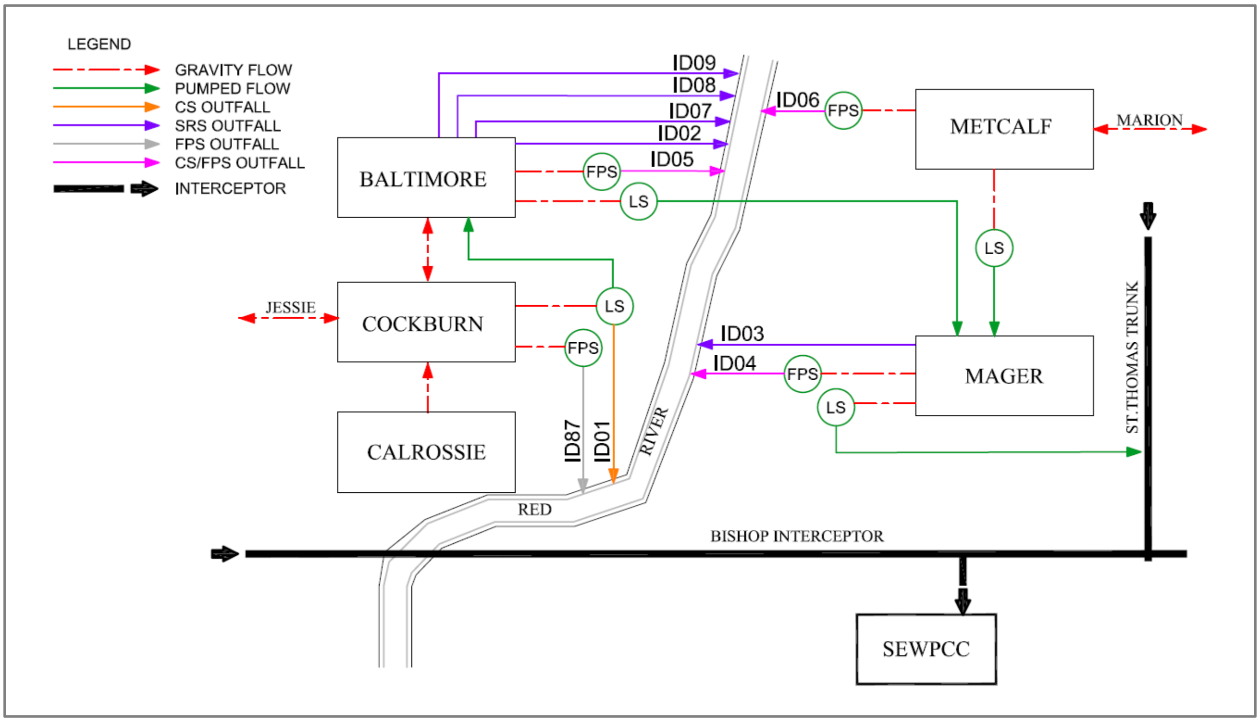


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 09 and are 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 (ID1)	S-CS00000475 DS.1	S-MA60012037	1675 mm	Red River Invert: 222.66 m
Flood Pumping Outfall (ID87)	S-TE70028256.1	S-MA60012037	1524 mm	Red River Invert: 221.93 m
Other Overflows	N/A	N/A	N/A	
Main Sewer Trunk	N/A	S-MA60012153	2800 x 2100 mm	Invert: 223.07 m
Storm Relief Sewer Outfalls	N/A	N/A	N/A	
Storm Relief Sewer Interconnections	N/A	N/A	N/A	
Main Trunk Flap Gate	S-CS00000475.1	S-CG00000764	2000 mm	Invert: 223.21 m
Main Trunk Sluice Gate	S-CG00000765.1	S-CG00000765	1810 mm	Invert: 223.03 m
Off-Take	S-TE70008629.2	S-MA70018505	406 mm	Invert 223.00 m
Wet Well	S-MH70006766.1	S-MA70018509	14 m x 2.3 m	
Lift Station Total Capacity	N/A	N/A	0.098 m^3/s	1 x 0.035 m^3/s 1 x 0.063 m^3/s pumps
Lift Station ADWF	N/A	N/A	0.017 m^3/s	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Force Main	S-BE70003227.1	S-MA70018509	250 mm	Discharge Invert 230.10 m
Flood Pump Station Total Capacity	N/A	N/A	2.380 m^3/s	3 pumps at 0.851 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.052 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	223.75
2	Trunk Invert at Off-Take	223.00
3	Top of Weir	223.38
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Low Interconnection (Baltimore)	228.28
7	Low Basement	229.73
8	Flood Protection Level	230.16

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

Calrossie district was completely separated in 2010. The work included construction of a new LDS with reconnection of the catch basins to collect all road drainage and surface runoff. The original CS now serves as a WWS, with collection of foundation drainage and any flows from downspouts that may still be connected to the separate system.

A basement flooding relief (BFR) preliminary design report (KGS, 2015) was completed for Cockburn and the southeastern portion of the Jessie sewer district in 2015. Separation of a portion of the Jessie sewer district is included with Cockburn BFR, with separated stormwater collected through Cockburn West and the sanitary system continuing to be collected by Jessie district through the original CSs. Southeast Jessie relief was not included when the rest of the Jessie district was relieved in the 1970s and was added to the Cockburn district relief study because of proximity.

The study included creation of a drainage hydraulic model, flow monitoring for model calibration, and evaluation of BFR alternatives and associated cost estimates. Work to date has included a LDS trunk across the CNR, a stormwater retention basin on Parker Lands, and a land drainage trunk to the outfall at Toilers Memorial Park into the Red River. Table 1-3 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 Cockburn 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
Cockburn	2015 – Preliminary Design	Yes	2013	Under Construction	TBD
Calrossie	N/A	No	2013	Separation Complete	N/A
Southeast Jessie	2015 – Preliminary Design	Yes	2013	Under Construction	TBD

Note:
TBD = to be determined

1.5 Ongoing Investment Work

The Cockburn BFR program work began in 2013 with construction of a new LDS outfall and trunk sewer. Once completed, the LDS system will provide complete road drainage separation of Cockburn West and southeast Jessie.

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Cockburn 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 Cockburn sewer district are listed in Table 1-4. The proposed CSO control projects will include sewer separation, in-line storage with screening, and floatable management. 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 Cockburn sewer district is identified as a priority, because it was previously identified as needing basement flooding relief. The BFR program was well underway at the time of the CSO Master Plan development, and a decision had been previously made to separate Cockburn West, while deferring Cockburn East until more information became available under the CSO Master Plan.

The marginal evaluation indicated that in-line storage for Cockburn East will be more economical than continuing with full separation of the district and will provide a high level of CSO control. In-line storage is lower in cost and will be effective because of the reduced inflows resulting from partial separation and the subsequent large volume of storage available in the existing CS.

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 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.

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 Sewer Separation

The sewer separation project for Cockburn West will provide immediate benefits to the CSO program when complete. The work includes installation of an independent LDS system to collect road drainage. Collected stormwater runoff will be routed through a new stormwater retention pond to an outfall discharging to the Red River at Toilers Memorial Park, located in the Calrossie sewer district. The approximate area of sewer separation is shown on Figure 09.

The flows to be collected after Cockburn West separation will be as follows:

- DWF will remain the same for Cockburn district (and for southeast Jessie).
- Cockburn West WWF will consist of sanitary sewage combined with foundation drainage.
- Cockburn East will remain as combined sewage.

This will result in a significant reduction in combined sewage flow received at Cockburn CS LS after the separation project is complete. The separation project by itself will provide a partial reduction of overflows and must be accompanied by in-line storage at the Cockburn diversion.

In addition to BFR and reducing the CSO volume, the benefits of Cockburn West separation include making storage volume available in the CS system for in-line storage and reducing the amount of flood pumping required at the Cockburn FPS.

1.6.3 In-line Storage

In-line storage has been proposed as a CSO control for Cockburn 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 and will provide additional hydraulic head for screening operations.

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	223.07 m	
Trunk Height	2700 x 2075 mm	
Gate Height	1.35 m	Based on half pipe height
Top of Gate Elevation	224.42 m	
Bypass Weir Height	224.32 m	
Maximum Storage Volume	2,600 m^3	
Nominal Dewatering Rate	0.098 m^3/s	Based on existing CS LS capacity
RTC Operational Rate	TBD	Future RTC / dewatering review on performance

The proposed control gate will cause combined sewage to back-up in the collection system to the extent shown on Figure 09. The extent of the in-line storage and volume is related to the top elevation of the bypass side weir. The level of the bypass side weir and adjacent control gate level area 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 fate 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 wil 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 09-01 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 6 m in length and 3.5 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. The existing sewer configuration including the off-take, the 900 mm CS sewer along Churchill Drive, and the force main 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.

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 LS rehabilitation or replacement project.

The nominal rate for dewatering is set at the existing CS LS station capacity. The dewatering rate includes both the DWF and WWF components of the district flows. 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. Any future considerations, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing capacity for large events will adversely affect the overflows at this district. . This future RTC will provide the ability to capture and treat more volume for localized storms by using either the district in-line storage or the excess interceptor capacity where the runoff volume is less. Further assessment of the impact of the RTC and future dewatering arrangement will be necessary to review the impacts on downstream districts such as the Baltimore and Mager districts.

1.6.4 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The 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 hydraulic 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	224.55 m	
Bypass Weir Crest	224.40 m	
Normal Summer River Level	223.75 m	
Maximum Screen Head	0.65 m	
Peak Screening Rate	0.52 m^3/s	
Screening 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 09-01. The screens will operate with the control gate in the raised position, diverting flows to the bypass weir. 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 piping downstream of the gate are 4 m in length and 3 m in width. The existing sewer configuration including the off-take, the 900 mm CS sewer along Churchill Drive, and the LS force main 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.

Cockburn has been classified as a high GI potential district. A portion of Cockburn West between Grant Avenue and Taylor Avenue is primarily residential, with single-family residential areas and multi-family apartment buildings along Grant and Taylor Avenues. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, and rain gardens. The higher area of greenspace in Cockburn district is suitable for biorientation garden projects. The commercial buildings along Taylor Avenue, Grant Avenue, and Pembina Highway are ideal locations for green roof 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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flows with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers and requiring more frequent cleaning operations. However, the WWF flows from the non-separated east Cockburn area will offset part of this concern. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district. The stormwater retention pond and LDS gate chamber at Toilers Memorial Park are included as part of routine LDS operation.

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 Cockburn 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. However, the sewer separation will remove storm runoff flows that will lower the duration and frequency of the pump run times.

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)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	336	336	5,584	27	N/A
2037 Master Plan – Control Option 1	323	312	5,584	19	SEP, IS, SC

Notes:

SEP = Separation
IS = In-line Storage
SC = Screening

Table 1-7. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model

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. 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. District 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)	164,713	188,459	0	22	0.075 m^3/s
Cockburn West Separation	12,297 [a]	14,541	173,918	15	0.087 m^3/s
In-Line Storage + Cockburn West Separation		6,183	182,276	4	0.126 m^3/s
Control Option 1	**12,297**	**6,183**	**182,276**	**4**	**0.126 m^3/s**

[a] Separation 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 1-8above, 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 (Over 35-year period)
Sewer Separation	$89,370,000 [a]	$56,280,000 [c]	$30,000	$720,000
In-line Storage		$2,650,000	$40,000	$890,000

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 (Over 35-year period)
Screening	N/A [b]	$2,250,000 d	$30,000	$730,000
Subtotal	**$89,370,000**	**$61,180,000**	**$110,000**	**$2,340,000**
Opportunities	N/A	$6,120,000	$10,000	$230,000
District Total	**$89,370,000**	**$67,300,000**	**$120,000**	**$2,570,000**

[a] Solution development as refinement to Preliminary Proposal costs. Revised cost for this sewer separation work found to be $47,490,000 in 2014 dollars

[b] Solution development as refinement to Preliminary Proposal costs. Revised costs for these items of work found to be $4,400,000 in 2014 dollars

[c] Cockburn separation is approximately 20% complete and at the time of CSO Master Plan development. An adjustment to the total capital cost estimate has been included in the Master Plan cost to account for this

[d] 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 cost for RTC.
- 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. Each of these values include equipment replacement and O&M costs.
- 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 alternative plans for the entire system, 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	Separation	Unit costs were updated Cockburn West area removed from estimate. The percent separation was adjusted to account for construction completed.	

Table 1-10. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
	In-line Storage	A control gate was not included in the Preliminary Proposal estimate	Added for the Master Plan 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 Cockburn district would be classified as a high potential for implementation of complete sewer separation as the feasible approach to achieve the 98 percent capture in the representative year future performance target. 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. Focused use of green infrastructure, and reliance on said green infrastructure as well can provide volume capture benefits and could be utilized 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	• Separation of remainder of Cockburn district • Increased use of GI

The control options selected for the Cockburn district has been aligned with the City's committed projects for the BFR program. The expandability of this district to meet the 98 percent capture would be based on a system wide assessment. 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.

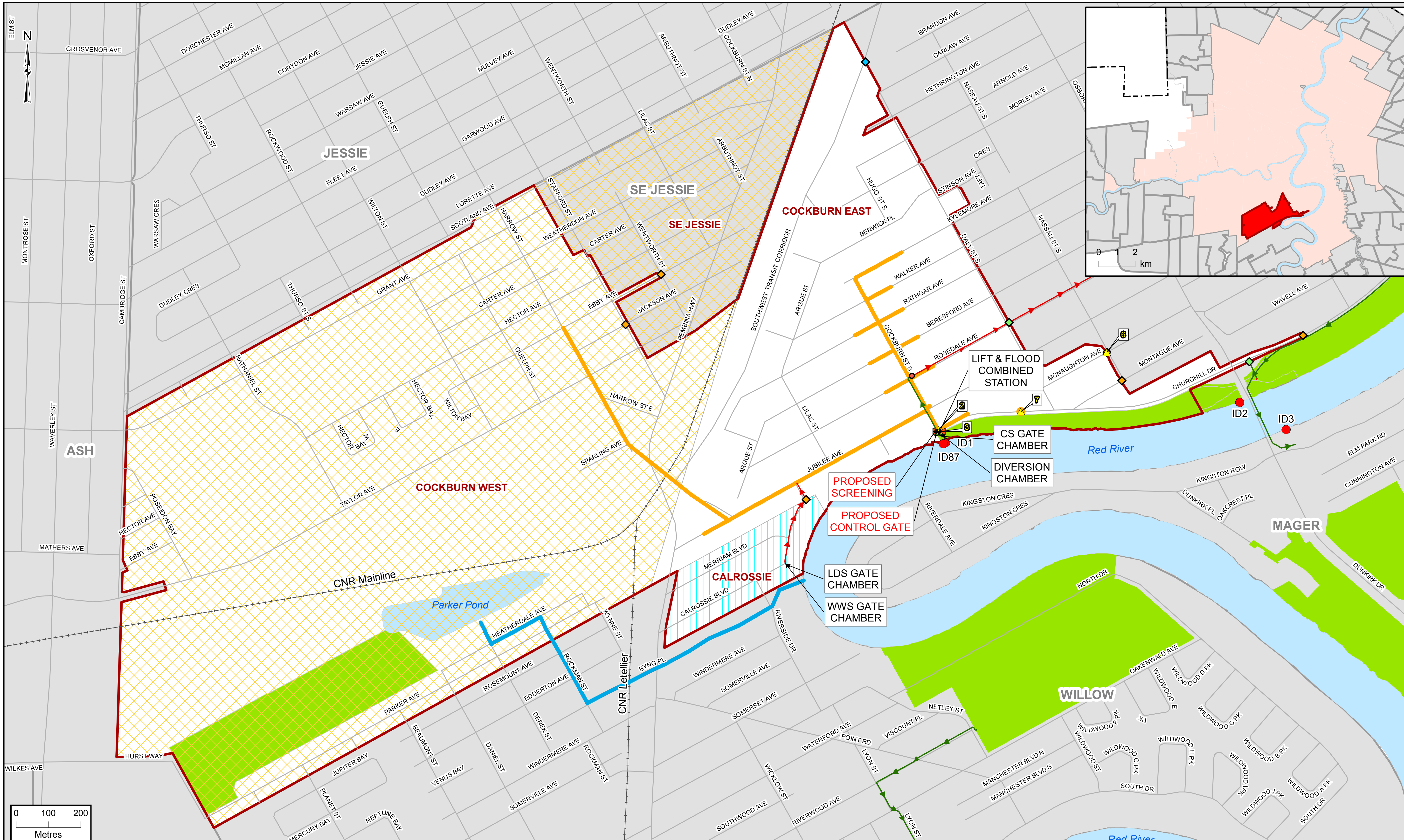
Table 1-12. Control Option 1 Significant Risks and Opportunities

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	-	-	O	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	R	-	-	-	-	-	-
7	Sewer Conflicts	-	R	-	-	R	-	-	-
8	Program Cost	-	R/O	-	-	R	-	-	O
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	R	-	-	R / O	R	O	R
13	Volume Capture Performance	-	O	-	-	-	O	O	-
14	Treatment	-	R	-	-	O	O	O	R

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

1.12 References

KGS Group. 2015. *Cockburn and Calrossie Combined Sewer Relief Works Preliminary Design Report.* Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. June.



LEGEND

Primary Weir	Inter-System Connection	District Boundary Crossing	Interceptor Sewer	District Boundary
Critical Elevation	CS - WWS	CS	Force Main	Watercourse
CSO Outfall		LDS	Street	Greenspace
Low CS Manhole		WWS	Railway	

CSO MASTER PLAN PROPOSED SOLUTIONS

- Proposed Control Gate
- Cockburn LDS Trunk
- Extent of In-line Storage
- Sewer Separation - Underway
- Sewer Separation - Complete

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 09
District Overview Map
Sewer District: Cockburn
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\COCKBURN\COCKBURN_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 6/20/2019 2:02:11 PM

LEGEND

Primary Weir
Critical Elevation
CSO Outfall
Manhole
Flap Gate
Sluice Gate
Pump Location
Force Main
Sewer By Type
CS
LDS
WWS
Control Structure Type
Gate Chamber
Pump Station Type
Diversion Chamber
Lift & Flood Combined 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 09-01
Control Gate and Screening
Sewer District: Cockburn
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\COCKBURN\COCKBURN_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 7:50:26 AM

CSO Master Plan

Colony District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Colony District Plan
Revision:	04
Date:	August 18, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Colony_Plan_Final_CO1MP_08182019

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	08/2018	Version 1 DRAFT	SG	ES	
1	12/2018	Version 2 DRAFT	SB	MF / ES / DT	
2	06/2019	Final Draft Submission	SB/JT	MF	SG
3	07/2019	Revised Final Draft Submission	SB/JT	MF	MF
4	08/18/2109	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figures

1. Colony District

1.1 District Description

Colony district is located along the northern bank of the Assiniboine River and west of the Red River. It is near the centre of the combined sewer area, towards the western edge of the City of Winnipeg's (City's) 'downtown'. Colony is bounded by Notre Dame Avenue on the north, Kennedy and Osborne Streets on the east, the Assiniboine River on the south, and Toronto and Maryland Streets on the west. Portage Avenue runs east-west through the centre of the district, extending the district slightly more towards the Portage Avenue and Main Street intersection. The three districts that border Colony are Assiniboine to the east, Bannatyne to the north, and Cornish to the west.

The district contains a mix of residential, commercial, and institutional land usage that includes a portion of downtown, the University of Winnipeg, the Misericordia Health Centre, and the Winnipeg Art Gallery. The area outside of downtown is mostly multi-family, with commercial areas built up along major transportation routes. The available land use and green space is minimal due to the density of existing residential and commercial developments. Approximately 7 ha of the district is classified as greenspace.

1.2 Developments

There is limited land area available for development within Colony district, so no significant developments that could impact the Combined Sewer Overflow (CSO) Master Plan are expected. Some redevelopment is underway by the University of Winnipeg, but no impact to the CSO Master Plan is anticipated.

A portion of Portage Avenue is located within the Colony district. Portage Avenue is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

The Colony district covers an approximate land area of 237 hectares (ha)[1] and includes a combined sewer (CS) system and a storm relief sewer (SRS) system. This district does not include any areas that may be identified as separated. Of the total district area, 6.8 percent (16 ha) is considered separation ready. The CS system was mostly constructed between 1880 and 1950. The SRS system was added in the 1960s to relieve the CS system. Further upgrades to the SRS to separate road drainage from the CS system were completed in the 1990s.

The CS system includes a diversion chamber, flood pump station (FPS) and CS outfall gate chamber. The Colony district does not contain an independent lift station (LS) for dry weather flow (DWF). The Colony FPS and CS outfall are located next to the Assiniboine River at the end of Colony Street and Granite Way. The diversion chamber and off-take pipe are set further north from the CS outfall between Broadway Avenue and Granite Way along Colony Street.

During wet weather flow (WWF), any flow that exceeds the diversion capacity overtops the weir and is discharged through the gate chamber to the Colony CS outfall to the Assiniboine River. Sluice and flap gates are installed on the CS outfall to prevent back-up of the Assiniboine River into the CS system. When the Assiniboine River levels are particularly high, the flap gate prevents gravity discharge from the Colony CS outfall. Under these conditions, the excess flow is pumped by the Colony FPS to a point downstream of the flap gate, where it can be discharged to the river.

[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.

The SRS system is installed throughout most of the district and connects to the CS system via various interconnections which consist of overflow pipes and weirs. During runoff events, the SRS system provides relief to the CS system. Most catch basins are still connected into the CS system, so no partial separation has been completed and the SRS system acts as an overflow conduit for the CS to prevent basement surcharge. The SRS system discharges directly to the Assiniboine River through the Spence SRS outfall located at the south end of Spence Street. A flap gate and sluice gate are installed on the outfall pipe to control backflow into the SRS system under high river level conditions. The SRS flows into and CS flows from the Cornish district along the western edge of the Colony district.

During DWF, the SRS system is not required; sanitary sewage is diverted by the weir located on the main sewer trunk, through a 680 mm off-take pipe to the 680 mm Colony secondary interceptor pipe and back to the Portage Interceptor by gravity and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

The two outfalls to the Assiniboine River are as follows:

- ID65 (S-MA20014505) – Colony CS and FPS Outfall
- ID64 (S-MA70103641) – Colony SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Colony and the surrounding three districts. They are shown on Figure 10 and show gravity and pumped flow from one district to another. Each interconnection is listed in the following subsections:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Assiniboine

- A 1500 mm intercepted WWS flows by gravity from the Colony district into the Assiniboine district and on to the NEWPCC for treatment.
  - Broadway Avenue at Memorial Boulevard interceptor invert - 223.72 m (S-MH20013425)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Cornish

- A 450 mm intercepted WWS flows from the Cornish district into the Colony district and to the NEWPCC for treatment.
  - Furby Street and Cornish Avenue interceptor invert - 225.48 m (S-TE20012409)
- A 1500 mm intercepted WWS flows from the Cornish district into the Colony district and on to the NEWPCC for treatment.
  - Wolseley Avenue and Maryland Street Interceptor invert - 225.46 m (S-TE20012409)

1.3.1.3 District Interconnections

Assiniboine

<u>SRS to SRS</u>

- A 450 mm SRS overflow pipe diverts flow from Assiniboine district SRS system at Edmonton Street and Graham Avenue, and then flows by gravity northbound along Edmonton Street and flows into Colony district CS system.
  - Graham Avenue and Edmonton Street overflow invert into 450 SRS - 227.18 m (S-TE20005333)

CS to CS

- A 300 mm SRS overflow pipe diverts flow form Assiniboine district CS system at Carlton Street near Portage Avenue, and then flows by gravity northbound along Carlton Street and flows into Colony district CS system.
  - Portage Avenue and Carlton Street overflow invert CS - 227.61 m (S-MH20014163)

CS to SRS

- A 1050 mm SRS overflow pipe diverts flow from Colony district CS system at Portage Avenue and Donald Street, and then flows by gravity southbound along Donald Street and flows into Assiniboine district SRS system.
  - Graham Avenue and Donald Street SRS overflow invert into 1050 SRS - 225.43 m (S-MA70023000)
- A 1350 mm SRS overflow pipe diverts flow from Colony district CS system at Portage Avenue and Kennedy Street and then flows by gravity southbound along Kennedy Street and flows into Assiniboine SRS system.
  - Graham Avenue and Kennedy Street SRS overflow invert into 1350 SRS - 225.54 m (S-MA20015634)
- A 450 mm SRS overflow pipe diverts flow from Colony district CS system at Vaughan Street and Mary Avenue and flows by gravity eastbound along St. Mary Avenue and flows into Assiniboine district SRS system.
  - St. Mary Avenue and Kennedy Street SRS overflow invert into 450 SRS - 225.38 m (S-MA70022895)

Bannatyne

CS to CS

- High point CS manholes (flow is directed into both districts from this manhole):
  - Victor Street invert - 229.33 m (S-MA20017614)
  - Agnes Street invert - 229.30 m (S-MA20016379)
  - McGee Street invert - 229.65 m (S-MA20016714)
  - Maryland Street invert - 229.24 m (S-MA20016720)
  - Young Street invert - 229.10 m (S-MA20016919)
  - Cumberland Avenue and Balmoral Street invert - 229.02 m (S-MA20016981)
  - Kennedy Street invert - 229.69 m (S-MA20016934)
  - Qu`Appelle Avenue invert - 228.97 m (S-MA20016817)

CS to SRS

- High point SRS manhole: A 250 mm SRS overflow pipe diverts flow from Bannatyne district CS system near Hargrave Street and Portage Avenue and flows by gravity southbound along Hargrave Street and flows into Colony CS system.
  - Hargrave Street and Portage Avenue SRS overflow invert into 250 mm SRS – 229.02 m (S-MA20015844)
- A 525 mm SRS overflow pipe diverts flow from Colony district CS system at Vaughan Street and Webb Place and flows by gravity northbound and then turns eastbound along Ellice Avenue and flows into Bannatyne SRS system.

  - Ellice Avenue and Kennedy Street SRS overflow invert into 1200 mm SRS - 226.14 m (S-MH20016684)
- A 450 mm SRS overflow pipe diverts flow from Colony district CS system near Donald and Ellice Avenue and flows by gravity northbound along Donald Street and flows into Bannatyne SRS.
  - Donald Street and Ellice Avenue SRS overflow invert into 375 mm SRS - 227.76 m (S-MA70087485)

CS to CS

- A 250 mm CS pipe flows northbound by gravity from Colony to Bannatyne district at Ellice Avenue and Kennedy Street
  - Ellice Avenue and Kennedy Street CS invert into 250 mm CS - 228.54 m (S-MH20016689)
- A 369 mm CS pipe flows southbound by gravity from Colony to Bannatyne district at Ellice Avenue and Kennedy Street
  - Ellice Avenue and Kennedy Street CS invert into 369 mm CS – 228.48 m (S-MH70003125)
- A 450 mm CS pipe flows eastbound by gravity along Portage Avenue that flows out of Colony CS into Bannatyne CS system.
  - Portage Avenue and Smith Street CS invert CS outfall - 227.94 m (S-MA20015831)

Cornish

CS to CS

- A 300 mm high point CS manhole (flow is directed into both districts from this manhole):
  - Toronto Street – 229.72 m (S-MA20017892)
- A 450 mm CS pipe high level overflow that flows by gravity from Cornish into Colony CS system.
  - Honeyman Avenue and Canora Street CS overflow invert – 225.63 m (S-MA20015466)

CS to SRS

- A 1245 mm SRS overflow pipe diverts flow from Cornish district CS system at Toronto Street and St. Matthews Avenue and flows by gravity eastbound into the Colony SRS system.
  - St. Matthews Avenue and Toronto Street SRS invert - 226.55 m (S-MA20015548)
- A 200 mm SRS overflow pipe diverts flow from Cornish district CS system at Toronto Street and St. Matthews Avenue and flows by gravity westbound and then southbound into the Colony SRS system.
  - St. Matthews Avenue and Toronto Street SRS invert - 226.68 m (S-MA20023073)

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

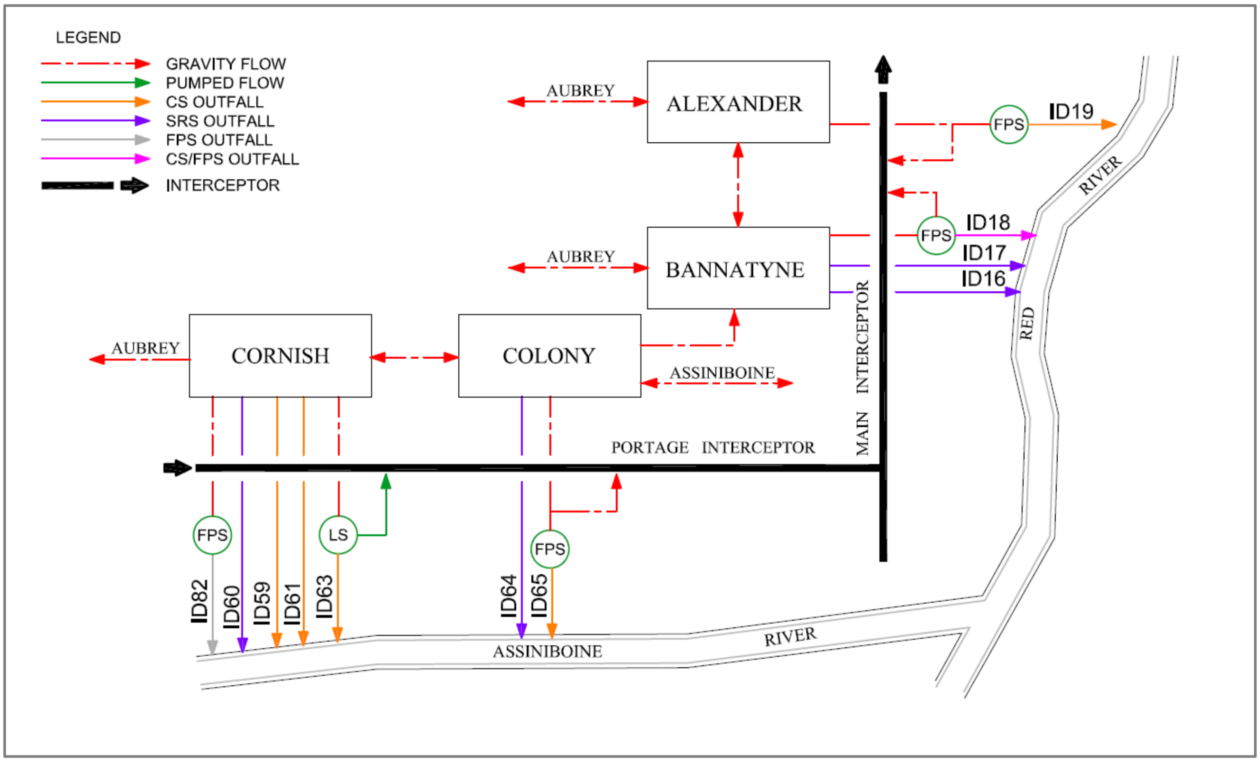


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 10 and are 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 (ID65)	S-AC70016494.1	S-MA20014505	1800 mm	Circular
Flood Pumping Outfall (ID65)	S-AC70016494.1	S-MA20014505	1800 mm	Circular
Other Overflows (ID#)	N/A	N/A	N/A	
Main Trunk	S-MH20013353.1	S-MA20014788	1350 x 1800 mm	Egg-shaped
SRS Outfalls (ID64)	S-CG00001168 DS.1	S-MA70103641	2750 mm	Spence Street
SRS Interconnections	N/A	N/A	N/A	61
Main Trunk Flap Gate	S-TE70018683.1	S-CG00001169	1520 mm	Invert: 223.51 m
Main Trunk Sluice Gate	COLONY_GC.1	S-CG00001041	750 x 1000 mm	Invert: 223.21 m
Off-Take	COLONY_WEIR.1	S-MA20014797	680 mm	No Pumping Station
Dry Well	N/A	N/A	N/A	No Pumping Station
Lift Station Total Capacity	N/A	S-MA20014797 [(1)]	680 mm [(1)]	1.716 m^3/s [(1)] (D/s pipe pff 0.281 m^3/s)
Lift Station ADWF	N/A	N/A	0.107 m^3/s	2.75 x ADWF – 0.193 m^3/s
Lift Station Force main	N/A	N/A	N/A	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Flood Pump Station Total Capacity	N/A	N/A	2.34 m^3/s	1 x 1.32 m^3/s 1 x 1.02 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.400 m^3/s	

Notes:

(1) – Gravity pipe replacing Lift Station as Colony is a gravity discharge district

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	District – 223.84
2	Trunk Invert at Off-Take	224.73
3	Top of Weir	225.76
4	SRS Outfall Invert at Flap Gate (Upstream of First Gate Chamber)	221.58
5	Low SRS Relief Interconnection (S-MH70007916)	226.12
6	Sewer District Interconnection (Interceptor Inverts at Colony District Boundary)	Assiniboine –223.15 Cornish (Furby Street and Cornish Avenue) – 224.70 Cornish (Wolseley Avenue and Maryland Street) – 225.80
7	Low Basement	228.60
8	Flood Protection Level	229.98

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

The Colony district has most recently undergone storm relief sewer work in 1998. This work included implementing a 5-year basement flood relief design level by disconnecting street inlets from the CS pipes and connecting them to the SRS pipes to regain capacity in the CS system. The inlet redirections, plus outfall improvements to increase the outfall capacity, are the most recent upgrades made to the district sewer system. A more detailed description can be found in the Colony 1998 report prepared by Dillon Consulting Limited and Sprenger & Associates Inc. (Sprenger/Dillon, 1998).

In 2011, the City installed an off-line underground storage facility at the University of Winnipeg between Young and Langside Streets beneath the Richardson Green Corridor as a pilot study for future CSO projects. The storage system consists of a series of manholes with sluice gates that operate to direct storm water runoff into four 1500 mm diameter high-density polyethylene pipes. The total length of the pipes is approximately 240 m, which amounts to a storage volume of approximately 420 m^3. Water from the storage facility is released back into a 300 mm diameter CS, which then connects back into the sewer system.

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 Colony 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.

No further relief projects are planned for the district. Table 1-3 provides a summary of the district status in terms of data capture and study.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
10 - Colony	1998	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Colony district. This consists of monthly site visits in confined entry spaces to verify 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 Colony sewer district are listed in Table 1-4. The proposed CSO control projects will include latent storage, gravity flow control, control gate, in-line storage and floatable management. 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 and SRS systems are suitable for use as in-line and latent storage. These control options will take advantage of the existing CS and SRS pipe networks for additional storage volume. Existing

DWF from the collection system would remain the same, and overall district operations would remain the same, although additional WWF will be collected from the SRS and transferred to the existing CS system and forwarded to the NEWPCC for treatment.

A gravity flow controller is proposed on the CS system to monitor and confirm the dewatering rate from the district back into the Main Street interceptor.

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 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 capture level.

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

Latent storage is proposed as a control option for Colony district. 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 1-5. The storage volumes indicated in Table 1-5 are based on the NSWL river conditions.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	221.58 m	
NSWL	223.84 m	
Trunk Diameter	2550 mm	
Design Depth in Trunk	2253 mm	
Maximum Storage Volume	4,380 m^3	
Force main	150 mm	
Flap Gate Control	N/A	
Pump Station	Yes	
Nominal Dewatering Rate	0.045 m^3/s	Based on 24 hour emptying requirement
RTC Operational Rate	TBD	Future RTC/ dewatering assessment

Notes:

RTC = real time control

NSWL = normal summer water level

The addition of a pump and force main that connects back to the CS system will be required for latent storage. A conceptual layout for the latent storage pump station (LSPS) and force main is shown on Figure 10-02. The LSPS will be located adjacent to the existing gate chamber on Spence Street to avoid interference with nearby residential lands and disruption to existing sewers. The latent force main will pump north to the nearby 300 mm CS sewer and into the manhole (S-MH20013095) south of the intersection of Balmoral Street and Scotia Street. The pump station 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 LSPS would connect to the SRS outfall chamber and discharge back to the CS system once capacity allows. Figure 10 identifies the extent of the SRS system within Colony district that would be used for latent storage. The maximum storage level is directly related to the NSWL and the size and depth of the SRS system. Once the level in the SRS exceeds the NSWL river level, the flap gate opens, and the combined sewage is discharged to the river.

The river level will keep the SRS flap gate closed and system level maintained at the NSWL for the representative year assessment. This level utilizes 88 percent of the SRS pipe height and, therefore, additional flap gate control was not recommended as part of the 85 percent capture target assessment. The lowest interconnection between the combined sewer and relief pipe is higher than the proposed latent and in-line storage control levels, meaning that the two systems would function independently.

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 existing gate chamber and the pump station would be sized to provide sufficient flow to the pumps while all pumps are operating.

1.6.3 In-line Storage

In-line storage has been proposed as a CSO control for Colony 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 and provide additional hydraulic head for screening operations.

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 1-6.

Table 1-6. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	224.52 m	
Trunk Diameter	1350 x 1800 mm	
Gate Height	0.75 m	Gate height based on half trunk diameter assumption (flood assessment included)
Top of Gate Elevation	225.86 m	
Bypass Weir Level	225.76 m	
Maximum Storage Volume	284 m^3	
Nominal Dewatering Rate	0.40 m^3/s	Minimum pass forward rate for gravity discharge district
RTC Operational Rate	TBD	Future RTC/dewatering review on assessment

Note:
RTC = Real Time Control

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 10. 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 bypass side weir and adjacent control level gate 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 flows 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 existing gravity pipe pass forward flow will continue its current operation while the control gate is in either position, with all DWF being diverted to the existing gravity pipe.

Figure 10-01 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 FPS. The dimensions of the chamber will be 5.0 m in length and 2.5 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. The existing sewer configuration may have to be modified to accommodate the new chamber. This will be confirmed in future design assessments.

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 FPS rehabilitation or replacement project.

The nominal rate for dewatering is already set at the existing pipe capacity as the district is a gravity discharge district. Any future considerations, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflows at this district. This future RTC control will provide the ability to capture and treat more volume for localized storms in other districts by using the excess interceptor capacity made available by restricting the pass forward flows through the control device where the runoff is less.

1.6.4 Gravity Flow Control

Colony district does not include a LS and discharges to the Portage Interceptor by gravity. A flow control device will be required to control the diversion rate for future RTC and dewatering. The controller will include flow measurement and a gate to control the discharge flow rate. A standard flow control device was selected as described in Part 3C.

The flow control would be installed at an optimal location on the connecting sewer between the proposed in-line control and existing diversion chamber. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction.

A gravity flow controller has been included as a consideration in developing a fully optimized CS system as part of the City's long-term objective. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

1.6.5 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 1-7.

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	225.86 m	
Bypass Weir Crest	225.76 m	
Normal Summer River Level	223.84 m	
Maximum Screen Head	1.92 m	

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Peak Screening Rate	0.82 m^3/s	
Screen Size	1.5 m x 1.0 m	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 10-01. The screens will operate with the control gate in its 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 system for routing to the NEWPCC for removal.

The dimensions for the screen chamber to accommodate influent from the side weir, the screen area, and the routing of the discharge piping downstream of the gate are 3.2 m in length and 3.1 m in width. The existing sewer configuration may have to be modified to accommodate the new chamber.

1.6.6 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 applicable GI controls.

Colony has been classified as a medium GI potential district. Land use in Colony is mix of residential, commercial, and institutional, the south end of the district is bounded by the Assiniboine River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

1.6.7 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.

The flow controller will require the installation of a chamber and flow control equipment. Monitoring and control instrumentation will be required. The flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required.

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.

The latent storage would take advantage of the SRS infrastructure already in place, therefore, minimal additional maintenance will need to be anticipated. The proposed latent LSPS will require regular maintenance that would depend on the frequency of operation. The flap control gate will require maintenance inspection for continued assurance that the flap gate would open during WWF events.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-8.

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	230	230	15,636	52	N/A
2037 Master Plan – Control Option 1	230	230	15,636	52	IS, Lat St, SC

Notes:

Total area is based on the model subcatchment boundaries for the district.

IS = In-line Storage
Lat St = Latent 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 1-9 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 1-9. 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 [a]
Baseline (2013)	89,783	163,833	-	20	0.347 m^3/s
Latent Storage	-[b]	126,058	37,775	20	0.354 m^3/s
In-Line Storage	82,693	108,985	54,848	20	0.354 m^3/s
Latent & In-line & Offline Storage	14,196 [c]	N/A	N/A	N/A	N/A
Control Option 1	**14,196**	**108,985**	**54,848**	**20**	**0.354 m^3/s**

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

[b] Latent Storage, In-Line Storage and Off-line Storage Tank solutions not modelled as single options for the Preliminary Proposal assessment. Each was modelled together and it's impact assessed.

[c] Preliminary Proposal included offline storage tank within this district to achieve the 85 percent capture target in the Master Plan re-assessment

The CSO Master Plan assessment did not require the selection of an off-line tank to achieve the 85 percent capture target in the representation year. As part of the refinements during the CSO Master Plan assessment, it was found that the cumulative 85 percent target was achieved prior to needing the benefits provided by the off-line tank. As the off-line tank is considered the highest marginal cost solution in comparison to the in-line and latent storage options recommended, it was removed from the recommendations for this district. Note however that the inclusion of off-line storage has been considered as one of the recommendations to meet future performance targets; see Section 1.10 below.

The percent capture performance measure is not included in Table 1-9, 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 1-10. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-10. Cost Estimate – 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 (Over 35-year period)
Latent Storage	$1,680,000	$2,340,000	$76,000	$1,640,000
In-Line Storage	$7,740,000 [a]	$2,360,000 [c]	$44,000	$940,000
Screens		$2,790,000 [d]	$54,000	$1,170,000
Gravity Flow Control	N/A [b]	$1,280,000	$34,000	$740,000

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance (Over 35-year period)
Off-line Storage Tank	$8,950,000	N/A [e]	N/A [e]	N/A [e]
Subtotal	**$18,360,000**	**$8,770,000**	$209,000	**$4,490,000**
Opportunities	N/A	$880,000	$21,000	$450,000
District Total	**$18,360,000**	**$9,650,000**	**$230,000**	**$4,940,000**

[a] In-Line storage and screening costs not separated during the Preliminary Proposal

[b] Gravity Flow Control not included in the Preliminary Proposal

[c] Cost associated with new off-take construction, as required, to accommodate control gate location and allow intercepted CS flow to reach the Portage Interceptor not included.

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

[e] Offline storage tank found to not be required to meet 85 Percent Capture target and was removed during Master Plan assessment.

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 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 alternative plans, 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 1-11.

Table 1-11. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	In-line Storage	Unit cost updates Separation of screening and in-line	In-line and Screening included as combined cost in Preliminary Proposal

Table 1-11. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
	Screening	Unit cost updates Separation of screening and in-line	In-line and Screening included as combined cost in Preliminary Proposal
	Gravity Flow Control(	A flow controller was not included in the preliminary estimate	Added for the Master Plan to further reduce overflows and control in-line
	Removal of Off-line Storage	Not included in the Master Plan	Removed through marginal analysis
	Latent Storage	Unit cost updates	
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 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 1-12 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 Colony district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. Opportunistic sewer separation within portions of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume.

Table 1-12. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Opportunistic Separation • Off-Line Storage (Tank/Tunnel) • Increased GI

The control options for the Colony district has been aligned for the 85 percent capture performance target based on the system wide assessment. The expandability of the district to the future 98 percent capture target will be restricted depending on the interaction of the system wide performance.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-13Table 1-13.

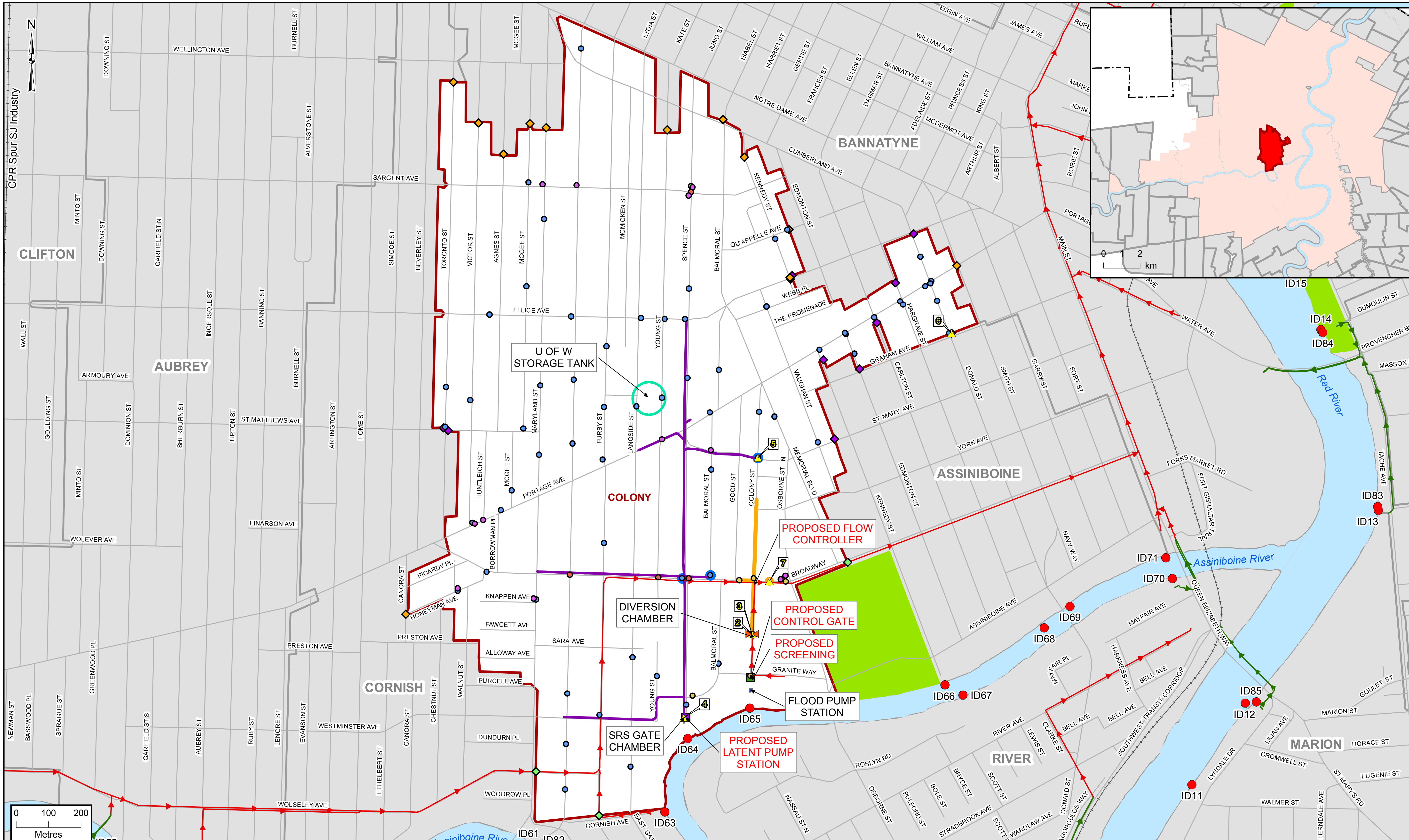
Table 1-13. Control Option 1 Significant Risks and Opportunities

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
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

Sprenger & Associates Inc. and Dillon Consulting Limited (Sprenger/Dillon). 1998. *Independent Review of the Colony Combined Sewer Relief Report.* Prepared for the City of Winnipeg, Water and Waste Department. September.



LEGEND

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

District Boundary Crossing
- CS
- SRS
- WWS

Inter-System Connection
- CS - LDS
- CS - WWS
- SRS - CS
- SRS - LDS
- SRS - 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
- 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 10
District Overview Map
Sewer District: Colony
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\COLONY\COLONY_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 7:56:29 AM

LEGEND

- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate
- Pump Location

Sewer By Type
- CS
- LDS
- SRS
- WWS

Pump Station Type
- Flood Pump Station

- Land Parcel

CSO MASTER PLAN
PROPOSED SOLUTIONS
- Control Gate
- Screening

ALL PROPOSED SOLUTIONS
SHOWN IN RED TEXT

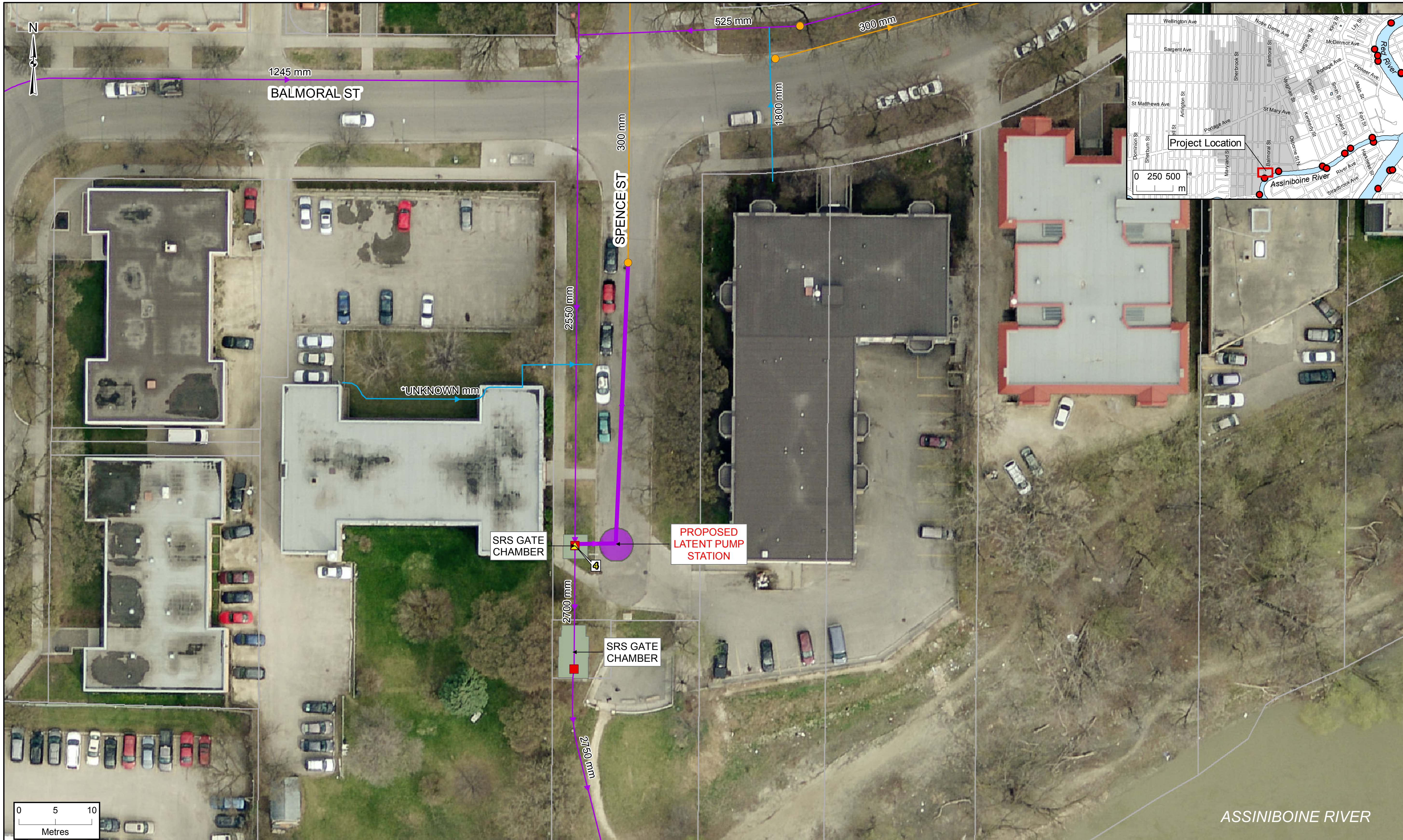
JACOBS

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

Winnipeg
THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 10-01
Control Gate and Screening
Sewer District: Colony
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\COLONY\COLONY_DISTRICT_DETAIL_COLONYST.MXD SBEGG1 6/24/2019 7:24:44 AM



LEGEND

- Critical Elevation
- Manhole
- Sluice Gate

Sewer By Type
- CS
- LDS
- SRS

Land Parcel

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 10-02
Latent SRS Control
Sewer District: Colony
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\COLONY\COLONY_DISTRICT_DETAIL_SPENCEST.MXD SBEGG1 6/24/2019 7:24:14 AM

LEGEND

- Critical Elevation
- Manhole
- Sewer By Type
  - CS
  - LDS
  - SRS
  - WWS
- Land Parcel

CSO MASTER PLAN PROPOSED SOLUTIONS

- Flow Controller

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 10-03
Gravity Flow Control
Sewer District: Colony
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\COLONY\COLONY_DISTRICT_DETAIL_FLOWCONTROLLER.MXD SBEGG1 6/24/2019 7:24:31 AM

CSO Master Plan

Cornish District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No: 470010CH
Document Title: Cornish District Plan
Revision: 03
Date: August 18, 2019
Client Name: City of Winnipeg
Project Manager: John Berry
Author: Danny Tinker
File Name: Cornish_Plan_Final_CO1MP_08182019

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	08/30/2018	Version 1 DRAFT	DT	SB / MF / SG	
1	02/15/2019	DRAFT 2 for City Review	SB / MF	SG	MF
2	06/2019	Final Draft Submission	DT	MF	MF
3	08/18/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Cornish District

1.1 District Description

Cornish district is located in the central portion of the combined sewer (CS) area along the northern edge of the Assiniboine River. Cornish is bounded by Toronto and Maryland Streets to the east; Lenore, Burnell, Arlington, and Simcoe Streets to the west; Notre Dame Avenue to the north; and the Assiniboine River to the south.

Land use within Cornish district includes a mix of commercial and residential, with the majority being two-family residential. Commercial property is located along the major roadways including Portage Avenue, Notre Dame Avenue, Ellice Avenue, Sargent Avenue, and Arlington Street, which are also the regional transportation routes within the district. There is approximately 18 ha of greenspace in the district. Greenspace is limited due to the high makeup of multi-family and commercial land use. Vimy Ridge Park, located on Portage Avenue, is the only significant greenspace within the district.

1.2 Development

A portion of Portage Avenue is located within the Cornish District. Portage Avenue is identified as Regional Mixed Use Corridor as part of the Our Winnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

Cornish district has an approximate area of 141 ha[1] based on the GIS district boundary information and includes CS and storm relief sewer (SRS) systems. This district does not include any areas that may be identified as separated or separation-ready. The CS system drains toward the Cornish outfall, located at the eastern end of Cornish Street where combined sewage is pumped to the Main Interceptor along Wolseley Avenue.

The CS system includes a flood pump station (FPS), CS lift station (LS), one CS primary outfall, two CS secondary outfalls, one SRS outfall and one FPS outfall. All domestic wastewater and CS flow collected in Cornish district is routed to the east end of Cornish Avenue, where the CS LS and primary CS outfall (Cornish East CS Outfall) are located.

There is a single main CS trunk sewer that collects the flow from the district. This main CS trunk changes in shape and size several times before reaching the Assiniboine River. North of Portage Avenue is serviced by a 300 mm to 750 mm CS along Simcoe Street that flows southbound from Notre Dame Avenue to Portage Avenue. From Portage Avenue, the trunk runs south on Canora Street, Walnut Street, and Maryland Street to eventually reach Cornish Avenue. The trunk sewer previously along Simcoe Street turns into a 1200 mm by 1550 mm egg-shaped CS on Canora Street and continues south, then east on Preston Avenue. The areas south of Preston Avenue are serviced by a series of laterals that collect combined sewage from the residential areas and connect to the CS collector on Westminster Avenue, which eventually connects to a 900 mm CS collector located in the southern section of Walnut at Purcell Avenue that connects to the trunk sewer for the district. Collected sewage eventually flows into a 1500 mm sewer trunk that connects into the Cornish Avenue gate chamber and CS LS at the eastern end of Cornish Avenue, as part of the primary CS outfall.

A flap gate and sluice gate are located in the Cornish east outfall pipe to prevent river water from backing up into the CS system during high river levels along the Assiniboine River. The FPS is located at the western end of Cornish Avenue upstream from the CS LS. The FPS has a separate outfall directly to the

[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.

Assiniboine River located near the Maryland bridge, and allows the CS system to discharge to the river when the flap gate remains closed during these high river level conditions. When the river level is high and gravity discharge is not possible, the excess flow is pumped by the Cornish FPS to the dedicated FPS outfall allowing gravity discharge to the river. There is no flap or sluice gate installed on the dedicated FPS outfall.

During wet weather flow (WWF) events, the SRS system provides relief to the CS system in Cornish district. The SRS system extends throughout the district and has multiple interconnections with the CS system. The SRS system in Cornish also receives SRS flow from parts of the neighboring Aubrey, Colony and Bannatyne districts. Most catch basins are still connected to the CS system in Cornish, so no partial separation has been completed. There is a main SRS trunk within the Cornish district which runs along Simcoe Street north of Portage Avenue, and then Canora Street south of Portage Avenue. The SRS system within this Simcoe/Canora trunk discharges directly to the Assiniboine River by gravity through the SRS outfall at the southern end of Canora Street. A sluice gate is located on this outfall pipe to prevent river water from backing up into the SRS system during high river levels along the Assiniboine River.

During dry weather flow (DWF), the SRS system is not required; sanitary sewage flow is diverted by the primary weir at the Cornish outfall, and is intercepted through the 450 mm off-take to the Cornish SPS, where it is pumped to the interceptor pipe along Wolseley Avenue and eventually reaches to the North End Sewage Treatment Plant (NEWPCC) for treatment. During wet weather flow (WWF), any flow that exceeds the diversion capacity overtops the primary weir and is discharged to the river through the Cornish East outfall.

There are also two secondary CS outfalls within the Cornish district, which provide relieve to the CS in the district under wet weather flow events and allow direct discharge to the Assiniboine River at different points, relieving the system and reducing the possibility of localized basement flooding. The Arlington CS secondary outfall is located at Palmerston and Arlington: when the capacity of the sewer laterals along Palmerston Ave and Arlington Street are exceeded, the outfall will overflow to the Assiniboine River. The Cornish West secondary outfall is located adjacent to the Maryland Bridge, near the Cornish FPS outfall. If the WWF exceeds the capacity of the Cornish East Primary CS outfall, then the Cornish West weir will overflow to the Assiniboine River. Sluice gate protection is provided on the Arlington secondary outfall, and both sluice and flap gate protection is provided on the Cornish West secondary outfall, to restrict back-up from the Assiniboine River into the CS system under high river level conditions along the Assiniboine River.

In total, there are five outfalls to the Assiniboine River (three CSs, one SRS, and one FPS) as follows:

- ID63 (S-MA70033535) – Cornish East Primary CS Outfall
- ID83 (S-MA70017433) – Cornish FPS Outfall
- ID61 (S-MA20013630) – Cornish West Secondary CS Outfall
- ID59 (S-MA70053466) – Arlington Secondary CS Outfall
- ID60 (S-MA70017866) – Canora SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between the Cornish district and the surrounding districts. Each interconnection is shown on Figure 11 and shows locations where gravity and pumped flow can cross from one district to another. The known district-to-district interconnections are identified as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Colony

- A 450 mm carries intercepted CS flows from the Cornish district into the Colony district and to the NEWPCC for treatment.
  - Furby Street and Cornish Avenue interceptor invert - 225.48 m (S-TE20012409)
- A 1500 mm interceptor flows by gravity through the Cornish district into the Colony district and on to the NEWPCC for treatment. This interceptor carries intercepted CS from the districts upstream of the Cornish district, and does not interact with the Cornish CS system.
  - Wolseley Avenue and Maryland Street Interceptor invert - 225.46 m (S-TE20012409)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Aubrey

- Two 1200mm interceptor gravity sewers discharge into the Cornish district from the Aubrey district and carries sewage to the NEWPCC for treatment:
  - Wolseley Avenue – 226.20 m (S-MH20012549)
  - Wolseley Avenue – 226.04 m (S-TE20004698)

1.3.1.3 District Interconnections

Aubrey

CS to CS

- High Point Manhole (flow can be directed into both districts from this manhole):
  - Portage Avenue – 229.09 m (S-MH20013779)

CS to SRS

- A 600 mm SRS diverts from the CS flowing southbound on Home Street into Cornish district on Wellington Avenue:
  - Wellington Avenue – 226.59 m (S-MA20018010)

Bannatyne

CS to CS

- A 375 mm CS flows by gravity northbound on Toronto Street and connects to the CS system in Bannatyne district:
  - Toronto Street – 229.12 m (S-MH20016131)
- A 450 mm CS acts as an overflow pipe from the Bannatyne district to the Cornish district:
  - Wellington Avenue and Toronto Street – 229.76 m (S-MH70028187)

SRS to SRS

- A 1200 mm SRS flows by gravity into Cornish district from Bannatyne district on Wellington Avenue:
  - Wellington Avenue and Toronto Street – 226.54 m (S-MA20018024)

Colony

CS to CS

- High Point Manhole (flow can be directed into both districts from this manhole):
  - Toronto Street – 229.72 m (S-MH20016007)
- A 450 mm CS sewer acts as an overflow pipe from the Cornish CS system into the Colony CS system.
  - Honeymoon Avenue – 228.61 m (S-MH20013931)

SRS to SRS

- Two connections that flow via gravity at the intersection of St. Matthews Avenue and Toronto Street:
  - St. Matthews Avenue SRS invert at district boundary that flows from Cornish into Colony district into SRS outfall on Spence Street = 226.31 m (S-MA20015548)
  - Toronto Street SRS invert at district boundary that flows from Cornish into Colony district into SRS outfall on Spence Street = 226.68 m (S-MA70023075)

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

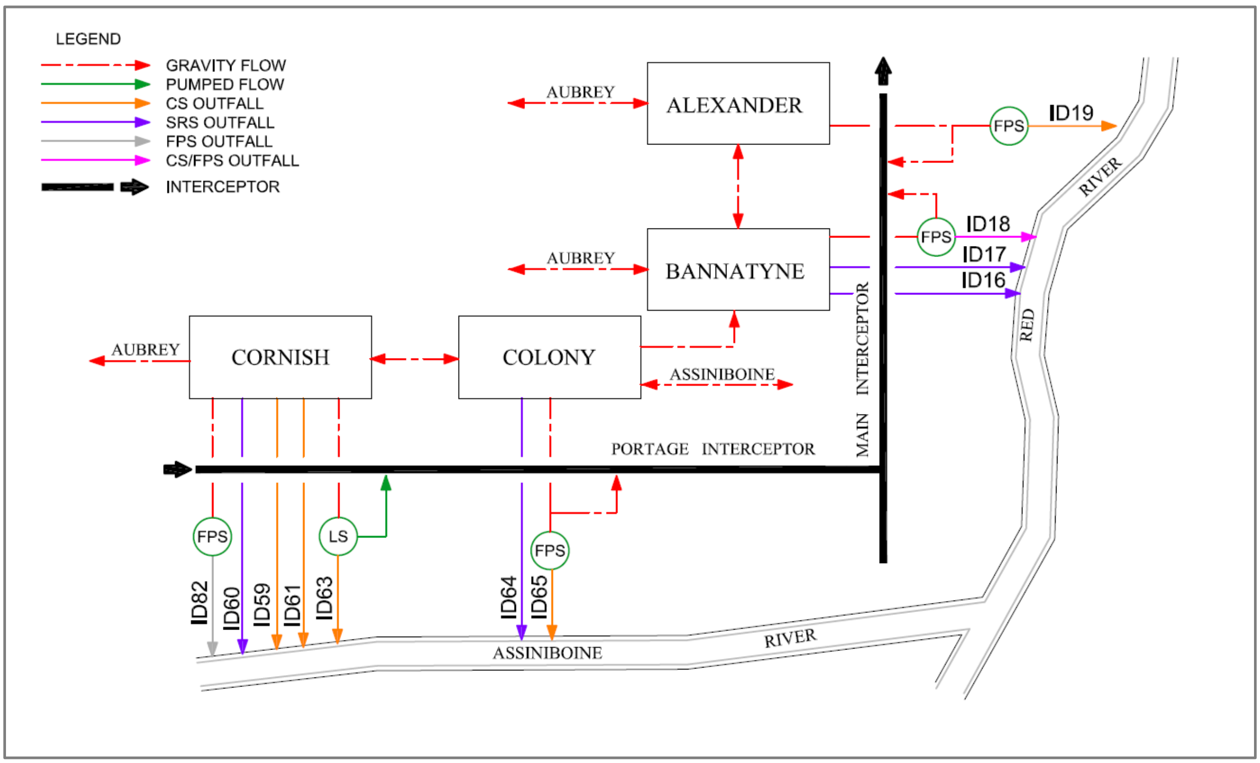


Figure 1-1**. District Interconnection Schematic**

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 11 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 (ID63)	S-MH70011815.1	S-MA70033535	1600 x 1450 mm	Assiniboine River Invert: 223.3 m
Flood Pumping Outfall (ID83)	S-AC70008049.1	S-MA70017433	1670 mm	Assiniboine River Invert: 223.29 m
Other Overflows (ID59 & ID61)	S-MH20012348.1 S-RE70014978.1	S-MA20013630 S-MA70053466	750 mm 400 mm	Invert: 223.38 m Invert: 224.20 m
Main Trunk	S-RE70008047.1	S-MA70017431	1450 mm	Circular Invert: 223.8 m
SRS Outfalls (ID60)	S-CO70008272.1	S-MA70017866	1980 mm	Invert: 222.1 m
SRS Interconnections	N/A	N/A	N/A	35 SRS - CS
Main Trunk Flap Gate	CORNISH_EAST_GC.1	S-CG00000755	1375 mm	Invert: 224 m
Main Trunk Sluice Gate	S-MH70011814.2	S-CG00001131	1500 x 1500 mm	Invert: 223.61 m
Off-Take	S-MH20012427.2	S-MA70017421	450 mm	Circular Invert: 223.84 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.148 m^3/s	1 x 0.059 m^3/s 1 x 0.089 m^3/s
Lift Station ADWF	N/A	N/A	0.059 m^3/s	
Lift Station Force Main	S-MH20012408.1	S-MA20013697	200 mm	Invert: 226.17 m
Flood Pump Station Total Capacity	N/A	N/A	1.87 m^3/s	1 x 0.72 m^3/s 1 x 0.29 m^3/s 1 x 0.86 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.151 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	Cornish East – 223.84 Cornish West – 223.84 Arlington – 223.85 Canora – 223.85
2	Trunk Invert at Off-Take	223.84
3	Top of Weir	224.44
4	Relief Outfall Invert at Flap Gate	Canora SRS Outfall – 221.18
5	Low Relief Interconnection (S-MH20013588)	225.88
6	Sewer District Interconnection (Colony)	226.55

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
7	Low Basement	228.60
8	Flood Protection Level	230.04

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

The most recent study completed in Cornish was the 1986 Basement Flood Relief study (Girling, 1986). No other work has been completed to evaluate the district sewer system since that time. Table 1-3 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 Cornish CS 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	Planned Completion
11 – Cornish	1986	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Cornish 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.

Future upgrades to the Outfall Gate Structure for the Canora SRS outfall are anticipated to take place in the next five to ten years. This work will include the addition of a flap gate to the Canora SRS outfall. Additional work including the installation of the necessary pumps to begin to implement the latent storage control solution recommended in this district plan may also be packaged with this flap gate installation work. This work is to be prioritized along with the other SRS outfalls requiring gate structure upgrade work.

1.6 Control Option 1 Projects

1.6.1 Project Selection

The proposed projects selected for the Cornish district to meet Control Option 1 – 85 Percent Capture in a Representative Year are listed in Table 1-4. The proposed CSO control options will include in-line storage via control gate, latent storage, and floatables 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% Capture in a Representative Year	✓	-	-	✓	✓	-	-	-	✓	✓	✓

Notes:

- = not included
✓ = included

The existing CS system is suitable for use as latent storage. These control options will take advantage of the existing CS pipe network for additional storage volume. Existing DWF from the collection system will remain the same, and overall district operations will remain the same.

The primary CS overflow for the district is to be screened under the current CSO control plan to address the floatables management requirements. The installation of a control gate at the primary CS outfall will be required for the screen operation in the Cornish district. This control gate installation will also be providing the mechanism for capture of minor additional in-line storage. It should be noted however that in-line storage for the Cornish district is not a cost effective solution specifically for additional volume capture. The control gate installation is recommended primarily to provide the necessary hydraulic head for screen operations. Should screening no longer be required in the Cornish district to address the floatables management requirements, it is recommended that alternative measures such as off-line storage be investigated in the Cornish district to provide the additional volume capture in a more cost effective manner.

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 additionally it will provide the mechanism for capture of the in-line station. 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

Latent storage is a suitable control option for the Cornish district. There is one SRS system and SRS outfall that will provide additional storage volume. The latent storage level is controlled by river level and resulting backpressure of the river level on the proposed Canora SRS outfall flap gate, as explained in Part 3C. The storage volumes indicated in the design criteria table below is based on the river level condition of NSWL (normal summer water level) during the 1992 representative year at the outfall location.

Latent storage is accessible and has a lower risk than other storage types. A latent pump station, flap gate, and interconnecting pipes will be required to access the storage. The latent storage design criteria are identified in Table 1-5. The storage volumes indicated in design criteria table below are based on the NSWL river conditions.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	Canora – 222.18 m	Existing Sluice Gate invert.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
NSWL	223.85 m	
Trunk Diameter	1975 mm	
Design Depth in Trunk	1667 mm	
Maximum Storage Volume	1471 m3	
Force Main	125 mm	
Flap Gate Control	N/A	
Lift Station	Yes	
Nominal Dewatering Rate	0.025 m^3/s	Based on 24 hour emptying requirement
RTC Operational Rate	TBD	Future RTC/dewatering assessment

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

The addition of a latent storage pump station (LSPS) and force main that connect to the CS system are necessary for the latent storage to be dewatered. A conceptual layout for the LSPS and force main is shown on Figure 11-02 for the Canora SRS outfall. The LSPS will be located to the northwest of the SRS outfall chamber to avoid interference with nearby private residential lands. It is expected that the structure (large manhole chamber) will be situated within the street and provide minor disruption to the street and adjacent streets will provide alternative access. The latent force main will be routed north on Palmerston Avenue and connect to the Cornish CS system at the manhole on Wolseley Avenue and Canora Street. 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.

As described in Section 1.5 above, much of this latent storage work may be pursued in conjunction with the critical flap gate installation work. This work is prioritized to occur within the Canora SRS outfall within the next five to ten years.

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 he river level regularly drops below the SRS flap gate elevation. The SRS flap gate control is described in the standard details in Part 3C.

1.6.3 In-Line Storage

In-line storage has been proposed as a CSO control for the Cornish district. The in-line storage will require the installation of a control gate at the CS outfall. The gate will primarily be used to provide additional hydraulic head for screening operations. The gate will also provide a secondary benefit in increasing the storage level in the existing CS to provide an overall higher volume capture, which is evaluated in further detail in this section. It is noted that the existing Cornish West secondary outfall will need to be monitored as any increases to the primary weir may adversely affect the performance at Cornish West secondary outfall. Assessment modelling did not indicate that additional overflows occur at the secondary outfall after implementation of the in-line storage arrangements described below.

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 1-6.

Table 1-6. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	223.80 m	Downstream invert of pipe at weir
Trunk Diameter	1450 mm	
Gate Height	0.72 m	Gate height based on half truck diameter assumption
Top of Gate Elevation	224.63 m	
Bypass Weir Height	226.53 m	
Maximum Storage Volume	202 m^3	
Nominal Dewatering Rate	0.148 m^3/s	Based on existing CS LS pump rate
RTC Operational Rate	TBD	Future RTC/dewatering rate assessment to be completed

The proposed control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 11. 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 is determined in relation to the critical performance level 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 or to this critical performance level within the system 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 spill over the weir and discharge to the river. After the sewer levels in the system drops back below this 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 position, with all DWF being diverted to the CS LS and pumped to the Main Interceptor on Furby Street. The CS LS will further dewater the in-line storage provided during a WWF event as downstream capacity becomes available after the WWF event.

Figure 11-01 provides an overview of the conceptual location and configuration of the proposed control gate and screening chambers. The proposed control gate will be installed in a new chamber within the trunk sewer alignment and be located west of the Cornish outfall gate chamber. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5 m in length and 3.5 m in width. The existing sewer configuration including the construction of an additional off-take, and force main modifications may have to be completed accommodate the new control gate chamber. This will be confirmed in future design assessments.

The inline storage level increase as a result of the control gate construction has been evaluated and does not affect the performance of the upstream Cornish West CS outfall. The in-line storage allows the smaller rainfall events to be collected downstream at the Cornish East CS outfall. It is however still recommended that the impact on the secondary CS outfall at Cornish West be evaluated further during preliminary design.

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 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. Future RTC / dewatering assessment will be necessary to define additional rates. This would provide some flexibility in the ability to increase the dewatering rate for spatial rainfall events. This would dewater the district more quickly, to capture and treat more volume for these localized storms by using the excess interceptor capacity where the runoff is less.

1.6.4 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. If outfall screening is required, 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 1-7.

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.63 m	
Bypass Weir Crest	224.53 m	
NSWL	223.85 m	
Maximum Screen Head	0.65 m	
Peak Screening Rate	0.53 m^3/s	
Screen Size	1.5 m x 1 m	Modelled Screen Size

The proposed side bypass overflow weir and screening chamber will be located adjacent to the existing combined trunk sewer, as shown on Figure 11-01. The screens will operate once levels within the sewer surpassed the bypass weir elevation. A side bypass weir upstream of the gate will direct the initial 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 the interceptor and on to the NEWPCC for removal.

The dimensions for the screen chamber to accommodate influent from the side bypass weir, the screen area, and the routing of discharge downstream of the gate are 5.5 m in length and 2.5 m in width. The existing sewer configuration will have to be modified to accommodate the new chamber to continue to allow the DWF to discharge to the CS LS. The chamber has been initially located within City-owned land available as part of Cornish Avenue.

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.

Cornish has been classified as a medium GI potential district. Land use in Cornish is a mix of residential, commercial, and institutional, the south end of the district is bounded by the Assiniboine River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

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 Section 3C. Periodic maintenance of the gate and screens would be required, depending on the type of gate and screening selected.

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 Cornish 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.

The latent storage would take advantage of the SRS infrastructure already in place, therefore, minimal additional maintenance will need to be anticipated. The proposed latent LSPS will require regular maintenance that would depend on the frequency of operation. The flap control gate will require maintenance inspection for continued assurance that the flap gate would open during WWF events.

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 1-8.

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added to Model
2013 Baseline	135	133	7,288	58	N/A
2037 Master Plan – Control Option 1	135	132	7,288	58	IS, Lat St, SC

Notes:

IS = In-line Storage
SC = Screening
Lat St = Latent Storage

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added to Model

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 in Table 1-9 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 number represent the comparison between the existing system and the proposed control options. Table 1-9 also includes overflow volumes specific to each individual control: these are listed to provide an indication of benefit gained only and are independent volume reductions.

Table 1-9. Performance Summary – Control Option 1

Control Option	Preliminary Proposal Annual Overflow Volume (m^3)	Master Plan Overflow Reduction (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [b]
Baseline (2013)	85,517	60,293	-	19	0.272 m^3/s
Latent Storage	85,372 [a]	-[c]	-[c]	-[c]	-[c]
Latent & In-line Storage		-[c]	-[c]	-[c]	-[c]
Control Option 1	**85,372**	**-[c]**	**-[c]**	**-[c]**	**-[c]**

[a] Latent 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

[c] Model instability issues encountered within the Cornish district as part of the Master Plan performance evaluation for overall City of Winnipeg sewer network. The individual district performance values were instead utilized for the control option performance evaluation, and are shown below:

Table 1-10. Master Plan Performance Summary – Control Option 1 (Individual Model)

Control Option	Master Plan Overflow Reduction (m^3)	Master Plan Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [a]
Revised Baseline (2013)	64,659	-	20	0.180 m^3/s
Latent Storage	64,122	547	20	0.181 m^3/s
Latent & In-line Storage	63,724	398	20	0.068 m^3/s
Control Option 1	**63,724**	**931**	**20**	**0.068 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 1-9 and Table 1-10, as it is applicable to the entire CS system and not for each individual district.

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 1-11. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-11. Cost Estimate – 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 (Over 35-year Period)
Latent Storage	$1,580,000	$2,440,000	$71,000	$1,520,000
In-line Control Gate	N/A [a]	$2,420,000 [b]	$44,000	$950,000
Screening		$2,350,000 [c]	$54,000	$1,150,000
Subtotal	**$1,580,000**	**$7,210,000**	**$168,000**	**$3,620,000**
Opportunities	N/A	$720,000	$17,000	$360,000
District Total	**$1,580,000**	**$7,930,000**	**$185,000**	**$3,980,000**

[a] Screening and In-line Storage were not included in the Preliminary Proposal 2015 costing. Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for these items of work found to be $2,500,000 in 2014 dollars

[b] Costs associated with new off-take construction, as required, to accommodate control gate and screening chambers in location and allow intercepted CS flow to reach existing Cornish CS LS was not included in Master Plan

[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 estimate for the in-line storage costs does not include the costs to construct the new off-take to the LS. 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 Opportunities costs.
- The Preliminary Proposal capital cost is on 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 difference between the Preliminary Proposal and CSO Master Plan estimates are identified in Table 1-12.

Table 1-12. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Latent	Updated unit costs One of the two SRS locations, the Canora SRS Outfall, includes a LS system	
	Control Gate	A control gate was not included in the Preliminary Proposal estimate	Added for the MP primarily to allow for screening operation, but also 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 Costs	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 1-13 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 Cornish district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. Flap gate control upgrades to the latent storage arrangements currently recommended could be implemented to provide further volume capture. It is recommended to review the Aubrey district upstream of Cornish, as the available latent storage could further be utilized though existing infrastructure alterations to CS to SRS connections or new interconnections to increase flow to the SRS system for low to medium rainfall events. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume.

Table 1-13. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Opportunistic separation • Latent Storage (Revised Interconnections or Flap Gate Control) • Off-line Storage (Tank/Tunnel) • Increase use of GI

The control options selected for the Cornish district have been aligned for the requirement to provide screening on each of the primary outfalls and not specifically 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 based on a stepped approach from the system wide basis.

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 1-14.

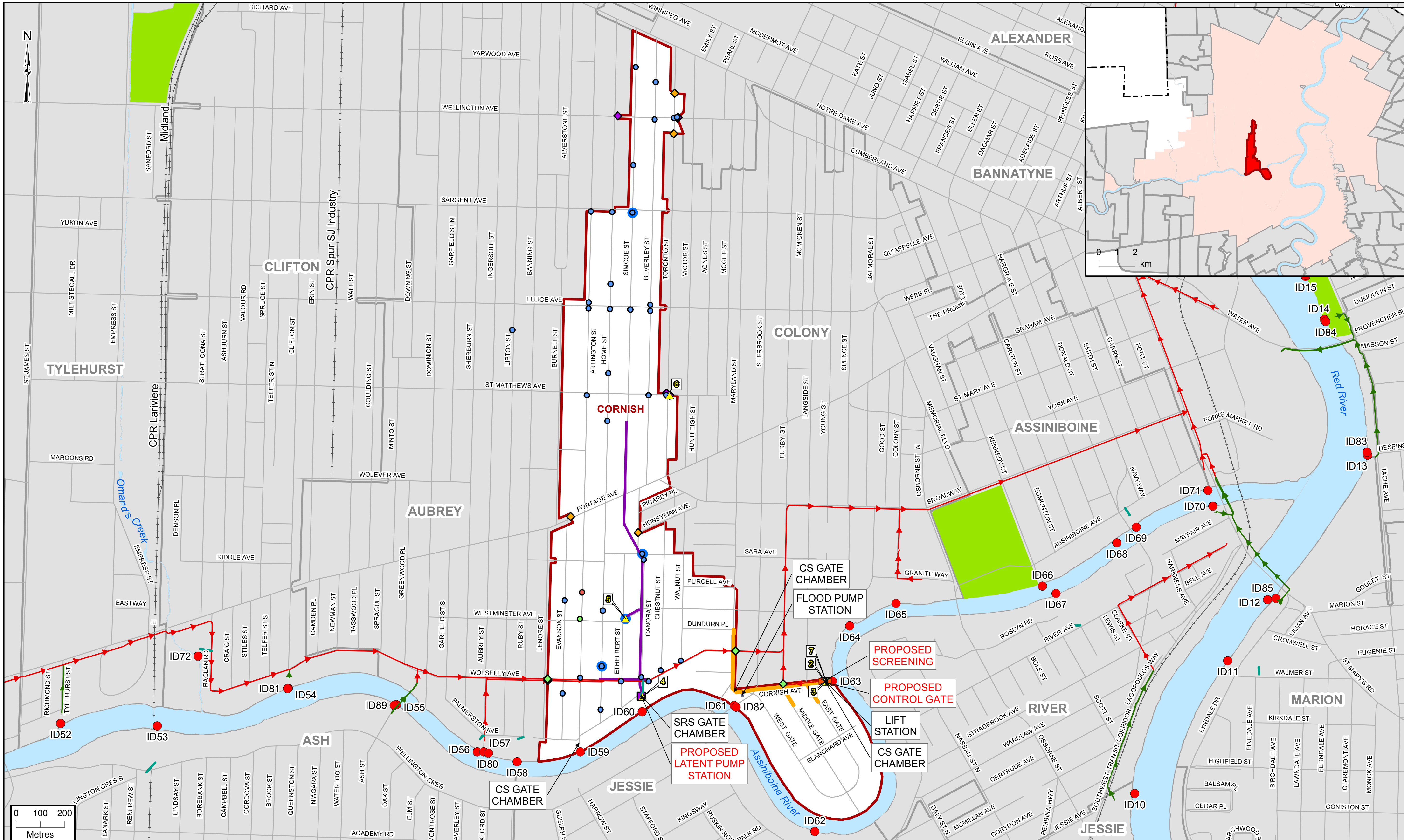
Table 1-14. Control Option 1 Significant Risks and Opportunities

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
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

Girling, R.M. 1986. *Basement Flooding Relief Program Review – 1986.*



LEGEND

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

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

District Boundary Crossing
- CS
- SRS
- 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
- Extent of In-line Storage
- Latent Force Main

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 11
District Overview Map
Sewer District: Cornish
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\CORNISH\CORNISH_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 9:23:29 AM

LEGEND

Primary Weir
Critical Elevation
CSO Outfall
Manhole
Flap Gate
Sluice Gate
Pump Location
Force Main
Sewer By Type
CS
WWS
Control Structure Type
Gate Chamber
Pump Station Type
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 11-01
Control Gate and Screening
Sewer District: Cornish
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\CORNISH\CORNISH_DISTRICT_DETAIL_CORNISHAV.MXD SBEGG1 7/29/2019 9:28:15 AM

LEGEND

Critical Elevation	Sewer By Type	Control Structure Type	Land Parcel
CSO Outfall	CS	Gate Chamber	
Manhole	SRS		
Sluice Gate	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 11-02
Latent SRS Control
Sewer District: Cornish
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGES\CORNISH\CORNISH_DISTRICT_DETAIL_PALMERSTONAV.MXD SBEGG1 6/24/2019 8:47:16 AM

LEGEND

- CSO Outfall
- Manhole
- Sluice Gate
- Pump Location

Sewer By Type
- CS

Control Structure Type
- Gate Chamber

Pump Station Type
- Flood Pump Station

- Land Parcel

CSO MASTER PLAN
PROPOSED SOLUTIONS

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 11-03
Flood Pumping Station
Sewer District: Cornish
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGES\CORNISH\CORNISH_DISTRICT_DETAIL_SHERBROOKEST.MXD SBEGG1 6/24/2019 8:46:38 AM

CSO Master Plan

Despins District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Despins District Plan
Revision:	03
Date:	August 22, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Despins_Plan_Final_CO1MP_08182019

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	Version 1 DRAFT	SG	ES	
1	02/15/2019	DRAFT 2 for City Review	SB	MF	SG
2	06/2019	Final Draft Submission	DT	MF	MF
3	08/18/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Despins District

1.1 District Description

Despins district is located along the eastern edge of the Red River near the centre of the combined sewer (CS) area. Hamel Avenue and Despins Street form the northern boundary, Bertrand Street and Eugenie Street form the southern boundary, and the Red River forms the western boundary. The Seine River runs along the eastern boundary.

Taché Avenue is a regional street that runs parallel to the Red River and connects Marion Street to Provencher Boulevard, providing access to the St. Boniface Hospital. Des Meurons Street also runs parallel to Taché Avenue and extends north to south along the eastern side of the district. Marion Street and Goulet Street are regional roads that run east-west through the district. The Canadian National Railway Sprague rail line passes through the northeastern section of the district.

Despins district is primarily residential with a small section of industrial and commercial land use. The industrial and commercial areas are located along Des Meurons Street and consist of general manufacturing facilities and community-based businesses. The residential land use make-up is primarily classified as two-family dwellings, but the district also includes small areas of single and multi-family.

The major non-residential areas are greenspaces which include Taché Promenade and La Verendrye Park located near the Red River. Approximately 14 ha of the district is classified as greenspace.

1.2 Development

There is limited land area available for new development within Despins district due to its location and residential land use. Due to its location close to the downtown however, there is a high potential for further densification via infill in the district. Redevelopment within this area could impact the CS system and will be investigated on a case-by-case basis for potential impacts to the combined sewer overflow (CSO) Master Plan. All developments within the CS districts are mandated to offset any peak combined sewage discharge by adding localized storage and flow restrictions, in order to comply with Clause 8 of the Environment Act Licence 3042.

1.3 Existing Sewer System

Despins district encompasses an area of 99 hectares[1] based on the district boundary and includes primarily combined sewer (CS), wastewater sewer (WWS), and land drainage sewer (LDS) systems. As shown in Figure 12, there is approximately 41 percent (41 ha) separated and 7 percent (7 ha) separation-ready areas.

The Despins sewer system includes a flood pump station (FPS), CS lift station (LS), FPS outfall, and a CS outfall gate chamber located adjacent to the Red River at Tache Avenue and Despins Street. Sewage flows collected in Despins district converge to a 1200 mm CS trunk flowing west on Despins Street and a 600 mm CS trunk sewer flowing north on Taché Avenue and drain towards the outfall. The two CS trunks meet at the intersection of Taché Avenue and Despins Street.

During dry weather flow (DWF), the Despins primary weir diverts flow through a 450 mm off-take pipe approximately 20 m south to the CS LS. The Despins CS LS pumps the flow through a 300 mm force main north along Tache Avenue across the Red River into the Bannatyne district and on to the North End Sewage Treatment Plant (NEWPCC).

[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 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 CS outfall structure. When river levels are high and gravity flow is not possible, the FPS pumps the flow into the Red River through the FPS outfall which contains an elevated discharge box and stop log weirs. A flap and sluice gate are in place on the CS outfall to prevent river water from flowing into the CS under high river level conditions.

LDSs service the eastern industrial and residential sections of Despins district and collect surface runoff and discharge through two LDS outfalls into the Seine River.

Three independent LDS systems with outfalls collect the surface runoff and discharge to the rivers. Runoff from the northeast portion of the district flows to a 600 mm LDS outfall on Bourgeault Street and discharges to the Seine River. A 1000 mm LDS along Bertrand Street collects runoff from the eastern extents of the Despins district and discharges to the Seine River. A 525 mm LDS collects runoff from the southeastern portion of the district before crossing into Marion district and discharging to the Seine River via a 900 mm LDS outfall. Each LDS outfall includes a sluice and flap gate to prevent river water from backing up into the system.

The CS and FPS outfalls to the Red River are as follows:

- ID13 (S-MA70087426) – Despins CS Outfall
- ID83 (S-MA70087428) – Despins FPS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Despins and the surrounding districts. Interconnection are shown on Figure 12 which identifies locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections

No interceptor connections are found in this district.

1.3.1.2 District Interconnections

Bannatyne

<u>WWS to WWS</u>

- A 300 mm force main carries flow from the Despins CS LS across the Red River to the Bannatyne district and on to the NEWPCC for treatment. There is a pipe and a valve that connects a parallel force main from Dumoulin district, but it is kept closed and only opened for maintenance.
  - Bannatyne district east of Main Street invert – 227.52 m (S-MH70021611)

Marion

<u>CS to CS</u>

- Common high point sewer manholes:
  - Horace Street invert at Marion invert – 226.85 m (S-MH50002230)
  - Goulet Street and Des Meurons Street invert – 227.34 m (S-MH50002282)
- A 250 mm CS pipe from Marion flows by gravity westbound into Despins CS system at the intersection of Taché Avenue and Thomas Berry Street:
  - Tache Avenue and Thomas Berry invert – 226.50 m (S-MH50002657)
- A 375 mm SRS overflow pipe from Marion flows by gravity westbound into Despins CS system during an overflow:

- Tache Avenue and Rinella Place invert – 226.13 m (S-MH50002666)

- A 450 mm CS pipe from Marion flows by gravity eastbound into Despins CS system at the intersection of Enfield Crescent and Bertrand Street:
  - Enfield Crescent and Bertrand Street Invert – 224.56 m (S-MH50007262)
- A 1050 mm CS pipe from Despins flows by gravity westbound into Marion CS system at the intersection of Enfield Crescent and Bertrand Street:
  - Enfield Crescent and Bertrand Street Invert – 224.74 m (S-MH50002428)
- A 600 mm CS pipe from Marion flows by gravity eastbound into Despins district CS system at the intersection of Marion Street and Des Meurons Street:
  - Marion Street and Des Meurons Street Invert – 226.68 m (S-MH50002243)
- A 300 mm CS pipe from Despins flows by gravity westbound into Marion district CS system between Youville Street and Des Meurons Street:
  - Youville Street and Des Meurons Street Invert – 226.85 m (S-MH50002230)

<u>WWS to WWS</u>

- A 250 mm WWS and a 300 mm WWS flows southbound by gravity and converge at a manhole at the corner of Bertrand Street and Enfield Crescent and flow by gravity from Despins district into Marion district:
  - Bertrand Street and Enfield Crescent Invert – 223.00 m (S-MH70025546)

<u>LDS to LDS</u>

- A 300 mm LDS pipe from Marion flows eastbound by gravity into Despins on Horace Street, between Youville Street and Des Meurons Street:
  - Youville Street and Des Meurons Street Invert – 225.37 m (S-MH70007961)
- A 525 mm LDS pipe from Despins flows southbound along Youville Street by gravity into Marion district LDS system between Eugenie Street and Edgewood Street:
  - Invert at Marion district boundary – 224.34 m (S-MH70007984)

<u>LDS to CS</u>

- A 250 mm LDS short section of the LDS system extends from Marion and flows by gravity into Despins CS at Tache Avenue near the back alley of Thomas Berry Street:
  - Invert at Marion district boundary – 226.15 m (S-MH50002944)

Dumoulin

<u>CS to CS</u>

- Common high point sewer manholes:
  - Desautels Street and Des Meurons Street invert – 228.38 m (S-MH50008956)
  - Bourgeault Street and Desautels Street invert – 229.44 m (S-MH50008651)
  - Ritchot Avenue and Hamel Avenue invert – 228.85 m (S-MH50002546)
- A 750 mm by 1150 mm CS pipe from Despins CS system flows by gravity westbound on Hamel Avenue and connects to an overflow CS pipe that flows northbound on Langevin Street into the CS system in Dumoulin district:
  - Hamel Avenue and Lavgevin Street invert – 228.63 m (S-MH50002548)

- A 750 mm by 1150 mm CS pipe from Despins CS system flows westbound on Hamel Avenue and connects to an overflow CS pipe that flows northbound on St Jean Baptiste Street into the CS system in Dumoulin district:
  - Hamel Avenue and St. Jean Baptiste Street invert – 228.80 m (S-MH50002313
- A 750 mm CS pipe from the Dumoulin CS system flows by gravity southbound on De La Morenie Street and connects to the CS system in Despins district:
  - Cathedrale Street and De La Morenie Street Invert – 226.38 m (S-MH50008928)

LDS to LDS

- A 300 mm LDS pipe from Despins district LDS system flows by gravity northbound on Des Meurons Street and connects to the LDS system in Dumoulin district.
  - Desautels Street and Des Meurons Street invert into 375 LDS – 226.45 m (S-MH50008203)
- A 450 LDS pipe from Dumoulin district LDS system flows by gravity westbound on Desautels Street and connects to the LDS system Despins district where it flows back out into Dumoulin to be discharged into the Seine River.
  - Bourgeault Street and Desautels Street Invert (into Despins) – 225.73 m (S-MH70008209)
  - Bourgeault Street and Desautels Street Invert (into Dumoulin) – 225.70 m (S-MA70008215)

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

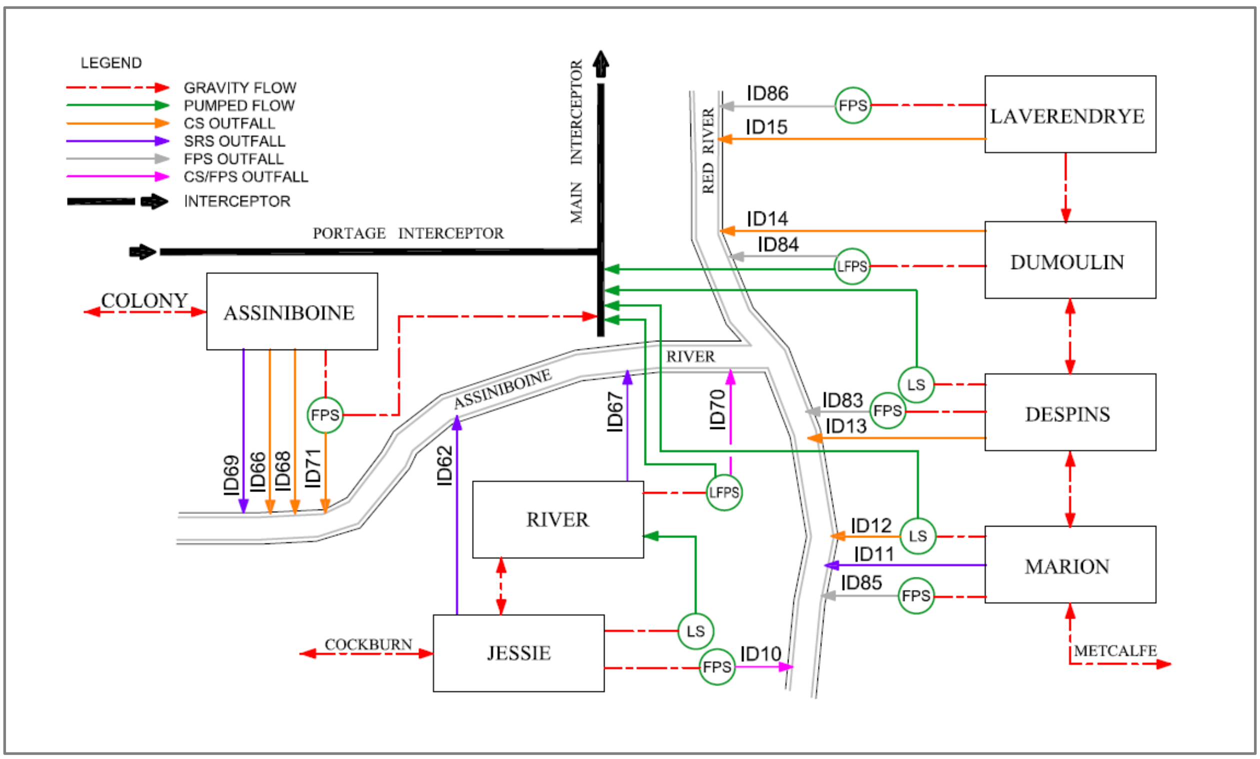


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 12 and are 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 (ID13)	S-MH70006397.1	S-MA70087426	1400 mm	Red River Invert: 222.51 m
Flood Pumping Station Outfall (ID83)	S-AC70008183.1	S-MA70087428	1200 mm	Red River Invert: 224.31 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	N/A	S-MA70028366	1200 mm	Invert: 222.71 m
SRS Outfalls	N/A	N/A	N/A	No SRS Outfalls within the district.
SRS Interconnections	Not modelled	S-MA70026766	300 mm	Invert: 222.17 m
Main Trunk Flap Gate	S-AC70013556.1	S-CG00000784	1375 mm	Invert: 223.10 m
Main Trunk Sluice Gate	S-CG00000785.1	S-CG00000785	1375 x 1375 mm	Invert: 223.08 m
Off-Take	S-MH70010291.2	S-MA70017878	450 mm	Circular Invert: 222.72 m
Dry Well	N/A	N/A	N/A	No dry well in lift station arrangement.
Lift Station Total Capacity	N/A	N/A	0.114 m^3/s	1 x 0.062 m^3/s 1 x 0.052 m^3/s
Lift Station ADWF	N/A	N/A	0.0354 m^3/s	
Lift Station Force Main		S-MA70017878	300 mm	Invert: 225.70
Flood Pump Station Total Capacity	N/A	N/A	1.20 m^3/s	1 x 0.73 m^3/s 1 x 0.47 m^3/s
Pass Forward Flow – First Overflow	N/A	0.155 m^3/s	N/A	

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	Despins – 223.73
2	Trunk Invert at Off-Take	222.72
3	Top of Weir	223.25
4	Relief Outfall Invert at Flap Gate	N/A
5	Relief Interconnection	N/A
6	Sewer District Interconnection (Marion district boundary)	223.00
7	Low Basement (Metcalfe, Marion, Despins)	224.33
8	Flood Protection Level (Metcalfe, Marion, Despins)	229.95

[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 Despins district was the *Marion and Despins Sewer Relief Project Preliminary Design Report* (Wardrop, 2005). The Marion and Despins Combined Sewer Relief Project upgraded the capacity of the existing CS systems to alleviate basement flooding (Wardrop, 2005 The CS district relief, including the separate LDS and WWS installation, was completed between 2000 and 2003 and is aligned with the Wardrop Sewer Relief project. Note that the final draft of the report was issued in 2005 after the work was complete, but the original design report was prepared prior to the work taking place. No other relief or CSO-related sewer work has been completed 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 Despins 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	Planned Completion
12 - Despins	2005 - Conceptual	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall of the Despins district. This consists of monthly site visits in confined entry spaces to verify 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 Despins sewer district are listed in Table 1-4. The proposed CSO control projects will include sewer separation. 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 was originally reviewed for in-line storage as well as floatable management as part of the system-wide Preliminary Proposal options. However, it was noted that the existing CS system is not fully suitable for in-line storage as the relative low level of the CS LS and associated CS outfall results in the modelling NSWL level being able the level of the recommended control gate level during the 1992 representative year assessment.

The existing CS system was originally reviewed for in-line storage as well as floatable management. The marginal evaluation indicated that complete separation will be similar to the in-line/screening control option. The capital costs to separate a district are higher than implementing the equivalent in-line storage and screening. Consideration of the operation and maintenance (O&M) costs however showed that the reduction of the pass forward flow to the downstream interceptor sewer from complete sewer separation would reduce the reliance on the Despins FPS, possibly removing its operation altogether. In addition, the more detailed analysis indicated the Despins CS outfall would not generate the hydraulic head conditions necessary for screen operation. Overflows from the district would still occur with implementation of in-line storage, making this district at risk of not having appropriate floatables management provisions in place. Therefore, the recommendation of complete separation would provide the added benefit of removing the requirement for screening at this outfall location. The additional operations and maintenance costs required with the in-line and screening implementation were also taken into consideration, and this associated O&M cost confirmed the selection of complete sewer separation for this district. Complete separation was recommended as it was found to be the most cost-effective solution from a life cycle cost perspective.

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 Sewer Separation

The sewer separation project for Despins will provide immediate benefits to the CSO program when complete. The proposed work may include installation of a new LDS trunk sewer along Despins Street as well as new LDS collector sewers along Dollard Boulevard. Current LDS systems will be extended to collect road drainage along Hamel Avenue and Bertrand Street. Collected stormwater runoff will be routed to the new LDS trunk sewer on Despins Street and from there will flow through a new LDS outfall parallel to the CS outfall at the Red River. The approximate area of sewer separation for Despins district is shown on Figure 12.

The flows to be collected after Despins separation will be as follows:

- Dry weather flows will remain the same for Despins district.
- Despins weather flow (WWF) will consist of sanitary sewage combined with foundation drainage.

This will result in a significant reduction in combined sewage flow received at Despins CS LS after the separation project is complete. The separation project will provide a full reduction of overflows for the 1992 representative year.

In addition to reducing the CSO volume, the benefits of Despins sewer separation include a reduction of pumped flows entering the downstream interceptor sewer, as well as reducing the amount of flood pumping required at the Despins FPS.

It is proposed that future flow monitoring of the district be completed to verify that the sewer separation is fully compliant with the modelled simulated elimination of all CSO overflows. A static weir elevation increase may be necessary at the CS diversion to eliminate the occurrence of all CSOs. Any weir elevation raise will also be evaluated in terms of existing basement flood protection to ensure the existing level of basement flood protection remains.

1.6.3 Green Infrastructure

The approach to green infrastructure (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 applicable GI controls.

Despins has been classified as a medium GI potential district. Land use in Despins is primarily residential with a small section of industrial and commercial land uses. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers and require more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district. There will also be a future reduction on FPS operational requirements, as the overflows in the district will be greatly reduced.

The reduction in storm flows entering the CS LS will reduce the requirement for operation of the flood pump within the FPS. It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the CS system) extent within the Despins district.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	96	96	3,621	62	N/A
2037 Master Plan – Control Option 1	96	39	3,621	16	SEP

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model

Notes:

SEP = Separation

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-6 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 1-6. District Performance Summary – Control Option 1

	Preliminary Proposal	Master Plan			
Control Option	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow
Baseline (2013)	30,553	43,955	0	20	0.155 m^3/s [b]
In-Line Storage	30,545	N/A [c]	N/A	N/A	N/A
Separation	N/A [a]	0	43,955	0	0.113 m^3/s [d]
Control Option 1	**30,545**	**0**	**43,955**	**0**	**0.113 m^3/s [d]**

[a] Separation was not simulated during the Preliminary Proposal assessment.

[b] Pass forward flows assessed with the 1-year design rainfall event

[c] In-Line Storage was not simulated as sewer separation proposed for the Master Plan assessment

[d] Pass forward flows assessed with the 5-year design rainfall event.

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entire CS system and not for each district individually. However, the elimination of the district overflows from complete sewer separation represents the 100 percent capture target at this district.

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 1-7. The cost estimates are Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-7. District Cost Estimate – 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 (Over 35-year period)
In-line Storage	- [a]	N/A [c]	N/A [c]	N/A [c]
Screening		N/A [c]	N/A [c]	N/A [c]
Separation	N/A [b]	$39,980,000	$24,000	$510,000
Subtotal	**$0**	**$39,980,000**	**$24,000**	**$510,000**
Opportunities	N/A	$4,000,000	$2,000	$50,000
District Total	**$0 [a]**	**$43,980,000**	**$26,000**	**$560,000**

[a] In-line storage and Screening not costs in initial Preliminary Proposal costs. Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for these items of work found to be $1,810,000 in 2014 dollars.

[b] Sewer separation not assessed in this district for the Preliminary Proposal

[c] In-line storage and screening not recommended as part of Master Plan assessment, in favour of complete separation.

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

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 alternative plans for the entire system, 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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Separation	Separation was not included in the Preliminary Proposal.	The Master plan identified sewer separation as the control option.
	Removal of In-Line Storage	In-Line Storage was not included in the Master Plan.	The Master plan identified sewer separation as the most

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
			cost effective control option over in-line storage.
	Removal of Screening	Screening was not included in the Master Plan.	With sewer separation recommended all CSO events will be removed, and there will no longer be a requirement for screening.
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 estimates were based on 2014-dollar values	

1.10 Meeting Future Performance Targets

The proposed complete separation of the Despins district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target.

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 1-9.

Table 1-9. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-

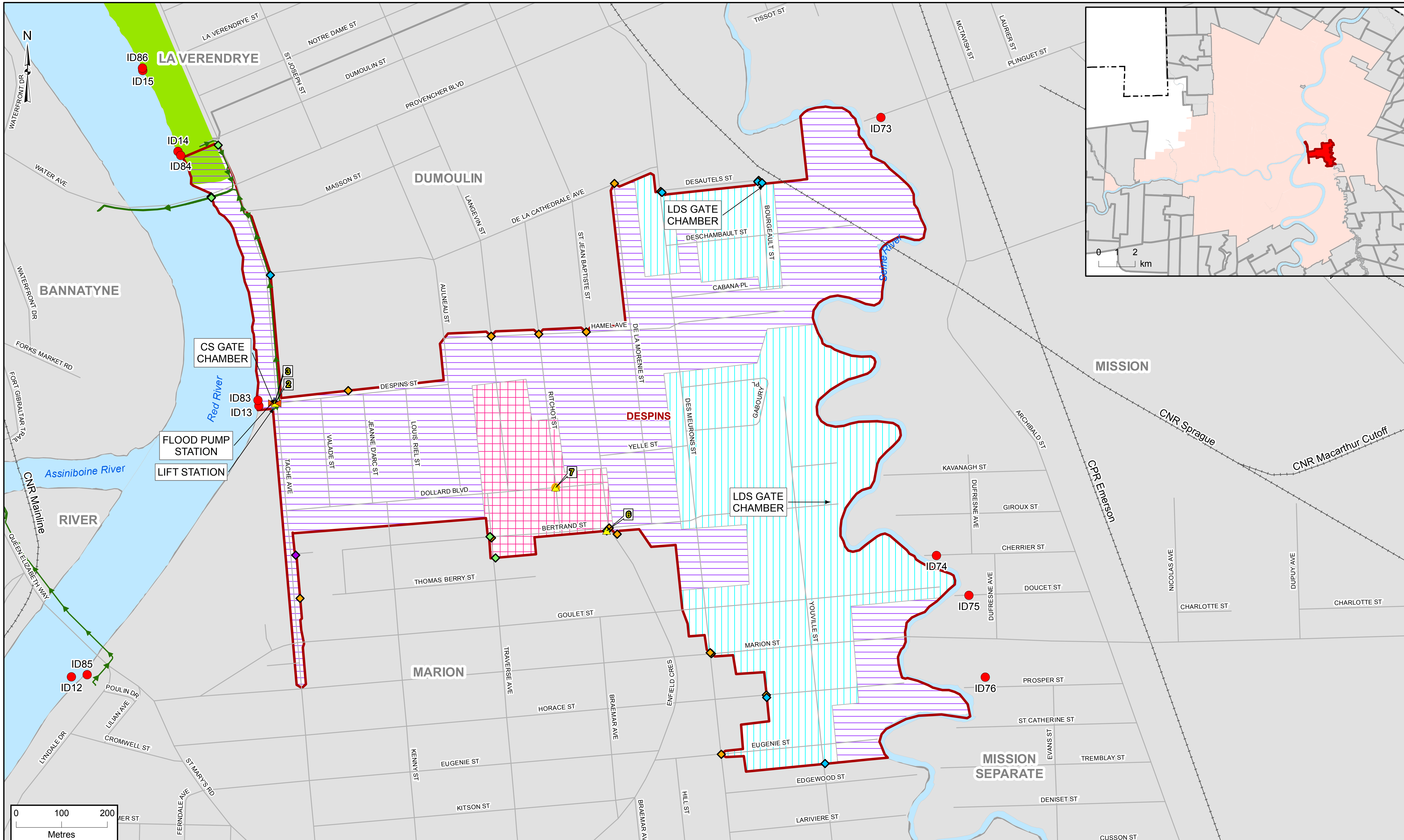
Table 1-9. Control Option 1 Significant Risks and Opportunities

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
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

Wardrop. 2005. *Marion and Despins Sewer Relief Project Preliminary Design Report*. Prepared for the City of Winnipeg Water and Waste Department. February.



LEGEND

Primary Weir
Critical Elevation
Decommissioned Outfall
CSO Outfall
Low CS Manhole

Inter-System Connection
CS - WWS

District Boundary Crossing
CS
LDS
SRS
WWS

Force Main
Street
Railway

District Boundary
Watercourse

CSO MASTER PLAN PROPOSED SOLUTIONS

Sewer Separation - Planning
Sewer Separation - Complete
Sewer Separation - Ready

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 12
District Overview Map
Sewer District: Despins
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE3\DESPINS\DESPINS_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 6/20/2019 7:38:33 AM

CSO Master Plan

Doncaster District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Doncaster District Plan
Revision:	03
Date:	August 16, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Doncaster_Plan_Final_CO1MP_08152019

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	08/2018	Version 1 DRAFT	SG	ES	
1	02/15/2019	DRAFT 2 for City Review	SB	MF	SG
2	05/2019	Final Draft Submission	DT	MF	MF
3	08/16/2019	Final Submission For CSO Master Plan	MF	MF	MF

Contents

Tables

Figure

1. Doncaster District

1.1 District Description

Doncaster district is located towards the southwestern limit of the combined sewer (CS) area. The district stretches from the Canadian National Railway main line north to the Assiniboine River. The eastern boundary consists of Centennial Street, Kenaston Boulevard, and Doncaster Street, and the western boundary follows Edgeland Boulevard and Morpeth Boulevard. Doncaster is surrounded by Ash to the east; Area 3.4 and Area 3.1 to the south; and Tuxedo, Area 3, and Area 1 to the west. Doncaster district contains numerous major transportation routes that pass through the district. They consist of Kenaston Boulevard, Tuxedo Avenue, Grant Avenue, and Corydon Avenue.

Land use in Doncaster is balanced between residential and commercial with the majority being occupied by residential. Most single-family residential homes are located in the northern and eastern section of the district. A mix of single and multi-family properties are located along Kenaston Boulevard. The commercial businesses are located along the major transportation routes. A large section of Doncaster is taken up by the Kapyong Barracks, which is currently unused but will be redeveloped in the future.

Major non-residential properties include the Real Canadian Superstore on the corner of Grant Avenue and Kenaston Boulevard, Joe Malone Park, and Kapyong Barracks on Kenaston Boulevard. Approximately 2 ha of the district is classified as greenspace.

1.2 Development

A Route 90 Improvement Study is currently underway that will lead to a significant amount of construction and right of way adjustments along Route 90/Kenaston Boulevard. This work, which will impact both the Doncaster and Ash districts, could impact the Combined Sewer Overflow (CSO) Master Plan.

One area within the Doncaster CS district has also been identified as a Major Redevelopment Site with OurWinnipeg, the former Kapyong Barracks. This site includes the lands primarily west of Kenaston Boulevard, from Taylor Avenue to Grenadier Drive. 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

Doncaster district encompasses an area of 152 ha[1] based on the district boundary GIS information and includes combined sewer (CS), wastewater sewers (WWS), and land drainage sewer (LDS) systems. As shown in Figure 13, there is approximately 1 percent (2 ha) already separated and 8 percent (12 ha) of the district by area is separation ready.

The Doncaster CS system includes a CS outfall gate chamber discharging to the Assiniboine River at the northern end of Doncaster Street. The CS system collects sewage from the district and transports it northward along the main 2100 mm sewer trunk on Doncaster Street towards the CS outfall. The trunk decreases in size to 450 mm on the western edge of Doncaster Street and connects with the interceptor pipe that carries sewage from Tuxedo district.

A small number of land drainage sewers (LDS) exist in the south part of the district. The district includes an LDS system at the southern boundary which flows south through a 750 mm pipe beneath the

[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.
The discrepancy between the area attributed to the Doncaster district between the GIS district boundary (152 ha) and InfoWorks model (118 ha) is due to the multiple bifurcations between the Doncaster and Ash districts changing the allocation of subcatchments, large permeable areas not included as model subcatchments and the missing area that is not covered by the GIS boundary. The City is currently reviewing the district boundaries.

Kenaston Boulevard underpass, and ties into the separate sewer districts south of Doncaster. In the future district boundary for Doncaster may be revised to exclude this section of LDS, as it is no longer associated with the CS system.

During dry weather flow (DWF), the primary weir diverts the wastewater southbound through a 2250 mm pipe and into the CS system of Ash district, where it is conveyed to the Ash sewage LS and sent across the Assiniboine River via river crossing, and ultimately to the North End Sewage Treatment Plant (NEWPCC) for treatment.

The district does not have a flood pump station (FPS) or a lift station (LS). During wet weather flow (WWF), any flow that exceeds the diversion capacity overtops the primary weir and is discharged to the Assiniboine river via the Doncaster CS outfall. Sluice and flap gates are installed on the Doncaster CS outfall to prevent back-up of the river into the CS system under high river levels along the Assiniboine River. When the Assiniboine River levels are high during WWF events however, no gravity discharge is possible due to the flap gate installed on the CS outfall. Under these high river level conditions, the excess flow assumes regular flow, diverting into the CS system of Ash district.

The single CS outfall to the Assiniboine River is as follows:

- ID48 (S-MA70019277) – Doncaster CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Doncaster and the surrounding districts. Each interconnection is shown in Figure 13 and shows gravity and pumped flow from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Ash

– A 750 mm CS pipe during a surge flows by gravity southbound on Doncaster Street and connects into the CS system in Ash:
    - Willow Avenue and Doncaster Street invert = 226.37 m (S-MH60006151)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Tuxedo

– A 150 mm force main from the Tuxedo CS lift and flood pumping station (CS LFPS) pumps CS into the Doncaster interceptor sewer along Wellington Crescent. This CS is then intercepted along with the CS in the Doncaster district by the primary weir for the Doncaster district, and flows by gravity to the Ash district.
    - Wellington Crescent and Doncaster boundary interceptor invert - 228.57 m (S-CO70008693)

1.3.1.3 District Interconnections

Ash

<u>CS to CS</u>

- Common high point CS manhole:

– Kenaston Boulevard and Corydon Avenue = 227.70 m (S-MH60006019)

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

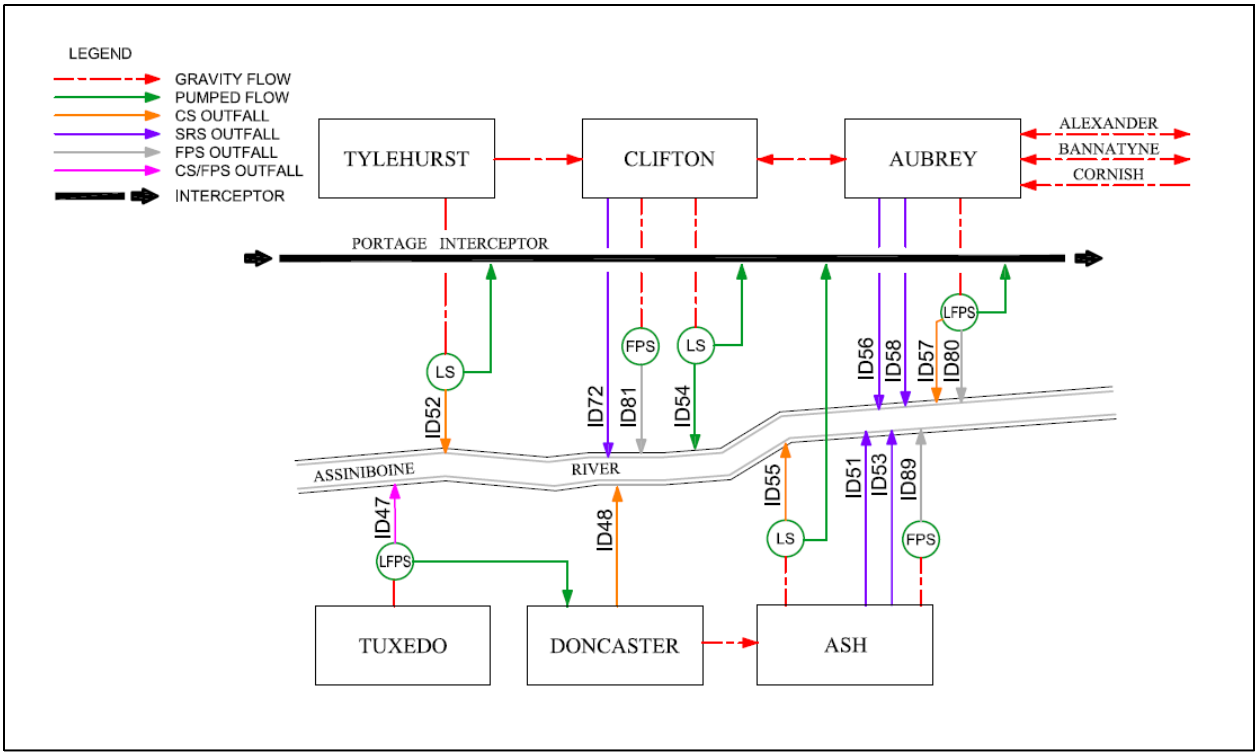


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 13 and are 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 (ID48)	S-AC70016534.1	S-MA70019277	1810 mm	Assiniboine River Invert: 225.22 m
Flood Pumping Outfall	N/A	N/A	N/A	No flood pumping station in this district.
Other Overflows	N/A	N/A	N/A	No flood pumping station in this district.
Main Trunk	S-TE60002661.2	S-MA60007598	2250 mm	Invert: 226.48 m
SRS Outfalls	N/A	N/A	N/A	No SRS system in this district.
SRS Interconnections	N/A	N/A	N/A	No SRS system in this district.
Main Trunk Flap Gate	DONCASTER_GC2.1	S-CG00000686	2250 mm	Invert: 226.76 m
Main Trunk Sluice Gate	DONCASTER_GC1.1	S-CG00000685	2250 x 2250 mm	Invert: 226.76 m
Off-Take	S-MH60006151.1	S-MA60007599	750 mm	Invert: 226.37 m
Dry Well	N/A	N/A	N/A	Diversion structure, no lift station as part of outfall in this district.
Lift Station Total Capacity	N/A	S-MA60007599 (1)	750mm (1)	0.355 m^3/s (1)
Lift Station ADWF	N/A	N/A	0.013 m^3/s	District ADWF (not considering Tuxedo ADWF)

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Force Main	N/A	N/A	N/A	Diversion structure, no lift station force main as part of outfall in this district.
Flood Pump Station Total Capacity	N/A	N/A	N/A	No flood pumping station in this district
Pass Forward Flow – First Overflow	N/A	N/A	0.106 m^3/s	

Notes:

(1) – Gravity pipe replacing Lift Station as Doncaster is a gravity discharge district

ADWF = average dry-weather flow
GIS = geographic information system
ID = identification
N/A = not applicable

Doncaster does not use an SRS system; therefore, an SRS outfall and interconnections to the combined sewers are not available.

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	Doncaster – 224.51
2	Trunk Invert at Off-Take	226.48
3	Top of Weir	227.25
4	Relief Outfall Invert	N/A
5	Relief Interconnection	N/A
6	Sewer District Interconnection (Willow Avenue and Doncaster Street)	Invert at district boundary = 226.37
7	Low Basement	230.67
8	Flood Protection Level	230.60

[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 Doncaster was the 1986 Basement Flooding Relief Program Review (Girling, 1986). No other work has been completed on the district 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 Doncaster 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
13 – Doncaster	1986	Future Work Following Separation	2013	Study Complete	N/A

1.5 Ongoing Investment Work

Proposed investment work is being considered for Kenaston Boulevard/Route 90, which will occur in both Doncaster and Ash with more of the work taking place in Doncaster. This major route runs through the central and eastern sections of Doncaster and, therefore, will affect the sewer systems in this district. The existing combined sewers will be evaluated for separation potential as part of the Route 90 Widening Project. Opportunistic separation will be incorporated where there is benefit. The separation costs may be reduced if separation work is planned as part of road reconstruction.

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Doncaster district. This consists of monthly site visits in confined entry spaces to verify 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 Doncaster sewer district are listed in Table 1-4. The proposed CSO control projects will be primarily complete sewer separation of the district. 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 marginal evaluation completed during the CSO Master Plan development indicated that complete separation will be similar to the in-line/screening control option in life cycle costs. In-line storage in combination with screening was originally recommended for the Doncaster district as part of the Preliminary Proposal. Operations and maintenance (O&M) costs required with the in-line / screening option are also taken into consideration, and this associated O&M cost results in the selection of full separation as the most preferable in this district. The redevelopment of the vacant Kapyong barracks may also provide the opportunity to fully separate these areas as part of the Doncaster district, which would be beneficial to the district as well as the downstream Ash district.

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 Sewer Separation

The sewer separation project for the Doncaster district will provide immediate benefits to the CSO program when complete. The work proposed includes installation of a new LDS trunk and collector sewers within the district. The existing CS trunks along Kenaston Boulevard will be separated into distinct storm and sanitary sewer systems, which will allow for sanitary sewage that contains untreated domestic, industrial, and commercial wastes to be separated from the storm runoff. A 2400 mm SRS outfall is currently in place off Wellington Crescent in the Ash district, which would allow for the addition of a new LDS or SRS system and a connection to the existing SRS system. The storm runoff could then be discharged into the Assiniboine River during high rainfall events. The existing combined sewers would be retained for use as separate WWS to convey sanitary sewage through the Ash sewer system to the appropriate treatment plant. The drawbacks of sewer separation are the high cost and the wide-spread disruption to the neighbouring residential homes, but the control option would address the majority of the CSO issues.

The approximate area of sewer separation is shown on Figure 13.

The flows to be collected after Doncaster separation are proposed to be as follows:

- Dry weather flows will remain the same for the Doncaster district with all DWF being diverted to the Ash CS system through the sewer trunk along Willow Avenue. To reach the desired interceptor pipe, the flow passes through Ash district to the Ash CS LS and into Aubrey district. From there, it is taken to the NEWPCC for treatment.
- Doncaster WWF will consist of sanitary sewage combined with foundation drainage.

Sewer separation will provide the near complete removal of overflows for the 1992 representative year. In addition to reducing the CSO volume, the benefits of Doncaster separation include a reduction of flows entering both the immediate downstream Ash district as well as reducing the amount of flood pumping required at the Ash FPS. A static weir elevation increase may be necessary at the CS diversion structure for Doncaster to eliminate the occurrence of a CSO as the hydraulic model shows one CSO occurring following complete separation under the 1992 representative year. An increase of 250 mm is predicted to be required, this does not impact upstream hydraulic grade due to the removal of WWF from the separation projects. This will be verified from on site flow monitoring within the district after the separation has been completed.

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 will be reviewed to identify applicable GI controls.

Doncaster has been classified as a high GI potential district. Land use in Doncaster is mainly residential with a small amount of commercial, the north end of the district is bounded by the Assiniboine River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers, requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district.

The reduction in storm flows entering the downstream Ash FPS will reduce the requirements and frequency of operation of the flood pump. It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (i.e. foundation drains) extent within the Doncaster district, and any static weir raises required.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	118	116	2,678	32	-
2037 Master Plan – Control Option 1	118	93	2,678	10	SEP

Notes:

SEP = Separation

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district will still need to be assessed and corrected.

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 discrepancy between the area attributed to the Doncaster district between the GIS district boundary (152 ha) and InfoWorks model (118 ha) is due to the multiple bifurcations between the Doncaster and Ash districts changing the allocation of subcatchments, large permeable areas not included as model subcatchments and the missing area that is not covered by the GIS boundary. The City is currently reviewing the district boundaries.

The performance results listed in Table 1-6 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 when simulations were completed; these are listed to provide an indication of benefit gained only and are independent volume reductions unless noted otherwise.

Table 1-6. District 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
Baseline (2013)	30,171	30,644	-	18	0.021 m^3/s [b]
In-Line	30,180	N/A	-	N/A	N/A
Separation	N/A [a]	0	30,644	0	0.126 m3/s [c]
Control Option 1	**30,180**	**0**	**30,644**	**0**	**0.126 m3/s [c]**

[a] Separation was not simulated during the Preliminary Proposal assessment

[b] Pass forward flows assessed with the 1-year design rainfall event

[c] Pass forward flows assessed with the 5-year design rainfall event

The revised CSO Master Plan control option to separate the Doncaster district has been based on the more focused district assessment as opposed to the previous Preliminary Proposal network performance assessment. In addition, several improvements to the overflow performance at the downstream Ash district was part of the overall selection process, but is not included as part of Table 1-6.

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entire CS system and not for each district individually. However, the elimination of the district overflows represents the 100 percent capture at this district.

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 recommended, 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 1-7. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-7. District Cost Estimate – 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)
Sewer Separation	N/A [a]	$49,890,000	$30,000	$640,000
In-Line Storage	$- [b]	N/A	N/A	N/A
Screening		N/A	N/A	N/A
Subtotal	**$0**	**$49,890,000**	**$30,000**	**$640,000**
Opportunities	N/A	$4,990,000	$3,000	$60,000

Table 1-7. District Cost Estimate – 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)
District Total	**$0**	**$54,880,000**	**$33,000**	**$700,000**

[a] Sewer separation not assessed in this district for the Preliminary Proposal

[b] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for these items of work found to be $1,710,000 in 2014 dollars.

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

- Capital costs 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. Each of these values include equipment replacement and O&M costs.
- 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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Separation	The Master plan identified sewer separation as the control option.	
	Removal Of In-Line Storage	Not included in the Master Plan Control Options	Removed during marginal analysis process in Master Plan development.
	Removal Of Screening	Not included in the Master Plan Control Options	Removed during marginal analysis process in Master Plan development.
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.	

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
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 proposed complete separation of the Doncaster district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target.

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 1-9.

Table 1-9. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	-	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-

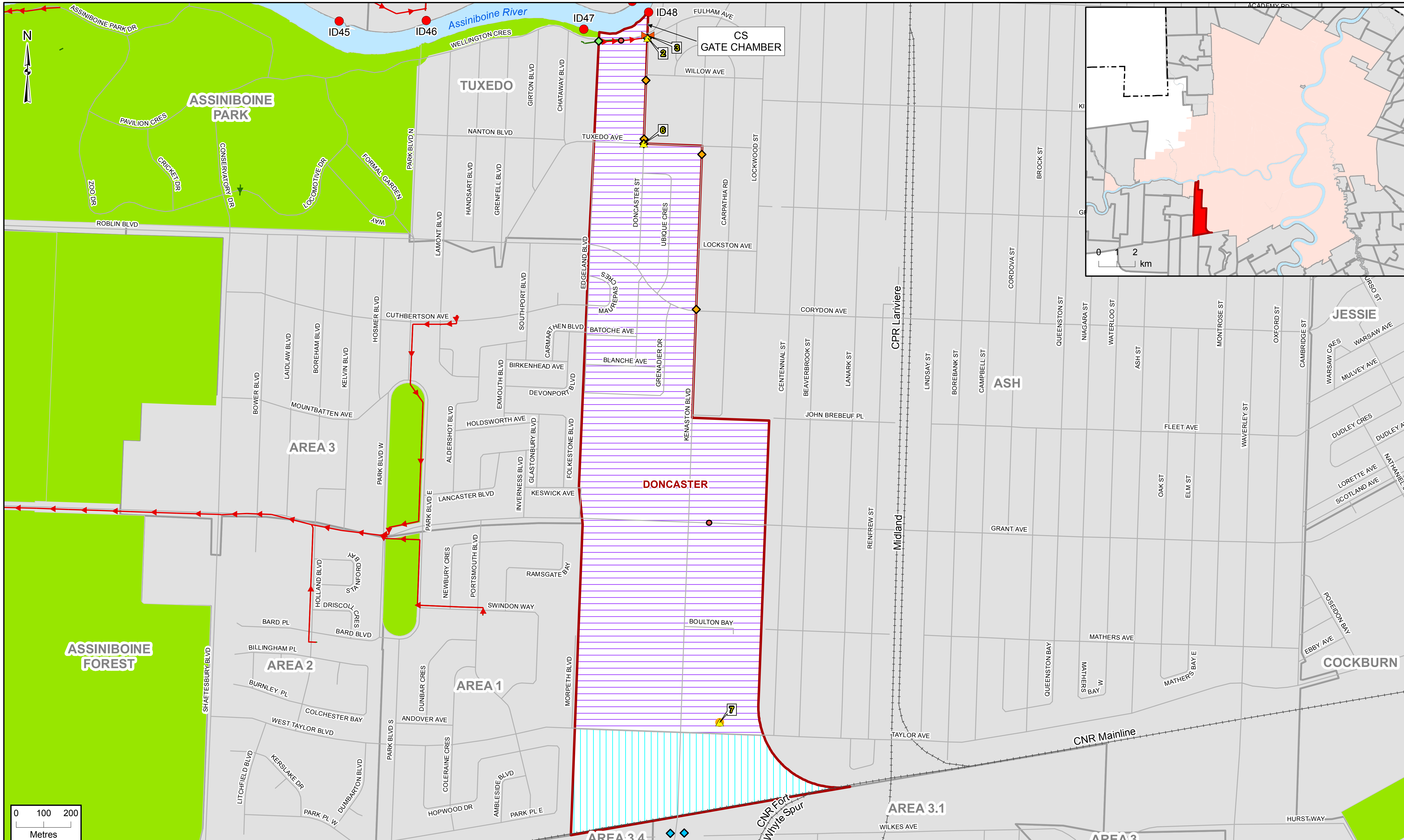
Table 1-9. Control Option 1 Significant Risks and Opportunities

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
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

Girling, R.M. & Sharp, E.J. 1986. *Basement Flooding Relief Program Review.* Prepared for City of Winnipeg.



LEGEND

Primary Weir
Critical Elevation
CSO Outfall
Low CS Manhole

Inter-System Connection
CS - WWS

District Boundary Crossing
CS
LDS
WWS

Interceptor Sewer
Force Main
Street
Railway

District Boundary
Watercourse
Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

Sewer Separation - Planning
Sewer Separation - Complete

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 13
District Overview Map
Sewer District: Doncaster
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\DONCASTER\DONCASTER_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:11:52 AM

CSO Master Plan

Douglas Park District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Douglas Park District Plan
Revision:	03
Date:	August 16, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Stephen Godon
File Name:	Dougals_Park_Plan_Final_CO1MP_08162019

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	08/2018	Version 1 DRAFT	SG	ES	
1	02/2019	DRAFT 2 for City Review	MF	SG	MF
2	08/2019	Final Draft Submission	DT	MF	MF
3	08/16/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Douglas Park District

1.1 District Description

Douglas Park is a small district located on the western edge of the north end treatment area of the combined sewer (CS) area. It is bounded by Ferry Road district to the north and east, Moorgate district to the west, and the Assiniboine River to the south. Portage Avenue forms the northern border, Deer Lodge Place forms the western border, and Library Place forms the eastern border.

Douglas Park district land use is classified primarily as residential and parks, with a commercial area located on Portage Avenue. The residential homes are classified mostly as single-family homes. Bruce Park is a green space located in the centre of the district. Truro Creek runs through Bruce Park to the Assiniboine River.

Portage Avenue is the only regional transportation route that passes through Douglas Park along the northern border running parallel to the Assiniboine River.

1.2 Development

A portion of Portage Avenue is located within the Douglas Park District. Portage Avenue is identified as Regional Mixed-Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

Douglas Park encompasses an area of 23 hectares (ha)[1] and consists of a CS system with one outfall located on the southern end of Douglas Park Road. The combined sewage is collected from three residential blocks including Douglas Park Road to Deer Lodge Place and flows to the 300 millimetre (mm) interceptor pipe that connects to the Douglas Park CS outfall. The western section of Douglas Park district flows beneath the Truro Creek using a 300-mm siphon. The area west of Bruce Park has undergone sewer separation with a separate land drainage sewer (LDS) to collect the overland runoff and the decommissioning of the Douglas Park secondary outfall.

During dry weather flow (DWF), combined sewage is diverted by the primary weir, through a 375 mm interceptor pipe that flows west to tie into the Ferry Road CS system. The intercepted CS from the Douglas Park district is then intercepted once more within the Ferry Road district, where it enters the Ferry Road LS. The CS is then pumped into the Portage Interceptor, and flows by gravity to the North End Sewage Treatment Plant (NEWPCC).

During wet weather flow (WWF) events, high flow in the system may cause the level in the trunk sewer to increase above the primary weir and overflow by gravity to the Assiniboine River via the Douglas Park CS outfall. This CS outfall consists of a sluice gate that may be closed during high river conditions to prevent backflow from the river entering the system. There is no flap gate at this outfall; thus, the response to high river conditions is not immediate and requires response and monitoring from the collections system operators for the district. There is also no flood station at this location; however, in the case where high river levels are predicted and overflow operation will be prevented by the positive gate during a WWF event, temporary flood pumping can be put in place.

The two CS outfalls to the Assiniboine River are as follows:

- ID44 (S-MA70028291) – Deer Lodge CS Outfall - Decommissioned

[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.

- ID45 (S-MA20008519) – Douglas Park CS Outfall

1.3.1 District-to-District Interconnections

There is one district-to-district interconnection between the Douglas Park and Ferry Road districts. This interconnection is shown on Figure 14 and shows the location where gravity flow crosses from one district to another Each interconnection is listed in the following subsections.

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Ferry Road

- Diverted wastewater sewage crosses into Ferry Road district from Douglas Park district through the 375 mm interceptor pipe. It flows through Bourkevale Park (east of Douglas Park Road), to be discharged to the Ferry Road LS:
  - Invert at district boundary - 226.1 m (S-MA20008531)

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

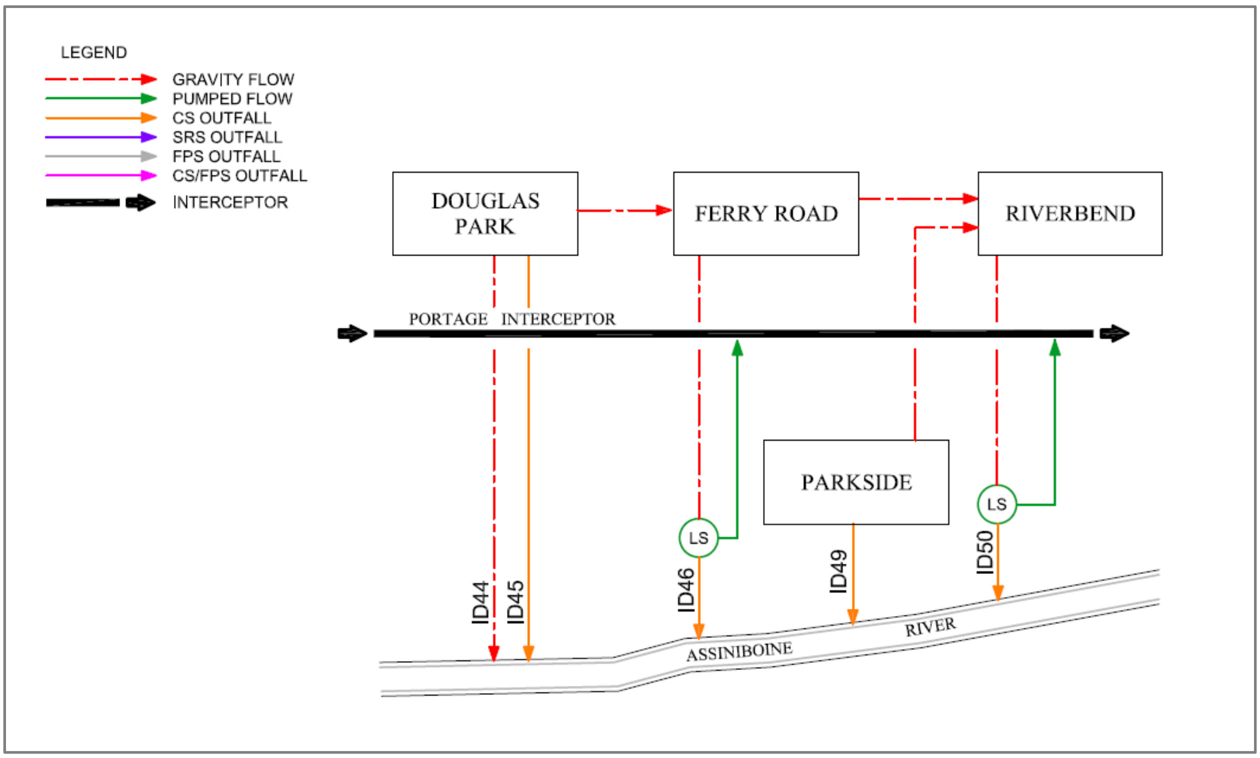


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 14 and are 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 (ID45)	S-MH20007846.1	S-MA20008519	300 mm	Circular Invert: 225.75 m
Flood Pumping Outfall	N/A	N/A	N/A	No flood pump station within the district.
Other Overflows	N/A	N/A	N/A	
Main Sewer Trunk	S-MH20007855.1	S-MA20008525	300	Circular Invert: 226.35 m
Storm Relief Sewer Outfalls	N/A	N/A	N/A	No SRS within the district.
Storm Relief Sewer Interconnections	N/A	N/A	N/A	No SRS within the district.
Main Trunk Flap Gate	N/A	N/A	N/A	No flap gate on the primary CS outfall.
Main Trunk Sluice Gate	DOUGLAS_PARK_GC.1	S-CG00001141	300 x 300 mm	Invert: 226.00 m
Off-Take (Interceptor)	S-MH20007847.2	S-MA20008518	375 mm	Circular Invert: 226.34 m
Dry Well	N/A	N/A	N/A	No lift station within the primary CS outfall.
Lift Station Total Capacity	N/A	S-MA20008518 (1)	375mm (1)	0.078 m^3/s (1)
Lift Station ADWF	N/A	N/A	0.004 m^3/s	
Lift Station Force Main	N/A	S-MA70017062	200 mm	Invert: 229.30 m
Flood Pump Station Total Capacity	N/A	N/A	N/A	No flood pump station within the district.
Pass Forward Flow – First Overflow	N/A	N/A	0.053 m^3/s	

Note:
(1) – Gravity pipe replacing Lift Station as Douglas Park is a gravity discharge district
ADWF = average dry-weather flow
GIS = geographic information system
ID = identification
N/A = not applicable

The critical 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	Douglas Park – 224.55
2	Trunk Invert at Off-Take	226.34
3	Top of Weir	226.78
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	N/A

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
6	Sewer District Interconnection (Ferry Road)	226.10
7	Low Basement	228.86
8	Flood Protection Level	230.68

[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 for Douglas Park was in 2006 with the *Ferry Road and Riverbend Combined Sewer Relief Works* (Wardrop, 2006). This study discussed the possible separation work available for both the Ferry Road and Riverbend CS systems to reduce the incidence of basement flooding. To date, the separation work within the Douglas Park district located west of Bruce Park has been completed and the Deer Lodge outfall (ID 44) has been decommissioned.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
14 – Douglas Park	2006 - Conceptual	Future Work Following Complete Separation	2013	Study Complete Separation Ongoing	2018

1.5 Ongoing Investment Work

The Ferry Road and Riverbend basement flooding relief (BFR) work began in 2013 with ongoing separation work being completed within the districts. Once completed, it will provide complete road drainage separation of Ferry Road and Douglas Park.

The separation work within the Douglas Park district has been ongoing since 2016 and has been integrated into the CSO Master Plan. The remainder of the district is anticipated to be separated in the next 5-10 years.

There is no further study or construction proposed for the Douglas Park district at this time.

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 Douglas Park district are listed in Table 1-4. The proposed CSO control is complete sewer separation to align with the work currently underway. 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 decision to include complete separation of Douglas Park under the basement flooding relief work will remove a volume of land drainage from the CS system, thereby completely removing CSO occurrences for the Douglas Park district. The intent of complete separation was to eliminate all CSOs from the district under the 1992 representative year rainfall conditions. Post separation flow monitoring is required to confirm the sewer system performance and remaining wet weather response in the district from existing building foundation drainage connections to the CS system.

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 Sewer Separation

Sewer separation is proposed for Douglas Park district as part of the CSO Master Plan and is underway as part of the Ferry Road and Riverbend separation projects.

The work to date includes installation of a new independent LDS system to collect road drainage. New LDSs have been installed along Deer Lodge Place as east and west legs with connection to Truro creek in Bruce Park. The collected stormwater runoff was routed through the new LDS to a new outfall discharging to the Truro Creek. This separates the west section of the Douglas Park district. The remainder of the district is anticipated to be separated in the next 5-10 year.

The flows to be collected after separation will be as follows:

- DWF will remain the same – with it being diverted by gravity to the Ferry Road CS LS via the primary weir for the district.
- WWF will consist of sanitary sewage combined with foundation drainage.

This has resulted in a reduction in combined sewage flow received at Ferry Road CS LS since the separation project was complete. Future monitoring of the district will be completed to verify that the sewer separation is fully compliant with the goal of elimination of all CSO overflows under 1992 rainfall conditions. The monitored data will also be used to determine if a raise to the static weir elevation is necessary. Any weir elevation raise will also be evaluated in terms of existing basement flood protection to ensure the existing level of basement flood protection remains.

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 will be reviewed to identify the most applicable GI controls.

Douglas Park has been classified as a high GI potential district. The land usage is categorized as mainly residential. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, and rain gardens. The higher area of greenspace in Douglas Park district is suitable for biorientation 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 Systems Operations and Maintenance

Systems operations and maintenance (O&M) changes were required to address the completed control options. This section identifies general O&M requirements for each control option completed 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.

Sewer separation included the installation of additional sewers that require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers, and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district.

The primary CS outfall is believed to be either collapsed or plugged with river silt. Physical access to the outfall structure is also limited, previous City inspections have been attempted but unsuccessful. The separation of the district will greatly reduce the operation of this outfall and any post separation monitoring and impact assessment undertaken, may result in this outfall being decommissioned in the future. This will reduce this aspect of operations and maintenance requirements for the district.

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 model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	13	13	698	32	N/A
2037 Master Plan – Control Option 1	13	8	698	2	SEP

Notes:

Total area is based on the model subcatchment boundaries for the district.
SEP = Separation
% = percent

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-6, are for the hydraulic model simulations using the year-round 1992 representative year applied uniformly. 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 1-6. 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)	754	739	-	5	0.053 m^3/s
Separation	0	0	739	0	TBD
Control Option 1	**0**	**0**	**739**	**0**	**TBD**

[a] Pass forward flows assessed up to 5-year design rainfall event. Possible overflow for larger design events to be confirmed.

The percent capture performance measure is not included in the table above as it is applicable to the entre CS system, and not for each district individually. However, the full capture of overflows volumes for the Douglas Park district would represent a 100 percent capture rate on a district level.

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 relevant 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 1-7. The cost estimates are a Class 5 planning level estimate with a level of accuracy range of minus 50 percent to plus 100 percent.

Table 1-7. Cost Estimates – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost [a]	2019 Annual Operations and Maintenance Cost [b]	2019 Total Operations and Maintenance Cost (Over 35-year period) [b]
Sewer Separation	$11,000,000	$0	$0	$0
Subtotal	**$11,000,000**	**$0**	**$0**	**$0**
Opportunities	N/A	$0	$0	$0
District Total	**$11,000,000**	**$0**	**$0**	**$0**

[a] Douglas Park separation work has yet to be fully completed, with the separation of the area along Douglas Park Road to be finalized within the near future (5-10 year period). This cost was not included for the CO1MP submission cost breakdown. Costs for this item of work found be $3,200,00 in 2019 dollars.

[b] O&M costs within the Cost Estimation Breakdown are based on future proposed control option and not on previously completed work. Since the Douglas Park district is not completely separated, additional O&M costs should be attributed to the overall cost program. Cost for the Annual O&M Costs in 2019 dollars found to be $6,400. Total O&M Cost (Over 35-year Period) found to be $150,000 in 2019 dollars. Both O&M costs include opportunities allowance of 10%.

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 (depending on future monitoring of post separation WWF impacts).
- 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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Sewer Separation	Updated Unit costs	Separation of part of district still ongoing.
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 proposed complete separation of the Douglas Park district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target. It is recommended to complete post separation modelling to confirm the target is fully achieved.

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 as part of the CSO Master Plan and is included as part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-9.

Table 1-9. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	-	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	-	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	-	-
12	Operations and Maintenance	-	-	-	-	R / O	R	-	-
13	Volume Capture Performance	-	-	-	-	-	O	--	-
14	Treatment	-	-	-	-	O	O	-	-

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

1.12 References

Wardrop. 2006. *Ferry Road and Riverbend Combined Sewer Relief Works*. Prepared for the City of Winnipeg Water and Waste Department. November.

LEGEND

- Primary Weir
- Critical Elevation
- Decommissioned Outfall
- CSO Outfall
- Low CS Manhole
- Inter-System Connection: CS - WWS
- District Boundary Crossing: WWS
- Force Main
- Street
- District Boundary
- Watercourse
- Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Underway
- 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 14
District Overview Map
Sewer District: Douglas Park
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE4\DOUGLASPARK\DOUGLASPARK_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:55:01 AM

JACOBS

CSO Master Plan

Dumoulin District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Dumoulin District Plan
Revision:	03
Date:	August 22, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Dumoulin_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	Version 1 DRAFT	SG	ES	
1	02/15/2019	Second DRAFT for City Review	SB	MF	SG
2	06/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Dumoulin District

1.1 District Description

Dumoulin district is located near the centre of the combined sewer (CS) area. Dumoulin is bounded by Mission district to the east, Despins district to the south and west, La Verendrye district to the north, and the Red River to the west. Dumoulin Street forms the northern boundary, De La Cathedrale the southern boundary, the Red River the western boundary, and the Seine River the eastern boundary.

The regional transportation routes that pass through Dumoulin district are Provencher Boulevard, Taché Avenue, and Des Meurons Street. Provencher Boulevard runs east-west and crosses the Red River and connects from the St. Boniface area to downtown. Taché Avenue runs parallel to the Red River and connects Marion Street to Provencher Boulevard, providing access to the St. Boniface Hospital. The Canadian National Railway Sprague rail line passes through the northeastern section of the Dumoulin district.

This district includes residential, with commercial areas located along the Provencher Boulevard and Des Meurons corridors. A small area of industrial land use with light and general manufacturing is located in the eastern portion of the district. The residential land use areas contain an distribution of multi-family, single-family, and two-family homes. Numerous institutional facilities are located in this district including St. Boniface University and College Louis-Riel. Other significant properties include the St. Boniface Cathedral, and Provencher Park, which encompass a large area in the centre of the district. Approximately 10 ha of the district is classified as greenspace.

1.2 Development

Provencher Boulevard, which is recognized as a Mixed Used Corridor within OurWinnipeg and will be promoted for future development and densification.

Provencher Boulevard has also been identified as one of the potential routes for the Eastern Corridor of Winnipeg's Bus Rapid Transit. This 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 separation within the Dumoulin district. This would reduce the extent of the Control Options listed in this plan required.

1.3 Existing Sewer System

Dumoulin district encompasses an area of 70 ha[1] based on the district boundary and includes combined sewer (CS), wastewater sewer (WWS), and land drainage sewer (LDS) systems. As shown in Figure 15, there is approximately 38 percent (27 ha) separated and no separation-ready areas.

The Dumoulin sewer system includes a diversion chamber, a dual lift and flood pump station (LFPS), a flood pump station (FPS) outfall, and a CS outfall with gate chamber located adjacent to the Red River at Tache Avenue and Dumoulin Street. Sewage flows collected in the Dumoulin district converge to a 1050 mm CS trunk flowing west on Dumoulin Street and a 450 mm CS trunk sewer flowing west on Provencher Boulevard and drain towards the outfall. The two CS trunks meet at the intersection of Taché Avenue and Dumoulin Street. Intercepted CS from the La Verendrye district also enters Dumoulin district, from either a 300 mm pipe offtake pipe or a 450 mm overflow pipe. Each of these interconnections with the La Verendrye district flow south along Tache Avenue to tie into the Dumoulin CS trunk upstream of the district primary weir.

[1] City of Winnipeg GIS information relied upon from 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), the Dumoulin primary weir diverts flow to the lift station section of the Dumoulin LFPS through a 300 mm off-take pipe. The Dumoulin LFPS pumps the flow south down Tache Avenue through a 350 mm force main, and across the Red River into the Bannatyne district and on to the North End Sewage Treatment Plant (NEWPCC). The river crossing from the Despins district is located adjacent to this Dumoulin river crossing, with interconnection valves installed between the two river crossings. During normal operations however these valves remains closed and there is no interaction between the two river crossings.

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 CS outfall structure. A flap and sluice gate are in place on the CS outfall to prevent the Red River from back flowing into the CS under high river level conditions. When river levels are high such this however the flap gate prevents gravity flow discharge from the CS outfall. Under these conditions the FPS pumps from the Dumoulin LFPS collect the excess CS trapped behind the outfall flap gate, and pump the flow to an elevated discharge box. The discharge box then allows flow by gravity into the Red River through a dedicated FPS outfall which contains no positive or flap gate.

Three independent LDS systems with outfalls collect the surface runoff and discharge to the adjacent rivers. Runoff from the southeast portion of the district (mainly from Despins district) flows to a 600 mm LDS outfall on Bourgeault Street and discharges to the Seine River. A 1050 mm LDS along De La Cathedrale Avenue collects runoff from the southern extents of the Dumoulin district. This LDS trunk crosses Taché Avenue in the Despins district and discharges to the Red River via a 1200 mm LDS outfall. Each LDS outfall includes a sluice and flap gate to prevent river water from backing up into the system.

The two outfalls (one CS and one FPS) to the Red River are listed as follows:

- ID14 (S-MA70047759) – Dumoulin CS Outfall
- ID84 (S-MA70016522) – Dumoulin FPS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Dumoulin and the surrounding districts. Each interconnection is shown on Figure 15 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections

No interceptor connections

1.3.1.2 District Interconnections

Despins

<u>WWS to WWS</u>

- A 350 mm force main carries intercepted flow from the Dumoulin LFPS to the Despins district. Within the Despins district the CS then crosses the Red River via river crossing, and on to the North End Sewage Treatment Plant (NEWPCC) for treatment:
  - Bannatyne district east of Main Street invert – 227.52 m (S-MH70021611)

<u>CS to CS</u>

- Common high point sewer manholes:
  - Desautels Street and Des Meurons Street invert – 228.38 m (S-MH50008956)
  - Bourgeault Street and Desautels Street invert – 229.44 m (S-MH50008651)

- Ritchot Avenue and Hamel Avenue invert – 228.85 m (S-MH50002546)

- A 750 mm by 1150 mm CS pipe from Despins CS system flows by gravity westbound on Hamel Avenue and connects to an overflow CS pipe that flows northbound on Langevin Street into the CS system in Dumoulin district:
  - Hamel Avenue and Lavgevin Street invert – 228.63 m (S-MH50002548)
- A 750 mm by 1150 mm CS pipe from Despins CS system flows westbound on Hamel Avenue and connects to an overflow CS pipe that flows northbound on St Jean Baptiste Street into the CS system in Dumoulin district:
  - Hamel Avenue and St. Jean Baptiste Street invert – 228.80 m (S-MH50002313
- A 750 mm CS pipe from the Dumoulin CS system flows by gravity southbound on De La Morenie Street and connects to the CS system in Despins district:
  - Cathedrale Street and De La Morenie Street Invert – 226.38 m (S-MH50008928)

<u>LDS to LDS</u>

- A 300 mm LDS pipe from Despins district LDS system flows by gravity northbound on Des Meurons Street and connects to the LDS system in Dumoulin district.
  - Desautels Street and Des Meurons Street invert into 375 LDS – 226.45 m (S-MH50008203)
- A 450 mm LDS pipe from Dumoulin district LDS system flows by gravity westbound on Desautels Street and connects to the LDS system Despins district where it flows back out into Dumoulin to be discharged into the Seine River.
  - Bourgeault Street and Desautels Street Invert (into Despins) – 225.73 m (S-MH70008209)
  - Bourgeault Street and Desautels Street Invert (into Dumoulin) – 225.70 m (S-MA70008215)

La Verendrye

<u>CS to CS</u>

- A 300 mm CS pipe carries the intercepted CS diverted by the primary weir from the La Verendrye district, and flows by gravity southbound on Tache Avenue and connects to the CS system in the Dumoulin district.
  - Tache Avenue and Dumoulin Street invert – 222.53 m (S-MH50008804)
- A 450 mm CS high overflow pipe diverts CS from the La Varendrye trunk sewer upstream of the primary weir, and flows by gravity southbound on Tache Avenue and connects to the CS system in the Dumoulin district.
  - Tache Avenue and Dumoulin Street invert – 225.49 m (S-MH50004016)

<u>WWS to CS</u>

- A 600 mm WWS pipe from La Verendrye flows by gravity southbound on Langevin Street and connects into the CS system in Dumoulin district.
  - Langevin Street and Dumoulin district boundary invert – 226.77 m (S-MH-50003890)

<u>LDS to LDS</u>

- A 600 mm LDS pipe from Dumoulin district flows by gravity northbound into La Verendrye district at the intersection of Thibault Street and Dumoulin Street and is discharged into the outfall at the Seine River and does not interact with the CS system.
  - Thibault Street and Dumoulin Street at district boundary invert - 227.19 m (S-MH50004223)

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

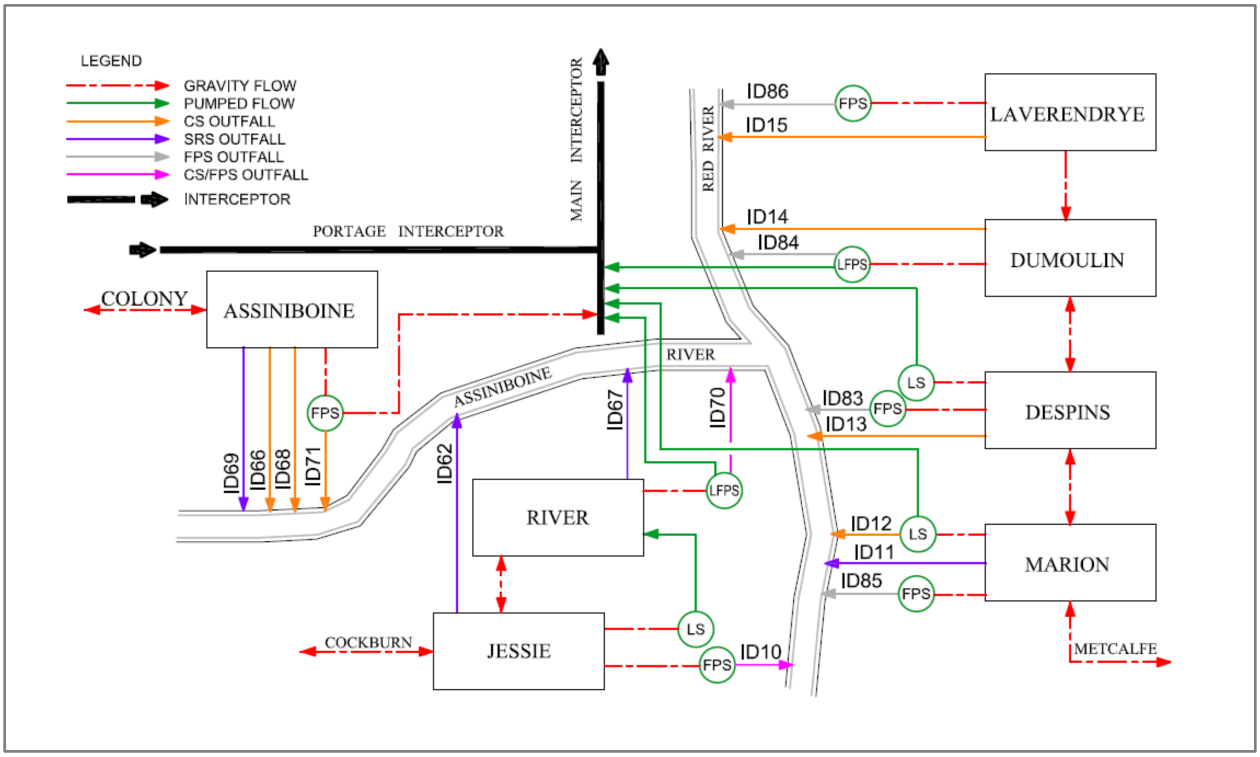


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 15 and are 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 (ID14)	S-CO70023242.1	S-MA70047759	1050 mm	Red River Invert: 222.70 m
Flood Pumping Outfall (ID84)	S-AC70007576.1	S-MA70016522	1200 mm	Red River Invert: 225.30 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	N/A	S-MA70017914	1050 mm	Invert: 225.19 m
SRS Outfalls	N/A	N/A	N/A	No SRS within the Dumoulin district.
SRS Interconnections	N/A	N/A	N/A	No SRS within the Dumoulin district.
Main Trunk Flap Gate	S-CG00000787.1	S-CG00000786	1350 mm	Invert: 224.38 m
Main Trunk Sluice Gate	S-AC70008153.1	S-CG00000787	1200 x 1200 mm	Invert: 224.15 m
Off-Take	S-MH50008801.2	S-MA70017598	300 mm	Circular Invert: 224.73 m

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Dry Well	N/A	N/A	N/A	No dry well arrangement within the LFPS.
Lift Station Total Capacity[1]	N/A	N/A	0.15 m^3/s	2 x 0.075 m^3/s
Lift Station ADWF	N/A	N/A	0.036 m^3/s	
Lift Station Force Main	S-BE70008151.1	S-MA70017614	350 mm	Invert: 226.60 m
Flood Pump Station Total Capacity	N/A	N/A	1.77 m^3/s	1 x 0.59 m^3/s, 1 x 1.18 m^3/s
Pass Forward Flow – First Overflow	N/A	0.178 m^3/s	N/A	

Notes:

ADWF = average dry-weather flow
GIS = geographic information system
ID = identification
N/A = not applicable

[1]Lift Station pump capacity will need to be verified from flow monitoring.

The critical system elevations for the existing system relevant to the development of the Combined Sewer Overflow (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	Dumoulin – 223.73
2	Trunk Invert at Off-Take	224.85
3	Top of Weir	225.02
4	Relief Outfall Invert At Flap Gate	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Interconnection (La Verendrye district boundary)	222.53
7	Low Basement	228.75
8	Flood Protection Level	229.72

[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 Dumoulin district was the *Dumoulin and La Verendrye Districts Combined Sewer Relief Study* (Wardrop, 2006). This report led to the construction of relief works for the existing CS systems to alleviate basement flooding. The CS district relief was completed at the same time for both Dumoulin and La Verendrye districts from 2002 to 2004. No other sewer work has been completed 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 Dumoulin 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
15 - Dumoulin	2006 - Conceptual	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

There is no current or proposed CSO or sewer relief investment work occurring within Dumoulin district.

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Dumoulin 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 Dumoulin district has in-line and floatable control projects proposed to meet CSO Control Option 1. Table 1-4 provides an overview of the control options to be included in the 85 percent capture in a representative year option. 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 systems are suitable for use as in-line storage. These options would take advantage of the existing pipe networks for additional storage volume. Existing DWF from the collection system would remain the same, and overall district operations would remain the same.

Floatable control will be necessary to capture any undesirable 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 capture level. Installation of a control gate will be also required for the screen operation, in addition to providing the mechanism for capture of the in-line storage.

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 In-Line Storage

In-line storage has been proposed as a CSO control for Dumoulin 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, primarily during low to moderate rainfall events. The control gate installation also provides the additional hydraulic head necessary for screening operations. It should be noted that for more severe rainfall events the control gate will no longer increase the storage levels in the existing CS, allowing the system to maintain the level of basement flooding protection.

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	225.19 m	
Trunk Diameter	1050 mm	
Gate Height	0.80 m	Gate height based on half trunk height assumption
Top of Gate Elevation	225.82 m	
Bypass Weir Elevation	225.70 m	
Maximum Storage Volume	109 m^3	
Nominal Dewatering Rate	0.15 m^3/s	Based on capacity of existing CS LS
RTC Operational Rate	TBD	Future RTC/dewatering review on assessment

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 15. The extent of the in-line storage and volume is related to the top elevation of the bypass weir. The level 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 raised 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 15-01 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 LFPS. The dimensions of the chamber to accommodate the bottom pivoting gate and an allowance for a side weir for floatables control are 5.3 m in length and 2.3 m in width, with an allowance for a longitudinal overflow weir. The existing sewer configuration including the construction of an additional off-take, and force main modifications may have to be completed accommodate the new chamber. This will be confirmed in future design assessments.

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 LS rehabilitation or replacement project. The control gate is proposed to be constructed within the existing lands the LFPS is located; therefore, minor disruptions are expected.

The nominal rate for dewatering is set at the capacity of the existing CS LS. This accommodates dewatering through the existing interceptor system within 24 hours following the runoff event, allowing it to recover in time for a subsequent event. Any future considerations, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflows at this district. Similar basis for the rate matching the lift station philosophy of two times nominal dewatering rate would be adopted. This future RTC control will provide the ability to capture and treat more volume for localized storms by using the excess interceptor capacity where the runoff is less.

1.6.3 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens would allow the system to maintain the current level of basement flooding protection. The screens would operate with the control gate in the raised position. A side weir upstream of the gate would direct the flow to the screens located in a new screening chamber, with screened flow discharged to the downstream side of the gate to reconnect into the outfall structure, and discharge to the river.

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

Table 1-6. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	225.82 m	
Bypass Weir Crest	225.7 m	
Normal Summer River Level	223.73 m	
Maximum Screen Head	1.97 m	
Peak Screening Rate	0.32 m^3/s	
Screen Size	1.5 m x 1.0 m	Modelled Screen Size

The proposed side overflow bypass weir and screening chamber will be located adjacent to the proposed control gate and existing CS trunk, as shown on Figure 15-01. The screens will operate with the control gate in its fully raised position. The 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 LS for routing to the NEWPCC for removal. The provision of screening pumps is dependent on final level assessment within the existing infrastructure and the Dumoulin trunk has potential for gravity screening return to occur. This will be confirmed during the future assessment stage.

The dimensions for the screen chamber to accommodate flow from the side by-pass weir, the screen area, and the routing of the discharge piping downstream of the gate are 2.0 m in length and 3.1 m in width. The existing sewer configuration may have to be modified to accommodate the new chamber.

1.6.4 Green Infrastructure

The approach to green infrastructure (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 applicable GI controls.

Dumoulin has been classified as a high GI potential district. Land use in Dumoulin is mix of residential, commercial, and institutional. The west end of the district is bounded by the Red River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. Commercial areas are suitable to green roofs and parking lot areas are ideal for paved porous pavement. Bioswales may be suitable to the industrial areas.

1.6.5 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 LS, which may 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 would be directed from the main outfall 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 would 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. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options 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	59	59	2,837	74	N/A
2037 Master Plan – Control Option 1	59	59	2,837	74	IS, SC

Notes:

Table 1-7. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model

Notes:
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. District Performance Summary – Control Option 1

	Preliminary Proposal	Master Plan			
Control Option	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [a]
Baseline (2013)	47,112	49,524	-	14	0.169 m^3/s
In-Line Storage	46,894	42,539	6,985	14	0.162 m^3/s
Control Option 1	**46,894**	**42,539**	**6,985**	**14**	**0.162 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. The improvement of this district is also associated with the proposed control options for the upstream gravity La Verendrye district.

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. District Cost Estimate – 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 (Over 35-year period)
In-Line Storage	N/A [a]	$2,250,000 [b]	$41,000	$880,000

Table 1-9. District Cost Estimate – 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 (Over 35-year period)
Screening		\$1,920,000 [c]	\$45,000	\$970,000
Subtotal	**\$0**	**\$4,170,000**	**\$86,000**	**\$1,850,000**
Opportunities	N/A	\$420000	\$9,000	\$190,000
District Total	**\$0**	**\$4,590,000**	**\$95,000**	**\$2,040,000**

[a] Solution development as refinement to Preliminary Proposal costs submission. Revised costs for this control gate and screenings work found to be \$1,810,000 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 Dumoulin CS LS are 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 calculation of the cost estimate for the CSO Master Plan 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.

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	In-Line Storage	Control Gate was not included in the Preliminary Proposal cost estimate	Added for the MP to further reduce overflows and optimize in-line storage

Table 1-10. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
	Screening	Screening was not included in the Preliminary Proposal cost 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 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 Dumoulin district would be classified as high potential for implementation of complete sewer separation as a feasible approach to meet future performance targets. 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 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	• Sewer Separation • Increased use of GI

The control options selected for the Dumoulin 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 not align with the proposed options for the 85 percent capture target. The future higher level of percent capture indicate that complete sewer separation would be applicable in this district. This district is linked to the upstream La Verendrye district, as this district discharges via gravity directly to the Dumoulin CS LS and any recommendations require to be integrated with those of La Verendrye district.

The cost for upgrading to 98 percent capture 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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-12.

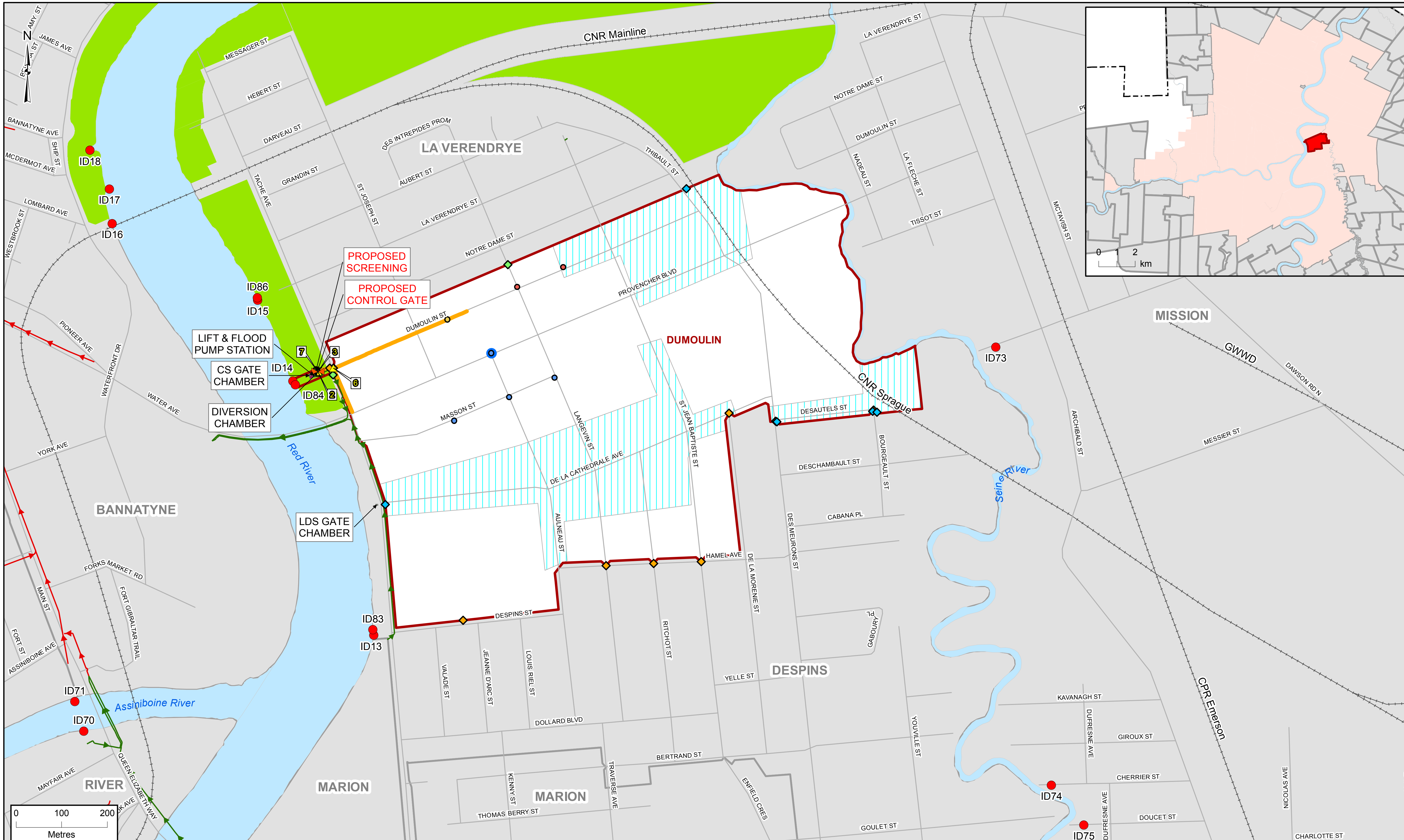
Table 1-12. Control Option 1 Significant Risks and Opportunities

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	-	-	-	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
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). 2006. *Dumoulin and La Verendrye Districts Combined Sewer Relief Study*. Prepared for the City of Winnipeg. December.



LEGEND

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

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

Winnipeg
THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 15
District Overview Map
Sewer District: Dumoulin
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE3\DUMOULIN\DUMOULIN_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:30:30 AM

LEGEND

- Primary Weir
- Critical Elevation
- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate
- Pump Location
- Force Main
- Sewer By Type
  - CS
  - WWS
- Control Structure Type
  - Gate Chamber
- Pump Station Type
  - Diversion Chamber
  - Lift & Flood Combined 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 15-01
Control Gate and Screening
Sewer District: Dumoulin
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE3\DUMOULIN\DUMOULIN_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 8:30:17 AM

CSO Master Plan

Ferry Road District Plan

August 2019

City of Winnipeg

JACOBS

CSO Master Plan

Project No: 470010CH
Document Title: Ferry Road District Plan
Revision: 03
Date: August 16, 2019
Client Name: City of Winnipeg
Project Manager: John Berry
Author: Stephen Godon
File Name: FerryRoad_Final_CO1MP_08162019

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	08/2018	Version 1 DRAFT	DT / SG	ES	
1	02/15/2019	DRAFT 2 for City Review	MF	SG	MF
2	08/13/2019	Final Draft Submission	DT	MF	MF
3	08/16/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Ferry Road District

1.1 District Description

Ferry Road district is located towards the western edge of the combined sewer (CS) area, southeast of the Winnipeg James Armstrong Richardson International Airport (Winnipeg Airport). This district is bounded by Moorgate and Douglas Park districts to the west, Parkside and Riverbend districts to the east, and the Red River to the south. The district is bounded by Sargent Avenue to the north and the Assiniboine River to the south. The boundaries to the east and west vary but are generally from Queen Street to Winchester Street north of Portage Avenue and from Library Place to Bourkevale Drive south of Portage Avenue.

Regional transportation routes that pass through this district include Portage Avenue, Ness Avenue, Ellice Avenue and Ferry Road.

Ferry Road is primarily residential with commercial areas along Portage Avenue and Ness Avenue and a general manufacturing/industrial region north of St. Matthews Avenue near the Winnipeg Airport. A small section in the east of Ferry Road is split by the Riverbend district. This area contains a mixture of residential and commercial areas and stretches from Silver Avenue to Portage Avenue and from Century Street to St. James Street.

The most significant non-residential building in Ferry Road is the Royal Aviation Museum of Western Canada, located south of the Winnipeg Airport. Other small green spaces, such as Truro Park and a section of St. James Rods Football club, can be found within Ferry Road. Truro Creek, which flows through and divides the west side of Ferry Road, flows from the Winnipeg Airport lands to the Assiniboine River.

1.2 Development

A portion of Portage Avenue is located within the Ferry Road District. Portage Avenue is identified as Regional Mixed-Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

Ferry Road encompasses an area of 290 hectares (ha)[1] based on the district boundary. Ferry Road is currently undergoing separation work that includes the installation of a separate land drainage sewer (LDS) system. The area to the north west of the district, around the airport lands has been classed as a separation ready area, covering approximately 7 percent by area. As of December 2018, the area east of Hampton Street has been completed and overall 30 percent of the district by area has been separated. As part of the separation work ongoing 100 percent of the district is anticipated to be separated in the future.

The CS system includes a CS lift station (LS) and one CS outfall. CS collected from the northern, western, and eastern sections flows into collector pipes along Ness Avenue, St. Matthews, and Ferry Road. These collectors then meet at the intersection of Ness Avenue and Ferry Road and flow southbound through the main 1950 by 3000 mm egg-shaped sewer trunk. The Ferry Road CS outfall located on the Assiniboine River near Assiniboine Avenue and Ferry Road receives the CS from this main trunk and from a 900 mm CS on Assiniboine Avenue serving the district area south of Portage Avenue. The Ferry Road main trunk also receives the intercepted CS from the Douglas Park district via a 375 mm interceptor pipe which connects upstream of the primary interception weir.

[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), the flow is diverted by the primary weir through a 500 mm off-take pipe to the Ferry Road CS LS. The sewage is then pumped through the 350 mm force main pipe north towards to the Portage Interceptor along Portage Avenue, where it flows eastwards ultimately towards the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), high flow in the system may cause the level in the trunk sewer to increase above the primary weir and overflow to the Assiniboine River via the Ferry Road CS outfall. The outfall consists of a positive and flap gate to protect against back-up due to high river levels. Under these same conditions however gravity discharge from the CS outfall is not possible, due to sewage backing up against the flap gate. There is no flood station at this location; however, in the case where high river levels are predicted to prevent flap gate operation during a WWF event, temporary flood pumping can be put in place.

The northern section of the Ferry Road district encompasses a small area surrounding the Winnipeg Airport lands and includes separate LDS and wastewater sewer (WWS) network that serves the buildings locally. Both the LDS and WWS for this area connect to the CS system and flow to the CS trunk on Ferry Road.

The CS outfall to the Assiniboine River is as follows:

- ID46 (S-MA70019349) – Ferry Road CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Ferry Road and the surrounding districts. Each interconnection is shown on Figure 16 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed in the following subsections.

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Riverbend

– The Ferry CS LS discharges to the Portage Avenue Interceptor, a 900mm interceptor carrying intercepted CS flows by gravity from the Ferry Road district into the Riverbend district and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

    - Portage Avenue interceptor invert – 230.65 m (S-MH20008213)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Douglas Park

- Intercepted CS from the Douglas Park district crosses into Ferry Road district through the 375 mm interceptor pipe. It flows through Bourkevale Park (east of Douglas Park Road), to be discharged to the Ferry Road LS.
    - Invert at district boundary - 226.1 m (S-MA20008531)

1.3.1.3 District Interconnections

Riverbend

<u>CS to CS</u>

- High Point Manholes (flow is directed into both districts from this manhole)
    - Marjorie Street and St. Matthews Avenue. 230.65 m (S-MH20007039)
    - Silver Avenue and Madison Street (Riverbend district boundary) – 231.52 m (S-MH20009635)

Parkside

CS to CS

- A 450 mm CS overflow into Parkside district from Ferry Road is at the intersection of Assiniboine Avenue and Bourkevale Drive
  - Assiniboine Avenue – 228.93 m (S-MH20008113)

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

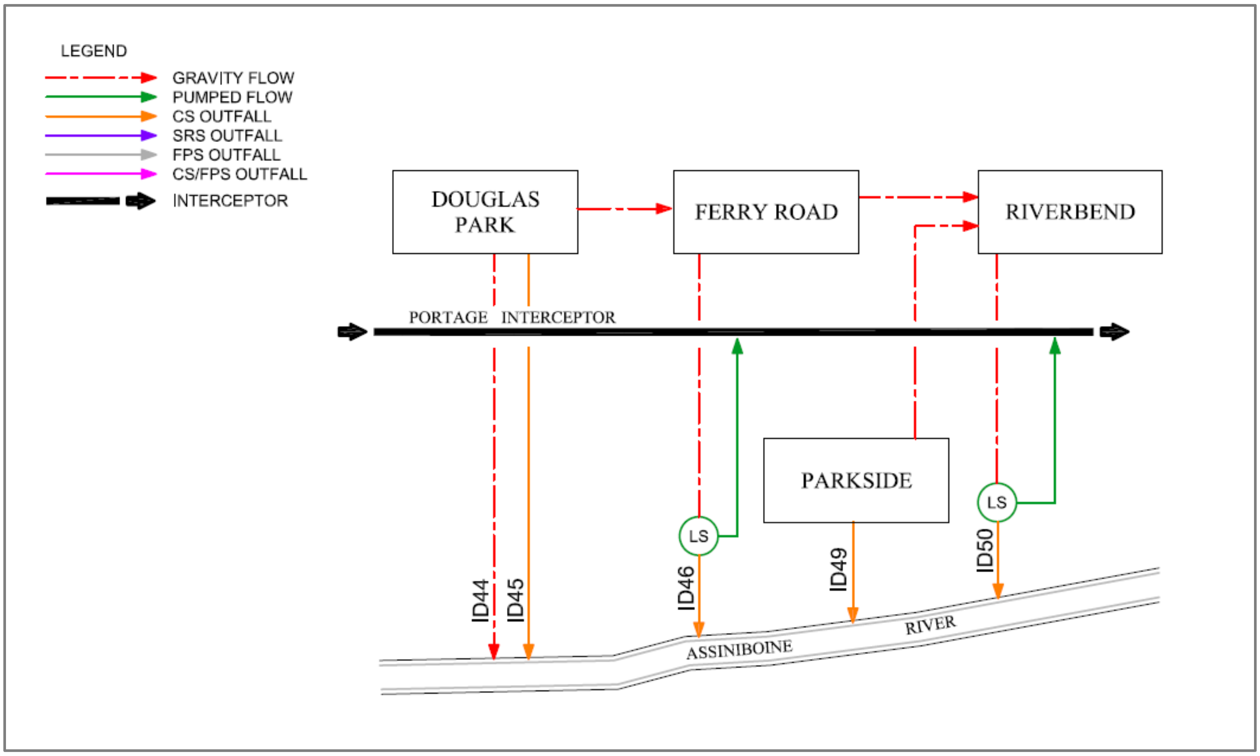


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 16 and are 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 (ID46)	S-AC70009025.1	S-MA70019346	1800 mm	Circular Invert: 224.99 m
Flood Pumping Outfall (ID46)	N/A	N/A	N/A	No flood pump station within the district.
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-AC70013535.1	S-MA70028302	1980 x 3050 mm	Egg-shaped Invert: 224.99 m
SRS Outfalls	N/A	N/A	N/A	No SRS within the district.
SRS Interconnections	N/A	N/A	N/A	No SRS within the district.
Main Trunk Flap Gate	S-AC70013537.1	S-CG00000807	1800 mm	Invert: 224.97 m
Main Trunk Sluice Gate	S-AC70009023.1	S-CG00000808	1800 x 1800 mm	Invert: 224.97 m

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Off-Take	S-MH70010263.1	S-MA70019359	500 mm	Circular Invert: 224.99 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.158 m^3/s	1 x 0.082 m^3/s 1 x 0.076 m^3/s
Lift Station ADWF	N/A	N/A	0.061 m^3/s	Ferry Road district as 0.057 m^3/s (no Douglas Park contribution)
Lift Station Force Main	S-AC70009022.1	S-MA70019343	350 mm	Invert: 223.35 m
Flood Pump Station Total Capacity	N/A	N/A	N/A	No flood pump station within the district.
Pass Forward Flow – First Overflow	N/A	N/A	0.155 m^3/s	

Note:
ADWF = average dry-weather flow
GIS = geographic information system ID = identification m^3/s = cubic metre(s) per second
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	224.55
2	Trunk Invert at Off-Take	224.99
3	Top of Weir	225.29
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Interconnection (Douglas Park)	226.34
7	Low Basement	228.75
8	Flood Protection Level	230.55

[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 for Ferry Road was in 2006 with the *Ferry Road and Riverbend Combined Sewer Relief Works* (Wardrop, 2006). This study discussed the possible separation work available for both Ferry Road and Riverbend CS systems to reduce the incidence of basement flooding. Since that time dedicated sewer separation work aligned with this study has been designed and constructed. To date, the area located to the east of Hampton Street has been completely separated.

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 Ferry Road 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
16 – Ferry Road	2006 - Conceptual	Future Work – Following Sewer Separation	2013	Sewer Separation Ongoing	TBD (estimated completion of 2028)

Note:
TBD = to be determined

1.5 Ongoing Investment Work

The Ferry Road basement flooding relief program began in 2013 with separation work being completed within the district. It is expected to continue through the beginning stages of the CSO Master Plan. Once completed, it will provide complete road drainage separation of the Ferry Road, Douglas Park, Parkside and Riverbend districts. Separation work will be integrated into the CSO Master Plan along with other control options.

To date, the separation work has been completed on the sections of Berry Street, Brooklyn Street, King Edward Street, Queen Street, and Madison Street between Portage Avenue and Silver Avenue and a section of Kensington Street between Ness Avenue and Silver Avenue. A further 10 Contracts for separation work on various segments of streets are to be completed in the future to completely separate the Ferry Road district.

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Ferry Road district. This consists of monthly site visits in confined entry spaces to verify 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 Ferry Road district are listed in Table 1-4**Error! Reference source not found.**. The proposed CSO control is sewer separation to align with work currently underway. 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% Capture in a Representative Year	-	-	-	-	-	-	-	✓	✓	✓	-

Notes:

- = not included
✓ = included

The decision to include complete sewer separation of Ferry Road under the BFR work will remove a large volume of land drainage from the CS system, thereby reducing the volume and number of CSOs for the district. The intent of complete separation would be to eliminate all CSOs from the district under the 1992 representative year rainfall conditions. This will require post separation monitoring to confirm the elimination of CSOs and remaining wet weather response in the district from existing building foundation drainage connections to the CS system.

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 Sewer Separation

Sewer separation is proposed for Ferry Road district as part of the CSO Master Plan and is underway as part of the Ferry Road and Riverbend separation work. Complete separation of Douglas Park is also included as part of this work will also remove a large volume of land drainage runoff from the neighboring district's CS system entering Ferry Road, thereby reducing the volume and number of CSOs for the district.

The work includes installation of a new independent LDS system to collect road drainage and divert this flow to a new connection point on the existing 1500 mm LDS sewer at intersection of Ness Avenue and Century Street, which is part of the Riverbend CS district. This existing LDS system drains to the Assiniboine River at near Century Street and Wolseley Avenue West.

The flows to be collected after separation will be as follows:

- DWF will remain the same – collected flow pumped from Ferry Road CS LS to the interceptor.
- WWF will consist of sanitary sewage combined with foundation drainage.

This will result in a reduction in combined sewage flow received at Ferry Road CS LS after the separation project is complete. It is proposed that future monitoring of the district is completed to verify that the sewer separation is fully compliant with the goal of elimination of all CSO overflows under 1992 rainfall conditions. A static weir elevation increase may be necessary at the CS diversion to eliminate the occurrence of all CSO events during the 1992 representative year. The initial hydraulic model assessment indicated that using the existing static weir level one CSO occurrence for the Ferry Road district would continue to occur after the separation work is complete. An increase of 580 mm in the primary weir height was assessed to be required, and this increase has been evaluated in the hydraulic model and was found to not impact the upstream hydraulic grade. This is primarily due to the removal of WWF from the separation projects in neighboring districts as part of the BFR work. Any weir elevation raise will be further evaluated in terms of actual flow monitoring data to confirm ensure the existing level of basement flood protection remains.

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 will be reviewed to identify the most applicable GI controls.

Ferry Road has been classified as a high GI potential district. The land use is primarily residential with commercial areas along Portage Avenue and Ness Avenue and a general manufacturing/industrial region north of St. Matthews Avenue near the Winnipeg Airport. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, and rain gardens. The commercial buildings along Portage Avenue would be ideal for green roof projects, and the greenspace areas in the district would be ideal for bioretention 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 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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers, and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district.

It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the CS system) extent within the Ferry Road district.

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 model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	235	235	6,822	36	N/A
2037 Master Plan – Control Option 1	235	216	6,822	1	SEP

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model

Notes:

Total area is based on the model subcatchment boundaries for the district.
SEP = Separation
% = percent

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-6, are for the hydraulic model simulations using the year-round 1992 representative year applied uniformly. 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 1-6. 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
Baseline (2013)	124,634	136,599	-	22	0.185 m^3/s [b]
Sewer Separation	0 [a]	420	136,179	1	0.171 m^3/s [b]
Separation & Static Weir Height Increase		0	420	0	0.170 m^3/s [c]
Control Option 1	**0**	**0**	**136,599**	**0**	**0.170 m^3/s [c]**

[a] Separation and In-line storage were not simulated independently during the Preliminary Proposal assessment

[b] Pass forward flows assessed with the 1-year design rainfall event

c Pass forward flows assessed with the 5-year design rainfall event

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entre CS system, and not for each district individually. However, the full capture of overflows volumes for the Ferry Road district would represent a 100 percent capture rate on a district level.

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 relevant 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 1-7. The cost estimates are a Class 5 planning level estimate with a level of accuracy range of minus 50 percent to plus 100 percent.

Table 1-7. Cost Estimates – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost [a]	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance Cost (Over 35-year period) [a]
Sewer Separation	$195,600,000	$129,360,000 [b]	$77,000	$1,650,000
Subtotal	**$195,600,000**	**$129,360,000**	**$77,000**	**$1,650,000**
Opportunities	N/A	$12,940,000	$8,000	$170,000
District Total	**$195,600,000**	**$142,300,000**	**$85,000**	**$1,820,000**

[a] Ferry Road separation is approximately 30% complete and an adjustment has been included in the CSO Master Plan district capital cost estimate to account for this.

[b] Separation capital costs do not include static weir height raise work recommended.

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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Sewer Separation	Unit Costs were updated. Cost adjusted for percentage of sewer separation completed	
-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	

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
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 complete separation of the Ferry Road district will achieve the 100 percent capture figure, and no other further work will be required to meet the future performance target. It is recommended to complete post separation modelling to confirm the target is fully achieved.

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 as part of the CSO Master Plan and is included as part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-9.

Table 1-9. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-

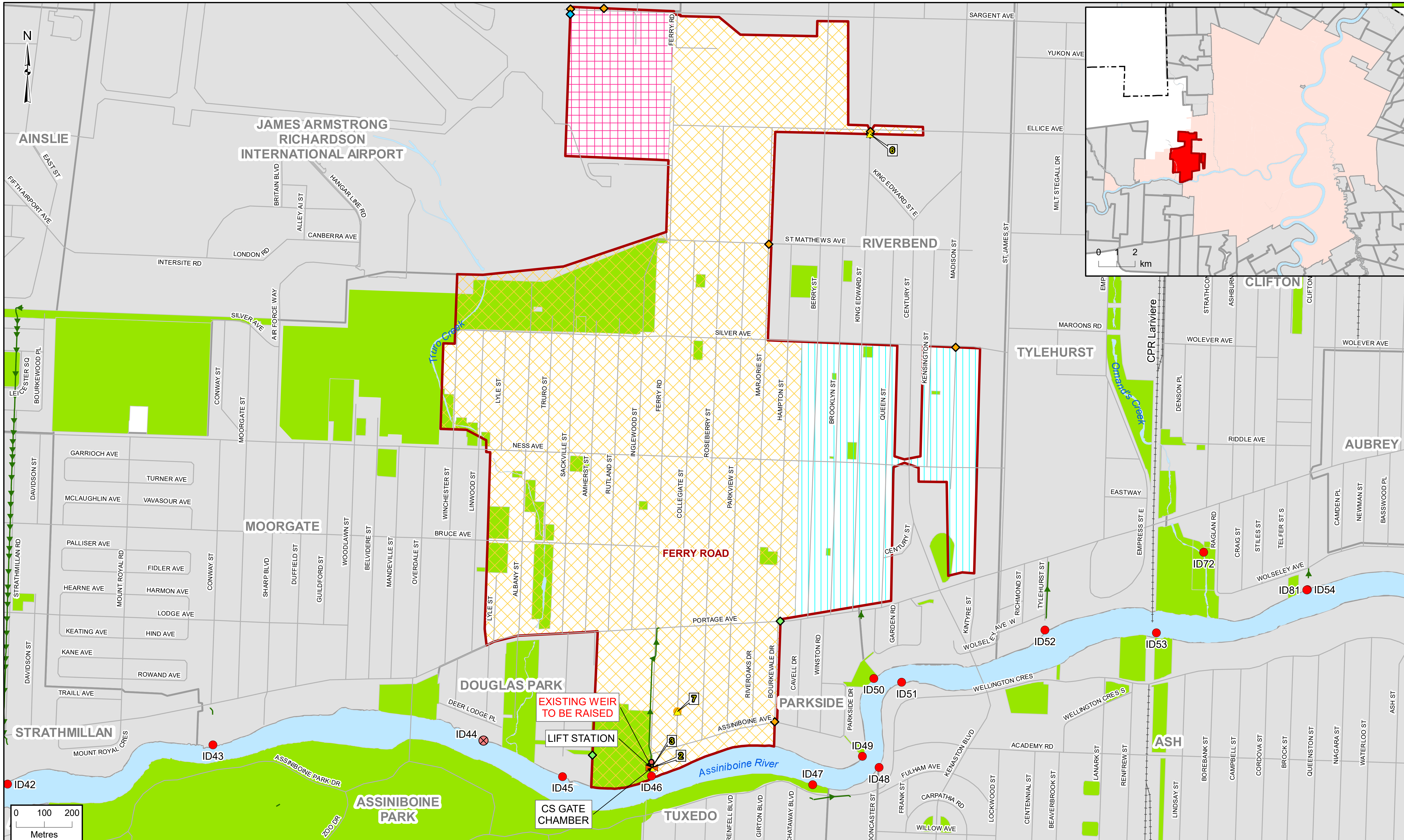
Table 1-9. Control Option 1 Significant Risks and Opportunities

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
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

Wardrop. 2006. *Ferry Road and Riverbend Combined Sewer Relief Works*. Prepared for the City of Winnipeg Water and Waste Department. November.



LEGEND

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

Inter-System Connection
- CS - WWS

District Boundary Crossing
- CS
- LDS
- WWS

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

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Underway
- Sewer Separation - Complete
- Sewer Separation - Ready

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 16
District Overview Map
Sewer District: Ferry Road
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE4\FERRYROAD\FERRYROAD_DISTRICT_OVERVIEW_MAP.MXD DT072410 7/29/2019 8:55:47 AM

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

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

<u>CS to CS</u>

- 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)

<u>SRS to SRS</u>

- 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.

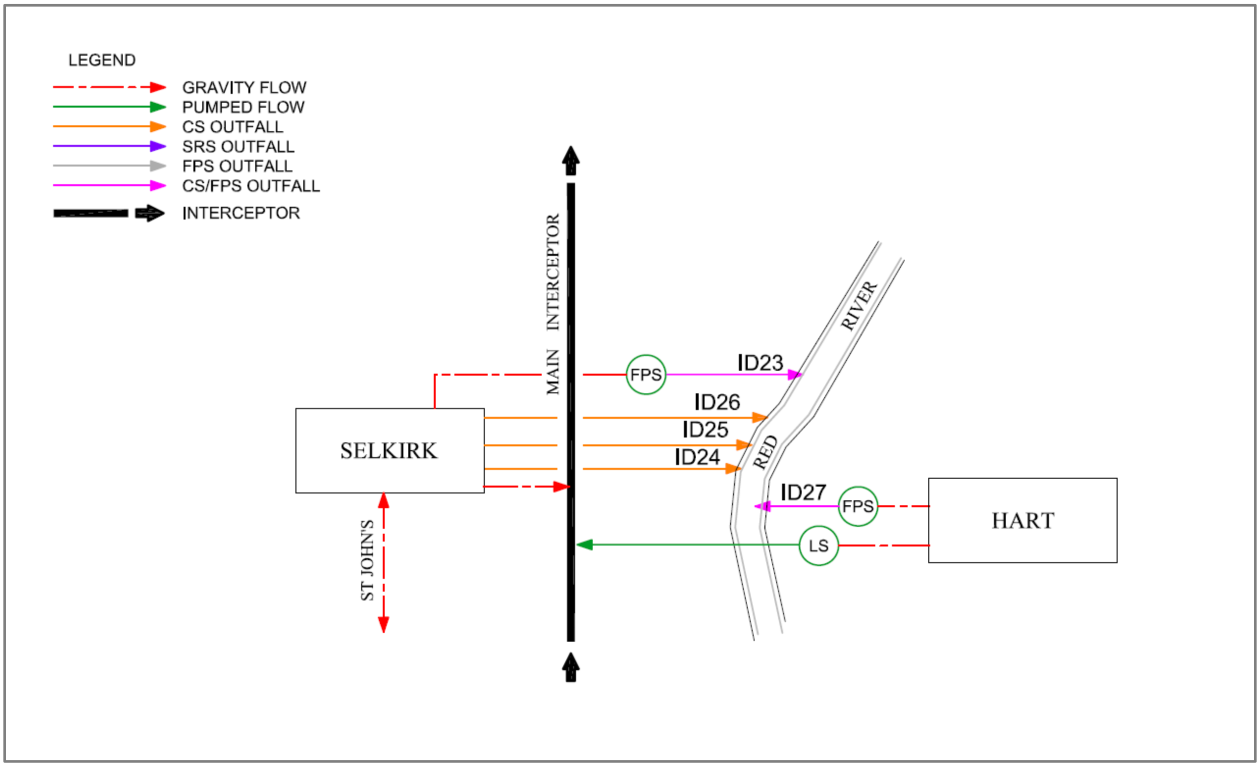


Figure 1-1. District Interconnection Schematic

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	-

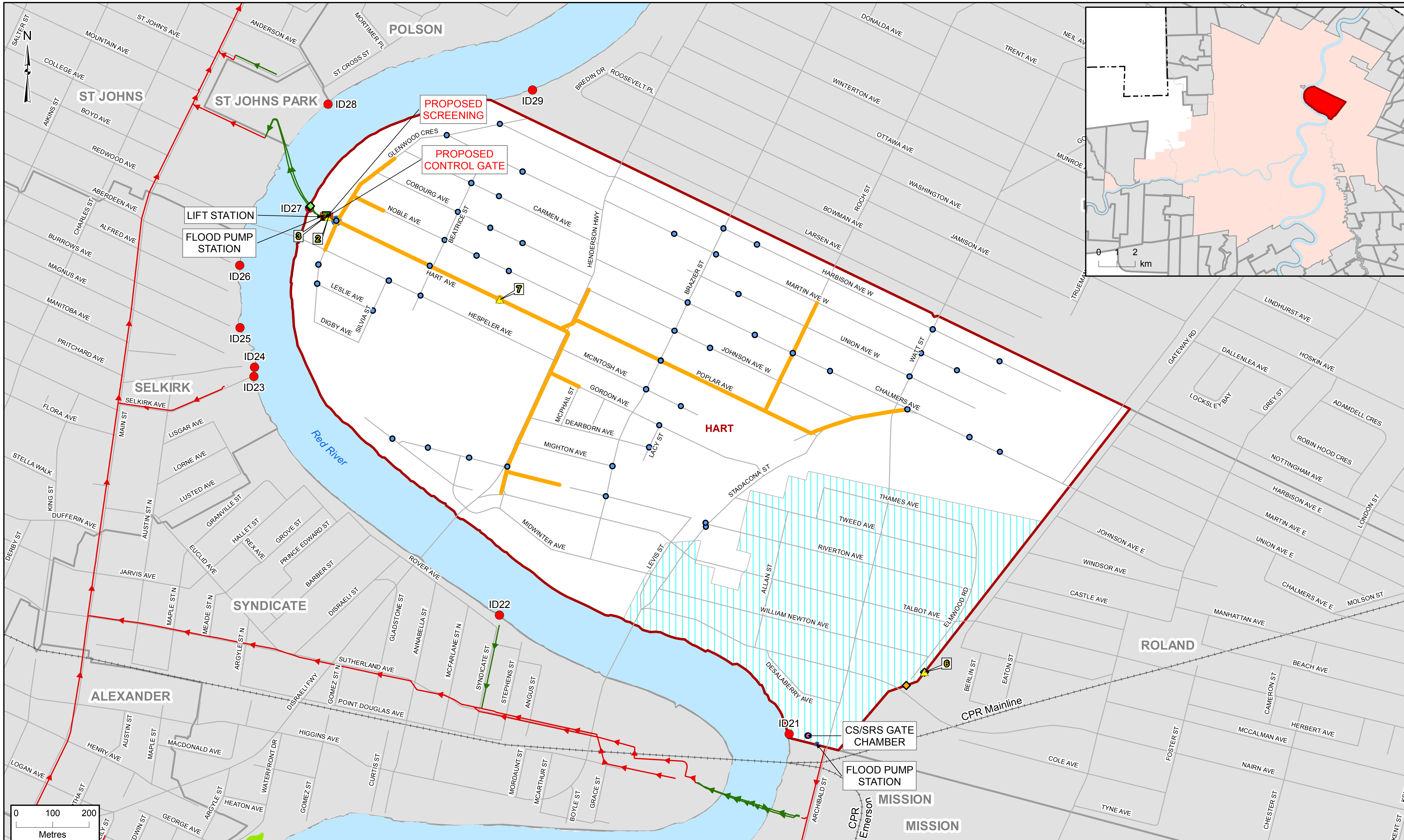
Table 1-12. Control Option 1 Significant Risks and Opportunities

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	Inter-System Connection	District Boundary Crossing	Interceptor Sewer	District Boundary
Critical Elevation	CS - WWS	CS	Force Main	Watercourse
CSO Outfall	SRS - CS	SRS	Street	Greenspace
Low CS Manhole	SRS - LDS	WWS	Railway	
Low SRS Connection				

CSO MASTER PLAN PROPOSED SOLUTIONS

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

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

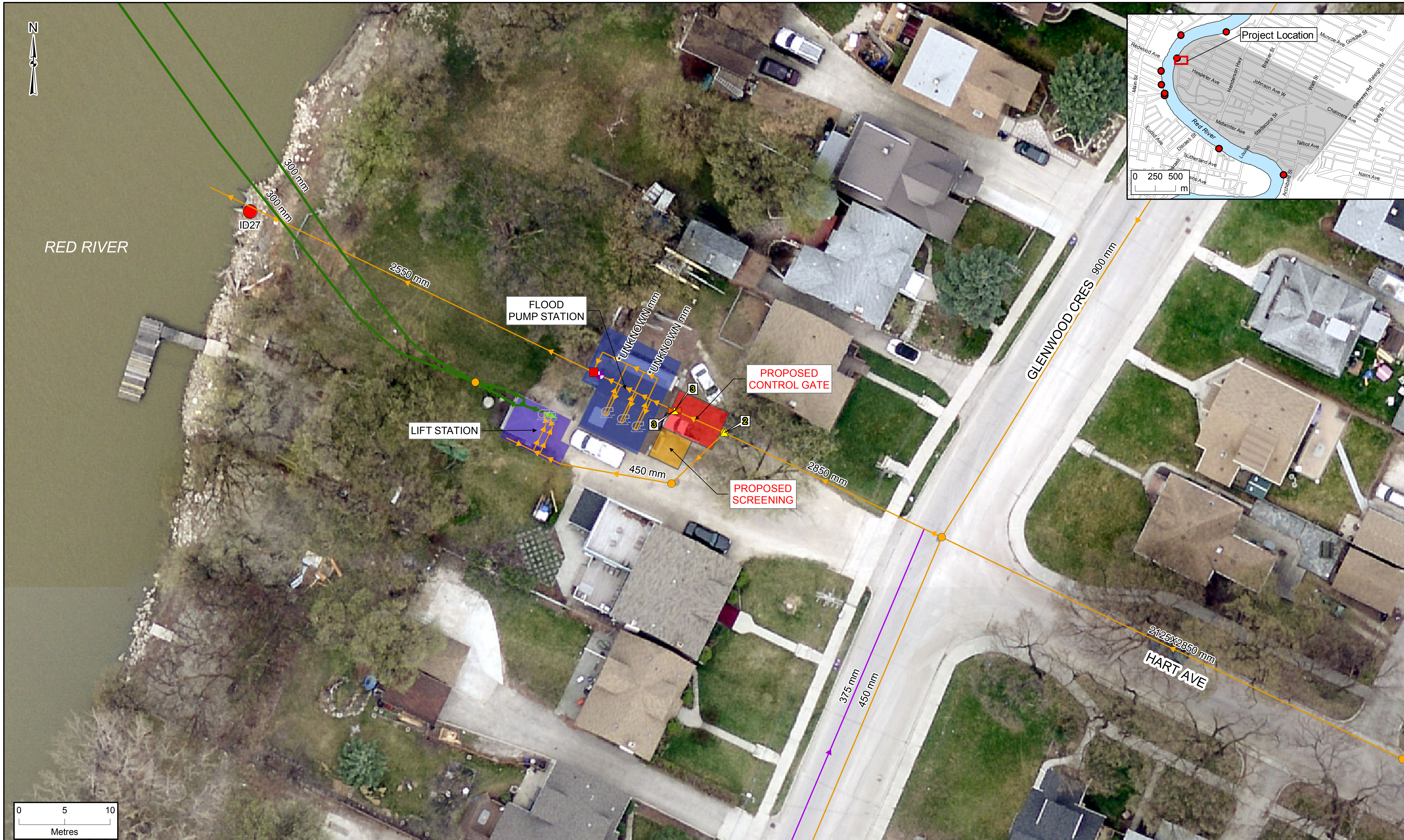
JACOBS

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

CSO Master Plan

Hawthorne District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No: 470010CH
Document Title: Hawthorne District Plan
Revision: 03
Date: August 22, 2019
Client Name: City of Winnipeg
Project Manager: John Berry
Author: Scott Begg
File Name: Hawthorne_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	Version 1 DRAFT	KM	DT SG	
1	02/15/2019	DRAFT 2 for City Review	SB	SG	MF
2	07/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Hawthorne District

1.1 District Description

Hawthorne district is in the northeast sector of the combined sewer (CS) area along the eastern edge of the Red River and north of Linden and Munroe Annex districts. Hawthorne is approximately bounded by Fraser's Grove, Colvin Avenue, and Cameo Crescent to the south, the Red River to the west, Springfield Road to the north, and Raleigh Street to the east.

Most of the Hawthorne district is residential with portions of commercial and greenspace land use. Most of the residential units consist of single-family dwellings; multi-family and two-family units are located along Edison Avenue and Henderson Highway. Several parks are located throughout the district, with greenspace areas and parks bounding portions of the district. Approximately 17 ha of the district is classified as greenspace.

Henderson Highway, running in the north-south direction, is the only regional roadway in the district. Other main transportation routes include Roch Street, Rothesay Street, and Raleigh Street in a north-south direction and Kingsford Avenue, Edison Avenue, Oakland Avenue, Mcleod Avenue, and Hawthorne Avenue in the east-west direction.

1.2 Development

A portion of Henderson Highway is located within the Hawthorne District. Henderson Highway is identified as a Regional Mixed-Use Corridors as part of the OurWinnipeg future development plans. As such, focused intensification along Henderson Highway is to be promoted in the future.

1.3 Existing Sewer System

Hawthorne district encompasses an area of 245 ha[1] based on the district boundary and includes a CS system with a relatively small portion of separated wastewater sewer (WWS) and land drainage sewer (LDS) in the southwestern corner of the district. As shown in Figure 18, there is approximately 11 ha (4 percent) already separated. There are no identifiable separation ready areas. Hawthorne district does not have an SRS system.

The CS system includes a dual lift and flood pump station (LFPS), and one combined CS/FPS outfall. All of the CS from the district flows towards to the primary CS outfall, located at the intersection of Hawthorne Avenue and Kildonan Drive. Two main CS trunk sewers collect flow from the district. The larger of the two trunks is a 1050 mm increasing to 1650 mm CS, which extends east to west along Hawthorne Avenue and Kingsford Avenue. The second CS trunk sewer is a 600 mm increasing to 1350 mm sewer that generally extends east to west along Mcleod Avenue, Rowandale Avenue, Larchdale Crescent, and Kildonan Drive. Multiple secondary sewers connect to the CS trunks from the north and south to service the entire district.

During dry weather flow (DWF), the Hawthorne primary weir diverts flow to the lift section of the Hawthorne LFPS through a 525 mm off-take pipe, where it is pumped under pressure through a force main crossing the Red River and to the Newton district. From here, the intercepted combined sewage ties into the secondary sewer in the Newton district, which ties into the Main Interceptor, and eventually on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), any flows that exceeds the diversion capacity overtops the primary weir and is discharged to the Red River through the Hawthorne CS outfall. Sluice and flap gates are installed

[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

on the outfall to prevent back-up of the Red River into the system under high river level conditions. However not only does the flap gate prevent river water intrusion, but it also prevents gravity discharge from the Hawthorne CS outfall. Under these conditions the excess flow is pumped by the flood pumps of the Hawthorne LFPS to a point in the Hawthorne CS Outfall downstream of the flap gate, where it can be discharged to the river by gravity once more.

The WWS system in the southwest corner of the Hawthorne district, and directs flow to a small WWS lift Station (LS) on Rowandale Avenue and Larchdale Crescent, where sewage is pumped into the CS system.

The LDS system is predominately in the southwestern corner of the Hawthorne district, and directs the surface runoff flow received from this area to the Red River via a dedicated LDS outfall located near the intersection of Rowandale Crescent and Kildonan Drive. Sluice and flap gates are installed on this LDS outfall to prevent back-up of the Red River into the LDS system under high river level conditions.

There is also an older LDS system, which flows through what was previously McLeod Creek in the northwestern corner of Hawthorne district. To allow for development over this existing creek, LDS pipes were installed where the creek originally existed to still allow for drainage of surface runoff to the Red River. Two distinct LDS systems exist surrounding McLeod Creek, one north of Hawthorne Avenue and another south. The LDS system north of Hawthorne drains north via a combination of buried pipes and open channel ditch arrangements, and eventually discharges into the Red River immediately north of Chief Peguis Trail. The LDS system south of Hawthorne collects in a 750 mm corrugated metal pipe, which then ties into the Hawthrone CS trunk sewer at Hawthorne Avenue immediately east of Kildonan Drive.

There is one CS outfall to the Red River:

- ID38 (S-MA70062167) – Hawthorne CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Hawthorne and the surrounding districts. Each interconnection is shown on Figure 18 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

Newton

- Two 350 mm force mains carry flow from the sewage pump stations in the Linden and Hawthorne districts across the Red River to the Newton district. These force mains are connected back assumed isolated from each other within the current system and the Linden force main is added for information:
  - Invert at manhole on Newton Avenue at Newton district boundary (Hawthorne force main) – 225.66 m (S-MA70021128)
  - Invert at manhole on Newton Avenue at Newton district boundary (Linden force main) – 225.63 m (S-MA00017639)

1.3.1.2 District Interconnections

Linden

<u>CS to CS</u>

- A 300 mm CS on Brazier Avenue and Colvin Avenue is diverted into the CS system in the Hawthorne from the 375 mm CS flowing by gravity westbound on Colvin Avenue:
  - Invert at Linden district boundary 226.68 m (S-MH40001749)

- High Point Manhole
  - 300 mm CS on Colvin Avenue and Roch Street – 227.71 m (S-MH40005627)

Whellams (Area 2 (NE))

<u>WWS to CS</u>

- A 200 mm WWS is diverted from the WWS system in Whellams district on Springfield Road and flows by gravity into the CS system in the Hawthorne district:
  - Invert at Hawthorne district boundary 226.94 m (S-MA40002474) LDS to LDS

<u>LDS to LDS</u>

- A 550X900 mm LDS flows north from the Hawthorne district into Whellams district:
  - Invert at Whellams district boundary 224.07 m (S-MA70133155)

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

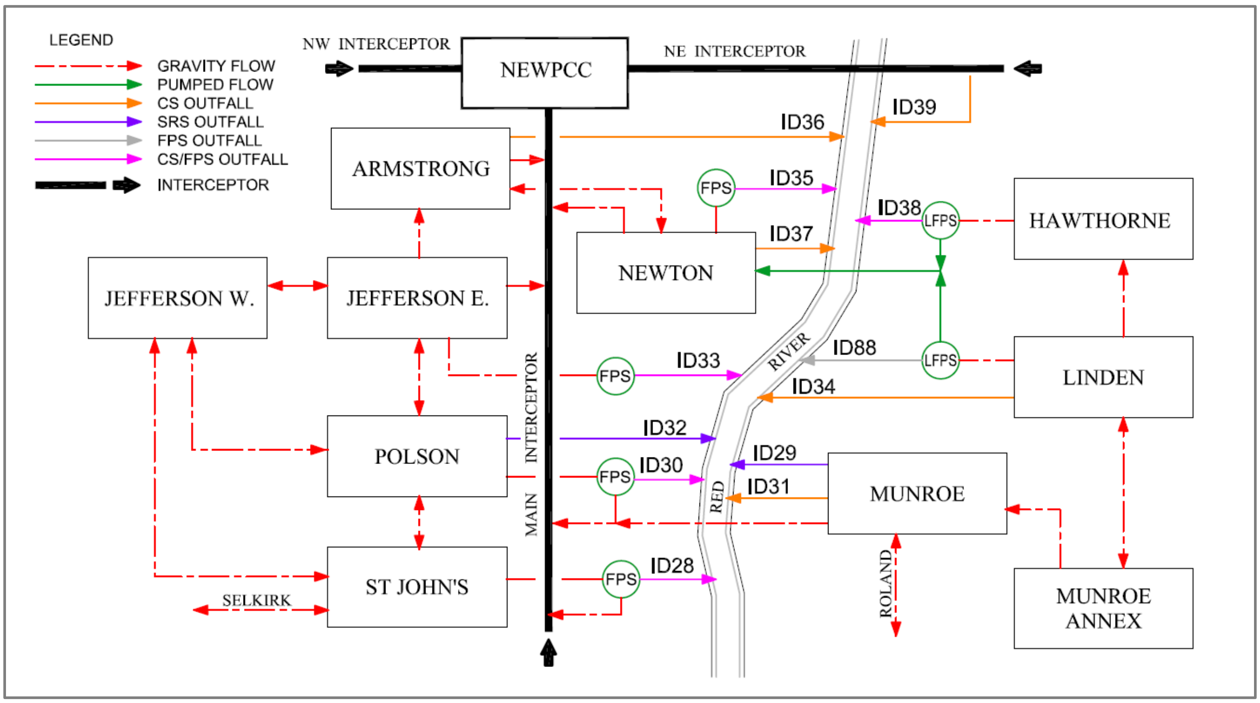


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 18 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 (ID38)	S-CO70033943.1	S-MA70062167	2100 mm	Red River Invert: 222.19 m
Flood Pumping Outfall (ID38)	S-CO70033943.1	S-MA70062167	2100 mm	Red River Invert: 222.19 m

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-TE40000580.1	S-MA40003335 S-MA40002190	1650 mm 1350 mm	Invert: 223.73 m Invert: 223.86 m
SRS Outfalls	N/A	N/A	N/A	No SRS within the district.
SRS Interconnections	N/A	N/A	N/A	No SRS within the district.
Main Trunk Flap Gate	S-TE70026151.2	S-CG00000954	1650 mm	Invert: 223.74 m
Main Trunk Sluice Gate	S-CG00000813.1	S-CG00000813	1500 x 1500 mm	Invert: 223.43 m
Off-Take	HAWTHORNE_WEIR.1	S-MA70021133	525 mm	223.76 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.116 m^3/s	2 x 0.058 m^3/s
ADWF	N/A	N/A	0.054 m^3/s	
Lift Station Force Main	S-RE70009952.1	S-MA70021119	250 mm	Upstream invert: 223.40 m
Flood Pump Station Total Capacity	N/A	N/A	2 x 0.58 m^3/s	
Pass Forward Flow – First Overflow	N/A	N/A	0.159 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	Hawthorne – 223.64
2	Trunk Invert at Off-Take	223.76
3	Top of Weir	224.27
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Interconnection (Newton)	226.67 m
7	Low Basement	225.40
8	Flood Protection Level (Munroe, Linden, Hawthorne)	229.04

[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 LDS system was installed in the late 1970s. The most recent study completed in Hawthorne was the *Linden and Hawthorne Districts Combined Sewer Relief Study Conceptual Design Report* (Wardrop Engineering Inc., 1994). The study's purpose was to develop a sewer relief system to protect the Linden and Hawthorne districts against basement flooding to a 5-year and 10-year level of service. An analysis to reduce overflows from the CS system to the Red River was also completed. 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 Hawthorne 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
18 – Hawthorne	1994	2015 Summer Flow Monitoring Campaign	2013	Conceptual Study Complete	N/A

Source: Report on *Linden and Hawthorne Districts combined sewer relief study*, 1994

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Hawthorne 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.

Repair and investigation work is ongoing within part of the LDS system, which flows through what was previously McLeod Creek, in the northwestern corner of Hawthorne District. This work includes repairing collapsed sewers, cross connections, and other issues found within this LDS system.

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 Hawthorne sewer district are listed in Table 1-4. The proposed CSO control projects will include in-line storage via a control gate, gravity flow control, 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. These 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 installation of a control gate will provide the mechanism for capture of the additional in-line storage.

Floatable control will be necessary to capture any undesirable 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. A screen will be installed on the primary outfall located at the west end of Hawthorne Avenue. The control gate utilized for in-line storage will also be required to provide the necessary hydraulic head for the screen operation.

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 Hawthorne 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 and provide additional hydraulic head for screening operations. The existing lift section of the LFPS 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	223.73 m	
Trunk Diameter	1650 mm	
Gate Height	0.33 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	224.60 m	
Bypass Weir Elevation	224.50 m	
Maximum Storage Volume	565 m^3	
Nominal Dewatering Rate	0.116 m^3/s	Based on existing CS LS capacity
RTC Operational Rate	TBD	Future RTC/dewatering review on assessment

Note:
RTC = Real Time Control

TBD = to be determined

It should be noted that while the in-line storage arrangement design will only provide a minor additional volume capture, this performance is still acceptable for the solution to be considered cost effective compared to other control options for the district.

The proposed control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 18. 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 level in the system for basement flooding protection: when the system level increases the flow overtops the bypass weir and is screened prior to discharging to the river. If the system level continues to rise, it will reach the critical level where the control gate drops out of the way. This allows for a free discharge as per existing system conditions and all excess CS would flow over the weir and discharge to the river. After the level 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 river crossing via pumping. The CS LS will further dewater the in-line storage provided during a WWF event as downstream capacity becomes available.

Figure 18-01 provides an overview of the conceptual location and configuration of the control gate and screening chambers. The proposed control gate will be installed in a new chamber within the existing trunk sewer alignment downstream from the off-take pipe that connects to the LFPS and upstream of the existing outfall gate chamber. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5.0 m in length and 3.0 m in width. The existing sewer configuration including the off-take and the force main may have to be modified to accommodate the new chamber. This will be confirmed in future design assessments. It is envisaged that the construction of the gate and screen chambers will be within the City owned land around the existing Hawthorne LS. There would be minimal disruptions to the local area from the proposed construction activities, as this would involve access via local minor residential streets.

The Larchdale wastewater LS connects into the CS system along the length that will be used for in-line storage. The operation and interaction of this lift station with the in-line storage will not be affected by the in-line storage extent due to the higher level of the force main connection level with the existing CS sewer. This assessment would be further confirmed/evaluated during the next stage of design although not expected to influence any changes to the system.

The nominal rate for dewatering is set at the existing 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. Any future considerations, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing pipe capacity/LS operation for large events will adversely affect the overflows at this district. This future RTC control will provide the ability to capture and treat more volume for localized storms by using the excess interceptor capacity where the runoff is less.

1.6.2 Floatables Management

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

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

Table 1-6. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.60 m	
Bypass Weir Crest	224.50 m	
NSWL	223.64 m	
Maximum Screen Head	0.86 m	
Peak Screening Rate	0.35 m^3/s	
Screen Size	1.5 m x 1.0 m	Modelled Screen Size

The proposed side overflow weir and screening chamber will be located adjacent to the proposed control gate and the existing CS, as shown on Figure 18-01. The screens will operate with the control gate in its raised position. A side bypass weir upstream of the 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 the CS system and on to the NEWPCC for removal. As the screening chamber would be constructed with the control gate chamber, the construction activities will be similar in that minimal disruption with the location being on City owned land have been envisaged.

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 3.0 m in length and 3.0 m in width. The existing sewer configuration may have to be modified to accommodate the new chamber.

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 will be reviewed to identify the most applicable GI controls.

Hawthorne has been classified as a medium GI potential district. Land use in Hawthorne is residential with portions of commercial and greenspace. The west end of the district is bounded by the Red River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. Commercial areas are suitable to green roofs and parking lot areas are ideal for paved porous pavement.

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. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options 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	238	238	8,886	15	N/A
2037 Master Plan – Control Option 1	238	238	8,886	15	IS,

Notes:

IS = In-line 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 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	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 [a]
Baseline (2013)	33,395	33,245	-	18	0.159 m^3/s
In-Line Storage	26,616	30,493	2,752	17	0.159 m^3/s
Control Option 1	**26,616**	**30,493**	**2,752**	**17**	**0.159 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 **Error! Reference source not found.**. 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 Estimate – 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)
Separation	$144,110,000	N/A [a]	N/A	N/A
In-Line Storage	N/A [b]	$2,650,000 [c]	$44,000	$940,000
Screening		$1,990,000 [d]	$50,000	$1,080,000
Subtotal	**$144,110,000**	**$4,640,000**	**$94,000**	**$2,020,000**
Opportunities	N/A	$460,000	$9,000	$200,000
District Total	**$144,110,000 [b]**	**$5,100,000**	**$103,000**	**$2,220,000**

a Sewer Separation recommendation as part of Preliminary Proposal was eliminated during the Master Plan percent capture assessment

[b] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Preliminary Proposal recommended in-line storage and screening for CO1 PP. Costs for these items of work found to be $2,010,000 in 2014 dollars

[c] Costs associated with new off-take construction, as required, to accommodate control gate and screening chambers in location and allow intercepted CS flow to reach existing Hawthorne CS LS was not included in Master Plan

[d] 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 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.

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	Removal Of Separation	Determined to not be required to achieve the capture requirement during the Master Plan assessments.	
	In-Line Storage	A control gate was not included in the preliminary estimate.	Added for the MP to further reduce overflows and optimize existing in-line storage.
	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	
Lifecyle 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 for construction inflation	Preliminary 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 Hawthorne district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. The City however has previously identified Hawthorne as a district where sewer separation would be preferable. This is due to existing land drainage runoff concerns surrounding the McLeod Creek, previous basement risks, and operational issues with the lift station and outfall structure. The modelled existing overflow volume overall though indicates that a more cost-effective solution would involve off-line tank or tunnel storage. The provision for opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure may be utilized in key locations to provide additional storage and increase capture volume 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	• Opportunistic sewer separation • Increased GI • Off-line Storage (Tank/Tunnel)

The control options selected for the Hawthorne 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 not be aligned if the district went to complete separation based on the City's potential preferred separation district nominations. However, this district could also be considered for recommendation to the alternative floatables management approach, where this is achieved by targeting floatables source control as a replacement to screening facilities.

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.

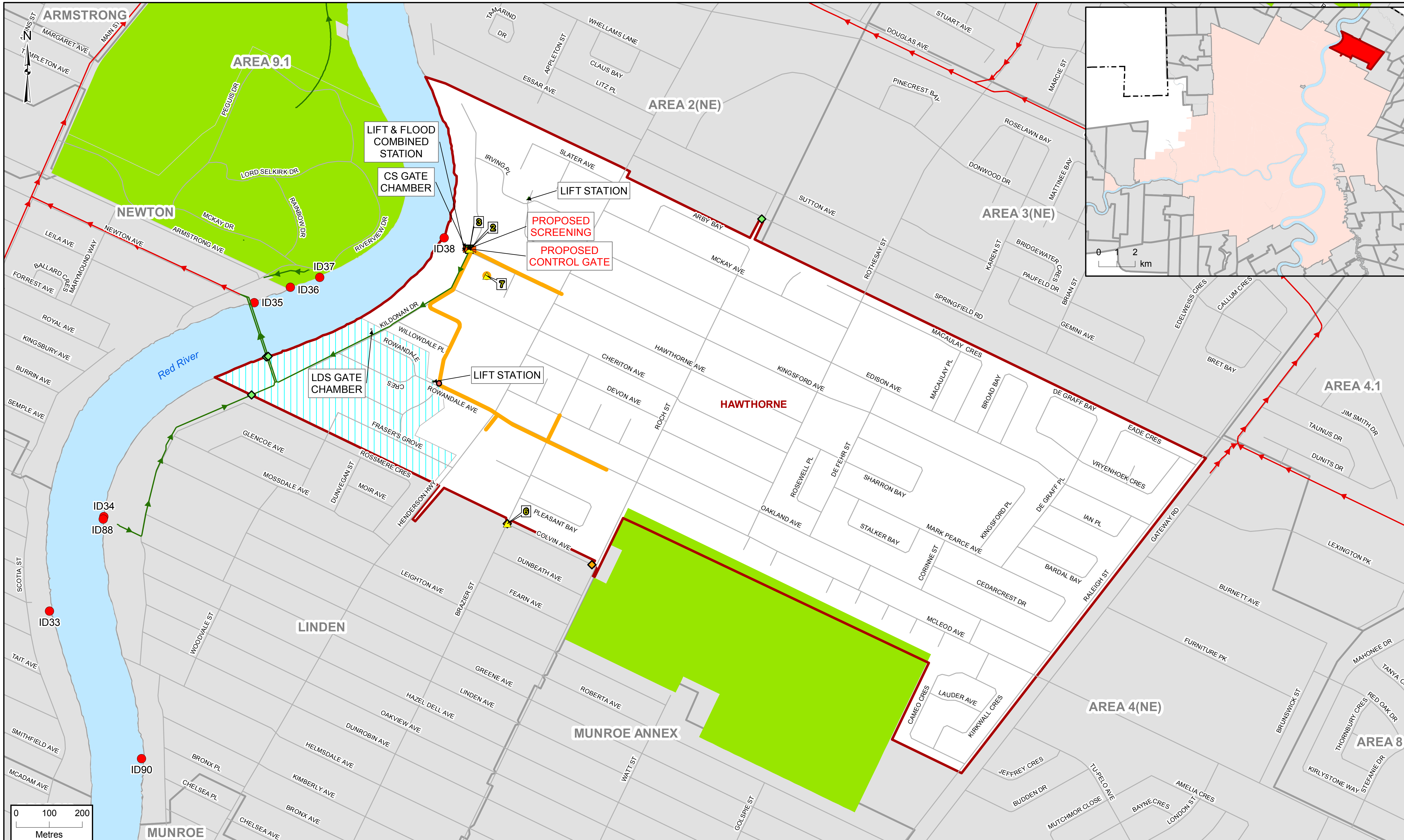
Table 1-12. Control Option 1 Significant Risks and Opportunities

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	-
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 Inc, TetrES Consultants Inc. 1994. *Linden and Hawthorne Districts Combined Sewer Relief Study Conceptual Design Report.* Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. May.



LEGEND

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

Inter-System Connection
- CS - WWS

District Boundary Crossing
- CS
- WWS

- Interceptor Sewer
- Force Main
- Street
- 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

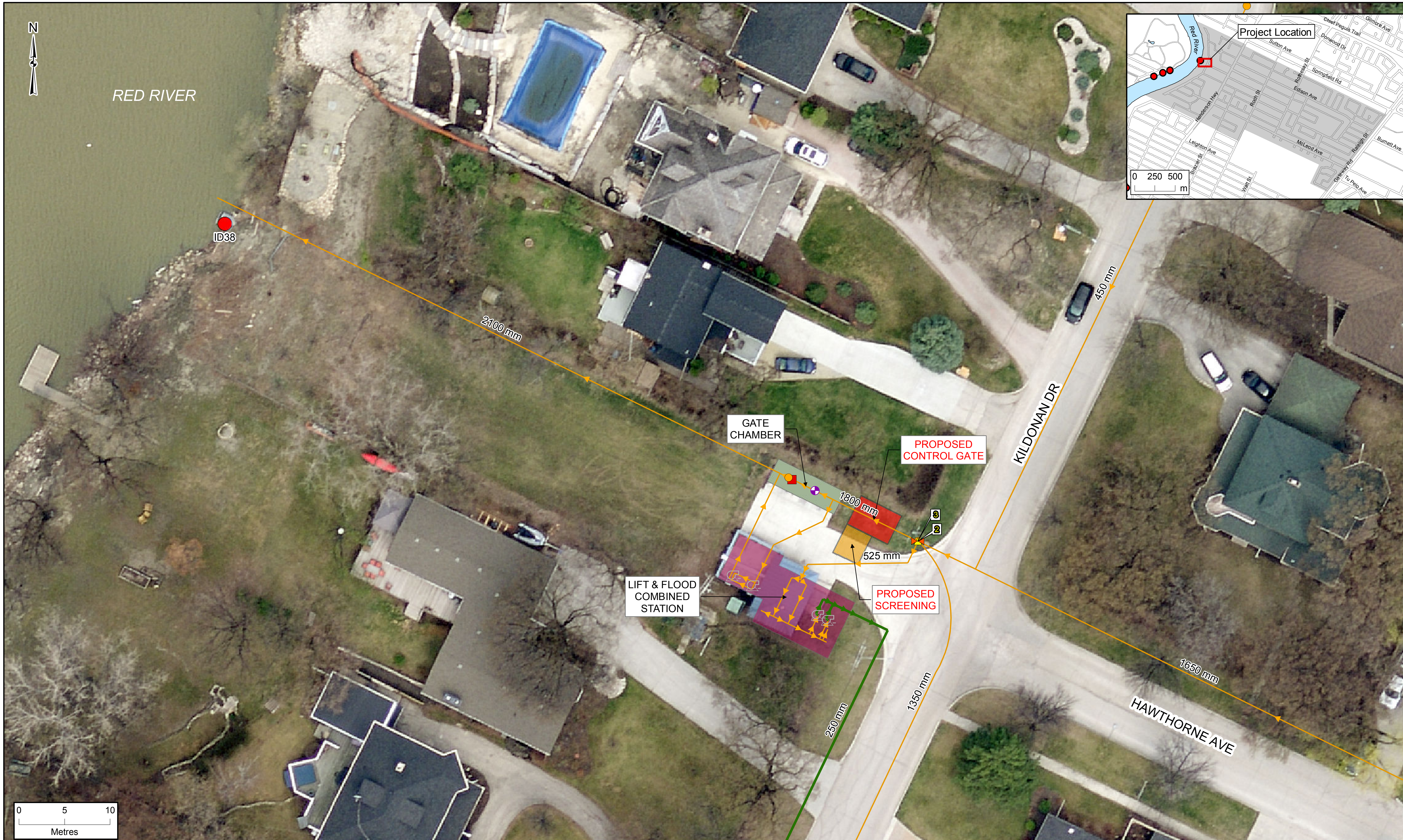
Notes:
1. Map data source - City of Winnipeg, 2013

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 18
District Overview Map
Sewer District: Hawthorne
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE7\HAWTHORNE\HAWTHORNE_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 9:59:59 AM



LEGEND

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

Sewer By Type
- CS
- WWS

Control Structure Type
- Gate Chamber

Pump Station Type
- Lift & Flood Combined 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 18-01
Flood Pumping Station
Sewer District: Hawthorne
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE7\HAWTHORNE\HAWTHORNE_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 10:02:20 AM

CSO Master Plan

Jefferson East District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Jefferson East District Plan
Revision:	03
Date:	August 20, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	JeffersonE_Plan_Final_CO1MP_08202019

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	09/14/2018	DRAFT for City Comment	JT	SB, MF, SG	
1	06/2019	Draft 2 for City Review	JT	MF	MF
2	08/12/2019	Final Draft Submission	DT	MF	MF
3	08/20/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Jefferson East District

1.1 District Description

Jefferson East district is located in the northern portion of the combined sewer (CS) area and west of the Red River. This district is approximately bounded by Kingsbury Avenue to the north, McPhillips Street to the West, Carruthers Avenue and McAdam Avenue to the south, and the Red River to the east.

Jefferson East district is primarily residential including single-family land use throughout the district. Commercial areas within Jefferson East are found along the major transportation routes including Main Street and McPhillips Street. Regional transportation routes passing through Jefferson East include McPhillips Street, Main Street, Jefferson Avenue, and Inkster Boulevard. Greenspace is found scattered throughout the district. Approximately 18 ha is identified as greenspace; this includes Aster/Dahlia Park, school yards, playgrounds, and community areas.

1.2 Development

A portion of Main Street is located within the Jefferson East District. Main Street is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Main Street is to be promoted in the future.

1.3 Existing Sewer System

The Jefferson East district has an approximate area of 445 hectares (ha)[1] based on the district boundary. There is approximately 10 percent by area (44 ha) separation ready and 45 percent by area (199 ha) where separation development is planned/underway.

The CS system includes two primary weirs, three offtake structures, a flood pump station (FPS), and an outfall gate chamber. The CS system drains towards the diversion structure and primary weir located along Jefferson Avenue immediately east of Main Street. There is also a small section of SRS pipe that runs through Jefferson East district from the Polson district along Inkster Boulevard. There are four main flow paths for the CS system to connect to the north Main interceptor. The main 2850 mm by 4270 mm CS trunk flows from the Jefferson West district along Inkster Boulevard and connects to Jefferson Avenue along Sinclair Street. This main CS trunk services the areas west of Main Street which includes the Jefferson West district; a 450 mm CS trunk flows south on Main Street, servicing a small area north on Main Street interconnecting with the Armstrong CS system; and a 300 mm CS trunk flows north on Main Street servicing a small area south on Main Street.

During dry weather flow (DWF), sanitary sewage flows into the diversion structure located at the intersection of Jefferson Avenue and Main Street upstream of the CS outfall. Note that sanitary sewage collection from the adjacent Jefferson West district is collected at this point. The sanitary sewage is diverted by the primary weir to a 1520 mm secondary interceptor pipe via a 525 mm offtake and then into the north Main Interceptor. Sewage from the areas east of Main Street during DWF is conveyed directly to the Main Interceptor without being intercepted by the primary weir. This is accomplished by either wastewater flow to the secondary interceptor on Jefferson Avenue, or via a direct connection to the Main Interceptor on Seven Oaks Avenue. The sanitary sewage from the Jefferson East and Jefferson West districts within the Main Interceptor then flows by gravity to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), any flows that exceed the primary weir at Jefferson Avenue and Main Street flows and is intercepted by a second primary weir at Jefferson Ave and Scotia street. This second

[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.

weir is remainder from the CS arrangement in the district prior to recent sewer separation work underway. As a result of this second weir the excess CS then backs up once more within the outfall trunk. A secondary 450mm offtake is then located within this outfall trunk, near the intersection of Jefferson Avenue and Jones Street. A portion of the excess CS may then flow in this secondary offtake and may be intercepted and treated once more. The excess CS under WWF events which then spills over the second Scotia Street primary weir is discharged into the Red River by gravity. Sluice and flap gates are installed on the CS outfall to prevent river water from backing up into the CS system under high river level conditions on the Red River. Under these high river level conditions gravity discharge is not possible, and excess flow is pumped by the Jefferson 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. The Jefferson outfall and adjacent Scotia Street weir however are quite low and often below the river level, which can require significant surcharge conditions to trigger an overflow event or activation of the flood pumps.

Additionally, the CS outfall may act as a high-level relief overflow for the Main Interceptor. There is a third 2280 x 1520 egg shaped offtake and diversion structure immediately west of the main 525 mm offtake pipe at Jefferson Avenue and Main Street. A flap gate is installed on this offtake, which allows surcharged flow in the Main Interceptor to flow south back into the CS system, but does not allow this offtake to divert intercepted CS into the interceptor system.

The majority of the district east of Main Street is a separation ready sewer system, as part of previous sewer separation works. Wastewater is conveyed either to the diversion structure on Jefferson Avenue and Main Street, or conveyed to a new WWS pipe on Seven Oaks Avenue which discharges directly into the Main Interceptor. The LDS system for the portion of the district east of Main Street reconnects to the Jefferson CS outfall trunk downstream of the main 525mm primary weir at two locations: along Scotia Street; at Seven Oaks Avenue, and St Anthony Avenue. Currently, with wet weather events, the land drainage flow is restricted from overflowing by the second weir located at the outfall at the intersection of Jefferson Avenue and Scotia Street. This excess land drainage flow then intercepted by the secondary 525mm offtake and is ultimately treated at the NEWPCC.

The one outfall (CS) to the Red River is as follows:

- ID33 (S-MA70007473) – Jefferson CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Jefferson East and the surrounding districts. Each interconnection is shown on Figure 19 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

Newton

- The 2250 mm Main Interceptor pipe flows north by gravity out of Jefferson East district:
  - Invert at Jefferson East district boundary 217.61 m (S-MA00017587)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Polson

- The 2250 mm Main Interceptor flows by gravity on Main Street from Polson district into Jefferson East district:
  - Invert at Jefferson East district boundary 218.03 m (S-MA70008112)

1.3.1.3 District Interconnections

Polson

<u>CS to CS</u>

- High point manhole:
  - Polson Avenue – 229.11 m (S-MH00009095)
- High sewer overflow:
  - McGregor Street at Carruthers Avenue – 228.60 m (S-MH00006709)

<u>CS to SRS</u>

- An 1800 mm SRS relieves the main CS trunk on Polson Avenue and flows by gravity northbound on Airlies Street from Polson district to Jefferson East district. It connects with the Jefferson East CS network at the corner of Inkster Boulevard and Airlies Street before continuing onto Inkster Boulevard:
  - Invert at Jefferson East district boundary 224.01 m (S-MA00011342)

<u>SRS to SRS</u>

- A 2950 mm SRS flows by gravity on Inkster Boulevard from Jefferson East district into Polson district:
  - Invert at Polson district boundary 223.00 m (S-MA00008238)

Jefferson West

<u>CS to CS</u>

- The 2400 mm CS pipe flows by gravity east on Inkster Boulevard into Jefferson East district:
  - Inkster Boulevard at McPhillips Street – 224.53 m (S-MH00009032)
- The 450 mm CS pipe flows by gravity west on Polson Avenue into Jefferson West district:
  - Invert at Jefferson West district 225.27 m (S-MA00007321)
- The 375 mm CS pipe flows west by gravity on Lansdowne Avenue into Jefferson West district:
  - Invert at Jefferson West district boundary 227.02 m (S-MA00011271)

Armstrong

<u>CS to CS</u>

- The 300 mm CS pipe flows south by gravity on Powers Street from Armstrong district into Jefferson East district:
  - Invert at Jefferson East district 227.31 m (S-MA00001541)

Newton

<u>CS to CS</u>

- The 375 mm CS pipe flows south by gravity on Main Street into Jefferson East district:
  - Invert at Newton district boundary 226.90 m (S-MA00017220)
- The 250 mm CS pipe flows east by gravity on Kingsbury Avenue into Jefferson East district:
  - Invert at Newton district boundary 226.59 m (S-MA00017588)
- The 225 mm CS pipe flows west by gravity on Burrin Avenue into Jefferson East district:

– Invert at Newton district boundary 228.68 m (S-MA00001001)

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

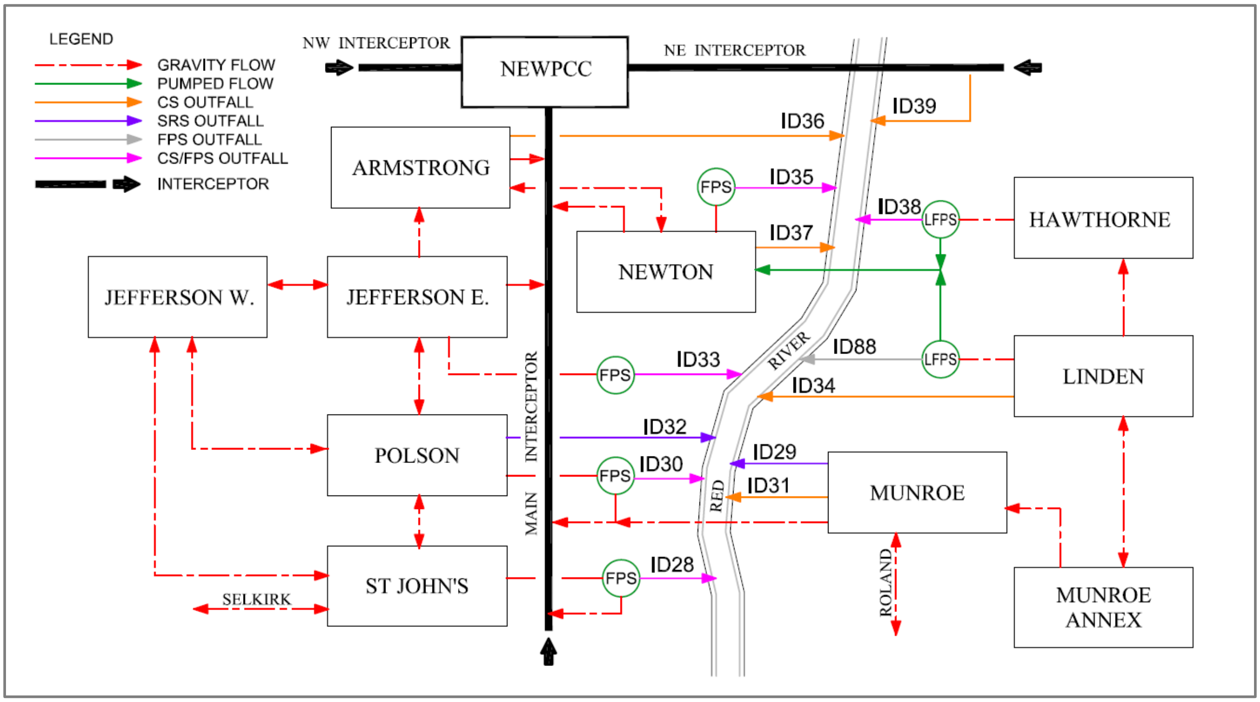


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 19 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 (ID33)	S-TE70003093.1	S-MA70007473	3350 mm	Red River Invert: 222.88 m
Flood Pumping Outfall (ID33)	S-TE70003093.1	S-MA70007473	3350 mm	Red River Invert: 222.88 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-MH00006000.1	S-MA00008944	2850 x 4270 mm	Egg shaped Invert: 223.16 m
SRS Outfalls	N/A	N/A	N/A	
SRS Interconnections	S-MH70015794	S-MH70015794	N/A	Combined Invert: 224.78 m
Main Trunk Flap Gate	S-AC70007929.1	S-CG00000814	3000 mm	Invert: 223.29 m Circular
Main Trunk Sluice Gate	S-AC70007969.1	S-CG00000815	3000 x 3000 mm	Invert: 223.08 m
Offtake	JEFFERSON_WEIR1.1	S-MA70017216	525 mm	Invert: 223.06 m

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
	S-TE00005277.2	S-MA70017296	1520 mm	Invert: 224.16 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	S-MA70017216 [(1)]	525 mm [(1)]	0.195 m3/s [(1)]
ADWF	N/A	N/A	0.208 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	
Flood Pump Station Total Capacity	N/A	N/A	6.85 m^3/s	3 x 1.35 m^3/s 2 x 1.4 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	1.059 m^3/s	

Notes:

[(1)] – Gravity pipe replacing Lift Station as Jefferson East is a gravity discharge district

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	Jefferson – 223.66
2	Trunk Invert at Offtake	223.06
3	Top of Weir	Weir at FPS: 223.75
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection (S-MH70015794)	Invert – 224.78
6	Sewer District Interconnection (Polson)	223.00
7	Low Basement	226.47
8	Flood Protection Level (Jefferson East)	228.92

[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 Jefferson East was the *Jefferson Combined Sewer Districts Sewer Relief and CSO Abatement Study* (AECOM Canada Ltd, 2009). The study's purpose was to determine the most cost-effective means to upgrade the hydraulic capacity of the combined sewer system to reduce basement flooding during extreme rainfall events. Works ongoing now include implementation of many of the recommendations of this 2009 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 Jefferson East 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.

From 2012 to 2016, the Jefferson East Sewer Relief project work has been completed within the majority of the area to the east of Main Street, to align with the 2009 AECOM study. Four separation construction contracts have been completed during this time with a construction cost of approximately $11.5 Million spent to date.

- The Jefferson East Relief Sewer Contracts 1 to 3 involved the installation of LDS pipes to collect runoff from the catch basins within the majority of the area (Kilbride Avenue still to be separated).
    - The LDS system reconnects to the existing CS system at two locations along Scotia Street; at Seven Oaks Avenue and St Anthony Avenue.
    - At each reconnection point, a new WWS pipe diverts wastewater flows from the existing CS system immediately upstream of both locations, these flow into the new WWS pipes to connect to the Main Interceptor pipe.
- Contract 4 involved the construction of a new LDS gate chamber and 2100 mm diameter outfall pipe.
    - The outfall pipe and gate chamber is located within the adjacent Newton district and on the City land near Scotia Street and Semple Avenue, within the Newton district.
    - It is proposed that the new LDS system will connect to the new LDS gate chamber within future contracts.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
19 – Jefferson E	2009	Future Work – Following Sewer Separation	2013	Construction Underway	TBD

1.5 Ongoing Investment Work

As part of the Jefferson East Sewer Relief work, a further six Contracts are planned (AECOM Canada Ltd, 2009). The six Contracts are estimated to cost approximately $35 Million (AACE Class 3, 2011 estimate). This work includes sewer separation of the area between Main Street and the C.P.R. Winnipeg Beach Rail Line (i.e. east of rail line). This work has been recommended as part of the solutions to meet Control Option 1 for this district (see Section 1.6).

The City has also developed a conceptual sewer separation plan for the area west of the Winnipeg Beach Rail Line (201 ha). The sewer separation work in this part of the district is estimated to cost $45 Million (AACE Class 3, 2011 estimate). The City however has not committed to having this work west of the rail line completed, and it has not been recommended as part of the solutions to meet Control Option 1.

The City is also currently investigating multiple items of work to improve the performance of this district. These have been summarized below:

- The potential to remove the second Scotia Street weir just upstream of the FPS. The recent sewer separation work allows all wastewater flows to be diverted out of this section of the CS system. Therefore, the existing weir is only holding back LDS flow and excess CS during WWF events at present. The weir located at the primary diversion adjacent to the main 525mm offtake will then be treated as the new critical overflow location.
- Due to the Jefferson outfall being very low, the river level is often higher than the current weir, and to keep the Jefferson outfall drained the secondary 450mm offtake is left open. This however also results in the unnecessary collection and treatment of land drainage flow backed up by the second Scotia Street. As a result, the closure of the secondary diversion 450mm offtake on Jefferson Avenue is also to be investigated.

- The proposed work identified in the points above would result in the requirement for a portion of the existing permanent CSO instrumentation to be relocated. New instrumentation upstream and downstream of the new primary diversion weir would need to be installed.
- The flood pumping arrangements are under review by the City, so that the closure of the secondary offtake mentioned above can be evaluated. The aim would be for the FPS to be reclassified as a land drainage flood pumping station as this would more accurately reflect the upstream system. Any CSO overflow volume would have to be modelled, estimated, and verified based on the new instrumentation at the new primary weir and not the outfall in order to separate the portion of CS and LDS flow.
- The primary 525mm offtake is potentially undersized and should also be reviewed as part of the work tasks listed above. The completion of the reminder of the partial sewer separation work planned in the district may result in a sufficient reduction in the wet weather response from the district such that this offtake is appropriately sized.

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Jefferson East 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 Jefferson East sewer district are listed in Table 1-4. The proposed CSO control projects will include partial sewer separation, in-line storage via 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 1-4. District Control Option

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

Notes:

- = not included
✓ = included

Jefferson East has been identified for partial sewer separation. This work is underway and will continue as part of the CSO Master Plan. The potential for stepped sewer separation of the remainder of the district was also investigated, but found that more cost effective measures such as in-line storage could achieve the remaining volume capture required from the district. As the remainder of the district is not currently prioritized for separation as part of the BFR program, it has not been recommended as part of the CSO Master Plan.

A gravity flow controller is proposed on the CS system to optimize and monitor the dewatering rate from the district back into the Main Interceptor. A second controller is not proposed for the new Seven Oaks Avenue WWS direct connection to the Main Interceptor, due to the relatively small catchment area.

The existing CS system is suitable for use as in-line storage. This control option will take advantage of the existing CS system for additional storage volume. The Jefferson East district has a large volume of potential in-line storage capacity due in part to the interconnection with upstream Jefferson West district and the large diameter pipes conveying flows from West to East.

Floatable control will be necessary to capture any undesirable 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. Screens will be on the primary CS outfall near the intersection of Jefferson Avenue and Scotia 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 Sewer Separation

Partial sewer separation is currently underway for the Jefferson East district and is proposed to continue as part of the CSO Master Plan. Sewer separation will free up capacity in the CS trunk and reduce the overflows from this district. A subsequent impact is that the additional capacity can then be utilized as storage in the form of in-line storage to help balance flow to the Main Street interceptor, and ultimately to the NEWPCC.

The area east of Main Street has undergone LDS separation work including installation of a separate LDS system to collect overland drainage. At present, the new LDS collects flows from area between Main Street and Scotia Avenue from Smithfield Avenue to Hartford Avenue. A new LDS outfall was constructed on Scotia Avenue and will be connected to the new LDS in the future. . Continued LDS separation work is proposed up to the C.P.R. Winnipeg Beach Rail Line that divides the district. This will reduce overall flow to the outfall and reduce CSOs. Partial sewer separation will also increase the available capacity for in-line storage and would reduce the sewage flow being diverted at the primary weir.

1.6.3 In-Line Storage

In-line storage has been proposed as a CSO control for Jefferson East 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 provide a secondary benefit by increasing the hydraulic head necessary for screening operations. Note that the flows from the upstream Jefferson West district also discharges directly to the Jefferson East district, and will be additionally captured by this in-line storage arrangement.

It should be noted that due to only partial separation being completed in the Jefferson East district, in combination with the Jefferson West combined district also discharging into this district, that the in-line storage measures are being recommended. If complete separation was pursued for the remainder of this district and for the Jefferson West district, this recommendation would no longer be required.

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	
Trunk Diameter	2850 x 4270 mm	
Gate Height	1.47 m	Gate height based on half trunk diameter assumption

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

Item	Elevation/Dimension	Comment
Top of Gate Elevation	225.22 m	
Maximum Storage Volume	12335 m^3	
Nominal Dewatering Rate	0.195 m^3/s	Based on pipe pass forward flow at Jefferson diversion chamber
RTC Operational Rate	TBD	Future RTC / dewatering review on performance

Note:
TBD = to be determined

RTC – Real Time Control

The control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 19. The extent of the in-line storage and volume is related to the top elevation of the gate. 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 eventually 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 existing DWF diversion rate will continue with its current operation, with all DWF being diverted to the Main Interceptor. The area east of Main Street within the Jefferson East district will continue to divert into the Main Interceptor via the Seven Oaks Avenue WWS pipe.

Figure 19-01 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 trunk sewer alignment. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 6 m in length and 4.5 m in width. The existing diversion chamber and weir may be impacted by the construction of the chambers and require some reconfiguration. The physical requirements for a modification to existing diversion chamber have not been considered in detail, but they will be required in the future as part of removal of the secondary offtake that the City is currently investigating. The removal of this secondary offtake would allow more space for these chambers. The physical location will cause disruptions due to being located adjacent to a main road interception (Jefferson Avenue and Main Street) and potential to move further away from the interconnection would be considered in the next stage.

The nominal rate for dewatering is determined by the performance of the existing pipe capacity as the district is a gravity discharge district. As such the flows will vary over the duration of a rainfall event and has been nominated for a gravity flow control device. Any future consideration, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflow at this district. The control device would be set to a rate similar to the existing pipe full capacity to allow the set limit to be known. This would allow the future RTC to control the ability to capture and treat more volume for localized storms in other districts by using the excess interceptor capacity made available by restricting the pass forward flows through the control device where the runoff is less.

1.6.4 Gravity Flow Control

Jefferson East district does not include a LS and discharges to the Main Interceptor by gravity. A flow control device will be required to control the diversion rate at the main diversion pipe on Jefferson Avenue for future RTC. The flow controller will include flow measurement and a gate to control the discharge flow rate. A standard flow control device was selected as described in Part 3C. The small contributing area associated with the second WWS pipe directly connecting to the Main Interceptor sewer from Seven Oaks Avenue will not require a flow controller.

It should be noted that due to only partial separation being completed in the Jefferson East district, in combination with the Jefferson West combined district also discharging into this district, that gravity flow control is still required. If complete separation was pursued for the remainder of this district and for the Jefferson West district, this recommendation would no longer be required.

The flow control would be installed at an optimal location on the connecting sewer between the proposed in-line control and existing diversion chamber. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction.

A gravity flow controller has been included as a consideration in developing a fully optimized CS system as part of the City's long-term objectives. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

1.6.5 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials from the Jefferson East district. The off-line screens would be proposed to maintain the current level of basement flooding protection.

It should be noted that due to only partial separation being completed in the Jefferson East district, in combination with the Jefferson West combined district also discharging into this district, that floatables management of CSO events is still required. If complete separation was pursued for the remainder of this district and for the Jefferson West district, this recommendation would no longer be required.

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

Table 1-6. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	225.22 m	
Bypass Weir Crest	225.12 m	
NSWL	223.66 m	
Maximum Screen Head	1.455 m	
Peak Screening Rate	0.89 m^3/s	
Screen Size	1.5 m wide x 1 m high	Modelled Screen Size

The proposed bypass side overflow weir and screening chamber will be located adjacent to the existing combined trunk sewer, as shown on Figure 19-01. The screens will operate once levels within the sewer surpassed the in-line control elevation. A bypass side weir upstream of the gate will direct the initial 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 may include screenings pumps with a discharge returning the screened material back to the interceptor and on to the NEWPCC for removal. The provision of screening pumps is dependent on final level assessment within the existing infrastructure and the Jefferson trunk has potential for gravity screening return to occur. This would be confirmed 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 4 m in length and 3.5 m in width. The impact of this chamber was defined in the in-line storage section.

1.6.6 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 applicable GI controls.

Jefferson East has been classified as a medium GI potential district. Jefferson East district is primarily residential including single-family land use throughout the district. Commercial areas within Jefferson East are found along the major transportation routes including Main Street and McPhillips 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 district which make an ideal location for green roofs.

1.6.7 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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flows with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the districts.

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.

The flow controller will require the installation of a chamber and flow control equipment. Monitoring and control instrumentation will be required. The flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required.

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 model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized in Table 1-7.

Table 1-7. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added To Model
2013 Baseline	444	444	13,614	59	N/A
2037 Master Plan – Control Option 1	444	250	13,614	59	IS, SC, SEP

Notes:

IS = In-line Storage
SC = Screening
SEP = Sewer Separation

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 for Control Option 1 as shown in Table 1-8 are based on the hydraulic model simulations using the year-round 1992 representative year applied uniformly. 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 when simulation was completed: these are listed to provide an indication of benefit gained only and are independent volume reductions unless noted otherwise.

Table 1-8. District Performance Summary – Control Option 1

	Preliminary Proposal	Master Plan			
Control Option	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)	274,354	287,466	-	20	0.730 m^3/s
In-Line Storage	89,720 [a]	101,217	186,249	18	0.730 m^3/s
In-line Storage & Partial Sewer Separation		47,252	53,965	11	1.059 m^3/s
Offline Storage, Partial Separation & In-line Storage	48	N/A [c]	N/A [c]	N/A [c]	N/A [c]

Table 1-8. District 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]
Control Option 1	**48**	**47,252**	**240,214**	**11**	**1.059 m^3/s**

[a] Partial Separation 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

[c] Off-line storage solution proposed during Preliminary Proposal, but not carried forward as part of Master Plan recommendations.

The control options proposed for the CSO Master Plan were based on the more focused district assessment and provision to achieve the system-wide 85 percent capture target. The off-line storage facility was not necessary to achieve this percent capture target and a stepped approach for the provision of sewer separation was assessed to be a more cost-effective approach for Control Option No.1. 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. District Cost Estimate – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 Master Plan Capital Cost	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance Cost (Over 35-year period)
Separation	- [a]	$145,510,000	$87,000	$1,860,000
Screening	$7,740,000 [b]	$2,890,000 [f]	$33,000	$710,000
In-Line Storage Control Gate		$3,130,000	$44,000	$940,000
Gravity Flow Control	N/A [d]	$1,280,000	$34,000	$740,000
Off-line Storage	$25,820,000 [c]	N/A [e]	N/A [e]	N/A [e]
Subtotal	**$33,560,00**	**$152,810,000**	$198,000	**$4,250,000**
Opportunities	N/A	$15,280,000	$20,000	$430,000
District Total	**$33,560,00**	**$168,090,000**	$218,000	**$4,680,000**

[a] Separation cost not included in Preliminary Proposal. Solution developed as refinement to Preliminary Proposal costs. Costs for the partial separation item of work found to be $101,700,000 in 2014 dollars.

[b] Screening and In-Line Storage Control Gate cost combined in the Preliminary Proposal cost estimates.

Table 1-9. District Cost Estimate – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 Master Plan Capital Cost	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance Cost (Over 35-year period)

[c] Solution was refined following initial Preliminary Proposal cost submission of $25,820,000. Updated costs for this item of work estimated at $67,550,000 in 2014 dollars.

[d] Gravity Flow Control recommendation developed as part of Master Plan, and was not part of the Preliminary Proposal.

[e] Off-line storage solution proposed during Preliminary Proposal, but not carried forward as part of Master Plan recommendations.

[f] Cost for bespoke screenings return pump 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 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 alternative plans, 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	In-line Storage Control Gate	Preliminary estimate was based on a standard cost per district, which has been updated to a site-specific cost estimate.	The change may result in significant changes to individual districts but balances out over the entire CS area.
	Screening	Preliminary estimate was based on a standard cost per district, which has been updated to a site-specific cost estimate.	The change may result in significant changes to individual districts but balances out over the entire CS area.

Table 1-10. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
	Removal Of Off-line Storage	Not included in the Master Plan	Removed through marginal analysis
	Separation	Not included in Preliminary Proposal Estimate	
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 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, a future performance target of 98 percent capture for the representative year measured on a system-wide basis was evaluated. 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 No.1.

Overall the Jefferson East district would be classified with medium 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. The cost comparison indicated that due to the potential storage capacity within the existing system, in-line storage would be a cost-effective interim solution. However, if the planned sewer separation of the remainder of the Jefferson East district was pursued, there would no longer be the requirement the in-line storage to be constructed. At this point the separation of the remaining Jefferson West district would need to be completed before the solutions recommended to meet Control Option 1 would not be required.

If complete separation is not pursued, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume 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	• Separation of remaining Jefferson East district • Increase use of GI • Off-line storage facilities

The control options selected for the Jefferson East district have been aligned with the City's Basement Flood Relief program that was ongoing prior to the development of the CSO Master Plan. The 85 percent capture performance target is achieved on a system wide basis and the interactions with the adjacent districts (Jefferson West discharges directly to Jefferson East) did not require sewer separation of the entire Jefferson East district. As a result, the construction of a control gate and screening facility are still required for floatables management. The gate and screening installation would restrict the expandability of the control arrangement in this district. Reduced expandability may limit the district's contribution towards achieving the 98 percent capture performance target if not assessed on a system wide basis.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-12.

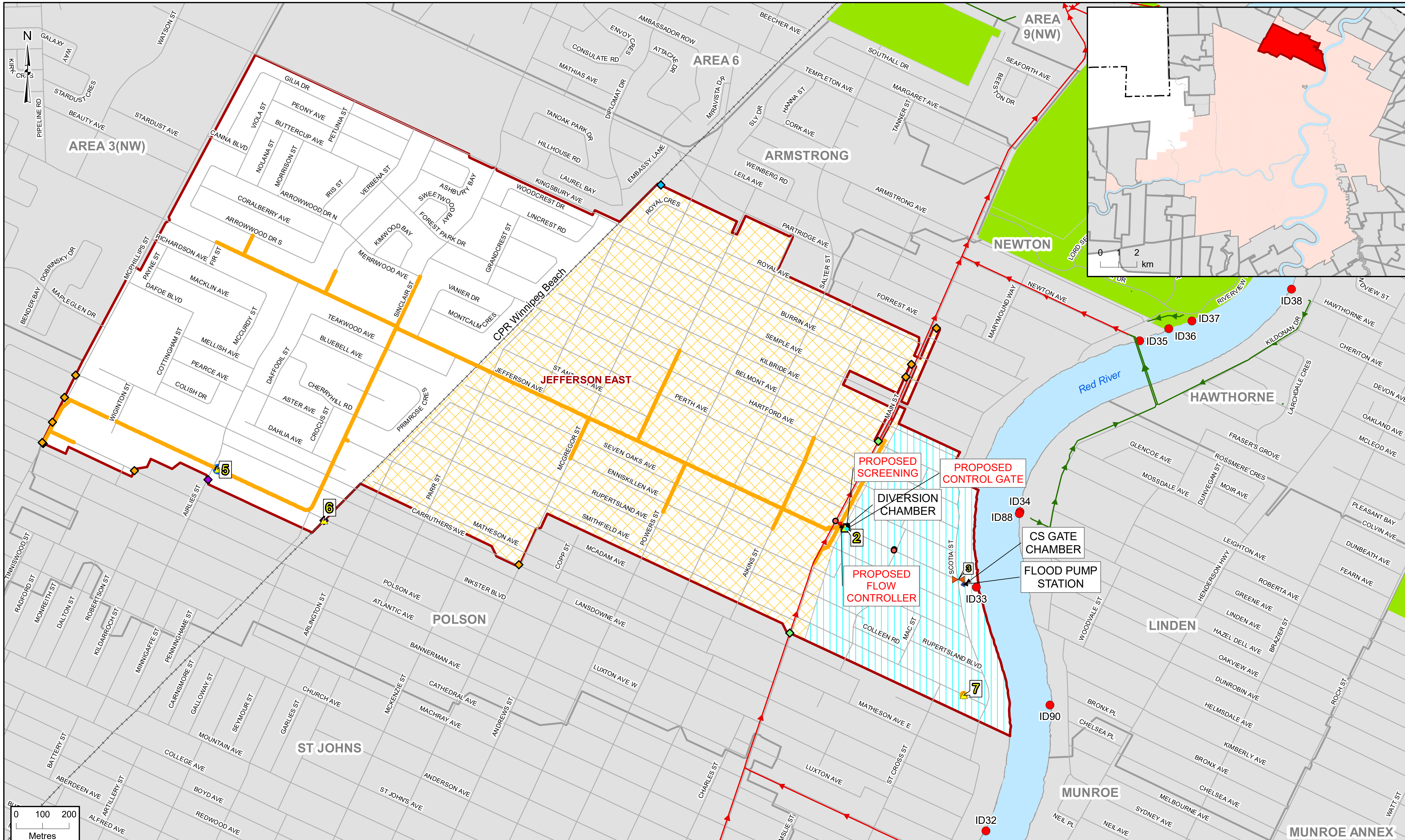
Table 1-12. Control Option 1 Significant Risks and Opportunities

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	-	-	O	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	R	-	-	-	-	-	-
7	Sewer Conflicts	-	R	-	-	R	-	-	-
8	Program Cost	-	O	-	-	R	-	-	O
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	R	-	-	R / O	R	O	R
13	Volume Capture Performance	-	O	-	-	-	O	O	-
14	Treatment	-	R	-	-	O	O	O	R

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

1.12 References

AECOM Canada Ltd. 2009. *Jefferson Combined Sewer Districts Sewer Relief and CSO Abatement Study.* Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. March.



LEGEND

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

Inter-System Connection

- CS - WWS
- SRS - CS

District Boundary Crossing

- CS
- LDS
- 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 - Underway
- 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 19
District Overview Map
Sewer District: Jefferson East
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEG\WWD\OF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\JEFFERSONE\JEFFERSONE_DISTRICT_OVERVIEW_MAP2.MXD DT072410 8/12/2019 3:19:10 PM

LEGEND

- Critical Elevation
- Manhole
- Flap Gate

Sewer By Type
- CS
- WWS

Pump Station Type
- Diversion Chamber

- Land Parcel

CSO MASTER PLAN PROPOSED SOLUTIONS
- Control Gate
- Screening
- Flow Controller

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 19-01
Control Gate, Screening, and Flow Controller
Sewer District: Jefferson East
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\JEFFERSONE\JEFFERSONE_DISTRICT_DETAIL_MAINST.MXD DT072410 8/12/2019 3:36:14 PM

CSO Master Plan

Jefferson West District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Jefferson West District Plan
Revision:	03
Date:	August 20, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	JeffersonW_Plan_Fianl_CO1MO_08202019

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	09/14/2018	DRAFT for City Comment	DT	SB, MF, SG	
1	02/15/2019	DRAFT 2 for City Review	JT	SG	MF
2	08/12/2019	Final Draft Submission	DT	MF	MF
3	08/20/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Jefferson West District

1.1 District Description

Jefferson West district is located towards the northwestern section of the combined sewer (CS) area. This district is approximately bounded by McPhillips Street to the east, The Canadian Pacific Railway (CPR) Winnipeg Yards to the south, Keewatin Street to the west, and Inkster Boulevard to the north.

Jefferson West primarily includes industrial land use with a mix of commercial, residential, and greenspace within the district. The industrial land includes general and heavy manufacturing with the general manufacturing facilities located north of Burrows Avenue and west of Fife Street, while the heavy manufacturing includes the CPR Winnipeg Yards on the southern perimeter of Jefferson West district. The residential area includes both single and multi-family residential buildings, with the majority of multi-family buildings located on Burrows Avenue. The single-family residential homes are located between Selkirk Avenue and Burrows Avenue and east of Fife Street. The commercial businesses can be found along Keewatin Street and McPhillips Street.

The southern end of the CPR Winnipeg Beach passes through Jefferson West and the CPR Arborg passes through the industrial sections of the district. McPhillips Street, Keewatin Street, and Inkster Boulevard are the major transportation routes within Jefferson West. Approximately 44 ha is identified as greenspace: this includes Shaughnessy Park, Northwood Park, and Fort Whyte Park.

1.2 Development

There are several areas within the Jefferson West combined sewer district which have been identified as a General Manufacturing Lands as part of OurWinnipeg. Focused intensification within these areas is to be promoted in the future, with a particular focus on mixed use development. This is to ensure adequate employment lands available to support future population growth.

1.3 Existing Sewer System

The Jefferson West district has an approximate area of 600 hectares (ha)[1] based on the GIS district boundary data. This district does not include any areas identified as land drainage sewer (LDS) separated or separation-ready.

The CS system is connected to the Jefferson East CS network, which includes a diversion structure, flood pump station (FPS), and outfall gate chamber. The CS system drains along the main CS trunk on Inkster Boulevard with combined sewers from the northern and western portions of the district connecting to the main trunk. The remainder of CS system in the Jefferson West district connects to the large CS on McPhillips Street, which in turn flows north and connects to the main trunk on Inkster Boulevard. These describe the two main paths that the combined sewage flows to connect to Jefferson East district.

During dry weather flow (DWF), the system flows by gravity throughout the district, where it connects to the Jefferson East CS system. Within the Jefferson East CS system, sanitary sewage flows into the diversion chamber located at the intersection of Jefferson Avenue and Main Street upstream of the CS outfall. The sanitary sewage is diverted by the weir to a 1520 mm interceptor pipe and into the Main Interceptor. Sewage from the areas east of Main Street flow to the FPS weir and is allowed to back up until reaching the diversion chamber at Jefferson Avenue and Jones Street. This diversion has a 450 mm off-take pipe, which connects into the Main Street diversion and the 1520 mm off-take pipe to the North End Sewage Treatment Plant (NEWPCC) for treatment.

[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 wet weather flow (WWF), any flows from the Jefferson West district which reaches the Jefferson East outfall and exceeds the diversion capacity will overtop the weir and is discharged into the Red River. Sluice and flap gates are installed on the Jefferson East CS outfall to prevent river water from backing up into the CS system. When the river level is high such as this gravity discharge from the CS outfall is not possible; under these conditions the excess flow is pumped by the Jefferson FPS to a point downstream of the flap gate to allow gravity discharge to the river once more.

Additionally, during WWF the SRS system provides relief to the southern CS system in the Jefferson West district. The SRS system extends through certain routes and has multiple interconnections with the CS system. Most catch basins are still connected to the CS system, so no partial separation has been completed. The SRS system connects to the 2150 mm SRS on Burrows Avenue. The SRS on Burrows then connects to the St. Johns SRS system on Burrows Avenue and ultimately uses the SRS outfall in the Selkirk district to discharge directly the Red River. A flap gate is located on this SRS outfall pipe to prevent river water from backing up into the SRS system.

There is also an overflow weir arrangement on the McPhillips CS trunk sewer that relieves the overall CS system from the Jefferson West district, and ties to the Inkster SRS system in the Polson district. This SRS system discharges directly to the Red River through the Inkster SRS outfall located near the intersection of Inkster Boulevard and Scotia Street. Upstream of the Inkster SRS outfall is an SRS off-take pipe, which will divert all collected CS in the SRS system into the Polson secondary interceptor and back into the CS system, under DWF and minor WWF conditions.

There are no CS outfalls in the Jefferson East district.

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Jefferson West and the surrounding districts. Each interconnection is shown on Figure 19 and shows locations where gravity flow can cross from one district to another. Each interconnection is listed as follows:

St. Johns

SRS to SRS

- A 2900 mm SRS trunk flows by gravity from Jefferson West district into St Johns district on Mountain Avenue and connects to the SRS network in St Johns district:
  - Invert at St Johns district boundary 224.78 m (S-MA00010486)
- A 2150 mm SRS diverts from the CS system in Jefferson West district and flows eastbound by gravity on Burrows Avenue into St. Johns district:
  - Invert at Jefferson West district boundary 224.50 m (S-MA70015831)
- High sewer overflow:
  - Selkirk Avenue and McPhillips Street – 229.68 m (S-MH00008715)
  - Manitoba Avenue and McPhillips Street – 229.43 m (S-MH00008744)
  - Alfred Avenue and McPhillips Street – 229.49 m (S-MH00008303)
  - Aberdeen Avenue and McPhillips Street – 229.19 m (S-MH00008304)
  - McPhillips Street and Mountain Avenue – 225.46 m (S-MH00008426)
  - McPhillips Street and Mountain Avenue – 225.43 m (S-MH00008425)

Jefferson East

CS to CS

- The 2400 mm CS pipe flows by gravity east on Inkster Boulevard into Jefferson East district:

  - Inkster Boulevard at McPhillips Street 224.53 m (S-MH00009032)
- The 450 mm CS pipe flows by gravity west on Polson Avenue into Jefferson West district:
  - Invert at Jefferson West district 225.27 m (S-MA00007321)
- The 375 mm CS pipe flows west by gravity on Lansdowne Avenue into Jefferson West district:
  - Invert at Jefferson West district boundary 227.02 m (S-MA00011271)

Manitoba

<u>WWS to WWS</u>

- High Point manhole:
  - Selkirk Avenue at Arrow Street – 230.16 m (S-MH00007585)

Burrows

<u>LDS to CS</u>

- A 375 mm LDS overflows by gravity along Burrows Avenue from Burrows district into the 900 mm CS on Burrows Avenue:
  - Invert at Jefferson West district boundary 227.77 m (S-MA00006842)

King Edward

<u>LDS to LDS</u>

- A 750 mm LDS flows by gravity on Inkster Boulevard from Jefferson West district into King Edward district:
  - Invert at King Edward district boundary 228.44 (S-MA70106301)

Polson

<u>CS to CS</u>

- High Point manhole:
  - Machray Avenue at McPhillips Street – 228.74 m (S-MH00007230)

A district interconnection schematic is included as Figure 1-1**Error! Reference source not found.**. The drawing illustrates the collection areas, interconnections, pumping systems, and discharge points for the existing system.

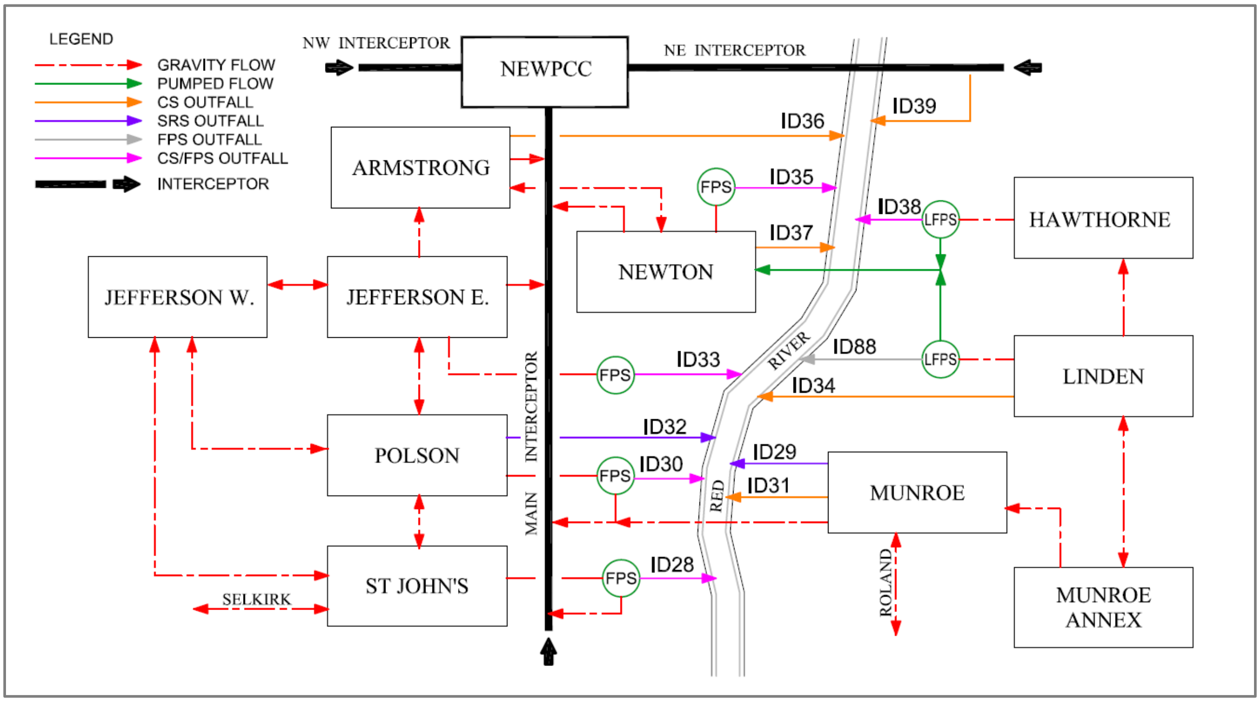


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 20 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	N/A	N/A	N/A	No CS outfall within the district.
Flood Pumping Outfall	N/A	N/A	N/A	No flood pump station within the district.
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-MH00007387.1	S-MA00007312	2400 mm	Circular CS as it enters Jefferson East Invert: 224.53 m
SRS Outfalls	N/A	N/A	N/A	
SRS Interconnections	N/A	N/A	N/A	29 SRS-CS
Main Trunk Flap Gate	N/A	N/A	N/A	No CS outfall within the district.
Main Trunk Sluice Gate	N/A	N/A	N/A	No CS outfall within the district.
Off-Take	N/A	N/A	N/A	No CS outfall within the district.
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	S-MA00011232 (1)	2400 mm (1)	3.7 m^3/s (1)

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
ADWF	N/A	N/A	0.2075 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	No Lift station within the district.
Flood Pump Station Total Capacity	N/A	N/A	N/A	No flood pump station within the district.
Pass Forward Flow – First Overflow	N/A	N/A	No spill	No CS outfall and primary overflow arrangement within the district.

Notes:

[(1)] – Gravity pipe replacing Lift Station as Jefferson West gravity discharge district
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	N/A
2	Trunk Invert at Off-Take	N/A
3	Top of Weir	N/A
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection (S-MH00008425 & S-MH00008426)	Invert – 225.46
6	Sewer District Interconnection (St Johns)	224.50
7	Low Basement	226.47
8	Flood Protection Level (Jefferson East)	228.92

[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 Jefferson West was the *Jefferson Combined Sewer Districts Sewer Relief and CSO Abatement Study* (AECOM Canada Ltd, 2009). The study's purpose was to determine the most cost-effective means to upgrade the hydraulic capacity of the combined sewer system to reduce basement flooding during extreme rainfall events. No other study or district evaluation work has been completed on the district sewer system since that time.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
20 – Jefferson West	2009	Future Work – Following Sewer Separation	2013	Study Complete	N/A

Source: Report on *Jefferson Combined Sewer Districts Sewer Relief and CSO Abatement Study*, 2009

1.5 Ongoing Investment Work

There is not any current or proposed CSO or sewer relief investment work occurring in Jefferson West district.

1.6 Control Option 1 Projects

1.6.1 Project Selection

There are no proposed projects selected to meet Control Option 1 – 85 Percent Capture in a Representative Year for the Jefferson West sewer district. Program opportunities including green infrastructure (GI) and real time control (RTC) will also be included as applicable as part of the Jefferson East district performance.

Table 1-4. District Control Option

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

Notes:

- = not included
✓ = included

A portion of the existing CS trunk for Jefferson East extends into Jefferson West and will be impacted by the proposed in-line storage project recommended for Jefferson East. The in-line storage extends upstream from the control gate within Jefferson East and into the CS trunk in Jefferson West as shown in Figure 20.

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.

Floatable controls with screening will not be required. Inter-system floatables management programs like catch basin cleaning and public education programs would impact this district.

1.6.2 In-Line Storage

The proposed in-line storage in Jefferson East extends into Jefferson West district. The design criteria for the in-line storage can be found in the Jefferson East plan. The amount of storage that extends into Jefferson West is 8815 m^3. The proposed extent of the in-line storage is shown on Figure 19-01 and Figure 20.

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 LS rehabilitation or replacement project.

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 will be reviewed to identify applicable GI controls.

Jefferson West has been classified as a medium GI potential district. Land use in Jefferson West primarily includes industrial land use with a mix of commercial, residential, and greenspace within the district. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels. The flat roof commercial buildings make for an ideal location for green roofs.

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.

The impact of the in-line storage proposed in Jefferson East may impact the existing sewers in Jefferson West. Additional system monitoring, and level controls will be installed which will require regular scheduled maintenance.

It is noted that the current pipe configuration associated with the Mountain SRS system has attributed to O&M issues. This SRS system includes interconnections between the Jefferson West and the St Johns districts, at manholes S-MH00008425 and S-MH00008426. The location is problematic and has led to frequent DWF flows entering the Mountain SRS due to siphon blockages. The system allows the DWF flows to be diverted back to the Main Interceptor system, but it is noted as not ideal. Any proposed work in the Jefferson West district as part of the CSO Master Plan should also investigation the operation of this SRS system, and correct this to reduce the operational burden on the City.

1.8 Performance Estimate

1.8.1 InfoWorks Model

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 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	528	528	7,277	68	N/A
2037 Master Plan – Control Option 1	528	528	7,277	68	N/A

Notes:

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 of this district has been included in the Jefferson East district engineering plan, as this district does not have an overflow discharge point directly to the river.

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 relevant control option with overall program costs summarized and described in Section 3.4 of Part 3A of the CSO Master Plan. 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 1-6. The cost estimates are a Class 5 planning level estimate with a level of accuracy range of minus 50 percent to plus 100 percent.

Table 1-6: Cost Estimates – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost [a]	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance Cost (Over 35-year period) [a]
Subtotal	**$0**	**$0**	**$0**	**$0**
Opportunities	N/A	$0	$0	$0
District Total	**$0**	**$0**	**$0**	**$0**

[a] No work is proposed in the Jefferson West district and therefore zero costs have been included for the Master Plan capital cost and O&M costs.

The estimates include updated construction costs based on level of completion of work to date. The calculations for the CSO Master Plan cost estimate include 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. As there are no capital costs allocated to this district as the work to align with the CSO Master Plan is complete, there has also been no capital costs in this district allocated to GI or RTC opportunities.
- The Preliminary Proposal capital cost is in 2014-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 1-7.

Table 1-7. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Opportunities	A fixed allowance of 10 percent has been included for program opportunities	Preliminary Proposal estimate did not include a cost for GI opportunities	No costs allocated opportunities as capital costs for district removed.
Lifecycle Costs	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 1-8 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 Jefferson West district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume to meet future performance targets.

Table 1-8. Upgrade to 98 Percent Capture in a Representative Year Summary

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

The control options selected for the Jefferson West district were aligned for the system wide target of 85 percent capture and covered the downstream district of Jefferson East. The migration of the control options to meet the 98 percent capture target will be in conjunction with the requirements of Jefferson East and on a system wide basis. The existing SRS systems that extent into this district may be able to be utilized for opportunistic future sewer separation. A further investigation into the performance of these SRS pipes would be needed prior to increasing the runoff flows to these systems.

The district performance and cost for upgrading to 98 percent capture will depend 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 approach to moving the program to an increased level of performance to meet regulatory requirements will be presented in detail in the CSO Master Plan update 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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-9.

A specific acceptable risk for the Jefferson West district is associated with no proposed work measures being required for this district. As a result, no costs for GI opportunities have been allocated, since this cost is a percentage of future capital costs. However, this does not restrict any GI or RTC opportunities from occurring in this district, as in this situation the 10% allowance attributed to other districts will be utilized.

Table 1-9. Control Option 1 Significant Risks and Opportunities

Risk Number	Risk Component	Latent Storage / Flap Gate Control	In-line Storage / Control Gate [a]	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	-
6	Sewer Condition	-	R	-	-	-	-	-	-
7	Sewer Conflicts	-	R	-	-	-	-	-	-
8	Program Cost	-	O	-	-	-	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	-	O	O	-

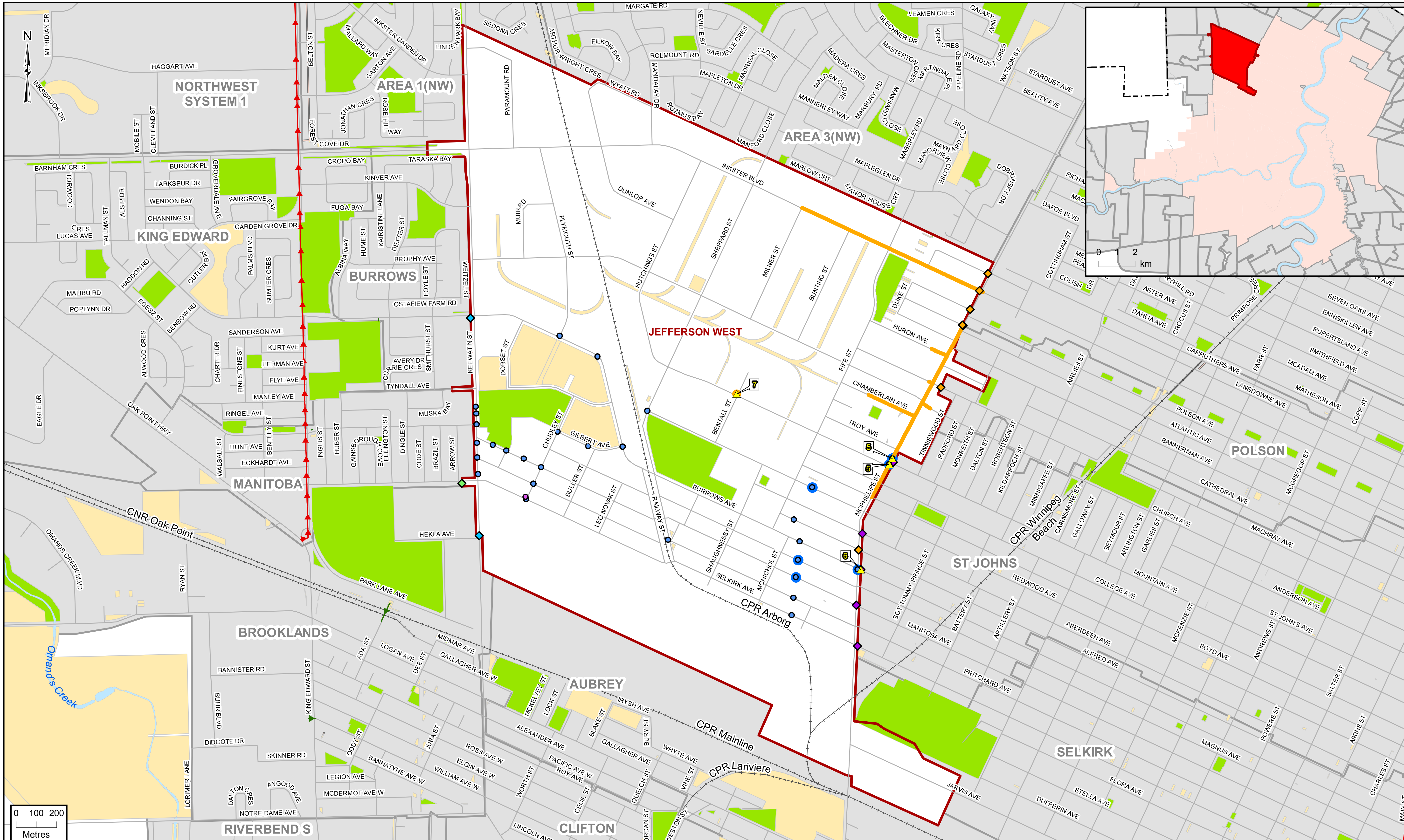
Table 1-9. Control Option 1 Significant Risks and Opportunities

Risk Number	Risk Component	Latent Storage / Flap Gate Control	In-line Storage / Control Gate [a]	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
12	Operations and Maintenance	-	R	-	-	-	R	O	-
13	Volume Capture Performance	-	O	-	-	-	O	O	-
14	Treatment	-	R	-	-	-	O	O	-

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

1.12 References

AECOM Canada Ltd. 2009. *Jefferson Combined Sewer Districts Sewer Relief and CSO Abatement Study.* Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. March.



LEGEND

- Critical Elevation
- Low CS Manhole
- Low SRS Connection

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

District Boundary Crossing
- CS
- LDS
- SRS
- WWS

- Interceptor Sewer
- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace
- City Owned Land

CSO MASTER PLAN PROPOSED SOLUTIONS

Extent of In-line Storage

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 20
District Overview Map
Sewer District: Jefferson West
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\JEFFERSONW\JEFFERSONW_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 6/24/2019 9:02:36 AM

CSO Master Plan

Jessie District Plan

August 2019

City of Winnipeg

JACOBS

CSO Master Plan

Project No: 470010CH
Document Title: Jessie District Plan
Revision: 04
Date: August 20, 2019
Client Name: City of Winnipeg
Project Manager: John Berry
Author: Jack Tinker
File Name: Jessie_Plan_Final_CO1MP_08202019_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	08/2018	DRAFT for City Comment	SG	ES	
1	11/2018	DRAFT 2 for City Review	JT	SG / MF	
2	05/2019	Final Draft Submission	JT	MF / SG	MF
3	07/2019	Revised Final Draft Submission	JT	SG / MF	MF
4	08/20/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Jessie District

1.1 District Description

Jessie district is located in the southwest of the combined sewer (CS) area, south of the Assiniboine River and west of the Red River. Jessie is bounded by the River district to the northeast, Cockburn and Baltimore districts to the south, and Ash district to the west. Figure 34 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan control options.

Regional roadways in Jessie include Pembina Highway, Grant Avenue, Corydon Avenue, and Taylor Avenue. The Southwest Transitway is located near the eastern boundary and parallel to Pembina Highway.

The district contains mostly residential land use with commercial land parcels around major transportation routes of Corydon Avenue and Pembina Highway. A small area of industrial land is located near the Red River. Development in the district is mainly the conversion of single family homes to multi-family and the addition of new developments around the Southwest Transit Corridor. Non-residential use in the area is the Winnipeg Transit Fort Rouge Garage, the Deaf Centre Manitoba institute on Pembina Highway, and Earl Grey Community Centre.

1.2 Development

A portion of Pembina Highway is located within the Jessie District. Pembina Highway is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Pembina Highway is to be promoted in the future.

1.3 Existing Sewer System

The Jessie district has an approximate area of 397 ha[1] and is serviced within Jessie district with a mix of storm relief sewer (SRS) and combined sewer (CS) pipe. There is no existing separation and none of the district is separation ready. Most of the combined system was constructed between 1900 and 1960. The SRS system was added in the 1970s to provide additional capacity and relieve the CS system.

The CS system includes a lift station (LS), flood pump station (FPS) and one combined CS/FPS outfall. The CS system drains towards the Jessie outfall, located at the east end of Jessie Avenue at the Assiniboine River. The main collector sewer is egg-shaped and is aligned down Jessie Avenue. This sewer varies in size from 1350 by 1800 mm to 1800 by 2400 mm. At the outfall, flow is diverted to the Jessie CS lift station (LS) where it is pumped through River district, across the Assiniboine River and to the Main Interceptor. Otherwise, flow may overflow the diversion weir to the outfall and flow by gravity to the Assiniboine River.

The SRS system extends throughout the district and has multiple interconnections with the CS system. The SRS system provides relief and extra capacity during high flow event and allows the CS to overflow into the SRS. When CS capacity is regained, the SRS drains back into the CS system. Most catch basins are still connected to the CS system, so partial separation has not been completed throughout most of the district. The northwest portion of Jessie includes a SRS system with an independent outfall. A 1350 mm SRS is installed along Grosvenor Avenue and flows to the Assiniboine River off Wellington Crescent. A flap gate and sluice gate are installed on the outfall pipe to control backflow into the SRS system under high river level conditions in the Red River.

During dry weather flow (DWF), the existing weir diverts flow to the Jessie CS LS through two 600 mm off-take pipes and is pumped through two 300 mm force mains to the River district, then travel via a 600

[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.

mm interceptor pipe to the River CS LS and river crossing to the Assiniboine district and on to the North End Sewage Treatment Plant (NEWPCC). During wet weather flow (WWF), any flows that exceeds the diversion capacity of the primary weir is discharged to the river. 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 high river level conditions when gravity flow is not available, Jessie FPS pumps flow to the river through the outfall pipe.

The combined CS and FPS outfall to the Red River is as follows:

- ID10 (S-MA70016174) – Jessie CS/FPS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Jessie, Ash, Cockburn, Baltimore, and River districts. Each interconnection is shown on Figure 34, and this figure shows gravity and pumped flow from one district to another. The interconnections are as follows:

1.3.1.1 Interceptor Connections – Downstream Of Primary Weir

River

- The Jessie CS LS discharges into a force main that separates into two 250 mm pipes that flow north into River district:
  - Dual 250 mm force mains

1.3.1.2 District Interconnections

Ash

<u>CS to CS</u>

- High Point Manhole (Flow is directed into both districts from this manhole)
  - Corydon Avenue and Cambridge Street – 229.50 m (S-MH60009462)

Cockburn

<u>CS to CS</u>

- High Point Manhole (flow is directed into both districts from this manhole)
  - Ebby Avenue and Wentworth Street – 228.93 m (S-MH60010140)
- A 300 mm CS sewer acts as an overflow pipe from the Cockburn CS system into the Jessie CS system.
  - Jackson Avenue and Stafford Avenue – 229.29 m (S-MH60010066)

Baltimore

<u>LDS to LDS</u>

- A 1350 mm LDS trunk conveys flow from the Fort Rouge Yards development area in Cockburn to an LDS outfall discharging to the Red River by gravity flow in the Jessie sewer district.

River

<u>SRS to CS</u>

- A 450mm SRS discharges into Jessie district CS system at the intersection of Jessie Avenue, between Pembina Highway and Osborne Street:
  - Southern River District SRS Tie-In – 224.35 m (S-MH60009040)
- A 350mm SRS in the River district discharges into Jessie CS system by gravity flow at the intersection of Corydon Avenue and Daly Street:
  - Corydon Avenue SRS Tie-In – 228.353 m
- A 250mm SRS in the River district discharges into Jessie CS system by gravity flow at the intersection of McMillan Avenue and Daly Street:
  - McMillan Avenue SRS Tie-In – 228.32 m (S-MH70016737)
- High Sewer Overflow 250mm SRS overflow pipe connects River's CS to Jessie's CS system).
  - Wellington Crescent & Gertrude - 229.06 m (S-MH60017449)

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

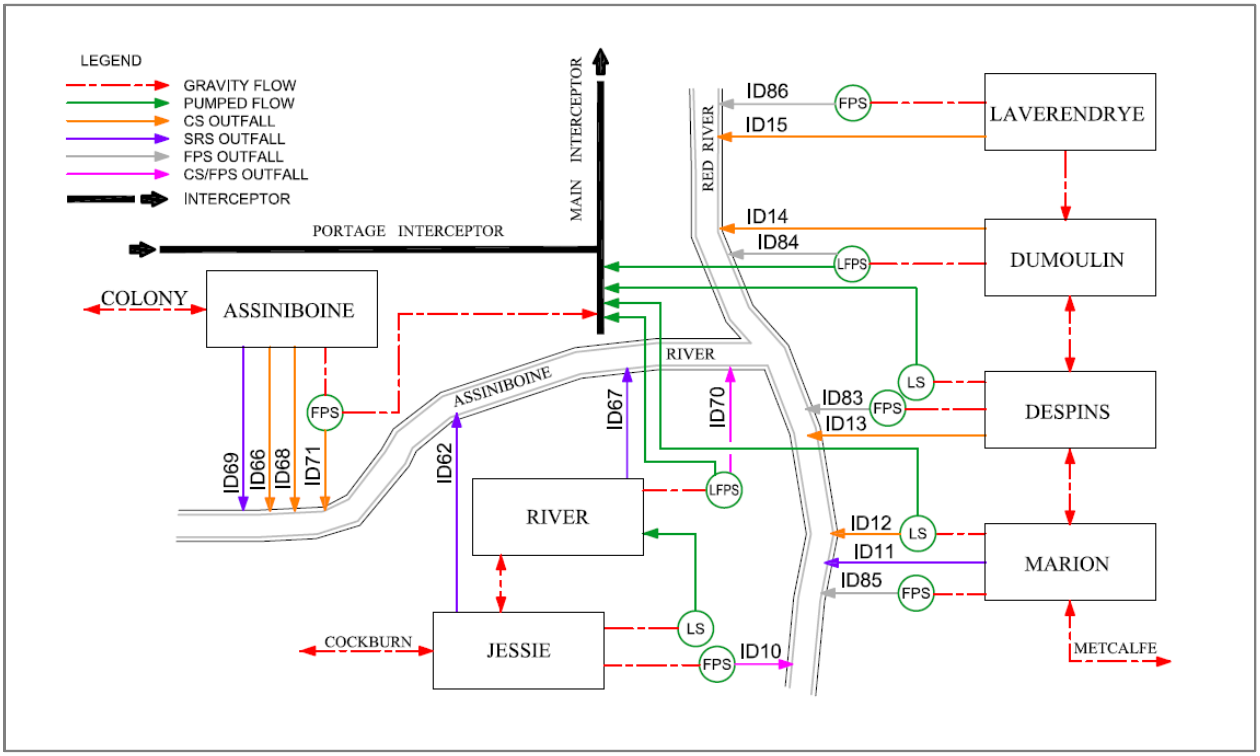


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 21 and are 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	S-CO70007409.1	S-MA70016174	2130 mm	Circular Invert: 221.91
Flood Pumping Outfall	S-CO70007409.1	S-MA70016174	2130 mm	Circular Invert: 221.91
Other Overflows	N/A	N/A	N/A	N/A
Main Trunk	S-TE70007799.1	S-MA70016174	1800 x 2400 mm	Egg-shaped Invert: 222.65m
SRS Outfalls (ID62)	S-CO70003029.1	S-MA70002491	1400 mm	Circular Invert: 224.81
SRS Interconnections	N/A	N/A	N/A	25 SRS - CS (also 4 district interconnections)
Main Trunk Flap Gate	S-CG00000817.1	S-CG00000817	1800 x 2100 mm	Square shaped Invert: 222.78
Main Trunk Sluice Gate	S-CG00000816.1	S-CG00000816	1800 x 2100 mm	Square shaped Invert: 222.78
Off-Take	S-TE70007800.2 S-TE70007799.2	S-MA70003857	600 mm	Invert: 222.78 Invert: 222.87
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.27 m^3/s	2 pumps at 0.135 m3/s
Lift Station ADWF	N/A	N/A	0.088 m^3/s	
Lift Station Force Main	S-YY70021068.2 S-BE70025982.1	S-MA70003857	250 mm	2 x 250 mm Invert: 230.58
Flood Pump Station Total Capacity	N/A	N/A	3.12 m^3/s	2 pumps at 1.156 m^3/s, 1 x 0.808 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.261 m^3/s	

Note:
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	Jessie – 223.73 Grosvenor – 223.84
2	Trunk Invert at Off-Take Pipes	222.78 – West Offtake 222.87 – East Offtake
3	Top of Weir	223.11
4	Relief Outfall Invert at Flap Gate	Grosvenor – 224.83

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
5	Low Relief Interconnection	226.03[1]
6	Sewer District Low Interconnection (River Combined Sewer District)	224.35
7	Low Basement	230.89
8	Flood Protection Level	230.14

[a] City of Winnipeg Data, 2013

[1]This relief interconnection height is based on an assumed weir structure at this location, with a weir height equal to half of the connecting pipe diameter. This assumption was applied to all locations where SRS overflow pipes are indicated, but based on GIS records an overflow height is not provided.

1.4 Previous Investment Work

The most recent study of Jessie district was completed in 1974 (MacLaren, 1974). This study led to the design and construction of the SRS system to add discharge capacity and increase the level of service for basement flood protection. South East (SE) Jessie was included with the Cockburn sewer relief project, Cockburn Preliminary Design Report (KGS, 2010), and is planned for complete separation. Table 1-3 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 Jessie Combined Sewer District was included as part of this program. Instruments installed at each of the thirty nine 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 ID	District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
21	Jessie	1974 - Conceptual	Future Work	2013	Study Complete	N/A
21	SE Jessie	2010 - PDR	Future Work	2013	Under Construction (SE Jessie Only)	TBD

Note:
TBD = To Be Determined

1.5 Ongoing Investment Work

As part of the Cockburn BFR program, an LDS system within southeast Jessie will be completed and provide complete road drainage separation.

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Jessie 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 Jessie sewer district are listed in Table 1-4. The proposed CSO control projects will include partial sewer separation and an alternative floatable management approach. 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% Capture in a Representative Year	-	-	-	-	-	-	-	✓	✓	✓	✓

Notes:
- = not included
✓ = included

The existing CS system is not fully suitable for use as in-line storage as the relative low level of the CS LS and associated CS outfall results in the NSWL level being at a similar level to the recommended control gate level (within 100mm) during the 1992 representative year assessment. An area within SE Jessie is undergoing separation in conjunction with the Cockburn district sewer relief project, and will provide the required benefits to the overall CSO Master Plan to meet Control Option 1.

Floatable control will be necessary to capture any undesirable floatables in the sewage overflows. Floatables are typically captured via a screening facility, however, the hydraulic constraints within the Jessie district do not allow sufficient positive head to be achieved and an alternative floatables management approach will be necessary.

The SRS system does not fully allow a cost effective installation of the latent storage option due to minor overflow volume reduction during the 1992 representative year and has not been proposed in this district.

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 Sewer Separation

The SE portion of the Jessie district is programmed to be separated as part of the Cockburn BFR project, this will provide some benefits to the CSO program when complete.

The flows to be collected from the Jessie separation will be as follows:

- Dry weather flows will remain the same for the Jessie district.
- Jessie wet weather flow (WWF) from this separation area will consist of sanitary sewage combined with foundation drainage.
- The majority of Jessie will remain as combined sewage.

This will result in a reduction in the combined sewage flow received at the Jessie CS LS and FPS after the separation project is complete.

1.6.3 Floatables Management

Floatables management for the Jessie district, due to the existing hydraulic constraints, is proposed to be an alternative floatables management approach. This approach is to ensure that the proposed required floatable management requirements outlined within the Environment Act Licence 3042 can be maintained.

This alternative approach to floatables management will be achieved by targeting floatables source control. This will be achieved by implementing more focused efforts towards street cleaning and catch-basin cleaning, to remove floatable material from surface runoff before it enters the combined sewer system. The second broad component of this alternative approach will focus on public education in an effort to reduce the sanitary components from ever entering plumbing systems. This is expected to achieve similar or better results while eliminating the end-of-pipe screening. The proposed approach will be similar to the program currently carried out in the City of Ottawa to meet their CSO mitigation requirements.

The alternative approach will be further investigated and demonstrated during the interim period between the submission of the CSO Master Plan (August 2019) and the revised CSO Master Plan submission (April 2030), and is discussed in further detail in Part 2 of the CSO Master Plan. It is recommended that as part of this work these measures will be undertaken in the Jessie district, due to screening limitations mentioned above.

1.6.4 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 applicable GI controls.

Jessie has been classified as a medium GI potential district. Land use in Jessie is mostly single-family residential. Corydon Avenue includes a mix of commercial businesses. This means the district would be an ideal location for bioswales, permeable paved roadways, cistern/rain barrels, and rain gardens. The flat roof commercial buildings along Corydon Avenue make would be an ideal location for green roofs.

1.6.5 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 considerations for implementation on a system wide basis.

1.7 System Operations and Maintenance

Systems 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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers, and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district. The alternative floatable management control is based on implementing additional operating and maintenance measures, in an effort to match the performance of the capital construction projects to meet the floatables management requirements. As such dedicated additional operating and maintenance costs should be allocated to this district. The goal however is for this work to overall be more cost effective from a life cycle perspective, considering the upfront capital and operating and maintenance costs associated with screening facilities.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	389	382	14,129	36	N/A
2037 Master Plan – Control Option 1	389	374	14,129	32	SEP

Notes:

SEP - Separation

No change to the future population was completed as from a wastewater generation perspective from the update to the 2012 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 statics. 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 1-6 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 when simulations were completed; these are listed to provide an indication of benefit gained only and are independent volume reductions unless noted otherwise.

Table 1-6. District 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 [a]
Baseline	189,233	187,594	-	21	0.261 m^3/s
In-Line Storage	189,233	N/A	N/A	N/A	N/A
Latent Storage	189,008	N/A	N/A	N/A	N/A
Separation	161,801	164,392	23,202	21	0.266 m^3/s
Control Option 1	**189,008 [b]**	**164,392**	**23,202**	**21**	**0.266 m^3/s**

Note:
[a] Pass forward flows assessed on the 1-year design rainfall event
[b] Incorrect volume taken forward for Preliminary Proposal assessment due to interim solution results. Small reduction due to latent storage component of PP assessment.

The predicted small overflow volume reduction of approximately 400 m^3 for the MP proposed latent storage option at the Grosvenor SRS system was not taken forward due to the relatively high cost component.

Percent capture is not included in the table above, as it is reported for the entire CS collection system and not for each district individually.

1.9 Cost Estimates

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 1-7. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-7. District Cost Estimate – 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)
Separation	$ - [a]	$25,900,000	$15,000	$330,000
Latent Storage	$2,020,000	N/A [b]	N/A	N/A
In-Line Storage (incl. screening)	$ - [a]	N/A [b]	N/A	N/A
Floatables Management Allowance	N/A	$2,540,000 [c]	$45,000 [c]	$960,000
Subtotal	**$2,020,000**	**$28,440,000**	**$60,000**	**$1,290,000**
Opportunities	N/A	$2,840,000	$6,000	$130,000
District Total	**$2,020,000**	**$31,280,000**	**$66,000**	**$1,420,000**

Notes:

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for the Separation item of work found to be $16,120,000 and for In-Line Storage (including screening) item of work to be $5,840,000, both in 2014 dollars

b

[b] Latent storage and In-line storage (incl. screening) not taken forward in Master Plan costing

[c] Cost allowance to account for the alternative floatable management measures. This allowance is based on a typical district control gate cost.

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. Each of these values include equipment replacement and O&M costs.
- 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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Floatables Management	Control Gate and screening were not included in the Preliminary Proposal estimate. Screening later determined to not be feasible due to hydraulic constraints. Added to Master Plan cost, assumed to be comparable to typical control gate projected cost.	
	Removal of Latent Storage	The Master Plan assessment found that latent storage not a preferred control solution.	
	Removal of In-Line Storage	The Master Plan assessment found that in-line storage not a preferred control solution.	
	Sewer Separation	Revised unit costs for separation work.	Refer to Cockburn PP costs for the Jessie separation costs
Opportunities	A fixed allowance of 10 percent has been included for program opportunities such as Green Infrastructure	Preliminary Proposal estimate did not include a cost for 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 1-9 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 Jessie district would be classified as a 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. Opportunistic separation of portions of the district may be achieved with synergies with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line storage tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume.

Table 1-9. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Opportunistic Separation • Off-line Storage (Tunnel / Tank) • Increased GI

The control options for Jessie district have been aligned to meet the 85 percent capture performance target based on the system wide basis. The expandability of this district to meet 98 percent capture target would be based on the system wide basis analysis and the results of the alternative floatables management approach.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-10.

Table 1-10. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	-	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	O
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-

Table 1-10. 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
11	Technology Assumptions	-	-	-	-	-	O	O	R
12	Operations and Maintenance	-	-	-	-	-	R	R / O	R
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	R

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

1.12 References

KGS Group. 2015. *Cockburn and Calrossie Combined Sewer Relief Works Preliminary Design Report.* Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. June.

LEGEND

Primary Weir	Inter-System Connection	District Boundary Crossing	Extent of Existing In-line Storage	District Boundary
Critical Elevation	SRS - CS	CS	Interceptor Sewer	Watercourse
CSO Outfall		LDS	Force Main	Greenspace
Low CS Manhole		SRS	Street	City Owned Land
Low SRS Connection		WWS	Railway	

CSO MASTER PLAN PROPOSED SOLUTIONS

Sewer Separation - Underway

Note: Alternative Floatables Management Approach to be tested prior to implementation.

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 34
District Overview Map
Sewer District: Jessie
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\JESSIE\JESSIE_DISTRICT_OVERVIEW_MAP.MXD DT072410 7/29/2019 8:04:40 AM

CSO Master Plan

La Verendrye District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	La Verendrye District Plan
Revision:	03
Date:	August 19, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	LaVerendrye_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	08/2018	DRAFT for City Comment	SG	ES	
1	02/15/2019	DRAFT 2 for City Review	SB	MF	MF
2	05/2019	Final Draft Submission	JT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figures

1. La Verendrye District

1.1 District Description

La Verendrye district is located near the centre of the combined sewer (CS) area in the northern section of St. Boniface community. La Verendrye is bounded by Mission district to the east, Dumoulin district to the south, and the Red River to the north and west. Notre Dame Street forms the southern boundary, and the Seine River runs along the eastern boundary.

The Canadian National Railway (CNR) Mainline and CNR Sprague railway pass through the district. The CNR Mainline passes east-west and crosses the Red River to the west. The CNR Sprague railway splits from the CNR Mainline and travels south parallel with Thibault Street into Dumoulin district.

The land use in La Verendrye district is a split between residential and parks and recreation with some commercial businesses interspersed throughout the district. The residential area is located on the western and southern areas of the district and consists of mainly single-family homes with some two-family residences. Most of the district consists of greenspace located along the edge of the Red River. Approximately 40 ha of the district is classified as greenspace. Lagimodiere-Gaboury Park and Whittier Park can be found in La Verendrye district and are divided by the CNR Mainline.

1.2 Development

There is limited land area available for new development within La Verendrye district due to its location and residential land use. As such, no significant developments that would impact the Combined Sewer Overflow (CSO) Master Plan are expected.

1.3 Existing Sewer System

La Verendrye district encompasses an area of 81 ha[1] based on the GIS district boundary information and includes combined sewer (CS), wastewater sewer (WWS) and land drainage sewer (LDS) systems. As shown in Figure 22, there is approximately 84 percent (34 ha) of the district already separated and no separation-ready areas.

The La Verendrye sewer system includes the primary diversion weir, CS primary outfall, a flood pump station (FPS), FPS outfall, and a CS outfall gate chamber located adjacent to the Red River at Tache Avenue and La Verendrye Street. A flap and sluice gate are in place on the CS outfall to prevent river water from flowing into the CS under high river level conditions. There is a WWS lift station (LS) located on St. Jean Baptist Street and Thibault Street (referred to as the Thibault WWS LS) which serves a small portion of the district north of Aubert Street. Sewage flows collected in La Verendrye district converge to a single 450 mm CS trunk sewer flowing south on Tache Avenue and draining towards the outfall.

During dry weather flow (DWF), the primary diversion weir diverts flow south by gravity through a 300 mm CS off-take pipe along Taché Avenue and into the Dumoulin district. The Dumoulin primary weir then diverts the intercepted flow from the La Varendrye district in addition to the CS from the Dumoulin district to the lift section of the Dumoulin lift and flood pumping station (LFPS). The Dumoulin LFPS pumps across the Red River into the Bannatyne district and on to the North End Sewage Treatment Plant (NEWPCC).

During wet weather flow (WWF) events, a parallel 450 mm overflow pipe immediately upstream of the diversion weir diverts some of the additional WWF southbound along Tache Avenue by gravity, also entering into the Dumoulin district and being intercepted by the Dumoulin primary weir. Any flow that exceeds the diversion capacity overtops the primary weir and is discharged to the Red River via the CS

[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.

outfall. When the river levels are high gravity flow is not possible in the CS outfall due to the flap gate in place, as mentioned above. Under these conditions the FPS pumps are activated, and redirect the flow which has spilt over the primary weir through the FPS outfall, at which point it can discharge by gravity into the river. The FPS outfall contains no flap or sluice gate.

An LDS system is installed throughout the majority of the district. Figure 22 shows a small section located in the northwest that remains unseparated along Herbert, Darveau, Messager Streets and Tache Avenue. Three independent LDS systems with dedicated LDS outfalls collect the surface runoff and discharge to the rivers adjacent to the district. In the southwestern portion of the district runoff flows to a 1200 mm LDS outfall located adjacent to the CS outfall at La Verendrye Street and discharges to the Red River. The eastern portion of the district flows to a 1200 mm outfall on Notre Dame Street and into the Seine River. The northwestern portion of the district with LDS installed flows through a 750 mm outfall located off Messager Street and into the Red River. Each LDS outfall includes a sluice and flap gate to prevent river water from backing up into the system under high river level conditions.

The outfalls to the Red River (one CS and one FPS) are listed as follows:

- ID15 (S-MA70017688) – La Verendrye CS Outfall
- ID86 (S-MA70017667) – La Verendrye FPS Outfall

1.3.1 District-to-District Interconnections

There are four district-to-district interconnections between La Verendrye and Dumoulin districts. Each interconnection is shown on Figure 22 and identifies locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections

No interceptor connections are found in this district.

1.3.1.2 District Interconnections

Dumoulin

CS to CS

- A 300 mm CS pipe carries the intercepted CS diverted by the primary weir from the La Verendrye district, and flows by gravity southbound on Tache Avenue and connects to the CS system in the Dumoulin district.
  - Tache Avenue and Dumoulin Street invert – 222.53 m (S-MH50008804)
- A 450 mm CS high overflow pipe diverts CS from the La Varendrye trunk sewer upstream of the primary weir, and flows by gravity southbound on Tache Avenue and connects to the CS system in the Dumoulin district.
  - Tache Avenue and Dumoulin Street invert – 225.49 m (S-MH50004016)

WWS to CS

- A 600 mm WWS overflow pipe from La Verendrye flows by gravity southbound on Langevin Street and connects into the CS system in Dumoulin district.
  - Langevin Street and Notre Dame Street overflow pipe invert – 227.09 m (S-MH-50003880)

LDS to LDS

- A 600 mm LDS pipe from Dumoulin district flows by gravity northbound into La Verendrye district at the intersection of Thibault Street and Notre Dame Street and is discharged into the outfall at the Seine River and does not interact with the CS system.

– Thibault Street and Notre Dame Street invert – 226.62 m (S-MH50009369)

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

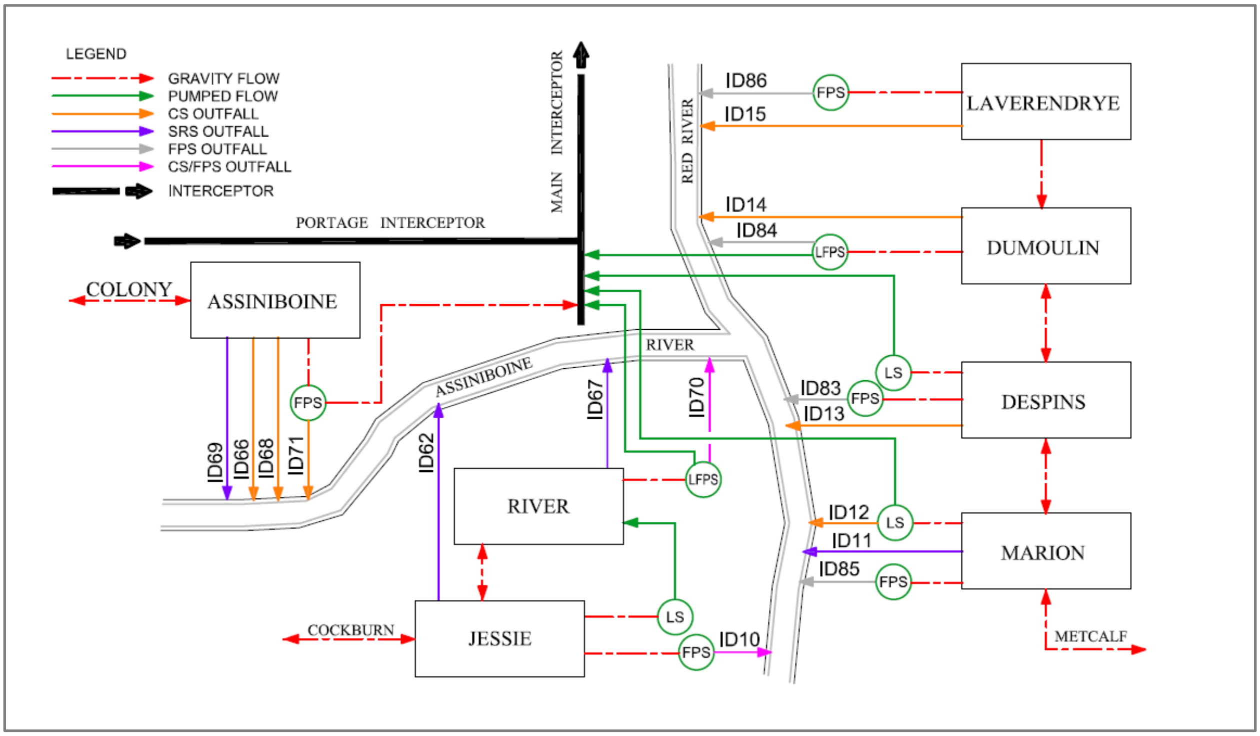


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 22 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 (ID15)	S-AC70008179.1	S-MA70017688	600 mm	Red River Invert: 221.40 m
Flood Pumping Outfall (ID86)	S-CO70017960.1	S-MA70017667	600 mm	Red River Invert: 225.65 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-MH50003874.1	S-MA70028293	450 mm	Invert: 223.19 m
SRS Outfalls	N/A	N/A	N/A	No SRS within the district.
SRS Interconnections	N/A	N/A	N/A	No SRS within the district.
Main Trunk Flap Gate	S-AC70008178.1	S-CG00000827	750 mm	Invert: 223.00 m
Main Trunk Sluice Gate	S-CG00000828.1	S-CG00000828	750 x 750 mm	Invert: 223.00 m
Off-Take	S-MH70010257.1	S-MA50004821	300 mm	Circular Invert: 223.08 m CS that takes sewage to Dumoulin LS
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	S-MA50004821 (1)	300 mm (1)	0.043 m3/s (1)

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
				This is based on the Thibault WWS LS
Lift Station ADWF	N/A	N/A	0.012 m^3/s	This is based on the Thibault WWS LS
Lift Station Force Main	N/A	N/A	N/A	
Flood Pump Station Total Capacity	N/A	N/A	0.24 m^3/s	1 x 0.24 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.017 m^3/s	

Notes:

(1) – Gravity Pipe replacing Lift Station as La Vernedrye is a gravity discharge district
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	La Verendrye – 223.73
2	Trunk Invert at Off-Take	223.08
3	Top of Weir	224.00
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Low Interconnection (Dumoulin)	222.53
7	Low Basement	227.38
8	Flood Protection Level [District(s) Included]	229.72

[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 La Verendrye district was the Dumoulin and La Verendrye Districts Combined Sewer Relief Study (Wardrop, 2006). This study provided for relief works of the existing CS systems to alleviate basement flooding. The CS district relief was completed at the same time for both Dumoulin and La Verendrye districts from 2002 to 2004. No other sewer work has been completed 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 La Verendrye 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	Planned Completion
22 – La Verendrye	2006 - Conceptual	Future Work Following Complete Separation	2013	Study Complete	N/A

Source: Report on Dumoulin and La Verendrye Districts Combined Sewer Relief Study, 2006

1.5 Ongoing Investment Work

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

1.6 Control Option 1 Projects

1.6.1 Project Selection

The La Verendrye district has complete sewer separation and tunnel storage proposed to meet CSO Control Option 1. Table 1-4 provides an overview of the control options to be included in the 85 percent capture in a representative year option. 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	Storage / Transport Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year	-	-	-	-	-	-	✓	✓	✓	✓	-

Notes:

- = not included
✓ = included

For the assessment, this district was assessed in conjunction with the downstream Dumoulin district.

The existing CS system was originally reviewed for in-line storage and found to already be in place. The existing weir level is already close to full-pipe providing in-line storage capacity. The marginal evaluation indicated that complete sewer separation will be similar to the screening option in terms of initial capital costs. The capital cost of sewer separation was similar to that required for construction a screening chamber since the majority of the La Verendrye district has already been separated. The O&M costs are reduced for the sewer separation proposed option however in comparison to the construction of screening, which therefore resulted in sewer separation having a lower overall lifecycle cost.

The hydraulic capacity downstream in the Dumoulin district is limited which increases the occurrence of CS overflows within La Verendrye. Overflows can be alleviated in La Verendrye once the proposed control options are implemented along with the Dumoulin future control options. The system wide assessment resulted in the Dumoulin control options being deferred to future conditions and this resulted in minor overflowing being predicted at the La Verendrye outfall in the interim until future work in the Dumoulin district is complete. It was found however that a static weir height raise would not be feasible to provide the necessary additional volume capture to eliminate overflows from the district. Tunnel Storage and flap gate installation on the main CS sewer to the downstream Dumoulin district was therefore proposed as an additional item for La Verendrye to eliminate the overflows from the district.

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 Sewer Separation

The sewer separation project for La Verendrye will provide immediate benefits to the CSO program when complete. Current LDS systems will be extended on Darveau Street and Herbert Street to collect road drainage. Collected stormwater runoff will be routed to the existing 750 mm LDS outfall discharging to the Red River at Messager Street. The approximate area of sewer separation is shown on Figure 22.

The flows to be collected after La Verendrye separation will be as follows:

- Dry weather flows will remain the same for La Verendrye district (and Dumoulin district).
- La Verendrye weather flow (WWF) will consist of sanitary sewage combined with foundation drainage from the existing old housing stock. All new homes will be constructed with foundation drainage disconnected from the CS system.

The separation project would provide the full reduction of overflows for the 1992 representative year when assessed as an individual district. However, based on the capacity of the downstream Dumoulin district the hydraulic model stills predicts overflowing at this district after sewer separation control option is implemented.

In addition to reducing the CSO volume, the benefits of La Verendrye separation include a reduction of pumped flows entering both the immediate downstream Dumoulin district, as well as reducing the amount of flood pumping required at the La Verendrye FPS. After further measures are implemented to eliminate the overflows from the district the FPS will be no longer be required to operate. This will provide an additional benefit to the long term operating and maintenance costs.

It is proposed that future monitoring of the district is completed to verify that the sewer separation is fully compliant with the modelled simulated elimination of all CSO overflows. If the modelled wet weather response for the district is found to be overly conservative, and the actual wet weather response is sufficient to eliminate overflows from the district, then the tunnel storage and flap gate installation items will no longer be required.

1.6.3 Tunnel Storage

Tunnel storage is proposed as a control option for the La Verendrye district to alleviate the remaining overflows found to occur after complete separation is implemented. This control option will include the addition of a sewer storage tunnel to provide additional storage capacity. Tunnel storage requires connections from the existing system into the tunnel and will be able to empty via gravity.

The design criteria for tunnel storage are listed in Table 1-5.

Table 1-5. Tunnel Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Number of Connections	2	
Diameter	900 mm	

Table 1-5. Tunnel Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Length	200 m	
Storage Volume	127 m^3	
Nominal Dewatering Rate	0.043 m^3/s	Based on existing gravity pipe capacity
RTC Operational Rate	TBD	Future RTC/ dewatering assessment

Notes:

RTC = real time control

The proposed location for the tunnel storage is shown in Figure 22. A tunnel 900 mm in diameter and approximately 200 m in length connecting at manhole S-MH50003792 along Tache Avenue at Grandin Street and La Verendrye Street and then discharges to manhole S-MH70010257. To ensure the isolation of the La Verendrye district from the downstream Dumoulin district it was also proposed to install a flap gate within manhole S-MH50008804 as part of this work.

As mentioned above, following the complete separation of the district flow monitoring of the La Verendrye district will be completed. If the modelled wet weather response for the district is found to be overly conservative, and the actual wet weather response is sufficient to eliminate overflows from the district, then the tunnel storage and flap gate work recommended will no longer be required. As well the green infrastructure and real time control opportunities may be pursued in the La Verendrye district to sufficiently eliminate any overflows remaining after complete separation is implanted. This would also remove the requirement for the off-line tunnel/flap gate work.

The nominal rate for dewatering is determined by the performance of the existing pipe capacity as the tunnel is able to discharge back into the CS system by gravity. As such the flows will vary over the duration of a rainfall event but due to the small nature of the district and interaction with the downstream Dumoulin has not been nominated for a gravity flow control device, since it discharges via lift station pumps. Any future consideration, for RTC improvements, would be assessed in conjunction with the downstream Dumoulin district.

1.6.4 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 applicable GI controls.

La Verendrye has been classified as a high GI potential district. Land use in the La Verendrye district is a mix of residential and commercial. The west end of the district is bounded by the Red River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. Commercial areas are suitable to green roofs and parking lot areas are ideal for paved porous pavement.

1.6.5 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

Systems 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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers, and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district. There will also be a future reduction on FPS operational requirements, as the overflows in the district will be greatly reduced.

Tunnel storage includes the installation of a large diameter sewer and flap gate, as well as monitoring and control instrumentation to dewater the tunnel. System monitoring and level controls will be installed which will require regular scheduled maintenance. The tunnel will operate intermittently during wet weather events and may require operational review and maintenance after each event.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-6.

Table 1-6. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	38	38	843	38	N/A
2037 Master Plan – Control Option 1	38	8	843	3	SEP, TS, FG

Notes:

SEP - Sewer Separation

TS - Tunnel Storage

FG - Flap Gate

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-7 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 1-7 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 1-7. District 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
Baseline (2013)	14,855	13,191	-	18	0.017 m^3/s [b]
Sewer Separation	N/A [a]	722	12,469	11	0.017 m^3/s [b]
Separation & Tunnel Storage		0	722	0	0.025 m^3/s [c]
Control Option 1	**14,997**	**0**	**0**	**0**	**0.025 m3/s** [c]

[a] Separation and Tunnel Storage were not simulated during the Preliminary Proposal assessment.

[b] Pass forward flows assessed with the 1-year design rainfall event.

[c] Pass forward flows assessed with the 5-year design rainfall event.

The percent capture performance measure is not included in Table 1-7, 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 1-8. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-8. District Cost Estimate – 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 (Over 35-year period)
Screening	$ - [a]	N/A	N/A	N/A
Sewer Separation	N/A	$2,080,000	$1,000	$30,000
Tunnel Storage		$1,060,000	$10,000	$210,000
Subtotal	**$0**	**$3,140,000**	**$11,000**	**$240,000**
Opportunities	N/A	$310,000	$1,000	$20,000
District Total	**$0**	**$3,450,000**	**$12,000**	**$260,000**

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Cost for this item of work found to be $550,000 in 2014 dollars.

[b] Sewer separation and tunnel storage not assessed in this district for the Preliminary Proposal

[c] Item does not include the cost for the flap gate installation

The estimates include changes to the control option selection since the Preliminary Proposal, updated construction costs, and the addition of GI opportunities. The impacts of extending the implementation schedule to 2045 are included in are included in the program development and program summary in Section 5 of Part 3A.

The calculation of the cost estimate for the CSO Master Plan 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.

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 1-9.

Table 1-9. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Tunnel Storage	Tunnel Storage was not included in the Preliminary Proposal estimate	Added for the MP to further reduce overflows
	Sewer Separation	Sewer Separation was not included in the preliminary estimate	The Master plan identified sewer separation as the most cost effective control option over in-line storage.
	Removal of Screening	Screening was not included in the Master Plan.	With sewer separation and tunnel storage recommended all CSO events will be removed, and there will no longer be a requirement for screening.
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 Costs	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 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 1-10 provides a description of how the regulatory target adjustment could be met by building off the proposed work identified for Control Option 1.

Table 1-10. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Assessment of performance in conjunction with Dumoulin district

For the La Verendrye district, the complete separation option will not change if the control limit is increased from 85 percent to 98 percent capture. The full implementation of the Control Options for the 85 percent capture target (including construction of tunnel storage and a flap gate on off-line tunnel storage) will be excessive and no longer required when the Dumoulin district control options are implemented for the future 98 percent capture target. Therefore, this work should not be prioritized, and instead evaluated following the implementation of the Dumoulin work.

The cost for upgrading to 98 percent capture 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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-11.

Table 1-11. 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	-	-	-	O	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	O	O	-	-	-

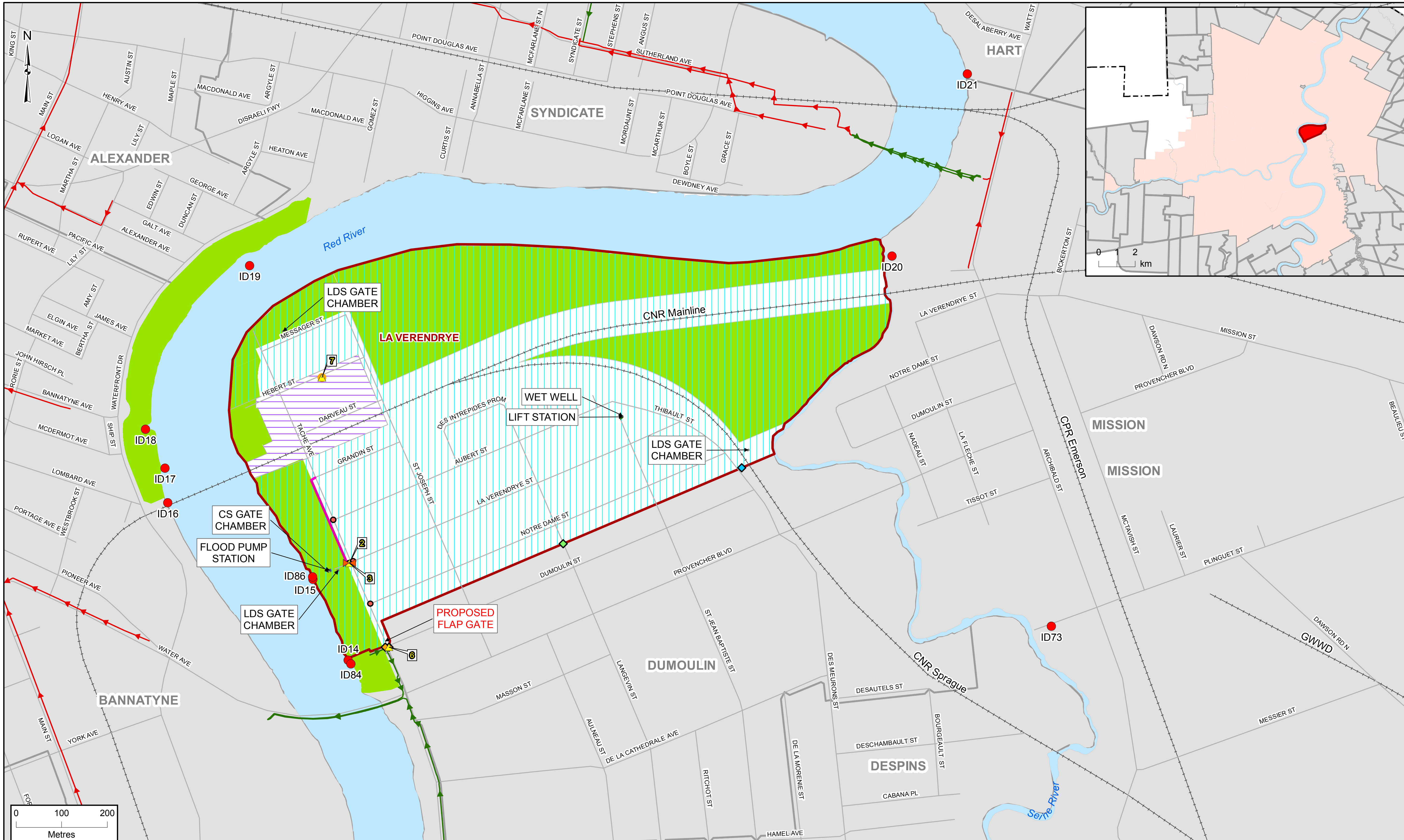
Table 1-11. Control Option 1 Significant Risks and Opportunities

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
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	R	R	-	-	-
8	Program Cost	-	-	-	O	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	O	-	R	-	-
11	Technology Assumptions	-	-	-	O	O	O	O	-
12	Operations and Maintenance	-	-	-	R	R / O	R	O	-
13	Volume Capture Performance	-	-	-	O	-	O	O	-
14	Treatment	-	-	-	R	O	O	O	-

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

1.12 References

Wardrop Engineering Consultants. 2006. *Dumoulin and La Verendrye Districts Combined Sewer Relief Study*. Report to the City of Winnipeg. December.



LEGEND

Primary Weir	Inter-System Connection	District Boundary Crossing	Interceptor Sewer	District Boundary
Critical Elevation	CS - WWS	CS	Force Main	Watercourse
CSO Outfall		LDS	Street	Greenspace
Low CS Manhole		WWS	Railway	

CSO MASTER PLAN PROPOSED SOLUTIONS

- Tunnel Storage
- Sewer Separation - Planning
- Sewer Separation - Complete

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

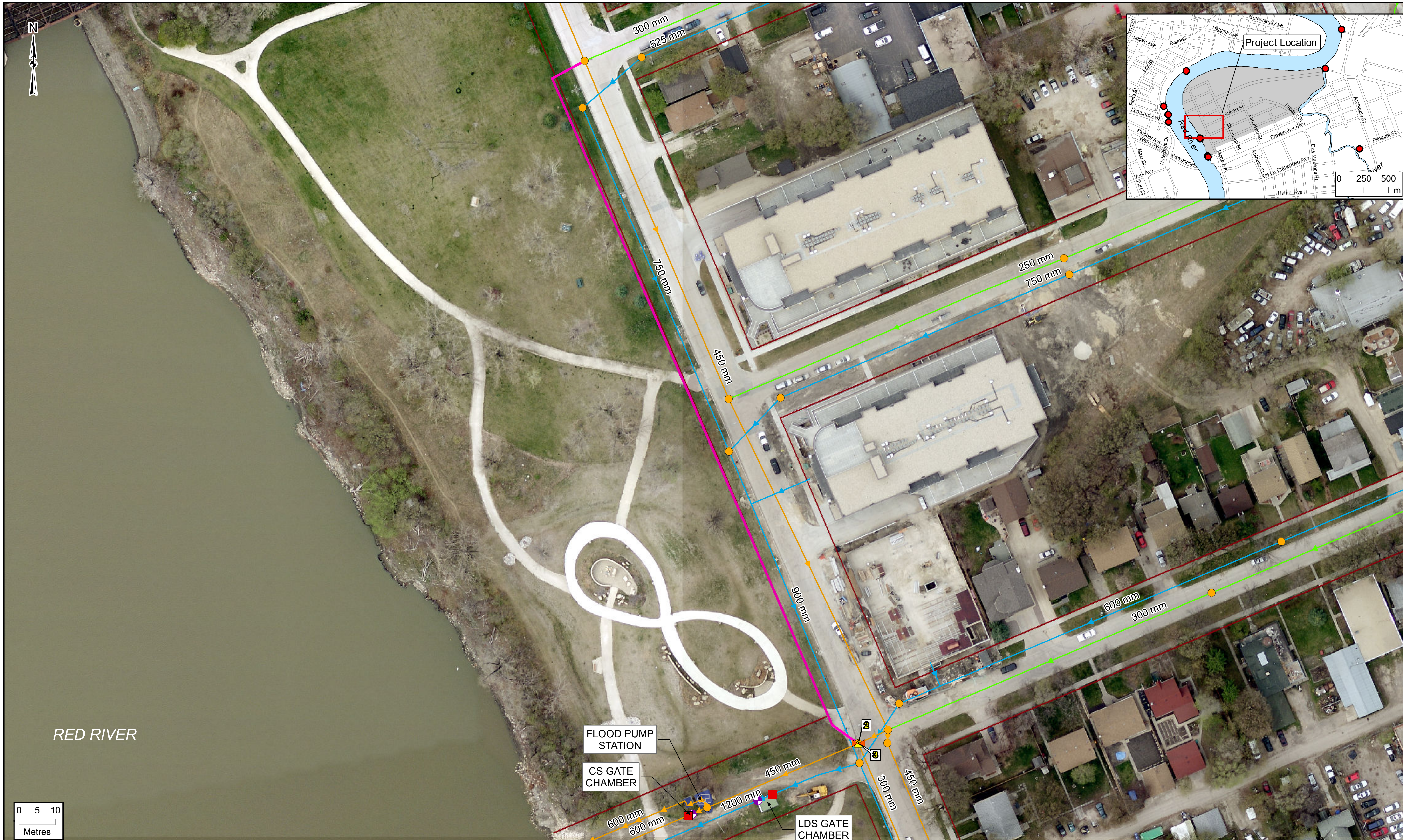
JACOBS

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

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 22
District Overview Map
Sewer District: La Verendrye
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE3\LAVERENDRYE\LAVERENDRYE_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:37:01 AM



LEGEND

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

Sewer By Type
- CS
- LDS
- WWS

Control Structure Type
- Gate Chamber

Pump Station Type
- Flood Pump Station

CSO MASTER PLAN PROPOSED SOLUTIONS
- Tunnel 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 22-01
Tunnel Storage
Sewer District: La Verendrye
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE3\LAVERENDRYE\LAVERENDRYE_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 8:35:22 AM

JACOBS

CSO Master Plan

Linden District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Linden District Plan
Revision:	03
Date:	August 22, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Linden_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	02/22/2019	DRAFT 2 for City Review	SB	MF	MF
2	07/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Linden District

1.1 District Description

Linden district is located in the northeast sector of the combined sewer (CS) area to the east of the Red River and north of the Munroe district. The Linden district is approximately bounded by Melbourne Avenue to the south, Roch Street to the east, Colvin Avenue and Rossmere Crescent to the north, and the Red River to the west.

The majority of the Linden district is residential land use with a small area of commercial land use. The residential areas are primarily single-family dwellings. Commercial businesses are located along Henderson Highway. Greenspace areas include Bronx Park and various school parks, playgrounds, and community areas throughout the district.

Henderson Highway, running in a north-south direction, is the only regional roadway in the district. Other main transportation routes include Brazier Street, Roch Street, and Kildonan Drive in the north-south direction and Kimberly Avenue, Linden Avenue, Greene Avenue, and Roberta Avenue in the east-west direction.

1.2 Development

A portion of Henderson Highway is located within the Linden District. This street is identified as a Regional Mixed Use Corridors as part of the OurWinnipeg future development plans. As such, focused intensification along Henderson Highway is to be promoted in the future.

1.3 Existing Sewer System

Linden district encompasses an area of 153 ha[1] based on the GIS district boundary information and includes a CS system and a land drainage system (LDS). As shown in Figure 23, there are approximately 115 ha (75 percent) already separated and 3 ha (2 percent) identifiable as separation-ready. The Linden district does not contain an SRS system. Approximately 15 ha of the district is classified as greenspace.

The Linden sewer system includes a dual flood and lift pump station (LFPS), one CS outfall gate chamber with flap and sluice gates, and a separate FPS outfall. The CS system drains towards the Linden outfall and primary weir, located at the west end of Linden Avenue at the Red River. At the outfall, sewage is diverted by gravity to the CS LS or flows through the Linden outfall to the Red River.

A single sewer trunk collects flow from most of the district and flows to the primary weir on Linden Avenue. The 2250 mm by 3375 mm CS trunk extends from the primary weir to Kildonan Drive. Multiple secondary trunk sewers extend from the CS trunk to the east along Kildonan Drive and along Linden Avenue, branching north and south, to service the district.

During dry weather flow (DWF), sanitary sewage flow is diverted by the primary weir to a 750 mm off-take pipe, where it flows by gravity into the lift station component of the Liden LFPS. Within the lift station sewage is pumped into a force main north along Kildonan Drive. This force main then becomes a river crossing, where it crosses the Red River and connects into the secondary interceptor sewer for the Newton district. From here, the intercepted combined sewage ties into the Main Interceptor, and eventually on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), any flow that exceeds the diversion capacity of the primary weir in the Linden district overtop the weir and is discharged into the Linden outfall, where it discharges to the Red

[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.

River by gravity. Sluice and flap gates are installed on this 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 when gravity discharge through the Linden CS outfall is not possible, the excess flow is pumped by the Linden FPS to instead discharge in a separate outfall adjacent to the CS outfall, where it will discharge by gravity to the Red River. There are no sluice or flap gates on this FPS outfall.

The LDS system extends throughout the majority of the district and has a single interconnections with the CS system. Only an area along Kildonan Drive in the southwestern corner of the district near the Red River remains as a CS system. A CS to LDS connection exists at the intersection of Linden Avenue and Woodvale Street where the CS system can overflow into the LDS. There are two dedicated LDS outfalls as part of the LDS system in the Liden district. The first LDS outfall is located near the intersection of Kildonan Drive and Chelsea Place. The second LDS outfall is located at the southern extents of Fraser's Grove Park, near the intersection of Kildonan Drive and Mossdale Avenue.

The two outfalls to the Red River (one CS and one FPS) are as follows:

- ID34 (S-MA70007427) – Linden CS Outfall
- ID88 (S-MA00017914) – Linden FPS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Linden and the surrounding districts. Each interconnection is shown on Figure 23 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

Hawthorne

- A 300 mm force main on Kildonan Drive at Rossmere Crescent carries flow from the sewage pump station in the Linden district to the Hawthorne district, and across the Red River to the Newton district. An interconnection is present between the force mains from each district prior to the river crossing.
  - Invert at Hawthorne district boundary – 225.25 m (S-MA70016777)
  - Invert at interconnection between force mains – 225.25 m (S-MA70021120)

1.3.1.2 District Interconnections

Hawthorne

<u>CS to CS</u>

- A 300 mm CS on Brazier Avenue and Colvin Avenue is diverted into the CS system in Hawthorne from the 375 mm CS flowing by gravity westbound on Colvin Avenue:
  - Invert at Linden district boundary – 226.67 m (S-MA40001960)
- High Point Manhole:
  - Colvin Avenue and Roch Street – 227.71 m (S-MH40005627)
- A 300 mm force main on Kildonan Drive at Rossmere Crescent carries flow from the sewage pump station in the Linden district to the Hawthorne district, and across the Red River to the Newton district. An interconnection is present between the force mains from each district prior to the river crossing.
  - Invert at Hawthorne district boundary – 225.25 m (S-MA70016777)
  - Invert at interconnection between force mains – 225.25 m (S-MA70021120)

Munroe Annex

CS to CS

- High point manholes
  - 300 mm CS at Roch Street and Roberta Avenue – 228.16 m (S-MH40006178)
  - 375 mm CS at Roch Street and Linden Avenue – 226.66 m (S-MH40006068)
  - 300 mm CS at Roch Street and Oakview Avenue – 227.26 m (S-MH40006027)
  - 300 mm CS at Roch Street and Helmsdale Avenue – 227.42 m (S-MH40005973)
- A 300 mm CS flows by gravity west at the intersection of Roch Street and Bronx Avenue from Munroe Annex district into Linden district:
  - Invert at Munroe Annex district boundary – 227.76 m (S-MA40005134)

LDS to LDS

- A 300 mm LDS flows by gravity west at the intersection of Roch Street and Leighton Avenue from Munroe Annex district into Linden district:
  - Invert at Linden district boundary – 224.54 m (S-MA40006148)
- A 300 mm LDS flows by gravity west at the intersection of Roch Street and Roberta Avenue from Munroe Annex district into Linden district:
  - Invert at Linden district boundary – 224.39 m (S-MA40006749)
- A 250 mm LDS flows by gravity east at the intersection of Roch Street and Linden Avenue from Linden district into Munroe Annex district:
  - Invert at Munroe Annex district boundary – 224.40 m (S-MA40006701)
- A 250 mm LDS flows by gravity east at the intersection of Roch Street and Oakview Avenue from Linden district into Munroe Annex district:
  - Invert at Munroe Annex district boundary – 224.59 m (S-MA40006599)
- A 450 mm LDS flows by gravity west at the intersection of Roch Street and Dunrobin Avenue from Munroe Annex district into Linden district:
  - Invert at Munroe Annex district boundary – 224.56 m (S-MA40006595)
- A 300 mm LDS flows by gravity west at the intersection of Roch Street and Helmsdale Avenue from Munroe Annex district into Linden district:
  - Invert at Linden district boundary – 224.91 m (S-MA40006501)
- A 250 mm LDS flows by gravity east at the intersection of Roch Street and Kimberly Avenue from Linden district into Munroe Annex district:
  - Invert at Munroe Annex district boundary – 225.28 m (S-MA40006513)
- A 600 mm LDS trunk flows by gravity south at the intersection of Roch Street and Roberta Avenue from Linden district into Munroe Annex district:
  - Invert at Linden district boundary – 224.15 m (S-MA40006722)
- A 2100 mm LDS trunk flows by gravity west at the intersection of Roch Street and Greene Avenue from Munroe Annex district into Linden district:
  - Invert at Munroe Annex district boundary – 22.84 m (S-MA40006725)
- A 750 mm LDS trunk flows by gravity north at the intersection of Roch Street and Dunrobin Avenue from Linden district into Munroe Annex district:

- Invert at Linden district boundary – 224.29 m (S-MA40006602)

- A 375 mm LDS flows by gravity north at the intersection of Roch Street and Helmsdale Avenue from Munroe Annex district into Linden district:
  - Invert at Linden district boundary – 224.83 m (S-MA40006509)
- A 2250 mm LDS trunk flows by gravity west at the intersection of Roch Street and Chelsea Avenue from Munroe Annex district into Linden district:
  - Invert at Munroe Annex district boundary – 222.72 m (S-MA40005093)

Munroe

CS to CS

- A 250 mm CS can overflow by gravity east on Canterbury Place into Munroe district from Linden district:
  - Invert at Linden district boundary – 230.00 m (S-MA70099421)
- High point manhole
  - 300 mm CS at Kildonan Drive – 227.18 m (S-MH40006295)

LDS to LDS

- A 450 mm LDS flows by gravity north on Brazier Street from Munroe district into Linden district:
  - Invert at Munroe district boundary – 225.93 m (S-MA40005084)
- A 2250 mm LDS truck flows by gravity west on Chelsea Avenue at Henderson Highway from Linden district into Munroe district:
  - Invert at Munroe district boundary – 222.09 m (S-MA40006395)
- A 2250 mm LDS trunk flows by gravity west on Chelsea Place at Kildonan Drive from Munroe district into Linden district:
  - Invert at Linden district boundary – 221.94 m (S-MA40006935)
- A 300 mm LDS flows by gravity north on Kildonan Drive from Munroe district into Linden district:
  - Invert at Linden district boundary – 224.53 m (S-MA40006870)
- A 250 mm LDS flows by gravity west on Canterbury Place from Munroe district into Linden district:
  - Invert at Linden district boundary 224.59 m (S-MA40006869)

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.

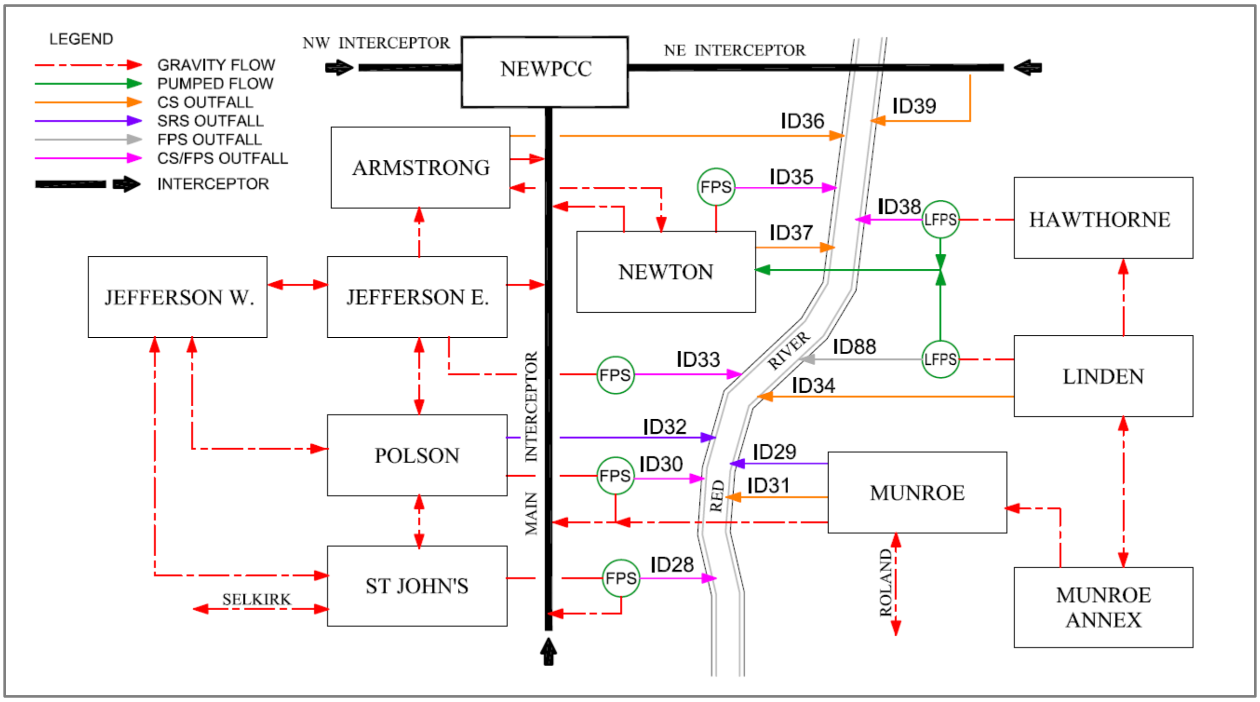


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 23 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 (ID34)	S-CO70017599.1	S-MA70016792	1,676 mm	Red River Invert: 222.47 m
Flood Pumping Outfall (ID89)	S-AC70007694.1	S-MA40001841	1525 mm	Red River Invert: 223.13 m
Main Trunk	S-TE40002177.1	S-MA70016788	2250 x 3375 mm	Invert: 223.50 m
SRS Outfalls	N/A	N/A	N/A	
SRS Interconnections	N/A	N/A	N/A	1 CS-LDS Interconnection
Main Trunk Flap Gate	S-TE70026334.2	S-CG00000990	1525 mm	Invert: 223.63 m
Main Trunk Sluice Gate	S-CG00000991.1	S-CG00000991	1800 x 1800 mm	Invert: 223.58 m
Off-Take	LINDEN_WEIR.1	S-MA70016777	750 mm	Invert: 223.47 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.058 m^3/s	1 x 0.058 m^3
ADWF	N/A	N/A	0.012 m^3/s	
Lift Station Force Main	S-RE70007688.1	S-MA70016777	300 mm	Invert: 227.26 m
Flood Pump Station Total Capacity	N/A	N/A	2.38 m^3/s	1 x 0.97m^3/s 1 x 1.40 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.107 m^3/s	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments

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	223.66
2	Trunk Invert at Off-Take	223.47
3	Top of Weir	223.68
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	227.00
6	Sewer District Interconnection (300 mm CS)	226.67
7	Low Basement	225.40
8	Flood Protection Level (Munroe, Linden, Hawthorne)	229.04

[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 Linden was the *Linden and Hawthorne Districts Combined Sewer Relief Study Conceptual Design Report* (Wardrop Engineering Canada Inc, 1994). The study's purpose was to develop sewer relief options that provide a 5-year and 10-year level of protection against basement flooding and to develop alternatives for reducing and eliminating pollutants from CSOs. A large portion of the sperate LDS system within the Linden district was installed following this study in the mid to late 1990s. 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 Linden CS 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	Planned Completion
23 – Linden	1994	Future Work	2013	Study Complete Partial Separation Complete	N/A

Source: Report on *Linden and Hawthorne Districts Combined Sewer District*, 1994

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Linden 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 Linden district are listed in Table 1-4. The proposed CSO control projects will include complete sewer separation. 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	Storage / Transport Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year	-	-	-	-	-	-	-	✓	✓	✓	-

Notes:

- = not included
✓ = included

The existing Linden district was originally reviewed for in-line storage in conjuction with floatable management via screening. The marginal evaluation indicated that complete separation capital costs will be similar to the in-line/screening control option, as the majority of the district has already been separated. Operations and maintenance (O&M) costs required with the in-line/screening option are also talken into consideration, and this assocated O&M cost results in the selection of complete separation as the most preferable option for this district.

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 Sewer Separation

Sewer separation is proposed as part of the solution for Linden district. The existing district has a large component of partial separation, and the complete sewer separation within Linden district would remove all of the WWF overflows from the CS system. This would reduce the pass forward flow received at the existing outfall, and eliminating all CSO overflows from the district under the 1992 representaive year conditions. Separation would also eliminate the amount of flood pumping required at the Linden FPS, reducing O&M costs.

Work would include the installation of an independent LDS systems to separate the surface runoff from the CS system. It is proposed that a collector LDS pipe will be located on Kildonan Drive to collect the stormwater runoff from Kildonan Drive and adjacent local roads. This will then be routed through the new

LDS system to the Chelsea LDS outfall along the Red River. A second LDS system within the north west corner of Linden district will collect the storm flows from the area around Kildonan Drive and Mossdale Avenue will connect to the existing LDS system outfall at Fraser's Grove Park.

The flows to be collected after separation will be as follows:

- DWF will remain the same – collected flow pumped from Linden LFPS to the river crossing and interceptor system.
- WWF will consist of sanitary sewage combined with foundation drainage from existing older homes.

This will result in a reduction in combined sewage flow received at Linden LFPS after the separation project is complete. It is proposed that future monitoring of the district is completed to verify that the sewer separation is fully compliant with the modelled simulated elimination of all CSO overflows under the 1992 representative year. A static weir elevation increase may be necessary at the CS diversion to eliminate the occurrence of all CSOs. Any weir elevation raise will also be evaluated in terms of existing basement flood protection to ensure the existing level of basement flood protection remains.

Potential drawbacks of sewer separation include the high cost and the wide-spread disruption to the neighbouring residential homes. Thearea to be separated however has been greatly reduced due to previous separation work and the magnitude of these drawbacks will be reduced.

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 will be reviewed to identify applicable GI controls.

Linden has been classified as a medium GI potential district. Linden district is mainly residential with a small area of commercial land use. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers, and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district.

The reduction in storm flows entering the Linden LS will reduce the requirement for operation of the FPS. It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the CS system) extent within the Linden district.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	147	147	3,885	10	N/A
2037 Master Plan – Control Option 1	147	70	3,885	3	SEP

Notes:

SEP = Sewer Separation

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 While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-6 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. Theable 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 1-6. District 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 (L/s) [a]
Baseline (2013)	13,903	14,033	-	18	109
In-line Storage	13,885	N/A	N/A	N/A	N/A
Sewer Separation	N/A	0	14,033	0	No overflow
Control Option 1	**13,885**	**0**	**14,033**	**0**	**No overflow**

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

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entire CS system and not for each individual district. However, the predicted capture of all modelled overflows will result in a 100 percent capture rate.

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 1-7. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-7. District Cost Estimate – 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 (Over 35-year period)
Control Gate	$0 [a]	N/A	N/A	N/A
Screening	$0 [a]	N/A	N/A	N/A
Separation	N/A[b]	$10,900,000	$6,500	$140,000
Subtotal	**$0**	**$10,900,000**	**$6,500**	**$140,000**
Opportunities	N/A	$1,090,000	$500	$10,000
District Total	**$0 [a]**	**$11,990,000**	**$7,000**	**$150,000**

[a] Solutions developed as refinement to Preliminary Proposal costs. Costs for the control gate and screening work together found to be $1,290,000 in 2014 dollars.

[b] Sewer separation not assessed in this district for the Preliminary Proposal

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

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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Sewer Separation	Sewer Separation was not included in the preliminary estimate	Master Plan review of suitable options and cost assessment resulted in change to control option for Linden
	Removal Of In-line Storage Control Gate	Removed from Master Plan	No longer required with complete separation work.
	Removal Of Screening	Removed from Master Plan	No longer required with complete separation work.
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 estimates were based on 2014 dollar values	

1.10 Meeting Future Performance Targets

The proposed complete separation of the Linden district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-9.

Table 1-9. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-

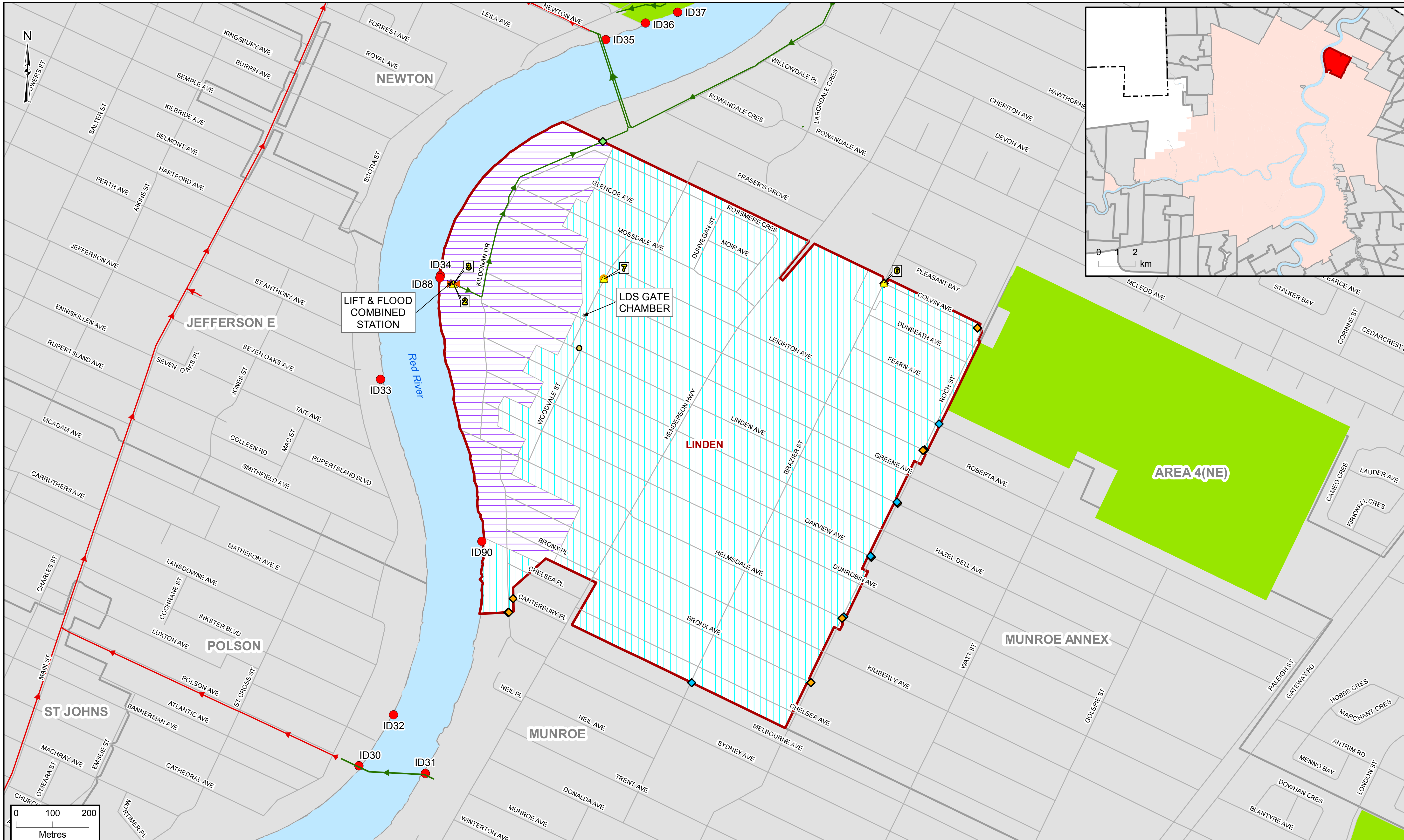
Table 1-9. Control Option 1 Significant Risks and Opportunities

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
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

Wardrop Engineering Inc, TetrES Consultants Inc. 1994. *Linden and Hawthorne Districts Combined Sewer Relief Study Conceptual Design Report.* Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. May.



LEGEND

	Inter-System Connection	District Boundary Crossing		
Primary Weir	CS - LDS	CS	Interceptor Sewer	District Boundary
Critical Elevation	CS - WWS	LDS	Force Main	Watercourse
CSO Outfall		WWS	Street	Greenspace
Low CS Manhole				

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Planning
- Sewer Separation - Complete

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 23
District Overview Map
Sewer District: Linden
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE7\LINDEN\LINDEN_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 10:11:41 AM

CSO Master Plan

Mager District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Mager District Plan
Revision:	03
Date:	August 18, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Danny Tinker
File Name:	Mager_Plan_Final_CO1MP_08182019

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	Version 1 DRAFT	DT	ES / SG	
1	02/15/2019	DRAFT 2 for City Review	DT	SG	MF
2	05/2019	Final Draft Submission	DT	MF	MF
3	08/18/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Mager District

1.1 District Description

Mager district is located at the southeast limit of the combined sewer (CS) area and is included within the South End Sewage Treatment Plant (SEWPPC) catchment area. Mager is bounded by the Red River to the west, Bethune Way, Bishop Grandin Boulevard, and Worthington Avenue to the South, Carriere Avenue to the north, and the Seine River forms the eastern border from Berrydale Avenue north to Carriere Avenue. Figure 24 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan control options.

St. Mary's Road and St. Anne's Road are two of the major transportation routes that travel through Mager. Fermor Avenue (Trans-Canada Highway), runs east-west through the central portion of the district. Most development within the district took place in the 1950s and 1960s, and little development has taken place since.

The Mager district is highly residential with greater than 60 percent made up of residential land use and less than 10 percent commercial land use. The commercial land use is concentrated along St. Mary's Road and St. Anne's Road. Other land use in the district is park space and schools, such as Saint Vital Memorial Park and Windsor School. Approximately 100 ha of the district is classified as greenspace which includes multiple parcels spread throughout the district.

1.2 Development

A portion of St. Mary's Road and St. Anne's Road are located within the Mager district. These streets are identified as Regional Mixed Use Corridors as part of the Our Winnipeg future development plans. As such, focused intensification along St. Mary's Road and St. Anne's Road is to be promoted in the future.

1.3 Existing Sewer System

Mager district is the largest of all the combined sewer (CS) districts with an area of 768 ha[1] based on the GIS district boundary data. The sewer system contains a mix of combined sewers and separate wastewater and land drainage sewers (LDS). As shown on Figure 24, approximately 70 percent (575 ha) of the CS in Mager district has been separated and approximately 3 percent (20 ha) of the CS in Mager district is considered separation ready. The northern and central portions of the district contain combined and separation ready sewers with the western, eastern, and southern areas consisting of a separate land drainage and wastewater sewer system.

Mager district includes a small remaining CS system, with piping installed in the 1950s and 1960s. The district has since been partially separated into separate land drainage sewer and wastewater sewer systems, with the central portion of the district remaining as a CS system. For a portion of this area the separated wastewater sewers connect back into the existing CS, and would be considered separation ready.

The CS system includes a flood pump station (FPS), CS lift station (LS), one CS outfall, all located at the northern end of Mager Drive off St. Mary's Road. There is one SRS outfall beneath the St. Vital Bridge off Kingston Row, There is also a force main river crossing beneath the St. Vital Bridge, carrying all intercepted CS from the Cockburn, Calrossie, and Baltimore districts. The intercepted CS from the upstream districts is discharged into the CS system for the Mager district, such that it is intercepted once more at the primary weir for the Mager district.

---

[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), all domestic wastewater and combined sewage flows collected in Mager district are routed to the St Mary's Road CS trunk and to the CS LS off Mager Drive. Sewage flows are directed by the primary weir to the Mager CS LS and pumped to the trunk sewer on St. Thomas Toad that flows to the interceptor on Bishop Grandin Boulevard. From Mager district, flows are transported in the South End Interceptor System to the SEWPCC.

During wet weather flow (WWF), any flows that exceeds the diversion capacity of the primary weir is discharged into the Mager outfall where it flows 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 the flap gate which restricts river level infiltration into the CS system will prevent gravity discharge through the Mager CS outfall. Excess flow trapped behind the flap gate is then pumped by the Mager FPS downstream of the flap gate through the CS outfall, where it will discharge by gravity to the Red River.

The Mager district includes large areas that include LDS and wastewater sewer (WWS) sewer networks, which as mentioned above are classified as partially separated. The LDS system as part of these separated areas includes 15 outfalls from the district to the Red River and Seine River, installed along the perimeter of the district. In these areas, catch basins connect storm weather to the LDS systems that direct flow to the specific LDS outfalls. The Pulberry LS is located on St Vital Road at the intersection of Pulberry Street, and services the wastewater sewers in southwest section of the separated area of the Mager district. The Pulberry LS lifts WW to the CS system on directly adjacent to the WWLS on St Vital Road 8 metres downstream.

The combined sewer outfalls to the Red River are as follows:

- ID04 (S-MA70007510) – Mager CS Outfall
- ID03 (S-MA50014591) – Mager SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Mager and the surrounding districts. There are no district boundary crossings though the Seine River to the east. Each interconnection location is shown on Figure 24 and is listed as follows:

1.3.1.1 Interceptor Connections – Upstream 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)

Metcalfe

- The 200 mm Metcalfe LS force main flows under pressure into the Mager district CS system:
  - St Mary's Road force main at connection point to Mager CS – 227.52 m (S-MA70017062)

1.3.1.2 Interceptor Connections – Downstream of Primary Weir

Area 18

- The Mager 1375 mm interceptor flows by gravity from Mager district into Area 18 and connects to the South Interceptor and onto the SEWPCC:
  - St. George Road Interceptor Invert at District Boundary – 224.36 m (S-MA50018680)

1.3.1.3 District Interconnection

Area 16

WWS to WWS

- A 250 mm WWS collecting wastewater from Hardy Bay and a 250 mm WWS from River Road overflow pipe within the Mager District flow into WW system in the Area 16 district:
  - River Road and Hardy Bay – 227.76 m (S-MA50014668)

LDS to LDS

- A 525 mm land drainage gravity sewer within River Road and Hardy Bay within the Mager District which does not interact with the Mager CS System flows into Area 16 and the nearby LDS outfall:
  - River Road LDS Invert at connecting LDS sewer- 228.08 m (S-MA50018409)

Area 17

WWS to WWS

- High point sewer manhole (flow is directed into both districts from this manhole):
  - 250 mm WWS on Bethune Way – 228.30 m (S-MH50011761)

LDS to LDS

- Gravity flows from the land drainage system in Area 17 into the LDS system in Mager district at multiple points. The LDS system in Mager as part of previous sewer separation work. This LDS flows directly to outfall to the Red River, however there is an SRS interconnection with the LDS network and WWS network at Parkville Bay and Parkville Drive
  - 750 mm LDS at Bethune Way and Glen Meadow Street, LDS Invert at District Boundary – 228.76 m (S-MA50014745)
  - 600 mm LDS at Pulberry Street, LDS Invert at District Boundary – 229.20 m (S-MA50015276)
- Gravity flow from the land drainage system in Mager district, servicing part of Bethune way and a three block stretch of St. Mary's Road flows into LDS system within the separated Area 17. This does not interconnect with the Mager CS system:
  - St. Mary's Road at Bishop Grandin LDS Invert at District Boundary – 228.70 m (S-MA50015300)

Area 18

WWS to WWS

- High point sewer manhole (flow is directed into both districts from this manhole):
  - 250 mm at Dakota Street and Chesterfield Avenue – 226.28 m (S-MH50015058)
  - 250 mm at Marlene Street – 226.75 m (S-MH50015034)

LDS to LDS

- A 900 mm LDS flows westbound on Beliveau Road from Area 18 and connects to the LDS network in Mager. This does not interconnect with the Mager CS system:
  - Beliveau Road LDS Invert at District Boundary – 227.73 m (S-MA50018013)

Marion

LDS to LDS

- A 525 mm LDS servicing a short stretch of Carriere within Marion district flows into the LDS system in Mager district and directly to outfall. There is no interaction with Mager CS system
  - – Youville Street LDS Invert at District Boundary – 227.17 m (S-MA70001110)

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

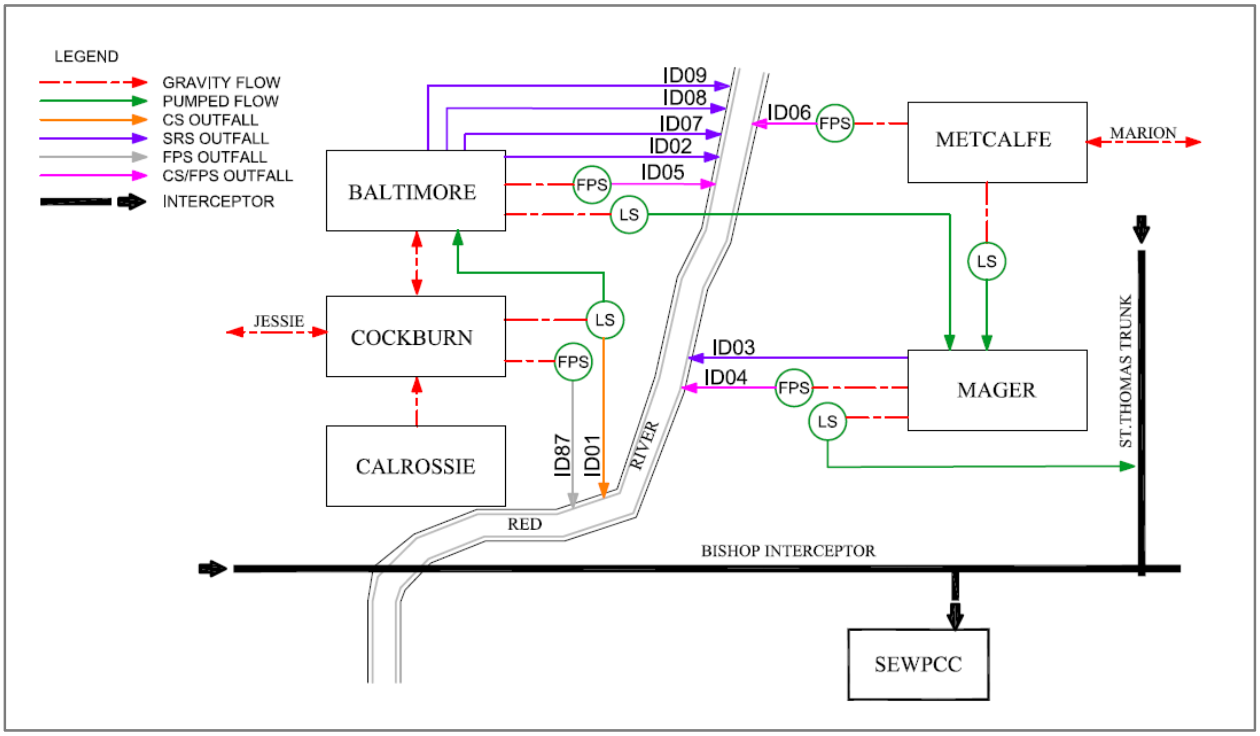


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 24 and are 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 (ID4)	S-YY70021073.1	S-MA70007510	1660 mm	Circular Invert: 221.72 m
Flood Pumping Outfall (ID4)	S-YY70021073.1	S-MA70007510	1660 mm	Circular Invert: 221.72 m
Other Overflows	N/A	N/A	N/A	N/A
Main Trunk	S-MH50012525.1	S-MA70018393	2250 x 3375 mm	Egg-shaped Invert: 223.92 m
SRS Outfalls (ID3)	S-CO50003092.1	S-MA50014591	800 mm	Circular Invert: 222.60 m
SRS Interconnections	S-MH50011684.1 S-MH70003108.1 S-MH70003109.1	S-MH50011684 S-MH70003108 S-MH70003109 S-TE70002942	N/A N/A N/A N/A	Invert: 226.51 m Invert: 227.88 m Invert: 228.43 m Invert: 227.25 m

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
	S-TE70002942.1 N/A N/A			
Main Trunk Flap Gate	S-TE70027658.2	S-CG00001114	2000 mm	Invert: 224.22 m
Main Trunk Sluice Gate	Mager Gate.1	S-CG00001115	2000 x 2000 mm	Invert: 224.15 m
Off-Take	S-TE70024868.2	S-MA70068576	450 mm	To lift station Invert: 223.92
Dry Well	N/A	N/A	N/A	No dry well associated with Mager LS
Lift Station Total Capacity	N/A	N/A	0.517 m^3/s	2 pumps @ 0.315 m^3/s, and 0.202 m^3/s
Lift Station ADWF	N/A	N/A	0.095 m^3/s	
Lift Station Force Main	S-TE70027636.1	S-MA70007687	600 mm	Invert: 227.91
Flood Pump Station Total Capacity	N/A	N/A	Minimum - 1.71 m^3/s Maximum - 2.15 m^3/s	Minimum - 0.58, 1.13 m^3/s for each pump Maximum - 0.71, 1.44 m^3/s for each pump
Pass Forward Flow – First Overflow	N/A	N/A	0.477 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	Kingston Row – 223.75 Mager Drive – 223.75
2	Trunk Invert at Off-Take	223.92
3	Top of Weir	224.95
4	Relief Outfall Invert Immediately Upstream of Gate Chamber	225.20
5	Relief Interconnection (S-MH50011684)	226.51
6	Sewer District Interconnection (Area 18)	226.28
7	Low Basement (Mager)	226.70
8	Flood Protection Level (Mager)	230.04

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

A stormwater management study (I.D. Engineering, 1992) was completed for Mager district in 1992. The study described the potential of implementing relief alternatives and recommended an alternative to meet the 1 in 5-year and 1 in 10-year level of service for basement flooding. A portion of the Mager district was separated, but the entire district was not completed with the most recent construction in 2011. Table 1-3 provides a summary of the district status in terms of data capture and study.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
Mager	1992	Future Work	2013	Partially Separated	N/A

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 Mager Combined Sewer 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.

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of the permanent instruments installed within the primary outfall within the Mager 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 Mager sewer district are listed in Table 1-4. The proposed CSO control projects will include in-line storage via a control gate and 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 option will take advantage of the existing CS pipe network for additional storage volume.

The primary outfall location in the Mager district is 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 additional in-line storage.

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 In-Line Storage

In-line storage has been proposed as a CSO control for the Mager 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 the additional hydraulic head necessary for screening operations.

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	223.92 m	
Trunk Diameter	2250 x 3375 mm	Egg-shaped
Gate Height	0.76 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	225.71 m	
Bypass Weir Height	225.51 m	
Maximum Storage Volume	3,450 m^3	
Nominal Dewatering Rate	0. 517 m^3/s	Based on existing CS LS capacity
RTC Operational Rate	TBD	Future RTC / dewatering review on performance

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

The proposed control gate will cause combined sewage to back-up in the collection system to the extent shown on Figure 24. 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 CS system are reduced following wet weather events, below the bypass side weir critical performance level. the control gate moves back to its original position to provide additional in-line storage capture for future wet weather events. 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 providing during a WWF event as downstream capacity becomes available.

Figure 24-01 provides an overview of the conceptual location and configuration of the control gate, bypass side weir and screening chambers. The proposed control gate will be installed in a new chamber within the existing trunk sewer alignment near the existing FPS. The dimensions of the chamber will be 5.5 m in length and 4.0 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. 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 Mager 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 existing 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 FPS rehabilitation or replacement project.

The nominal rate for dewatering is set at the existing CS LS capacity. The dewatering rate includes both the DWF and WWF components of the district flows. 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. Any future considerations, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing capacity for large events will adversely affect the overflows at this district. This future RTC will provide the ability to capture and treat more volume for localized storms by using the either the district in-line storage or the excess interceptor capacity where the runoff volume is less. Further assessment of the impact of the RTC and future dewatering arrangement will be necessary to review the downstream impacts.

1.6.3 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 hydraulic 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	225.71 m	
Bypass Weir Crest	225.51	
Normal Summer River Level	223.75 m	
Maximum Screen Head	1.76 m	
Peak Screening Rate	0.196 m^3/s	
Screen Size	1 m high x 1.5 m wide	Modelled Screen Size

The proposed bypass side weir and screening chamber will be located adjacent to the proposed control gate and existing CS trunk, as shown on Figure 24-01. The screens will operate with the control gate in its fully raised position., diverting flows to the bypass weir. 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 piping downstream of the gate are 3.0 m in length and 3.5 m in width. The existing sewer configuration including the 2250 mm by 3375 mm sewer trunk and the 450 mm off-take may have to be modified to accommodate the new chamber.

1.6.4 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.

Mager has been classified as a medium GI potential district. Land use in Mager is mostly single-family residential, with the remaining consisting of commercial land use. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels. The flat roof commercial buildings make for an ideal location for green roofs.

1.6.5 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. In-line storage dewatering will be controlled with the existing CS LS which will require more frequent and longer duration pump run times. Lower velocities in the CS trunks 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.

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. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options 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	743	743	21,429	5	N/A
2037 Master Plan – Control Option 1	743	743	21,429	5	IS, SC

Notes:

IS = In-line Storage
SC = Screening

Table 1-7. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model

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. 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 1-8 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	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 [a]
Baseline (2013)	22,652	21,912	-	18	0.477 m^3/s
In-Line Storage	5,989	1,056	20,856	2	0.517 m^3/s
Control Option 1	**5,989**	**1,056**	**20,856**	**2**	**0.517 m^3/s**

Note:
[a] Pass forward flows assessed on the 1-year (baseline) and 5-year (CO1) design rainfall events

It is possible that volume capture improvement in this district is due to a combination of the reduction in flows from the upstream pumping stations and the provision of the in-line storage control option at the Mager CS LS. However, no change to the peak pumped flows from the upstream districts of Baltimore and Metcalfe was noted from the implementation of in-line storage within the Mager district. This would indicate that the in-line storage component within Mager alone provides the majority of the modelled overflow volume reduction. 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 Control Gate	$7,740,000	$2,710,000 [b]	$41,000	$880,000
Screening		$1,590,000 [c]	$30,000	$640,000
Subtotal	**$7,740,000**	**$4,300,000**	**$71,000**	**$1,520,000**
Opportunities	N/A	$430,000	$7,000	$150,000
District Total	**$7,740,000 [a]**	**$4,730,000**	**$78,000**	**$1,670,000**

[a] Solution development as refinement to Preliminary Proposal costs, refined shortly after Preliminary Proposal submission. Revised costs for the control gate and screening work found to be $1,910,000 in 2014 dollars.

[b] Cost associated with new off-take construction, as required, to accommodate control gate location and allow intercepted CS flow to reach existing Mager 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 Options	Control Gate	Unit cost updates Separation of screening and in-line	In-line and Screening included as combined cost in Preliminary Proposal

Table 1-10. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
	Screening	Unit cost updates Separation of screening and in-line	In-line and Screening included as combined cost in Preliminary Proposal
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 Mager district would be classified as a low potential for implementation of complete sewer separation as the feasible approach to achieve the 98 percent capture in the representative year future performance target. The favorable performance and additional volume capture potentially available via control gate construction and in-line storage utilization was found to not require any additional measures to within this district to address future performance targets. The existing extent of sewer separation within the district has also been found to sufficient as is to meet future performance targets. Additional opportunistic separation of the portions of the district would still be recommended however, so long as there are sufficient synergies and cost savings with other major infrastructure work. In addition, focused use of green infrastructure could also be utilized 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	• Opportunistic additional sewer separation • Increased use of GI • Increased use of In-line

The control options for the Mager district have been aligned for the 85 percent capture performance target. The expandability of this district to meet the 98 percent capture would again involve a system wide basis analysis to be completed to determine the next phase for the district. As noted in the performance summary, this district already achieves a high level of percent capture and is impacted from the upstream districts that discharge to the Mager district. Any increases to the districts percent capture would be to eliminate overflows from this district or improve the system-wide percent capture overall 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.

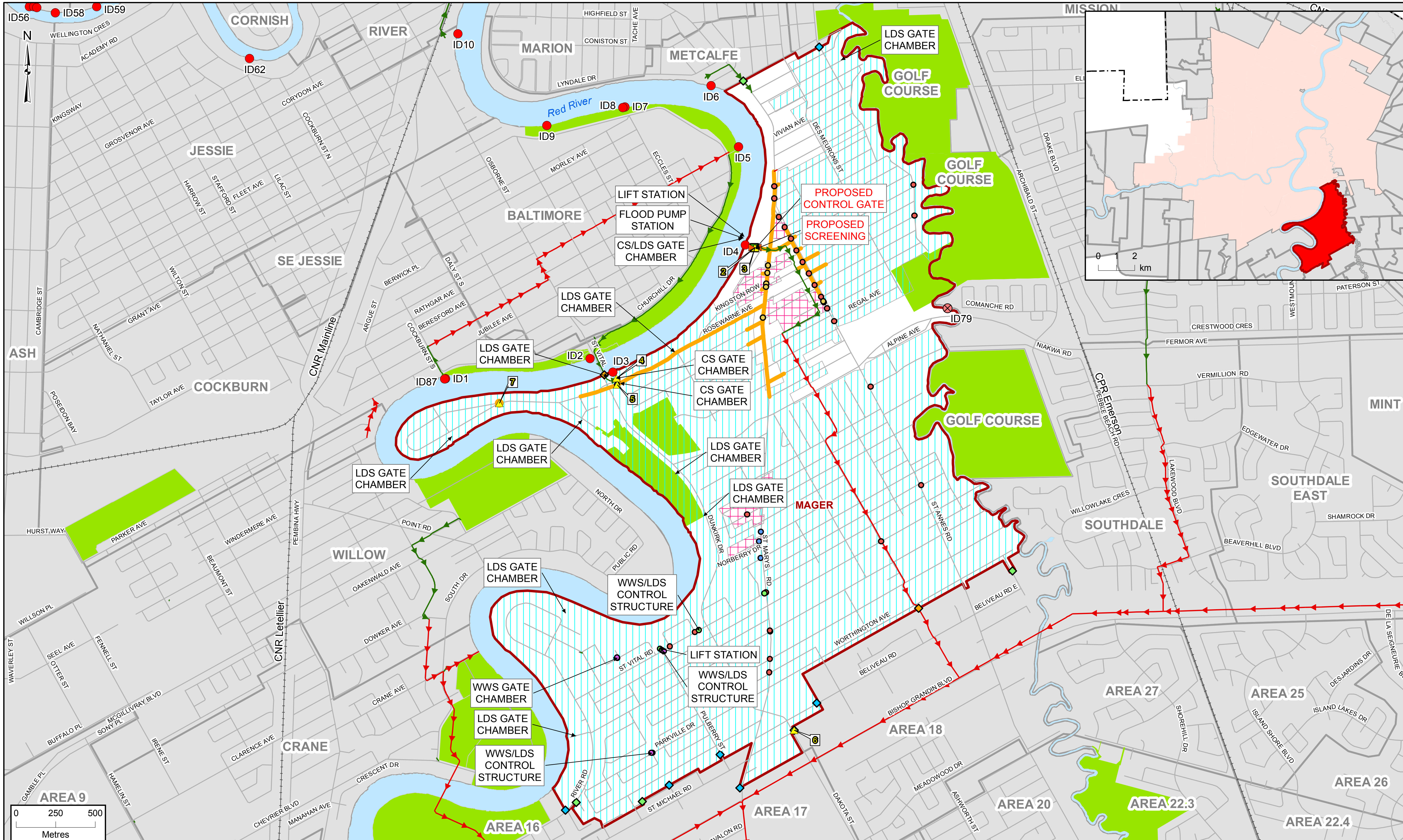
Table 1-12. Control Option 1 Significant Risks and Opportunities

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	-
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

I.D. Engineering Canada Inc. 1992. *Sewer Relief Study Mager Combined Sewer District*. Prepared for the City of Winnipeg, Waterworks, waste and disposal department. October.



LEGEND

Primary Weir	Inter-System Connection	District Boundary Crossing	Interceptor Sewer	District Boundary
Critical Elevation	CS - LDS	CS	Force Main	Watercourse
Decommissioned Outfall	CS - WWS	LDS	Street	Greenspace
CSO Outfall	SRS - CS	WWS	Railway	
Low CS Manhole	SRS - LDS			
	SRS - WWS			

CSO MASTER PLAN PROPOSED SOLUTIONS

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

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 24
District Overview Map
Sewer District: Mager
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\MAGER\MAGER_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 6/24/2019 7:36:44 AM

LEGEND

- Primary Weir
- Critical Elevation
- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate
- Pump Location
- Force Main
- Sewer By Type
  - CS
  - LDS
- 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 24-01
Control Gate and Screening
Sewer District: Mager
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE1\MAGER\MAGER_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 8:04:31 AM

CSO Master Plan

Marion District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Marion District Plan
Revision:	03
Date:	August 19, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	Marion_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	08/2018	Version 1 DRAFT	SG	ES	
1	03/2019	DRAFT 2 for City Review	JT	MF / SG	MF
2	07/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Marion District

1.1 District Description

Marion district is located along the eastern edge of the Red River and west of Seine River. The district is bounded by Despins district to the north and east, Metcalfe and Mager districts to the south, Mission district to the east, and the Red River to the west. Coniston Street, Niverville Avenue, and Carriere Avenue form the southern border, the Seine River and Des Meurons Street form the eastern border, and Bertrand Street forms the northern border.

The land use within Marion district developed gradually from 1900 to 1950 as single-family residential land. Single family housing is primarily located to the southwest of St Mary's Road and multi-family housing extends to the northwest of St. Mary's Road. Marion is mostly residential, but it has many commercial businesses on St. Mary's Road, Marion and Goulet Streets, and Taché Avenue. The area includes the St. Boniface Hospital and Research facilities, Dominion Centre, Nelson McIntyre Collegiate, the Champlain and Norwood Community Centres and a portion of the St. Boniface Golf Club.

Marion district contains numerous regional transportation routes: St. Mary's Road, Taché Avenue, and Marion and Goulet Streets. St. Mary's Road and Marion Street converge and cross the Red River at the Norwood Bridge. Approximately 20 ha of the district is classified as greenspace, which includes Coronation Park and Lyndale Drive Park.

1.2 Development

Marion is a medium density residential neighbourhood located around a commercial corridor and close to downtown. Due to its location close to the downtown however, there is a high potential for further densification via infill in the district. Redevelopment within this area could impact the CS system and will be investigated on a case-by-case basis for potential impacts to the combined sewer overflow (CSO) Master Plan. All developments within the CS districts are mandated to offset any peak combined sewage discharge by adding localized storage and flow restrictions, in order to comply with Clause 8 of the Environment Act Licence 3042.

A portion of St. Mary's Road is located within the Marion district. St. Mary's Road is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along St. Mary's Road is to be promoted in the future.

1.3 Existing Sewer System

Marion district has an approximate area of 233 ha[1] based on the district boundary. There is approximately 24 percent (55 ha) separated, 13 percent (30 ha) partial separation, and 14 percent (33 ha) separation ready areas.

The district is serviced by combined sewer (CS), storm relief sewer (SRS), land drainage sewer (LDS), and wastewater sewer (WWS) systems. There are two CS outfalls (one CS outfall to the Red River and another CS outfall to the Seine River), one flood pumping station (FPS) outfall, and one SRS outfall. The second CS outfall to the Seine River however has been disconnected from the CS system and is no longer in use. Figure 25 provides an overview of the Marion district and includes key infrastructure locations for existing sewer infrastructure and additional CSO Master Plan details.

[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.

Three CS trunk sewers connect to the Marion FPS and sewage pumping station (SPS) that service the district, located near the intersection of Lyndale Drive and St Marys Road. A 900 mm by 1350 mm sewer trunk and a 1650 mm trunk on St. Mary's Avenue run parallel along St. Mary's Road. The 1650 mm services the southwest area, and the 900 mm by 1350 mm services the south-central portion along St. Mary's Road. A 1650 mm trunk sewer runs along Horace Street and services the northern and eastern portions of the district. The sewer trunks converge and flow adjacent to the FPS to the Marion SPS. A portion of the collection system for the St. Boniface Hospital connects downstream of the FPS through a 450 mm sewer. Within the Marion FPS and SPS, there is a separate control structure that includes a primary weir and a 1600 mm CS outfall pipe to the Red River protected by flap and sluice gates against back-up due to high river levels. The FPS pumps directly to the river through an independent 1800 mm outfall with no flap gate or sluice gate installed. A 300 mm CS outfall was located off Dubuc Street in the eastern portion of the district to provide relief as needed. This secondary outfall has recently been disconnected from the Marion CS system, and is no longer in use.

Separate wastewater sewers (WWS) were installed in the eastern portion of the district in the early 2000s. Wastewater is collected from a portion of the district and flows by gravity along Enfield Crescent before it is pumped back into the existing CS system via a CS lift station (LS) at Enfield Crescent and St. Mary's Road. This SPS pumps into the 900 mm CS sewer on Enfield Crescent. These separate wastewater sewers in the Marion district also receive wastewater from separate sewers installed in the Despins district to the north.

The Marion SRS system includes a 1200 mm outfall to the Red River and extends as a 1500 mm SRS trunk along Walmer Street to provide relief to the CS system in the southwestern portion of the district. A disconnected upstream portion of the SRS provides some additional capacity to the south-central portion of the district by interconnecting the two trunk sewers running along St. Mary's Road. This SRS pipe connects back into the CS system.

The southwestern and eastern areas of the Marion district are partially separated, in which separate LDSs were installed. The southwestern LDS system has a separate outfall into the Red River, constructed near the intersection of Lyndale Drive and Balsam Place, and the eastern LDS system discharges to the Seine River along Edgewood Street. Both LDS outfalls have positive and flap gate protection against high river levels.

During DWF, the sewage flows by gravity through the Marion FPS and is diverted by a weir to the Marion SPS. The SPS pumps through a 500 mm force main across the Red River to the River district, across the Assiniboine River to the Assiniboine District, and ultimately to the Main Street interceptor in the Bannatyne district, which flows by gravity to the North End Sewage Treatment Plant (NEWPCC).

High flow in the system from runoff events may cause the level in the trunk sewer to increase above the outfall weir and overflow to the Red River. The FPS is available to pump excess flow in the system directly to the Red River as required.

The three outfalls to the Red River and Seine River (one CS, one SRS, and one FPS) are as follows:

- ID12 (S-MA50008337) – Marion CS Outfall
- ID85 (S-MA70105998) – Marion FPS Outfall
- ID11 (S-MA70008060) – Walmer SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Marion and the surrounding districts. Each interconnection is shown on Figure 25 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 **Interceptor Connections – Downstream of Primary Weir**

River

- A 500 mm force main conveys CS from Marion LS across the Red River and into the River district:
  - Queen Elizabeth Way invert at district boundary – 225.06 m (S-MA70057928)

1.3.1.2 District Interconnections

Metcalfe

CS to CS

- High Point Manholes (flow is directed into both districts from these manholes):
  - Lyndale Drive and Tache Avenue – 229.00 m (S-MH50003338)
  - Niverville Avenue and Braemar Avenue invert at district boundary – 227.28 m (S-MH50006462)
- A 300 mm CS sewer acts as an overflow pipe from the Metcalfe district to the Marion district:
  - Coniston Street and Crawford – 228.37 m (S-MH50003505)
- A 300 mm CS sewer acts as an overflow pipe from the Metcalfe district to the Marion district:
  - Coniston Street and Chandos Avenue – 228.08 m (S-MH50003573)
- A 450 mm CS sewer acts as an overflow pipe from the Marion district to the Metcalfe district:
  - Dubuc Street and Hill Street – 225.67 m (S-MH50006379)
- A 450 mm CS sewer acts as an overflow pipe from the Metcalfe district to the Marion district:
  - Dubuc Street and Des Meurons Street – 225.83 m (S-MH50006377)

SRS to SRS

- The SRS from Marion's CS system flows by gravity into Metcalfe's SRS system at the intersection of Des Meurons Street and Yardley Street, and the intersection of Des Muerons Street and Bristol Avenue. The Metcalfe SRS system then connects to the CS system in Metcalfe near the intersection of Carriere Avenue and Des Meurons:
  - 450 mm on Yardley Street, invert at Marion district boundary – 226.07 m (S-MA70026907)
  - 375 mm on St Luc Street, invert at Marion district boundary - 226 m (S-MA70026912)

Despins

CS to CS

- Common high point sewer manholes:
  - Horace Street invert at Marion invert – 226.85 m (S-MH50002230)
  - Goulet Street and Des Meurons Street invert – 227.34 m (S-MH50002282)
- A 250 mm CS pipe from Marion flows by gravity westbound into Despins CS system at the intersection of Taché Avenue and Thomas Berry Street:
  - Tache Avenue and Thomas Berry invert – 226.50 m (S-MH50002657)
- A 375 mm SRS overflow pipe from Marion flows by gravity westbound into Despins CS system during an overflow:
  - Tache Avenue and Rinella Place invert – 226.13 m (S-MH50002666)

- A 450 mm CS pipe from Marion flows by gravity eastbound into Despins CS system at the intersection of Enfield Crescent and Bertrand Street:
  - Enfield Crescent and Bertrand Street Invert – 224.56 m (S-MH50007262)
- A 1050 mm CS pipe from Despins flows by gravity westbound into Marion CS system at the intersection of Enfield Crescent and Bertrand Street:
  - Enfield Crescent and Bertrand Street Invert – 224.74 m (S-MH50002428)
- A 600 mm CS pipe from Marion flows by gravity eastbound into Despins district CS system at the intersection of Marion Street and Des Meurons Street:
  - Marion Street and Des Meurons Street Invert – 226.68 m (S-MH50002243)
- A 300 mm CS pipe from Despins flows by gravity westbound into Marion district CS system on Horace Street into the manhole near the intersection with Youville Street:
  - Horace Street near Youville Street Invert – 226.85 m (S-MH50002230)

<u>WWS to WWS</u>

- A 250 mm WWS and a 300 mm WWS flows southbound by gravity and converge at a manhole at the corner of Bertrand Street and Enfield Crescent and flow by gravity from Despins district into the localized WWS installed in the Marion district:
  - Bertrand Street and Enfield Crescent Invert – 223.00 m (S-MH70025546)

<u>LDS to LDS</u>

- A 300 mm LDS pipe from Marion flows eastbound by gravity into Despins on Horace Street, between Youville Street and Des Meurons Street:
  - Youville Street and Des Meurons Street Invert – 225.37 m (S-MH70007961)
- A 525 mm LDS pipe from Despins flows southbound along Youville Street by gravity into Marion district LDS system between Eugenie Street and Edgewood Street:
  - Invert at Marion district boundary – 224.34 m (S-MH70007984)

<u>LDS to CS</u>

- A 250 mm LDS short section of the LDS system extends from Marion and flows by gravity into Despins CS at Tache Avenue near the back alley of Thomas Berry Street:
  - Invert at Marion district boundary – 226.15 m (S-MH50002944)

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

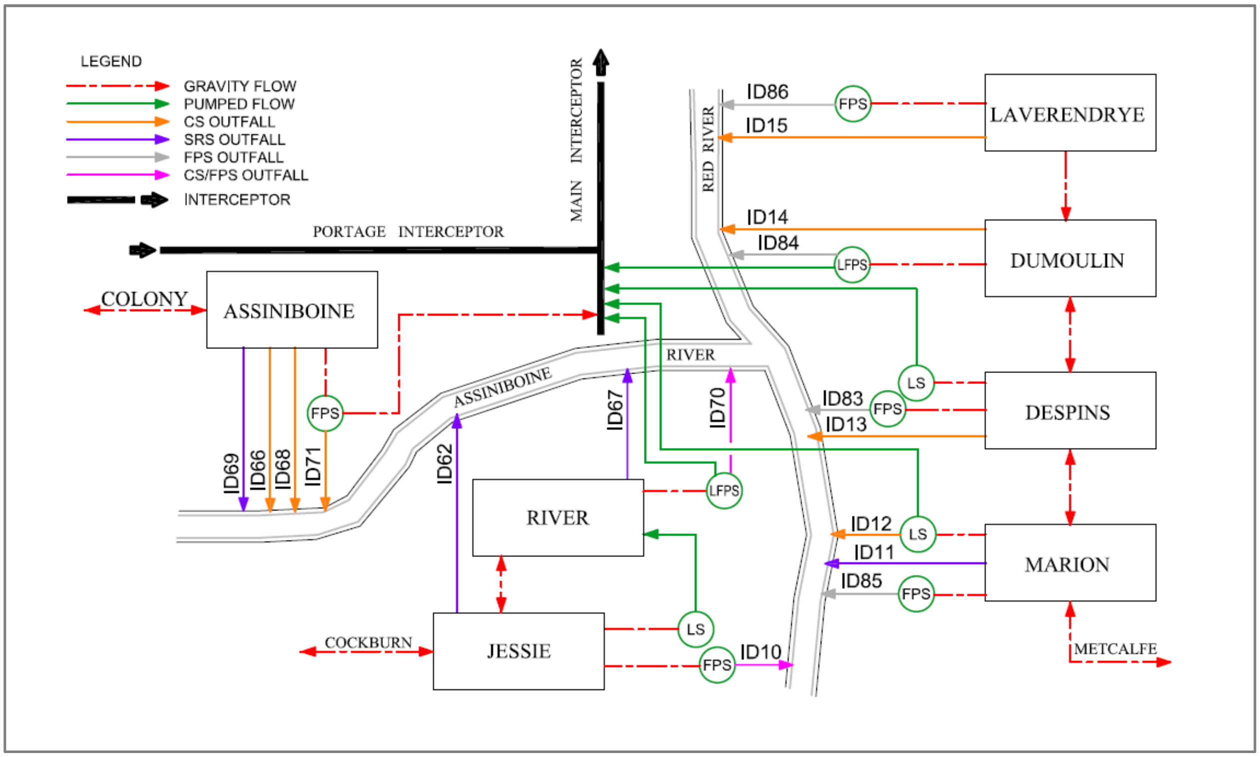


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 25 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 (ID12)	S-CO70008489.1	S-MA50008337	1600 mm	Red River Invert = 221.89 m
Flood Pumping Outfall (ID85)	S-AC70008319.1	S-MA70015955	1800 mm	Red River Invert = 222.20 m
Other Overflows	N/A	N/A	N/A	CS secondary outfall into Seine River has been disconnected.
Main Trunk	N/A	S-MA70101974	1650 mm	Circular Invert: 222.44 m
SRS Outfalls	S-RE70003431.1	S-MA70008060	1200 mm	Red River
SRS Interconnections	N/A	N/A	N/A	24 SRS - CS
Main Trunk Flap Gate	N/A	S-CG00001116	1650 mm	Invert: 222.65 m
Main Trunk Sluice Gate	N/A	S-CG00000837	1351 mm	Invert: 222.03 m
Off-Take	N/A	S-MA70040771	600 mm	Circular Invert: 222.56 m

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Dry Well	N/A	N/A	N/A	No dry well within this lift station.
Lift Station Total Capacity	N/A	N/A	0.230 m^3/s	1 x 0.120 m^3/s 1 x 0.110 m^3/s
Lift Station ADWF	N/A	N/A	0.044 m^3/s	
Lift Station Force Main	N/A	S-MA70003510	500 mm	Invert: 224.44 m
Flood Pump Station Total Capacity	N/A	N/A	3.01 m^3/s	1 x 0.79 m^3/s, 2 x 1.11 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.331 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	Marion – 223.73 Dubuc – 225.00 Walmer – 223.73
2	Trunk Invert at Off-Take	222.56
3	Top of Weir	222.87
4	Relief Outfall Invert at Flap Gate	222.31
5	Low Relief Interconnection	224.17
6	Sewer District Interconnection (Despins)	223.00
7	Low Basement (Metcalfe, Marion, Despins)	224.64
8	Flood Protection Level (Metcalfe, Marion, Despins)	229.81

[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 Marion district was the *Marion and Despins Sewer Relief Project Preliminary Design Report* (Wardrop, 2005). The Marion and Despins CS Relief Project improved the capacity of the existing CS system to alleviate basement flooding. The CS district relief, including the separate LDS and WWS installation, was completed between 2000 and 2003. is aligned with the Wardrop Sewer Relief project. Note that the final draft of the report was issued in 2005 after the work was complete, but the original design report was prepared prior to the work taking place. No other relief or CSO related sewer work has been completed 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

Marion 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
25 - Marion	2005 - Conceptual	Future Work	2013	Complete	N/A

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall of the Marion district. This consists of monthly site visits in confined entry spaces to verify 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 Marion sewer district are listed in Table 1-4. The proposed CSO control projects will include latent storage and an alternative floatable management approach.. 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 SRS system is suitable for use as latent storage. This option would take advantage of the some of the existing pipe networks for additional storage volume. Existing DWF from the collection system would remain the same, and overall district operations would remain the same.

The existing CS system is not suitable for in-line storage as the relative low level of the SPS and associated CS outfall results in the NWSL level being at a higher level than the recommended control gate level during the 1992 representative year assessment.

Floatable control will be necessary to capture any undesirable floatables in the sewage overflows. Floatables are typically captured via a screening facility, however, the hydraulic constraints within the Marion district do not allow sufficient positive head to be achieved and an alternative floatables management approach will be necessary.

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. RTC is not included in detail within each plan and is described further in Section 3 of Part 3A.

1.6.2 Latent Storage

Latent storage is the first consideration for district controls and would be a suitable control option for Marion because of the existing SRS system. The latent storage level and volume would be controlled by the backpressure of the river on the Walmer SRS outfall flap gate, as explained in Part 3C. The latent storage design criteria are identified in Table 1-5.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	222.56 m	
NSWL	223.73 m	Above invert elevation
Trunk Diameter	1500 mm	
Design Depth in Trunk	1170 mm	
Maximum Storage Volume	563 m^3	
Force Main	100 mm	
Flap Gate Control	N/A	NSWL > SRS Invert at Flap Gate
Lift Station	Included	Off-line wet well
Nominal Dewatering Rate	0.02 m^3/s	Based on existing pump capacity
RTC Operational Rate	TBD	Future RTC / dewatering review on performance

Notes:

NSWL – normal summer water level

RTC – Real Time Control

The addition of latent storage pump station (LSPS) and force main that connects back to the CS system will be required for latent storage. A conceptual layout for the LSPS and force main is shown on Figure 25-01. The LSPS will be on the Walmer Street and Pinedale Avenue intersection to avoid interference with nearby residential lands and disruption to existing sewers. The latent force main will connect directly to the nearest CS manhole (S-MH50002905), which is located within the property of the Norwood Community Centre. The LSPS will operate to dewater the SRS system in preparation for the next runoff event, with the requirement that the system is ready for the next event within a 24-hour period after completion of the previous event.

Figure 25 identifies the extent of the SRS system within Marion district that would be used for latent storage. The maximum storage level is directly related to the NSWL and the size and depth of the SRS system. Once the level in the SRS exceeds the river level, the flap gate opens, and the combined sewage is discharged to the river.

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 chamber and the pump station would 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 he river level regularly drops below the SRS flap gate elevation. The SRS flap gate control is described in the standard details in Part 3C

1.6.3 Floatables Management

Floatables management for the Marion district, due to the existing hydraulic constraints, is proposed to be an alternative floatables management approach. This approach is to ensure that the proposed required floatable management requirements outlined within the Environment Act Licence 3042 can be maintained.

This alternative approach to floatables management will be achieved by targeting floatables source control. This will be achieved by implementing more focused efforts towards street cleaning and catch-basin cleaning, to remove floatable material from surface runoff before it enters the combined sewer system. The second broad component of this alternative approach will focus on public education in an effort to reduce the sanitary components from ever entering plumbing systems. This is expected to achieve similar or better results while eliminating the end-of-pipe screening. The proposed approach will be similar to the program currently carried out in the City of Ottawa to meet their CSO mitigation requirements.

The alternative approach will be further investigated and demonstrated during the interim period between the submission of the CSO Master Plan (August 2019) and the revised CSO Master Plan submission (April 2030), and is discussed in further detail in Part 2 of the CSO Master Plan. It is recommended that as part of this work these measures will be undertaken in the Marion district, due to screening limitations mentioned above.

1.6.4 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.

Marion has been classified as a medium GI potential district. Land use in Marion is mostly single-family residential, while St Mary’s Road includes a mix of commercial businesses. 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 St. Mary’s Road make would be an ideal location for green roofs.

1.6.5 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.

The SRS latent storage would fill by gravity during wet weather events and would be dewatered through the dedicated LSPS back to the existing CS. The latent storage would take advantage of the infrastructure already in place, and the sewer would require minimal additional maintenance. The additional LSPS would require intermittent maintenance which would depend on the frequency of operation.

The alternative floatable management control is based on implementing additional operating and maintenance measures, in an effort to match the performance of the capital construction projects to meet the floatables management requirements. As such dedicated additional operating and maintenance costs should be allocated to this district. The goal however is for this work to overall be more cost effective from a life cycle perspective, considering the upfront capital and operating and maintenance costs associated with screening facilities.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-6.

Table 1-6. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	97	97	3,652	62	N/A
2037 Master Plan – Control Option 1	97	97	3,652	62	Lat St

Notes:

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 reported in Section 1.3 Existing Sewer System, and in Section 1.8 Performance Estimate may occur.

The performance results listed in Table 1-7 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 1-7. District 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)	34,108	51,773	-	21	0.184 m^3/s
Latent Storage	30,522 [a]	37,548	14,225	13	0.241 m^3/s
Latent & In-Line Storage		37,548	0	13	0.241 m^3/s
Control Option 1	**30,522**	**37,548**	**14,225**	**13**	**0.241 m^3/s**

Note:

[a] Preliminary Proposal did not independently separate latent and in-line storage

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

The difference between the Preliminary and CSO Master Plan Baseline and Control Option 1 results are directly due to the update in SPS pump capacity provided via the Clear SCADA data information for the existing Marion SPS. The expected no change in overflow reduction for the in-line storage is due to the modelled NSWL being continuous for the representative year. The overflows from the Walmer SRS have been completely eliminated from the assessment.

The percent capture performance measure is not included in Table 1-7, 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 1-8. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-8. District Cost Estimate – 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)
Latent Storage	$1,620,000	$2,170,000	$74,000	$1,600,000
Floatables Management Allowance	N/A [a]	$2,730,000 [b]	$47,000	$1,010,000
Subtotal	**$1,620,000**	**$4,900,000**	**$121,000**	**$2,610,000**
Opportunities	N/A	$490,000	$12,000	$260,000
District Total	**$1,620,000**	**$5,390,000**	**$133,000**	**$2,870,000**

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for In-line Storage and Screening items of work found to be $2,140,000 in 2014 dollars

[b] Cost allowance to account for the alternative floatable management measures. This allowance is based on a typical district control gate cost

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 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.

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 1-9.

Table 1-9. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Alternative Floatables Management	Control Gate and screening were not included in the Preliminary Proposal estimate. Screening later determined to not be feasible due to hydraulic constraints. Added to Master Plan cost, assumed to be comparable to typical control gate projected cost.	
	Removal of In-line Storage	The Master Plan assessment found that in-line storage not a preferred control solution.	
	Latent Storage	Unit costs updated for this control option	
Opportunities	A fixed allowance of 10 percent has been included for program opportunities such as GI	Preliminary Proposal estimate did not include a cost for 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 1-10 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 Marion 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. Opportunistic separation of portions of the district may be achieved with synergies with other major infrastructure work to address future performance targets. The provision of an in-line control gate would provide additional storage, during periods when the actual river level is below the 1992 representative year NSWL level used in the CSO Master Plan assessment. This would provide a reduction in overflow volume for real time events although this is not reflected in the CSO Master Plan modelling assessment due to the influence of the NSWL being higher than the proposed control gate level. In addition, green infrastructure and off-line storage tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume.

Table 1-10. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Increased In-line Storage • Opportunistic Sewer Separation • Off-line Storage (Tunnel / Tank) • Increased GI

The control options for Marion district have been optimized for the 85 percent capture performance target based on the system wide basis. The expandability of this district to meet 98 percent capture target would be based on a system wide basis analysis and the results of the alternative floatables management approach.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-11.

Table 1-11. 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	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
6	Sewer Condition	R	_	-	-	-	-	-	-
7	Sewer Conflicts	R	-	-	-	-	-	-	-
8	Program Cost	O	-	-	-	-	-	-	O
9	Approvals and Permits	-	-	-	-	-	R	-	-

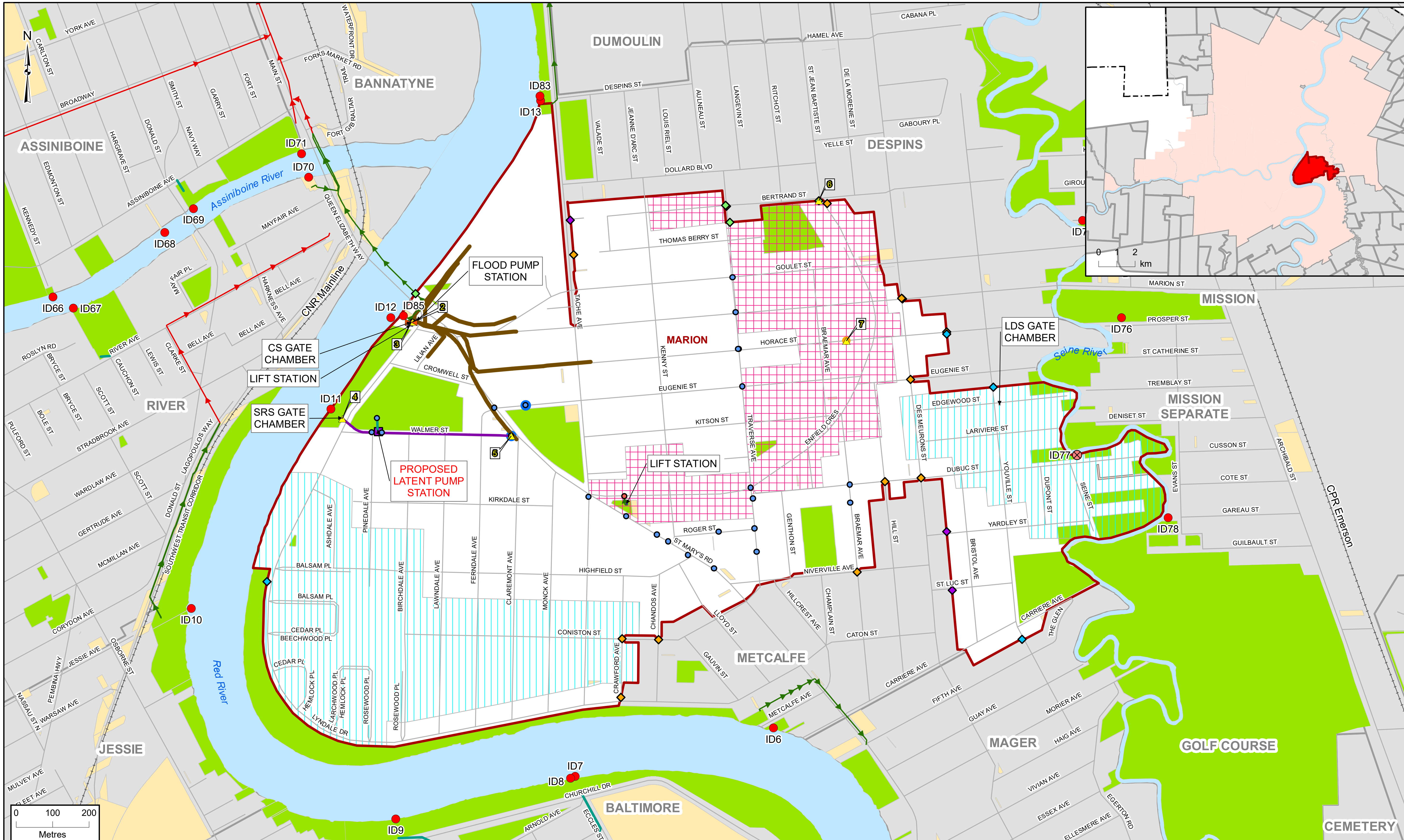
Table 1-11. Control Option 1 Significant Risks and Opportunities

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
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	R	-	-	-	-	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. 2005. *Marion and Despins Sewer Relief Project Preliminary Design Report*. Prepared for the City of Winnipeg Water and Waste Department. March.



LEGEND

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

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

District Boundary Crossing
- CS
- LDS
- SRS
- WWS

- Extent of Existing In-line Storage
- Interceptor Sewer
- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace
- City Owned Land

CSO MASTER PLAN PROPOSED SOLUTIONS

- Proposed SRS Latent Storage Pump
- Latent Storage Limit
- Latent Force Main
- Sewer Separation - Complete
- Sewer Separation - Ready

Note: Alternative Floatables Management Approach to be tested prior to implementation.

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 25
District Overview Map
Sewer District: Marion
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE3\MARION\MARION_DISTRICT_OVERVIEW_MAP.MXD DT072410 7/29/2019 8:41:12 AM

LEGEND

- Critical Elevation
- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate

Sewer By Type
- CS
- SRS

Control Structure Type
- Gate Chamber

- Land Parcel

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 25-01
Latent SRS Control
Sewer District: Marion
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE3\MARION\MARION_DISTRICT_DETAIL_WALMERST.MXD SBEGG1 6/24/2019 8:12:32 AM

CSO Master Plan

Metcalfe District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Metcalfe District Plan
Revision:	03
Date:	August 18, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Stephen Godon
File Name:	Metcalfe_Plan_Final_CO1MP_08182019

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	08/2018	Version 1 DRAFT	DT	SG	
1	02/15/2019	DRAFT 2 for City Review	DT	MF	SG
2	05/2019	Final Draft Submission	DT	MF	MF
3	08/18/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Metcalfe District

1.1 District Description

Metcalfe district is located towards the eastern limit of the Combined Sewer (CS) area. Regional Roadways bordering the district include Coniston Street and Niverville Street to the north, Carriere Avenue to the south, Des Meurons Street to the east, and Chandos Avenue to the west. Figure 26 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan control options.

St. Mary's Road is the only regional transportation route that passes through the district. Lyndale Drive Park located along the Red River is the only greenspace.

Metcalfe district land use is classified primarily as residential with a small commercial area present along St. Mary's Road. Significant buildings and areas in the district include the Aria Medical Centre located on the west side of St. Mary's Road.

1.2 Development

A portion of St. Mary's Road is located within the Metcalfe District. St. Mary's Road is identified as Regional Mixed-Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along St. Mary's Road is to be promoted in the future.

1.3 Existing Sewer System

Metcalfe district encompasses an area of 41 ha[1] based on the district boundary and consists of a CS system with one outfall. There is approximately 0.5 percent (0.2 ha) separated and no separation-ready areas.

The CS system includes a flood pump station (FPS), CS lift station (LS), and one combined CS / flood pump station (FPS) outfall. All domestic wastewater and combined sewage collected throughout the district flows to the main 1050 mm by 1600 mm sewer that connects to the Metcalfe FPS and CS outfall.

During dry weather flows (DWF), sewage is diverted past the Metcalfe outfall weir into the 300 mm off-take pipe and north to the Metcalfe sewage LS. Sewage is pumped through a 200 mm force main south down St. Mary's Road, and then ties into Mager district CS system at St Mary's Road and Fifth Avenue. From here, sewage is conveyed via gravity through the Mager District, where it is pumped to the South Interceptor sewer and ultimately transported to the South End Sewage Treatment Plant (SEWPCC). Note that prior to 1990 the intercepted CS flows from the Metcalfe district were pumped the Metcalfe LS north into the Marion district, and eventually was transported to the North End Sewage Treatment Plant (NEWPCC). The interceptor connection for the Metcalfe district into the Marion district was relocated to tie into the Mager district in 1990 to reduce the risk of failure of the interceptor pipe from riverbank stability issues experienced in the area.

During wet weather flow (WWF), any flow that exceeds the diversion capacity of the primary weir is discharged into the Metcalfe CS outfall, where it flows 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 gravity discharge through the Metcalfe CS outfall is not possible due to the flap gate in place on the outfall. In this situation the excess flow is pumped by the Metcalfe FPS, and redirected to tie into the CS outfall downstream of the flap gate, allowing gravity discharge to the Red River once more.

[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.

Metcalfe contains a section of storm relief sewer (SRS) pipe along the eastern boundary on Des Meurons Street. The SRS connects Marion district CS flow into Metcalfe's CS system. There is no dedicated SRS outfall in the Metcalfe district.

The one CS outfall to the Red River is as follows:

- ID06 (S-MA70011115) – Metcalfe CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Metcalfe and the surrounding districts. Each interconnection is shown on Figure 26 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed in the following subsections.

1.3.1.1 Interceptor Connections

No interceptor connections are found in this district.

1.3.1.2 District Interconnections

Marion

<u>CS to CS</u>

- High Point Manholes (flow is directed into both districts from these manholes):
  - Lyndale Drive and Tache Avenue – 229.00 m (S-MH50003338)
  - Niverville Avenue and Braemar Avenue invert at district boundary – 227.28 m (S-MH50006462)
- A 300 mm CS sewer acts as an overflow pipe from the Metcalfe district to the Marion district:
  - Coniston Street and Crawford overflow pipe invert – 228.37 m (S-MH50003505)
- A 300 mm CS sewer acts as an overflow pipe from the Metcalfe district to the Marion district:
  - Coniston Street and Chandos Avenue overflow pipe invert – 228.08 m (S-MH50003573)
- A 450 mm CS sewer acts as an overflow pipe from the Marion district to the Metcalfe district:
  - Dubuc Street and Hill Street overflow pipe invert – 225.67 m (S-MH50006379)
- A 450 mm CS sewer acts as an overflow pipe from the Metcalfe district to the Marion district:
  - Dubuc Street and Des Meurons Street overflow pipe invert – 225.83 m (S-MH50006377)

<u>SRS to SRS</u>

- The SRS from Marion's CS system flows by gravity into Metcalfe's SRS system at the intersection of Des Meurons Street and Yardley Street, and the intersection of Des Muerons Street and Bristol Avenue. The Metcalfe SRS system then connects to the CS system in Metcalfe near the intersection of Carriere Avenue and Des Meurons:
  - 450 mm on Yardley Street, invert at Marion district boundary – 226.07 m (S-MA70026907)
  - 375 mm on St Luc Street, invert at Marion district boundary - 226 m (S-MA70026912)

Mager

<u>CS to CS</u>

- The Metcalfe CS LS discharges into the Mager Interceptor, a gravity sewer beginning at St Mary's Road and Fifth Avenue that flows through the Mager district to the Mager CS LS.

- St Mary's Road and Fifth Avenue – 227.52 m (S-MH50008551)

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

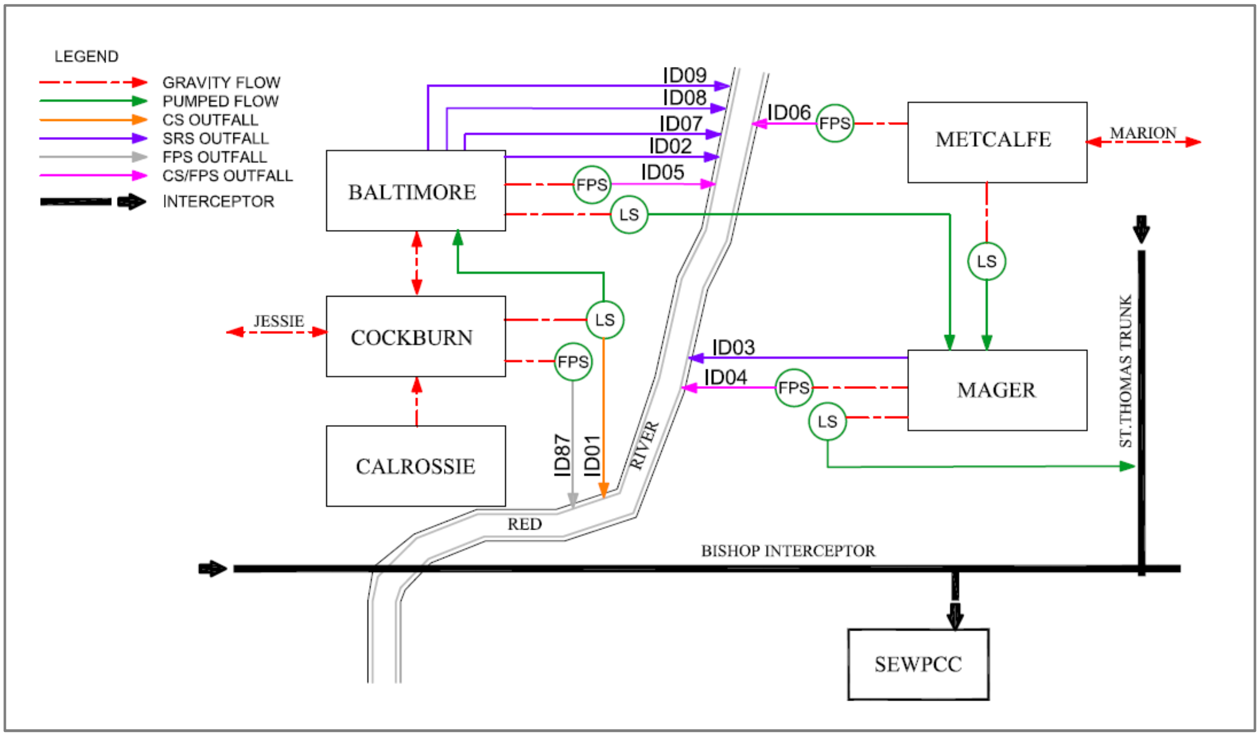


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 26 and are 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 (ID06)	S-CO70004641.1	S-MA70011115	2100 mm	Circular Invert: 222.23 m
Flood Pumping Outfall (ID06)	S-CO70004641.1	S-MA70011115	2100 mm	Circular Invert: 222.23 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	N/A	S-MA50004337	1050 x 1600 mm	Egg-shaped Invert: 222.56 m
SRS Outfalls	N/A	N/A	N/A	No dedicated SRS outfall in this district.
SRS Interconnections	N/A	S-MA70026870 S-MA70026890 S-MA70026891 S-MA70026900	225.97 m 225.39 m 225.01 m 224.63 m	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
		S-MA70026905	224,17 m	Flowing into CS system
Main Trunk Flap Gate	S-RE70004673.1	S-CG00000845	1375 mm	Invert: 223.14 m
Main Trunk Sluice Gate	S-CG00000846.1	S-CG00000846	1200 mm	Invert: 223.00 m
Off-Take	S-MH50003713.1	S-MA50004317	300 mm	Circular Invert: 222.99 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.039 m^3/s	1 x 0.020 m^3/s 1 x 0.019 m^3/s
Lift Station ADWF	N/A	N/A	0.0027 m^3/s	
Lift Station Force Main	N/A	S-MA70017062	200 mm	Invert: 229.30 m
Flood Pump Station Total Capacity	N/A	N/A	1.32 m^3/s	1 x 0.67 m^3/s 1 x 0.65 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.032 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	223.74
2	Trunk Invert at Off-Take	222.99
3	Top of Weir	223.33
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection (S-MA70026905)	224.17
6	Sewer District Interconnection (Marion)	225.67
7	Low Basement (Despins, Marion, Metcalfe)	224.33
8	Flood Protection Level (Despins, Marion, Metcalfe)	229.95

[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 Metcalfe was in 1996 with the *Metcalfe Combined Sewer District Sewer Relief Study* (Reid Crowther & Partners Ltd., 1996). This study discussed the possible relief work available for Metcalfe CS. No other sewer work has been completed 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 Metcalfe Combined Sewer 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
26 - Metcalfe	1996	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

The City has proposed to rebuild the Metcalfe CS LS within the next 6 years. This construction will allow for an optimized pumping rate of combined sewage from Metcalfe district into Mager district. It is noted that this upgrade should be assessed in conjunction the proposed solutions to meet control option 1, detailed below.

There is ongoing maintenance and calibration of the permanent instruments installed within the primary outfall within the Metcalfe 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 Metcalfe district are listed in Table 1-4. The proposed CSO control solution is primarily complete sewer separation. 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 not fully suitable for use an in-line storage as the relative low level of the CS LS and associated CS outfall results in the NSWL level being at a similar level to the recommended control gate level (within 100mm) during the 1992 representative year assessment.

The marginal evaluation on the performance of the district for the future 98% percent capture target indicated that complete sewer separation has an advantage over any off-line storage facilities for the Metcalfe district. The initial capital costs to separate a district were found to be higher than implementing the equivalent off-line storage. However, with the implementation of a off-line storage arrangement, flotable control would also be needed as overflows would still occur under the 1992 representative year. Floatables are typically captured via a screening facility, however, the hydraulic constraints within the Metcalfe district do not allow sufficient positive head to be achieved and an alternative floatables management approach will be necessary. In addition, the implementation of complete separation would reduce the reliance on the Metcalfe FPS, further reducing long term operating costs. It is for these reasons that complete sewer separation was found to be most feasible and cost-effective solutions over a long term perspective, and was recommended over any in-line storage or off-line storage control solutions.

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 Sewer Separation

Sewer separation is proposed for the Metcalfe district and will provide immediate benefits to the CSO program. The work includes installation of an independent LDS system to collect road drainage. Collected stormwater runoff will be routed through the new LDS to an outfall discharging to the Red River. The approximate area of sewer separation is shown on Figure 26. The flows to be collected after separation will be as follows:

- DWF will remain the same – pumped through the Metcalfe CS LS to Mager district.
- WWF will consist of sanitary sewage combined with foundation drainage.

This will result in a reduction in combined sewage flow received at Mager CS LS after the separation project is complete. The separation project will also reduce the requirements for the future upgrades to the existing LS.

In addition to added basement flood relief (BRF) and reducing the CSO volume, the benefits of separation include increasing the storage volume available in the CS system. With the implementation of separation, consideration should be given to the possibility of reducing the use of or elimination of the Metcalfe FPS. The implementation of separation at Metcalfe will also eliminate the overflows from the district, and will no longer require screening at the primary outfall for the district.

It is proposed that future monitoring of the district is completed to verify that the sewer separation is fully compliant with the modelled simulated elimination of all CSO overflows. A static weir elevation increase may be necessary at the CS primary weir to eliminate the occurrence of all CSOs. Any weir elevation raise will also be evaluated in terms of existing basement flood protection to ensure the existing level of basement flood protection remains.

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 will be reviewed to identify the most applicable GI controls.

Metcalfe has been classified as a high GI potential district. Metcalfe district land use is classified primarily as residential with a small commercial area present along St. Mary's Road. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, rain gardens, and green roofs. The greenspace areas in the district would be ideal for bioretention 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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district.

The reduction in storm flows entering the downstream Metcalfe FPS will reduce the requirement for operation of the station. It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the CS system) extent within the Metcalfe district.

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 model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	35	35	865	50	N/A
2037 Master Plan – Control Option 1	35	35	865	5	SEP

Notes:

SEP = Separation

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-6 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 1-6 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 1-6. 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
Baseline (2013)	10,335	12,191	-	15	0.032 m^3/s [c]
In-line Storage	12,931	N/A [b]	N/A	N/A	N/A
Separation	N/A [a]	0	12,191	0	0.038 m^3/s [d]
Control Option 1	**12,931**	**0**	**12,191**	**0**	**0.038 m^3/s [d]**

[a] Separation was not simulated during the Preliminary Proposal assessment.

[b] In-line storage not part of Master Plan Control Options

[c] Pass forward flows assessed with the 1-year design rainfall event

[d] Pass flow flows assessed with the 5-year design rainfall event

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entire CS system and not for each district individually. However, the full capture of overflows volumes for the Metcalfe district would represent a 100 percent capture rate on a district level.

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 1-7. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-7. 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)
Sewer Separation	N/A [a]	$17,430,000	$16,000	$350,000
In-line Storage	$- [b]	N/A	N/A	N/A
Screening		N/A	N/A	N/A
Subtotal	**$0**	**$17,430,000**	**$16,000**	**$350,000**
Opportunities	N/A	$1,740,000	$2,000	$40,000
District Total	**$0**	**$19,170,000**	**$18,000**	**$390,000**

[a] Separation not included in the Preliminary Proposal

[b] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for these items of work found to be $1,130,000 in 2014 dollars.

The estimates include changes to the control option selection since the Preliminary Proposal, updated construction costs, and the addition of GI opportunities. The impacts of extending the implementation schedule to 2045 are included in the program development and program summary in Section 5 of Part 3A. 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. Each of these values include equipment replacement and O&M costs.
- 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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Sewer Separation	Sewer Separation was not included in the preliminary estimate	The Master plan identified sewer separation as the most cost effective control option over in-line storage.
	Removal of In-Line Storage	In-Line Storage was not included in the Master Plan.	The Master plan identified sewer separation as the most cost effective control option.
	Removal of Screening	Screening was not included in the Master Plan.	With sewer separation recommended all CSO events will be removed, and there will no longer be a requirement for screening.
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 proposed complete separation of the Metcalfe district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-9.

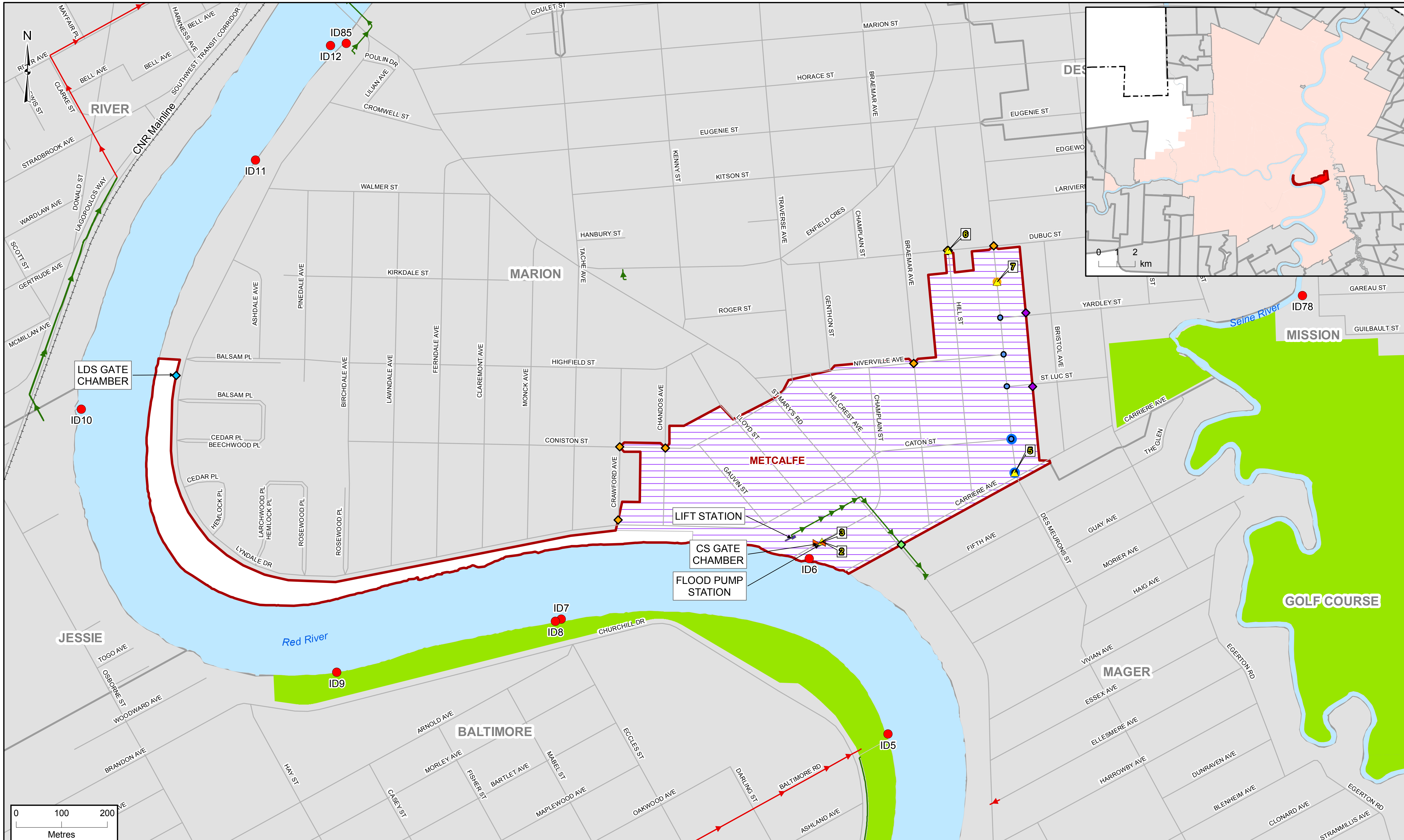
Table 1-9. Control Option 1 Significant Risks and Opportunities

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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

Reid Crowther & Partners Ltd. 1996. *Metcalfe Combined Sewer District Sewer Relief Study SWMM Input and Output*. Prepared for the City of Winnipeg Water and Waste Department. January.



LEGEND

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

Inter-System Connection
SRS - CS

District Boundary Crossing
CS
LDS
SRS
WWS

Interceptor Sewer
Force Main
Street
Railway

District Boundary
Watercourse
Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

Sewer Separation - Planning

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 26
District Overview Map
Sewer District: Metcalfe
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE3\METCALFE\METCALFE_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:39:12 AM

CSO Master Plan

Mission District Plan

August 2019

City of Winnipeg

JACOBS

CSO Master Plan

Project No:	470010CH
Document Title:	Mission District Plan
Revision:	03
Date:	August 19, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Mission_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	08/2018	DRAFT for City Comment	SG	ES	
1	02/15/2019	DRAFT 2 for City Review	SB	MF	MF
2	08/13/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Mission District

1.1 District Description

Mission district is located along the eastern boundary of the combined sewer (CS) area. The district is bounded by the Hart and Roland districts to the north, Area 13 and Area 22 to the east, Windsor Park to the south, and the La Verendrye, Dumoulin, Despins, and Marion districts to the west. The Seine River forms the western boundary, the northern boundary is Thomas Avenue, the eastern boundary is Lagimodière Boulevard, and Maginot Street and Berkshire Bay within the Windsor Park area form the southern boundary.

Many regional transportation routes pass through the district. Archibald Street runs north-south through the western side of the district, Marion Street runs east-west through the centre of the district, Mission Street runs east-west, and Lagimodière Boulevard runs north-south along the eastern border. Mission is a major industrial area and contains many rail lines, including the following:

- Canadian National Railway (CNR) Mainline
- Canadian Pacific Railway (CPR) Emerson
- CPR Mainline
- City-owned Greater Winnipeg Water District
- CNR Sprague
- CNR St. Bon Stocky

Mission consists mainly of industrial land with smaller commercial and residential areas spread throughout the district. The commercial land is found along the major transportation routes. Residential land use areas, including single-family, two-family, and multi-family, are located in three district areas spread throughout the district. In each case the residential land use consists of a small neighborhood. Industrial land is distributed in the Mission district and ranges from light to heavy industrial uses, with approximately 450 ha of heavy manufacturing land use classification. Greenspace in Mission district includes small areas for parks and recreational use, including Shell Canada Park and part of St. Boniface Golf Club.

1.2 Development

Mission is historically a heavy industrial neighbourhood; however, based on its location near downtown and surrounding residential areas, it is undergoing some de-industrialization. This includes the Stock Yards south of Marion Street and east of the CPR Emerson, which is identified as the Public Markets Major Redevelopment Site in OurWinnipeg. This Major Redevelopment Site is considered underused and will be prioritized to be developed into a higher density, mixed-use community.

A portion of Lagimodière Boulevard is located within the Mission District. Lagimodière Boulevard is identified as a Regional Mixed-Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Lagimodière Boulevard is to be promoted in the future.

A study was completed concerning Marion Street and Dugald Road to explore different options of transportation through this area in order to avoid widening or separation of these transportation routes. The *Marion Dugald Transportation Improvement Study* was developed due to the affordability and risk of the Marion Street widening and grade separation project (City of Winnipeg, 2017). This study was completed in September 2017.

Winnipeg Bus Rapid Transit could potentially impact the northern and western portions of the district. The Eastern Corridor Study (City of Winnipeg, 2018) is underway to determine the most suitable location for providing service between downtown and the eastern portion of the city. This study will include a review of drainage and utility infrastructure to determine if modifications and upgrades are required to support development and to minimize the impact to existing infrastructure. One of the options for the eastern corridor is conceptually shown as running north-south along the eastern side of the Seine River. This could also present an opportunity to coordinate sewer separation works alongside the transit corridor development.

1.3 Existing Sewer System

Mission district encompasses an area of approximately 730 hectares (ha)[1] based on the GIS district boundary information and includes combined sewer (CS), wastewater sewer (WWS) and land drainage sewer (LDS) systems. As shown in Figure 27, there is approximately 2.6 percent (19 ha) already separated and less than 1 percent (2 ha) of the total district is separation-ready. Approximately 43 ha of the district is classified as greenspace.

The Mission combined sewer system includes a CS lift station (LS) (also referred to as the Montcalm CS LS), a flood pump station (FPS), CS outfall and a gate/junction chamber. The CS system for the district ultimately drains towards Mission Street west of Archibald Street near the confluence of the Seine River with the Red River, where the FPS and primary CS outfall are located. Sewage flows collected in Mission district converge to a 1950 by 2925 mm CS trunk sewer that runs west along Mission Street towards the Mission CS outfall. An 1800 by 2700 mm CS sewer runs northwest on Dawson Road towards the Mission trunk sewer, this Dawson Road secondary trunk sewer carries the majority of the CS from the central and southeastern portions of the district. There is then a collector pipe that runs north of Archibald that carries the sewage from the primarily residential areas on the western portion of the district.

During dry weather flow (DWF), the sewage received is diverted by the primary weir, located beneath Archibald Street at the intersection of Archibald Street and Mission Street. The intercepted sewage then flows northbound by gravity via the 750 mm interceptor approximately 225 m along Archibald Street to the gate/junction chamber before entering the Montcalm CS LS. The intercepted sewage from the Roland district to the north also enters the Mission district from a 600 mm pipe flowing southbound along Archibald Street and ties into this same gate/junction chamber for the Montcalm CS LS. From there, the intercepted sewage from the Mission district and the Roland district is pumped across the Red River via two parallel 600 mm WWS force mains and into a 1200 mm CS secondary interceptor sewer in the Syndicate district. It then flows into the Main Interceptor, and eventually to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF) events the CS flow in the system may increase the level in the sewer above the primary weir, causing an overflow which discharges by gravity through the Mission primary CS outfall into the Seine River. A flap gate and a sluice gate are installed at the outfall to prevent high river levels from entering back into the system when the Seine River levels are particularly high. However not only does the flap gate prevent river water intrusion, but it also prevents gravity discharge from the Mission CS outfall. Under these conditions the excess flow is pumped by the Mission FPS to a point in the Mission CS Outfall downstream of the flap gate, where it can be discharged to the river by gravity once more.

In addition to the Mission FPS and Montcalm LS, a small pumping station is located at the Lagimodière Boulevard underpass. This station pumps a small volume of collected runoff from the immediate catchment area into the existing CS network within Mission. A second underpass pumping station is located approximately 100 m north of the Montcalm LS. This second underpass pumping station however pumps the collected runoff into the Red River via a dedicated land drainage sewer (LDS) outfall.

The LDS system within the Mission district is scattered in various locations. Ditches and swales are present throughout the industrial areas of the district and interconnect with the CS system in multiple locations. One major LDS ditch crosses the district from east to west along Dugald Road, called the Dugald Drain. The Dugald Drain extends along the south side of Dugald Road from Murdock Road in the South Transcona area of the city to the St. Boniface Industrial Park across Lagimodière Boulevard and receives surface runoff from a significant part of east Winnipeg. This LDS drains then travels southwest of Dugald, eventually

[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.

discharging into the Seine River just south of Marion Street near Happyland Park. The Dugald Drain receives the majority of its runoff flow from the South Transcona Drainage Basin (AECOM, 2014). The Shell Terminal on Panet Road has a private LDS system that collects all internal storm water from within the Shell boundary. These flows are transferred to the existing CS system at a rate as determined by the City. The LDS systems discharge surface runoff directly to the Seine River with outfalls located at the ends of Guilbault Street, Evans Street, St. Catherine Street, Kavanagh Street, La Verendrye Street, and Dumoulin Street.

Mission district has a single storm relief sewer (SRS) interconnection located at the end of Dumoulin Street that connects the partially separated WWS to an LDS outfall. This interconnection will relieve the WWS if there is a particularly large wet weather response along this wastewater lateral sewer. All combined sewage received in this WWS during a large wet weather response would then discharge into the Seine River via this LDS outfall.

In addition to the main CS outfall, there are a number of secondary CS outfalls located along the Seine River. Each of the secondary CS outfalls act as a high level overflow within the district CS system. These will only operate under high return design storm events, and provide localized relieve to one or more laterals at the far upstream extents of the district. The City has decommissioned the Prosper CS outfall (ID76) and this is no longer operational.

The six CS outfalls to the Red River and Seine River are as follows:

- ID20 (S-MA70016004) – Mission CS Outfall (Seine River)
- ID73 (S-MA70041411) – Plinguet CS Outfall (Seine River)
- ID74 (S-MA70041464) – Cherrier CS Outfall (Seine River)
- ID75 (S-MA70041462) – Doucet CS Outfall (Seine River)
- ID76 (S-MA50002566) – Prosper CS Outfall (Seine River) - decommissioned
- ID78 (S-MA70042084) – Gareau CS Outfall (Seine River)

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Mission and the surrounding districts. Each interconnection is shown in Figure 27 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections - Downstream of Primary Weir

Roland

- A 600 mm secondary interceptor from Roland flows southbound by gravity into the Mission 600 mm interceptor sewer along Archibald Street towards the Montcalm LS gate/junction chamber. Flow is then pumped across the Red River to the North End Sewage Treatment Plant (NEWPCC) for treatment.
  - Archibald Street and Mission district boundary invert – 223.56 m (S-MA50018054)

Syndicate

- Two 600 mm force mains from the Montcalm LS pumps WWS west of Archibald Street and south of Elmwood Road, across the Red River into Syndicate district secondary interceptor:
  - Invert at Syndicate district boundary CS connection – 227.50 m (S-MH20012321)
  - Invert at Syndicate district boundary CS connection – 227.28 m (S-MH20012321)

1.3.1.2 District Interconnections

Windsor Park

WWS to WWS

- Common high point sanitary sewer manhole:
  - Ormiston Road invert at Windsor Park district boundary – 228.60 m (S-MH50004635)
- A 400 mm WWS force main pumps sewage from Windsor Park into the Mission district along Speers Road where it connects to the CS system:
  - Invert at WWS connection in Mission at the district boundary – 229.82 m (S-MA70020236)

LDS to LDS

- A 375 mm LDS collects surface runoff from Carolyn Bay and Ormiston Road, and crosses into Windsor Park district by gravity. Windsor Park is currently separated, and the LDS from Mission district flows into the LDS system in Windsor Park district:
  - Invert at Mission district boundary – 228.02 m (S-MA50011061)
- A 600 mm LDS collects surface runoff from the northeastern part of Windsor Park flows by gravity eastbound into Mission district. The LDS flows into Mission along and connects as follows:
  - Windsor Park district boundary and Maginot Street Invert – 228.49 m (S-MA70051318)
- A 750 mm LDS extends along Archibald Street from near Maginot Street to the district boundary near Autumnwood Drive. The LDS flows by gravity south on Archibald Street through Windsor Park district, where it is discharged into creeks in Niakwa Park:
  - Invert at Niakwa Park district boundary – 227.63 m (S-MA50009101)

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

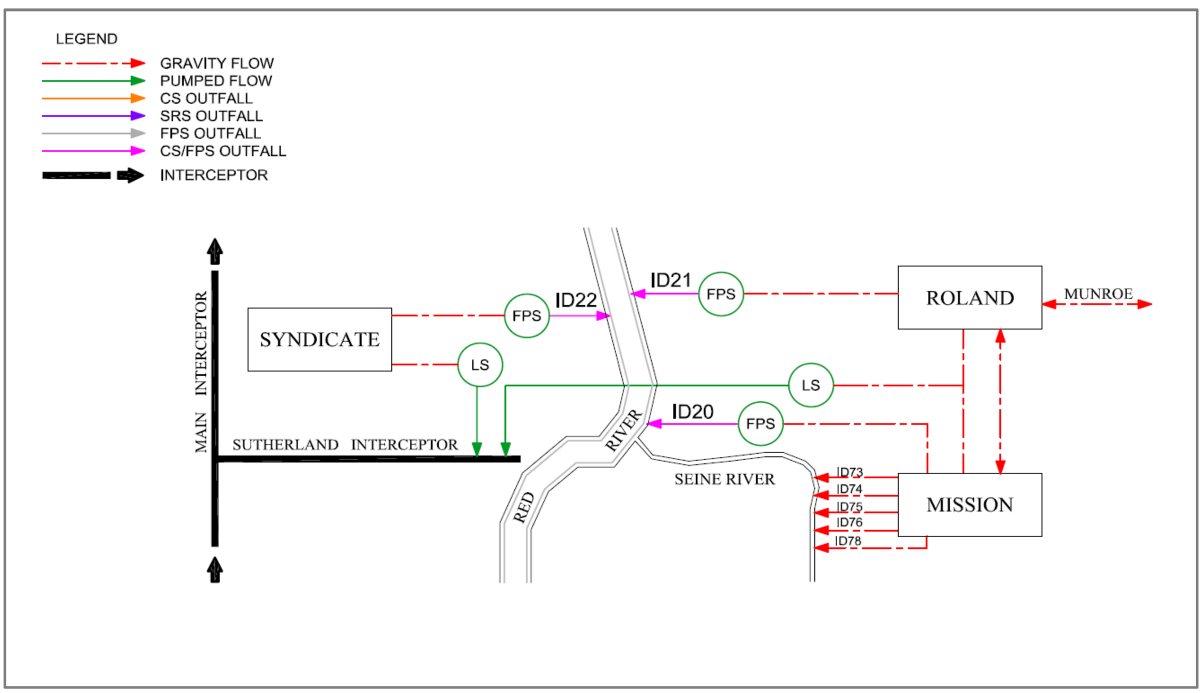


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 27 and are 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 (ID20)	S-MH70001112.1	S-MA70016004	2600 mm	Seine River Outfall
Flood Pumping Outfall (ID20)	S-MH70001112.1	S-MA70016004	2600 mm	Seine River Outfall
Other Overflows	364X001080.1 364X001013.1 364X001012.1 S-PL50000392.1 S-AC70015634.1	S-MA70041411 S-MA70041464 S-MA70041462 S-MA50002566 S-MA70042084	300 300 300 300 450	Seine River Outfall Seine River Outfall Seine River Outfall Seine River Outfall Seine River Outfall
Main Trunk	N/A	S-MA70019992	1950 x 2950 mm	Egg-shaped Invert: 222.50 m
SRS Outfalls	N/A	N/A	N/A	No SRS outfall within district
SRS Interconnections	S-MH50008095.2	S-MH50008095	227.39 m	SRS Overflow into Seine River. WWS connects to the CS on Archibald Street
Main Trunk Flap Gate	S-TE70026473.2	S-CG00001077	1685 mm	Invert: 222.6 9 m
Main Trunk Sluice Gate	S-CG00001078.1	S-CG00001078	1829 x 1829 mm	Invert: 222.78 m
Off-Take	S-MA-ID-70028467	S-MA70028467	750 mm	Circular Invert: 222.50 m
Dry Well	N/A	N/A	N/A	N/A
Lift Station Total Capacity	S-TE70026535.1 (P1) S-TE70026538.1 (P2) S-TE70026539.1 (P3) S-TE70026537.1 (P4)	N/A	1.037 m^3/s max discharge rate	P1 x 0.192 m^3/s P2 x 0.328 m^3/s P3 x 0.186 m^3/s P4 x 0.331 m^3/s
Lift Station ADWF	N/A	N/A	0.126 m^3/s	Montcalm CS LS includes Roland district. Mission ADWF at 0.110 m^3/s
Lift Station Force Main	North force main S-AC70017214.1 South force main S-AC70017215.1	North force main S-MA70046432 South force main S-MA70046417	600 mm 600 mm	North force main Invert: 221.04 m South force main Invert: 220.90 m
Flood Pump Station Total Capacity	N/A	N/A	2.67 m^3/s (min) 3.12 m^3/s (max)	1 x 0.710 m^3/s 1 x 0.950 m^3/s 1 x 1.010 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.464 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	Mission – 223.71
2	Trunk Invert at Off-Take Pipe	222.77
3	Top of Weir	223.76
4	Relief Outfall Invert	N/A
5	Relief Interconnection (S-MH50008095)	227.39
6	Sewer District Interconnection (Windsor Park)	223.20
7	Low Basement	229.03
8	Flood Protection Level	229.39

[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 concept design completed in Mission district was the *Mission Combined Sewer District Sewer Relief, Pollution Abatement Works and North East Interceptor Study* (AECOM, 2014). This study provides a report on design work on sewer basement flooding relief and CSO abatement for the Mission CS district, the provision of a land drainage outlets to relieve certain areas in the district, and a review of the Northeast Interceptor service area (AECOM, 2014).

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. Both the Mission and Montcalm outfall structures from the Mission Combined Sewer District were 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
27 - Mission	2014 - Conceptual	2018 District Flow Monitoring	2013	Planning and Design for Separation	N/A

Source: Report on Mission Combined Sewer District Sewer Relief, Pollution Abatement Works and North East Interceptor Review, 2014

1.5 Ongoing Investment Work

Study and preliminary design of the Mission district is currently underway as a result of the City's Basement Flood Relief program. It is expected that this work will progress as normal and continue through the beginning stages of the CSO Master Plan.

A flow monitoring campaign was commenced over the summer of 2018 to capture current sewer system observed flow data for future hydraulic model calibration.

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Mission 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 Mission district are listed in Table 1-4. The proposed CSO control projects will include complete sewer separation. 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	Storage / Transport Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year	-	-	-	-	-	-	-	✓	✓	✓	-

Notes:- = not included
✓ = included

Mission was previously identified as a priority project as part of the City's Basement Flooding Relief program. The proposed complete sewer separation scheme includes the entire Mission district.

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 Sewer Separation

Complete sewer separation is proposed as part as part of the CSO Master Plan. The proposed sewer separation will remove a large volume of land drainage runoff from the CS system, thereby reducing the flow at the outfall and eliminating CSO events under the 1992 representative year. A reduction of the runoff would also reduce the pass forward flow to the interceptor system. Separation would also reduce the amount of flood pumping required at the Mission FPS, potentially allowing for the FPS to be decommissioned in the future.

Work would include the installation of an independent LDS system to separate the surface runoff from the CS system. Collected storm water runoff will be routed through the new LDS system to outfalls along the Seine River.

The 2014 AECOM study, identified in Table 1-3, focused on the basement flooding issues within the Mission district. The study district indicated that complete separation could be achieved through expansion of the proposed land drainage system construction, developed originally for basement flood protection. This sewer separation design would provide basement flood protection under the 10-year MacLaren design storm. The main components of the conceptual LDS system construction proposed in this 2014 study are outlined below:

- Construction of a Plinguet Street LDS outfall proposed, with the upstream system capturing stormwater from the north west portion of the Mission district. This includes the areas surrounding Dawson Road, Archibald Street and Plinguet Street.

- Construction of an outfall structure and upstream system capturing stormwater from the northern portion of the district, collecting the area along Mission Street, west of Plinguet Street, and around Provencher Boulevard within the Mission district.

- Construction of an LDS outfall at Happyland Park immediately south of Marion Street discharging into the Seine River proposed. This outfall would service the southeast portion of the Mission district, beginning at the intersection of Dugald Road and Lagimodiere Boulevard, travelling south along Lagimodiere Boulevard, west along Dawson Road and following Marion Road up to the Seine River as the west boundary. This area is referred to as South Transcona Stormwater Trunk Service Area in the design study.

- Construction of two storm retention basins (SRB); one located southwest of Dawson Road and south of the South Transcona Stormwater Truck collecting stormwater from southeast area of the Mission district. The second pond is proposed to be located in the northeast corner of the district, north of Warman Road and east of the Lagimodiere overpass. This second pond would collect surface runoff flows from the northeast portion of the district including the areas surorunding Mission Street, Softley Road and Warman Road.

The proposed separation scheme outlined in the study focused on partial separation, associated with the existing primary weir level increases and offline storage implementation. This was based on the requirements to achieve a four-overflow target as was defined for the particular study. As the CSO Master Plan has the 85 percent capture target as the long-term goal, the complete separation proposal is now the most cost effective solution to address within the Mission district. Further investigation will be necessary to assess the proposed SRB pond and LDS system arrangement to determine what would be most beneficial to the Mission district.

The flows to be collected after separation will be as follows:

- DWF will remain the same – collected flow pumped from Montcalm CS LS to the interceptor.
- WWF will consist of sanitary sewage combined with foundation drainage from the older residential homes in the district.

This will result in a reduction in combined sewage flow received at the Montcalm CS LS after the separation project is complete. It is proposed that future monitoring of the district is completed to verify that the sewer separation is fully compliant with the goal of elimination of all CSO overflows under the 1992 representative year rainfall conditions. A static weir elevation increase may be necessary at the primary weir to eliminate the occurrence of all CSO events during the 1992 representative year. Any weir elevation raise will be further evaluated in terms of actual flow monitoring data to confirm ensure the existing level of basement flood protection remains.

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 will be reviewed to identify the most applicable GI controls.

Mission has been classified as a medium GI potential district. Land use in Mission is mostly industrial with some residential and commercial. Bioswales and green roofs may be suitable to the industrial areas while cisterns/rain barrels, and rain garden bioretention are suitable for the residential areas. Parking lots located in commercial areas are ideal for paved porous pavement.

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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers, and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district.

The reduction in storm flows entering the Montcalm LS will reduce the requirement for operation of the FPS. It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the CS system) extent within the Mission district.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	735	384	2,668	16	N/A
2037 Master Plan – Control Option 1	735	127	2,668	12	SEP

Notes:

Total area is based on the model subcatchment boundaries for the district.
SEP = Sewer Separation

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-6 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 1-6 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 1-6. District 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
Baseline (2013)	19,567	12,809	-	6	0.464 m^3/s [a]
Separation	0	0	12,809	0	0.434 m^3/s [b]
Control Option 1	**0**	**0**	**12,809**	**0**	**0.434 m^3/s [b]**

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

[b] Pass forward flows assessed with the 5-year design rainfall event

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entire CS system and not for each district individually. However, the proposed elimination of CSO overflow results in 100 percent capture at this district.

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 1-7. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-7. District Cost Estimate – 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)
Separation	N/A [a]	$130,320,000	$77,000	$1,660,000
Subtotal	N/A [a]	**$130,320,000**	**$77,000**	**$1,660,000**
Opportunities	N/A	$13,030,000	$8,000	$170,000
District Total	**N/A [a]**	**$143,350,000**	**$85,000**	**$1,830,000**

[a] Sewer Separation not included in the Preliminary Proposal 2015 costing. Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for the Sewer Separation item of work found to be $77,070,000 in 2014 dollars.

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.

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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Sewer Separation	Sewer Separation was not included in the preliminary estimate.	Sewer separation added as Master Plan solution.
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 estimates were based on 2014-dollar values	

1.10 Meeting Future Performance Targets

The proposed complete separation of the Mission district will achieve the 100 percent capture figure and no further work will be required in this district to meet the future performance target.

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 as part of the CSO Master Plan and is included as part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-9.

Table 1-9. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

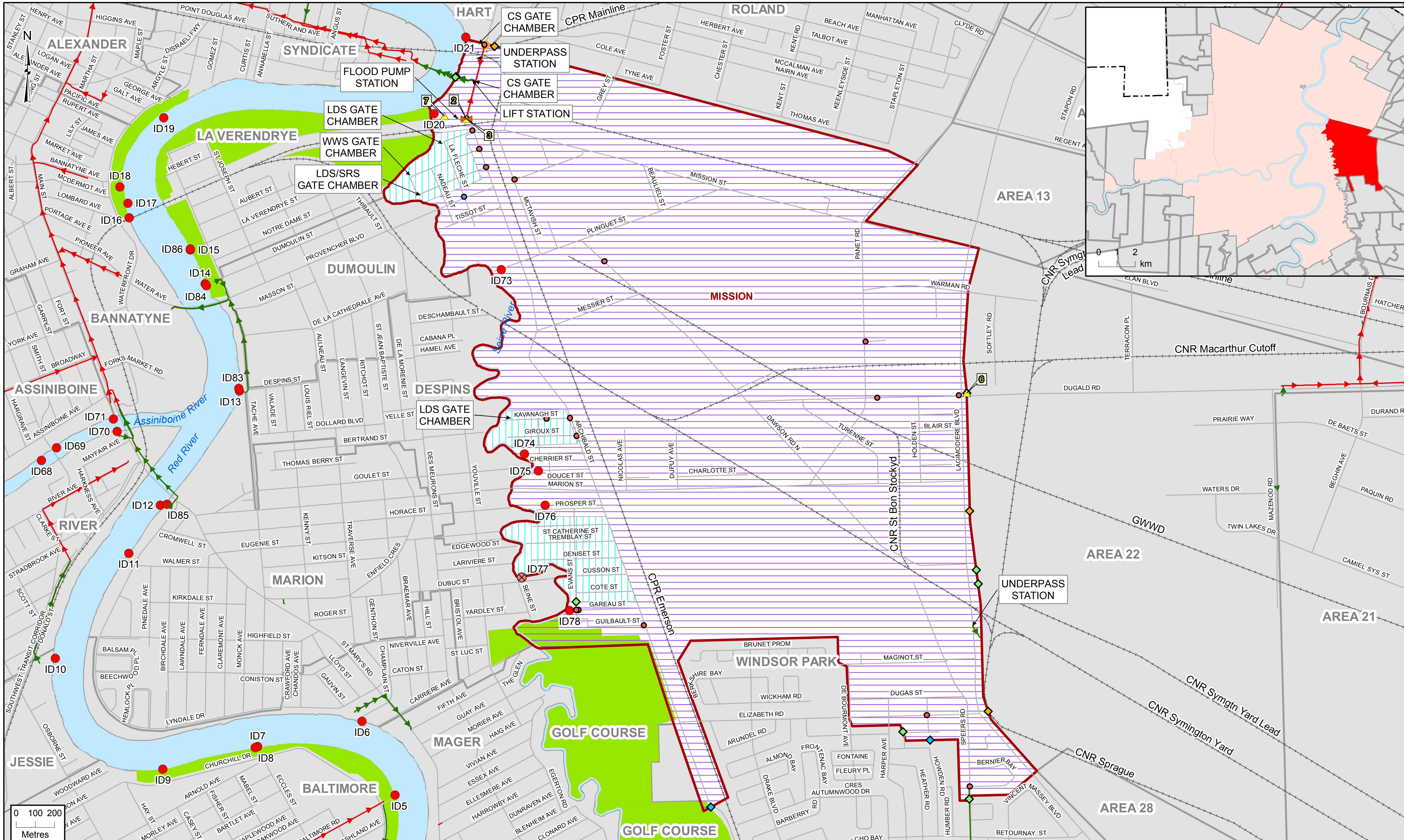
Risks and opportunities will require further review and actions at the time of project implementation.

1.12 References

AECOM. 2014. *Mission Combined Sewer District Sewer Relief Pollution Abatement Works and North East Interceptor Study*. August.

City of Winnipeg. 2017. *Marion Dugald Transportation Improvement Study Engagement Planning Summary Report*. September. Accessed August 15, 2018. https://www.winnipeg.ca/publicworks/construction/projects/MarionDugald.stm.

City of Winnipeg. 2018. *Eastern Corridor Study*. Accessed August 15, 2018. http://winnipegtransit.com/en/major-projects/rapid-transit/eastern-corridor-study/.



LEGEND

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

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

District Boundary Crossing
- CS
- LDS
- WWS

- Interceptor Sewer
- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Planning
- 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 27
District Overview Map
Sewer District: Mission
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE3\MISSION\MISSION_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:44:25 AM

CSO Master Plan

Moorgate District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Moorgate District Plan
Revision:	03
Date:	August 15, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	Moorgate_Plan_Final_CO1MP_08152019.docx

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	08/2018	DRAFT for City Comment	SG	ES	
1	12/2018	DRAFT 2 for City Review	JT	SG / MF	
2	06/2019	Final Draft Submission	JT	MF	SG
3	08/15/2019	Final Submission For CSO Master Plan	MF	MF	MF

Contents

Table(s)

Figure(s)

1. Moorgate District

1.1 District Description

Moorgate district is located near the western border of the combined sewer (CS) area and is bounded by Strathmillan district to the west, Ferry Road and Douglas Park districts to the east, and the Winnipeg Airport lands to the north. Ness Avenue and Silver Avenue make up the northern border, Davidson Street forms the western border, and Linwood Street forms the eastern border. The Assiniboine River is located along the southern border. Figure 28 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan control options.

Portage Avenue is a major transportation route that passes through Moorgate district along the south border and parallel to the Assiniboine River. Ness Avenue is also a highly travelled route that connects to Portage Avenue via numerous north-south streets.

Land use in Moorgate is mostly single-family residential. Portage Avenue corridor includes a mix of apartments and commercial businesses. The Assiniboine Golf Club is located along the northern edge and the Deer Lodge Centre is located just north of Portage Avenue. Approximately 34 ha of the district is classified as greenspace which includes multiple parcels spread throughout the district. Development in the eastern portion of the district occurred prior to 1925 with other developments added towards the west boundary up to the 1950s. Canadian Forces Base Winnipeg is located to the north of the district.

1.2 Development Potential

A portion of Portage Avenue is located within the Moorgate District. Portage Avenue is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

Moorgate district has a drainage area of approximately 190 hectares (ha)[1] based on the district boundary. The system consists of a CS system and a land drainage sewer (LDS) system. Approximately 29 percent (56 ha) is separated and 2 percent (3 ha) identifiable as separation ready. Storm relief sewers (SRSs) are installed on Lodge Avenue, Ness Avenue, Conway Street, and Sharp Boulevard. Two LDS outfalls are located south of Portage Avenue and discharge to the Assiniboine River. The LDS system also connects into the CS outfall close to the western border, off Portage Avenue.

The CS system includes a diversion structure, lift station and one CS outfall. The CS system drains towards the Moorgate outfall and diversion chamber, located at the southern end of Conway Street at the Assiniboine River. At the outfall, flow is either diverted to the Conway CS lift station (LS) where it is pumped to the St James Interceptor or overflows the diversion weir into the Assiniboine River.

A 1900 mm by 2475 mm egg-shaped trunk sewer running along Moorgate Street collects flow from throughout the district. It connects to a 1900 mm by 2475 mm egg-shaped trunk sewer at the corner of Moorgate Street and Portage Avenue which flows into the outfall.

There is a separate LDS system in the southeast part of district along Portage Avenue and Mandeville Street. This LDS system collects flow and directs it to three LDS outfalls along the Assiniboine River. The areas along Lodge Avenue and Mount Royal Road contain a separate LDS system. The Lodge Avenue

[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.

LDS collects runoff from the road and conveys it to the adjacent Strathmillan district and ultimately to the Strathmillan CS outfall, which is a combined CS/LDS outfall.

During dry weather flow (DWF), the existing weir diverts flow through a 525 mm off-take to the Conway CS LS, where it is pumped through the 250-mm force main to the 375 mm St. James interceptor that takes the wastewater to the West End Sewage Treatment Plant (WEWPCC) for treatment. The Conway CS LS also receives wastewater from the Assiniboine Park Zoo. During wet weather flow (WWF) the weir may be overtopped, and WWF can bypass to the CS outfall into the Assiniboine River.

The CS outfall to the Assiniboine River is as follows:

- ID43 (S-MA70016333) – Moorgate CS Outfall

1.3.1 District-to-District Interconnections

There are five district-to-district interconnections between Moorgate and Strathmillan to the west. Each interconnection is shown in Figure 28 and shows locations of gravity and pumped flow from one district to another. The known district-to-district interconnections are identified as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Strathmillan

- The 375 mm interceptor pipe conveys flow from the Conway CS LS along Portage Avenue through Strathmillan district, and then to WEWPCC:
  - Portage Avenue and Conway Street invert at Strathmillan district boundary – 232.98 m

1.3.1.2 District Interconnections

Strathmillan

<u>LDS to LDS</u>

- A 750 mm LDS trunk conveys flow to connect into the LDS system in Strathmillan on the eastern end of Lodge Avenue before Strathmillan Street that flows into the Strathmillan CS Outfall:
  - Lodge Avenue and Davidson Street invert at Strathmillan district boundary – 231.53 m
- A 450 mm LDS trunk conveys flow to connect into the LDS system in Strathmillan on the eastern end of Bruce Avenue before Strathmillan Street that flows into the Strathmillan CS Outfall:
  - Bruce Avenue invert at Strathmillan district boundary – 232.55 m
- A 450 mm LDS trunk conveys flow into Moorgate District on Mount Royal Road, this then flows into the Strathmillan CS Outfall:
  - Mount Royal Road and Traill Avenue invert at Strathmillan district boundary – 233.16 m

Assiniboine Park

<u>Wastewater Sewer (WWS) to CS</u>

- A 250 mm WWS pipe uses gravity to convey flow from Assiniboine Park zoo to Moorgate district to Conway gate chamber then out the outfall
  - To Conway Street from Assiniboine Park invert at district boundary – 223.96 m

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

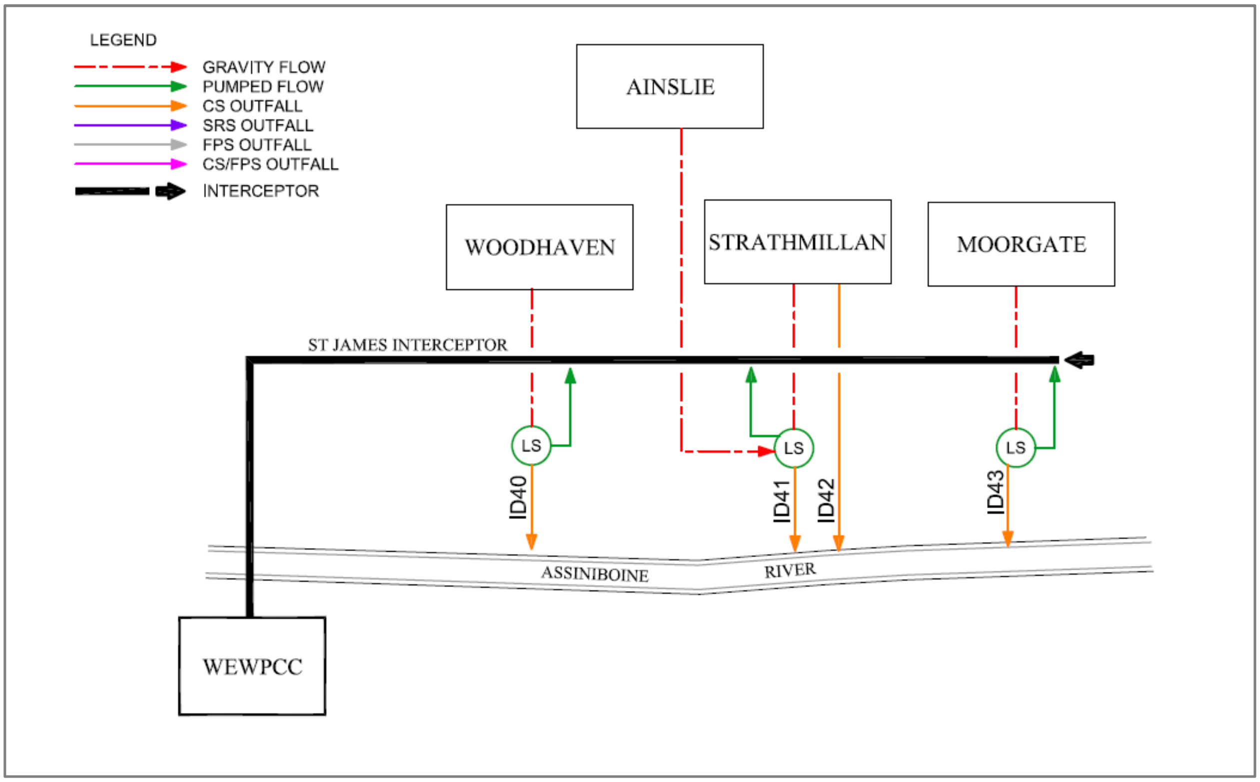


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 28 and are 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 (ID43)	S-RE70015578.1	S-MA70016333	1830 mm	Invert: 226 m
Flood Pumping Outfall (ID87)	N/A	N/A	N/A	
Other Overflows	N/A	N/A	N/A	
Main Sewer Trunk	S-MH20004697.1	S-MA70019493	1930 x 2515 mm	Egg-shaped Invert: 226.71 m
Storm Relief Sewer Outfalls	N/A	N/A	N/A	
Storm Relief Sewer Interconnections	N/A	S-MH20004697 S-MH70019502 S-MH70021238 S-MH70022308 S-TE70021263 S-TE70021285	233.25 231.37 229.48 228.63 228.06 228.86	SRS -CS SRS -CS SRS -CS SRS -CS SRS -CS SRS -CS
Main Trunk Flap Gate	Moorgate_Weir.1	S-CG00000722	1800 mm	Circular Invert: 227.41 m
Main Trunk Sluice Gate	S-CS00000677.1	S-MA70019487	1980 x 2590 mm	Invert: 227.25 m
Off-Take	S-MH20004694.2	S-MA70019465	525 mm	Circular Invert 226.71 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.136 m^3/s	2 pumps @ 0.068 m^3/s each

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station ADWF	N/A	N/A	0.023 m^3/s	
Lift Station Force Main	S-MA70017371A.1	S-MA70017371	250 mm	Discharge Invert 226.73 m
Flood Pump Station Total Capacity	N/A	N/A	N/A	
Pass Forward Flow – First Overflow	N/A	N/A	0.141 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	Moorgate – 225.24
2	Trunk Invert at Off-Take	226.71
3	Top of Weir	227.41
4	Relief Outfall Invert	N/A
5	Relief Interconnection	N/A
6	Sewer District Interconnection at Strathmillan	Invert at district boundary: 28-02 = 231.53
7	Low Basement	230.43
8	Flood Protection Level	230.98

[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 was the *Sewer Relief and CSO Abatement Study* (UMA, 2005). It describes the CSO abatement alternatives and sewer relief implications for both Strathmillan and Moorgate CS districts.

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 Moorgate CS 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
28 - Moorgate	2005 - Conceptual	Future Work	2013	Partial Separation Work Complete	N/A

Source: Sewer Relief and CSO Abatement Study, 2005

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary Moorgate outfall. This consists of monthly site visits in confined entry spaces to verify that physical readings concur with displayed transmitted readings and replacing desiccants when 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 Moorgate sewer district are listed in Table 1-4. The proposed CSO control projects will include sewer separation, in-line storage with screening, and floatable management. 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	Storage / Transport 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 option would take advantage of the existing pipe networks for additional storage volume. Existing DWF from the collection system will remain the same, and overall district operations will remain the same. A review of the existing separation extent and potential remaining district separation requirement indicated a significant capital cost to reach district separation and this option was not taken forward to achieve the system wide 85 percent capture target.

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 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.

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. RTC is not included in detail within each plan and is described further in Section 3 of Part 3A.

1.6.2 In-Line Storage

In-line storage has been proposed as a CSO control for Moorgate 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 and provide additional hydraulic head for screening operations.

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	226.71 m	N/A
Trunk Diameter	1930 x 2515 mm	Egg-shaped
Gate Height	0.58 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	227.99 m	N/A
Bypass Weir Elevation	227.89 m	N/A
Maximum Storage Volume	633 m^3	N/A
Nominal Dewatering Rate	0.136 m^3/s	Based on existing CS LS capacity
RTC Operational Rate	TBD	Future RTC / dewatering review on performance

The proposed control gate will cause combined sewage to back-up in the collection system to the extent shown on Figure 28. 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 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 28-01 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. The dimensions of the chamber will be 6 m in length and 3.2 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. DWF will continue to be diverted to the lift station through the off-take pipe and pumped through the 250-mm force main into the 375-mm interceptor pipe. This flows through Strathmillan and eventually to the WEWPCC for treatment. Further optimization of the gate chamber size may be provided if a decision is made not to include screening.

The physical requirements for the off-take and station sizing for a modification to pumping capacity have not been considered in detail, but they may be required in the future as part of an RTC program or CS LS rehabilitation or replacement project. The proposed gate chamber (also the screening chamber) are within the existing City of Winnipeg Right-Of-Way (ROW) associated with the existing CS LS and CS outfall. The location is such that residential properties border both side of the site with Portage Avenue as the north limit of the City ROW. Construction work could potentially affect the traffic on this main route and cause disruptions. The existing sewer configuration including construction of an additional off-take may have to be completed to accommodate the new control gate chamber. This will be confirmed in future design assessments

The nominal rate for dewatering is set at the existing CS LS capacity. The dewatering rate includes both the DWF and WWF components of the district flows. 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. Any future considerations, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing capacity for large events will adversely affect the overflows at this district. This future RTC control will provide the ability to capture and treat more volume for localized storms by using either district in-line storage or excess interceptor capacity where the runoff volume is less. Further assessment of the impact of the RTC and future dewatering arrangement will be necessary to review the downstream impacts (i.e., on Strathmillan district).

1.6.3 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The 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 hydraulic 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	227.99 m	
Bypass Weir Crest	227.89	
Normal Summer River Level	225.24 m	
Maximum Screen Head	2.65 m	
Peak Screening Rate	0.59 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 28-01. The screens will operate once levels within the sewer surpass the bypass weir elevation. The side bypass weir upstream of the gate will direct initial 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 may include screenings pumps with a discharge returning the screened material to the CS LS for routing to the WEWPCC for removal. The provision of screening pumps is dependent on final level assessment within the existing infrastructure and the Moorgate trunk. This will be confirmed 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 the discharge piping downstream of the gate are 3.5 m in length and 2.5 m in width. The existing sewer configuration including the off-take and the CS LS force main may have to be modified to accommodate the new chamber.

1.6.4 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.

Moorgate has been classified as a high GI potential district. Land use in Moorgate is mostly single-family residential. Portage Avenue corridor includes a mix of apartments and commercial businesses. 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 Portage Avenue make would be an ideal location for green roofs.

1.6.5 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 report.

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 Conway CS LS, which may require more frequent and longer duration pump run times. Lower velocities in the CS trunks 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.

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 screenings pumped back to the interception system via a small pump and force main may be required. Additional maintenance for the pumps will be required at regular intervals in line with typical list station maintenance and after screening event. The frequency of a screened event will correlate to the number overflows identified for the district.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options 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	195	195	5,311	37	N/A
2037 Master Plan – Control Option 1	195	195	5,311	37	IS, SC

Notes:

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)	65,328	64,937	-	20	0.157 m^3/s
In-line Storage	68,104	57,419 [b]	7,515	18	0.160 m^3/s
Control Option 1	**68,104**	**57,419 [b]**	**7,515**	**18**	**0.160 m^3/s**

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

b The benefit for this district is offset due to a modelled increase of overflow volume in the downstream Strathmillan district. Therefore, the proposed control option for this district should be programmed for after the Strathmillan control option construction.

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

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. District Cost Estimate – 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 (Over 35-year period)
In-Line Storage	N/A[a b]	$2,590,000	$40,000	$940,000
Screens		$2,450,000 [c]	$50,000	$1,100,000
Subtotal	**N/A**	**$5,040,000**	**$90,000**	**$2,040,000**
Opportunities	N/A	$500,000	$10,000	$200,000
District Total	**N/A**	**$5,540,000**	**$100,000**	**$2,240,000**

[a] Screening and In-line not included in the Preliminary Proposal 2015 costing

[b] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for this item of work to be $3,050,000 in 2014 dollars.

[c] Cost for bespoke screenings return pump/force main not included in Master Plan as well 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 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 Options	Control Gate	A control gate was not included in the Preliminary Proposal estimate	
	Screening	Screening was not included in the Preliminary Proposal estimate	
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 Moorgate district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume.

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	• Opportunistic Separation Increased use of GI • Off-line Tank / Tunnel Storage

The control options selected for the Moorgate district has been aligned for the 85 percent capture performance target based on the system wide basis, and the requirement for screening at all primary outfalls. The proposed solutions in the Moorgate district are influenced by the downstream Strathmillan district and these two districts should be assessed together. The expandability of the district to the future performance target will be restricted depending on the interaction of the system wide performance.

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 part of 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	-	-	-	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-

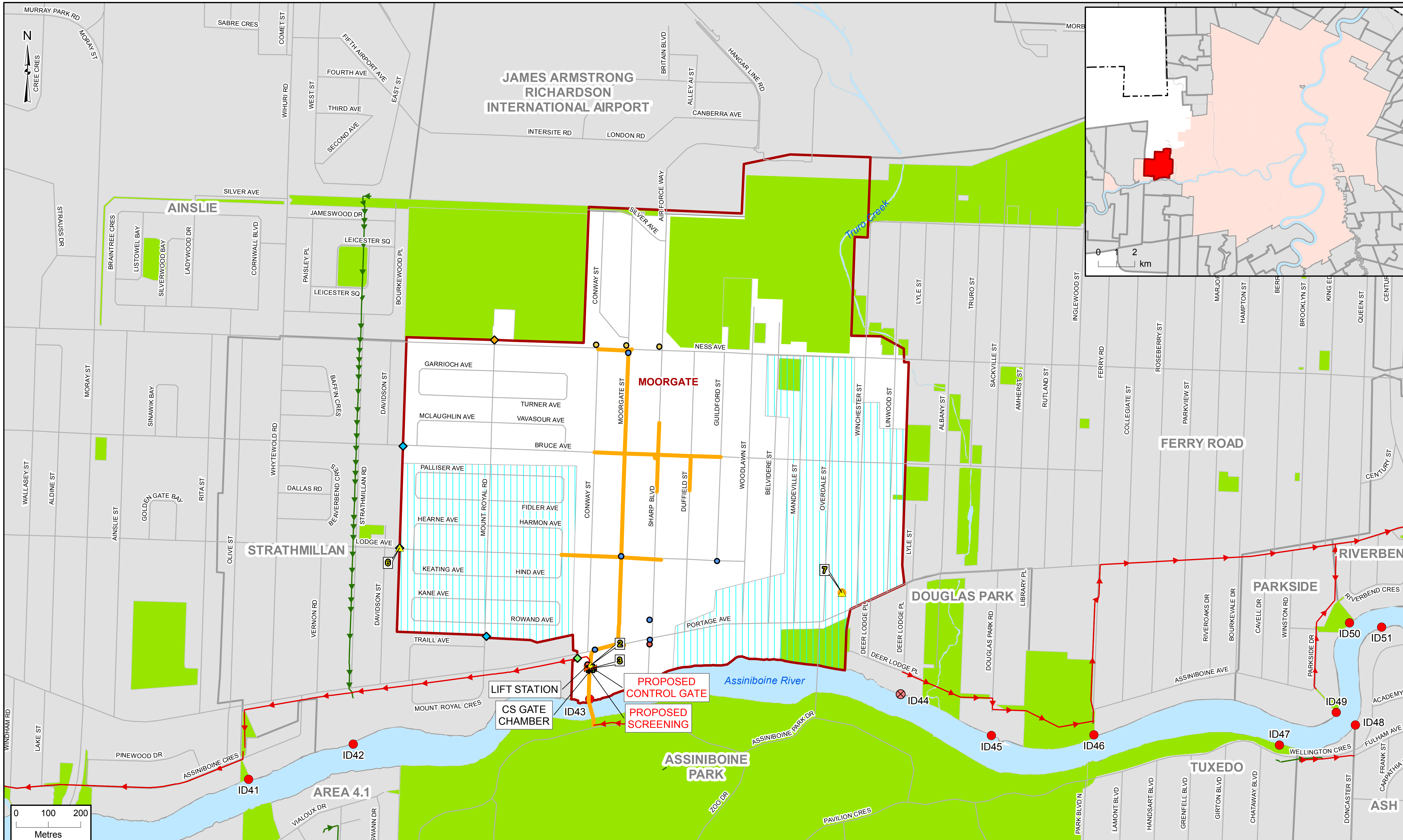
Table 1-12. Control Option 1 Significant Risks and Opportunities

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
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

UMA Engineering Ltd. (UMA). 2005. *Sewer Relief and CSO Abatement Study*. Prepared for City of Winnipeg, Water and Waste Department. August



LEGEND

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

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

District Boundary Crossing
- CS
- LDS
- WWS

- Interceptor Sewer
- Force Main
- Street
- 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

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 28
District Overview Map
Sewer District: Moorgate
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\MOORGATE\MOORGATE_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:17:26 AM

LEGEND

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

Sewer By Type
- CS
- SRS
- WWS

Control Structure Type
- Gate Chamber

Pump Station Type
- 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 28-01
Control Gate and Screening
Sewer District: Moorgate
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\MOORGATE\MOORGATE_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 8:14:59 AM

CSO Master Plan

Munroe District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Munroe District Plan
Revision:	03
Date:	August 20, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	Munroe_Plan_Final_CO1MP_08202019

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	Version 1 Draft	DT	SG	
1	05/2019	DRAFT 2 for City Review	JT	SG/JB/MF	
2	08/19/2019	Final Draft Submission	MF	MF	MF
3	08/20/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Munroe District

1.1 District Description

Munroe district is located in the northeastern sector of the combined sewer (CS) area east of the Red River, north of the Hart and Roland districts and south of the Munroe Annex and Linden districts. Munroe is approximately bounded by Harbison Avenue, Kent Road, and Clyde Road to the south, the Red River to the west, Concordia Avenue and Chelsea Avenue to the north, and Panet Road and Molson Street to the east. Figure 29 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan control options.

The majority of the Munroe district land use is residential with portions of commercial and manufacturing. The residential area is mainly single-family homes with some multi-family dwellings located east of the Canadian Pacific Railway (CPR) tracks along Molson Street. An area of light manufacturing is located between Watt Street and Raleigh Street. The few commercial parcels in the district are scattered within residential neighbourhoods.

The CPR Mainline passes through the southeast end of Munroe district. Henderson Highway and Gateway Road, both running in a north-south direction, are regional roadways in the district. Other main transportation routes include Raleigh Street, Watt Street, Roch Street, Grey Street, and London Street in a north-south direction and Munroe Avenue, Washington Avenue, Trent Avenue, and Ottawa Avenue in the east-west direction.

1.2 Development

A portion of Henderson Highway is located within the Munroe District. This street is identified as a Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Henderson Highway is to be promoted in the future.

There are areas within the Munroe CS district which have been identified as a General Manufacturing Lands as part of OurWinnipeg. Focused intensification within these areas is to be promoted in the future, with a particular focus on mixed use development. This is to verify that adequate employment lands are available to support future population growth.

1.3 Existing Sewer System

Munroe district has an approximate area of 400 ha[1] based on the GIS district boundary information and includes a CS system, a storm relief sewer (SRS) system, and a few areas with a land drainage sewer (LDS) system. There is approximately 3 percent (11 ha) already separated and 1 percent (6 ha) identifiable as separation-ready. Approximately 31 ha of the district is classified as greenspace, which includes multiple parcels spread throughout the district.

The CS system includes a diversion structure and one CS outfall. The CS system flows towards the Munroe outfall and diversion structure, located near the intersection Munroe Avenue and Henderson Highway near the Red River. At the outfall, sewage may be passed forward by a gravity siphon across the Red River to the Polson district or overflow the diversion weir and discharge into the Red River via the CS outfall.

A single sewer trunk collects flow from most of the district and flows to the diversion chamber on Munroe Avenue. The 2150 mm by 3150 mm egg-shaped CS trunk extends east to west primarily along Munroe Avenue, from Panet Street at the east limit to Henderson Highway as the west limit. Multiple secondary

[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.

sewers connect to the CS trunk along Munroe Avenue, collecting and discharging flows from the north and south to service the district.

The SRS system extends throughout the district and has multiple interconnections with the CS system. During runoff events, the SRS system provides relief to the CS system in Munroe district. Except for the Bredin Drive SRS, the majority of the SRS system 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 CS system. Most catch basins are still connected to the CS system, so partial separation has not been completed through the majority of the district. A small portion of the SRS system at Bredin Drive is connected a separate, dedicated SRS outfall which provides an overflow relief to the local CS and discharges directly to the Red River. A flap gate and sluice gate are installed on this outfall pipe to control backflow into the SRS system under high river level conditions in the Red River.

The LDS system for the district is located in small localized areas in the district along Raleigh Street and Melbourne Avenue. The Raleigh Street LDS collects runoff from the road and conveys it to the CS system in the Munroe district. The Melbourne Avenue LDS is an extension of the separation completed in the Linden district. This LDS collects runoff from the road and directs it to the Linden LDS system.

During dry weather flow (DWF), the SRS is not required; sanitary sewage flows are intercepted by the primary weir in the diversion structure to a siphon river crossing. This siphon river crossing allows the intercepted sewage to crosses the Red River under pressure, and flows into Polson district eventually tying into the Main Interceptor. From this point the intercepted sewage from the Munroe district flows by gravity to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), any flows that exceeds the diversion capacity overtops the primary weir is discharged by gravity to the Red River through the Munroe CS outfall. 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. However not only does the flap gate prevent river water intrusion, but it also prevents gravity discharge from the Munroe CS outfall. There is no dedicated flood pumping station (FPS) within this outfall, and so temporary flood pumps are installed in the Munroe CS outfall based on the flood manual high river level triggers to deal with situations such as this.

The two outfalls to the Red River (one CS and one SRS) are as follows:

- ID31 (S-MA70017186) – Munroe CS Outfall
- ID29 (S-MA40005212) – Bredin SRS Outfall

1.3.1 District-to-District Interconnections

There are several sewer system interconnections between this district and the adjacent districts; see Figure 29. Interconnections include gravity and pumped flow from one district to the other. The known district-to-district interconnections are identified as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Polson

- One 300 mm WWS siphon river pipe and one 450 mm WWS siphon river pipe carry flow west by gravity from the Munroe diversion structure, across the Red River into the Polson district:
  - 300 mm WWS sewer invert at Polson district boundary 222.5 m (S-MA70017147)
  - 450 mm WWS sewer invert at Polson district boundary 222.5 m (S-MA70017149)

1.3.1.3 District Interconnections

Roland

<u>SRS to SRS</u>

- A 375 mm SRS relieves a 600 mm CS sewer located off Keenleyside Street in Munroe District and flows by gravity south to Kent Road into Roland District SRS System:
  - Invert at Munroe district boundary 226.24 m (S-MA40010345)
- A 2900 mm SRS flows by gravity south along Besant Street and crosses into Roland district at Molson Street:
  - Invert at Munroe district boundary 223.31 m (S-MA40007633)
- A 375 mm SRS flows by gravity south on London Street and crosses into the Roland district:
  - Invert at Roland district boundary 224.34 m (S-MA40007675)
- A 2900 mm SRS flows by gravity south along Gateway Road into the Roland district:
  - Invert at Roland district boundary 222.76 m (S-MA40008399)
- A 525 mm SRS flows by gravity south along Grey Street from Munroe district to Roland district:
  - Invert at Munroe district boundary 224.50 m (S-MA40007593)

Linden

The CS and LDS systems between the Munroe and Linden districts interact at several locations:

<u>CS to CS</u>

- A 250 mm CS can overflow by gravity east on Canterbury Place into Munroe district from Linden district:
  - Invert at Linden district boundary – 230.00 m (S-MA70099421)
- High point manhole
  - 300 mm CS at Kildonan Drive – 227.18 m (S-MH40006295)

<u>LDS to LDS</u>

- A 450 mm LDS flows by gravity north on Brazier Street from Munroe district into Linden district:
  - Invert at Munroe district boundary – 225.93 m (S-MA40005084)
- A 2250 mm LDS truck flows by gravity west on Chelsea Avenue at Henderson Highway from Linden district into Munroe district:
  - Invert at Munroe district boundary 222.09 m (S-MA40006395)
- A 2250 mm LDS trunk flows by gravity west on Chelsea Place at Kildonan Drive from Munroe district into Linden district:
  - Invert at Linden district boundary 221.94 m (S-MA40006935)
- A 300 mm LDS flows by gravity north on Kildonan Drive from Munroe district into Linden district:
  - Invert at Linden district boundary – 224.53 m (S-MA40006870)
- A 250 mm LDS flows by gravity west on Canterbury Place from Munroe district into Linden district:
  - Invert at Linden district boundary – 224.59 m (S-MA40006869)

Munroe Annex

CS to CS

- A 300 mm CS pipe flows south by gravity on Gateway Road to the Munroe district:
  - Invert at Munroe district boundary 227.35 m (S-MA40004574)
- A 900 mm CS pipe flows south by gravity on Golspie Street to the CS trunk on Munroe Avenue in the Munroe district:
  - Invert at Munroe district boundary 225.11 m (S-MA40004336)
- A 1200 mm CS pipe flows south by gravity on Watt Street to the CS trunk on Munroe Avenue in the Munroe district:
  - Invert at Munroe district boundary 224.74 m (S-MA40005030)
- A 375 mm CS pipe flows south by gravity on Roch Street to the CS trunk on Munroe Avenue in the Munroe district:
  - Invert at –Munroe Annex district boundary 226.57 m (S-MA40005099)

WWS to CS

- A 300 mm WWS pipe flows south by gravity on Moncton Avenue to the CS system in the Munroe district:
  - Invert at Munroe district boundary 228.20 m (S-MA40007499
- A 375 mm WWS pipe flows south by gravity on Louelda Street to the CS system in the Munroe district:
  - Invert at Munroe district boundary- 227.20 m (S-MA40007458)
- A 300 mm CS pipe flows south by gravity on Besant Street to the CS trunk on Munroe Avenue in the Munroe district:
  - Invert at Munroe district boundary- 226.46 m (S-MA70051892)
- A 300 mm WWS pipe flows south by gravity on Grey Street to the CS system in the Munroe district:
  - Invert at Munroe district boundary –225.92 m (S-MA40004591)

LDS to LDS

- A 525 mm LDS pipe flows south from Munroe Annex district to Munroe district on Raleigh Street:
  - Invert at Munroe district boundary 228.27 m (S-MA40004522)
- A 450 mm LDS pipe flows north on Roch Street from the Munroe district to the 2250 mm LDS trunk sewer on Chelsea Avenue in the Munroe Annex district:
  - Invert at Munroe Annex district boundary 223.98 m (S-MA40005096)

Callsbeck (Area 12.2)

LDS to LDS

- A 1200 mm LDS pipe flows east by gravity along the CPR tracks at Panet Road from Munroe district to Callsbeck district:
  - Invert at Munroe district boundary 227.29 m (S-MA70003652)

Kildonan Place (Area 13.1)

LDS to LDS

- A 750 mm LDS pipe flows north by gravity from Kildonan Place district to Munroe district:
  - Invert at Kildonan Place district boundary 228.12 m (S-MA70003615)

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

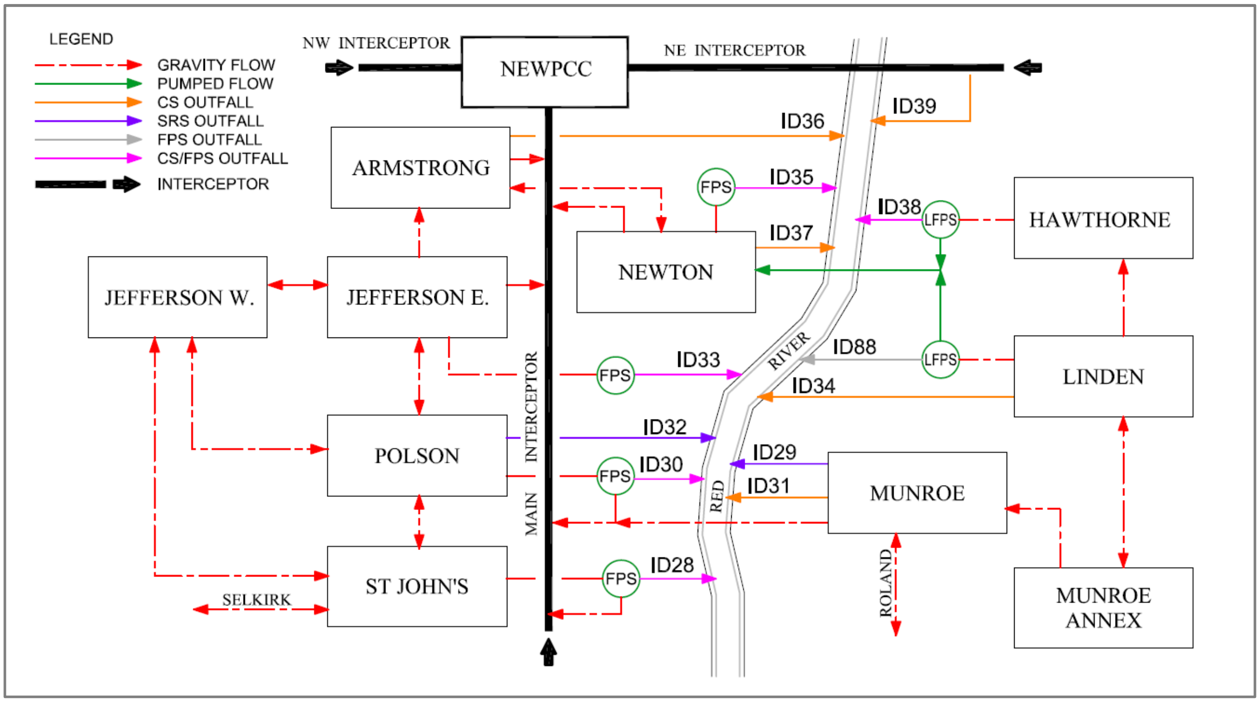


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 29 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 (ID31)	S-MH70022470.1	S-MA70017186	2150 x 3150 --> 2500	Red River Invert: 223.29 m Egg-shaped to circular
Flood Pumping Outfall	N/A	N/A	N/A	No Flood Pump Station within this district.
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-TE40001634.1	S-MA400005434	2150 x 3150	Main CS that flows west on Munroe Avenue Egg-shaped Invert: 223.6 m
SRS Outfalls (ID29)	S-MH40004730.1	S-MA40005212	750 --> 900	Red River Invert: 221.71 m
SRS Interconnections				53 SRS - CS
Main Trunk Flap Gate	MUNROE_GC2.1	S-CG00001088	2,500	Invert: 224.06 m
Main Trunk Sluice Gate	MUNROE_GC1.1	S-CG00001089	2,500	Invert: 224.01 m
Off-Take	S-TE70027696.1	S-MA70017177	450 mm	Invert: 223.60 m

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	S-TE70027696.1 [(1)]	450 mm [(1)]	0.67 m^3/s [(1)]
ADWF	N/A	N/A	0.141 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	
Flood Pump Station Total Capacity	N/A	N/A	N/A	
Pass Forward Flow – First Overflow	N/A	N/A	0.269 m^3/s	

Notes:

[(1)] Gravity pipe replacing Lift Station as Munroe is a gravity discharge district

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	Bredin – 223.68 Munroe – 223.67
2	Trunk Invert at Off-Take	223.60
3	Top of Weir	224.06
4	Relief Outfall Invert at Flap Gate	224.53
5	Low Relief Interconnection (S-MH40007071)	224.85
6	Sewer District Interconnection (Roland)	221.93
7	Low Basement	225.40
8	Flood Protection Level (Munroe, Linden, Hawthorne)	229.04

[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 Engineering Consultants, 1985). The study's purpose was to develop sewer relief options to reduce surcharge level and relieve basement flooding. No other work has 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 Munroe Combined Sewer District was included as part of this program. Instruments installed at each of the thirty-nine 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
29 – Munroe	1985	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Munroe 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 Munroe sewer district are listed in Table 1-4. The proposed CSO control projects will include gravity flow control, in-line storage via 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 in the Munroe district is suitable for use as in-line storage. These control options will take advantage of the existing CS pipe networks for additional storage volume. A gravity flow controller is also proposed on the CS system to optimize the dewatering rate from the district across the Red River to the Main Interceptor.

Floatable control will be necessary to capture any undesirable 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. A screen will be installed on the primary outfall located at the east end of Munroe Avenue.

The SRS system in the Munroe district was found to not allow the cost effective implementation of latent storage, due to the minor overall volume reduction during the 1992 representative year analysis found during the Preliminary Proposal and CSO Master Plan modeling assessments. Latent storage has therefore not been proposed in this district.

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 Munroe 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.

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	223.60 m	
Trunk Diameter	2150 x 3200 mm	Egg-shaped
Gate Height	1.16 m	Based on half pipe diameter assumption
Top of Gate Elevation	224.76 m	
Bypass Weir Elevation	224.71	
Maximum Storage Volume	2004 m^3	
Nominal Dewatering Rate	0.270 m^3/s	Based on minimum pass forward rate due to existing gravity sewer and river siphon crossing
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 within the collection system to the extent shown on Figure 29. The extent of the in-line storage and volume is related to the elevation of the bypass weir. The level of the bypass weir is the maximum control level in the system: when the system level increases the flow overtops the bypass weir and is screened prior to discharging to the river. If the system level continues to rise, it will reach the critical level where 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 gravity discharge will continue with its current operation while the control gate is in either position, will all DWF being diverted to the existing siphon river crossing.

Figure 29-01 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 trunk sewer alignment upstream of the diversion chamber. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5.5 m in length and 3.5 m in width. The existing weir and off-take pipe configuration 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. Additionally, residential buildings are located directly adjacent to the easement. This location is dependent on the extent of the existing underground structures and will require additional investigation to confirm the suitability of the proposed chamber locations. The relocation of the chambers to the street, Henderson Highway, also has issues with construction impacts and no dedicated overflow pipe that would require to be constructed. The implementation of the proposals may result in modifications to the existing diversion chamber and repurposing of the abandoned pump station.

The nominal rate for dewatering is per the existing downstream gravity sewer system. This accommodates dewatering through the existing interceptor system within 24 hours following the runoff event, allowing it to recover in time for a subsequent event. Any future considerations for RTC improvements would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflows at this district. This future RTC control will provide the ability to capture and treat more volume for localized storms by using the excess interceptor capacity where the runoff is less.

1.6.2 Gravity Flow Control

Munroe district does not include a LS and discharges to the Main Interceptor by gravity, however a siphon river crossing is also utilized. A flow control device will be required to control the diversion rate for future RTC and dewatering. The controller will include flow measurement and a gate to control the discharge flow rate. A standard flow control device was selected as described in Part 3C.

The flow control would be installed at an optimal location on the connecting sewer between the proposed in-line control and existing diversion chamber. Figure 29-01 identifies a conceptual location for flow controller installation. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction. The flow controller would operate independently during DWF and WWF and would require only minimal operational interaction.

A gravity flow controller has been included as a consideration in developing a fully optimized CS system as part of the City's long-term objective. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

It should be noted that in addition to the gravity flow controller on the off-take pipe in the Munroe district, there is also a gravity flow controller proposed to be constructed in the Polson district immediately downstream of the Munroe district. As spatially varying rainfall may occur in either district this would require gravity flow controllers in both locations to allow for future RTC optimization within the combined sewer system.

1.6.3 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens would be proposed while still maintaining the current level of basement flooding protection.

The type and size of screens depend on the diversion chamber configuration, the siphon operation and the hydraulic head available. A generic design was assumed for screening and is described in Part 3C. The design criteria for screening with gate control implemented are listed in Table 1-6.

Table 1-6. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.76 m	
Bypass Weir Crest	224.71 m	
NSWL	223.67 m	
Maximum Screen Head	1.04 m	
Peak Screening Rate	1.16 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 existing combined trunk sewer, as shown on Figure 29-01. The screen will operate with the control gate in its raised position. The side bypass weir upstream of the 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 the interceptor and on to the NEWPCC for removal.

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 5 m in length and 3.5 m in width. The outfall easement is constricted which may add difficulty to construction in this location. Additionally, residential buildings are located directly adjacent to the easement. This location is dependent on the extent of the existing underground structures and will require additional investigation to confirm the suitability of the proposed chamber locations. The relocation of the chambers to the street, Henderson Highway, also has issues with construction impacts and no dedicated overflow pipe that would require to be constructed. The implementation of the proposals may result in modifications to the existing diversion chamber and repurposing of the abandoned pump station.

1.6.4 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 applicable GI controls.

Munroe has been classified as a medium GI potential district. Land use in Munroe is mostly single-family residential, with the remaining consisting of commercial land use. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels. The flat roof commercial buildings make for an ideal location for green roofs.

1.6.5 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 Systems Operations and Maintenance

Systems 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 would be directed from the main outfall 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. Additional O&M will also be required to check the screenings pump return and envisaged to be completed in conjunction with the screen review. The frequency of a screened event would 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)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	402	402	14,354	70	N/A
2037 Master Plan – Control Option 1	402	402	14,354	70	IS, SC

Notes:

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. 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 1-8 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

	Preliminary Proposal	Master Plan			
Control Option	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [a]
Baseline (2013)	431,121	432,465	-	23	0.208 m^3/s
In-Line Storage	430,508	370,430	62,035	22	0.262 m^3/s
Control Option 1	**430,508**	**370,430**	**62,035**	**11**	**0.262 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 1-9, as it is applicable to the entire CS system and not for each district individually. The performance of this district is influenced by levels in the downstream interceptor system as this district has a gravity discharge.

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 estimate 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	N/A [a]	$2,670,000 [c]	$46,000	$990,000
Screening		$3,340,000 d	$57,000	$1,230,000
Gravity Flow Control	N/A [b]	$1,280,000	$34,000	$740,000
Subtotal	**N/A**	**$7,290,000**	**$138,000**	**$2,960,000**
Opportunities	N/A	$730,000	$14,000	$300,000
District Total	**N/A**	**$8,020,000**	**$151,000**	**$3,260,000**

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for this item of work found to be $6,570,000

[b] Gravity Flow Control was not included in the Preliminary Proposal 2015 costing

[c] Cost associated with potential modifications to off-take to existing Munroe diversion chamber or potential modification to existing chamber location not included in in-line storage cost estimate.

[d] 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 include 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. Each of these values include equipment replacement and O&M costs.
- 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 Options	In-Line Storage	A Control Gate was not included in the Preliminary Proposal estimate	Added for the Master Plan to further reduce overflows
	Screening	Screening was not included in the Preliminary Proposal estimate	Added in conjunction with the Control Gate
	Gravity Flow Control	Gravity Flow Control 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 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 Munroe district would be classified as a 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. Opportunistic separation of portions of the district may be achieved with synergies with other major infrastructure work to address future performance targets. In addition, off-line storage elements such as an underground tank or storage tunnel with associated dewatering pump infrastructure be utilized to provide additional volume capture. Finally for focused use of green infrastructure, and reliance on said green infrastructure to provide volume capture benefits could be utilized 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	• Opportunistic Separation • Off-line Storage (Tunnel/Tank) • Increased use of GI

The control options for the Munroe district has been aligned to meet the 85 percent capture performance target based on the system wide basis. The expandability of this district to meet 98 percent capture target would be based both on the system wide basis analysis and the achievement of the construction of the in-line storage and screenings chambers. This may lead to the requirement for the alternative floatables management approach to be adopted in the future for this district.

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, CSO Master Plan update 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.

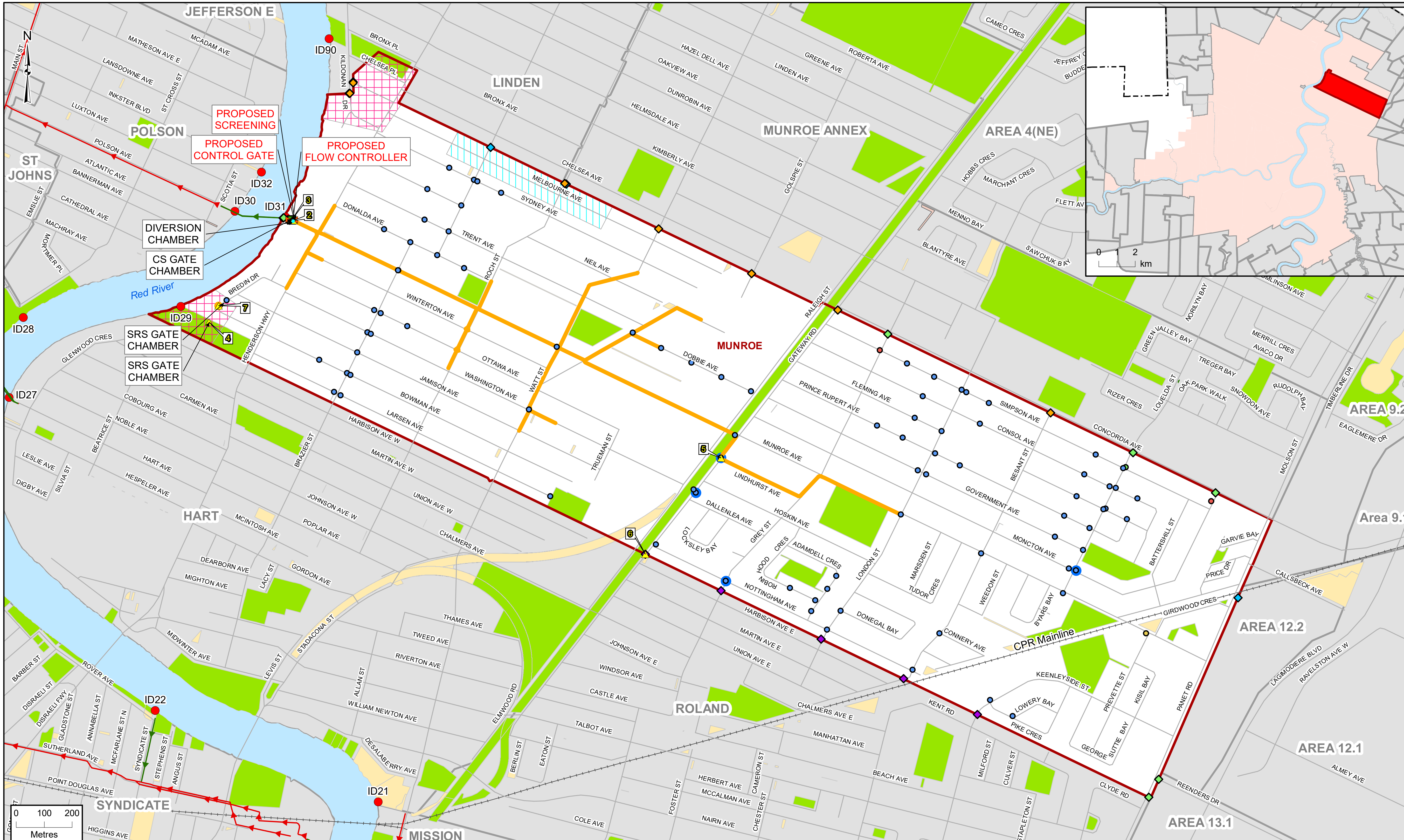
Table 1-12. Control Option 1 Significant Risks and Opportunities

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	-	O	-	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	-	-
3	Flood Pumping Station	-	-	-		-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
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. 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 - LDS
CS - WWS
SRS - CS
SRS - WWS

District Boundary Crossing
CS
LDS
SRS
WWS

Interceptor Sewer
Force Main
Street
Railway

District Boundary
Watercourse
Greenspace
City Owned Land

CSO MASTER PLAN PROPOSED SOLUTIONS

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

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 29
District Overview Map
Sewer District: Munroe
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE7\MUNROE\MUNROE_DISTRICT_OVERVIEW_MAP.MXD DT072410 7/29/2019 10:12:20 AM

LEGEND

- Primary Weir
- Critical Elevation
- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate
- Force Main
- Sewer By Type
  - CS
  - WWS
- Control Structure Type
  - Gate Chamber
- Pump Station Type
  - Diversion Chamber

CSO MASTER PLAN PROPOSED SOLUTIONS

- Control Gate
- Screening
- Flow Controller

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 29-01
Control Gate and Screening
Sewer District: Munroe
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE7\MUNROE\MUNROE_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 10:09:53 AM

CSO Master Plan

Munroe Annex District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Munroe Annex District Plan
Revision:	03
Date:	August 20, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	MunroeAnnex_Plan_Final_CO1MP_08202019

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	DT	SG	
1	02/15/2019	DRAFT 2 for City Review	JT	SG	MF
2	08/19/2019	Final Draft Submission	DT	MF	MF
3	08/20/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Munroe Annex District

1.1 District Description

Munroe Annex district is located in the northeastern limit of the City's combined sewer network, and is immediately east of the Linden district. Munroe Annex is approximately bounded by Concordia Avenue and Chelsea Avenue to the south, Rock Street to the west, Roberta Avenue, Norilyn Bay, Sawchuk Bay, and Menno Bat to the north, and Molson Street to the east. Figure 30 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan control options.

Gateway Road bisects the Munroe Annex district into east and west; this is the only regional roadway in the district. Other major transportation routes include Raleigh Street, Watt Street, Golspie Street, Roch Street, and Louelda Street in a north-south direction and Kimberly Avenue, Linden Avenue, Chelsea Avenue, Dunrobin Avenue, and Helmsdale Avenue in the east-west direction.

Munroe Annex is primarily residential but includes a few commercial and industrial locations. Of the residential units, the majority are single-family residential, with a few multi-family and two-family units located mostly east of Gateway Road. There are a few scattered commercial and industrial land-use designations within the district. There are also six greenspace areas within the Munroe Annex district; two of these are Civic Park, a large greenspace area bordering the northwestern boundary of the district, and East Kildonan Centennial Park. Concordia Hospital is located at the eastern end of the district near Lagimodiere Boulevard.

1.2 Development

There is limited land area available for new development within Munroe Annex district. No significant developments that would impact the Combined Sewer Overflow (CSO) Master Plan are planned or expected.

1.3 Existing Sewer System

Munroe Annex district encompasses an area of 188 ha[1] based on the existing GIS district boundary information. In general, the area east of Gateway Road consists of separate LDS and WWS systems, while the area west of Gateway Road consists of a CS and SRS system. Both the east and the west sides of the district are separate systems that connect into the Munroe and Linden CS systems. There is approximately83 percent by area (156 ha) of LDS separated area and 3 percent by area (5 ha) identifiable as separation ready. The greenspace area in the district accounts for the remaining 14 percent by area, and totals approximately 27 ha.

There are no diversion structures, flow control structures, outfalls, pumping stations or lift stations (LSs) within the district. A 975 mm and a 750 mm trunk within the CS system carry flow south by gravity towards the CS system in the Munroe district. Multiple secondary sewers extend from the CS trunks along Munroe Avenue to the east and west to service the entire area. The WWS system is mainly on the east side of the district, with northern WWS sewers diverting flows to the Valley Gardens (Area 4NE) WWS system, and southern WWS sewers diverting flows to the CS system in the Munroe district.

Although the majority of the catch basins are connected to the SRS piped network, some catch basins remain connected to the CS system. CBs currently connect to specific sections of the CS system within Munroe Annex. Future plans to separate the remaining CBs from the existing CS system into the LDS system should be considered to allow for this district to be completely separation. The majority of the SRS flows in the district are diverted to an 1800 mm LDS sewer on Greene Avenue, which carries the flows

[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.

west towards the Linden district LDS system. Flows from the southwest portion of the Munroe Annex district is directed towards the 2100 mm LDS sewer on Chelsea Avenue, which carries flows west towards Linden district.

Secondary LDS sewers direct flow via gravity to a 1200 mm to 2100 mm LDS pipe that carries flow to the Linden district. There is also two secondary overflow points from the CS system in the Munroe Annex district to the 2100 mm LDS pipe on Chelsea Avenue at the intersections of Golspie Street and Chelsea Avenue, and Watt Street and Chelsea Avenue (S-TE40001450 and S-MH70022447). These cross-connection pipes have been reviewed as previous overflow locations and can now be utilized as emergency secondary overflows. Each overflow consists of a reduction in the CS collector pipe diameter to allow it to pass within the Chelsea LDS trunk sewer, and a side overflow weir interconnection into the LDS trunk sewer. A positive gate is installed at the overflow point to control when these overflows are allowed to connect into the LDS system to reduce basement flooding risks. At this time the positive gate for both of these CS-LDS interconnections are closed and are to remain closed until further evaluations have been completed.

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Munroe Annex and the surrounding districts. Each interconnection is shown on Figure 30 and shows locations where gravity flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 District Interconnections

Munroe

CS to CS

- A 1200 mm CS pipe flows south by gravity on Watt Street to the CS trunk on Munroe Avenue in the Munroe district:
  - Invert at Munroe district boundary 224.74 m (S-MA40005030)
- A 900 mm CS pipe flows south by gravity on Golspie Street to the CS trunk on Munroe Avenue in the Munroe district:
  - Invert at Munroe district boundary 225.11 m (S-MA40004336)
- A 300 mm CS pipe flows south by gravity on Gateway Road to the Munroe district:
  - Invert at Munroe district boundary 227.35 m (S-MA40004574)
- A 375 mm CS pipe flows south by gravity on Roch Street to the CS trunk on Munroe Avenue in the Munroe district:
  - Invert at Munroe Annex district boundary 226.57 m (S-MA40005099)

LDS to CS

- A 525 mm LDS pipe flows south from Munroe Annex district to Munroe district on Raleigh Street:
  - Invert at Munroe district boundary 228.27 m (S-MA40004522)

WWS to CS

- A 375 mm WWS pipe flows south by gravity on Louelda Street to the CS system in the Munroe district:
  - Invert at Munroe district boundary 227.20 m (S-MA40007458)
- A 300 mm WWS pipe flows south by gravity on Moncton Avenue to the CS system in the Munroe district:
  - Invert at Munroe district boundary 228.20 m (S-MA40007499)

- A 300 mm CS pipe flows south by gravity on Besant Street to the CS trunk on Munroe Avenue in the Munroe district:
  - Invert at Munroe district boundary 226.46 m (S-MA70051892)
- A 300 mm WWS pipe flows south by gravity on Grey Street to the CS system in the Munroe district:
  - Invert at Munroe district boundary 225.92 m (S-MA40005491)

<u>LDS to LDS</u>

- A 450 mm LDS pipe flows north on Roch Street from the Munroe district to the 2250 mm LDS trunk sewer on Chelsea Avenue in the Munroe Annex district:
  - Invert at Munroe Annex district boundary 223.98 m (S-MA40005096)

Linden

The CS and LDS systems between Munroe Annex and Linden interact at several locations.

<u>CS to CS</u>

- High point manholes
  - 300 mm CS at Roch Street and Roberta Avenue – 228.16 m References Munroe Annex District, 227.56 m References Linden District (S-MH40006178)
  - 375 mm CS at Roch Street and Linden Avenue – 225.78 m References Munroe Annex District, 226.66 m References Linden District (S-MH40006068)
  - 300 mm CS at Roch Street and Oakview Avenue – 227.42 m References Munroe Annex District, 227.26 m References Linden District (S-MH40006027)
  - 300 mm CS at Roch Street and Helmsdale Avenue – 227.42 m References Munroe Annex District, 227.30 m References Linden District (S-MH40005973)
- A 300 mm CS flows by gravity west at the intersection of Roch Street and Bronx Avenue from Munroe Annex district into Linden district:
  - Invert at Munroe Annex district boundary 227.76 m (S-MA40005134)

<u>LDS to LDS</u>

- A 2250 mm LDS trunk flows by gravity west at the intersection of Roch Street and Chelsea Avenue from Munroe Annex district into Linden district:
  - Invert at Munroe Annex district boundary 222.72 m (S-MA40005093)
- A 2100 mm LDS trunk flows by gravity west at the intersection of Roch Street and Greene Avenue from Munroe Annex district into Linden district:
  - Invert at Munroe Annex district boundary 22.84 m (S-MA40006725)
- A 750 mm LDS trunk flows by gravity north at the intersection of Roch Street and Dunrobin Avenue from Linden district into Munroe Annex district:
  - Invert at Linden district boundary 224.29 m (S-MA40006602)
- A 600 mm LDS trunk flows by gravity south at the intersection of Roch Street and Roberta Avenue from Linden district into Munroe Annex district:
  - Invert at Linden district boundary 224.15 m (S-MA40006722)
- A 450 mm LDS flows by gravity west at the intersection of Roch Street and Dunrobin Avenue from Munroe Annex district into Linden district:
  - Invert at Munroe Annex district boundary 224.56 m (S-MA40006595)

- A 375 mm LDS flows by gravity north at the intersection of Roch Street and Helmsdale Avenue from Munroe Annex district into Linden district:
  - Invert at Linden district boundary 224.83 m (S-MA40006509)
- A 300 mm LDS flows by gravity west at the intersection of Roch Street and Leighton Avenue from Munroe Annex district into Linden district:
  - Invert at Linden district boundary 224.54 m (S-MA40006148)
- A 300 mm LDS flows by gravity west at the intersection of Roch Street and Roberta Avenue from Munroe Annex district into Linden district:
  - Invert at Linden district boundary 224.39 m (S-MA40006749)
- A 300 mm LDS flows by gravity west at the intersection of Roch Street and Helmsdale Avenue from Munroe Annex district into Linden district:
  - Invert at Linden district boundary 224.91 m (S-MA40006501)
- A 250 mm LDS flows by gravity east at the intersection of Roch Street and Linden Avenue from Linden district into Munroe Annex district:
  - Invert at Munroe Annex district boundary 224.40 m (S-MA40006701)
- A 250 mm LDS flows by gravity east at the intersection of Roch Street and Oakview Avenue from Linden district into Munroe Annex district:
  - Invert at Munroe Annex district boundary 224.59 m (S-MA40006599)
- A 250 mm LDS flows by gravity east at the intersection of Roch Street and Kimberly Avenue from Linden district into Munroe Annex district:
  - Invert at Munroe Annex district boundary 225.28 m (S-MA40006513)

Valley Gardens (Area 4NE)

WWS to CS

- High point manhole
  - 250 mm WWS on Dowhan Crescent at Blantyre Avenue – 228.00 m References Munroe Annex District, 228.01 m References Valley Gardens District (S-MH40004250)

LDS to LDS

- A 1650 mm LDS pipe flows south by gravity on London Street from Valley Gardens district to the LDS system in Munroe Annex district:
  - Invert at Munroe Annex district boundary 226.53 m (S-MA40004119)
- A 1375 mm LDS pipe flows south by gravity on Louelda Street from Valley Gardens district to the LDS trunk in Munroe Annex district:
  - Invert at Munroe Annex district boundary 227.26 m (S-MA40004083)
- A 525 mm LDS pipe flows south by gravity on Tregar Bay from Valley Gardens district to the LDS system in Munroe Annex district:
  - Invert at Valley Gardens district boundary 228.21 m (S-MA40004065)
- A 300 mm LDS pipe flows south on Nathan Lane from Valley Gardens district into Munroe Annex district:
  - Invert at Munroe Annex district boundary 228.26 m (S-MA40004642)

- A 300 mm LDS pipe flows south on Dowhan Crescent at Blantyre Avenue from Valley Gardens district into Munroe Annex district:
  - Invert at Munroe Annex district boundary 228.11 m (S-MA40003990)

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

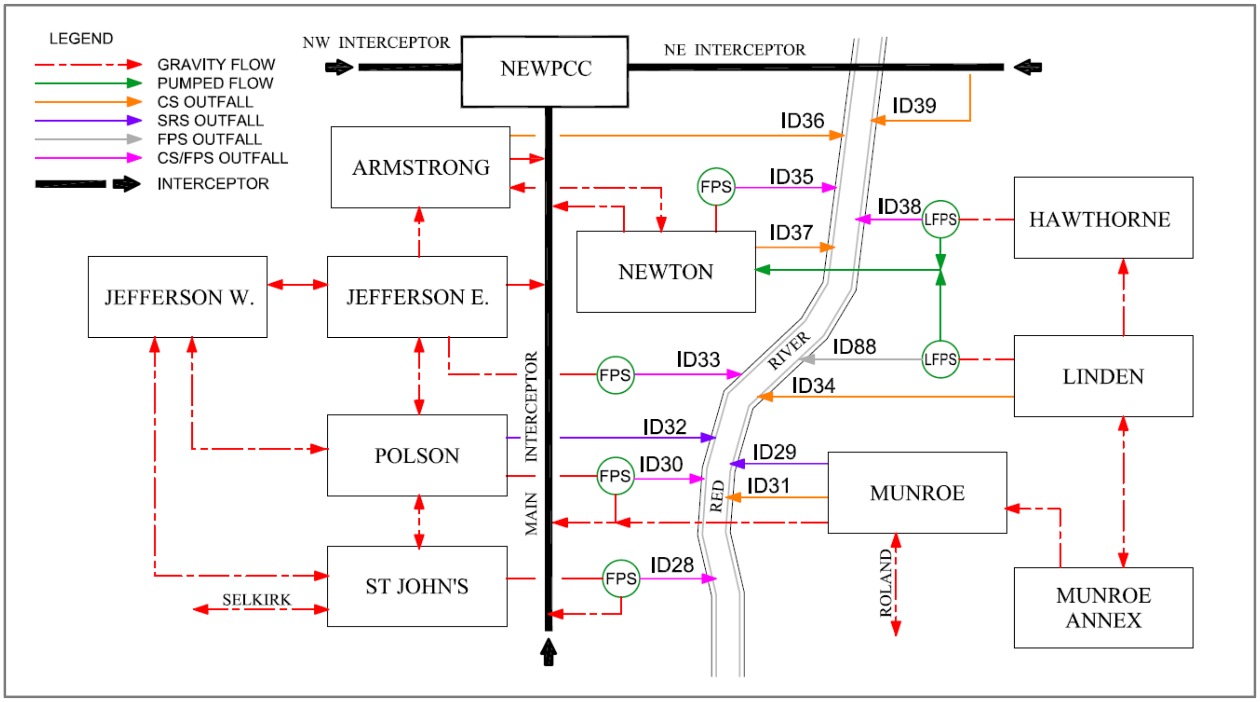


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 30 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 (ID23)	N/A	N/A	N/A	No CS outfall within the district.
Flood Pumping Outfall (ID23)	N/A	N/A	N/A	No Flood Pumping Station within the district.
Other Overflows (ID24 & ID26))	N/A	N/A	N/A	
Main Trunk	N/A	N/A	N/A	There is not a single CS trunk within the district.
SRS Outfalls (ID25)	N/A	N/A	N/A	There is no dedicated SRS outfall in the district.
SRS Interconnections	S-TE40001450.2 S-MH70022447.2	S-TE40001450 S-MH70022447	Weir width: 3000 mm Weir Crest: 225.66	This is a cross-connection between a CS and LDS system

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
			Weir Width: 900 mm Weir Crest: 225.59	This is a cross-connection between a CS and LDS system
Main Trunk Flap Gate	N/A	N/A	N/A	No CS outfall within the district.
Main Trunk Sluice Gate	N/A	N/A	N/A	No CS outfall within the district.
Off-Take	N/A	N/A	N/A	No CS outfall within the district.
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	N/A	
ADWF	N/A	N/A	0.141 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	No lift station within the district.
Flood Pump Station Total Capacity	N/A	N/A	N/A	No Flood Pumping Station within the district
Pass Forward Flow – First Overflow	N/A	N/A	N/A	

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	N/A
2	Trunk Invert at Off-Take	N/A
3	Top of Weir	N/A
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection (S-MH70022447)	225.59
6	Sewer District Interconnection (Munroe - 1200 mm CS)	225.07
7	Low Basement	225.40
8	Flood Protection Level (Munroe, Linden, Hawthorne)	229.04

[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 Munroe Annex was the *Munroe, Roland, Hart Combined Sewer Study* (Wardrop Engineering Consultants, 1985). The study's purpose was to develop sewer relief options to reduce surcharge level and relieve basement flooding. No further study work has been completed on the district sewer system since that time. As a result of this study several measures to implement separation of the Munroe Annex district was completed. The Munroe Annex district was in fact part of the Munroe district originally but was separated to distinguish the portion of the district where the majority of the separation work recommended as part of this study was completed.

The district is deemed to be close to complete separation at this time as a result of previous investment work. Two individual systems are present to capture and route surface runoff, with the eastern section of the district draining to the Chelsea LDS system and the west section draining to the SRS system that flows from Munroe Annex to the adjacent Linden district and ultimately to the Red River.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
30 – Munroe Annex	1985	Future Work After Complete Separation	2013	Study Complete Separation Work Ongoing	N/A

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

1.5 Ongoing Investment Work

There is not any current or proposed CSO or sewer relief investment work occurring in Munroe Annex district.

1.6 Control Option 1 Projects

1.6.1 Project Selection

The Munroe Annex district is an almost completely separate system and primarily has the remaining work required to allow for complete separation of the district proposed to meet CSO Control Option 1. Table 1-4 provides an overview of the control options included in the 85 percent capture in a representative year option. 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	In-Line Storage	In-line Control Gate	Gravity Flow Control	Off-line Storage	Storage / Transport Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year *	-	-	-	-	-	-	-	✓	✓	✓	-

Notes:- = not included
✓ = included

* = Cross connection work not covered in the above table.

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 Sewer Separation

The redirection of the existing CBs to the adjacent SRS in Chelsea Avenue and extension of the minor SRS systems in the Kimberly Avenue and Rayleigh Avenue locations would allow the system to be completely separated. It is recommended that an investigation into the system be completed to ensure that no additional WWS/CS connections to the existing SRS network are present.

Also, as part of the remaining sewer separation work, it is recommended that the interconnection between the CS and LDS systems at Golspie Street and Chelsea Avenue be modified. Each of the two CS-LDS interconnections were assessed as part of the CSO Master Plan and indicated two overflows at the Golspie Street cross connection for the representative year assessment. The reduction in pipe diameter through the cross connection is taken as a limiting factor and the weir level was taken to be too low for the WWF flows within the system. It is proposed to raise the weir and increase the pipe diameter to ensure that the cross connection does not operate for the representative year event. Optimizing the weir level/pipe diameter would require additional flow monitoring, and this is recommended that this be undertaken prior to any construction work. Further investigation and monitoring also would be needed to allow this cross connection to be abandoned. It should be noted that this work has not been included in the sewer separation capital cost estimates for the Munroe Annex district.

Upon completion of removing the WWS connections to the existing SRS connections at the Watt and Golpsie locations, the SRS systems that extend through the northern portion of the district can be classified as LDS systems.

It is proposed that future monitoring of the district is completed to verify that the sewer separation is fully compliant with the conditions modelled under the 1992 representative year conditions.

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 will be reviewed to identify applicable GI controls.

Munroe Annex has been classified as a high GI potential district. Land use in Munroe Annex is primarily residential but includes a few commercial and industrial locations. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels. The flat roof commercial buildings make for an ideal location for green roofs. There are also higher areas of greenspace which could be used for bioretention 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

Major changes to the existing system operations and maintenance (O&M) requirements for the Munroe Annex district will be minimal. The sewer separation work outstanding will include the installation of additional sewers that will require inspection, cleaning and rehabilitation.

It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the CS system) extent within the Munroe Annex district.

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 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added To Model
2013 Baseline	177	177	5,585	7	N/A
2037 Master Plan – Control Option 1	177	177	5,585	7	SW/Pipe

Notes:

SW/Pipe – Static Weir Increase and pipe diameter increase

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 of this district (from outfall perspective) is provided in the Munroe District Engineering Plan as Munroe Annex does not have a CS outfall. The overflow volume of 201m^3 is noted for the existing conditions and 0 m^3 for implementation the Control Option 1 conditions have been included in the Munroe performance estimate.

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 1-6. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 to plus 100 percent.

Table 1-6. Cost Estimate – 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)
Sewer Separation Minor Work Outstanding	N/A	$ - [b]	N/A	N/A
Static Weir / Pipe Diameter Increase	N/A [a]	$15,000 [c]	N/A	N/A
Subtotal	**N/A**	**$15,000**	**N/A**	**N/A**
Opportunities	N/A	$0	N/A	N/A

Table 1-6. Cost Estimate – 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)
District Total	**N/A**	**$15,000 [b c]**	**N/A**	**N/A**

[a] Static Weir / pipe diameter increase not included in the Preliminary Proposal costs

[b] Separation proposal costs developed as refinement to CO1MP work following submission of CSO Master Plan Control Option 1 costs. Costs for this item of work found to be $480,000 in 2019 dollars.

[c] No costs have been included for any monitoring needed to determine the optimum weir level

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 estimate 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 1-7.

Table 1-7. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Static Weir / Pipe Diameter Increase	Static Weir / Pipe Diameter Increase was not included in the preliminary estimate	Recent cross connection added to the Master Plan model and option
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.	

Table 1-7. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
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 remaining catch basin disconnections and proposed static weir/pipe diameter increase work recommended for the Munroe Annex district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-8.

Table 1-8. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-

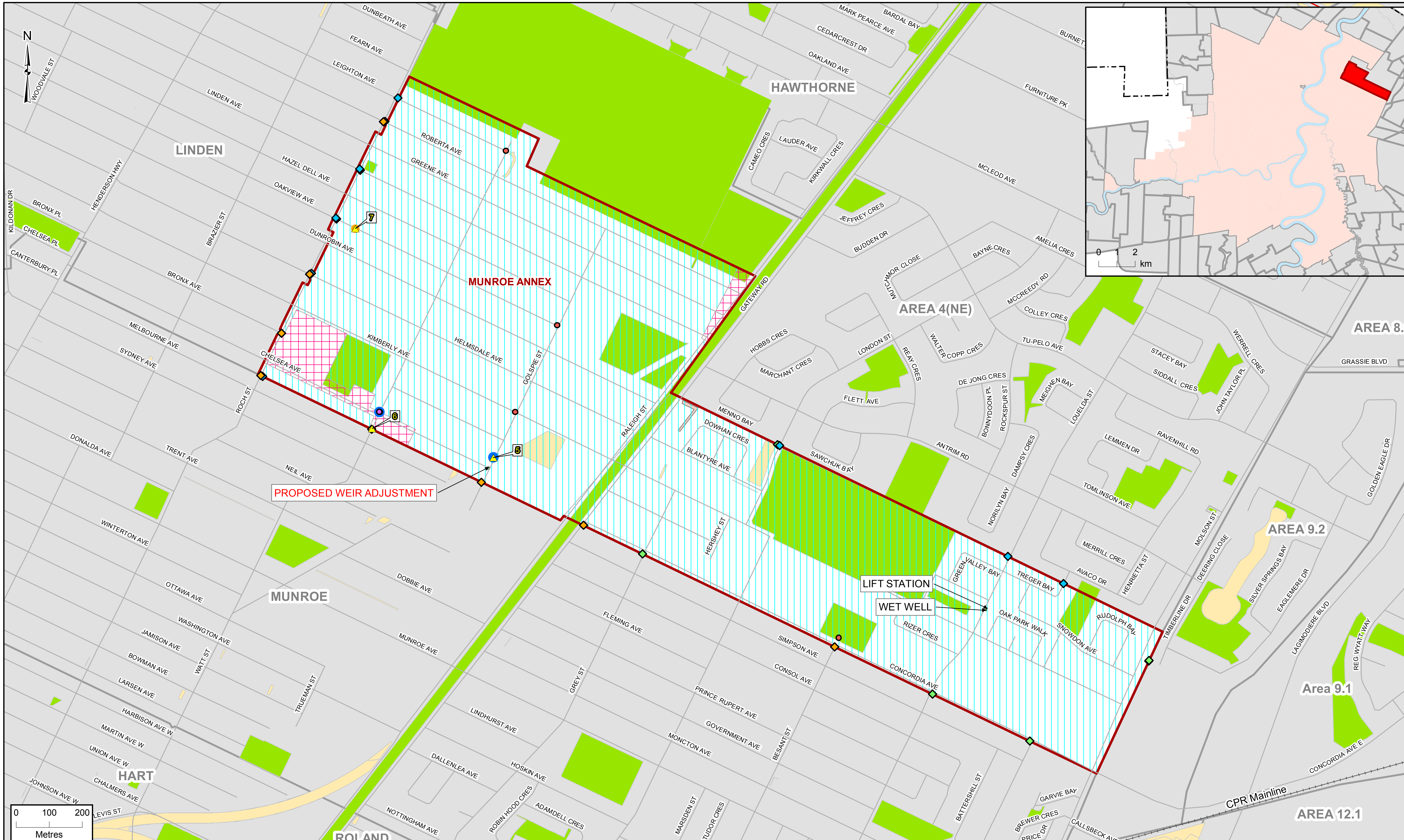
Table 1-8. Control Option 1 Significant Risks and Opportunities

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
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

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



LEGEND

Critical Elevation	Inter-System Connection	District Boundary Crossing	Interceptor Sewer	District Boundary
Low CS Manhole	CS - WWS	CS	Force Main	Greenspace
Low SRS Connection	SRS - CS	LDS	Street	City Owned Land
	SRS - LDS	WWS	Railway	

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Complete
- Sewer Separation - Ready

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 30
District Overview Map
Sewer District: Munroe Annex
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE7\MUNROE_ANNEX\MUNROEANNEX_DISTRICT_OVERVIEW_MAP.MXD SGODON 8/19/2019 11:13:19 AM

CSO Master Plan

Newton District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Newton District Plan
Revision:	03
Date:	August 19, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	Newton_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	09/14/2018	Version 1 DRAFT	JT	SB, MF, SG	
1	02/15/2019	DRAFT 2 for City Review	JT	SG	MF
2	07/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Newton District

1.1 District Description

Newton district is located in the northern section of the combined sewer (CS) area to the west of the Red River. This district is approximately bounded by Margaret Avenue to the north, Main Street to the west, Kilbride Avenue to the south, and the Red River to the east.

Newton district primarily includes residential, parks and recreation land use areas. Kildonan Park is a large park located in the north end of the district which takes up approximately 40% of the district by area. Overall, the district includes approximately 40 ha of greenspace. Single family residential is located south of Kildonan Park between Main Street and the Red River. Commercial land use is located along Main Street and Partridge Avenue

Main Street, Partridge Avenue and Leila Avenue are the regional transportation routes in the district. Main Street runs north-south through the district. Partridge and Leila Avenue are one-way segments that run east-west and join up to Main Street.

1.2 Development

A portion of Main Street is located within the Newton District. Main Street is identified as Regional Mixed-Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Main Street is to be promoted in the future.

1.3 Existing Sewer System

Newton district encompasses an area of 102 ha[1] based on the district GIS boundary information and primarily includes a CS system. This district does not include any areas identified as LDS separated or separation ready.

The CS system includes a flood pumping station (FPS), diversion structure and outfall gate chamber. The system flows towards the Newton outfall located at the east end of Newton Avenue at the intersection of Newton Avenue and Scotia Street, where it is intercepted and diverted into the Main Interceptor. The diversion structure includes a weir and a 525 mm off-take pipe which reduces to 450 mm and then connects to a 1350 mm secondary interceptor that flows by gravity west along Newton Avenue to tie back into the Main Interceptor. The intercepted CS from the Linden and Hawthorne districts is conveyed across the Red River via two river crossing pipe and both also tie into this 1350 mm secondary interceptor sewer.

There are two main routes for CS to flow to the diversion structure. An 1800 mm CS trunk flows east on Newton Avenue, servicing the district area west of Main Street; a 900 mm CS trunk on Scotia Street south of the outfall services the district area south of Leila Avenue. An interconnection with the Armstrong district is present near the Armstrong diversion structure near the intersection of Armstrong Avenue and Main Street, which allows flow from Armstrong to flow into Newton. This provides the ability to utilize the Newton FPS to dewater the Armstrong CS system during wet weather flow (WWF) and high river level conditions.

During dry weather flow (DWF), sanitary sewage from the Newton district flows into the diversion chamber located at the intersection of Newton Avenue and Scotia Street upstream of the CS outfall. The sanitary sewage is then diverted by the weir to a 450 mm off-take pipe and flows by gravity back to the Main Interceptor to be treated at the North End Sewage Treatment Plant (NEWPCC).

[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 WWF, flows that exceed the diversion capacity overtop the primary weir and is discharged into the river via the CS primary outfall located near the intersection of Newton Avenue and Scotia Street. Sluice and flap gates are installed on this CS outfall to prevent river water from backing up into the CS system when the Red River levels are particularly high. However not only does the flap gate prevent river water intrusion, but it also prevents gravity discharge from the Newton CS outfall. Under these conditions the excess flow is pumped by the Newton FPS to a point in the Newton CS Outfall downstream of the flap gate, where it can be discharged to the river by gravity once more.

A CS relief outfall acts an emergency overflow for the Rainbow Stage lift station (LS), which services the Rainbow Stage and other properties located in Kildonan Park east of Riverview Drive. This includes a sewage control structure with a LS and 150 mm force main that pumps sewage from some of the park facilities into a 375 mm CS pipe which then flows by gravity back towards the Newton diversion structure.

The two outfalls to the Red River (CS):

- ID35 (S-MA00017645) – Newton CS Outfall
- ID37 (S-MA70069313) – Kildonan Park CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Newton and the surrounding districts. Each interconnection is shown on Figure 31 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

Armstrong

- The 2250 mm Main Interceptor pipe flows north by gravity on Main Street out of the Newton district into the Armstrong district:
  - Invert at Newton district boundary 215.85 m (S-MA00000900)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Jefferson East

- The 2250 mm Main Interceptor pipe flows north by gravity on Main Street into the Newton district out of the Jefferson East district:
  - Invert at Jefferson East district boundary 217.61 m (S-MA00017587)

1.3.1.3 District Interconnections

Jefferson East

<u>CS to CS</u>

- The 375 mm CS pipe flows south on Main Street out of the Newton district:
  - Invert at Newton district boundary 226.90 m (S-MA00017220)
- The 250 mm CS pipe flows east by gravity on Kingsbury Avenue out of the Newton district:
  - Invert at Newton district boundary 226.59 m (S-MA00017588)
- The 225 mm CS pipe flows west by gravity on Burrin Avenue into the Jefferson East district:
  - Invert at Newton district boundary 228.68 m (S-MA00001001)

Armstrong

CS to CS

- The 2700 mm CS main sewer trunk flows east on Armstrong Avenue out of the Armstrong district towards the Armstrong CS outfall located at the far end of Armstrong Avenue:
  - Invert at Armstrong district boundary 223.58 m (S-MA00000802)
- The 1350 mm CS pipe diverts south onto Main Street into the Newton district and connects to the Newton CS network:
  - Invert at Armstrong district boundary 225.03 m (S-MA00000789)
- The 600 mm CS pipe flows south by gravity on Main Street out of the Newton district:
  - Invert at Armstrong district boundary 224.64 m (S-MA00000784)
- The 450 mm CS pipe flows south by gravity on Main Street into the Newton district:
  - Invert at Armstrong district boundary 225.55 m (S-MA00000930)
- The 450 mm CS pipe flows south by gravity on Main Street out of the Newton district:
  - Invert at Armstrong district boundary 225.55 m (S-MA00000779)
- The 600 mm CS pipe flows east by gravity though Beeston Drive onto Main Street into the Newton district:
  - Invert at Newton district boundary 225.67 m (S-MA00000869)

Hawthorne

WWS to WWS

- The 350 mm WWS pipe flows north by pump into the Newton district:
  - Newton Avenue – 225.66 m (S-MA70021128)
- The 350 mm WWS pipe flows north by pump into the Newton district:
  - Newton Avenue – 222.63 m (S-MA00017639)

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.

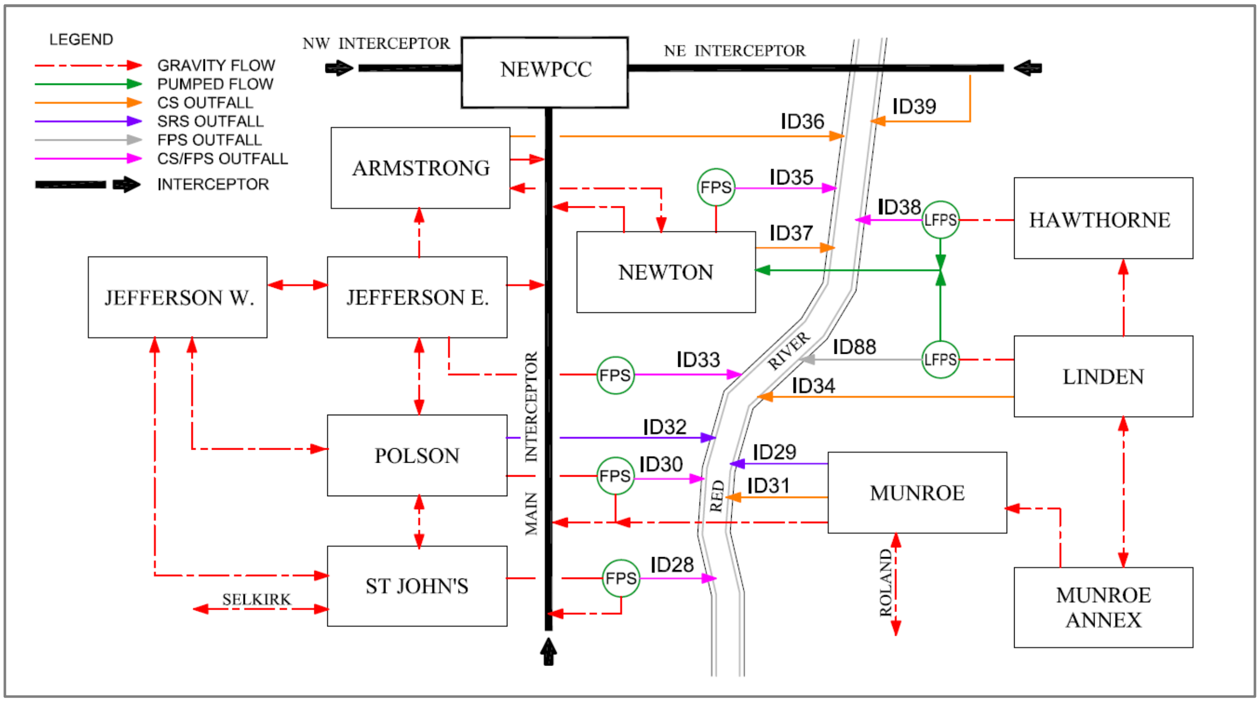


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 31 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 (ID35)	S-CO70003176.1.1	S-MA00017645	1850 mm	Red River Invert: 223.55 m
Flood Pumping Outfall (ID35)	S-CO70003176.1.1	S-MA00017645	1850 mm	Red River Invert: 223.55 m
Other Overflows (ID37)		S-MA70069313	250 mm	Invert: 223.05 m
Main Trunk	S-TE70000766.1	S-MA00001804	1800 mm	Invert: 223.59 m
SRS Outfalls	N/A	N/A	N/A	No SRS system within the district.
SRS Interconnections	N/A	N/A	N/A	No SRS system within the district.
Main Trunk Flap Gate	S-TE70026554.1	S-CG00000773	1800 mm	Invert: 224.14 m Circular
Main Trunk Sluice Gate	NEWTON_GC1.1	S-CG00000772	1800 x 1800 mm	Invert: 224.02 m
Off-Take	S-TE70000754.2	S-MA00017635	525	Invert: 223.81 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	S-MA00017635 (1)	525 mm (1)	0.35 m^3/s (1)
ADWF	N/A	N/A	0.002 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Flood Pump Station Total Capacity	N/A	N/A	2.17 m^3/s	1 x 1.35 m^3/s 1 x 0.82 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.64 m^3/s	

Notes:

(1) – Gravity pipe replacing lift station as Newton is a gravity discharge district
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[a] (m)
1	Normal Summer River Level	Newton – 223.65 Kildonan Park – 223.65
2	Trunk Invert at Off-Take	223.81
3	Top of Weir	223.90
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Interconnection (Armstrong)	224.64
7	Low Basement	226.64
8	Flood Protection Level	228.80

[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 Newton was the *Newton Combined Sewer District Sewer Relief Study* (IDG Stanley Inc, 1994). The study's purpose was to develop sewer relief options that provide a 5-year level of protection against basement flooding and to develop alternatives for reducing and eliminating pollutants from CSOs. No other work has 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 Newton 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
31 – Newton	1994	Planned in Next 5 Years	2013	Study Complete	N/A

Source: Report on *Newton Combined Sewer District Sewer Relief Study*, 1994

1.5 Ongoing Investment Work

District flow monitoring is planned to be undertaken within the next 5 years due to its interaction with the Armstrong district.

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Newton 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 Newton 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. These 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. A gravity flow controller is proposed on the CS system to optimize the dewatering rate from the district back into the Main Interceptor.

Floatable control will be necessary to capture any undesirable 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. A screen will be installed on the primary outfall located at the east end of Newton Avenue.

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 In-Line Storage

In-line storage has been proposed as a CSO control for Newton 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.

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	223.59 m	N/A
Trunk Diameter	1800 mm	N/A
Gate Height	0.69 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	224.59 m	N/A
Maximum Storage Volume	330 m^3	N/A
Nominal Dewatering Rate	0.35 m^3/s	Based on existing pipe system pipe full capacity
RTC Operational Rate	TBD	Future RTC/dewatering review on performance

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 31. 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 gate drop 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 down 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 gravity discharge will continue with its current operation while the control gate is in either position, , with all DWF being diverted to the Main Interceptor.

Figure 31-01 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. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5.5 m in length and 3.5 m in width. The existing sewer configuration including the construction of an additional off-take pipe will have to be completed to allow for CS captured by the control gate to be intercepted to the Newton diversion structure. 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 proposed is located within a residential street with minor disruptions expected.

The nominal rate for dewatering is determined by the performance of the existing pipe capacity as the district is a gravity discharge district. As such the flows will vary over the duration of a rainfall event and has been nominated for a gravity flow control device. Any future consideration, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflow at this district. The control device would be set to a rate similar to the existing pipe full capacity to allow the set limit to be known. This would allow the future RTC control the ability to capture and treat more volume for localized storms in other districts by using the excess interceptor capacity made available by restricting the pass forward flows through the control device where the runoff is less.

1.6.3 Gravity Flow Control

Newton district does not include a LS and discharges to the Main Interceptor by gravity. A flow control device will be required to control the diversion rate for future RTC and dewatering. The controller will include flow measurement and a gate to control the discharge flow rate. A standard flow control device was selected as described in Part 3C.

The 1350 mm sewer connecting into the Main Interceptor also receives flow from the Hawthorne and Linden districts. The flow control would be installed at an optimal location between the diversion structure and the connection into the Main Street interceptor. Figure 31-01 identifies a conceptual location for flow controller installation. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction. The flow controller would operate independently during DWF and WWF and would require only minimal operational interaction. The impact of the flow controller on the force main connections to Hawthorne and Linden districts must also be considered during preliminary design.

A gravity flow controller has been included as a consideration in developing a fully optimized CS system as part of the City's long-term objective. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

1.6.4 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens would 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	224.59	
Bypass Weir Crest	224.49	
NSWL	223.649	
Maximum Screen Head	0.84	
Peak Screening Rate	0.29 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 31-01. The screens will operate once levels within the sewer surpassed the in-line control elevation. A side weir upstream of the 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 the interceptor.

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 2.5 m in length and 3.5 m in width.

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.

Newton has been classified as a high GI potential district, the land use mainly consists of greenspace and single family residential land use, meaning it would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, and rain gardens. There are some commercial buildings that would be suitable for green roof 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 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.

The flow controller will require the installation of a chamber and flow control equipment. Monitoring and control instrumentation will be required. The flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required.

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 Added To Model
2013 Baseline	93	93	2,539	36	N/A
2037 Master Plan – Control Option 1	93	88	2,539	35	IS, SC

Notes:

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

	Preliminary Proposal	Master Plan			
Control Option	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [a]
Baseline (2013)	7,218	8,614	-	6	0.315 m^3/s
In-line Storage	2,771	2,994	5,620	2	0.315 m^3/s
Control Option 1	**2,771**	**2,994**	**5,620**	**2**	**0.315 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 Control Gate	$7,740,000 [a]	$2,550,000 [c]	$40,000	$860,000
Screening		$1,840,000 [d]	$31,000	$660,000
Gravity Flow Controller	N/A	$1,280,000	$34,000	$740,000
Off-line Storage Tank	$6,870,000 [b]	N/A	N/A	N/A
Subtotal	**$14,610,000**	**$5,670,000**	**$105,000**	**$2,260,000**
Opportunities	N/A	$570,000	$11,000	$230,000
District Total	**$14,610,000**	**$6,240,000**	**$116,000**	**$2,490,000**

[a] Screening and In-line cost was combined in the Preliminary Proposal. Solution development as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for these items of work found to be $1,000,000 in 2014 dollars

[b] Offline storage tank part of Armstrong assessment during Preliminary Proposal (however located within the Newton district).

[c] Cost associated with new off-take construction, as require, to accommodate control gate and screening chambers in location and allow intercepted CS flow to reach existing Newton gravity discharge was not included in Master Plan cost estimates.

[d] 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 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 Options	Control Gate	A control gate was not included in the Preliminary Proposal estimate	Added for the Master Plan to further reduce overflows
	Screening	Screening was not included in the Preliminary Proposal estimate	Added in conjunction with the Control Gate
	Removal Of Off-line Storage Tank	The Master Plan assessment found that off-line tank storage not a preferred control solution.	
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 Newton district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume.

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	• Opportunistic Sewer Separation • Increased use of GI • Off-line Storage (Tank/Tunnel)

The control options selected for the Newton district has been aligned for the requirement to provide screening on each of the primary outfalls and not specifically 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 based on a stepped approach from the system wide basis. The proposed control options at the adjacent Armstrong district provide overflow reduction to this district and would be programmed to be completed prior to any work commenced in this district.

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	-	-	-	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
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

IGD Stanley Inc. 1994. *Newton Combined Sewer District Sewer Relief Study*. Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. September.

LEGEND

Primary Weir	Inter-System Connection	District Boundary Crossing	Interceptor Sewer	District Boundary
Critical Elevation	CS - WWS	CS	Force Main	Watercourse
CSO Outfall		LDS	Street	Greenspace
Low CS Manhole		WWS	Railway	

CSO MASTER PLAN PROPOSED SOLUTIONS

- Proposed Control Gate
- 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 31
District Overview Map
Sewer District: Newton
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\NEWTON\NEWTON_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 9:38:58 AM

LEGEND

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

Sewer By Type
- CS
- WWS

Pump Station Type
- Diversion & Flood Combined Station

CSO MASTER PLAN PROPOSED SOLUTIONS
- Control Gate
- Screening
- Flow Controller

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 31-01
Control Gate, Screening and Flow Control
Sewer District: Newton
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\NEWTON\NEWTON_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 9:38:03 AM

CSO Master Plan

Parkside District Plan

August 2019

City of Winnipeg

JACOBS

Winnipeg CSO Master Plan

Project No: 470010CH
Document Title: Parkside District Plan
Revision: 03
Date: August 16, 2019
Client Name: City of Winnipeg
Project Manager: John Berry
Author: Stephen Godon
File Name: Parkside_Plan_Final_Co1MP_08162019.docx

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	08/2018	Version 1 DRAFT	DT / SG	ES	
1	02/15/2019	DRAFT 2 for City Review	MF	SG	MF
2	08/12/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

1. Parkside District

1.1 District Description

The Parkside sewer district is in the western section of north end sewage treatment plant (NEWPCC) catchment area of the combined sewer (CS) area and adjacent to the Assiniboine River. Parkside is bordered by Portage Avenue to the north, Bourkevale Drive to the west, and the Assiniboine River to the south and east.

Land use in Parkside is mainly single-family residential with commercial along Portage Avenue. École Assiniboine School and Jae Eadie Park are significant non-residential land use parcels present in the district. Portage Avenue is the only regional transportation route that passes through Parkside district parallel to the Assiniboine River along the north district boundary.

1.2 Development

A portion of Portage Avenue is located within the Parkside District. Portage Avenue is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

Parkside encompasses a combined area of 16 hectares (ha)[1] based on the district boundary. Parkside was identified for sewer separation as part of the Ferry Road and Riverbend sewer relief work. As of December 2018, sewer separation work has been completed in the Parkside district.

This district includes both a CS and LDS system and a CS outfall. It is interconnected to the Riverbend district. The combined sewage from the western section of the district is collected from three residential blocks from Cavell Drive eastwards and flows to the 600 mm trunk sewer for the district. This trunk sewer is then intercepted by the primary weir at the CS outfall, flows north into the Riverbend CS district, via a 250 mm offtake along Parkside Drive. There is also a 450 mm CS which serves the small residential area along Riverbend Crescent east of the Parkside District in the past, this 450 mm pipe would pass directly over the Riverbend CS outfall, and continue west to the Parkside district. It was realized that by constructing an outlet pipe directly below the base of where this 450 pipe passes over the Riverbend CS outfall trunk can be used to more efficiently tie this CS into the Riverbend district directly. This was constructed in the late 1960s, along with a 1 meter high brick weir to ensure the CS collected from the Riverbend Crescent area is captured by the hole in the manhole base. This essentially diverts all CS flow from this Riverbend Crescent area from the Parkside district to the Riverbend district, under DWF conditions.

During dry weather flow (DWF) Parkside district combined sewage flows towards the 600 mm trunk sewer along Assiniboine Avenue, and enters a manhole with a flap gate located within it at the intersection of Assiniboine Ave and Parkside Drive. This manhole flap gate structure is part of the CS outfall for the Parkside district. The flap gate's invert is higher than the invert of all CS pipes entering the manhole, and the flap gate invert acts as the district's primary weir to prevent DWF from spilling to the outfall. All intercepted DWF in this manhole then flows north into a 250 mm interceptor sewer along Parkside Drive that connects to the Riverbend CS system.

During wet weather flow (WWF) events, the CS outfall provides relief to sewers along Assiniboine Avenue. The Parkside CS outfall allows overflow to the Assiniboine River during wet weather flow (WWF) events when the level rises above the flap gate invert. Any flow that exceeds the flap gate invert and

[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.

exerts a significant enough fluid pressure to push open the flap gate is discharged to the river. A sluice gate is installed further downstream at the end of the CS outfall for flap gate maintenance purposes. The flap gate restricts back-up from the Assiniboine River into the CS system under high river level conditions. There is also no flood station at this location; when high river levels are expected and overflow operation will be prevented by the flap gate during a WWF event, temporary flood pumping can be put in place. Under WWF conditions as well, the flow received from the 450 mm CS servicing the Riverbend Crescent area in the Riverbend CS district may spill over the 1 metre brick weir installed in the manhole directly above the Riverbend CS outfall. All flow which spills over this brick weir then continues west to be intercepted in the Parkside district, at which point it may rise above the flap gate invert and discharge to the Assiniboine River.

The single CS outfall to the Assiniboine River for the Parkside District is as follows:

- ID49 (S-MA20008800) – Parkside CS Outfall

1.3.1 District-to-District Interconnections

There are three district-to-district interconnections between Parkside and the surrounding districts. These interconnections are shown on Figure 32 for Parkside district and show the locations where gravity flow crosses from one district to another. Each interconnection is listed in the following subsections.

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Riverbend

- Combined sewage is directed into a 300 mm interceptor pipe at the Parkside outfall gate chamber, and into the Riverbend CS district:
  - Invert at district boundary - 226.79 m (S-MH70005194)

1.3.1.2 District Interconnections

Ferry Road

<u>CS to CS</u>

- The main 750 mm interceptor pipe flows eastbound by gravity on Portage Avenue from Ferry Road into Riverbend:
  - Invert at Riverbend district boundary – 230.65 m (S-MA20008863)
- High Point Manhole (flow is directed into both districts from this manhole)
  - Assiniboine Avenue and Bourkevale Drive – 229.87 m (S-MH70016002)

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

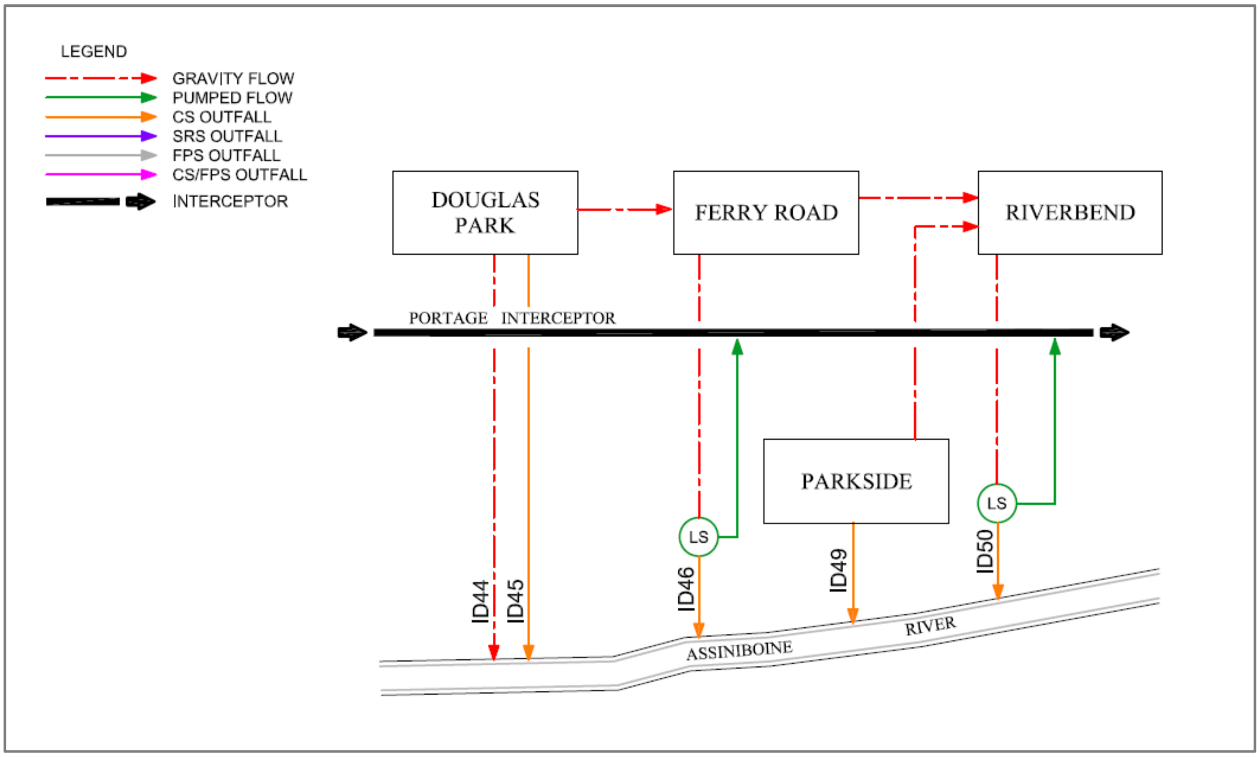


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for Parkside are shown on Figure 32 and are listed in Table 1-1.

Table 1-1. Parkside Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Combined Sewer Outfall (ID49)	S-CG00001138.1	S-MA20008800	750 mm	Circular Invert: 227.00 m
Flood Pumping Outfall	N/A	N/A	N/A	No flood pump station within the district.
Other Overflows	N/A	N/A	N/A	
Main Trunks (from Ferry Road and Riverbend)	S-AC70013535.1 S-MH70007104.1	S-MA20008803 S-MA70019339	750 mm 600 mm	Circular, Invert: 228.21 m Circular, Invert: 228.46 m
SRS Outfalls	N/A	N/A	N/A	No SRS within the district.
SRS Interconnections	N/A	N/A	N/A	No SRS within the district.
Main Trunk Flap Gate	S-MH70005190.2	S-CG00000894	750 mm	Flap Gate size Invert: 228.36 m
Main Trunk Sluice Gate	S-MH20008110.1	S-CG00001138	750 x 750 mm	Sluice Gate size Invert: 227.25 m
Off-Take	S-MH70005190.1	S-MA70013033	250 mm	Circular Invert: 228.17 m
Dry Well	N/A	N/A	N/A	No lift station within the primary CS outfall.
Lift Station Total Capacity	N/A	S-MA70013033 (1)	250 mm (1)	0.049 m^3/s (1)

Table 1-1. Parkside Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station ADWF	N/A	N/A	0.0002 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	No lift station within the primary CS outfall.
Flood Pump Station Total Capacity	N/A	N/A	N/A	No flood pump station within the district.
Pass Forward Flow – First Overflow	N/A	N/A	0.011m^3/s	

Notes:

(1) – Gravity pipe replacing Lift Station as Douglas Park is a gravity discharge district
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	Parkside Drive – 224.40
2	Trunk Invert at Off-Take	228.17
3	Top of Weir	N/A
4	Relief Outfall Invert	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Interconnection (Ferry Road)	228.93
7	Low Basement	231.49
8	Flood Protection Level	229.69

[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 for Parkside was in 2006 with the *Ferry Road and Riverbend Combined Sewer Relief Works* (Wardrop, 2006). This study discussed the possible relief work available for the Ferry Road, Douglas Park, Parkside and Riverbend CS Systems to reduce the incidences of basement flooding.

The majority of Parkside has been separated as part of a large scale sewer relief project which resulted from this 2006 study. This includes the installation of a separate land drainage sewer (LDS) system to collect surface runoff. There are plans to abandon the Parkside CS outfall completely following post separation flow monitoring. All three contracts for the sewer separation portion of the works have been completed.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
32 - Parkside	2006 - Conceptual	Future Work	2013	Sewer Separation Complete	2018

1.5 Ongoing Investment Work

The separation work was completed between 2016 and 2018 and will be integrated into the CSO Master Plan. Post-separation flow monitoring and decommissioning of the Parkside CS outfall is to be completed as future work. There is no further study or construction proposed for the Parkside district at this time.

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 Parkside district are listed in Table 1-4. The proposed CSO control is complete sewer separation. 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 decision to include complete separation of Parkside as part of the CSO and BFR program has removed a large volume of existing land drainage from the CS system, thereby reducing the volume and number of CSOs for the district. The proposed outfall abandonment would eliminate CSO occurrences entirely from the district.

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 Sewer Separation

Sewer separation has been recently completed in the Parkside district as part of the Ferry Road and Riverbend Basement Flood Relief project. Complete separation of Parkside removes a large volume of land drainage runoff from the CS system, thereby reducing the volume and number of CSOs for the district.

The work included installation of a new independent LDS system to collect road drainage. The collected stormwater runoff will be routed through the new LDS via local streets to Winston Drive, east along Parkside Drive and through Jae Eadie Park to a new dedicated LDS outfall discharging to the Assiniboine River.

The flows to be collected after separation will be as follows:

- DWF will remain the same – with it being diverted by gravity to the Riverbend CS LS via the primary weir for the district.
- WWF will consist of sanitary sewage combined with foundation drainage.

This will result in a reduction in combined sewage flow received at Riverbend CS LS after the separation project is complete. It is proposed that future flow monitoring of the district during DWF and WWF is completed to verify that the sewer separation is fully compliant with the modelled removal of all CSOs. A static weir elevation increase may be necessary at the CS diversion to eliminate all occurrences of CSO. Should the flow monitoring confirm the removal of all CSOs occurrences, work to abandon the Parkside CS outfall entirely will be evaluated.

1.6.3 Green Infrastructure

The approach to GI is described in Section 5.2.1 of Part 2 of the CSO Master Plan. 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.

Parkside has been classified as a medium GI potential district. Land use in Parkside is mainly single-family residential with commercial along Portage Avenue. There are also greenspace areas. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, rain gardens, and green roofs. The greenspace areas in the district would be ideal for bioretention 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 master plan projects with long term consideration for implementation on a system wide basis.

1.7 System Operations and Maintenance

Systems 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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers, and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district.

It is recommended to complete a temporary flow monitoring campaign for the district, and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the CS system) extent within the Riverbend district. Should it be confirmed that there is no further CSOs under WWF events, complete decommissioning of the Parkside CS outfall can occur. This will remove the O&M component for this outfall from the City's overall O&M program.

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 model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	11	11	88	77	N/A
2037 Master Plan – Control Option 1	11	8	88	7	SEP

Notes:

Total area is based on the model subcatchment boundaries for the district.
SEP = Separation
% = percent

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-6, are for the hydraulic model simulations using the year-round 1992 representative year applied uniformly. 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 1-6. 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)	2,983	2,979	-	16	0.011 m^3/s
Separation	0	0	2,979	0	TBD
Control Option 1	**0**	**0**	**2,979**	**0**	**TBD**

[a] Pass forward flows assessed up to 5-year design rainfall event. Possible overflow for larger design events to be confirmed.

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entre CS system, and not for each district individually. However, the full capture of overflows volumes for the Parkside district would represent a 100 percent capture rate on a district level.

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 relevant control option with overall program costs summarized and described in Section 3.4 of Part 3A of the CSO Master Plan. 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 1-7. The cost estimates are a Class 5 planning level estimate with a level of accuracy range of minus 50 percent to plus 100 percent.

Table 1-7. Cost Estimates – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost [a]	2019 CSO Master Plan Capital Cost [b]	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance (Over 35-year period) [b]
Sewer Separation	$0	$0	$0	$0
Subtotal	**$0**	**$0**	**$0**	**$0**
Opportunities	N/A	$0	$0	$0
District Total	**$0**	**$0**	**$0**	**$0**

[a] Parkside separation was underway at the time of the Preliminary Proposal Cost development, however all costs for the remaining work for the district was already budgeted within the City of Winnipeg. Therefore the remaining separation costs for the district were omitted from the Preliminary Proposal future cost projections.

[b] Parkside separation has been recently completed and therefore zero costs have been included for the Master Plan capital cost and O&M costs. Actual Annual O&M costs were established as $5,200 and Total cost of $120,000 over the 35-year period.

The estimates include updated construction costs based on level of completion of work to date. The calculations for the CSO Master Plan cost estimate include 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. As there are no capital costs allocated to this district as the work to align with the CSO Master Plan is complete, there has also been no capital costs in this district allocated to GI or RTC opportunities.
- 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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Opportunities	A fixed allowance of 10 percent has been included for program opportunities	Preliminary Proposal estimate did not include a cost for GI opportunities	No costs allocated opportunities as capital costs for district removed.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Lifecycle Costs	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 complete separation of the Parkside district has achieved the 100 percent capture figure, and no further work in this district will be required to meet the future performance target. It is recommended to complete post separation flow monitoring and model calibration to confirm the performance.

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 as part of the CSO Master Plan and is included as part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-9.

A specific acceptable risk for the Parkside district is connected to the complete sewer separation work already implemented within this district. As a result, no costs for GI opportunities have been allocated, since this cost is a percentage of future capital costs. However, this does not restrict any GI or RTC opportunities from occurring in this district, as in this situation the 10% allowance attributed to other districts will be utilized.

Table 1-9. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-

Table 1-9. 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
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

Wardrop. 2006. *Ferry Road and Riverbend Combined Sewer Relief Works*. Prepared for the City of Winnipeg Water and Waste Department. November.

LEGEND

- Critical Elevation
- CSO Outfall
- Low CS Manhole
- Inter-System Connection
  - CS - WWS
- District Boundary Crossing
  - CS
  - WWS
- Force Main
- Street
- District Boundary
- Watercourse
- Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

Sewer Separation - Complete

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 32
District Overview Map
Sewer District: Parkside
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE4\PARKSIDE\PARKSIDE_DISTRICT_OVERVIEW_MAP.MXD DT072410 8/12/2019 9:36:27 AM

CSO Master Plan

Polson District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Polson District Plan
Revision:	03
Date:	August 20, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	Polson_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	09/14/2018	DRAFT for City Comment	DT	SB MF SG	
1	02/15/2019	DRAFT 2 for City Review	JT	SG	MF
2	07/2019	Final Draft Submission	DT/MF	MF	MF
3	08/20/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Polson District

1.1 District Description

Polson district is located in the northern section of the combined sewer (CS) area west of the Red River and north of St Johns district. Polson is approximately bounded by Church Avenue and Atlantic Avenue to the south, Tinniswood Street and McPhillips Street to the west, Polson Avenue, Carruthers Avenue and McAdam Avenue to the north, and the Red River to the east.

The district is mainly a residential area with a mix of single and two-family land use. The single-family homes are located in the west, east and north part of the district, while the two-family homes are located in the south-central portion around Main Street. Approximately 20 ha of greenspace is distributed throughout the district at schools and various parks and playgrounds.

The Canadian Pacific Railway (CPR) Winnipeg Beach passes through the Polson district parallel with Sinclair Street running north-south. Regional transportation routes in the district include Main Street, Salter Street, McGregor Street, Arlington Street and McPhilips Street in a north-south direction and Inkster Boulevard in the east-west direction.

1.2 Development

A portion of Main Street is located within the Polson District. Main Street is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Main Street is to be promoted in the future.

1.3 Existing Sewer System

Polson district encompasses an approximate area of 242 ha[1] based on the district boundary and includes a CS system and a storm relief sewer (SRS) system. This district does not include any areas that may be identified as LDS separated or separation ready. The interceptor pipe from the Polson district also receives intercepted combined sewage flow from the Munroe sewage pump station (SPS) via river crossing across the Red River. The flow from Munroe SPS connects into the interceptor pipe for the Polson district, immediately upstream of the diversion off-take pipe for the Polson outfall.

The CS system includes a diversion structure, flood pump station (FPS) and outfall gate chamber. The CS system drains towards the Polson CS outfall and diversion chamber, located at the eastern end of Polson Avenue and Scotia Street adjacent to the Red River. There are three primary routes for CS to flow to the diversion chamber. A 1750 mm by 2175 mm CS trunk collects all flow from the district areas west of Main Street and runs primarily along Polson Avenue. A 750 mm CS services the northeastern areas of Polson east of Main Street which runs south along Scotia Street. Finally, a 750 mm CS services the southeastern section of Polson from Emsue Street to Scotia Street and also runs north along Scotia Street. At the outfall, combined sewage is diverted to the Polson secondary interceptor and back to the Main Street interceptor, or may be discharged by gravity/via the FPS adjacent to the CS outfall directly into the Red River. Intercepted combined sewage flow from the Munroe district enters the Polson district from across the Red River via a 450mm/300mm steel force main river crossing, and discharges into the 750 mm diameter secondary interceptor adjacent to the flood pump station, which also received the intercepted combined sewage from the Polson district as a whole. The SRS system within the Polson district includes various interconnections to the CS system and an outfall gate chamber. The SRS system is installed throughout most of the district and connects to the CS system via various interconnections which consist of overflow pipes and weirs. During runoff events, the SRS system provides relief to the CS system in the Polson district. Most catch basins are still connected into the CS system, so no partial

[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.

separation has been completed and the SRS system acts as an overflow conduit for the CS to prevent basement surcharge. The SRS system discharges directly to the Red River through the Inkster SRS outfall located near the intersection of Inkster Boulevard and Scotia Street. Upstream of the Inkster SRS outfall is an SRS offtake pipe which will divert all collected CS in the SRS system into the Polson secondary interceptor and back into the CS system, under DWF and minor WWF conditions. A flap gate and sluice gate is installed on the Inkster SRS outfall pipe to control backflow into the SRS system.

During dry weather flow (DWF), the SRS is not required; sanitary sewage is diverted by the weir within the Polson FPS, through a 500 offtake to the 750 mm Polson secondary interceptor pipe and back to the Main Street interceptor by gravity and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), any flow that exceeds the diversion capacity overtops the weir and is discharged through the gate chamber to the Polson CS outfall to the Red River. Sluice and flap gates are installed on the CS outfall to prevent back-up of the Red River into the CS system. When the Red River levels are particularly high the flap gate prevents gravity discharge from the Polson CS outfall. Under these conditions the excess flow is pumped by the Polson FPS to a point in the Polson CS Outfall downstream of the flap gate, where it can be discharged to the river by gravity.

The two outfalls to the Red River (one CS, and one SRS) are as follows:

- ID30 (S-MA00017967) – Polson CS Outfall
- ID32 (S-MA00017939) – Inkster SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Polson and the surrounding districts. Each interconnection is shown on Figure 33 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections - Downstream of Primary Weir

Jefferson E

- The 2250 mm Main Interceptor flows north by gravity on Main Street from Polson district into Jefferson East district:
  - Invert at Jefferson East district boundary 218.03 m (S-MA70008112)

St Johns

- The 750 mm Interceptor flows west by gravity on Polson Street from Polson district into St Johns district into the 2250 mm Main Interceptor on Main Street:
  - Invert at St Johns district boundary 219.54 m (S-MA00018028)

1.3.1.2 Interceptor Connections - Upstream of Primary Weir

Munroe

- Two force mains river crossings flow by gravity from the Munroe diversion chamber and cross the Red River to connect to the Polson CS diversion chamber on Polson Avenue, where it flows to the Main Interceptor:
  - 450 mm force main sewer on Polson Avenue – 222.5 m (S-MA70017149)
  - 300 mm force main sewer on Polson Avenue – 222.5 m (S-MA70017147)

1.3.1.3 District Interconnections

St Johns

CS to CS

- The main 1675 mm by 2150 mm CS trunk in Polson district flows by gravity into St Johns district at the corner of Polson Avenue and Main Street:
  - Invert at Polson district boundary 222.99 m (S-MA00009348)
- The main 1750 mm by 2175 mm CS trunk flows east by gravity back into Polson district at the corner of Polson Avenue and Main Street:
  - Invert at St Johns district boundary 223.07 m (S-MA00009318)
- A 925 mm by 1200 mm CS flows southbound on Main Street servicing sections of Polson district and crosses into St Johns district where it connects to the main CS trunk at the corner of Polson Avenue and Main Street:
  - Invert at St Johns district boundary 223.45 m (S-MA00009340)
- High point manhole:
  - Tinniswood Street – 229.48 m (S-MH00008542)
  - Radford Street – 229.45 m (S-MH00008556)
  - Monreith Street at Church Avenue – 229.24 m (S-MH00008543)
  - Robertson Street at Church Avenue – 228.90 m (S-MH00010474)
  - Kildarroch Street – 229.08 m (S-MH00010481)
  - Airlies Street at Church Avenue – 228.78 m (S-MH00010493)
  - Minnigaffe Street at Church Avenue – 229.271 m (S-MH00010536)
  - Penninghame Street at Church Avenue – 228.82 m (S-MH00010604)
  - Luxton Avenue – 228.34 m (S-MH00011069)
  - Atlantic Avenue – 227.71 m (S-MH00014025)
  - Bannerman Avenue at Emslie Street – 228.19 m (S-MH00014033)
  - Cathedral Avenue at Emslie Street – 227.68 m (S-MH00014021)
- High sewer overflow:
  - Dalton Street at Machray Avenue – 229.35 m (S-MH00010407)
  - Bannerman Avenue – 227.96 m (S-MH00006413)

SRS to CS

- A 750 mm SRS flows northbound by gravity on Salter Street and connects to the CS system in Polson district at the intersection of Salter Street and Polson Avenue:
  - Invert at Polson district boundary 224.55 m (S-MA00009212)
- A 450 mm SRS provides relief from the manhole at the intersection of Atlantic Avenue and Aikins Street in St Johns district and flows by gravity to connect to the main CS in Polson district:
  - Invert at Polson district boundary 224.21 m (S-MA00009270)
- A 450 mm SRS flows by gravity from a manhole at the intersection of Main Street and Luxton Avenue where it relieves the CS and connects to the 925 mm by 1200 mm CS in Polson district:
  - Invert at Polson district boundary 224.05 m (S-MA00009352)

SRS to SRS

- A 375 mm SRS flows southeast by gravity at Cathedral Avenue and Emslie Street from Polson district into St Johns district:

- Invert at St Johns district boundary 225.69 m (S-MA00016728)
- A 450 mm SRS flows south by gravity on Emslie Street from Polson district into St Johns district:
  - Invert at St Johns district boundary 225.43 m (S-MA00015777)
- A 750 mm SRS relieves the CS system on Machray Avenue in Polson district and flows by gravity southbound on Kildarroch Street into St Johns district where it connects to the main 2900 mm SRS on Mountain Avenue:
  - Invert at St Johns district boundary 225.20 m (S-MA00012123)

Jefferson West

CS to CS

- High point manhole:
  - Machray Avenue at McPhillips Street – 228.74 m (S-MH00007230)

Jefferson East

CS to CS

- High point manhole
  - Polson Avenue – 229.11 m (S-MH00009095)
- High sewer overflow:
  - McGregor Street at Carruthers Avenue – 228.60 m (S-MH00006709)

SRS to SRS

- An 2950 mm SRS flows by gravity on Inkster Boulevard from Jefferson East district into Polson district SRS system:
  - Invert at Polson district boundary 223.00 m (S-MA00008238)

SRS to CS

- An 1800 mm SRS relieves the main CS trunk on Polson Avenue and flows by gravity northbound on Airlies Street from Polson district to Jefferson East district. It connects with the Jefferson East CS network at the corner of Inkster Boulevard and Airlies Street before continuing onto Inkster Boulevard:
  - Invert at Jefferson East district boundary 224.01 m (S-MA00011342)

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

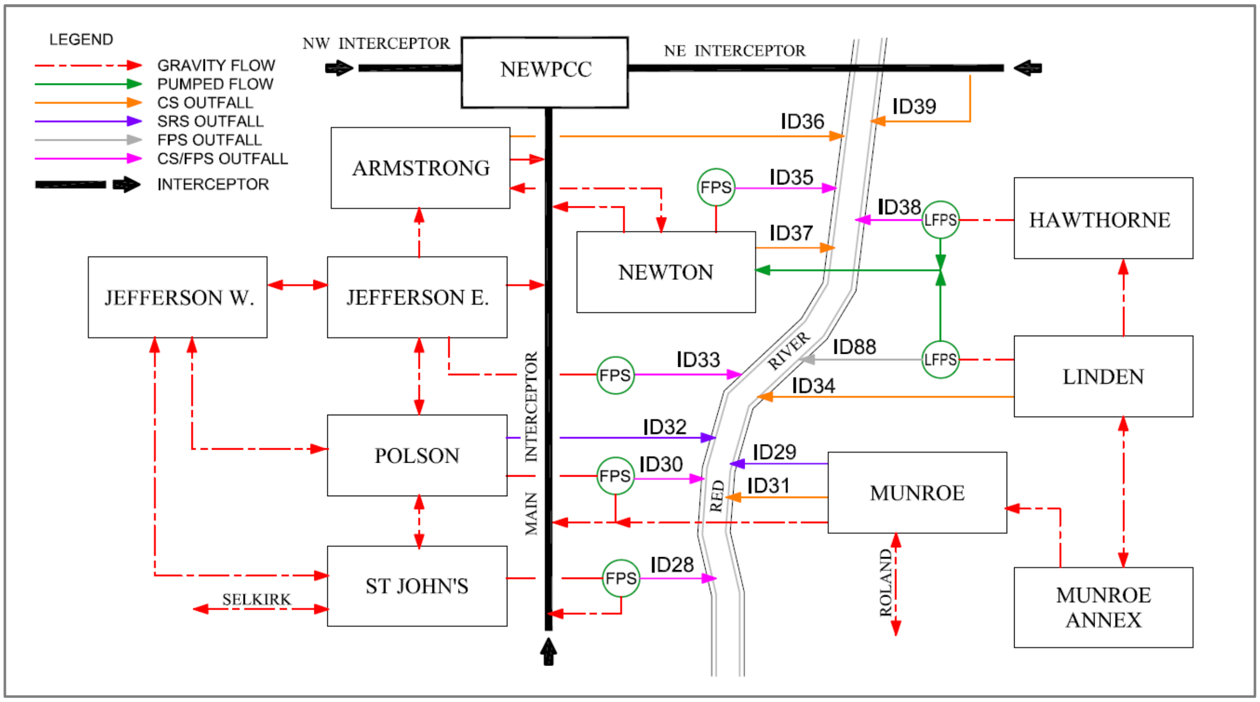


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 33 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 (ID30)	S-AC00007716.1	S-MA00017967	1750 x 2175 mm – 1800 mm	Red River Invert: 222.38 m
Flood Pumping Outfall (ID30)	S-AC00007716.1	S-MA00017967	1750 x 2175 mm – 1800 mm	Red River Invert: 222.38 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	Polson Flood PS.1	S-MA70016460	1750 x 2175 mm	Egg-shaped Invert: 222.38 m
SRS Outfalls (ID32)	S-AC00007709.1	S-MA00017939	2900 mm	Red River Invert: 220.60 m
SRS Interconnections	N/A	N/A	N/A	38 SRS - CS
Main Trunk Flap Gate	S-CG00001045.1	S-CG00001045	2000 mm	Invert: 222.92 m
Main Trunk Sluice Gate	S-CG00001046.1	S-CG00001046	2000 x 2000 mm	Invert: 222.76 m
Off-Take	S-AC70007899.1	S-MA00017968	500 mm	Invert: 222.53 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	S-MA00017968 (1)	500 mm (1)	1.578 m^3/s (1)
ADWF	N/A	N/A	0.170 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	
Flood Pump Station Total Capacity	N/A	N/A	1.82 m^3/s	1 x 0.74 m^3/s 2 x 0.54 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.298 m^3/s	

Notes:

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments

[(1)] – gravity pipe replacing the Lift Station as Polson is a gravity discharge district

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	Polson – 223.67 Inkster – 223.67
2	Trunk Invert at Off-Take	222.53
3	Top of Weir	223.12
4	Relief Outfall Invert at Flap Gate	221.85
5	Low Relief Interconnection (S-TE70023427)	223.98
6	Sewer District Interconnection (St Johns)	222.96
7	Low Basement	229.82
8	Flood Protection Level	229.04

[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 the Polson district was the Flood Relief Study (IDE, 1980). An SRS system was installed in the district as a result of this study. No other work has 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 Polson 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
33 – Polson	1980 I.D. Engineering	Future Work	2013	SRS Relief Sewer Installed	N/A

Source: Report on Flood Relief Study, 1980

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Polson 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 Polson sewer district are listed in Table 1-4. The proposed CSO control projects will include gravity flow control and an alternative floatable management approach. 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	-	-	✓	-	-	-	-	-	✓	✓	✓ [a]

Notes:

- = not included
✓ = included

[a] = proposed alternative floatables management approach

The existing SRS system is suitable for use as latent storage. An existing drain from the SRS system to the CS system already provides the necessary dewatering of the latent storage by gravity. Further improvements in the latent storage arrangements could be made with the addition of a latent flood pumping station (LFPS) but it was determined this would not be required to meet the Control Option 1 performance target.

The existing CS system was found to already provide sufficient in-line storage capture based on the outfall and CS LS elevations relative to the Red River. From modeling the sewer system in the Polson district, it was found that the NSWL at this location was well above the primary weir. The NSWL was found to be approximately 100mm above the half pipe diameter height, which would have been provided by the control gate installation. The NSWL bears against the flap gate on the CS outfall at this location, and essential behaves as a weir with this height under these conditions. Under these conditions the installation of a control gate would not provide any further improvement to the volume of in-line storage volume capture, and was therefore not recommended as a solution for the Polson district. It should be noted that if modifications to the modelling methods dictate a river level other than the NSWL be applied this should be further evaluated. If it is found through these modifications that the river level no longer impacts CS discharges from this outfall, then further evaluation of the potential to construct a control gate to provide additional in-line storage should be completed.

The Polson district discharges to the interceptor by gravity; therefore, it will also require a method of gravity flow control to optimize and control the discharge rate to the interceptor for future dewatering Real Time Controls (RTCs).

Floatable control will be necessary to capture any undesirable floatables in the sewage overflows. Floatables are typically captured via a screening facility, however, the hydraulic constraints within the Polson district do not allow sufficient positive head to be achieved and an alternative floatables management approach will be necessary.

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 Gravity Flow Control

Polson district does not include a LS and discharges to the Main Interceptor by gravity. A flow control device will be required to control and monitor the diversion rate for future RTC and dewatering. The controller will include flow measurement and a gate to control the discharge flow rate. Due to the interaction with the upstream Munroe district, this control would also have to account for the pumped flows from the Munroe district. Any flow restriction will have to be fully assessed to minimize the risk to both districts.

A standard flow control device was selected as described in Part 3C. This has been taken as part of the City's future vision to develop a fully integrated CS system network and will be needed to review flows during spatial rainfall WWF scenarios. The CSO Master Plan assessment utilized a uniform rainfall event and no further investigative work has been completed within the CSO Master Plan.

The gravity flow controller would be installed at an optimal location on the connecting sewer between the existing diversion chamber and the Main Street interceptor. Figure 33-01 identifies a conceptual location for flow controller installation. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction. The work proposed will take place within the boulevard of a minor residential collector street, with minimal disruption to the local area expected.

A gravity flow controller has been included as a consideration in developing a fully optimized CS system as part of the City's long-term objective. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

1.6.3 Floatables Management

Floatables management for the Polson district, due to the existing hydraulic constraints, is proposed to be an alternative floatables management approach. This approach is to ensure that the proposed required floatable management requirements outlined within the Environment Act Licence 3042 can be maintained.

This alternative approach to floatables management will be achieved by targeting floatables source control. This will be achieved by implementing more focused efforts towards street cleaning and catch-basin cleaning, to remove floatable material from surface runoff before it enters the combined sewer system. The second broad component of this alternative approach will focus on public education in an effort to reduce the sanitary components from ever entering plumbing systems. This is expected to achieve similar or better results while eliminating the end-of-pipe screening. The proposed approach will be similar to the program currently carried out in the City of Ottawa to meet their CSO mitigation requirements.

The alternative approach will be further investigated and demonstrated during the interim period between the submission of the CSO Master Plan (August 2019) and the revised CSO Master Plan submission (April 2030), and is discussed in further detail in Part 2 of the CSO Master Plan. It is recommended that as part of this work these measures will be undertaken in the Polson district, due to screening limitations mentioned above.

1.6.4 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 applicable GI controls.

Polson has been classified as a medium GI potential district. The district is mainly a residential area with a mix of single and two-family land use. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels.

1.6.5 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.

The flow controller will require the installation of a chamber and flow control equipment. Monitoring and control instrumentation will be required. The flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required.

The alternative floatable management control is based on implementing additional operating and maintenance measures, in an effort to match the performance of the capital construction projects to meet the floatables management requirements. As such dedicated additional operating and maintenance costs should be allocated to this district. The goal however is for this work to overall be more cost effective from a life cycle perspective, considering the upfront capital and operating and maintenance costs associated with screening facilities.

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 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	242	242	10,500	70	N/A
2037 Master Plan – Control Option 1	242	242	10,500	70	N/A

Notes:

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 1-6 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. Note that as a result of the CSO Master Plan Assessments, all Control Options which would provide a volume capture benefit were not recommended. As a result, there be no improvements in terms of overflow reduction. Due to issues surrounding dewatering of the district, the performance results are in fact increased above the baseline results. This is further detailed below.

Table 1-6. District 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 [b]
Baseline (2013)	436,714	455,282	-	20	0.373 m^3/s
In-line Storage	317,812 [a]	N/A [c]	N/A [c]	N/A [c]	N/A [c]
Off-line Storage		N/A [c]	N/A [c]	N/A [c]	N/A [c]
Tunnel Storage		N/A [c]	N/A [c]	N/A [c]	N/A [c]
Control Option 1	**317,812**	**455,282 [d]**	**N/A [d]**	**20**	**0.295 m^3/s**

[a] In-line, Off-line and Tunnel storage not simulated independently during the Preliminary Proposal assessments.

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

[c] This control option not recommended as part of the Master Plan assessment.

[d] Modelled increase in overflow volume found due to dewatering constraints in the Polson district, interaction with adjacent districts and high water levels within the Main Interceptor during peak rainfall events.

The district performance summary indicates the high level of interaction between the Polson district and the existing CS system, resulting in erroneous performance. This is primarily due to the additional CS contained within the Main Interceptor at the point the Polson district ties in. All of the additional volume capture from the solutions recommended throughout the CSO Master Plan result in insufficient capacity available in the Main Interceptor to accommodate the captured volume from the Polson district. As a result from the system-wide modelling assessments the volume captured would surcharge within the Polson secondary interceptor, and ultimately spill over the primary weir and result in CSOs. The issue that must be corrected to allow for the existing in-line storage arrangement to provide volume capture is to ensure the Main Interceptor has sufficient capacity to accommodate this flow. Therefore the Polson district should be prioritized to be implemented in tandem with Real Time Control (RTC), as part of the dewatering strategy. By implementing RTC with the dewatering strategy, neighboring districts dewatering can be delayed sufficiently to allow the volume capture from the Polson district to be collected within the interceptor system and sent to treatment.

The percent capture performance measure is not included in Table 1-6, 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 1-7. The cost estimates are AACE Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-7. 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 (Over 35-year period)</th></tr>
<tr><td>In-line Control Gate</td><td rowspan="2">N/A [a]</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Screening</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Latent Storage</td><td>$1,670,000</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Gravity Flow Control</td><td>N/A</td><td>$1,290,000</td><td>$34,000</td><td>$740,000</td></tr>
<tr><td>Off-line Tank Storage</td><td>$16,430,000</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Off-line Tunnel Storage</td><td>$7,400,000</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Floatables Management Allowance</td><td>N/A</td><td>$2,540,000 [b]</td><td>$40,000</td><td>$860,000 [b]</td></tr>
<tr><td>Subtotal</td><td>$25,490,000</td><td>$3,830,000</td><td>$74,000</td><td>$1,600,000</td></tr>
<tr><td>Opportunities</td><td>N/A</td><td>$380,000</td><td>$7,000</td><td>$160,000</td></tr>
<tr><td>District Total</td><td>$25,490,000</td><td>$4,210,000</td><td>$81,000</td><td>$1,760,000</td></tr>
</table>

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for the In-Line Storage and Screening items of work found to be $2,330,000 in 2014 dollars

[b] Cost allowance to account for the alternative floatable management measures. This allowance is based on a typical district control gate cost.

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.
- Refinements in solutions selected from analysis during Master Plan phase.
- 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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Removal of Control Gate	The Master Plan assessment found that in-line storage was sufficiently provided by the existing outfall based on the river level in that location.	
	Removal Of Screening	Screening determined to not be feasible due to hydraulic constraints.	
	Alternative Floatables Management	Added to Master Plan cost, assumed to be comparable to typical control gate projected cost.	
	Removal Of Latent Storage	Minor latent storage arrangement currently in place by gravity, therefore no cost added to Master Plan	
	Removal Of Off-line Tunnel Storage	The Master Plan assessment found that off-line tunnel storage was not a preferred control solution for CO1.	
	Removal Of Off-line Tank Storage	The Master Plan assessment found that off-line tank storage was not a preferred control solution for CO1.	
Opportunities	A fixed allowance of 10 percent has been included for program opportunities such as Green Infrastructure.	Preliminary estimate did not include a cost for 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 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, a future performance target of 98 percent capture for the representative year measured on a system-wide basis was evaluated. This target will permit the number of overflows and percent capture to vary by district to meet 98 percent capture. Table 1-9 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 Polson district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. The interactions with upstream Jefferson West SRS system would result in continued CSOs at the Polson district (via the Inkster SRS outfall) and this would require assessment and quantifying prior to selection of appropriate future control options. Off-line storage was previously recommended for the district as part of the Preliminary Proposal, and could be utilized once the interactions with the Jefferson West SRS is evaluated. Focused use of green infrastructure, and reliance on said green infrastructure as well can provide volume capture benefits and could be utilized to meet future performance targets.

A future monitoring program is recommended to establish the flow linkage between Polson, Jefferson West, Jefferson East and Munroe districts as well as the Main Interceptor sewer.

Table 1-9. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Off-line Storage (Tank or Tunnel) • Increased use of GI

The control options for the Polson district have been aligned for the requirement to provide screening on each of the primary outfalls and not specifically for the 85 percent capture performance target on a system wide basis, although district hydraulic issues result an alternative floatables management approach being recommended. The gravity discharge and interaction with the upstream Munroe and Jefferson West districts, and the downstream Main Interceptor sewer system result in a negative impact at this location, once all other Control Option 1 proposals have been implemented.

The cost for upgrading to meet an enhanced performance level 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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-10.

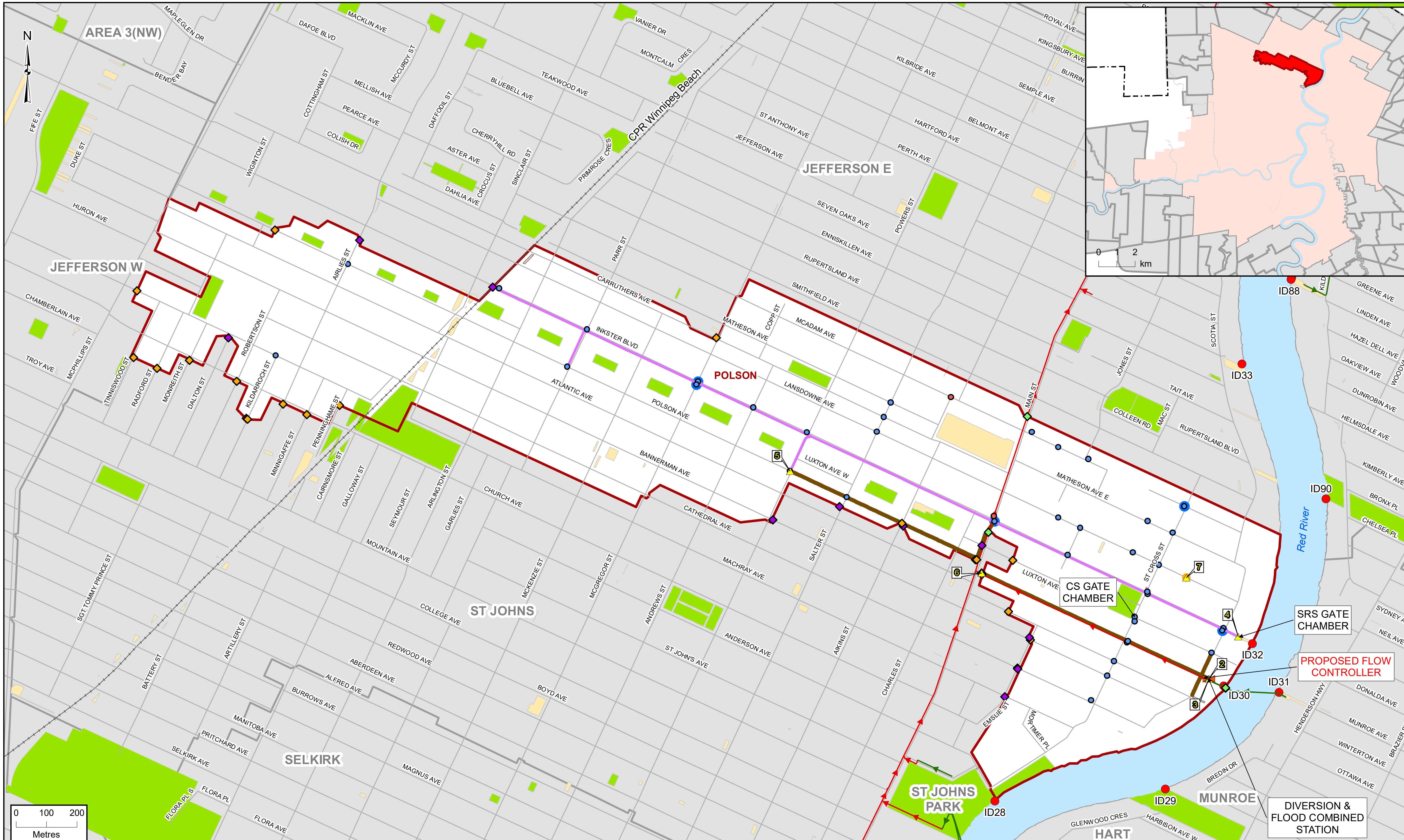
Table 1-10. Control Option 1 Significant Risks and Opportunities

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	-	-	-	-	-	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	-	-	-	-
8	Program Cost	-	-	-	-	-	-	-	O
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	-	O	O	R
12	Operations and Maintenance	-	-	-	-	-	R	O	R
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	-	O	O	R

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

1.12 References

I.D. Engineering. 1980. Flood relief study - St. John's and Polson districts and the Sisler ward. Prepared for the City of Winnipeg.



LEGEND

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

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

District Boundary Crossing
- CS
- SRS
- WWS

- Existing Latent Storage Limit
- Extent of Existing In-line Storage
- Interceptor Sewer
- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace
- City Owned Land

CSO MASTER PLAN PROPOSED SOLUTIONS

Note: Alternative Floatables Management Approach to be tested prior to implementation.

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 33
District Overview Map
Sewer District: Polson
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\POLSON\POLSON_DISTRICT_OVERVIEW_MAP.MXD DT072410 7/29/2019 9:46:07 AM

LEGEND

- Primary Weir
- Critical Elevation
- CSO Outfall
- Manhole
- Flap Gate
- Sluice Gate
- Pump Location
- Force Main
- Sewer By Type
  - CS
  - WWS
- Pump Station Type
  - Diversion & Flood Combined Station
- Land Parcel

CSO MASTER PLAN PROPOSED SOLUTIONS

- Flow Controller

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 33-01
Flow Controller
Sewer District: Polson
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\POLSON\POLSON_DISTRICT_DETAIL_POLSONAV.MXD DT072410 7/29/2019 9:44:31 AM

CSO Master Plan

River District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	River District Plan
Revision:	03
Date:	August 18, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	River_Plan_Final_CO1MP_08182019

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	07/2018	Version 1 DRAFT	SG	ES	
1	03/22/2019	Version 2 DRAFT	JT	SG	MF
2	07/2019	Final Draft Submission	DT	MF	MF
3	08/18/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. River District

1.1 District Description

River district is situated immediately south of the junction of the Assiniboine River and Red River, and is just south of downtown Winnipeg. The boundaries are the Assiniboine River to the north and west, the Red River to the east, and the Jessie combined sewer (CS) district to the south. Jessie Avenue and Daly Street act as the southern border for the district. River district is three-quarters residential and one-quarter commercial land use, with the commercial businesses located along Pembina Highway and Osborne Street. River district is a high traffic and densely populated area, with the presence of Osborne Village, which includes many restaurants, shops, and services.

The major transportation routes are Pembina Highway, Donald Street, and Osborne Street; each of which travel north into downtown Winnipeg or south into the Jessie district. The Canadian National Railway Mainline passes over Osborne Street and parallel with Donald Street. It travels north towards The Forks in the Bannatyne district and south into Jessie district.

The residential section of River district is a mix of single-family houses to the west and high-rise apartments predominately based along the Assiniboine River. A major non-residential feature is the Winnipeg Winter Club, which is located on the southeastern corner of River Avenue and Donald Street. The Southwest Bus Rapid Transit Corridor travels along the eastern boundary of the River District and ends at Queen Elizabeth Way.

Approximately 21 ha of the River district is made up of greenspace, which includes Gerald James Lynch Park, Fort Rouge Park, and Mayfair Park East and West, all located on River Avenue. South Point Park is located in the northern corner of the district.

1.2 Development

River district includes a significant portion of the Osborne Village area, and the potential for redevelopment and further densification in the future is high. Redevelopment within this area could impact the CS and will be investigated on a case-by-case basis for potential impacts to the combined sewer overflow (CSO) Master Plan. All developments within the CS districts are mandated to offset any peak combined sewage discharge by adding localized storage and flow restrictions, in order to comply with Clause 8 of the Environment Act License 3042.

The Southwest Bus Rapid Transit Corridor is also located along the eastern boundary of the River District. Existing land adjacent to this transit corridor will be prioritized to be developed into a higher density, mixed-use community, to align with Transit Oriented Development (TOD) principles.

A portion of Pembina Highway and Osborne Street are located within River district. These streets are identified as Regional Mixed Use Corridors as part of the Our Winnipeg future development plans. As such, focused intensification along Pembina Highway and Osborne Street is to be promoted in the future.

1.3 Existing Sewer System

The River district has an approximate area of 130 ha[1] based on the district boundary. The district is serviced by both a CS system and storm relief sewer (SRS) system. There is a small section serviced by a land drainage sewer (LDS). There is no separated or separation ready areas.

[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.

River district receives the sewage from the Jessie district through dual 300 mm force mains that connect into the 600 mm secondary interceptor pipe on Clarke Street. The Clarke Street secondary interceptor then connects to the CS trunk on River Avenue. As a result the intercepted combined sewage from the Jessie district is intercepted once more by the primary weir in the River district. The River district also receives pumped combined sewage flow from the Marion district through a 500 mm force main. The Marion LS force main connects into the Mayfair LFPS force main downstream of the LFPS.

The CS system includes a combined lift and flood pump station (LFPS), one combined FPS and CS outfall and one SRS outfall. All domestic wastewater and CS flows collected in River district are routed to Mayfair Avenue, where the Mayfair LFPS and outfall are located. Sewage primarily flows through the main 1000 by 1500 mm CS trunk that runs eastbound on River Avenue. All minor CSs within River district connect to the main CS trunk including flow from Jessie district. The force main from Jessie connects to this main CS at the eastern edge of River Avenue. A CS varying in size runs along Nassau Street North collecting combined sewage from the south western part of the River district. All other streets include minor CSs that flow by gravity towards the main CS trunks and Mayfair LFPS. The height of the existing primary weir in the Mayfair LFPS is high enough that it negates the need to add a control gate to utilize additional in-line storage. A level of in-line storage is provided by the existing primary weir height. This is discussed in further detail in Section 1.6.3 below.

During heavy rainfall events, the SRS system provides relief to the CS system in the River district. Most catch basins are still connected into the CS system, so the SRS acts as an overflow conduit for the CS system with the captured CS flow continuing to the Mayfair CS LS. The SRS system was completed in 1967, with a main 1650 mm trunk along Scott Street, and connects to a dedicated SRS outfall pipe at Fort Rouge Park off River Avenue. A flap gate and sluice gate installed along the outfall pipe prevents river water from backing up into the SRS system under high river level conditions. Latent storage pumps are located upstream of the flap gate. Where high river levels keep the flap gate closed, the pumps keep the SRS dewatered following wet weather events. The pumps discharge upstream of the River district primary weir, but are prevented from dewatering in the event of high levels in the River CS System. SRS sub-trunks along River Avenue, Clarke Street, Roslyn Road, and Stradbrook Avenue branch out from the main SRS trunk sewer. In addition, there are SRS which relief existing combined sewers on Wellington Crescent, Wardlaw Avenue, and Gertrude Avenue, and re-connect to the CS system on the CS trunk on Osborne Street.

A minor land drainage sewer (LDS) system within the River district services a portion of the Southwest Transit Corridor. The majority of this LDS connect directly to the River LFPS where both the overflow from the CS system and the LDS flow gravity through a combined outfall pipe to the Assiniboine River. A portion of the LDS system installed with the Southwest Transit Corridor also ties into the existing SRS system. There is also localized LDS installation work installed in the southeast corner of the River district servicing businesses surrounding the Osborne Junction. This LDS work also eventually ties into the SRS system.

During dry weather flow (DWF), intercepted sewage flows are directed by the primary weir to the Mayfair LFPS and pumped across the Assiniboine River via a 500 mm and 600 mm dual river crossing to connect to the Main interceptor in the Bannatyne district. The Main interceptor then eventually reaches the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), any flow that exceeds the diversion capacity of the primary weir is discharged into the River CS/FPS outfall, where it flows to the Red River by gravity. Sluice and flap gates are installed on the CS outfall to prevent back-up of the Assiniboine River into the systems 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 within the LFPS and redirected to a point in the combined outfall downstream of the flap and positive gates allowing gravity discharge to the river once more. Note that the Mayfair LFPS utilizes the same pumps for both pumping intercepted CS to the river crossing as mentioned above, and for redirecting excess CS to the CS outfall under high river level conditions. A small LDS system also discharges to the LFPS, collecting storm flows from a small area along Stradbrook Avenue, and discharges to the Mayfair LFPS downstream of the primary weir.

The two outfalls (one CS and one SRS) to the Assiniboine River are as follows:

- ID70 (S-MA70004387) – River CS/FPS Outfall
- ID67 (S-MA60020193) – Fort Rouge Park SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between the River district and the surrounding districts. Each interconnection is shown on Figure 34 and shows gravity and pumped flow from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Bannatyne

- Two force mains (600 mm and 500 mm diameter) convey sewage across the Assiniboine River at Queen Elizabeth Way and Main Street flow out of River district into Bannatyne district:
  - Invert at Queen Elizabeth Way in Bannatyne district, flowing from River District – 227.72 m
  - Invert at Queen Elizabeth Way in Bannatyne district, flowing from River District – 227.72 m

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Jessie

- The Jessie CS LS has two 300 mm force mains that convey flow into River district from Jessie district:
  - Southwest Transit Corridor and Jessie Avenue invert at district boundary – 230.41 m

Marion

- A 500 mm force main conveys sewage from Marion CS LS and across the Red River at Queen Elizabeth Way and St. Mary's Road flowing from Marion district into River district:
  - Invert at Queen Elizabeth Way in River district, flowing from Marion district – 225.06 m

1.3.1.3 District Interconnections

Jessie

<u>CS to SRS</u>

- A 450 mm SRS discharges into Jessie district CS system at the intersection of Jessie Avenue, between Pembina Highway and Osborne Street:
  - Southern River District SRS Tie-In – 224.35 m (S-MA70010953)
- A 350 mm SRS in the River district discharges into Jessie CS system by gravity flow at the intersection of Corydon Avenue and Daly Street:
  - Corydon Avenue SRS Tie-In – 228.353 m (S-MH60008961)
- A 250 mm SRS in the River district CS discharges into Jessie CS system by gravity flow at the intersection of McMillan Avenue and Daly Street:
  - McMillan Avenue SRS Tie-In – 228.32 m (S-MH70016737)
- High Sewer Overflow (SRS overflow pipe connects River's CS to Jessie's CS system).
  - Wellington Crescent & Gertrude - 229.06 m (S-MH60017449)

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

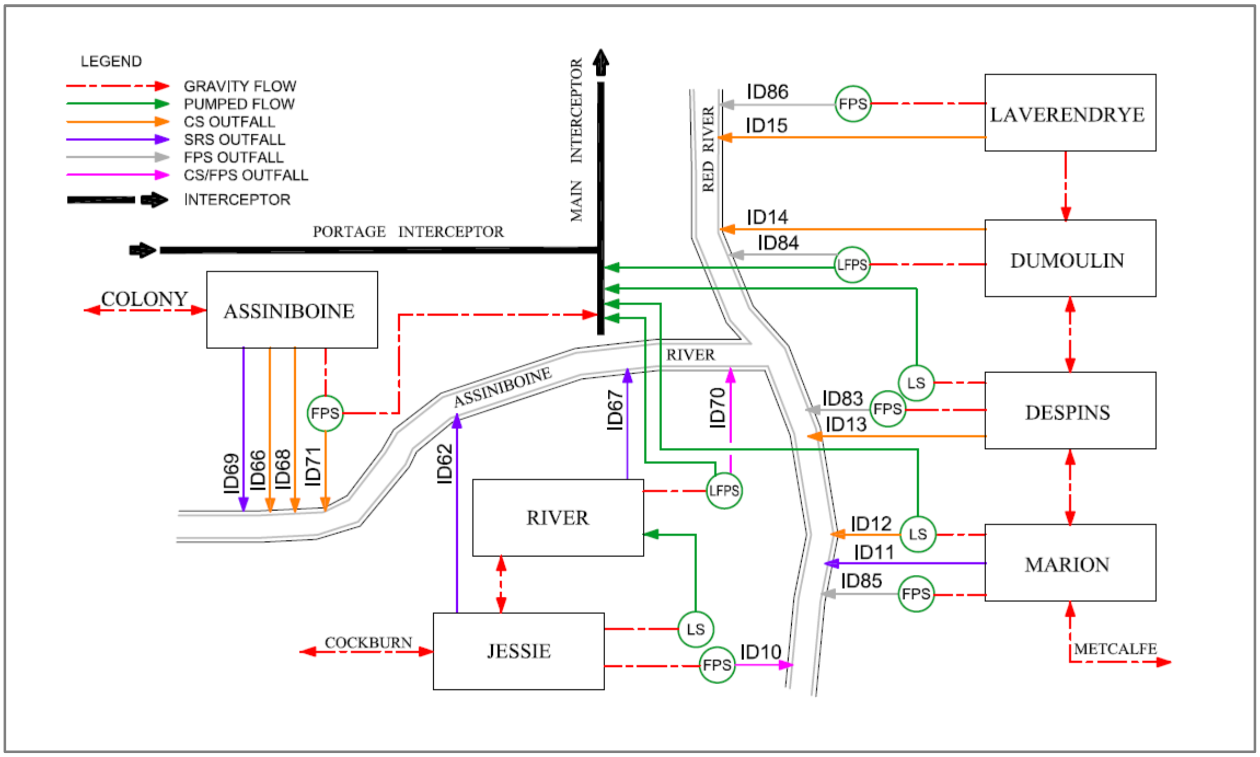


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 34 and are 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 (ID70)	S-TE70001756.1	S-MA70004375	1600 mm	Invert: 221.71 m
Flood Pumping Outfall (ID70)	S-MH70010676.1	S-MA70029012	1600 mm	Invert: 221.71 m
Other Overflows	N/A	N/A	N/A	
Main Sewer Trunk	S-MH60006079.3	S-MA70029065	1350 mm	Invert: 222.94 m
Storm Relief Sewer Outfall (ID67)	S-CO60007999.1	S-MA60020193	2400 mm	Invert: 221.61 m
Storm Relief Sewer Interconnections	N/A	N/A	N/A	
Main Trunk Flap Gate	RIVER_GC1.1	S-CG00001081	1600 mm	Invert: 222.50 m
Main Trunk Sluice Gate	RIVER_GC2.1	S-CG00001082	1600 mm	Invert: 222.33 m
Off-Take	N/A	N/A	N/A	CS trunk flows directly into wet well and is either intercepted or discharged.
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.49 m^3/s	1 x 0.275 m^3/s 1 x 0.215 m^3/s
Lift Station ADWF	N/A	N/A	0.119 m^3/s	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Force Main	S-BE70001773.1	S-MA70012102	600 mm	Discharge Invert 224.77 m
Flood Pump Station Total Capacity	N/A	N/A	0.95 m^3/s	LFPS combined, single pump
Pass Forward Flow – First Overflow	N/A	N/A	0.55 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	River/Mayfair – 223.83 Fort Rouge Park – 223.83
2	Trunk Invert at Off-Take	N/A
3	Top of Weir	224.00
4	Relief Outfall Invert (Upstream of Fort Rouge Gate Chamber)	221.72
5	Low Relief Interconnection (S-MH60017478)	224.62
6	Sewer District Interconnection (S-MA70010953)	Invert at district boundary: 34-02 = 224.35
7	Low Basement	230.28
8	Flood Protection Level	229.91

[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 River was the 1986 Basement Flooding Relief Program Review (Girling & Sharp, 1986). No other work has been completed on the district 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 River 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.

A latent pump and gate chamber have been constructed on the Fort Rouge Park SRS pipe. This work was completed in 2017 and upgraded the existing SRS gate chamber with a new dual chamber attached to the existing chamber that provided new sluice and flap gates on the SRS pipe. The existing chamber was re-designed as a latent pump chamber with a new submersible pump and a new force main connecting back to the CS system on River Avenue.

From 2009 – 2012 the Southwest Rapid Transit Corridor for the City of Winnipeg was constructed. A portion of this major development was constructed in the River district. As part of this work a local LDS system was installed to capture all surface runoff from the corridor itself. This LDS system ultimately ties back into the River district at various points.

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
34 - River	1986	Ongoing	2013	Complete	N/A

1.5 Ongoing Investment Work

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

Specific to the Fort Rouge SRS, an ongoing annual flow monitoring program will be completed to assess the performance of the Fort Rouge latent storage facility previously constructed.

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 River sewer district are listed in Table 1-4. The proposed CSO control projects will include screening installation primarily. In-line storage and latent storage facilities are either already provided by existing infrastructure, or have already been recently implemented within this district and are described in the sub-sections below. 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	Storage / Transport Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year		-	-	-		-	-	-	✓	✓	✓

Notes:

- = not included
✓ = included

The River district has an existing primary weir elevation of 224 m just upstream of the River CS outfall and located inside the LFPS. The height of the existing weir is high enough that it negates the need to add a control gate to utilize additional in-line storage. The weir height is already above the sewer obvert. The existing height of the weir provides an existing in-line storage of 508 m^3 when evaluated against the 1992 representative year, and will continue to operate in this fashion.

The City has also previously completed the SRS latent storage arrangements utilizing the Fort Rouge Park SRS outfall. This project is discussed in further detail in Section 1.6.2 below.

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. The screening arrangement for River will be located on the CS trunk and upstream from the Mayfair LFPS.

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. RTC is not included in detail within each plan and is described further in Section 3 of Part 3A.

1.6.2 Latent Storage

Latent storage is a suitable control option for the River district for the utilizing the Fort Rouge SRS system. Latent storage has been recently installed in the district at the Fort Rouge SRS outfall and has been included as part of the CSO Master Plan performance evaluation. The latent storage level in the system is controlled by the 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 which was utilized in the 2017 design is identified in Table 1-5. The storage volumes indicated in Table 1-5 are based on the NSWL river level conditions over the course of the 1992 representative year.

Table 1-5. Latent Storage Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	221.95 m	
NSWL	223.83 m	
Trunk Diameter	2400 / 1200 mm	Two different pipes upstream from gate chamber
Design Depth in Trunk	1880 mm	
Maximum Storage Volume	1284 m^3	
Force Main	150 mm	
Flap Gate Control	N/A	
Lift Station	N/A	In-line pump
Nominal Dewatering Rate	0.07 m^3/s	Based on existing pump capacity
RTC Operational Rate	TBD	Future RTC/dewatering review on assessment

Note:

NSWL = normal summer water level

The existing latent pumping system is located within the SRS outfall gate chamber located along River Avenue between Cauchon Street and Scott Street. Figure 34-02 provides an overview of the gate chamber and connections to the CS system constructed as part of this recent work. A dual chamber was constructed adjacent to the existing gate chamber and provided new sluice and flap gates on the SRS outfall pipe. The existing chamber was then re-designed as a latent pump chamber with a new submersible pump and a new force main. The force main pumps into the nearby 900 mm x 1350 mm CS pipe into the manhole (S-MH60017500) on River Avenue. The operational intent is for the existing latent pump to dewater the SRS system in preparation for the next runoff event. This would align with the requirement for the system to be ready for the next event within a 24-hour period after completion of the previous event.

Figure 34 identifies the extent of the SRS system within the River district that is being used now to provide latent storage. The maximum storage level as part of the CSO Master Plan performance evaluation is directly related to the NSWL and the size and depth of the SRS system. Once the level in the SRS exceeds the river level, the flap gate opens to allow discharge to the Assiniboine River.

The lowest interconnection between the combined sewer and SRS systems is higher than the proposed latent and in-line storage control levels, meaning that the two systems would function independently.

As part of the evaluation of the latent storage volume was completed using the continuous NSWL river conditions, This NSWL was found to utilize 90 percent of the SRS pipe height with the existing latent storage arrangements and, therefore, additional flap gate control was not recommended as a further measure to provide the required latent storage as part of the CSO Master Plan.

In situations where non modelled assessments are to be completed, the actual river levels will be both lower and higher than the NSWL level at various points throughout an annual year. Where the level is below the NSWL, the latent volume will be less than predicted during the MP assessment, while conversely when the level is above the NSWL, the latent volume will be more than predicted. The continuous assessment is seen as a conservative approach since the majority of the representative year rainfall events occur when the river levels are higher than the NSWL.

1.6.3 In-Line Storage

Any potential additional in-line storage within the River district via control gate construction has already been maximized based on the height of the existing primary weir in this district. The primary outfall consists of a combined lift and FPS with the primary weir located inside. The existing in-line storage will not require a control gate due to the existing height of the weir, but will still utilize the existing combined sewers for in-line storage. The obvert of the main trunk rests at 224.25 m, and the top of primary weir elevation rests close to this obvert elevation at 224 m. Therefore no further work associated with in-line storage is proposed for the River district.

The nominal rate for dewatering is set at the existing 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. Future RTC / dewatering assessment will be necessary to define additional rates. This would provide some flexibility in the ability to increase the dewatering rate for spatial rainfall events. This would dewater the district more quickly, to capture and treat more volume for these localized storms by using the excess interceptor capacity where the runoff is less.

1.6.4 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials that bypass the LS. There are limitations in the application of an off-line screening arrangement at this location due to the primary weir being located within the LFPS structure. As well, a separate LDS connection is also located within the LFPS. Therefore, in order to accommodate screening of this outfall, an arrangement is proposed to bypass the existing primary weir via a new pipe to transfer excess CS collected to the screened chamber. All screened flow would then tie back into the LFPS chamber downstream of the primary weir, where it can be discharged to the Assiniboine River. This would occur for the first flush flow as per normal screening operation noted in other district screening operations.

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 are listed in Table 1-6.

Table 1-6. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.00 m	
Bypass Weir Crest	N/A	Existing high level weir

Table 1-6. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Normal Summer River Level	223.83 m	
Maximum Screen Head	0.17 m	
Peak Screening Rate	0.96 m^3/s	
Screen Size	1.5 m wide x 1 m high	Modelled Screen Size

The proposed screening chamber will be located in-line on the existing 1350 mm CS trunk and upstream of the existing primary weir, as shown on Figure 34-01. Within the new screening chamber, it is proposed that the flow in the CS trunk would overtop the bypass side weir, situated within the 1350mm trunk pipe wall, and this will flow through the screens. also located in the new screening chamber. The screened flow will be discharged to the existing LFPS downstream of the primary weir via new pipework and then overflow as per existing conditions via gravity/pumped and discharge 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 NEWPCC for removal. High flows would be still be directed to the primary weir as per existing conditions.

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 was reviewed to identify the most applicable GI controls.

River has been classified as a medium GI potential district. Land use in River is mostly single-family residential, with the remaining consisting of commercial land use. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels. The flat roof commercial buildings make for an ideal location for green roofs.

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.

The latent storage facilities constructed will take advantage of the SRS infrastructure already in place; therefore, minimal additional maintenance will be required for the sewers. The latent LS and dewatering pumps will require regular maintenance that would depend on the frequency of operation. Additional system monitoring, and level controls will be installed which will require regular scheduled maintenance.

Floatable control with outfall screening will require another chamber with screening equipment installed. The chamber will be upstream of the existing weir due to the weir being located within the LFPS structure. Screening operation will occur during WWF events that surpass the existing in-line storage control level. WWF will flow over the bypass weir and through the screens directed to discharge into the river via a new transfer pipe and the existing outfall pipe. 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 would correlate to the number overflows identified for the district. The screenings return will require a small LS and force main to pump this back to the CS trunk. Additional maintenance for the pump will be required at regular intervals in line with typical lift station maintenance after screening events.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options 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	121	121	10,214	38	N/A
2037 Master Plan – Control Option 1	121	121	10,214	38	LS, SC

Notes:

Total area is based on the model subcatchment boundaries for the district.
LS = Latent Storage (Latent Storage was constructed by the City in 2017)

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. 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 1-8 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. District 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 [a]
Baseline (2013)	11,331	15,904	-	11	0.490 m^3/s
Latent Storage	8,452	15,904	0	11	0.490 m^3/s
Control Option 1	**8,452**	**15,904** [b]	**0**	**11**	**0.490 m^3/s**

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

[b] Model influenced by other districts performance

A slight increase to the overflow volume was found when modeling the system with the control options implemented. This is believed to be due to the influence from other districts discharging to the interceptor sewer upstream of the connection point for the River district. This will require further modelling to establish suitable option to reduce flows and assess the performance of the existing SRS system.

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 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)
Latent	$1,740,000	N/A	N/A	N/A
Screening	N/A [a]	$2,950,000 [b c]	$44,000	$950,000
Subtotal	**$1,740,000**	**$2,950,000**	**$44,000**	**$950,000**
Opportunities	N/A	$300,000	$4,500	$100,000
District Total	**$1,740,000**	**$3,250,000**	**$48,500**	**$1,050,000**

[a] Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for the screening item of work found to be $590,000 in 2014 dollars

[b] Costs associated with new pipework including offtake construction, as required, to accommodate screening chamber in the location proposed and allow intercepted CS flow to reach existing River CS LS was not included in the Master Plan cost assessment.

[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.

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	Latent storage is already installed in the River district	Not included in Master Plan cost estimate.
	Screening	Unit cost for this control option updated for the Master Plan	
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 River district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume

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	• Opportunistic Separation • Increased use of GI • Off-Line Storage (Tank/Tunnel)

The control options selected for the River district have been aligned for the 85 percent capture performance target based on the results from the system wide basis. The expandability of this district to meet the 98 percent capture is to be determined on system wide basis. Additional separation in this district may be difficult due to the heavy traffic and development density.

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	-	-	-	-	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
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	R	-	-	-	-	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

Girling, R.M. and E.J. Sharp. 1986. *Basement Flooding Relief Program Review - 1986*. Month of publication if available.

LEGEND

Primary Weir	Inter-System Connection	District Boundary Crossing	Existing Latent Storage Limit	District Boundary
Critical Elevation	CS - LDS	SRS	Extent of Existing In-line Storage	Watercourse
CSO Outfall	CS - WWS	WWS	Interceptor Sewer	Greenspace
Low CS Manhole	SRS - CS		Force Main	City Owned Land
Low SRS Connection			Street	
			Railway	

CSO MASTER PLAN PROPOSED SOLUTIONS

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 34
District Overview Map
Sewer District: River
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\RIVER\RIVER_DISTRICT_OVERVIEW_MAP.MXD DT072410 7/29/2019 8:21:31 AM

LEGEND

Primary Weir
CSO Outfall
Manhole
Flap Gate
Sluice Gate
Pump Location
Force Main
Sewer By Type
CS
LDS
WWS
Control Structure Type
Gate Chamber
Pump Station Type
Lift & Flood Combined Station

CSO MASTER PLAN PROPOSED SOLUTIONS

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 34-01
Screening
Sewer District: River
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\RIVER\RIVER_DISTRICT_DETAIL_MAYFAIRAVE.MXD SBEGG1 7/29/2019 8:19:28 AM

LEGEND

- Critical Elevation
- CSO Outfall
- Manhole
- Sluice Gate
- Pump Location

Sewer By Type
- CS
- SRS
- WWS

Control Structure Type
- Weir Structure

Pump Station Type
- Flood Pump Station

CSO MASTER PLAN PROPOSED SOLUTIONS

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 34-02
Latent SRS Control
Sewer District: River
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\RIVER\RIVER_DISTRICT_DETAIL_FORTROUGELATENT.MXD DT072410 8/15/2019 7:47:45 AM

CSO Master Plan

Riverbend District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Riverbend District Plan
Revision:	03
Date:	August 16, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Stephen Godon
File Name:	Riverbend_Plan_Final_CO1MP_08162019

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	08/2018	Version 1 DRAFT	SG	ES	
1	02/15/2019	DRAFT 2 for City Review	MF	SG	MF
2	08/12/2019	Final Draft Submission	DT	MF	MF
3	08/16/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Riverbend District

1.1 District Description

The Riverbend district is located towards the western section of the North End Sewage Treatment Plant (NEWPCC) catchment area within the combined sewer (CS) area on the north side of the Assiniboine River. Riverbend is approximately bordered by Saskatchewan Avenue to the north, St. James Street to the east, Marjorie and Century Streets to the west, and the Assiniboine River to the south. The district is also bounded to the north by the Riverbend Separate district.

Riverbend land use includes areas of residential, commercial, and industrial. Commercial land use is located along St. James Street, Century Street, and King Edward Street; industrial manufacturing facilities are located in the north between Ellice Avenue and Saskatchewan Avenue.

Century Street, King Edward Street, and St. James Street are regional roadways that run north-south through the district. Portage Avenue, Silver Avenue, St Matthews Avenue, Ellice Avenue, Sargent Avenue, and Wellington Avenue are regional roadways that run east-west through the district. The area is a major shopping district and is a main link between Downtown and the airport.

1.2 Development

A portion of Portage Avenue is located within the Riverbend District. Portage Avenue is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

Riverbend encompasses a combined area of 227 hectares (ha)[1] based on the district boundary and includes CS and land drainage sewer (LDS) system. There is approximately 3 percent (8 ha) separated.

Riverbend is planned to have separation work that primary includes the installation of additional LDS and use of the existing CS system for wastewater primarily. As of December 2018, no additional areas of district have been separated, but as part of the work ongoing the district is anticipated to be completely separated in the future.

The CS system includes a CS lift station (LS) and one CS outfall. The CS outfall is located immediately west of Riverbend Crescent. The district is served by a 1500 mm main trunk flowing southbound on King Edward/Century Street; this becomes a 1950 mm CS south of Ellice Avenue, a 2100 mm from St. Matthews to Century Street, and a 2250 mm main trunk that runs south on Century Street. This trunk sewer on Century Street veers southwest at the Century near the Portage Underpass and flows to the Riverbend CS LS located in a back lane west of Riverbend Crescent and South of Portage Avenue. A 450 mm CS serves the small residential area along Riverbend Crescent, south of Portage Avenue and connects into the 2250 mm outfall trunk via a hole and outlet pipe in the base of the manhole in the 450 mm CS. In the past, this 450mm pipe would pass directly over the 2250 mm outfall, and continue west to the Parkside district. It was realized this hole in the pipe where the 450 mm pipe passes directly over the outfall trunk can be used to more efficiently tie this CS into the Riverbend district directly. A 1 meter brick weir is also installed in this manhole along the 450mm pipe, to ensure the CS collected from the Riverbend Crescent area is captured by the hole in the manhole base.

During dry weather flow (DWF), sewage is intercepted by the primary weir for the district, located immediately upstream of the outfall gate chamber. Sewage from the 450 mm Riverbend Crescent CS is

[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.

also intercepted by the 1 metre brick weir, and flows the Riverbend outfall to also be intercepted by the primary weir. The intercepted sewage backs up in the 2250 mm trunk sewer from the CS outfall and is diverted through a 600 mm off-take pipe to the Riverbend LS, located near the intersection of Portage Avenue and Riverbend Crescent. From here it is pumped to the 900 mm interceptor pipe on Portage Avenue and on to the NEWPCC for treatment.

During wet weather flow (WWF) the level of flow may exceed the primary weir height, at this point it spills over this weir and is discharged by gravity to the Assiniboine River via the Riverbend outfall. A sluice gate and flap gate are installed at the CS outfall, with the flap gate preventing back-up of the Assiniboine River into the CS system during high river levels. There is no flood station provided to relieve the CS which has spilled over the primary weir under these high river level conditions. Temporary flood pumps are installed in Riverbend based on the flood manual high river level triggers to deal with situations such as this. Under WWF conditions as well, the flow received from the 450mm CS servicing the Riverbend Crescent area may spill over the 1 metre brick weir installed in the manhole directly over the CS outfall. All flow which spills over this brick weir then continues west to the Parkside district.

A 1500 mm LDS runs north to south through the entire length of the district, called the Brookland-Rosser Industrial Trunk LDS. The Brookland-Rosser Industrial Trunk LDS serves two separate sewer districts north of Riverbend, the Riverbend Separate and Brooklands districts. This LDS trunk sewer includes an outfall to the Assiniboine River at Century near the St. James Bridge. This outfall has positive gate protection to protect against high Assiniboine River levels backflowing into the LDS system.

An underpass pumping station for the St. James Underpass is also located in this district. This underpass pumping station discharges to a 900 mm LDS outfall to the Assiniboine River, located beneath the St. James Bridge. This outfall has both flap and positive gates to protect against high Assiniboine River levels backflowing into the LDS system.

The areas already considered LDS separated within the Riverbend district cover the Madison Square shopping mall and the section of Route 90 approximately between Portage Avenue and St James Street.

The CS outfall to the Assiniboine River is as follows:

- ID50 (S-MA20008967) – Riverbend CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Riverbend and the surrounding districts. These interconnections are shown on Figure 35 for Riverbend district and show the locations where gravity flow crosses from one district to another. Each interconnection is listed in the following subsections.

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Tylehurst

- A 900mm interceptor carrying intercepted CS flows by gravity from the Riverbend district into the Tylehurst district and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.
  - Portage Avenue interceptor invert – 230.01 m (S-MH20010370)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Ferry Road

- A 900mm interceptor carrying intercepted CS flows by gravity from the Ferry Road district into the Riverbend district and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

- Portage Avenue interceptor invert – 230.65 m (S-MH20008213)

Parkside

- A 300 mm interceptor pipe carrying CS intercepted from the Parkside district enters the Riverbend district and ties into the Riverbend CS outfall upstream of the primary weir.
  - Invert at Riverbend district boundary – 226.79 m (S-MH70005194)

1.3.1.3 District Interconnections

Ferry Road

CS to CS

- A 300 mm CS sewer acts as an overflow pipe from the Ferry Road CS system into the Riverbend CS system:
  - St. Matthews Avenue and Marjorie Street – 230.65 m (S-MH20007039) – (GIS suspected to be incorrect and interconnection as high point manhole at 230.85 m (S-MH20007046), further investigation required)
- High Point Manhole (flow is directed into both districts from this manhole):
  - Silver Avenue and Madison Street – 231.52 m (S-MH20009635)

Riverbend Separate

CS to CS

- High Point Manhole (flow is directed into both districts from this manhole):
  - Sherwin Road and Saskatchewan Avenue – 231.48 m (S-MH20006484)
  - Border Street and Saskatchewan Avenue – 230.30 m (S-MH70058515)

WWS to CS

- A 600 mm WWS from Riverbend Separate flows by gravity into the Riverbend CS system in the manhole at the intersection of Saskatchewan Avenue and King Edward Street:
  - King Edward Street – 229.45 m (S-MH20006458)

LDS to LDS

- A 1500 mm LDS flows by gravity southbound on King Edward Street from Riverbend Separate into Riverbend. It flows through Riverbend to discharge into the Assiniboine River:
  - Invert at Riverbend district boundary –224.43 m (S-MH20006451)

A district interconnection schematic is included as Figure 1-1**Error! Not a valid bookmark self-reference.**. The drawing illustrates the collection areas, interconnections, pumping systems, and discharge points for the existing district.

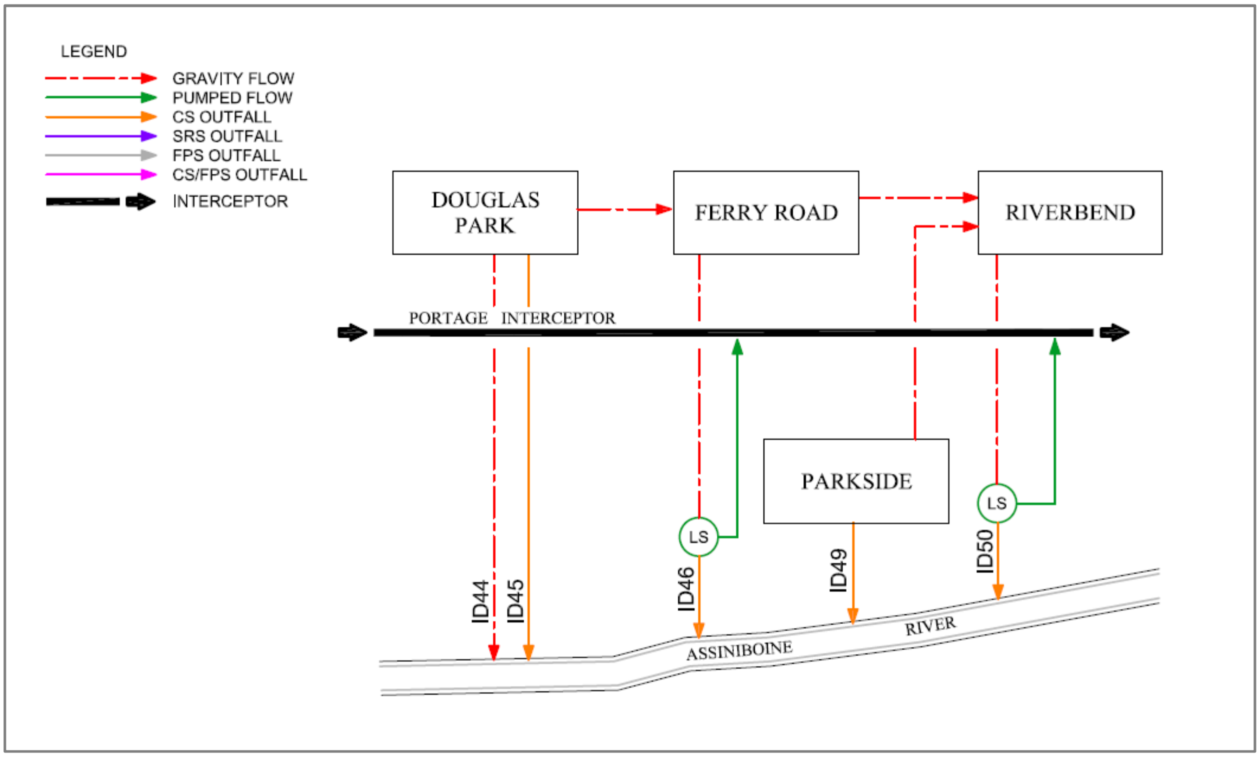


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for Riverbend are shown on Figure 35 and are listed in Table 1-1.

Table 1-1. Riverbend Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Combined Sewer Outfall (ID50)	S-CG00001136 DS.1	S-MA20008967	2340 mm	Circular Invert: 224.00 m
Flood Pumping Outfall	N/A	N/A	N/A	No flood pump station within the district.
Other Overflows	N/A	N/A	N/A	
Main Sewer Trunk	S-TE20002146.1	S-MA70040303	2280 mm	Circular Invert: 225.07 m
SRS Outfalls	N/A	N/A	N/A	No SRS within the district.
SRS Interconnections	N/A	N/A	N/A	No SRS within the district.
Main Trunk Flap Gate	S-CG00001136.1	S-CG00001137	1800	Flap Gate size Invert: 225.56 m
Main Trunk Sluice Gate	S-MH20008302.1	S-CG00001136	2250 x 2250 mm	Sluice Gate size Invert: 225.56 m
Off-Take	S-TE20002181.1	S-MA20008912	600 mm	Circular Invert: 225.20 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.302 m^3/s	

Table 1-1. Riverbend Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station ADWF	N/A	N/A	0.0268 m^3/s	
Lift Station Force Main	S-TE70026794.1	S-MA20008911	300 mm	Circular Invert: 224.00 m
Flood Pump Station Total Capacity	N/A	N/A	N/A	No flood pump station within the district.
Pass Forward Flow – First Overflow	N/A	N/A	0.040 m^3/s	

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	224.26
2	Trunk Invert at Off-Take	225.20
3	Top of Weir	226.09
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Interconnection (Tylehurst)	230.01
7	Low Basement	231.74
8	Flood Protection Level	230.41

[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 Riverbend was in 2006 with the *Ferry Road and Riverbend Combined Sewer Relief Works* (Wardrop, 2006). This study discussed the possible relief work available for Ferry Road and Riverbend CS Systems to reduce the incidence of basement flooding. The southern portion of the district has been separated with the installation of a separate LDS sewer.

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 Riverbend Combined Sewer 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
35 - Riverbend	2006 - Conceptual	Future Work Following Complete Separation	2013	Separation Ongoing	TBD

Note:
TBD = to be determined

1.5 Ongoing Investment Work

The Riverbend basement flooding relief (BFR) work began in 2013 with ongoing separation work being completed within the district. Once complete, it will provide complete road drainage separation of the Riverbend district. Once completed, it will provide complete road drainage separation of the Ferry Road, Douglas Park, Parkside and Riverbend districts. Separation work will be integrated into the CSO Master Plan along with other control options.

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Riverbend 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 Riverbend district are listed in Table 1-4. The proposed CSO control solution is complete sewer separation. 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 decision to include complete sewer separation of Riverbend under the BFR work will remove a large volume of land drainage from the CS system, thereby reducing the volume and number of CSOs for the district. The intent of complete separation would be to eliminate all CSOs from the district under the 1992 representative year rainfall conditions. This will require post separation monitoring to confirm the elimination of CSOs and remaining wet weather response in the district from existing building foundation drainage connections to the CS system.

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 Sewer Separation

Sewer separation is proposed for the Riverbend district as part of the CSO Master Plan and is underway as part of the Ferry Road and Riverbend BFR work. Complete separation of Riverbend will remove a large volume of land drainage runoff from the CS system, thereby reducing the volume and number of CSOs for the district.

The work would include the installation of an independent LDS system to collect road drainage. Collected stormwater would be routed down the local streets to new LDS pipes on Portage Avenue and diverted south down Winston Drive to connect to the new separate LDS outfall in Jae Eadie Park (as part of the Parkside district separation project). This Jae Eadie Park outfall will then discharge to the Assiniboine River. The extent of the proposed LDS system upstream of this point is still under development as part of the BFR work, and the location of the LDS system should be assessed further at the preliminary design stage. The flows to be collected after separation will be as follows:

- DWF will remain the same – collected flow pumped from Riverbend CS LS to the interceptor.
- WWF will consist of sanitary sewage combined with foundation drainage.

This will result in a reduction in combined sewage flow received at Riverbend CS LS after the separation project is complete. It is proposed that future monitoring of the district is completed to verify that the sewer separation is fully compliant with the modelled simulated elimination of all CSO overflows under the 1992 representative year. A static weir elevation increase may be necessary at the CS diversion to eliminate the occurrence of all CSOs. Any weir elevation raise will also be evaluated in terms of existing basement flood protection to ensure the existing level of basement flood protection remains.

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 will be reviewed to identify the most applicable GI controls.

Riverbend has been classified as a medium GI potential district. Riverbend land use includes areas of residential, commercial, and industrial. Commercial land use is located along St. James Street, Century Street, and King Edward Street; industrial manufacturing facilities are located in the north between Ellice Avenue and Saskatchewan Avenue. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, rain gardens, and green roofs.

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 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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers, and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district.

It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the CS system) extent within the Riverbend district.

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 model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	169	169	1,213	59	N/A
2037 Master Plan – Control Option 1	169	25	1,213	1	SEP

Notes:

Total area is based on the model subcatchment boundaries for the district.
SEP = Separation
% = percent

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 estimates for Control Option 1 as shown in Table 1-6 are based on the hydraulic model simulation using the 1992 representative year applied uniformly. The control option performance is compared to the baseline performance to determine the overflow reduction. The baseline performance was determined for the existing conditions represented in the hydraulic model based on 2013 system conditions.

Table 1-6. 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)	87,370	87,057	-	20	0.040 m^3/s
Separation	0	0	87,057	0	TBD
Control Option 1	**0**	**0**	**87,057**	**0**	**TBD**

[a] Pass forward flows assessed up to 5-year design rainfall event. Possible overflow for larger design events to be confirmed.

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entre CS system, and not for each district individually. However, the full capture of overflows volumes for the Riverbend district would represent a 100 percent capture rate on a district level.

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 relevant control option with overall program costs summarized and described in Section 3.4 of Part 3A of the CSO Master Plan are identified in Table 1-7. The cost estimates are a Class 5 planning level estimate with a level of accuracy range of minus 50 percent to plus 100 percent.

Table 1-7. 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)
Sewer Separation	$76,800,000	$76,590,000	$45,000	$980,000
In-line Control Gate	$7,700,000 [a]	N/A	N/A	N/A
Screening		N/A	N/A	N/A
Subtotal	**$84,500,000**	**$76,590,000**	**$45,000**	**$980,000**
Opportunities	N/A	$7,660,000	$5,000	$100,000
District Total	**$84,500,000**	**$84,250,000**	**$50,000**	**$1,080,000**

[a] Screening and In-line costs were combined in the Preliminary Proposal.

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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Sewer Separation	Unit Costs were updated	
	Control Gate	Removed from Master Plan	No longer required with complete separation work.
	Screening	Removed from Master Plan	No longer required with complete separation work.
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 complete separation of the Riverbend district will achieve the 100 percent capture figure, and no other further work will be required to meet the future performance target. It is recommended to complete post separation modelling to confirm the target is fully achieved.

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 as part of the CSO Master Plan and is included as part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-9.

Table 1-9. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-

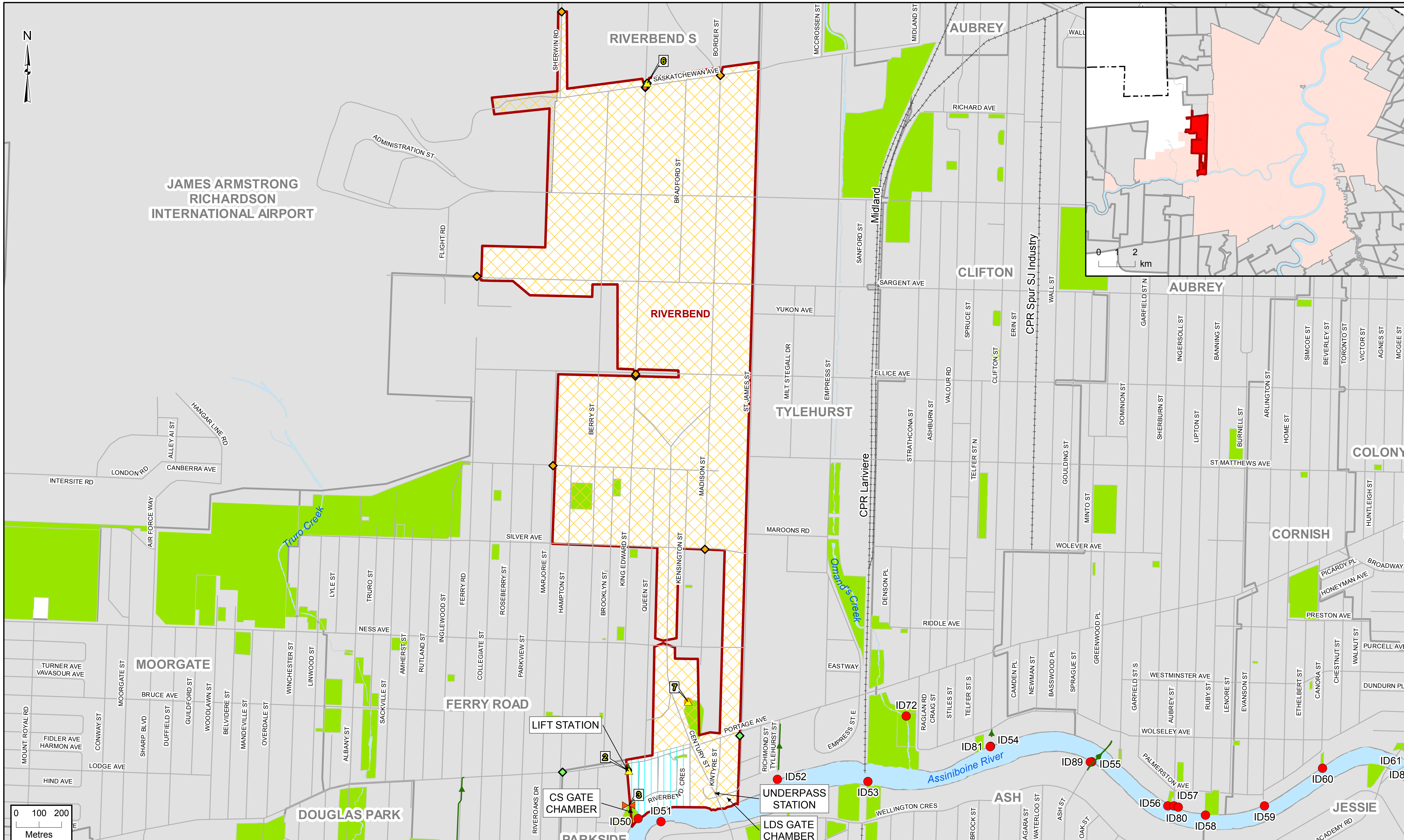
Table 1-9. Control Option 1 Significant Risks and Opportunities

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
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

Wardrop. 2006. *Ferry Road and Riverbend Combined Sewer Relief Works*. Prepared for the City of Winnipeg Water and Waste Department. November.



LEGEND

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

Inter-System Connection
- CS - WWS

District Boundary Crossing
- CS
- LDS
- WWS

- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Underway
- Sewer Separation - Complete

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 35
District Overview Map
Sewer District: Riverbend
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE4\RIVERBEND\RIVERBEND_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:58:43 AM

CSO Master Plan

Roland District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Roland District Plan
Revision:	03
Date:	August 20, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Roland_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	SB	MF	MF
2	07/2019	Final Draft Submission	JT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Roland District

1.1 District Description

Roland district is located in the northeastern sector of the combined sewer (CS) area along the eastern edge of the Red River and north of the Mission district. The district is bounded by Munroe district to the north, Area 13 and Kildonan Place district (Area 13.1) to the east, the Mission district to the south, and the Hart district to the west. Roland is bounded by Thomas Avenue to the south, Gateway Road to the west, Kent Road and Harbison Avenue East to the north, and Panet Road to the east.

Roland district is located in close proximity to downtown and has many major transportation routes run through the district. The Canadian Pacific Railway Mainline passes through this district. Nairn Avenue is the only regional road in the district.

Roland district is a mix of residential, commercial and manufacturing land use. The residential area is primarily single-family and two-family. The commercial area is located along Nairn Avenue and Panet Road and a manufacturing area is located along Thomas Avenue. The greenspace areas include Montcalm Playground, Chalmers Park, King Edward Park, Hap Hopkinson Memorial Park, and various school parks, playgrounds, and community areas throughout the district. The Canadian National Railways East Yards border the southern district boundary at Thomas Avenue.

1.2 Development

A portion of Nairn Avenue is located within the Roland District. This street is identified as a Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Nairn Avenue is to be promoted in the future.

Nairn Avenue, Thomas Avenue, and a portion of Foster Street within the Roland 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, which could also present an opportunity to coordinate sewer separation works alongside the transit corridor development, providing further sewer separation within the Roland District. This would reduce the extent of the Control Options listed in this plan required.

1.3 Existing Sewer System

Roland district encompasses an area of 204 ha[1] and includes a CS system and a storm relief sewer (SRS) system. There is approximately 3.5 ha (1.7 percent) identified as land drainage sewer (LDS) separated. There are no identifiable separation-ready areas. Approximately 12 ha of the district is classified as greenspace.

The Roland sewer system includes a diversion structure, flood pump station (FPS), CS outfall, and SRS outfall gate chambers. The CS systems drain towards the Roland diversion structure and primary CS outfall, located in the Hart district at the northern end of Archibald Street at the Red River. Approximately 120 m upstream of the Roland outfall, sewage is diverted to the Montcalm sewage Lift Station (LS) located in Mission district, at which point it is pumped into a river crossing pipe and enters the Syndicate district. A single sewer trunk collects flow from most of the district and directs flow to the diversion structure near Archibald Street. The 1625 mm by 2060 mm CS trunk extends from the diversion structure to Gateway Road. Multiple secondary sewers extend form the CS trunk along Gateway Road to the north and Talbot Avenue to the east to service the district.

[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.

The SRS system includes various interconnections to the CS system. The Roland SRS system also receives the excess CS diverted from the majority of the Munroe SRS system to the north. The Roland SRS connects into a dedicated SRS gate chamber, but utilizes the same Roland primary CS outfall for the SRS system discharge. The gate chamber on the SRS system includes sluice and flap gates to prevent river water from backing up into the SRS system when the Red River levels are particularly high. During runoff events, the SRS system provides relief to the CS system in Roland district and in turn the Munroe district. The SRS system extends throughout the district and has multiple interconnections with the CS system. Catch basins are connected to the CS system, so the SRS provide additional capacity to the CS to main basement flooding protection.

During dry weather flow (DWF), the SRS is not required; sanitary sewage flows to the diversion structure and is diverted by the primary weir to a 600 mm interceptor pipe, where it flows by gravity southbound along Archibald Street approximately 225 m to the gate/junction chamber to the Montcalm sewage LS in Mission district to be pumped across the Red River to the Syndicate district, which ties into the Main Street Interceptor, and eventually and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), any flow that exceeds the diversion capacity overtops the weir and is discharged to the river. When the river level is high and gravity discharge is not possible, excess flow is pumped by the Roland FPS to the river. Sluice and flap gates are installed within the FPS to prevent back-up of the Red River into the CS system. However not only does the flap gate prevent river water intrusion, but it also prevents gravity discharge from the Roland CS outfall. Under these conditions the excess flow is pumped by the Roland FPS to a point in the Roland CS Outfall downstream of the flap gate and downstream of the SRS gate chamber, where it can be discharged to the river by gravity once more.

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

- ID21 (S-MA40011011) – Roland CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Roland and the surrounding districts. Each interconnection is shown on Figure 36 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

Mission

- 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.
  - Archibald Street and Mission district boundary invert – 223.56 m (S-MA50018054)

1.3.1.2 District Interconnections

Hart

<u>SRS to SRS</u>

- 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 system upstream of the gate chamber.
  - Invert at Hart district boundary – 222.27 m (S-MA40011025)

<u>CS to CS</u>

- A 1625 x 2060 mm CS flows west by gravity on Elmwood Road at Watt Street from Roland district into Hart district:
  - Invert at Hart district boundary – 223.52 m (S-MA40011002)

Munroe

<u>SRS to SRS</u>

- A 375 mm SRS relieves a 600 mm CS sewer off of Keenleyside Street in Munroe district and flows by gravity south along Keenleyside Street into Roland SRS System:
  - Invert at Munroe district boundary – 226.24 m (S-MA40010345)
- A 2900 mm SRS flows from Munroe district by gravity south along Besant Street and crosses into Roland district SRS system at Molson Street:
  - Invert at Munroe district boundary – 223.31 m (S-MA40007633)
- A 375 mm SRS flows from Munroe district by gravity eastbound on London Street and crosses into the Roland district SRS system:
  - Invert at Roland district boundary – 224.34 m (S-MA40007675)
- A 2900 mm SRS flows from Munroe by gravity south along Gateway Road into the Roland district SRS system:
  - Invert at Roland district boundary – 222.76 m (S-MA40008399)
- A 525 mm SRS flows from Munroe by gravity south along Grey Street to Roland district SRS system:
  - Invert at Munroe district boundary – 224.50 m (S-MA40007593)

Kildonan Place (Area 13.1)

<u>CS to CS</u>

- A 450 mm CS flows from Kildonan Place district by gravity west on Talbot Avenue at Panet Road into Roland district:
  - Invert at Roland district boundary – 226.65 m (S-MA40011663)
- A 1050 mm CS flows from Kildonan Place district by gravity west on Regent Avenue West into Roland district:
  - Invert at Roland district boundary – 226.31 m (S-MA70040189)

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

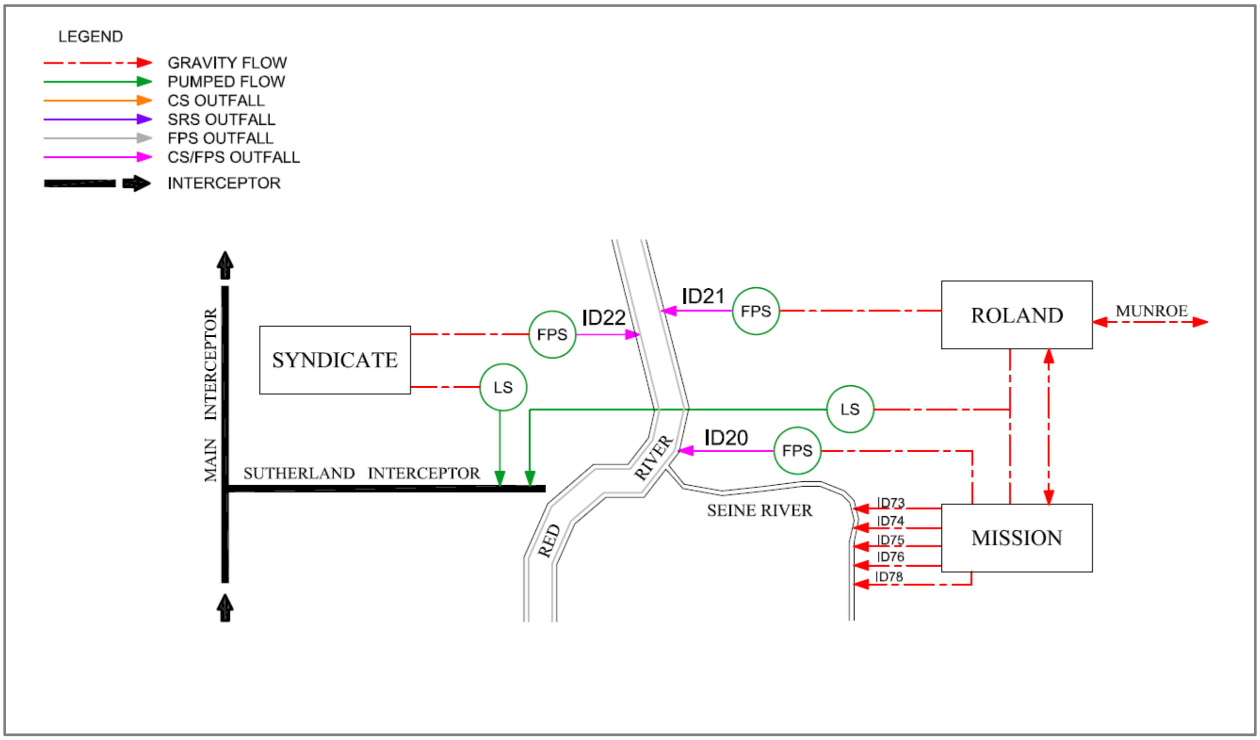


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 36 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 (ID21)	ROLAND_SRS_GC_03.1	S-MA40011011	3700 mm	Red River Invert: 221.39 m
Flood Pumping Outfall (ID21)	ROLAND_SRS_GC_03.1	S-MA40011011	3700 mm	Red River Invert: 221.39 m
Main Trunk	S-MH40009951.1	S-MA40011217	1625 x 2050 mm	Main CS that flows west across Archibald Street Invert: 223.48 m
SRS Outfalls (ID21)	ROLAND_SRS_GC_03.1	S-MA40011011	3700 mm	Red River Invert: 221.39 m
SRS Interconnections	N/A	N/A	N/A	43 SRS - CS
Main Trunk Flap Gate	S-TE70026812.2	S-CG00000732	1500 x 2100 mm	Invert: 223.71 m
Main Trunk Sluice Gate	S-CG00000733.1	S-CG00000733	1500 x 2100 mm	Invert: 223.61 m
Off-Take	S-MH70032213.2	S-MA50018054	600	Invert: 223.56
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.84 m^3/s + one more pump	3 x 0.28 m^3/s, 1 x N/A
ADWF	N/A	N/A	0.016 m^3/s	
Lift Station Force Main	N/A	S-MA70046417	600 mm	2 x 600 mm

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
		S-MA70046432		
Flood Pump Station Total Capacity	N/A	N/A	1.70 m^3/s	2 x 0.85 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.473 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	Roland – 223.70
2	Trunk Invert at Off-Take	223.56
3	Top of Weir	223.98
4	Relief Outfall Invert at Flap Gate (S-MA40011231)	222.11
5	Low Relief Interconnection (S-MA70024476)	224.50
6	Sewer District Interconnection (Hart)	222.42
7	Low Basement	229.06
8	Flood Protection Level	229.34

[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 Engineering Consultants, 1985). The study's purpose was to develop sewer relief options to reduce surcharge level and relieve basement flooding. No other work has 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 Roland Combined Sewer District was included as part of this program. Instruments installed at each of the thirty nine 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
36 – Roland	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 Roland district. This consists of monthly site visits in confined entry spaces to verify 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 Roland sewer district are listed in Table 1-4. The proposed CSO control projects will include latent storage, in-line storage via control gate, and floatable management via screening. Program opportunitiess 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	Storage / Transport 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 as in-line and latent storage. These control options will take advantage of the existing CS and SRS pipe networks for additional storage volume.

Floatable control will be necessary to capture any undesirable 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. A screen will be installed on the Roland primary CS outfall.

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 Latent Storage

Latent storage is proposed as a control option for the Roland district. There is one SRS system that shares the outfall with the main Roland CS outfall. The SRS system connects to the CS outfall pipe upstream of the SRS gate chamber with flap gate protection, and will provide additional storage. The latent storage level in the system is controlled by the river level, and the resulting backpressure of the river level on the SRS gate chamber flap gate, as explained in Part 3C. The SRS for the Roland district receives all the diverted CS flow from Roland as well as most of the SRS flow from Munroe to the north. The latent storage design criteria are identified in Table 1-5. The storage volumes indicated in Table 1-5 are based on the continuous NSWL river level conditions over the course of the 1992 representative year.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	Watt – 222.11 m	Flap Gate invert
NSWL	223.07 m	
Trunk Diameter	2900 mm	
Design Depth in Trunk	1600 mm	
Maximum Storage Volume	5200 m^3	
Force Main	225 mm	
Flap Gate Control	N/A	
Lift Station	Yes	
Nominal Dewatering Rate	0.075 m^3/s	Based on 24-hour emptying requirement
RTC Operational Rate	TBD	Future RTC/dewatering assessment required

Notes:

NSWL = normal summer water level
RTC = real time control

The addition of a pump and force main that connects back to the CS system will be required for the latent storage arrangement. A conceptual layout for the pump station and force main is shown on Figure 36-01. The pump station will be located north of the existing FPS in the adjacent parking lot near Archibald Street to avoid disruption to existing sewers or neighboring roads. The latent force main will pump east to the nearby 1625 by 2060 mm trunk sewer on Archibald Street and into the manhole (S-MH40009951) on the east curb on Archibald Street. The pump station 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.

Figure 36 identifies the extent of the SRS system within Roland district that would be used for latent storage. The maximum storage level is directly related to the NSWL and the size and depth of the SRS system. Once the level in the SRS exceeds the river level, the flap gate opens, and the combined sewage is discharged to the river.

The river level will keep the SRS flap gate closed and system level maintained at the NSWL. This level utilizes 55 percent of the SRS pipe height. As part of the evaluation, the latent storage volume was completed using the continuous NSWL river conditions. It was found that additional flap gate control will not be required to meet the Control Option 1 85% capture target. In situations where non modelled assessments are to be completed, the actual river levels will be both lower and higher than the NSWL level at various points throughout an annual year. Where the level is below NSWL, the latent volume will be less than predicted during the MP assessment, while conversely when the level is above the NSWL, the latent volume will be more than predicted. The continuous assessment is seen as a conservative approach since the majority of the representative year rainfall events occur when the river levels are higher than the NSWL.

As described in the standard details in Part 3C wet well sizing for the latent storage pump station will be determined based on the final pump selection, operation and dewatering capacity required. The interconnecting piping between the new gate chamber and the pump station would be sized to provide sufficient flow to the pumps while all pumps are operating.

1.6.2 In-Line Storage

In-line storage has been proposed as a CSO control for Roland 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 and provide an overall higher volume capture and provide additional hydraulic head for screening operations. The existing Montcalm sewage LS 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 is listed in Table 1-6.

Table 1-6. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	223.48 m	Downstream invert of lowest pipe at diversion chamber
Trunk Diameter	1625 x 2060 mm	
Gate Height	0.65 m	Gate height based on half trunk diameter assumption (flood assessment included)
Top of Gate Elevation	224.63 m	
Bypass Weir Height	224.53 m	
Maximum Storage Volume	1,151 m^3	
Nominal Dewatering Rate	0.443 m^3/s	Based on minimum pass forward rate for gravity discharge district (Montcalm LSPS located downstream)
RTC Operational Rate	TBC	Future RTC / dewatering

Note:
TBC = to be confirmed
RTC – Real Time Control

The proposed control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 36. . 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 the flow overtops the bypass weir and is screened prior to discharging to the river. If the system level continues to rise, it will reach the critical level where 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 gravity discharge will continue with its current operation while the control gate is in either position, will all DWF being diverted to the Montcalm Pumping Station.

Figure 36-01 provides an overview of the conceptual location and configuration of the control gate and screening chambers. The proposed control gate will be installed in a new chamber within the existing trunk sewer alignment near the FPS. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5.0 m in length and 3.0 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. The chamber will be located immediately east of the FPS, within the local street and minor disruptions to the Archibald Street traffic would be noted during the potential construction period. The existing sewer configuration may have to be modified to allow the installation of the in-line gate and screening chambers. 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 FPS rehabilitation or replacement project.

The nominal rate for dewatering is already set as the existing pipe capacity as the district is a gravity discharge district, although impacted by the downstream Montcalm sewage LS. Any future considerations, for RTC improvements, would be completed with spatial rainfall and the interactions of the Montcalm sewage LS and the Mission district, which also drains to the Montcalm sewage LS.

1.6.3 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens would be proposed while still maintaining the current level of basement flooding protection.

The type and size of screens depend on the LS and the hydraulic head available for operation. A standard design was assumed for screening and is described in Part 3C. The design criteria for screening with gate control implemented, are listed in Table 1-7.

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.63 m	
Bypass Weir Crest	224.53 m	
NSWL	223.70 m	
Maximum Screen Head	0.93 m	
Peak Screening Rate	0.35 m^3/s	
Screen Size	1.5 m x 1.0 m	Modelled Screen Dimensions

The proposed side overflow bypass weir and screening chamber will be located adjacent to the proposed control gate and existing CS trunk sewer, as shown on Figure 36-01. The screens will operate with the control gate in its raised position. A side bypass weir upstream of the 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 the interceptor and on to the NEWPCC for removal.

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 3.0 m in length and 2.3 m in width. The existing sewer configuration may have to be modified to accommodate the new chamber. The chamber will be located immediately east of the FPS, within the local street and minor disruptions to the Archibald Street traffic would be noted during the potential construction period.

1.6.4 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 applicable GI controls.

Roland has been classified as a medium GI potential district. Roland district is a mix of residential, commercial and industrial. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. Commercial areas are suitable to green roofs and parking lot areas are ideal for paved porous pavement. Bioswales may be suitable to the industrial areas.

1.6.5 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.

The latent storage would take advantage of the SRS infrastructure already in place, therefore, minimal additional maintenance will need to be anticipated. The proposed latent LSPS will require regular maintenance that would depend on the frequency of operation. The flap control gate will require maintenance inspection for continued assurance that the flap gate would open during WWF events.

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. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-8.

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	287	287	5,318	48	N/A
2037 Master Plan – Control Option 1	287	287	5,318	48	IS, Lat St, SC

Notes:

Lat St = Latent Storage
IS = In-line Storage
SC = Screening

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model

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 1-9 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 1-9 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 1-9. District Performance Summary – Control Option 1

	Preliminary Proposal	Master Plan			
Control Option	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)	301,845	299,396	-	20	0.401 m^3/s
In-Line Storage	301,103	290,998	8,398	18	0.479 m^3/s
In-Line & Latent Storage	N/A [a]	181,108	109,890	14	0.479 m^3/s
Control Option 1	**301,103**	**181,108**	**118,288**	**14**	**0.479 m^3/s**

[a] Latent storage was not simulated 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 1-9, as it is applicable to the entire CS system and not for each district individually.

1.9 Cost Estimates

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 **Error! Reference source not found.**. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-10. District Cost Estimate – 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)
Latent Storage	N/A [a]	$2,790,000	$82,000	$1,780,000

In-Line Storage	N/A [b]	$2,540,000 [c]	$40,000	$850,000
Screening		$1,990,000 [d]	$31,000	$660,000
Subtotal	**N/A**	**$7,320,000**	**$153,000**	**$3,290,000**
Opportunities	N/A	$730,000	$15,000	$330,000
District Total	**N/A [b]**	**$8,050,000**	**$168,000**	**$3,620,000**

[a] Latent Storage not included in the Preliminary Proposal

[b] Solution development as refinement to Preliminary Proposal costs. Revised costs for these items of work found to be $7,410,000 in 2014 dollars.

[c] 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 gravity interceptor are not included

[d] Cost for bespoke screening 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.

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 1-11.

Table 1-11. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	In-line Storage Control Gate	A control gate was not included in the initial preliminary estimate	Added to Master Plan
	Screening	Screening was not included in the initial Preliminary Proposal	Added for the Master Plan.
	Latent Storage	Latent Storage was not included in the Preliminary Proposal	Added for the MP to further reduce overflows.

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 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 1-12 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 Roland district would be classified as a high potential for implementation of complete sewer separation as the only 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. Focused use of green infrastructure, and reliance on said green infrastructure as well can provide volume capture benefits and could be utilized to meet future performance targets.

Table 1-12. 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 Roland 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 not align with the proposed options for the 85 percent capture target. The future higher level of percent capture indicates that complete sewer separation would be applicable in this district.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-13.

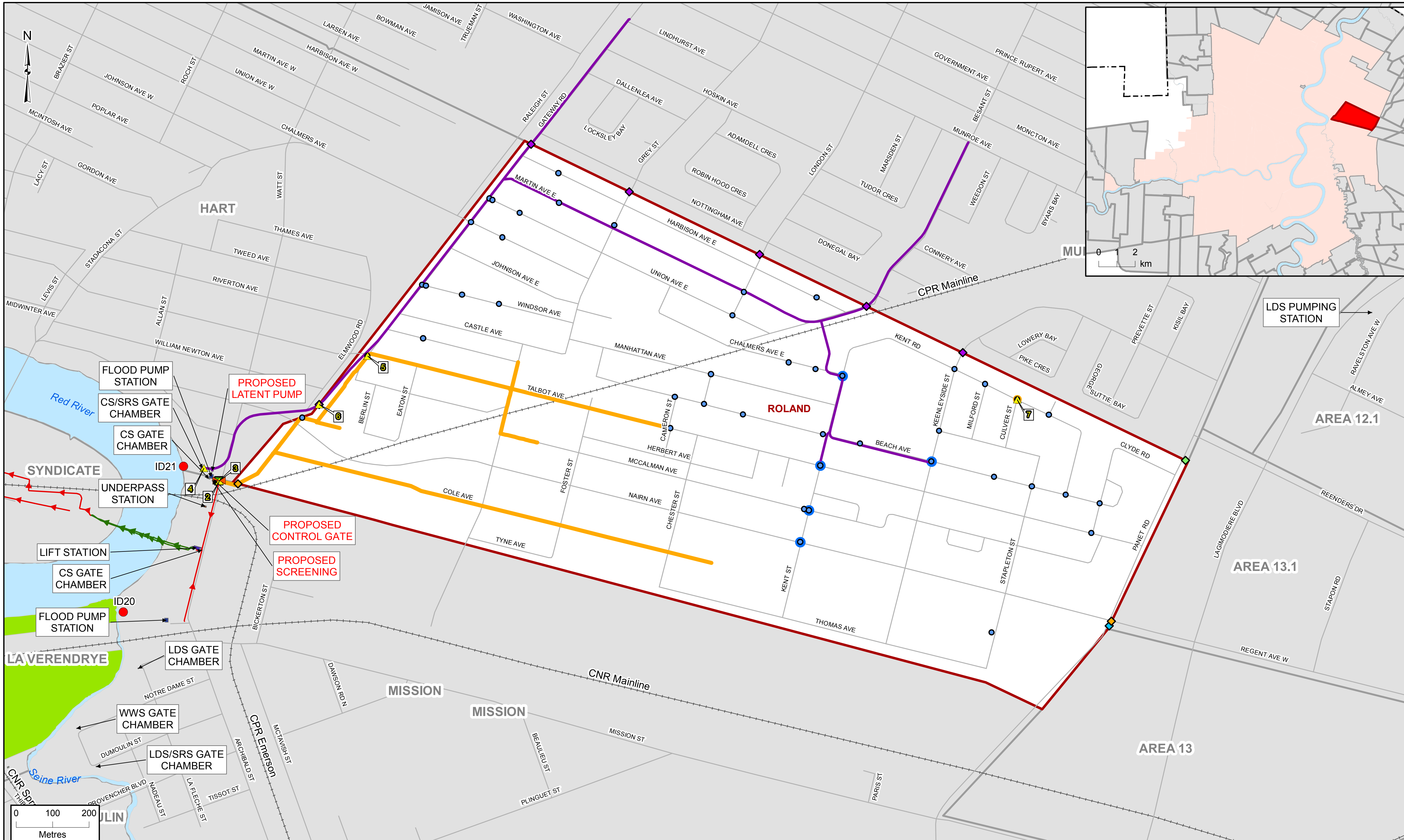
Table 1-13. Control Option 1 Significant Risks and Opportunities

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
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

Wardrop Engineering Consultants. 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
- SRS - CS

District Boundary Crossing
- CS
- LDS
- SRS
- WWS

- Interceptor Sewer
- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

- Proposed Control Gate
- Latent Storage Limit
- Extent of In-line Storage

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

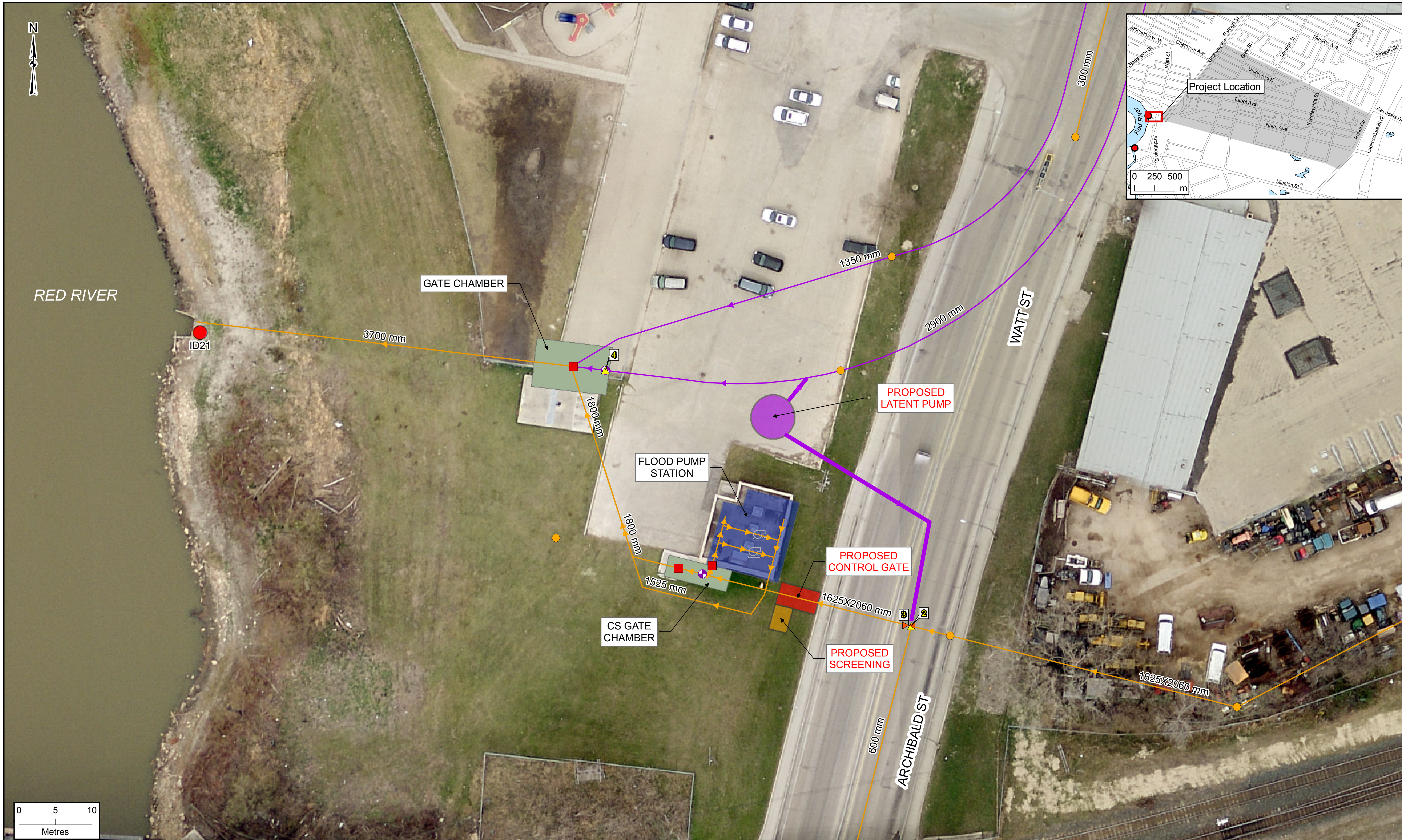
JACOBS

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

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 36
District Overview Map
Sewer District: Roland
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE7\ROLAND\ROLAND_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 10:20:14 AM



LEGEND

Primary Weir	Flap Gate	Sewer By Type	Control Structure Type	Pump Station Type
Critical Elevation	Sluice Gate	CS	Gate Chamber	Flood Pump Station
CSO Outfall	Pump Location	SRS		
Manhole				

CSO MASTER PLAN
PROPOSED SOLUTIONS

Proposed Latent Force Main
Control Gate
Screening
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 36-01
Control Gate, Screening, and Latent Pump
Sewer District: Roland
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE7\ROLAND\ROLAND_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 10:17:46 AM

JACOBS

CSO Master Plan

Selkirk District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Selkirk District Plan
Revision:	03
Date:	August 22, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Selkirk_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	09/14/2018	DRAFT for City Comment	DT	SB MF SG	
1	02/20/2019	DRAFT 2 for City Review	SB	SG	MF
2	07/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Selkirk District

1.1 District Description

Selkirk district is located in the northwest section of the combined sewer (CS) area west of the Red River and north of Alexander and Syndicate districts. Selkirk is approximately bounded by the Canadian Pacific Railway (CPR) Winnipeg Yards to the south, Sinclair Street and McPhillips Street to the west, Alfred Avenue to the north, and the Red River to the east.

Selkirk district includes a mix of commercial, industrial, and residential land use. Residential areas are mainly two-family and multi-family. Industrial manufacturing facilities are located primarily south of Dufferin Avenue. A heavy manufacturing land use area located south of Sutherland Avenue includes the CPR Winnipeg Yards. Commercial areas are found along Main Street and Selkirk Avenue. Greenspace areas include the Old Exhibition Grounds and Redwood Park, and various school parks, playgrounds, and community areas throughout the district.

This district is located in proximity to the downtown and has many transportation routes. The CPR Mainline passes through the southern end of Selkirk district. Regional roads in the district include Main Street, Salter Street, McGregor Street, Arlington Street, and McPhillips Street in a north-south direction and Selkirk Avenue and Dufferin Avenue in the east-west direction. Arlington Street includes the Arlington Bridge that extends over the CPR Winnipeg Yards into the Selkirk district.

1.2 Development

There is limited land area available for new development within the Selkirk district. However, some significant redevelopments that could impact the Combined Sewer Overflow (CSO) Master Plan are in the planning stages:

A study has been completed to construct a more improved bridge to replace the Arlington Bridge. The study began in 2014 with construction projected to be completed in 2024. The Arlington bridge is nearing the end of its usable life and plans to construct a more detailed bridge that allows for increased transportation and improvements for walking and cycling were considered in the study. The development of the bridge will have minimal impact on the CSO Master Plan.

There are several areas within the Selkirk CS district which have been identified as a General Manufacturing Lands as part of OurWinnipeg. Focused intensification within these areas is to be promoted in the future, with a particular focus on mixed use development. This is to verify that adequate employment lands are available to support future population growth.

A portion of Main Street is located within the Selkirk District. Main Street is identified as a Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Main Street is to be promoted in the future.

1.3 Existing Sewer System

Selkirk district encompasses an area of 310 ha[1] and includes a CS system and a storm relief sewer (SRS) system. This district does not include any areas that may be identified as LDS separated. There is approximately 6 ha (2.0 percent) identifiable as separation-ready and approximately 20 ha of greenspace.

The CS system includes a diversion structure, a flood pump station (FPS), four CS outfalls, and outfall gate chambers. The CS system drains towards the Selkirk outfall and diversion chamber, located at the

[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.

east end of Selkirk Avenue at the Red River. At the outfall, sewage is diverted to the Main Interceptor or may be discharged by gravity/via the FPS adjacent to the CS outfall into the Red River.

A single sewer trunk collects flow from most of the district and flows east to the diversion chamber on Selkirk Avenue. The main 1600 mm by 2000 mm CS trunk extends from the diversion chamber to McKenzie street. Multiple secondary sewers extend from the main CS trunk along Selkirk Avenue to the north and south to service the entire area. There are also two secondary CS outfalls at the east end of Aberdeen Avenue and Pritchard Avenue respectively. Each of these secondary outfalls provide local relief to the CS laterals on Aberdeen Avenue and Pritchard Avenue. A positive gate alone is constructed on the Pritchard secondary outfall, and there is no flap gate or sluice gates constructed on the Aberdeen secondary outfall. Frequent silting issues are encountered at the Aberdeen secondary outfall, and for periods of time this outfall is not operational. This outfall is to be further investigated and potentially decommissioned if found to not currently be in operation.

During runoff events, the SRS system provides relief to the CS system in the Selkirk district. The SRS system extends throughout the district and has multiple interconnections with the CS system. Most catch basins are still connected to the CS system, so no partial separation has been completed. The SRS system includes a dedicated SRS outfall at Burrows Avenue and discharges directly to the Red River. A flap gate and sluice gate are installed on the Burrows SRS outfall pipe to control backflow into the SRS system under high river level conditions in the Red River.

During dry weather flow (DWF), the SRS is not required; sanitary sewage flows to the diversion chamber and is diverted by the weir to a 600 mm interceptor pipe, where it flows by gravity west to the Main Street interceptor and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), any flows that exceeds the diversion capacity overtops the weir and is discharged to the river. Sluice and flap gates are installed on the CS outfall to prevent back-up of the Red River into the CS system When the Red River levels are particularly high the flap gate prevents gravity discharge from the Selkirk CS outfall. Under these conditions the excess flow is pumped by the Selkirk FPS to a point in the Selkirk CS Outfall downstream of the flap gate, where it can be discharged to the river by gravity.

The four outfalls to the Red River (three CS and one SRS) are as follows:

- ID23 (S-MA70007427) – Selkirk CS Outfall
- ID26 (S-MA00017914) – Aberdeen CS Outfall
- ID24 (S-MA00017936) – Pritchard CS Outfall
- ID25 (S-MA00017926) – Burrows SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Selkirk and the surrounding districts. Each interconnection is shown on Figure 37 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 Johns

- The 2250 mm Main Interceptor flows by gravity into St. Johns district north on Main Street towards the NEWPCC for treatment:
  - Invert at Selkirk district boundary – 219.83 m (S-MH000162165)

1.3.1.1 Interceptor Connections – Upstream of Primary Weir

Syndicate

- The 2250 mm Main Interceptor pipe flows by gravity north on Main Street into Selkirk district to carry sewage to the NEWPCC for treatment:
  - Invert at Syndicate district boundary 220.13 m (S-TE00005699)

1.3.1.2 District Interconnections

Syndicate

<u>CS to CS</u>

- High sewer overflow:
  - 375 mm CS on Main Street at Dufferin Avenue – 228.52 m (S-MH00012094)

<u>CS To SRS</u>

- High sewer overflow:
  - 500 mm SRS on Euclid Avenue at Lusted Avenue – 228.60 m (S-MA00013582)
  - 250 mm SRS on Austin Street N at Euclid Avenue – 228.62 m (S-MA00013587)

St. Johns

<u>CS to CS</u>

- A 300 mm CS flows north by gravity on Arlington Street into St. Johns district from Selkirk district:
  - Invert at Selkirk district boundary 228.65 m (S-MA00014590)
- A 300 mm CS flows by gravity northbound on Aikins Street into St. Johns district:
  - Invert at Selkirk district boundary 227.20 m (S-MA00015124)
- A 300 mm CS flows by gravity north on Main Street and connects to the CS network in St. Johns district at the intersection of Main Street and Redwood Avenue:
  - Invert at Selkirk district boundary 227.60 m (S-MA00015398)
- High point manhole:
  - 300 mm CS on Selkirk Avenue – 229.19 m (S-MH00008778)
  - 300 mm CS on McGregor Street – 228.33 m (S-MH00013219)

<u>CS to SRS</u>

- High sewer overflow:
  - 450 mm SRS on Artillery Street – 229.34 m (S-MH00012613)
  - 250 mm SRS on Alfred Avenue – 229.84 m (S-MH00012868)

<u>SRS to SRS</u>

- A 2150 mm SRS flows by gravity eastbound on Burrows Avenue from St. Johns district into Selkirk district:
  - Invert at Selkirk district boundary 223.64 m (S-MA00014318)
- A 2150 mm SRS flows by gravity northbound on Arlington Street into St. Johns district:
  - Invert at Selkirk district boundary 223.57 m (S-MA00014588)

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

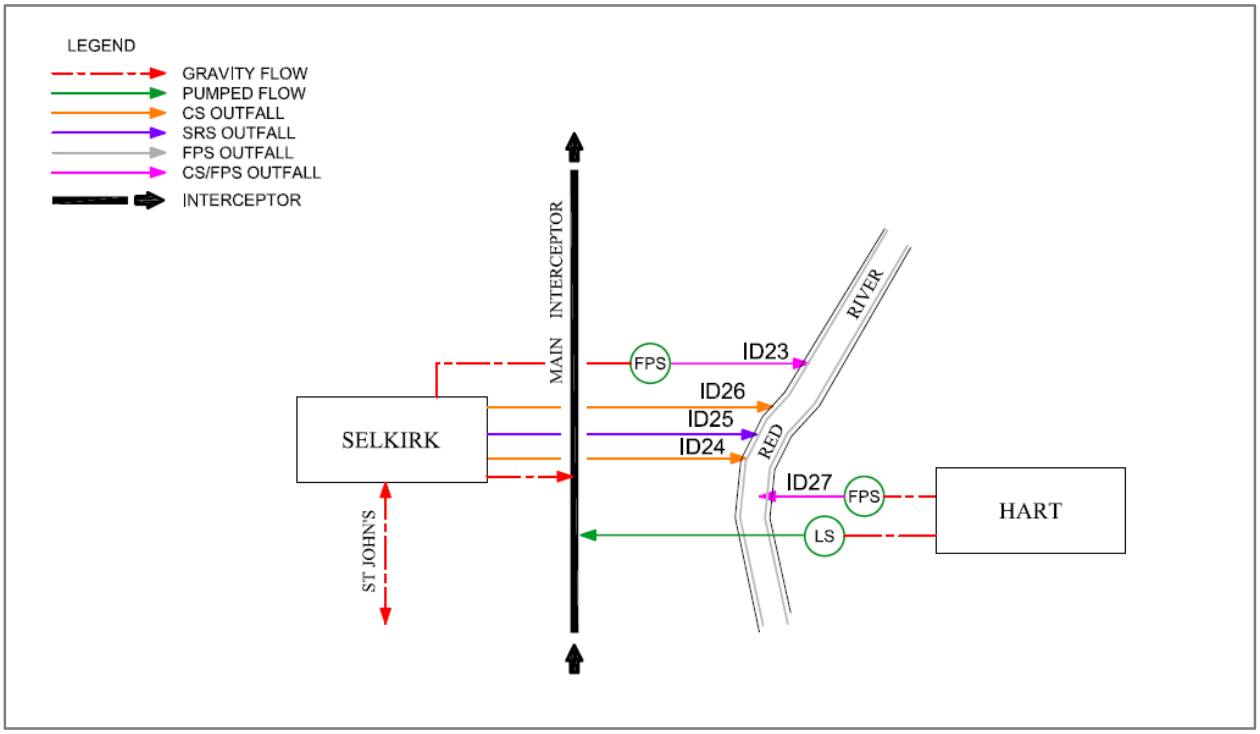


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 37 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 (ID23)	S-CO70003073.1	S-MA70007427	1800 mm	Red River Invert: 221.80 m
Flood Pumping Outfall (ID23)	S-CO70003073.1	S-MA70007427	1800 mm	Red River Invert: 221.80 m
Other Overflows (ID24 & ID26))	S-MH00012354.1 S-MH00014696.1	S-MA00017936 S-MA00017914	250 mm 200 mm	Invert: 222.99 m Invert: 223.29 m
Main Trunk	S-MH00012339.1	S-MA00013835	1600 x 2000 mm	Main CS that flows east on Selkirk Avenue Egg-shaped Invert: 223.67 m
SRS Outfalls (ID25)	S-BE00007701.1	S-MA00017926	2400 mm	Invert: 221.03 m
SRS Interconnections	N/A	N/A	N/A	54 SRS - CS
Main Trunk Flap Gate	S-AC70007831.1	S-CG00000997	1525 mm	Invert: 223.90 m
Main Trunk Sluice Gate	SELKIRK_GC.1	S-CG00001065	1600 x 1600 mm	Invert: 223.70 m
Off-Take	N/A	S-MA70049021	600 mm	Invert: 223.70 m
Dry Well	N/A	N/A	N/A	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Total Capacity	N/A	S-MA70049021 [(1)]	600 mm [(1)]	0.57 m^3/s [(1)]
ADWF	N/A	N/A	0.0316 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	
Flood Pump Station Total Capacity	N/A	N/A	3.84 m^3/s	2 x 0.52 m^3/s 2 x 1.40 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.474 m^3/s	

Notes:

[(1)] – Gravity pipe replacing Lift Station as Selkirk is a gravity discharge district
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	Selkirk – 223.69 Burrows – 223.69 Pritchard – 223.69 Aberdeen – 223.69
2	Trunk Invert at Off-Take	223.68
3	Top of Weir	224.38
4	Relief Outfall Invert at Flap Gate (Burrows SRS Outfall)	221.71
5	Low Relief Interconnection (S-MH00012136)	225.24
6	Sewer District Interconnection (St Johns)	223.57
7	Low Basement	228.90
8	Flood Protection Level (Selkirk)	229.20

[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 Selkirk was the *Sewer Relief Study: Selkirk Combined Sewer District* (I.D. Engineering Canada Inc., 1993). The study's purpose was to develop sewer relief options that provide a 5-year level of protection against basement flooding and to develop alternatives for reducing and eliminating pollutants from CSOs. No other work has 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 Selkirk 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	Planned Completion
37 – Selkirk	1993	Future Work	2013	Study Complete	N/A

Source: Report on *Sewer Relief Study: Selkirk Combined Sewer District*, 1993

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Selkirk 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 Selkirk district has latent storage, in-line storage via control gate, floatable control via screening, gravity flow control and green infrastructure (GI) projects proposed to meet CSO Control Option 1. Table 1-4 provides an overview of the control options included in the 85 percent capture in a representative year option.

Table 1-4. District Control Option

Control Limit	Latent Storage	Flap Gate Control	Gravity Flow Control	Control Gate	In-line Storage	Off-line Storage	Storage / Transport 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 as in-line and latent storage. These proposed control options will take advantage of the existing CS and SRS pipe networks for additional storage volume. Existing DWF from the collection system will remain the same, and overall district operations will remain the same, although additional WWF will be collected from the SRS/CS systems and forwarded to the NEWPCC for treatment.

The Selkirk district discharges to the interceptor by gravity; therefore, it will also require a method of flow control to optimize and control the discharge rate to the interceptor for future dewatering RTC controls. Refer to Section 3.3.5 of Part 2 of the CSO Master Plan for discussion on the interaction of the gravity control on the system for all gravity discharge locations.

Floatable control will be necessary to capture any undesirable 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.

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 Latent Storage

Latent storage is proposed as a control option for the Selkirk district. Latent storage will use the Burrows SRS outfall and associated SRS system. The latent storage level in the system is controlled by the river level on the Red River, which has been modelled as the NSWL for the 1992 representative year, and the resulting backpressure of the river level on the Burrows SRS outfall flap gate, as explained in Part 3C. The latent storage design criteria are identified in Table 1-5.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	Burrows – 221.84 m	Flap Gate invert
NSWL	223.69 m	
Trunk Diameter	2400 mm	
Design Depth in Trunk	1846 mm	
Maximum Storage Volume	1680 m^3	
Force main	100 mm	
Flap Gate Control	N/A	
Lift Station	Yes	
Nominal Dewatering Rate	0.015 m^3/s	Based on 24 hour emptying requirement
RTC Operational Rate	TBD	Future RTC/ dewatering assessment

Note:

NSWL - normal summer water level

RTC – Real Time Control

Latent storage is readily accessible and has lower risk for implementation than other combined sewage temporary storage means. In order to facilitate an operational latent system, a latent pump station and interconnecting pipes will be required to access the storage. The latent storage pumping system would connect to the SRS outfall chamber and discharge back to the CS system once capacity allows. A conceptual layout for the pump station and force main is shown on Figure 37-02. The pump station will be located adjacent to the SRS outfall gate chamber at the edge of Burrows Avenue. The latent force main will pump the stored combined sewage back into the Selkirk CS system via the upstream manhole on the CS lateral on Burrows Avenue immediately adjacent to the SRS outfall (S-MH00012329). The pump station 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.

Figure 37 identifies the extent of the SRS system within Selkirk district that would be used for latent storage. The maximum storage level is directly related to the NSWL under the 1992 representative year conditions, and the size and depth of the SRS system. Once the level in the SRS exceeds the river level, the flap gate opens, and the combined sewage is discharged to the river. At this point the latent storage in the system is no longer utilized.

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 chamber and the pump station would be sized to provide sufficient flow to the pumps while all pumps are operating.

1.6.2 In-Line Storage

In-line storage is proposed as a CSO control for the Selkirk 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 and provide an overall higher volume capture. The control gate installation will also provide the necessary additional hydraulic head for screening operations.

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 1-6.

Table 1-6. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	223.69 m	Downstream invert of lowest pipe at diversion chamber
Trunk Diameter	1600 x 2000 mm	Egg shaped sewer
Gate Height	0.41 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	224.79 m	
Bypass Weir Level	224.69 m	
Maximum Storage Volume	287 m^3	
Nominal Dewatering Rate	0.57 m^3/s	Based on minimum pass forward rate for gravity discharge district
RTC Operational Rate	TBC	Future RTC / dewatering

The proposed control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 37. 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 ecess 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 existing DWF diversion will continue with its current operation, with all DWF being diverted to the Main Interceptor.

Figure 37-01 provides an overview of the conceptual location and configuration of the control gate and screening chambers. The proposed control gate will be installed in a new chamber within the existing trunk sewer alignment and located west of the Selkirk FPS. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5.0 m in length and 3.0 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. The existing sewer configuration may have to be modified to allow the installation of the in-line gate and screening chambers. 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 FPS rehabilitation or replacement project.

The nominal rate for dewatering is determined by the performance of the existing pipe capacity as the district is a gravity discharge district. As such the flows will vary over the duration of a rainfall event and has been nominated for a gravity flow control device. Any future consideration for RTC improvements would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflow at this district. The control device would be set to a rate similar to the existing pipe full capacity to allow the set limit to be known. This would allow the future RTC control the ability to capture and treat more volume for localized storms in other districts by using the excess interceptor capacity made available by restricting the pass forward flows through the control device where the runoff is less.

1.6.3 Gravity Flow Control

Selkirk district does not include a lift station (LS) and discharges directly to the Main Interceptor by gravity. A flow control device will be required to control the diversion rate for future RTC and dewatering assessment. A standard flow control device was selected as described in Part 3C. This has been taken as part of the City's future vision to develop a fully integrated CS system network and will be needed to review flows during spatial rainfall WWF scenarios. The CSO Master Plan assessment utilized a uniform rainfall event and no further investigative work has been completed within the CSO Master Plan.

The flow controller would be installed at an optimal location on the connecting sewer between the diversion chamber and the Main Interceptor pipe on Selkirk Avenue. Figure 37-01 identifies a conceptual location for flow controller installation. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction. The diversion weir at the CS outfall may have to be adjusted to match the hydraulic performance of the flow controller.

A gravity flow controller has been included as a consideration in developing a fully optimized CS system as part of the City's long-term objective. The operation and configuration of the gravity flow controller will have to be further reviewed for additional flow and rainfall scenarios.

1.6.4 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens would be designed to maintain the current level of basement flooding protection. The overflows which would normally discharge over the existing primary weir will be directed to the screens via a new side overflow weir located in a new screening chamber, with screened flow discharged to the downstream side of the weir chamber to the river.

The type and size of screens depend on the LS and the hydraulic head available for operation. A standard design was assumed for screening and is described in Part 3C. The design criteria for screening with gate control implemented, are listed in Table 1-7.

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.79 m	
Bypass Weir Crest	224.69 m	
NSWL	223.69 m	
Maximum Screen Head	1.00 m	
Peak Screening Rate	1.00 m3/s	
Screen Size	1.5 m x 1.0 m	Modelled Screen Size

The proposed side overflow weir and screening chamber will be located adjacent to the existing combined trunk sewer, as shown on Figure 37-01. The screens will operate once levels within the sewer surpassed the bypass side weir elevation. The side weir will be located upstream of the control gate and 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 would include screenings pumps with a discharge returning the screened material back to the interceptor and on to the NEWPCC for removal.

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 3.3 m in length and 3.1 m in width. The existing sewer configuration 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 applicable GI controls.

Selkirk has been classified as a high GI potential district. Land use in Selkirk is mix of residential, commercial, and institutional. The east end of the district is bounded by the Red River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. Commercial areas are suitable to green roofs and parking lot areas are ideal for paved porous pavement.

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.

The latent storage would take advantage of the SRS infrastructure already in place, therefore, minimal additional maintenance will need to be anticipated. The proposed latent LSPS will require regular maintenance that would depend on the frequency of operation. The flap control gate will require maintenance inspection for continued assurance that the flap gate would open during WWF events.

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.

The flow controller will require the installation of a chamber, flow control equipment and monitoring and control instrumentation. The flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required.

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. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is summarized in Table 1-8.

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added to Model
2013 Baseline	256	256	10,500	70	N/A
2037 Master Plan – Control Option 1	256	256	10,500	70	Lat St, IS, SC

Notes:
Lat St = Latent Storage

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 1-9 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 1-9. 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)	159,995	172,507	-	21	0.537 m^3/s
Latent Storage	143,086	157,563 [b]	14,944	18	0.537 m^3/s
In-Line Storage & Latent Storage		150,161	22,346	18	0.540 m^3/s
Latent, In-line & Off-line Storage	29,210	N/A[d]	N/A[d]	N/A[d]	N/A[d]
Control Option 1	**29,210**	**150,161**	**22,346**	**18**	**0.540 m^3/s**

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

[b] Assessment completed with individual district models and reductions attributed to full model impact overflows provided

[c] In-line and Off-line storage not assessed independently during the Preliminary Proposal

[d] Off-line storage removed as recommendation during Master Plan assessment.

The percent capture performance measure is not included in Table 1-9, as it is applicable to the entire CS system and not for each district individually. It is noted that the location and gravity discharge nature of the Selkirk district are affected by the control options selected for both the upstream and downstream districts. The improvement or worsening of this district's performance will be affected and once all Control Option 1 recommended works are implemented will the overflow volumes be achieved.

The selection of an off-line storage tank during Preliminary Proposal has been reconsidered during the CSO Master Plan phase as it was found to not be required to meet the Control Option 1 limit.

1.9 Cost Estimates

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 1-10Table 1-10. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 to plus 100 percent.

Table 1-10. Cost Estimate – 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)
Latent Storage	$1,290,000	$1,830,000	$70,000	$1,510,000
In-Line Storage	$- [a]	$2,460,000 [b]	$43,000	$930,000
Screening		$3,030,000 [c]	$53,000	$1,130,000
Gravity Flow Control	N/A	$1,280,000	$34,000	$740,000
Off-Line Storage	$13,450,000	N/A [d]	N/A [d]	N/A [d]
Subtotal	**$14,740,000**	**$8,600,000**	**$201,000**	**$4,310,000**
Opportunities	N/A	$860,000	$20,000	$430,000
District Total	**$14,740,000**	**$9,460,000**	**$221,000**	**$4,740,000**

[a] Solutions developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Preliminary Proposal recommended in-line storage and screening for CO1 PP. Costs for these items of work found to be $4,520,000 in 2014 dollars

[b] Cost associated with new off-take construction, as required, to accommodate control gate and screening chambers in location and allow intercepted CS flow to reach Selkirk gravity discharge interceptor was not included in Master Plan

[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

[d] Off-line storage removed as recommendation during Master Plan assessment.

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.

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 1-11.

Table 1-11. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	In-Line Storage	A control gate was not included in the preliminary proposal estimate.	Added for the MP to further reduce overflows and optimize in-line.
	Screening	Not included in the preliminary proposal estimate.	Added in conjunction with the In-Line Storage Control Gate.
	Gravity Flow Control	A flow controller was not included in the preliminary proposal estimate	Added for the Master Plan to control and monitor pass forward flows
	Removal Of Off-Line Tank Storage	Removed from the Master Plan assessment	Not needed to achieve 85 percent capture target.
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 1-12 provides a description of how the regulatory target adjustment could be met by building off the proposed work identified in Control Option 1.

Overall the Selkirk district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume to meet future performance targets.

Table 1-12. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Increased use of GI • Opportunistic Sewer Separation • Off-line Storage (Tank/Tunnel)

The Selkirk district has been aligned to meet the 85 percent capture on a system wide basis. The applicability of the listed migration options will also be dependent on other district options as these interact and would be required to be assessed on a system wide basis rather than individual district option basis.

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 part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-13.

Table 1-13. 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
9	Approvals and Permits	-	-	-	-	-	R	-	-

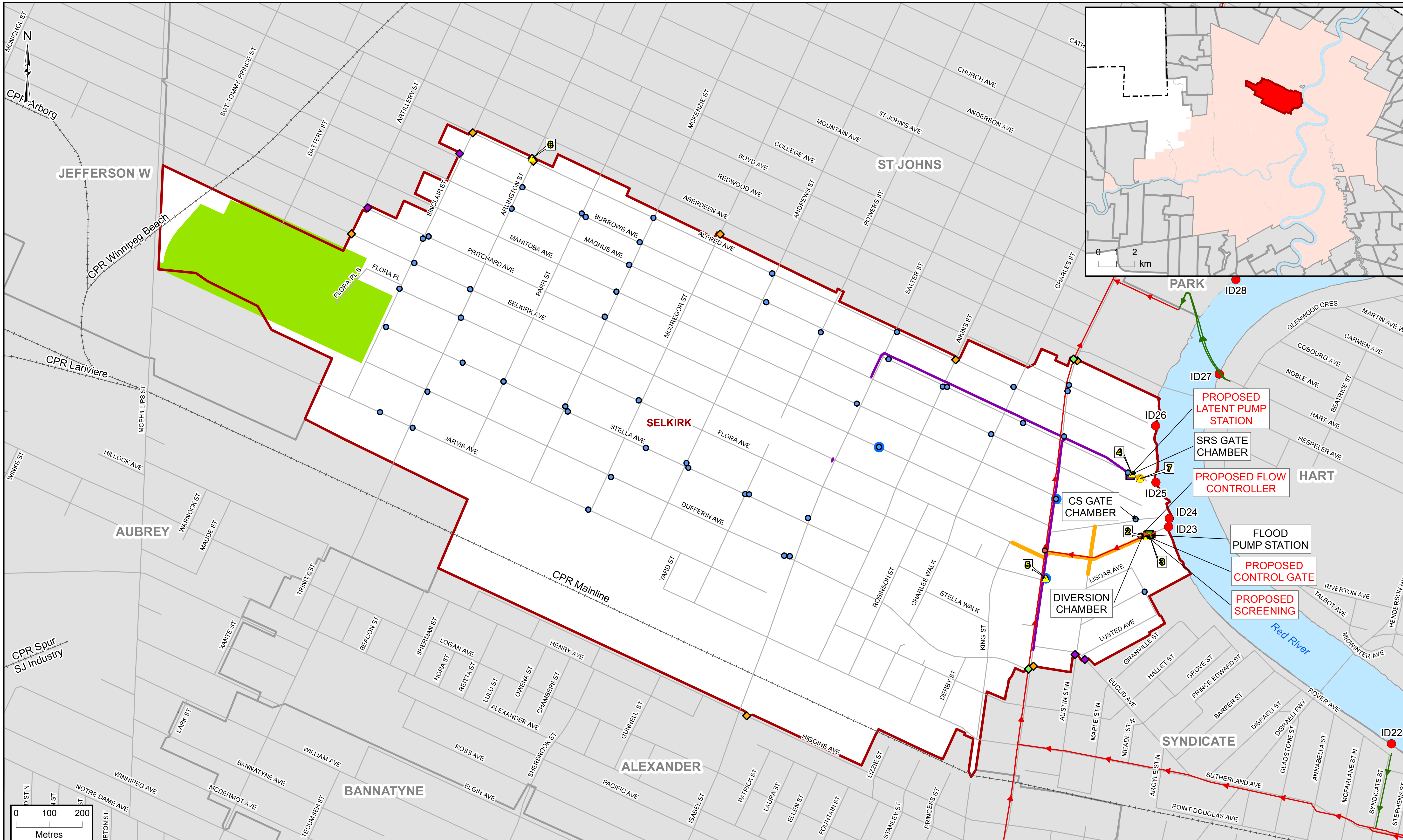
Table 1-13. Control Option 1 Significant Risks and Opportunities

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
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. *Sewer Relief Study: Selkirk Combined Sewer District*. Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. July.



LEGEND

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

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

District Boundary Crossing
- CS
- SRS
- 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
- Extent of In-line Storage
- Latent Force Main

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 37
District Overview Map
Sewer District: Selkirk
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\SELKIRK\SELKIRK_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 9:48:51 AM

LEGEND

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

Sewer By Type
- CS
- SRS

Control Structure Type
- Gate Chamber

Pump Station Type
- Diversion Chamber
- Flood Pump Station

CSO MASTER PLAN
PROPOSED SOLUTIONS
- Control Gate
- Screening
- Flow Controller

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 37-01
Control Gate, Screening, and Flow Control
Sewer District: Selkirk
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\SELKIRK\SELKIRK_DISTRICT_DETAIL_SELKIRKAV.MXD SBEGG1 7/29/2019 9:46:34 AM

LEGEND

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

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 37-02
Latent SRS Control
Sewer District: Selkirk
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\SELKIRK\SELKIRK_DISTRICT_DETAIL_BURROWSAV.MXD SBEGG1 6/24/2019 9:10:14 AM

CSO Master Plan

St. Johns District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	St. Johns District Plan
Revision:	04
Date:	August 22, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	StJohns_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	09/14/2018	DRAFT for City Comment	DT	SB MF SG	
1	03/12/2019	DRAFT 2 for City Review	SB	MF	MF
2	07/2019	Final Draft Submission	DT	MF	MF
3	08/15/2019	Revised Final Draft Submission	MF	MF	MF
4	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. St. Johns District

1.1 District Description

The St. Johns district is located in the northwest sector of the combined sewer (CS) area along the western edge of the Red River and north of Selkirk district. The St. Johns district is approximately bounded by Alfred Avenue and Selkirk Avenue to the south, McPhillips Street to the west, Church Avenue and Atlantic Avenue to the north, and the Red River to the east.

The St. Johns district is primarily residential with single-family residential buildings located from McPhillips Street to Power Street and two-family residential buildings located from McGregor Street to Main Street. Commercial areas are located along Main Street and Mountain Avenue. Greenspace is distributed throughout St. Johns and includes Sinclair Park and Machray Park. There is approximately 9 ha of greenspace.

The Canadian Pacific Railway (CPR) Winnipeg Beach extends north-south through the western portion of the district. Regional roads in the district include Main Street, Salter Street, McGregor Street, Arlington Street and McPhilips Street in a north-south direction and Mountain Avenue and Redwood Avenue in the east-west direction.

1.2 Development

A portion of Main Street is located within the St. John's District. Main Street is identified as Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Main Street is to be promoted in the future.

1.3 Existing Sewer System

St. John's district encompasses an area of 343 ha[1] and includes a CS system and a storm relief sewer (SRS) system. This district does not include any areas that may be identified as LDS separated or separation ready. St. John's contains a combined SRS and CS outfall pipe, where both systems connect upstream of the outfall gate chamber and are discharged through a single outfall. Additionally, the outfall may act as a high-level relief overflow for the Main Street interceptor. The Hart sewage pump station also discharges to the 2250 mm WWS main interceptor within the St. John's district via a 375 mm WWS secondary interceptor that connects to the interceptor just south of Mountain Avenue at Main Street but has no interaction with the St. John's District CS System.

The CS system includes a diversion chamber, flood pump station (FPS), a combined SRS/CS outfall and outfall gate chamber. A flap gate and sluice gate are installed on this outfall pipe in the outfall gate chamber to control backflow into the CS and SRS systems under high river level conditions along the Red River. The CS system drains towards the St. Johns diversion chamber located on the east side of Main Street at the intersection of Main Street and St. John's Avenue. At this diversion chamber combined sewage from the St. John's district is diverted to the Main Street interceptor under DWF conditions. All CS in excess of the district primary weir capacity spills over the primary weir for the district and flows by gravity through the St. John's CS outfall and may overflow to the Red River. The CS trunk extends from the diversion chamber to the CS outfall located at the eastern end of St. Johns Avenue.

A single CS sewer trunk collects flow from most of the district and flows to the diversion chamber on St. John's Avenue. This 1625 mm by 2025 mm CS trunk extends along St. John's Avenue from the outfall gate chamber to McGregor Street. Multiple lateral sewers extend north and south from this main trunk.

[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

The SRS system includes various interconnections to the CS throughout the district. The main 2900 mm SRS trunk sewer for the district runs along Mountain Avenue with SRS laterals extending north and south. During wet weather flow (WWF) events, the SRS system provides relief to the CS system via the interconnections. Most catch basins are still connected to the CS system; no partial separation has been completed. The SRS uses the same outfall as the CS system and may discharge directly to the Red River. The St. John's SRS System is connected with a portion of SRS system in the Selkirk District on Arlington Avenue and Burrows Avenue, and with the majority of the SRS System in the Jefferson West District via an interconnection at Mountain Avenue and McPhillips Street. There is also a 375 mm diversion pipe within the SRS that will send the SRS flow into the Main Street Interceptor. This diversion pipe is located just west of the intersection of Mountain Avenue and Charles Street. Under WWF conditions this diversion pipe will become surcharged, and all excess CS collected in the SRS will continue to the St. John's outfall to discharge to the river.

During dry weather flow (DWF), the SRS is not required; sanitary sewage flows to the diversion chamber upstream of the CS outfall and is diverted by the primary weir for the St. John's district to a1800 mm secondary interceptor pipe, where it flows by gravity west to connect to the Main Interceptor and eventually to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow, any flows that exceeds the diversion capacity overtops the primary weir and may be discharged to the river. When the river levels in the Red River adjacent to the St. John's CS/SRS outfall is high, the flap gate on the outfall gate chamber will prevent gravity discharge to the river. Under these conditions, the excess flow is pumped by the St Johns FPS to a point in the St Johns CS Outfall downstream of the flap gate, where it can be discharged to the river by gravity.

The one CS outfall to the Red River (combined CS and SRS outfall) is as follows:

- ID28 (S-MA70007551) – St. Johns CS/SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between St. Johns and the surrounding districts. Each interconnection is shown on Figure 38 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Polson

- The 2250 mm Main Interceptor flows by gravity north on Main Street from St. Johns district into Polson district towards the NEWPCC:
  - Invert at St. Johns district boundary 218.82 m (S-MA70008105)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Selkirk

- The 2250 mm Main Interceptor flows by gravity into St. Johns district north on Main Street towards the NEWPCC for treatment:
  - Invert at Selkirk district boundary 219.83 m (S-MA00016856)

1.3.1.2 District Interconnections

Selkirk

<u>CS to CS</u>

- A 300 mm CS flows north by gravity on Arlington Street into St. Johns district from Selkirk district:

  - Invert at Selkirk district boundary 228.65 m (S-MA00014590)
- A 300 mm CS flows by gravity northbound on Aikins Street into St. Johns district:
  - Invert at Selkirk district boundary 227.20 m (S-MA00015124)
- A 300 mm CS flows by gravity north on Main Street and connects to the CS network in St. Johns district at the intersection of Main Street and Redwood Avenue:
  - Invert at Selkirk district boundary 227.60 m (S-MA00015398)

<u>SRS to SRS</u>

- A 2150 mm SRS flows by gravity eastbound on Burrows Avenue from St. Johns district into Selkirk district:
  - Invert at Selkirk district boundary 223.64 m (S-MA00014318)
- A 2150 mm SRS flows by gravity northbound on Arlington Street into St. Johns district:
  - Invert at Selkirk district boundary 223.57 m (S-MA00014588)
- High point manhole:
  - 300 mm CS on Selkirk Avenue – 229.19 m (S-MH00008778)
  - 300 mm CS on McGregor Street – 228.33 m (S-MH00013219)
- High sewer overflow:
  - 450 mm SRS on Artillery Street – 229.34 m (S-MH00012613)
  - 250 mm SRS on Alfred Avenue – 229.84 m (S-MH00012868)

Jefferson West

<u>SRS to SRS</u>

- A 2900 mm SRS trunk flows by gravity from Jefferson West district into St. Johns district on Mountain Avenue and connects to the SRS network in St. Johns district:
  - Invert at Jefferson West district boundary 224.78 m (S-MA00010486)

<u>SRS to CS</u>

- A 2150 mm SRS diverts from the CS system in Jefferson West district and flows eastbound by gravity on Burrows Avenue into St. Johns district:
  - Invert at Jefferson West district boundary 224.50 m (S-MA70015831)
- High sewer overflow:
  - Selkirk Avenue and McPhillips Street – 229.68 m (S-MH00008715)
  - Manitoba Avenue and McPhillips Street – 229.43 m (S-MH00008744)
  - Alfred Avenue and McPhillips Street – 229.49 m (S-MH00008303)
  - Aberdeen Avenue and McPhillips Street – 229.19 m (S-MH00008304)
  - McPhillips Street and Mountain Avenue – 225.46 m (S-MH00008426)
  - McPhillips Street and Mountain Avenue – 225.43 m (S-MH00008425)

Polson

<u>CS to WWS</u>

- The 750 mm Interceptor flows west by gravity on Polson Street from Polson district into St. Johns district into the 2250 mm Main Interceptor on Main Street:

- Invert at St. Johns district boundary 219.54 m (S-MA00018028)

CS to CS

- The main 1675 mm by 2150 mm CS trunk in Polson district flows by gravity into St. Johns district at the corner of Polson Avenue and Main Street:
  - Invert at Polson district boundary 222.99 m (S-MA00009348)
- A 925 mm by 1200 mm CS flows southbound on Main Street servicing sections of Polson district and crosses into St. Johns district where it connects to the main CS trunk at the corner of Polson Avenue and Main Street:
  - Invert at St. Johns district boundary 223.45 m (S-MA00009340)

CS to SRS

- A 750 mm SRS relieves the CS system on Machray Avenue in Polson district and flows by gravity southbound on Kildarroch Street into St. Johns district where it connects to the main 2900 mm SRS on Mountain Avenue:
  - Invert at St. Johns district boundary 225.20 m (S-MA00012123)
- A 750 mm SRS flows northbound by gravity on Salter Street and connects to the CS system in Polson district at the intersection of Salter Street and Polson Avenue:
  - Invert at Polson district boundary 224.55 m (S-MA00009212)
- A 450 mm SRS provides relief from the manhole at the intersection of Atlantic Avenue and Aikins Street in St. Johns district and flows by gravity to connect to the main CS in Polson district:
  - Invert at Polson district boundary 224.21 m (S-MA00009270)
- A 375 mm SRS flows southeast by gravity at Cathedral Avenue and Emslie Street from Polson district into St. Johns district:
  - Invert at St. Johns district boundary 225.69 m (S-MA00016728)
- A 450 mm SRS flows south by gravity on Emslie Street from Polson district into St. Johns district:
  - Invert at St. Johns district boundary 225.43 m (S-MA00015777)

CS to CS

- A 450 mm SRS flows by gravity from a manhole at the intersection of Main Street and Luxton Avenue where it relieves the CSs and connects to the 925 mm by 1200 mm CS in Polson district:
  - Invert at Polson district boundary 224.05 m (S-MA00009352)
- High point manhole:
  - Tinniswood Street – 229.48 m (S-MH00008542)
  - Radford Street – 229.45 m (S-MH00008556)
  - Monreith Street at Church Avenue – 229.24 m (S-MH00008543)
  - Robertson Street at Church Avenue – 228.90 m (S-MH00010474)
  - Kildarroch Street – 229.08 m (S-MH00010481)
  - Airlies Street at Church Avenue – 228.78 m (S-MH00010493)
  - Minnigaffe Street at Church Avenue – 229.271 m (S-MH00010536)
  - Penninghame Street at Church Avenue – 228.82 m (S-MH00010604)
  - Luxton Avenue – 228.34 m (S-MH00011069)
  - Atlantic Avenue – 227.71 m (S-MH00014025)
  - Bannerman Avenue at Emslie Street – 228.19 m (S-MH00014033)

- Cathedral Avenue at Emslie Street – 227.68 m (S-MH00014021)
- High sewer overflow:
  - Dalton Street at Machray Avenue – 229.35 m (S-MH00010407)
  - Bannerman Avenue – 227.96 m (S-MH00006413)

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

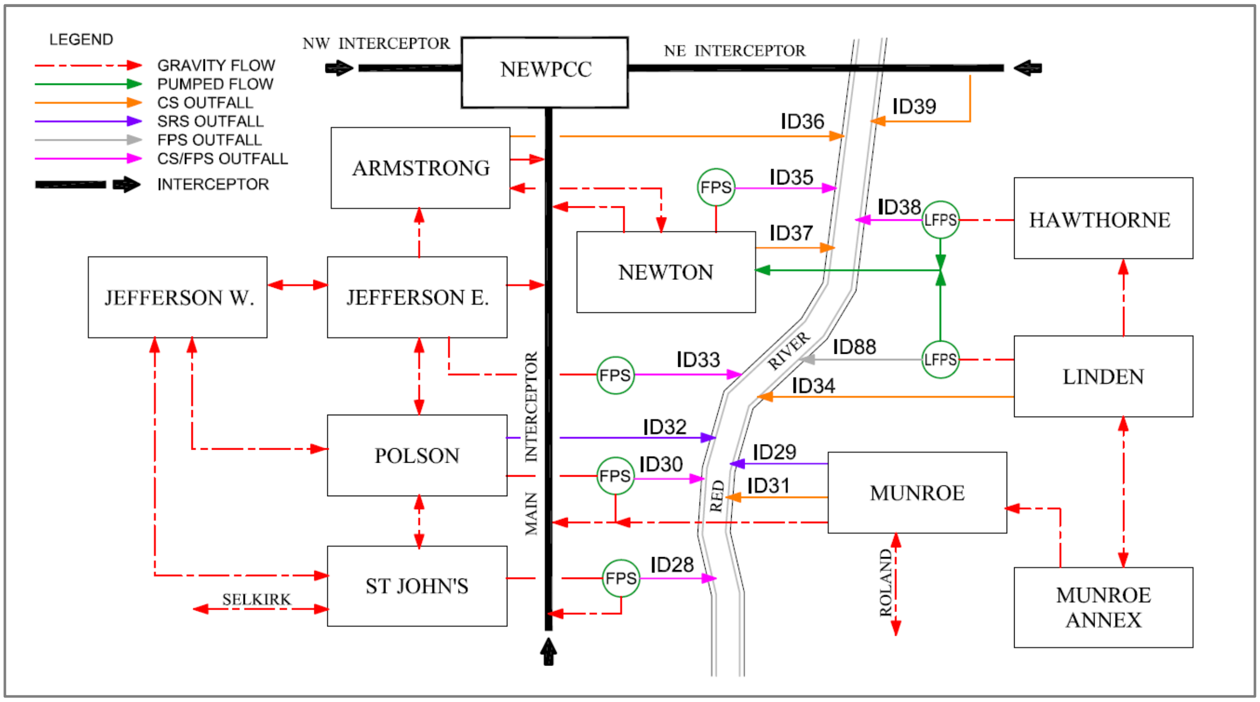


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 11 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/SRS Outfall (ID28)	S-CO70007985.1	S-MA70007551	3000 mm	Red River Invert: 220.66 m
Flood Pumping Outfall (ID28)	S-CO70007985.1	S-MA70007551	3000 mm	Red River Invert: 220.66 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-TE00006659.1	S-MA00015615	1625 x 2025 mm	Egg-shaped Invert: 223.28 m
SRS Interconnections	N/A	N/A	N/A	89 SRS - CS
Main Trunk Flap Gate	S-TE70026922.2	S-CG00000886	3000 mm	Invert: 221.97 m
Main Trunk Sluice Gate	S-CS00000450.1	S-CG00001019	1330 x 1330 mm	Invert: 221.17 m
Off-Take	S-TE00006662.2	S-MA70017206	600 mm	Invert 223.06 m
Dry Well	N/A	N/A	N/A	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Total Capacity	N/A	S-MA70017206 [(1)]	600 mm [(1)]	2.265 m3/s [(1)] (minimum pff 0.058 m^3/s downstream)
ADWF	N/A	N/A	0.045 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	St Johns is a gravity discharge district.
Flood Pump Station Total Capacity	N/A	N/A	3.8 m^3/s	2 x 1.4 m^3/s 2 x 0.52 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.311 m^3/s	

Notes:

[(1)] – Gravity pipe replacing Lift Station as St Johns is a gravity discharge district

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	St. Johns – 223.68
2	Trunk Invert at Off-Take	N/A
3	Top of Weir	223.77
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection (S-MH00013765)	221.76
6	Sewer District Interconnection (Polson)	222.96
7	Low Basement	229.97
8	Flood Protection Level (St. Johns)	229.14

[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 St. Johns was the Flood Relief Study (IDE, 1980). A storm relief sewer (SRS) system was installed in the district as a result of this study. No other work has 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 St. John's 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	Planned Completion
38 – St. Johns	1980	Future Work	2013	Study Complete	N/A

Source: Report on Flood Relief Study, 1980

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the St. John's 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 St. Johns district has latent storage, in-line storage via control gate, gravity flow control, and floatable control via screening proposed to meet CSO Control Option 1. Program opportunities including green infrastructure (GI) and real time control (RTC) will also be included as applicable.

Table 1-4 provides an overview of the control options included in the 85 percent capture in a representative year option.

Table 1-4. District Control Option

Control Limit	Latent Storage	Flap Gate Control	Gravity Flow Control	Control Gate	In-line Storage	Off-line Storage	Storage / Transport 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 as in-line and latent storage. These control options will take advantage of the existing CS pipe network for additional storage volume. Existing DWF from the collection system will remain the same, and overall district operations will remain the same.

A gravity flow controller is proposed on the CS system to optimize the dewatering rate from the district back into the Main Street interceptor. St. Johns district discharges to the interceptor by gravity; therefore, it will also require a method of flow control to optimize and control the discharge rate to the interceptor for future dewatering RTC controls. Refer to Section 3.3.5 of Part 2 for discussion on the interaction of the gravity control on the system for all gravity discharge locations.

Floatable control will be necessary to capture any undesirable 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. Screens will be installed downstream of the diversion chamber located near Main Street and St. Johns Avenue.

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 Latent Storage

Latent storage is proposed as an alternative control option for the St. Johns district. Latent storage will use the existing St. Johns SRS system. It is proposed to isolate the SRS from the CS outfall system, the St Johns district has a shared CS outfall (S-MA70007551) via the installation of a new flap gate. The proposed location of the new flap gate chamber is shown on Figure 38-02. The latent storage level in the system is controlled by river level and the resulting backpressure of the river level on the St. Johns SRS outfall flap gate, as explained in Part 3C. The latent storage design criteria are identified in Table 1-5. As noted in Section 1.3, the district has a gravity connection directly to the Main Interceptor sewer. This proposal allows the City to control and monitor the latent storage discharge needed as part of the future RTC controls. This will also isolate the SRS system from reverse flow and acting as overflow from Main Street Interceptor under spatial rainfall conditions.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	221.97 m	New Flap Gate invert
NSWL	223.68 m	
Trunk Diameter	2900 mm	
Design Depth in Trunk	1710 mm	
Maximum Storage Volume	8204 m^3	
Force main	300 mm	
Flap Gate Control	N/A	
Lift Station	Yes	
Nominal Dewatering Rate	0.085 m^3/s	Based on 24-hour emptying requirement
RTC Operational Rate	TBD	Future RTC/ dewatering assessment.

Note:

NSWL - normal summer water level
RTC – Real Time Control

Latent storage is accessible and has a lower risk than other storage types. In order to facilitate an operational latent system, a latent pump station and interconnecting pipes will be required to access the storage. A conceptual layout for the pump station and force main is shown on Figure 38-02. The pump station will be located adjacent to the SRS outfall gate chamber at the edge of St. Johns Avenue. The latent force main will pump to the manhole along the Main Interceptor on Main Street (S-TE00006649). The pump station 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 existing SRS system has a gravity discharge connection directly to the Main Interceptor via a 375mm diameter pipe and this has been replaced in this latent storage proposal. However, the inclusion of the latent pump station will allow the City to control the discharge flows for the future RTC considerations.

Figure 38 identifies the extent of the SRS system within Selkirk district that would be used for latent storage. The maximum storage level is directly related to the NSWL, and the size and depth of the SRS system. Once the level in the SRS exceeds the river level, the flap gate opens, and the combined sewage in the SRS system is discharged to the river.

The river level backpressure will keep the SRS flap gate closed and system level maintained at or below the NSWL. This level utilizes 59 percent of the SRS pipe height and it was found that additional flap gate control is not recommended as required to meet the Control Option 1 requirements. In situations where non modelled assessments are to be completed, the actual river levels will be both lower and higher than the NSWL level at various points throughout an annual year. Where the level is below NSWL, the latent volume will be less than predicted during the MP assessment, while conversely when the level is above the NSWL, the latent volume will be more than predicted. The continuous assessment is seen as a conservative approach since the majority of the representative year rainfall events occur when the river levels are higher than the NSWL.

The lowest interconnection between the combined sewer and relief pipe systems is higher than the proposed latent and in-line storage control levels, meaning that the two systems would function independently.

As described in the standard details in Part 3C wet well sizing for the latent pump station will be determined based on the final pump selection, operation and dewatering capacity required. The interconnecting piping between the new gate chamber and the pump station would be sized to provide sufficient flow to the pumps while all pumps are operating.

1.6.2 In-Line Storage

In-line storage is proposed as a CSO control for the St. Johns 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 and provide additional hydraulic head for screening operations.

A standard design was assumed for the control gate, as described in Part 3C. The standard approach used for conceptual gate sizing was to assume 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 1-6.

Table 1-6. In-Line Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	223.28 m	Downstream invert of lowest pipe at diversion chamber
Trunk Diameter	1625 x 2025 mm	
Gate Height	0.62 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	224.39 m	
Maximum Storage Volume	188 m^3	
Nominal Dewatering Rate	0.058 m^3/s	Based on minimum pass forward rate for gravity discharge district (pipe full capacity)
RTC Operational Rate	TBD	Future RTC/ dewatering assessment

Notes:

NSWL = normal summer water level
RTC = real time control

The proposed control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 38. 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 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 existing DWF diversion will continue with its current operation, with all DWF being diverted to the Main Interceptor.

Figure 38-01 provides an overview of the conceptual location and configuration of the control gate and screening chambers. The proposed control gate will be installed in a new chamber within the trunk sewer alignment and located west of the Selkirk FPS. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5.1 m in length and 3.0 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. The existing sewer configuration may have to be modified to allow the installation of the in-line gate and screening chambers. 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 FPS rehabilitation or replacement project. It is envisaged that a road closure would be necessary to allow construction activities to occur with minor disruptions to local residents. Road access could be achieved via adjacent local roads and the location within the local street is adjacent to the St John's Park reducing resident disruptions.

The lowest interconnection between the combined sewer and relief pipe systems is higher than the proposed latent and in-line storage control levels, meaning that the two systems would function independently.

The nominal rate for dewatering is determined by the performance of the existing pipe capacity as the district is a gravity discharge district. As such the flows will vary over the duration of a rainfall event and has been nominated for a gravity flow control device. Any future consideration, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflow at this district. The control device would be set to a rate similar to the existing pipe full capacity to allow the set limit to be known. This would allow the future RTC control the ability to capture and treat more volume for localized storms in other districts by using the excess interceptor capacity made available by restricting the pass forward flows through the control device where the runoff is less.

1.6.3 Gravity Flow Control

St. Johns district does not include a lift station (LS) and discharges directly to the Main interceptor by gravity. A flow control device will be required to control the diversion rate and the level of in-line storage for future RTC and dewatering assessments.

A standard flow control device was selected as described in Part 3C. This controller is considered suitable for the immediate dewatering rate control and future RTC applications. The device will include flow measurement and a gate to control the flow rate. This has been taken as part of the City's future vision to develop a fully integrated CS system network and will be needed to review flows during spatial rainfall WWF scenarios. The CSO Master Plan assessment utilized a uniform rainfall event and no further investigative work has been completed within the CSO Master Plan.

The flow control will be installed at an optimal location on the connecting sewer downstream of the diversion chamber within the offtake pipe or secondary interceptor, but upstream of the Main interceptor. Figure 38-01 identifies a conceptual location for the installation of the flow controller. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction. The diversion weir height at the St. Johns CS outfall may have to be adjusted to match the hydraulic performance of the flow controller. The structure would be located on the boulevard of Main Street and minor road closures would be required to provide sufficient working space during construction. This would cause disruptions to the street traffic along Main Street, but this would only be for a minimum amount of time during construction.

1.6.4 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens would be designed to maintain the current level of basement flooding protection. The overflow which discharges over the existing weir will be directed to the screens located in a new screening chamber, with screened flow discharged to the downstream side of the screening chamber to the river.

The type and size of screens depend on the LS and the hydraulic head available for operation. A generic design was assumed for screening and is described in Part 3C. The design criteria for screening with gate control implemented, are listed in Table 1-7.

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.39 m	
Bypass Weir Crest	224.29 m	
NSWL	223.68 m	
Maximum Screen Head	0.607 m	
Peak Screening Rate	1.2 m^3/s	
Screen Size	1.5 m x 1.0 m	Modelled Screen Size

The proposed side overflow weir and screening chamber would be located adjacent to the existing combined trunk sewer, as shown on Figure 38-01. The screens will operate once levels within the sewer surpassed the in-line control elevation. A side weir upstream of the 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 would include screenings pumps with a discharge returning the screened material back to the interceptor and on to the NEWPCC for removal. As this will be constructed with the control gate chamber, construction activity disruptions will be the same.

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 4.3 m in length and 3.1 m in width.

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 applicable GI controls.

St. Johns has been classified as a medium GI potential district. Land use in St. Johns is mix of residential and commercial. The east end of the district is bounded by the Red River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention within the residential areas. Commercial areas are suitable to green roofs and parking lot areas are ideal for paved porous pavement.

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.

The latent storage would take advantage of the SRS infrastructure already in place, therefore, minimal additional maintenance will need to be anticipated. The proposed latent LSPS will require regular maintenance that would depend on the frequency of operation. The flap gate proposed will require maintenance inspection for continued assurance that the flap gate would open during WWF events.

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.

The flow controller will require the installation of a chamber and flow control equipment. Monitoring and control instrumentation will be required. The flow controller will operate independently and require minimal operation interaction. Regular maintenance of the flow controller chamber and appurtenances will be required.

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. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is summarized in Table 1-8.

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	% Impervious
2013 Baseline	325	325	15,929	70	N/A
2037 Master Plan – Control Option 1	325	325	15,929	70	Lat St, SC, IS

Notes:

SC = Screening

IS = In-line Storage
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 reported in Section 1.3 Existing Sewer System, and in Section 1.8 Performance Estimate may occur.

The performance results listed in Table 1-9 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. Table 1-9 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 1-9. Performance Summary – Control Option 1

Control Option	Preliminary Proposal	Master Plan			
	Annual Overflow Volume (m^3) [a]	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [c]
Baseline (2013)	332,572	181,444	-	12	0.314 m^3/s
Latent Storage	335,263 [b]	- [d]	-	-	0.314 m^3/s
In-line & Latent Storage		- [d]	-	17	0.157 m^3/s
Tunnel, In-line & Latent Storage	72,428	N/A	N/A	N/A	N/A
Control Option 1	**72,428**	**- [d]**	**- [d]**	**- [d]**	**- [d]**

[a] Direct gravity connection from SRS system to Main Street Interceptor not included in Preliminary Proposal modelling assessment

[b] Latent and In-Line Storage were not simulated independently during the Preliminary Proposal assessment

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

[d] Model instability issues encountered with the St John's district as part of the Master Plan performance evaluation for overall City of Winnipeg sewer network. The individual district performance values were instead utilized for the control option performance evaluation, and are shown in the table below. Improvements to be investigated, CO1MP proposals allows system wide 85 percent capture target to be achieved.

Table 1-10. Performance Summary – Control Option 1 (Individual Model)

Control Option	Master Plan Overflow Reduction (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [a]
Revised Baseline (2013)	149,432	-	17	0.314 m^3/s
Latent Storage	146,112	3,320		0.314 m^3/s
Latent & In-line Storage	125,828	20,284	17	0.157 m^3/s
Control Option 1	**125,828**	**23,604**	**17**	**0.157 m^3/s**

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

The revisions to the baseline model performance is attributed to the updates to the InfoWorks model through the model maintenance process including the addition of a gravity discharge from the St Johns SRS system directly to the Main Interceptor. The performance of the district is seemingly negative due to the interaction of this gravity discharge district with the adjacent districts. No single change to the adjacent system for the 85 percent capture has been selected as the main contributor. The reduction in pass forward flows is attributed to the increase in CS in-line storage and the overflow profile being the same but the interaction with the Main Interceptor sewer being at a higher level for an extended period while other districts are contributing to the flows in the interceptor.

The percent capture performance measure is not included in Table 1-9, 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 1-11. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 to plus 100 percent.

Table 1-11. Cost Estimate – 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)
Latent Storage	N/A [a]	$3,140,000 [c]	$88,000	$1,890,000
Gravity Flow Control	N/A	$1,350,000	$34,000	$740,000
In-Line Storage	$7,740,000 [b]	$2,570,000 [d]	$44,000	$940,000
Screening		$3,220,000 [e]	$48,000	$1,040,000
Offline Tunnel Storage	$6,960,000	N/A	N/A	N/A
Offline Tank Storage	$21,550,000	N/A	N/A	N/A
Subtotal	**$36,240,000**	**$10,280,000**	**$215,000**	**$4,610,000**
Opportunities	N/A	$1,030,000	$21,000	$460,000
District Total	**$36,240,000**	**$11,310,000**	**$236,000**	**$5,070,000**

[a] Latent Storage not included in the Preliminary Proposal

[b] In-line Storage and Screening not costed separately in the Preliminary Proposal

Table 1-11. Cost Estimate – 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)

[c] Flap gate at new latent storage chamber not included in Master Plan costs.

[d] Cost associated with new off-take construction, as required, to accommodate control gate and screening chambers in location and allow intercepted CS flow to reach existing St John's gravity discharge was not included in Master Plan

[e] 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 opportunities, 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.

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 1-12.

Table 1-12. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Latent Storage	Not included in the preliminary estimate.	Added for the Master Plan to ensure the flows can be controlled for future RTC measures.
	Gravity Flow Controller	A flow controller was not included in the preliminary estimate	Added for the Master Plan to further reduce overflows.
	In-Line Storage	Updates to pricing and scope of work as part of Master Plan assessment.	
	Removal of Offline Tunnel Storage	Found to not be required to meeting Control Option 1 target during Master Plan assessment.	

Table 1-12. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
	Removal of Offline Tank Storage	Found to not be required to meeting Control Option 1 target during Master Plan assessment.	
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 1-13 provides a description of how the regulatory target adjustment could be met by building off the proposed work identified in Control Option 1.

Overall the St Johns district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increased capture volume. The existing SRS system could potentially be further utilized via the inclusion of flap gate control and flows to the Main Interceptor controlled further through the isolation of the gravity connection from the SRS to CS system on Mountain Avenue, although the removal of this connection will require additional infrastructure to ensure overflow volumes are improved.

Table 1-13. Upgrade to 98 Percent Capture in a Representative Year Summary

Upgrade Option	Viable Migration Options
98 Percent Capture in a Representative Year	• Opportunistic Sewer Separation • Increased use of GI • Further revisions to latent storage (flap gate control) • Off-Line Storage (Tank/Tunnel)

The control options for the St Johns district has been aligned for the 85 percent capture performance target based on the system wide evaluation basis. The interaction with the main interceptor and adjacent districts makes the expandability of this district to meet the 98 percent capture target potentially difficult without the increased isolation of the district or removal/storing of wet weather flows in the system.

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 as part of the CSO Master Plan and is included as part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-14.

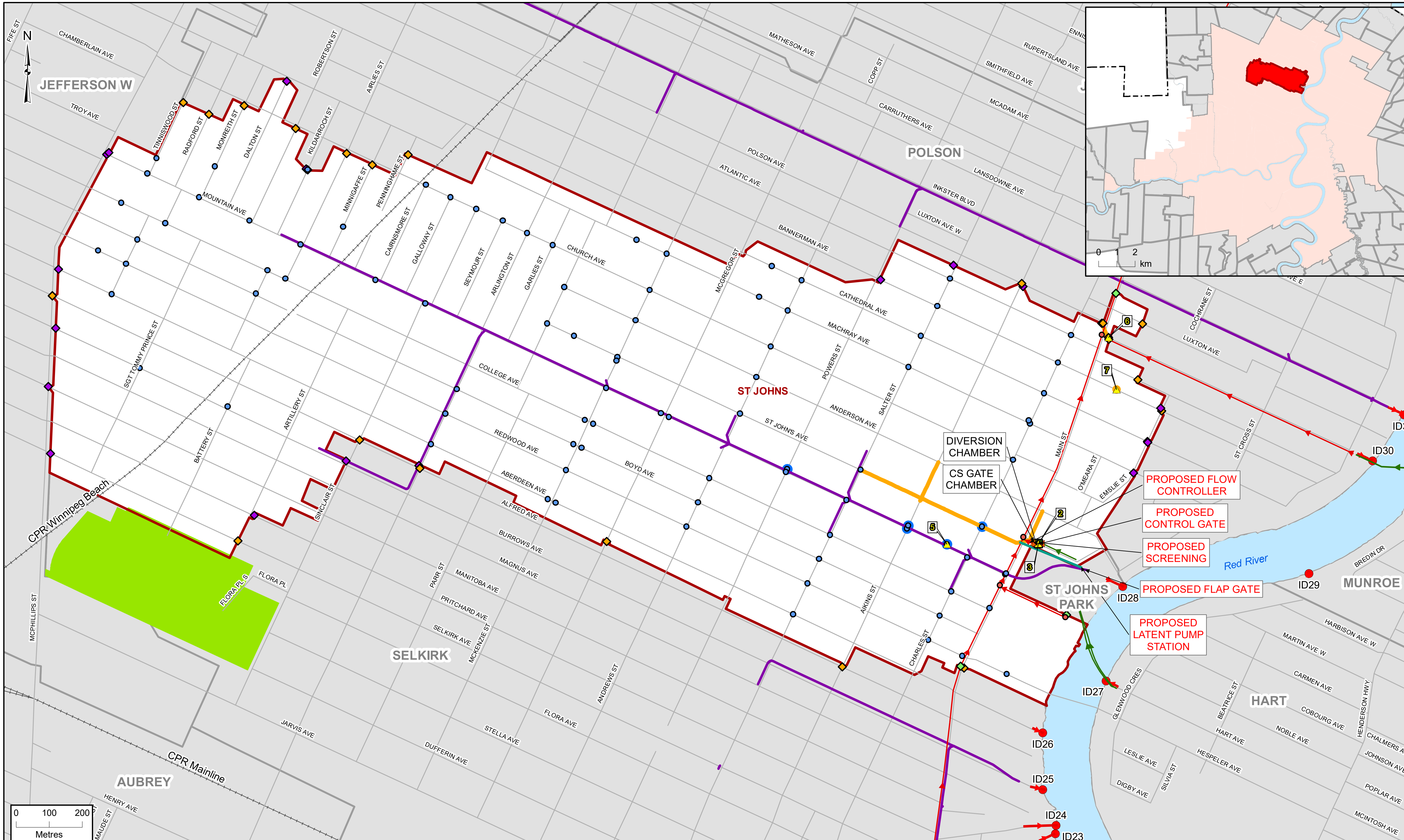
Table 1-14. Control Option 1 Significant Risks and Opportunities

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
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 (IDE). 1980. *Flood relief study - St. John's and Polson districts and the Sisler ward*. Prepared for the City of Winnipeg.



LEGEND

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

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

District Boundary Crossing
- CS
- SRS
- WWS

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

CSO MASTER PLAN PROPOSED SOLUTIONS

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

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 38
District Overview Map
Sewer District: St. Johns
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\STJOHNS\STJOHNS_DISTRICT_OVERVIEW_MAP.MXD DT072410 8/15/2019 10:56:33 AM

LEGEND

Primary Weir
Critical Elevation
Manhole
Force Main
Sewer By Type
CS
WWS
Control Structure Type
Gate Chamber
Pump Station Type
Diversion Chamber

CSO MASTER PLAN
PROPOSED SOLUTIONS
Proposed Latent Force Main
Control Gate
Screening
Flow Controller

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 38-01
Control Gate, Screening and Flow Control
Sewer District: St. Johns
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\STJOHNS\STJOHNS_DISTRICT_DETAIL_STJOHNSAVE.MXD SBEGG1 7/29/2019 9:53:19 AM

LEGEND

- Primary Weir
- Critical Elevation
- Manhole
- Force Main

Sewer By Type
- CS
- SRS
- WWS

Control Structure Type
- Gate Chamber

Pump Station Type
- Diversion Chamber

CSO MASTER PLAN
PROPOSED SOLUTIONS
- Proposed Latent Force Main
- Flap Gate
- Control Gate
- Screening
- Flow Controller
- Latent Pump

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 38-02
Latent SRS Control
Sewer District: St. Johns
City of Winnipeg
Combined Sewer Overflow Master Plan

Y:\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE6\STJOHNS\STJOHNS_DISTRICT_DETAIL_LATENTPUMP_2.MXD DT072410 8/15/2019 10:26:37 AM

JACOBS®

CSO Master Plan

Strathmillan District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No: 470010CH
Document Title: Strathmillan District Plan
Revision: 03
Date: August 15, 2019
Client Name: City of Winnipeg
Project Manager: John Berry
Author: Jack Tinker
File Name: Strathmillan_Plan_Final_CO1MP_08152019

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

Contents

Tables

Figure

1. Strathmillan District

1.1 District Description

Strathmillan district is located on the western edge of the combined sewer (CS) area. The district is bounded by Moorgate district to the east, Ainslie district to the north and west, and the Assiniboine River to the south. Ness Avenue is the northern border, Davidson Street and Conway Street are the eastern border, and Olive Street is the western border. This district has been developed primarily as a residential area, with a small commercial corridor located along Portage Avenue. Figure 39 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan control options.

Portage Avenue is the major transportation route that passes through the southern end of Strathmillan district and intersects with Mt. Royal Road, a high traffic route that connects Ness Avenue to Portage Avenue.

Land use in Strathmillan is mostly single-family residential. Approximately 6 ha of this district is classified as greenspace which includes the Strathmillan Lodge Park.

1.2 Development Potential

A portion of Portage Avenue is located within the Strathmillan District. Portage Avenue is identified as Regional Mixed-Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

Strathmillan has an approximate area of 81 ha[1] based on the district boundary. The system consists of a CS system and a land drainage (LDS) system. There is approximately 63 percent (51 ha) separated and no separation ready areas.

The CS system includes a diversion chamber, CS lift station (LS), and two CS outfalls. All domestic wastewater and CS flows collected in Strathmillan districts is routed to Portage Avenue, where the diversion chamber and main CS outfall are located

Two separate LDS systems provide CS separation and stormwater collection for a large portion of the district. The main 1350 mm LDS trunk runs south along Strathmillan Road through the whole of the district, commencing at Ness Avenue and discharges to the Assiniboine River at the district CS outfall. The CS outfall from the diversion chamber was connected to the LDS system during the construction of the LDS system. A second LDS system collects stormwater from the adjacent Ainslie district (between Silver Avenue and Ness Avenue) and discharges through the Strathmillan district in a 2100 mm and 2250 mm LDS trunk located in the back lane between Olive Street and Whytewold Road. The second LDS system discharges to the Assiniboine River via a dedicated LDS outfall, situated east of the Olive LS CS outfall.

A wastewater interceptor passes through the district along Portage Avenue flowing from east to west from the Moorgate district. The diversion chamber is located on Portage Avenue south of intersection with Strathmillan Road. The CS system for the district converges at this diversion chamber where flow is diverted to the interceptor. The interceptor continues west and drains to the Olive LS situated on the district border between Ainslie and Strathmillan.

[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) wastewater flows are directed by the diversion chamber weir to the Olive CS LS. DWF wastewater flows from the Ainslie district also discharge into the Olive LS. These flows are then pumped into the 900 mm St. James interceptor sewer on Assiniboine Avenue and transported ultimately to the West End Sewage Treatment Plant (WEWPCC) for treatment.

During wet weather flow (WWF), the diversion chamber weir may be overtopped, and the combined sewage is directed through the 900 mm combined sewer to the 1350 mm Strathmillan CS outfall. The CS outfall pipe connects with the 1350mm LDS trunk sewer pipe. The Strathmillan CS outfall pipe only has a positive gate protection, and must be manually activated under high river level conditions to protect the CS system. Under the conditions where the positive gate is closed however, gravity discharge from the CS outfall is not possible, due to sewage backing up against the positive gate. There is no flood station at this location; however, in the case where high river levels are predicted and the positive gate activation will prevent the outfall operation during a WWF event, temporary flood pumping can be put in place.

There is an infrequent manual interaction between the Strathmillan district and the 17 Wing Canadian Air Force Base immediately north of the district. A 400 mm force main flows south from 17 Wing in the Ainslie district, passing directly through Strathmillan and connecting to the Strathmillan outfall pipe immediately downstream of the Strathmillan diversion chamber and positive gate structure. The force main is part of the wastewater system surrounding the 17 Wing. 17 Wing has its own on-site wastewater treatment, and the treated sewage is transported via this force main. During normal operating conditions, the treated wastewater is prevented from entering the Strathmillan CS by a valve which is normally kept closed, resulting in the treated wastewater being discharged to the Assiniboine River. The City is instructed to open the valve when treatment capabilities within 17 Wing are offline, at which point the untreated wastewater is allowed to enter the Strathmillan CS upstream of the diversion chamber, so that it may be intercepted with the Strathmillan DWF to the downstream Olive CS LS for treatment by the City of Winnipeg.

The CS outfalls to the Assiniboine River is as follows:

- ID42 (S-MA70053789) – Strathmillan CS Outfall
- ID41 (S-MA20005373) – Ainslie CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Strathmillan and the surrounding districts. Each interconnection is shown on Figure 39 and shows gravity and pumped flow from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Ainslie

- A 400 mm force main from the 17 Wing base pumps sewage from a pump station in Ainslie on Silver Avenue through Strathmillan district to its outfall without connecting to other CS systems:
  - Ness Ave and Strathmillan Street invert at Ainslie district boundary - 231.93 m
- The Olive SPS pumps sewage through a 450 mm force main into the St James interceptor and into the Ainslie district:
  - Assiniboine Crescent at connection to Olive Lift station - 230.43m

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Moorgate

- A 375 mm force main pumps sewage from the Conway CS LS and along Portage Avenue into the interceptor sewer system within the Strathmillan district from Moorgate district:

- Portage Avenue and Conway Street invert at Strathmillan district boundary - 232.98 m

1.3.1.3 District Interconnections

Ainslie

CS to CS

- A 600 mm CS sewer flows by gravity from the Ainslie CS system into the Olive CS LS: Assiniboine Crescent at Olive LS invert at Strathmillan district boundary - 226.89 m

LDS to LDS

- The LDS crosses from Strathmillan into Ainslie by gravity flow to the LDS outfall at the Assiniboine River:
  - Assiniboine Crescent east of Olive CS LS, invert at Strathmillan district boundary - 228.86 m
- The 600 mm LDS from Ainslie flows by gravity into Strathmillan east of Olive Street and connects to the 2250 mm LDS that discharges into the Assiniboine River:
  - Olive Street and Portage Avenue invert at Strathmillan district boundary - 228.92 m
- The LDS uses gravity flow and connects to the large LDS in Strathmillan from Ainslie, on the west end of Lodge Avenue:
  - Lodge Avenue at Olive Street back lane invert at Strathmillan district boundary - 230.16 m
- The large 2100 mm LDS on Ness Avenue uses gravity flow to connect into Strathmillan district from Ainslie:
  - Ness Ave at Olive Street back lane invert at Ainslie district boundary - 230.52 m

Moorgate

LDS to LDS

- The LDS uses gravity flow to connect into the LDS system in Strathmillan on the eastern end of Lodge Avenue before Strathmillan Street:
  - Lodge Avenue and Davidson Street invert at Strathmillan district boundary - 231.53 m
- The LDS uses gravity flow to connect into the LDS system in Strathmillan on the eastern end of Bruce Avenue before Strathmillan Street:
  - Bruce Avenue invert at Strathmillan district boundary - 232.55 m
- A 450 mm LDS flows by gravity into Moorgate District on Mount Royal Road:
  - Mount Royal Road and Trail Avenue invert at Strathmillan district boundary - 233.16 m

A district interconnection schematic for the district is included as Figure 1-1**Error! Reference source not found.**. The drawing illustrates the collection areas, interconnections, pumping systems, and discharge points for the existing system.

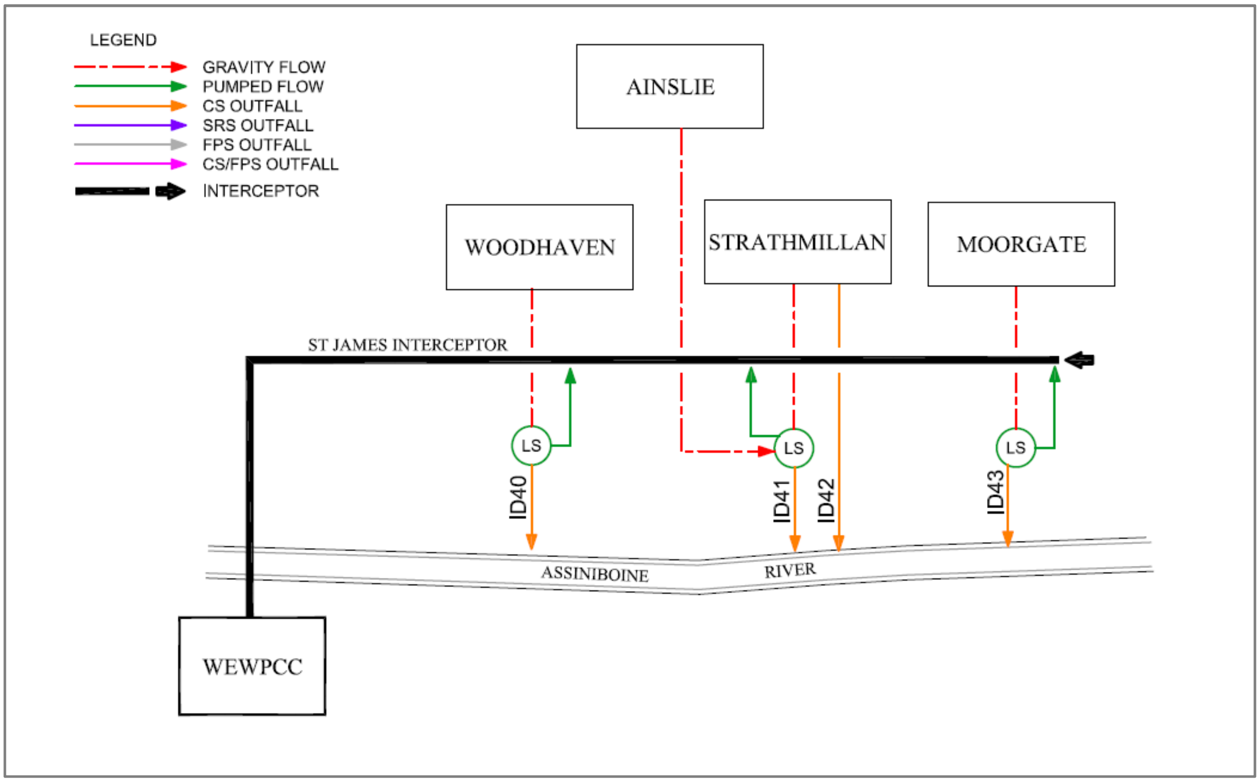


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 39 and are 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 (ID42)	S-TE70022123.1	S-MA70053789	1350 mm	Invert: 226.32 m Circular
Flood Pumping Outfall	N/A	N/A	N/A	No flood pumping station in this district
Other Overflows (ID41)	S-MA20005373.1	S-MA20005373	750 mm	Invert 228.0 m (model assumption) Circular
Main Sewer Trunk	S-TE70022127.1	S-MA70011333	900 mm	Invert: 228.29 m Circular
Storm Relief Sewer Outfalls	N/A	N/A	N/A	No SRS within district.
Storm Relief Sewer Interconnections	N/A	N/A	N/A	No SRS within district.
Main Trunk Flap Gate	S-CG00000923.1	S-CG00000923	750 mm	Invert: 228.30 m Circular
Main Trunk Sluice Gate	S-CG00001143.1	S-CG00001143	762 mm	Invert: 228.67 m Circular
Off-Take	S-TE70022127.2	S-MA70053808	300 mm	Invert: 228.47 m Circular
Wet Well	Olive Lift US.1	S-MA70016561	7.5 m x 2.14 m	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Total Capacity (Olive CS LS)	N/A	N/A	0.308 m^3/s	2 pumps @ 0.154 m^3/s
Lift Station ADWF (Olive CS LS)	N/A	N/A	0.075 m^3/s	
Lift Station Force Main (Olive CS LS)	Olive Lift DS.1	S-MA20005360	450 mm	Discharge Invert 229.44 m
Flood Pump Station Total Capacity	N/A	N/A	N/A	No flood pumping station in this district
Pass Forward Flow – First Overflow	N/A	N/A	0.093 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	226.06
2	Trunk Invert at Off-Take	228.47
3	Top of Weir	228.86
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Low Interconnection	N/A
7	Low Basement	230.43
8	Flood Protection Level	230.98

[a] City of Winnipeg Data, 2013

Due to the absence of an SRS system in the Strathmillan district, the relief outfall invert and relief interconnection are not available.

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 was the *Sewer Relief and CSO Abatement Study* (UMA, 2005). It describes the CSO abatement alternatives and sewer relief implications for both Strathmillan and Moorgate CS districts.

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 Strathmillan CS district, along with the CS outfall within the Ainslie separate sewer 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
38 - Strathmillan	2005- Conceptual	Planned in Next 5 Years	2013	Complete	N/A

Source: Sewer Relief and CSO Abatement Study, 2005

1.5 Ongoing Investment Work

There is no ongoing investment work within Strathmillan district that would impact the CSO Master Plan.

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Strathmillan district, and the primary outfall for the Ainslie 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

The proposed projects selected to meet Control Option 1 – 85 Percent Capture in a Representative Year for the Strathmillan sewer district are listed in **Error! Reference source not found.** The proposed CSO control projects will include in-line storage via a control gate with 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	Storage / Transport Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year	-	-	-	✓	✓	-	-	-	✓	✓	✓

The Strathmillan district plan includes implementing floatable control and in-line storage to meet the CSO Control Option 1 performance target.

Floatable control will be necessary to capture floatables in the sewage. The primary CS overflow for the district is to be screened under the current CSO control plan to address the floatables management requirements. The installation of a control gate at the primary CS outfall will be required for the screen operation in the Strathmillan district. This control gate installation will provide the mechanism for capture of minor additional in-line storage. It should be noted however that in-line storage for the Strathmillan district is not a cost-effective solution for additional volume capture. The control gate installation is recommended primarily to provide the necessary hydraulic head for screen operations. Should the screening option no longer be required in the Strathmillan district to address the floatables management requirements, it is recommended that alternative measures such as off-line storage or complete separation be investigated in the Strathmillan district to provide the additional volume capture in a more cost effective manner. Additional pass forward capacity at the CSO location provides an improvement to this district's performance.

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. RTC is not included in detail within each plan and is described further in Section 3 of Part 3A.

1.6.1 In-Line Storage

In-line storage has been proposed as a CSO control for the Strathmillan 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 a slightly higher volume capture, but will primarily be used to provide additional hydraulic head for screening operations.

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	228.29 m	
Trunk Height	900 mm	Circular
Gate Height	0.11 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	228.97 m	
Bypass Weir Height	228.87 m	
Maximum Storage Volume	19 m^3	Option has small storage volume as by-produce of proposed screening installation requirement
Nominal Dewatering Rate	0.353 m^3/s	Based on pass forward flow at Strathmillan CS overflow
RTC Operational Rate	TBD	Future RTC / dewatering review with future assessment

Note:
RTC = Real Time Control
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 39. 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 bypass side weir and adjacent control gate level are determined in relation to the critical performance level 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 existing gravity discharge will continue with its current operation while the control gate is in either position, with all DWF being diverted to the interceptor pipe.

Figure 39-01 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 primary weir. The dimensions of the chamber will be 5 m in length and 2.5 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. The existing sewer configuration including the off-take, 300 mm CS sewer, proposed 300 mm relief pipe and the CS LS force main 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.

The physical requirements for the off-take and chamber sizing for a modification to existing pipe capacity have not been considered in detail, but they will be required in the future as part of an RTC program or LS rehabilitation or replacement project. The proposed location adjacent to the existing gate chamber has been situated entirely within the City owned land. However, the location of the existing infrastructure is within a residential area and will cause local disruptions which may require relocation to the main street or if the alternative floatables management approach is adopted not implemented at this location.

It should also be noted that the existing 300 mm offtake pipe at the Strathmillan primary weir is under capacity due to the high levels of groundwater inflow this district receives in the summer months. This will restrict the performance of the overflow, and not allow for the required levels of in-line storage. To counter this, it is also recommended that a 15 m section of 300 mm relief pipe be connected from the diversion weir to the existing interceptor, to complement the existing 300 mm offtake. This will allow for reduced overflows at the Strathmillan outfall and increase the amount of intercepted CS transported into the interceptor system, fully utilizing the in-line storage provided by the control gate. The addition of this pipe was assessed and does not cause additional overflows at the Olive outfall downstream for the representative year assessment. The existing sewer configuration may also require the relocation of the existing 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 Olive 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 nominal rate for dewatering of the district 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. Future RTC / dewatering assessment will be necessary to define additional rates. This would provide some flexibility in the ability to increase the dewatering rate for spatial rainfall events. This would dewater the district more quickly, to capture and treat more volume for these localized storms by using the excess interceptor capacity where the runoff is less.

1.6.2 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens would 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	228.97 m	
Bypass Weir Crest	228.87 m	
Normal Summer River Level	226.06 m	
Maximum Screen Head	2.81 m	
Peak Screening Rate	0.55 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 39-01. The screens will operate with the control gate in its 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 may include screenings pumps with a discharge returning the screened material to the CS LS for routing to the WEWPCC for removal.

The dimensions for the screen chamber to accommodate influent from the side weir, the screen area, and the routing of the discharge piping downstream of the gate are 3 m in length and 3 m in width. The existing sewer configuration including the off-take, connection from the 17 Wing area, the 300 mm CS sewer and the proposed 300 mm relief pipe, may have to be modified to accommodate the new chamber.

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.

Strathmillan has been classified as a high GI potential district. Land use in Strathmillan is mostly single-family residential. Portage Avenue corridor includes a mix of apartments and commercial businesses. 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 Portage Avenue would also be an ideal location for green roofs.

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. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options 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 Added To Model
2013 Baseline	473	473	12,227	19	N/A
2037 Master Plan – Control Option 1	473	473	12,227	19	IS, SC

Notes:
IS = In-line Storage
SC = Screening

No influence from the 17 Wing site was modelled as part of the 1992 representative year assessment as this has a controlled discharge to the Strathmillan system which can be programmed to coincide with DWFW periods and not influence the CSO performance.

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.

As mentioned in the Section 1.3 there is an interaction with the Strathmillan district and the 17 Wing on-site private wastewater treatment system. Since the discharge of untreated sewage from 17 Wing base to the Strathmillan district is infrequent based on the 17 Wing treatment system maintenance requirements, no flows from 17 Wing have been included in the Strathmillan district assessment of the 1992 representative year.

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 [c]
Baseline (2013)	39,590	39,684	-	18	0.042 m^3/s
In-line Storage	41,117	43,678	- 3,994 [b]	18	0.042 m^3/s
In-line & Relief Pipe	N/A [a]	18,936	24,742	15	0.130 m^3/s
Control Option 1	**41,117**	**18,936**	**20,745**	**15**	**0.130 m^3/s**

[a] Relief sewer pipe was not simulated during the Preliminary Proposal assessment.

[b] Minor improvement to district on individual district model basis. Influenced by upstream Moorgate district and proposed options. Districts of Strathmillan and Moorgate to be developed as one project to ensure that the temporary worsening of the CSO performance does not occur at this district

[c] 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 Costs	2019 Total Operations and Maintenance Cost (Over 35-year Period)
In-line Control Gate	$0 [a]	$2,190,000 [b]	$39,000	$840,000
Screening	$0 [a]	$2,360,000 [c]	$48,000	$1,020,000
Relief Pipe	N/A	$30,000	$0	$0
Subtotal	**$0**	**$4,580,000**	**$87,000**	**$1,860,000**
Opportunities	N/A	$460,000	$9,000	$190,000
District Total	**$0 [a]**	**$5,040,000**	**$95,000**	**$2,050,000**

[a] Screening and In-line not included in the initial Preliminary Proposal 2015 costing. Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for these items of work found to be $1,710,000 in 2014 dollars

[b] Cost associated with new off-take construction, as required, to accommodate control gate and screening chambers in location and allow intercepted CS flows to reach existing Strathmillan gravity pipe was not included in Master Plan

[c] Cost for bespoke screening 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 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 Options	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
	Relief pipe	Requirement for additional off-take relief pipe not known in Preliminary Proposal assessment.	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 Strathmillan district would be classified as a high potential for implementation of complete sewer separation as a feasible approach to achieve the 98 percent capture in the representative year future performance target. The non-separation measures recommended as part of this district engineering plan to meet Control Option 1, specifically in-line storage via control gate and additional relief piping 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 initially 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 be utilized to provide volume capture benefits.

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	• Complete Sewer Separation • Increased use of GI

The Strathmillan district control options 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 not align with the proposed options for the 85 percent capture target. The future higher level of percent capture indicate that complete sewer separation would be most applicable in this district.

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 part of 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	-	-	-	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
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

UMA Engineering, Ltd. (UMA). 2005. *Sewer Relief and CSO Abatement Study*. Prepared for. Month of publication.

LEGEND

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

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

District Boundary Crossing
- CS
- LDS
- WWS

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

CSO MASTER PLAN PROPOSED SOLUTIONS

- Proposed Control Gate
- Duplicate Pipe
- 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

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 39
District Overview Map
Sewer District: Strathmillan
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\STRATHMILLAN\STRATHMILLAN_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 6/24/2019 8:01:30 AM

LEGEND

- Primary Weir
- Critical Elevation
- CSO Outfall
- Manhole
- Flap Gate
- Force Main
- Sewer By Type
  - CS
  - LDS
  - WWS
- Control Structure Type
  - Gate Chamber

CSO MASTER PLAN
PROPOSED SOLUTIONS

- Duplicate Pipe
- 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 39-01
Control Gate and Screening
Sewer District: Strathmillan
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\STRATHMILLAN\STRATHMILLAN_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 8:23:02 AM

CSO Master Plan

Syndicate District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Syndicate District Plan
Revision:	03
Date:	August 19, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Danny Tinker
File Name:	Syndicate_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	08/30/2018	Version 1 DRAFT	DT	SG	
1	02/15/2019	DRAFT 2 for City Review	MF	SG	MF
2	06/2019	Final Draft Submission	JT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Syndicate District

1.1 District Description

The Syndicate combined sewer (CS) district is located adjacent to the Red River and north of Alexander district. Syndicate is approximately bounded by the Red River to the north, east, and south; and by King Street to the west.

Syndicate has been developed primarily as residential and industrial, with general and light manufacturing located south of Sutherland Avenue and in the southeastern corner of the district; two-family residential buildings are found north of Sutherland Avenue. Some small commercial businesses are located along Main Street. The greenspace in Syndicate runs along the riverbank on the northern and southern sections.

The Canadian Pacific Railway Mainline runs through the centre of the district and crosses the Red River into Mission district. Main Street, Higgins Avenue, and Disraeli Freeway are the major regional transportation routes within the Syndicate CS district.

1.2 Development

Syndicate district includes a significant portion of the downtown area and the potential for redevelopment in the future is high. The OurWinnipeg development plan has prioritized the Downtown for opportunities to create complete, mixed-use, higher density communities. Redevelopment within this area could impact the CS and will be investigated on a case-by-case basis for potential impacts to the combined sewer overflow (CSO) Master Plan. All developments within the CS districts are mandated to offset any peak combined sewage discharge by adding localized storage and flow restrictions, in order to comply with Clause 8 of the Environment Act Licence 3042.

A portion of Main Street is located within the Syndicate District. Portage Avenue is identified as Regional Mixed-Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Main Street is to be promoted in the future.

One area within the Syndicate CS district has also been identified as a Major Redevelopment Site with OurWinnipeg, the South Point Douglas Lands. This site includes the lands adjacent to the Assiniboine River north of the Waterfront neighbourhood. This Major Redevelopment Site is considered underused and will be prioritized to be developed into a higher density, mixed-use community.

Higgins Avenue within the Alexander district has been identified as part of the potential routes for the Eastern Corridor of Winnipeg's Bus Rapid Transit. The work along Higgins Avenue 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 separation within Alexander district. This would reduce the extent of the Control Options listed in this plan required.

1.3 Existing Sewer System

Syndicate district encompasses an area of 111 ha[1] based on the district boundary GIS information. This includes an area of approximately 21 percent by area (24 ha) that contains a separate land drainage sewer (LDS) system and is partially separated, approximately 5 percent (5 ha) that is considered separation ready and approximately 13 percent (14 ha) of greenspace.

[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.

The collection system in the district includes CS, LDS and storm relief sewer (SRS) systems. The CS system includes a flood pump station (FPS), a CS lift station (LS) system and a combined CS/FPS outfall.

The CS system flows towards the Syndicate outfall, located at the northern end of Syndicate Street, where combined sewage is pumped to the Main Interceptor or may be discharged into the Red River. The Syndicate CS LS is located beside the Syndicate FPS at the outfall.

There are three main flow paths for CS connecting to the pump station. A 1050 mm CS trunk flows north on Syndicate Street, servicing the district east of that street; a 1350 mm CS trunk also flows north on Syndicate Street, servicing the district south of Euclid Avenue and Sutherland Avenue; and a 600 mm CS trunk flows east on Rover Avenue servicing the district north of Euclid Avenue. An interceptor pipe flows west on Sutherland Avenue through the Syndicate district, carrying pumped flows from the Montcalm CS LS in the Mission district to the Main Interceptor pipe on Main Street. This interceptor does not interact with the CS system in the Syndicate district.

During dry weather flow (DWF), LDS and SRS are not required; sanitary sewage passes through the main CS trunk sewers and is diverted by the primary diversion weir for the district through the 1350 mm off-take pipe to the Syndicate CS LS, where it is pumped to the Main Interceptor pipe and on to the North End Sewage Treatment Plant (NEWPCC) for treatment. During wet weather flow (WWF), any flow that exceeds the diversion capacity overtops the primary weir and is discharged to the river. A sluice gate and flap gate are installed on the CS outfall. The flap gate prevents flow from entering the CS system from the Red River when river levels are above the flap gate invert. When the river level are above the flap gate invert, gravity discharge through the CS outfall is not possible. The excess flow under these high river level conditions is instead pumped by the Syndicate FPS to discharge to the river at point downstream of the flap gate.

Approximately 21 percent of Syndicate district is separated with land drainage sewers installed to collect the surface runoff. These sewers discharge directly to the Red River through a separate LDS outfall located on the northern end of Disraeli Street. The southwestern section of Syndicate includes SRS pipework that relieve the CS network during runoff events but do not interconnect with other district SRS systems.

The one outfall to the Red River (one CS) is as follows:

- ID22 (S-MA70003283) – Syndicate CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between the Syndicate district and the surrounding districts. Each interconnection is shown on Figure 40 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is listed in the following subsections.

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Selkirk

- The 2250mm Main Interceptor pipe flows by gravity from the Syndicate district into the Selkirk district and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.
  - Main Street interceptor invert – 220.406 m (S-MH00012082)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Alexander

The 1950mm Main Interceptor pipe flows by gravity north on Main Street into the Syndicate district from the Alexander district and carries sewage to the NEWPCC for treatment

- Main Street interceptor invert – 220.861 m (S-MH20017433-CG)

Mission

- Two 600 mm force mains cross the Red River carrying pumped sewage from Montcalm CS LS in Mission district to the 1200 mm interceptor sewer in Syndicate:
  - Across Red River – Invert at Syndicate district boundary 227.28 m (S-MH20012321)
  - Across Red River – Invert at Syndicate district boundary 227.50 m (S-MH20012321)

1.3.1.3 District Interconnections

Selkirk

<u>CS to CS</u>

- A 375 mm CS sewer acts as an overflow pipe from the Selkirk CS system into the Syndicate CS system.
  - 375 mm CS on Main Street at Dufferin Avenue – 228.52 m (S-MH00012094)

<u>CS to SRS</u>

- A 250 mm SRS sewer acts as an overflow pipe from the Syndicate CS system into the Selkirk SRS system.
  - Euclid Avenue at Lusted Avenue – 228.60 m (S-MH00012247)
- A 250 mm SRS sewer acts as an overflow pipe from the Syndicate CS system into the Selkirk SRS system
  - Austin Street N at Euclid Avenue – 228.62 m (S-MH00012114)

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

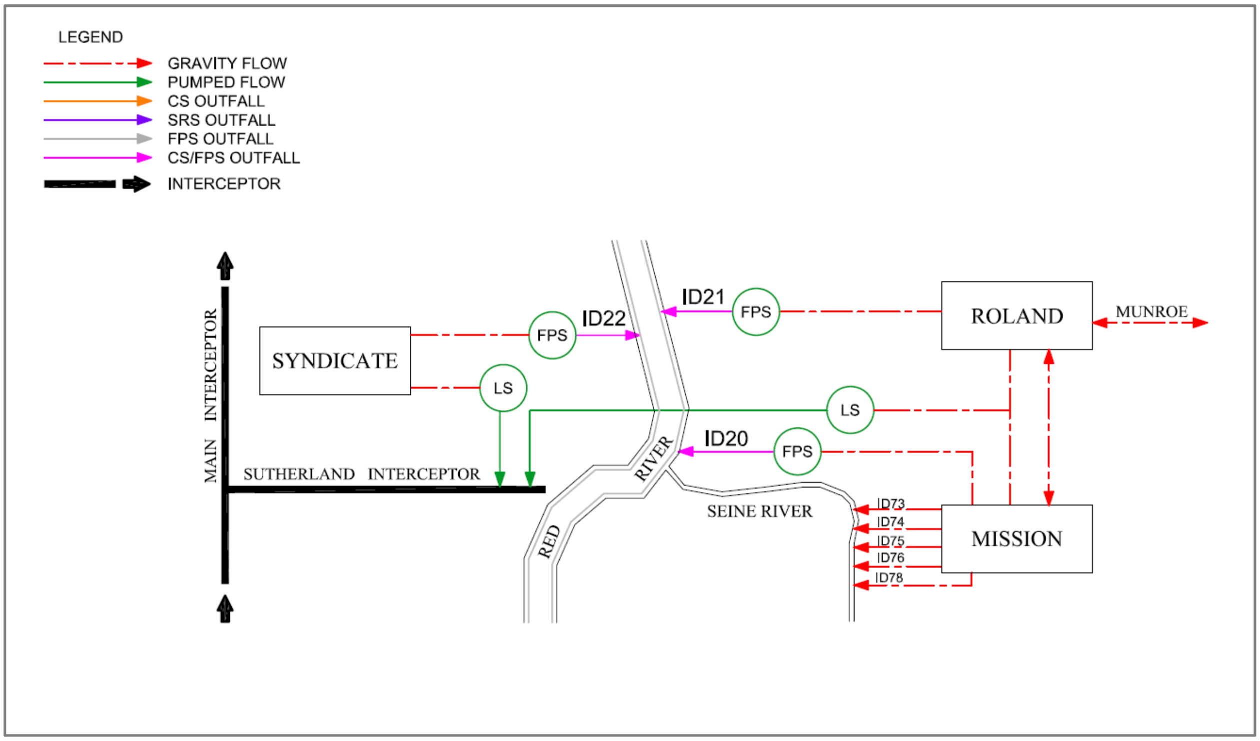


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 40 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 (ID57)	S-YY70021031.1	S-MA70003283	1800 mm	Red River Invert: 223.39 m
Flood Pumping Outfall (ID82)	S-YY70021031.1	S-MA70003283	1800 mm	Red River Invert: 223.39 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-TE70026975.2 S-YY70021032.1	S-MA70003270 S-MA70003278	1500 mm 1350 mm	Invert: 223.61 m Invert: 223.66 m
SRS Outfalls	N/A	N/A	N/A	
SRS Interconnections	N/A	N/A	N/A	2 SRS – CS
Main Trunk Flap Gate	S-TE70026956.1	S-CG00000789	1525 mm	Invert: 223.53 m
Main Trunk Sluice Gate	S-CG00000789.1	S-CG00000788	1800 x 1800 mm	Invert: 223.30 m
Off-Take	S-TE70026975.1	S-MA70003269	1350 mm	Circular Invert: 223.61 m
Wet Well	S-TE70026978	S-TE70026978	Chamber Area 12.7 m^2	
Lift Station Total Capacity	N/A	N/A	0.040 m^3/s	1 x 0.019 m^3/s 1 x 0.021 m^3/s
Lift Station ADWF	N/A	N/A	0.004 m^3/s	
Lift Station Force Main	S-YY70021034.1	S-MA70003269	250 mm	Invert: 225.80 m

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Flood Pump Station Total Capacity	N/A	N/A	0.910 m^3/s	1 x 0.230 m^3/s 1 x 0.680 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.128 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	Syndicate – 223.70
2	Trunk Invert at Off-Take	223.61
3	Top of Weir	224.15
4	Relief Outfall Invert at Flap Gate	N/A
5	Relief Interconnection (S-MH00012247)	228.60
6	Sewer District Low Interconnection (Selkirk)	220.41
7	Low Basement	227.08
8	Flood Protection Level (Boyle, Syndicate)	229.61

[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 Syndicate was the *Boyle/Syndicate Combined Sewer Relief Program* (UMA Engineering Ltd., 2007). The turnover package describes the summary for all works completed under the program and construction costs relating to the past studies and reports for Syndicate district that provided stabilization works for the Boyle site from 1989 to 1993 and CS relief. The Contract 4 construction to provide CS relief in the catchment area known as Higgins West was the most recent work and was completed in June 2002 (UMA Engineering Ltd., 2007). No other work has 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 Syndicate Combined Sewer 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 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
40 – Syndicate	2007	Future Work	2013	Study Complete CS Relief Work Complete 2002	N/A

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of the permanent instruments installed within the primary outfall within the Syndicate 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 the Control Option 1 – 85 Percent Capture in a Representative Year for the Syndicate sewer district are listed in Table 1-4. The proposed CSO control projects will include in-line storage via a control gate and 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% Capture in a Representative Year	-	-	-	✓	✓	-	-	-	✓	✓	✓

Notes:

- = not included
✓ = included

An assessment indicated that the combination of the relatively high separation costs and the lower ranking (volumetric based) concluded that sewer separation work in this district to achieve 85 percent capture is not cost effective.

The existing CS systems are suitable for use as in-line storage. This control option will take advantage of the existing CS pipe network for additional storage volume. Existing DWF from the collection system will remain the same, and overall district operations will remain the same.

Floatable control will be necessary to capture any undesirable 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. Screens will be installed only on the primary outfall located on the eastern end of Syndicate 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 In-Line Storage

The existing CS system is suitable for use as in-line storage. This control option will take advantage of the existing CS pipe network for additional storage volume. The existing CS LS will be used to dewater the in-line storage volume and direct it to the interceptor. Existing DWF from the collection system and overall district operations will remain the same.

In-line storage has been proposed as a CSO control for the Syndicate 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 than that already provided by the primary weir.

A standard design was assumed for the control gate, as described in Part 3C of the CSO Master Plan. 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	223.62 m	Downstream invert of pipe at weir
Trunk Diameter	1,350 mm	
Gate Height	0.74 m	Based on half pipe diameter assumption
Top of Gate Elevation	224.46 m	
Bypass Weir Elevation	224.36	
Maximum Storage Volume	329 m^3	
Nominal Dewatering Rate	0.040 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 within the collection system to the extent shown on Figure 40. 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 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 blow 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 would continue with its current operation while the control gate is in either position, with all DWF being diverted to the CS LS and pumped to the Main Interceptor on Main Street. The CS LS will further dewater the in-line storage provided during a WWF event as downstream capacity becomes available.

Figure 40-01 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 trunk sewer alignment and located south of the Syndicate outfall gate chamber. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5 m in length and 2.5 m in width. 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. This will allow CS flows captured by the proposed control gate to still be diverted to the 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 proposed chambers (control gate and screening) are to be located within the existing City of Winnipeg Right-of-Way (ROW) adjacent to the existing infrastructure. The construction will have a minor impact on the local street traffic, and there are alternative routes that can be taken to bypass this area.

The physical requirements for the off-take and station sizing for a modification to pumping capacity have not been considered in detail, but they may 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 and future dewatering arrangement will be necessary to review the downstream impacts on the existing force main and interceptor system.

1.6.3 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 CS LS configuration and the hydraulic head available for operation. A standard design was assumed for screening and is described in Part 3C of the CSO Master Plan.

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	224.46 m	
Bypass Weir Crest	224.36	
Normal Summer Water Level	223.70 m	
Maximum Screen Head	0.74 m	
Peak Screening Rate	0.30 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 combined trunk sewer, as shown on Figure 40-01. The screens will operate with the control gate in the raised position. A side bypass weir upstream of the gate will direct the overflow to the screens located in a 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 back to the interceptor and on to the NEWPCC for removal.

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 5.5 m in length and 2.5 m in width. The existing sewer configuration including the off-take and the 1350 mm and 1050 mm CS sewers down Syndicate Street, and possibly the 600 mm CS sewer along Rover Avenue and the CS LS force main, may have to be modified to accommodate the new chamber.

1.6.4 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.

Syndicate has been classified as a medium GI potential district. Syndicate has been developed primarily as residential and industrial. This means the district would be an ideal location for bioswales, permeable paved roadways (in the areas away to the riverbank), cisterns/rain barrels, rain gardens, and green roofs.

1.6.5 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	104	104	1,428	59	N/A
2037 Master Plan – Control Option 1	104	104	1,428	59	IS, SC

Note:

IS = In-line Storage
SC = Screening

No change to the future population was completed as from a wastewater 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 estimates 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 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 1-8 also includes overflow volumes specific to each individual control options; these are listed to provide an indication of benefit gained only and are independent volume reductions.

Table 1-8. District 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 [a]
Baseline (2013)	38,645	57,357	-	21	0.058 m^3/s
In-Line Storage	36,861	51,571	5,786	20	0.055 m^3/s
Control Option 1	**32,200**	**51,571**	**5,786**	**20**	**0.055 m^3/s**

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

The difference between the 2014 Preliminary and CSO Master Plan Baseline and Control Option 1 results are directly due to the update in CS LS pump capacity provided via the Clear SCADA data verification.

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

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 of the CSO Master Plan. 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 estimate 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 (Over 35-year period)
In-line Control Gate	$7,700,000 [a]	$2,360,000 [b]	$40,000	$920,000
Screening		$1,870,000 [c]	$50,000	$1,120,000
Subtotal	**$7,700,000**	**$4,230,000**	**$90,000**	**$2,040,000**
Opportunities	$0	$420,000	$9,000	$200,000
District Total	**$7,700,000**	**$4,650,000**	**$99,000**	**$2,240,000**

[a] Screening and In-line costs were combined in the Preliminary Proposal 2015 costing

[b] Cost associated with new off-take construction, as required, to accommodate control gate location and allow intercepted CS flow to reach existing Aubrey 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 Options	Control Gate	Preliminary estimate was based on a standard cost per district, which has been updated to a site-specific district cost estimate.	

Table 1-10. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
	Screening	Preliminary estimate was based on a standard cost per district, which has been updated to a site-specific district cost estimate.	
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 the 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 in Control Option 1.

Overall the Syndicate district would be classified as low to medium for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture in the representative year future performance target. The relatively high cost of sewer separation for the remaining district points to a low potential, however, the extent of the existing SRS system with CS connections may have potential for cost effective opportunistic separation that would point to a medium potential. This would require further study to evaluate the district runoff performance. 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 recommended in this district engineering plan. This will be with the understanding that while initially 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.

Opportunistic separation of portions of the district may also be achieved with synergies with other major infrastructure work to address future performance targets. The inclusion of off-line storage elements such as an underground tank or storage tunnel with dewatering pump infrastructure could be utilized to provide any additional volume capture. As with all districts, the use of green infrastructure will be investigated in the future as a potential benefit 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	• Opportunistic separation • Increased use of GI • Increased use of In-line • Off-Line Storage (Tunnel/Tank)

The control options for the Syndicate district have been aligned for the 85 percent capture performance target and the expandable nature to the 98 percent capture would be based on the system wide basis. The applicability of the listed viable migration options will be stepped rather than full district solutions.

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.

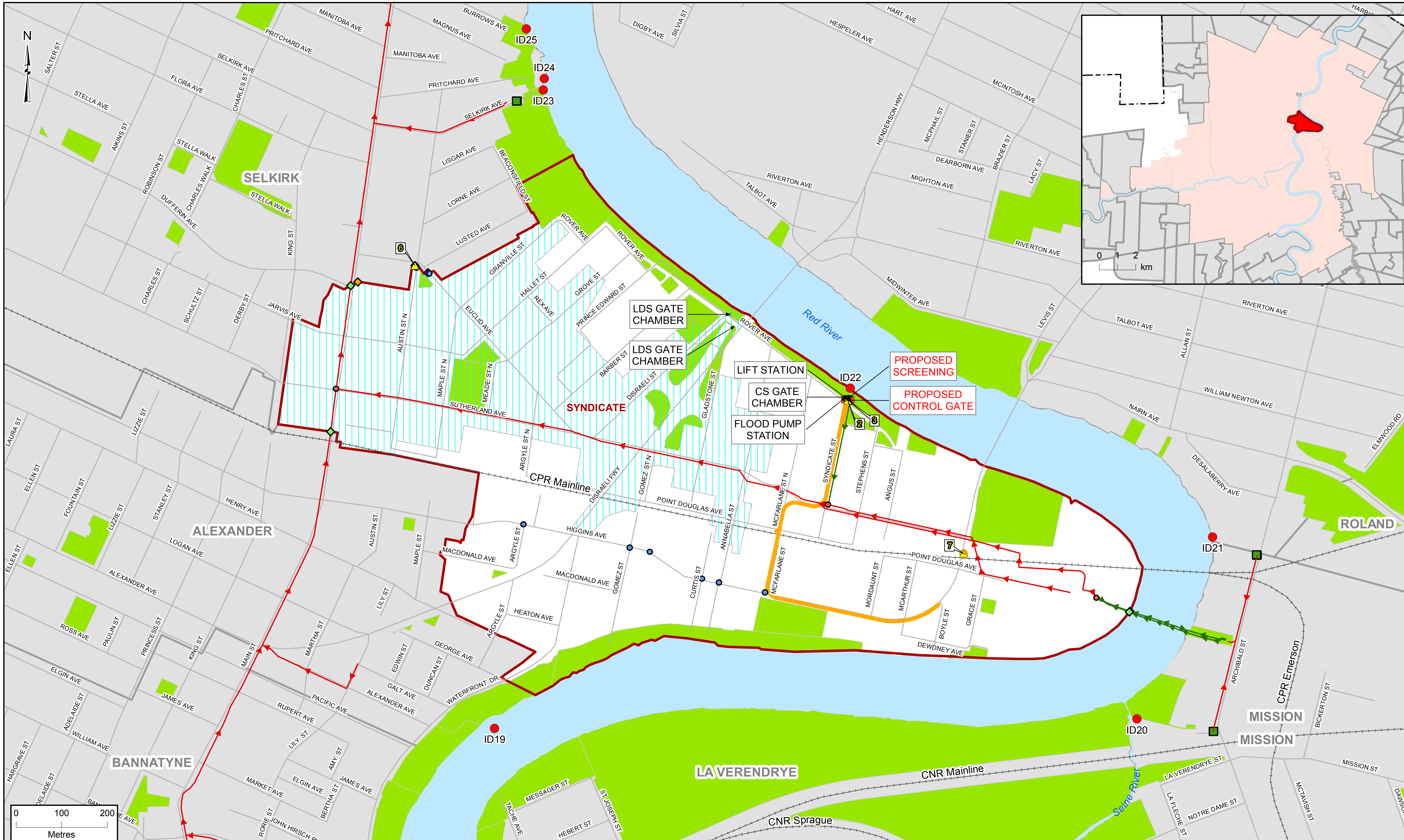
Table 1-12. Control Option 1 Significant Risks and Opportunities

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	-	-	-	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
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

UMA Engineering Ltd. 2007. *Boyle/Syndicate Combined Sewer Relief Program Final Turnover Package*. Prepared for the City of Winnipeg. July.



LEGEND

Primary Weir	Inter-System Connection	District Boundary Crossing	Interceptor Sewer	District Boundary
Critical Elevation	CS - WWS	CS	Force Main	Watercourse
CSO Outfall	SRS - CS	SRS	Street	Greenspace
Low CS Manhole		WWS	Railway	

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

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 40
District Overview Map
Sewer District: Syndicate
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\SYNDICATE\SYNDICATE_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 9:24:35 AM

LEGEND

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

Sewer By Type
- CS
- 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 40-01
Control Gate and Screening
Sewer District: Syndicate
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE5\SYNDICATE\SYNDICATE_DISTRICT_DETAIL.MXD SBEGG1 7/29/2019 9:26:10 AM

JACOBS

CSO Master Plan

Tuxedo District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Tuxedo District Plan
Revision:	03
Date:	August 15, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Tuxedo_Plan_Final_CO1MP_08152019

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	08/2018	Version 1 DRAFT	SG	ES	
1	12/2018	Version 2 DRAFT	SB	ES / JB / DT / SG / MAF	
2	05/2019	Final Draft Submission	SB / JT	MF	SG
3	08/15/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Tuxedo District

1.1 District Description

Tuxedo district is located towards the southwestern limit of the combined sewer (CS) area. Regional roadways bordering the district are Wellington Crescent to the north, Corydon Avenue to the south, Park Boulevard North to the west, and Edgeland Boulevard to the east. The major transportation routes passing through Tuxedo are Corydon Avenue and Tuxedo Avenue, each of which conveys a high volume of traffic. Figure 41 provides an overview of the sewer district and the location of the proposed Combined Sewer Overflow (CSO) Master Plan options. Tuxedo district is directly adjacent to Assiniboine Park and bounded by the Assiniboine River on the north.

Land use in Tuxedo is mainly residential with a small amount of commercial near major transportation routes. Commercial lands are located along Corydon Avenue and on the eastern side of Tuxedo Avenue including the large Tuxedo Park Shopping Centre and other smaller businesses. The district consists mostly of single-family homes with apartment complexes situated between Tuxedo Avenue and Edgeland Boulevard. Most of the area was developed in the 1960s to the early 1970s. Aside from the river bank along Assiniboine River, the district only has a few small parcels of green space.

1.2 Developments

A Route 90 Improvement Study is currently underway that will lead to a significant amount of construction and right of way adjustments along Route 90/Kenaston Boulevard. This work, which will impact both Doncaster and Ash districts but should not affect Tuxedo substantially as there is limited land area available for development within Tuxedo district.

Updates to the land drainage system along Wellington Crescent are anticipated to occur, and this will have a potential impact on control options selected.

1.3 Existing Sewer System

Tuxedo district has an approximate service area of 52 ha[1], based on the district boundary, making it the third smallest CS district and includes combined sewers (CSs), wastewater sewers (WWS), and land drainage sewers (LDSs). Approximately 27 percent (14 ha) of the total district is already separated. While approximately 28 percent (15 ha) of the total district area is considered separation ready. Approximately 3 ha of the district is classified as greenspace.

The CS system includes a dual flood and lift pump station (LFPS) (referred to as Chataway LFPS), primary diversion weir, and an outfall gate chamber located at Wellington Crescent adjacent to the Assiniboine River. All domestic wastewater and combined sewage flows collected in Tuxedo district converge to the 900 mm circular trunk sewer located along Nanton Boulevard, which then converts into an egg-shaped 2280 mm by 1520 mm main trunk flowing north along the back lane of Chataway Boulevard toward the CS outfall.

During dry weather flow (DWF), the Tuxedo primary weir diverts flow to the lift station pumps of the CS LFPS through a 200 mm off-take pipe. The 150 mm force main from the CS LFPS then pumps the combined sewage to the Doncaster interceptor sewer that flows by gravity into the Doncaster district and eventually to the Ash district. Flow is then pumped across the Assiniboine River to the North End Sewage Treatment Plant (NEWPCC) for treatment.

[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 wet weather flow (WWF) events, any flow that exceeds the diversion capacity overtops the weir and is discharged to the river from the 900 mm CS primary outfall. Sluice and flap gates are installed on the CS outfall to prevent back-up of the Assiniboine River into the CS system under high river level conditions. When the river level is high however gravity discharge is not possible due to the flap gate, the excess flow is then pumped through a 200 mm pipe by the flood chamber of the CS LFPS into the gate chamber downstream of the sluice gate and to the river via the CS primary outfall. The flood chamber component of the CS LFPS contains one pump to accommodate WWF.

Figure 41 shows the separate area located on the west and east boundaries of the district. The first separate area along the west boundary discharges LDS flow via gravity at a 2400 mm LDS outfall located along Park Boulevard North to the Assiniboine River. A second separate area located on the southeastern boundary of the district near Tuxedo Avenue and Edgeland Boulevard routes LDS flow by gravity into Tuxedo South separate sewer district through a 750 mm pipe and back through to the Tuxedo district eventually discharging at the Assiniboine River through the same 2400 mm LDS outfall along Park Boulevard North. There are three locations in Tuxedo where the separate WWSs connect into the CS system.

A central portion of the district is considered separation ready with LDS installed but flowing back into the CS system. LDS on Handsart Boulevard, Grenfell Boulevard and Girton Boulevard connect into the CS trunk along Nanton Boulevard.

The single CS outfall to the Assiniboine River is as follows:

ID47 (S-MA70029012) – Tuxedo CS Outfall

1.3.1 District-to-District Interconnections

There are several sewer system interconnections between Tuxedo district and the adjacent districts; see Figure 41. 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 – Downstream of Primary Weir

Doncaster

- A 150 mm force main from the CS LFPS pumps CS to the Doncaster interceptor sewer along Wellington Crescent and flows by gravity into the Doncaster district and then on to the Ash district. Flow is then pumped across the Assiniboine River to the North End Sewage Treatment Plant (NEWPCC) for treatment.
    - Wellington Crescent and Doncaster boundary interceptor invert - 228.57 m (S-CO70008639)

1.3.1.2 District Interconnections

Tuxedo South

<u>CS to CS</u>

- High point CS manhole (flow is directed into both districts from this manhole): A 750 mm CS pipe will either flow by gravity north to the NEWPCC service area or south to the West End Sewage Treatment Plant (WEWPCC) service area.
    - Corydon Avenue and Lamont Boulevard invert at Tuxedo district boundary - 228.98 m (S-MH60005864)

<u>LDS to LDS</u>

- A 750 mm LDS pipe from Tuxedo South district LDS system at Corydon Avenue and Park Boulevard North flows by gravity eastbound into Tuxedo LDS system and does not interact with the CS system.

- Corydon Avenue and Park Boulevard North invert at Tuxedo district boundary - 227.65 m (S-MH60003117)

- A 2400 mm LDS pipe from Tuxedo South district LDS system at Corydon Avenue and Park Boulevard North flows by gravity northbound into Tuxedo LDS system and does not interact with the CS system.
  - Corydon Avenue and Park Boulevard North invert at Tuxedo district boundary - 227.65 m (S-MH60003117)
- A 750 mm LDS pipe from Tuxedo district LDS system at Southport Boulevard and Corydon Avenue flows by gravity southbound into Tuxedo South LDS system and does not interact with the CS system.
  - Corydon Avenue and Southpoint Boulevard invert at Tuxedo district boundary - 228.79 m (S-MH60005920)

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

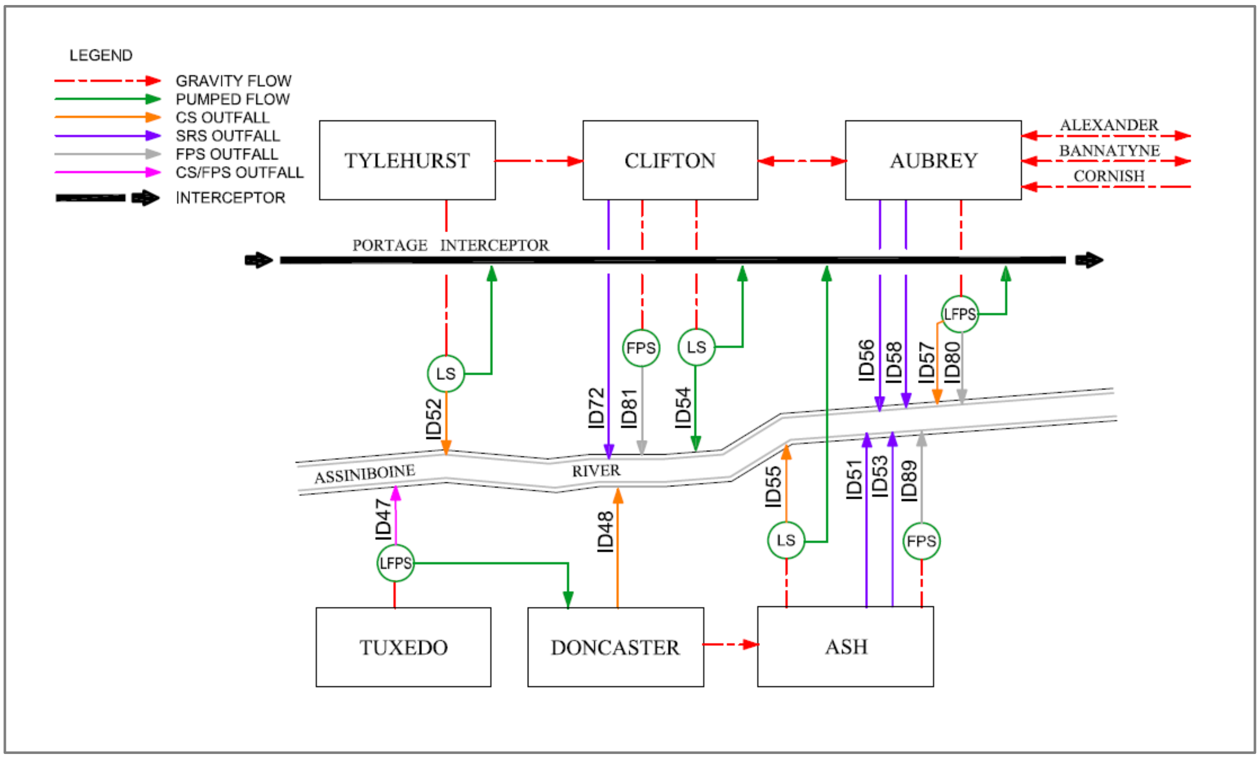


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 41 and are 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 (ID47)	S-MH70010676.1	S-MA70029012	900 mm	Circular pipe Invert: 225.33 m
Flood Pumping Outfall (ID47)	S-MH70010676.1	S-MA70029012	900 mm	Circular pipe Invert: 225.33 m

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Other Overflows	N/A	N/A	N/A	
Main Sewer Trunk	S-MH6006079.3	S-MA70029065	2280 x 1520 mm	Egg-shaped pipe
Storm Relief Sewer Outfalls	N/A	N/A	N/A	No SRS system within the district.
Storm Relief Sewer Interconnections	N/A	N/A	N/A	No SRS system within the district.
Main Trunk Flap Gate	S-AC70013735.1	S-CG00000749	900 mm	Circular, Invert = 225.51 m
Main Trunk Sluice Gate	TUXEDO_GC.1	S-CG00000750	900 mm	Invert = 225.42 m
Off-Take	S-MH60005247.1	S-MA70018595	200 mm	Circular pipe
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	N/A	N/A	0.036 m^3/s	2 pumps x 0.018 m^3/s
Lift Station ADWF	N/A	N/A	0.004 m^3/s	
Lift Station Force Main	S-AC70008688.1	S-MA70018599	150 mm	Dual Flood and Lift Station[a]
Flood Pump Station Total Capacity	N/A	N/A	0.063 m^3/s	1 pump, Force main – 200 mm
Pass Forward Flow – First Overflow	N/A	N/A	0.021 m^3/s	

Notes:

[a] Tuxedo uses a Dual Lift and Flood Pump Station, with the FPS using one pump that connects to its respective 200 mm force main. This force main flows past the sluice gate gates to the outfall.
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	Tuxedo – 224.51
2	Trunk Invert at Off-Take	225.40
3	Top of Weir	225.48
4	Relief Outfall Invert	N/A
5	Relief Interconnection	N/A
6	Sewer District Interconnection (Tuxedo South)	228.98
7	Low Basement	230.67
8	Flood Protection Level	230.53

[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 for Tuxedo district was the Report on Separate Sewer Relief Project, Tuxedo Sanitary Sewer District (Reid Crowther, 1982). It describes necessary relief measures to reduce or eliminate basement flooding for the Tuxedo combined sewer district. The report on Basement Flooding Relief Program was then completed in 1986.

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 Tuxedo CS district was included as part of this program. Instruments installed at each of the thirty nine 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	Planned Completion
41 – Tuxedo	1986	Future Work	2013	Study Complete	N/A

1.5 Ongoing Investment Work

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

The Route 90 Widening Project is planned from Carpathia Road to St. James Bridge in Ash district and will improve traffic along Kenaston Avenue. Implementation of sewer separation has yet to be determined at this stage; however, separation would be advantageous to reducing the overflows occurring in Ash as well as Doncaster districts.

The existing CSs will be evaluated for separation potential as part of the Route 90 Widening Project. Opportunistic separation will be incorporated where there is benefit. The separation costs may be reduced if separation work is planned as part of road reconstruction. There will be minimal impacts associated with Tuxedo CSD however.

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 Tuxedo sewer district are listed in Table 1-4. The proposed CSO control projects will include sewer separation. 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 Tuxedo district is not identified as a priority project within the existing Basement Flood Relief Program.

The existing CS system was originally reviewed for in-line storage as well as floatable management. The marginal evaluation indicated that full separation will be similar to the in-line/screening control option even though the majority of the district has already been separated along with its smaller overall area. Operations and maintenance (O&M) costs required with the in-line / screening option are also taken into consideration, and this associated O&M cost results in the selection of full separation is the most preferable in this district.

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 Sewer Separation

The sewer separation project for Tuxedo will provide immediate benefits to the CSO program when complete. The work includes installation of a new LDS trunk sewer along Nanton Boulevard as well as a new LDS collector sewer along Lamont Boulevard. Current LDS systems will be extended to collect road drainage along Handsart Boulevard, Grenfell Boulevard, and Girton Boulevard. Collected stormwater runoff will be routed to the existing 2400 mm LDS outfall discharging to the Assiniboine River at Park Boulevard North. The approximate area of sewer separation is shown on Figure 41.

The flows to be collected after Tuxedo separation will be as follows:

- Dry weather flows will remain the same for Tuxedo district.
- Tuxedo WWF will consist of sanitary sewage combined with foundation drainage.

This will result in a significant reduction in combined sewage flow received at Chataway LFPS after the separation project is complete. The separation project will provide a full reduction of overflows for the 1992 representative year.

In addition to reducing the CSO volume, the benefits of Tuxedo separation include a reduction of pumped flows entering both the immediate downstream Doncaster and Ash CS districts, as well as reducing the amount of flood pumping required at the Chataway LFPS.

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 will be reviewed to identify applicable GI controls.

Tuxedo has been classified as a medium GI potential district. Land use in Tuxedo is mainly residential with a small amount of commercial, the north end of the district is bounded by the Assiniboine River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

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 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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flows with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the districts.

The reduction in storm flows entering the CS LFPS will reduce the requirement for operation of the flood pump within the CS LFPS. It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (i.e., foundation drain connections to the CS system) within the Tuxedo district.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	47	47	932	31	-
2037 Master Plan – Control Option 1	47	18	932	3	SEP

Notes:

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model

SEP – Separation

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-6 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 when simulations were completed; these are listed to provide an indication of benefit gained only and are independent volume reductions unless noted otherwise.

Table 1-6. District 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
Baseline (2013)	14,695	13,843	0	18	0.021 m^3/s [b]
In-Line	14,658	N/A	N/A	N/A	N/A
Separation	N/A [a]	0	13,843	0	0.025 m^3/s [c]
Control Option 1	**14,658**	**0**	**13,843**	**0**	**0.025 m^3/s [c]**

[a] Separation was not simulated during the Preliminary Proposal assessment

[b] Pass forward flows assessed with the 1-year design rainfall event

[c] Pass forward flows assessed with the 5-year design rainfall event

The revised CSO Master Plan control option to separate the Tuxedo district has been based on the more focused district assessment as opposed to the previous Preliminary Proposal network performance assessment. In addition, the non-identified improvements (not recorded in Table 1-6) to the overflow performance at the downstream Doncaster and Ash districts were part of the overall selection process.

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entire CS system and not for each district individually. However, the elimination of the district overflows represents 100 percent capture at this district.

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 1-7. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-7. District Cost Estimate – 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)
Sewer Separation	N/A [a]	$8,790,000	$10,000	$110,000
In-Line Storage	$ [b]	N/A	N/A	N/A
Screening		N/A	N/A	N/A
Subtotal	**$0**	**$8,790,000**	**$10,000**	**$110,000**
Opportunities	N/A	$880,000	$1,000	$10,000
District Total	**$0**	**$9,670,000**	**$11,000**	**$120,000**

[a] Sewer separation not assessed in this district for the Preliminary Proposal

[b] Solution developed as refinement to Preliminary Proposal costs. Costs for these items of work found to be $1,200,000 in 2014 dollars

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

- Capital costs 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. Each of these values include equipment replacement and O&M costs.
- 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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Separation	Separation was not included in the Preliminary Proposal.	The Master Plan identified sewer separation as the control option.
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 proposed complete separation of the Tuxedo district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target.

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 1-9.

Table 1-9. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-

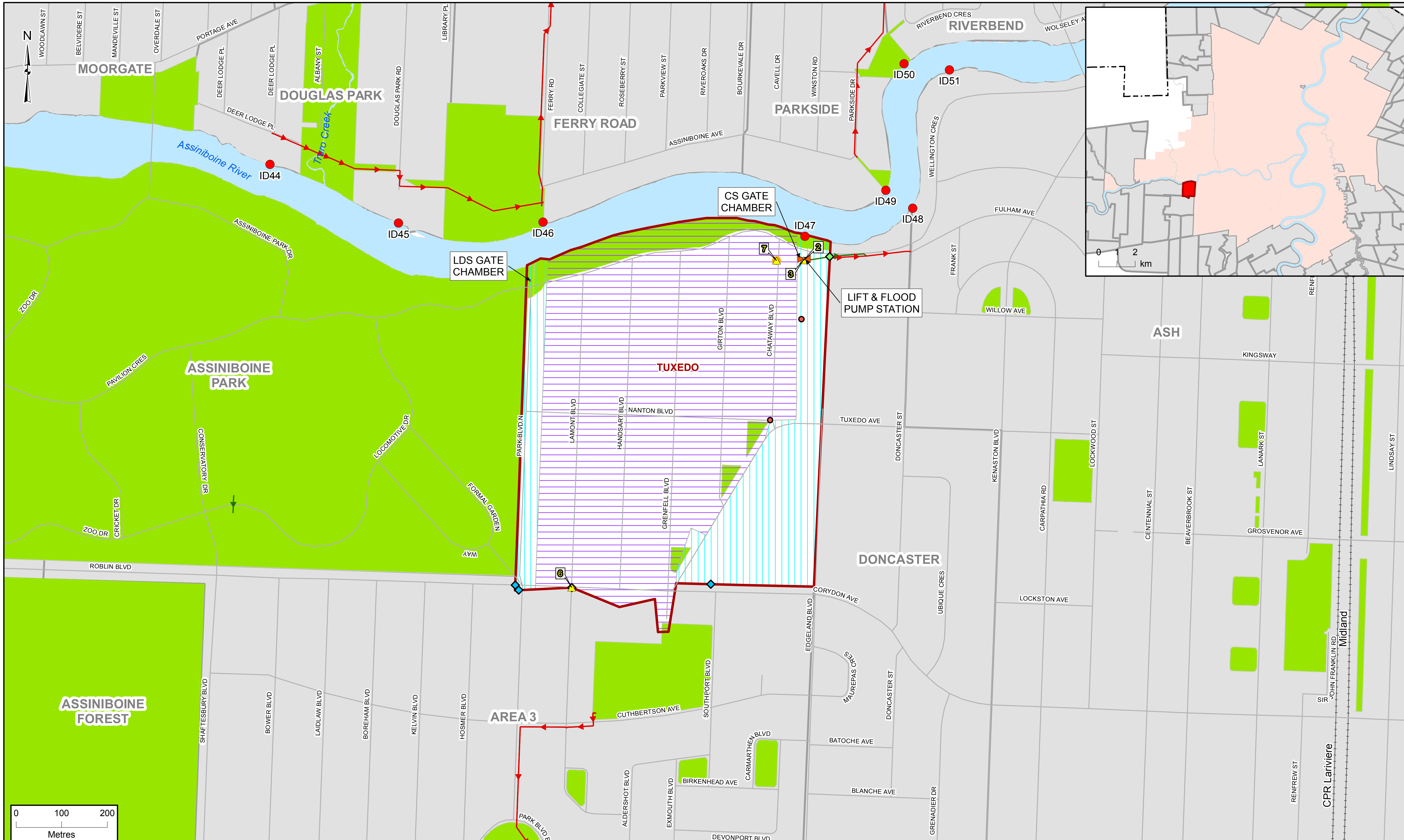
Table 1-9. Control Option 1 Significant Risks and Opportunities

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
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

Reid, Crowther & Partners Limited (Reid Crowther). 1982. *Report on Separate Sewer Relief Project, Tuxedo Sanitary Sewer District*. Prepared for City of Winnipeg. September.



LEGEND

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

Inter-System Connection
- CS - WWS

District Boundary Crossing
- CS
- LDS
- WWS

- Interceptor Sewer
- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Planning
- 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 41
District Overview Map
Sewer District: Tuxedo
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\TUXEDO\TUXEDO_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:25:41 AM

CSO Master Plan

Tylehurst District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Tylehurst District Plan
Revision:	03
Date:	August 19, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Scott Begg
File Name:	Tylehurst_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	08/2018	DRAFT for City Comment	SG	ES	
1	02/15/2019	DRAFT 2 for City Review	SB	MF	MF
2	08/14/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

Contents

Tables

Figure

1. Tylehurst District

1.1 District Description

Tylehurst district is located on the western side of the combined sewer (CS) area. It stretches from Bangor Avenue and Notre Dame Avenue in the north to the Assiniboine River in the south and is bounded by the Canadian Pacific Railway (CPR) Lariviere and Midland railway to the east and St. James Street to the west.

Tylehurst includes several rail lines that pass through the district, as follows:

- CPR Lariviere rail line
- Midland rail line
- Canadian National Railway (CNR) Oak Point

Land use in Tylehurst is primarily commercial and industrial with light manufacturing facilities located in the northern section of the district between Wellington Avenue and Notre Dame Avenue. Large commercial businesses are located throughout the district, the most significant being the Polo Park Shopping Mall Complex located just north of Portage Avenue. Tylehurst also includes a small area of residential homes and greenspace. Approximately 24 ha of the district is classified as greenspace. The residential area is found south of Portage Avenue and consists of mostly single- and two-family homes; the greenspace is Westview Park located on Wellington Avenue. Omand's Creek is a major waterway which flows through the district.

Tylehurst has a number of major transportation routes throughout the district. Empress Street and St. James Street are regional roadways that run north-south through the district. Portage Avenue, St. Matthews Avenue, Ellice Avenue, Sargent Avenue, Wellington Avenue and Dublin Avenue are regional roadways that run east-west through the district.

1.2 Development

The Tylehurst district is already considered dense industrial and commercial land use. However, significant developments that would impact the Combined Sewer Overflow (CSO) Master Plan are expected and are listed below.

Empress Street Overpass Reconstruction and Rehabilitation Project:

> This project includes the renewal of the following roads: Empress Street, Empress Street East, Eastway, Westway, and St. John Ambulance Way between Portage Avenue and St. Matthews Avenue. The project will improve the infrastructure of the area and impact the drainage. The construction began in August 2018 and will continue until completion in mid-summer 2020. This project will have impacts on the proposed separation work to Tylehurst and will be implemented in coordination with the CSO Master Plan.

Former Winnipeg Blue Bombers Canad Inns Stadium Site:

> The site in which the Canad Inns football stadium has been demolished, and development of this site into a shopping/entertainment/mixed-use centre is ongoing.

A portion of Portage Avenue is located within the Tylehurst District. Portage Avenue is identified as a Regional Mixed Use Corridor as part of the OurWinnipeg future development plans. As such, focused densification along Portage Avenue will be promoted in the future.

One area within the Tylehurst combined sewer district, the Polo Park Shopping Centre and surrounding areas, are identified as a Regional Mixed-Use Centre as part of OurWinnipeg. As such, focused intensification within this Mixed Used Centre is to be promoted in the future, with a particular focus on mixed use development blending housing with the commercial and light industrial uses already prevalent in the area.

1.3 Existing Sewer System

Tylehurst encompasses an area of 213 ha[1] based on the district boundary extending from Notre Dame Avenue to the Assiniboine River and includes a combined sewer (CS), wastewater sewers (WWS), and land drainage sewer (LDS). As shown in Figure 42, there is approximately 15.5 percent (33 ha) already separated along Omand's Creek. There are no separation ready areas.

The Tylehurst sewer system includes a lift station (CS LS), and a CS outfall gate chamber. The CS system drains towards the Tylehurst outfall, located at the southern end of Tylehurst Street and Wolseley Avenue at the Red River. Sewage flows collected in Tylehurst district converge to the main CS trunk sewer that flows southbound through the centre of the district. The main CS trunk begins as a 1350 mm diameter pipe and flows southbound starting at the upstream end at Bangor Avenue and crosses under Omand's Creek. The trunk increases in diameter as it flows south toward the CS outfall eventually up to 1950 mm diameter at Ellice Avenue as it flows further south along Milt Stegall Drive, Cactus Jacks Place, and directly beneath Polo Park Mall. A 750 mm sewer main flowing east on Portage Avenue and a 2150 mm sewer main flowing west on Portage Avenue interconnect with the main CS trunk at Portage Avenue and Tylehurst Street where they flow into a 2080 mm by 2690 mm egg-shaped trunk. Immediately prior to the Tylehurst CS outfall a 375 mm lateral connection representing the small Wolseley West residential area ties into the main CS trunk sewer.

During dry weather flow (DWF), CS is diverted by the primary weir within the main trunk sewer immediately upstream of the CS outfall. The weir diverts the intercepted flows by gravity through the 525 mm off-take pipe to the Tylehurst CS LS, where it is pumped to the Portage Interceptor pipe along Portage Avenue. The interceptor pipe carries flows to a siphon located under Omand's Creek, and eventually to the North End Sewage Treatment Plan (NEWPCC) for treatment.

During wet weather flow (WWF), flow that exceeds the diversion capacity overtops the weir and is discharged to the river via the CS outfall. A flap gate and a sluice gate are installed on the CS outfall to restrict back-up from the Assiniboine River into the CS system during high river levels. When the river level is high this flap gate structure prevents gravity discharge of excess flow through the outfall, the excess flow in this case will continue to surcharge within the main trunk sewer district. Temporary flood pumps are installed in Tylehurst based on the flood manual high river level triggers to deal with situations such as this. There is no flood pump station at this primary outfall.

LDS networks are found on the eastern portion of the district to relieve surface runoff from parking lots at commercial and industrial facilities. A 600 mm to 750 mm LDS network is located on Empress Street and discharges surface runoff directly to Omand's Creek. It services western Empress Street from Eastway to Jack Blick Place. Where these facilities front Empress Street the LDS network drain directly to Omand's Creek via local outfalls. Elsewhere in the district, these LDS pipes connect back into to the CS system for the district.

The single CS outfall to the Assiniboine River is as follows:

- ID52 (S-MA20020018) – Tylehurst CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Tylehurst and the surrounding districts. Each interconnection is shown on Figure 42 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is included in the following list:

[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.

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Clifton

- The 600 mm WWS Main interceptor passes through the siphon at the district boundary between Clifton and Tylehurst and on to the North End Sewage Treatment Plant (NEWPCC) for treatment:
  - Invert at manhole on Portage Avenue at Clifton district boundary – 228.11 m (S-MH20009684)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Riverbend

- The 900 mm WWS Main interceptor sewer flows by gravity eastbound on Portage Avenue from Riverbend into Tylehurst district:
  - Invert at manhole on Portage Avenue at Tylehurst district boundary –229.94 m (S-MH20010407)

1.3.1.3 District Interconnections

Brooklands

WWS to CS

- A 450 mm WWS is pumped from Notre Dame CS LS in Brooklands southbound and connects to the Tylehurst CS system at the intersection of Notre Dame Avenue and St. James Street:
  - Invert at manhole on St. James Street at Tylehurst district boundary – 231.17 m (S-MH20010779)

LDS to CS

- A 450 mm LDS flows westbound by gravity along Notre Dame Avenue from Brooklands district into the Tylehurst CS system at the intersection of Notre Dame Avenue and St. James Street:
  - Invert at manhole on Notre Dame Avenue at Tylehurst district boundary –230.35 m (S-MH20010748)

Clifton

CS to CS

- A 200 mm CS flows eastbound by gravity along Sargent Avenue from Tylehurst district into the Clifton CS system at the intersection of Sargent Avenue and Sanford Street:
  - Invert at manhole on Sargent Avenue at Clifton district boundary – 228.92 m (S-MH20009103)

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

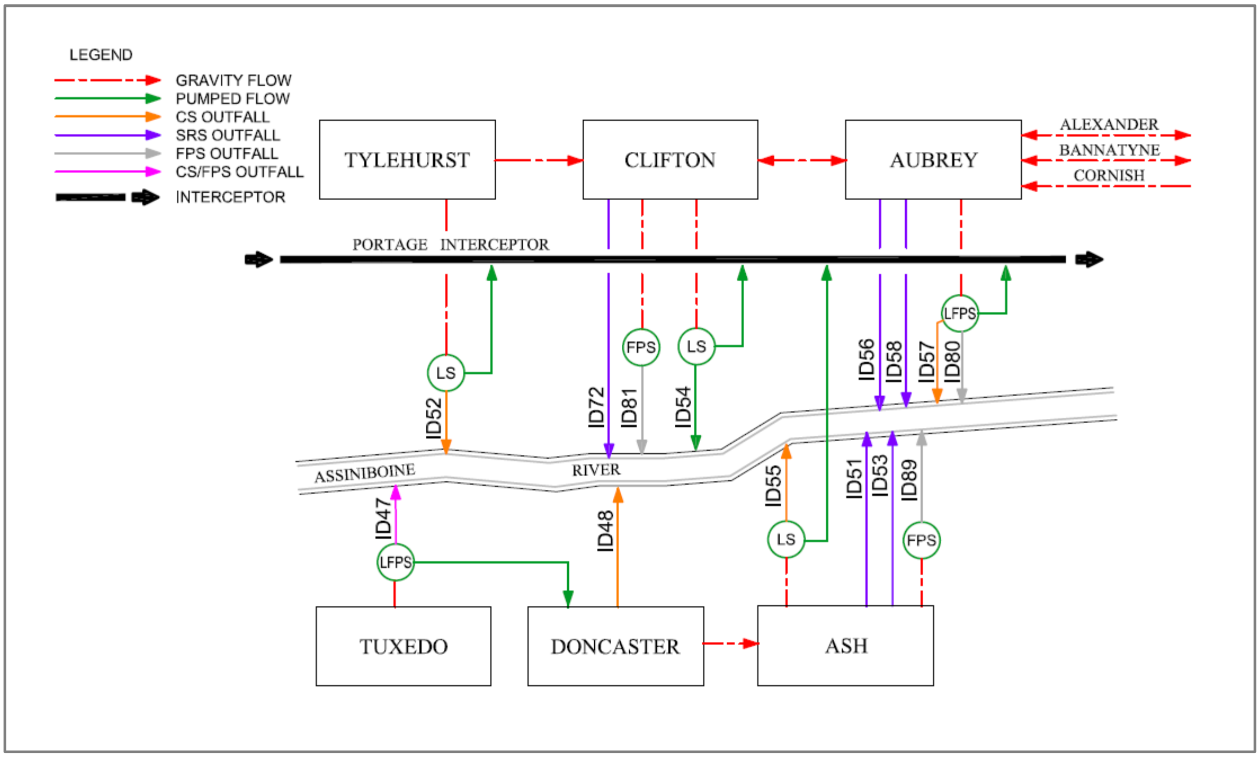


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 42 and are 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 (ID52)	S-RE70008619.1	S-MA20020018	2080 x 2690 2300 mm	Invert: 224.35 m
Flood Pumping Outfall (ID52)	S-RE70008619.1	S-MA20020018	2080 x 2690 2300 mm	Invert: 224.35 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-TE20007540.1	S-MA20020018	2080 x 2690 mm	Egg-shaped Invert: 225.04 m
SRS Outfalls	N/A	N/A	N/A	No SRS within the district.
SRS Interconnections	N/A	N/A	N/A	No SRS within the district.
Main Trunk Flap Gate	S-CG00000920.1	S-CG00000920	2300 mm	Invert: 225.09 m
Main Trunk Sluice Gate	S-CG00000921.1	S-CG00000921	1600 x 1600 mm	Invert: 225.06 m
Off-Take	S-TE70008606.1	S-MA70018463	525 mm	Circular Invert: 225.04 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	Tylehurst PS.1 Tylehurst PS.2 Tylehurst PS.3	N/A	0.424 m^3/s	1 x 0.158 m^3/s 1 x 0.131 m^3/s 1 x 0.135 m^3/s
Lift Station ADWF	N/A	N/A	0.081 m^3/s	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Force Main	S-RE70008604.1	S-MA70018459	375 mm	Invert: 229.5
Flood Pump Station Total Capacity	N/A	N/A	N/A	No FPS at the Tylehurst primary outfall.
Pass Forward Flow – First Overflow	N/A	N/A	0.183 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	Tylehurst – 224.01
2	Trunk Invert at Off-Take	225.04 m
3	Top of Weir	225.23
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection (S-MH20009801)	229.86
6	Sewer District Interconnection (Clifton)	226.50
7	Low Basement	231.34
8	Flood Protection Level	230.30

[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 for Tylehurst was in 1993 with the *Sewer Relief for Tylehurst Combined Sewer District Conceptual Report* (UMA Engineering LTD, 1993). This study discussed the optimum relief strategy and upgrading the service levels concerning the Tylehurst CS district.

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 Tylehurst 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
42 – Tylehurst	1993 - Conceptual	Future Work	2013	Study Complete	N/A

Source: *Sewer Relief for Tylehurst Combined Sewer District Conceptual Report*, 1993

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Tylehurst 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 Tylehurst district are listed in Table 1-4. The proposed CSO control projects will include sewer separation only. 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	Storage / Transport Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
85 Percent Capture in a Representative Year	-	-	-	-	-	-	-	✓	✓	✓	-

Notes:
- = not included
✓ = included

The Tylehurst district was identified during the Phase 2 work as high potential for future sewer separation based on the City's provided information. The district is not part of the currently planned Basement Flooding Relief (BFR) program but was taken forward for complete separation in the Control Option No.1 proposals. The cost-effectiveness of complete separation of the Tylehurst district in particular should be re-evaluated as part preliminary design of solutions in this district. The complete separation solution life cycle costs should be compared to alternative solutions, such as In-Line Storage via control gate construction.

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 Sewer Separation

Complete sewer separation is proposed for the Tylehurst district. This sewer separation will result in a reduction of the runoff and will reduce the pass forward flow to the interceptor and contribution of flow to NEWPCC. Sewer separation in Tylehurst would provide immediate benefits to the CSO program when complete. It would remove all CSO occurrences from the district as it will now be considered a separate district. The work would include the installation of an independent LDS system to separate the surface runoff from the CS system. Collected stormwater would be routed to a separate LDS outfall discharging to either Omand's Creek or Assiniboine River. It is envisaged that the separation would follow the existing separation arrangement where local streets are diverted to the adjacent Omand's Creek at multiple locations rather than a single large collection pipe and outfall location.

The flows to be collected after Tylehurst separation will be as follows:

- Dry weather flows will remain the same for Tylehurst district.
- Tylehurst wet weather flow (WWF) will consist of sanitary sewage combined with foundation drainage.

Potential drawbacks of sewer separation include the high construction cost and the wide-spread disruption to the neighbouring residential homes.

It is proposed that future monitoring of the district is completed to verify that the sewer separation is fully compliant with the modelled simulated elimination of all CSO overflows. A static weir elevation increase may be necessary at the CS diversion to eliminate the occurrence of all CSOs. Any weir elevation raise will also be evaluated in terms of existing basement flood protection to ensure the existing level of basement flood protection remains.

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 will be reviewed to identify applicable GI controls.

Tylehurst has been classified as a medium GI potential district. Land use in Tylehurst is mainly residential and commercial, the south end of the district is bounded by the Assiniboine River. This district would be an ideal location for cisterns/rain barrels, and rain garden bioretention. There are a few commercial areas which may be suitable to green roofs and parking lot areas which would be ideal for paved porous pavement.

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.

Sewer separation will include the installation of additional sewers that will require inspection, cleaning and rehabilitation. This will result in additional maintenance costs over the long term, but operational costs will be minimal. The existing larger CS pipes within the district may also receive insufficient flow with the separation work for proper scouring velocities in the sewer pipes. This could result in solids settling within the sewers, and requiring more frequent cleaning operations. The impacts of the reduced flows in larger CS pipes will be evaluated as part of the sewer separation design for the district.

It is recommended to continue to maintain and operate the flow monitoring instrumentation and assess the results after district separation work has been completed. This will allow the full understanding of the non-separated storm elements (foundation drain connections to the CS system) extent within the Tylehurst district.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	461	461	4,149	56	N/A
2037 Master Plan – Control Option 1	461	461	4,149	0	SEP

Notes:

SEP – Sewer Separation

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. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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 1-6 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 1-6 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 1-6. District Performance Summary – Control Option 1

	Preliminary Proposal	Master Plan			
Control Option	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow (L/s) [a]
Baseline (2013)	182,607	206,812	-	18	0.183 m^3/s
Separation	0	0	206,812	0	TBD
Control Option 1	**0**	**0**	**206,812**	**0**	**TBD**

[a] Pass forward flows assessed up to 5-year design rainfall event. Possible overflow for larger design events to be confirmed.

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entire CS system and not for each district individually. However, the proposed elimination of CSO overflow results in 100 percent capture at this district.

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 1-7. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-7. District Cost Estimate – 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 (Over 35-year period)
Separation	N/A [a]	$86,670,000	$52,000	$1,110,000
Subtotal	**$-**	**$86,670,000**	**$52,000**	**$1,110,000**
Opportunities	N/A	$8,670,000	$5,000	$110,000
District Total	**N/A [a]**	**$95,340,000**	**$57,000**	**$1,220,000**

[a] Solution development as refinement to Preliminary Proposal costs, Revised cost for the sewer separation work found to be $48,100,000 in 2014 dollars.

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

- Capital costs 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.

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 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Sewer Separation	Separation was not included in the initial Preliminary Proposal costs.	Costs updated to match the Control Option proposals.
Opportunities	A fixed allowance of 10 percent has been included for program opportunities	Preliminary Proposal estimate did not include a cost for GI opportunities	

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
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 estimates were based on 2014-dollar values	

1.10 Meeting Future Performance Targets

The proposed complete separation of the Tylehurst district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target. It is recommended to complete post separation modelling to confirm the target is fully achieved.

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 development 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 1-9.

Table 1-9. 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	-	-	-	-	O	-	-	-
2	Existing Lift Station	-	-	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	O	-	-	-
4	Construction Disruption	-	-	-	-	R	-	-	-
5	Implementation Schedule	-	-	-	-	R	-	R	-
6	Sewer Condition	-	-	-	-	-	-	-	-
7	Sewer Conflicts	-	-	-	-	R	-	-	-
8	Program Cost	-	-	-	-	R	-	-	-
9	Approvals and Permits	-	-	-	-	-	R	-	-
10	Land Acquisition	-	-	-	-	-	R	-	-

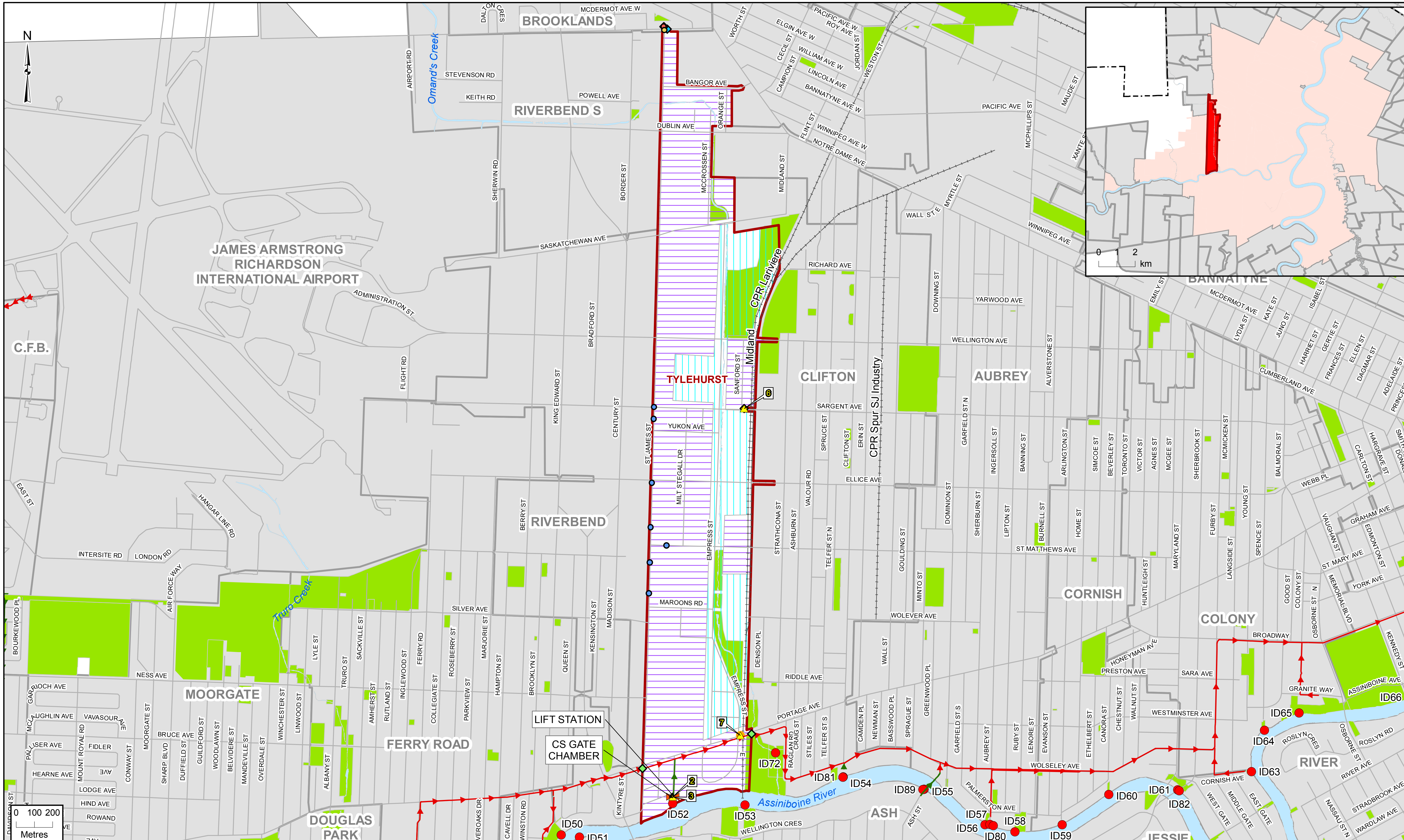
Table 1-9. Control Option 1 Significant Risks and Opportunities

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
11	Technology Assumptions	-	-	-	-	O	O	O	-
12	Operations and Maintenance	-	-	-	-	R / O	R	O	-
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

UMA Engineering Ltd. 1993. *Sewer Relief for Tylehurst Combined Sewer District Conceptual Report*. Prepared for the City of Winnipeg Water and Waste Department. July.



LEGEND

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

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

District Boundary Crossing
- CS
- LDS
- WWS

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

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Planning
- Sewer Separation - Complete

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 42
District Overview Map
Sewer District: Tylehurst
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE4\TYLEHURST\TYLEHURST_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/29/2019 8:58:24 AM

CSO Master Plan

Woodhaven District Plan

August 2019

City of Winnipeg

CSO Master Plan

Project No:	470010CH
Document Title:	Woodhaven District Plan
Revision:	03
Date:	August 15, 2019
Client Name:	City of Winnipeg
Project Manager:	John Berry
Author:	Jack Tinker
File Name:	Woodhaven_Plan_Final_CO1MP_08152019

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

Contents

Tables

Figure

1. Woodhaven District

1.1 District Description

Woodhaven is a small district located on the western perimeter of the combined sewer area. It is bounded by Ainslie district and Sturgeon Creek to the north and east, Westwood and Parkdale districts to the west, and the Assiniboine River to the south. Portage Avenue runs along the northern border of this district and is the only significant transportation route that connects with Woodhaven.

This district consists mostly of single family residential, with no industrial or commercial land use. This was one of the first districts to be developed in the history of Winnipeg's west end. Woodhaven also includes approximately 20 ha of greenspace which consists of the Woodhaven Park Community Club and a portion of the St. Charles Country Club on the eastern and western borders, respectively.

1.2 Development Potential

A portion of Portage Avenue is located within the Woodhaven District. Portage Avenue is identified as Regional Mixed-Use Corridor as part of the OurWinnipeg future development plans. As such, focused intensification along Portage Avenue is to be promoted in the future.

1.3 Existing Sewer System

The Woodhaven district has a drainage area of an approximate size of 55 ha[1] based on the district boundary. There is approximately 4 percent (2 ha) considered separated and no separation-ready areas.

The district is predominantly serviced by a CS system with a runoff collection ditch system surrounding the majority of homes, which collects the majority of rainfall runoff from the street right-of-way in the district. The surrounding districts all have separate sewer systems, isolating Woodhaven from the other CS districts. This district has only one CS outfall that goes to the Assiniboine River and no storm relief sewer system. The outfall is serviced by a 1200 mm by 900 mm egg-shaped sewer trunk that receives sewage from three connecting pipes at the intersection of Assiniboine Avenue and Woodhaven Boulevard. The district does not have a flood pump station (FPS).

During dry weather flow (DWF) the Woodhaven primary weir diverts flow at the 300 mm off-take pipe to the CS lift station (LS). Two pumps transport the combined sewage via a short stretch of 150 mm force main to the St James Interceptor sewer that runs through the district along Assiniboine Avenue and eventually transports it to the West End Sewer Treatment Plant (WEWPCC) for treatment.

During wet weather flow (WWF) events, any flow that exceeds the diversion capacity of the primary weir overtops the weir and is discharged to the river via a 900 x 1200 mm primary outfall. The Woodhaven outfall does not have a flap or sluice gate present. A review of the outfall specifically for the CSO Master Plan evaluation found that the normal summer water level (NSWL) is low relative to the invert of the CS outfall.

The single CS outfall to the Assiniboine River is as follows:

- ID40 (S-MA70019662) – Woodhaven CS Outfall

[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.

1.3.1 District-to-District Interconnections

There are three district-to-district interconnections between Woodhaven and the surrounding districts. Each interconnection is shown on Figure 43 and shows gravity and pumped flow from one district to another. The known district-to-district interconnections are as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Westwood

- The 1350 mm St. James Interceptor sewer flows by gravity into Westwood District and eventually to the WEWPCC for treatment:
  - St. James interceptor invert at Westwood/Woodhaven district boundary - 231.03 m (S-MH20002594)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Ainslie

- The St. James interceptor system splits into two 450 mm steel river crossing pipes under Sturgeon Creek, and flow into a single 900 mm pipe in the Woodhaven district at Assiniboine Avenue and Woodbridge Road:
  - St. James interceptor invert at Ainslie/Woodhaven district boundary - 231.93 m (S-MH20004628)

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

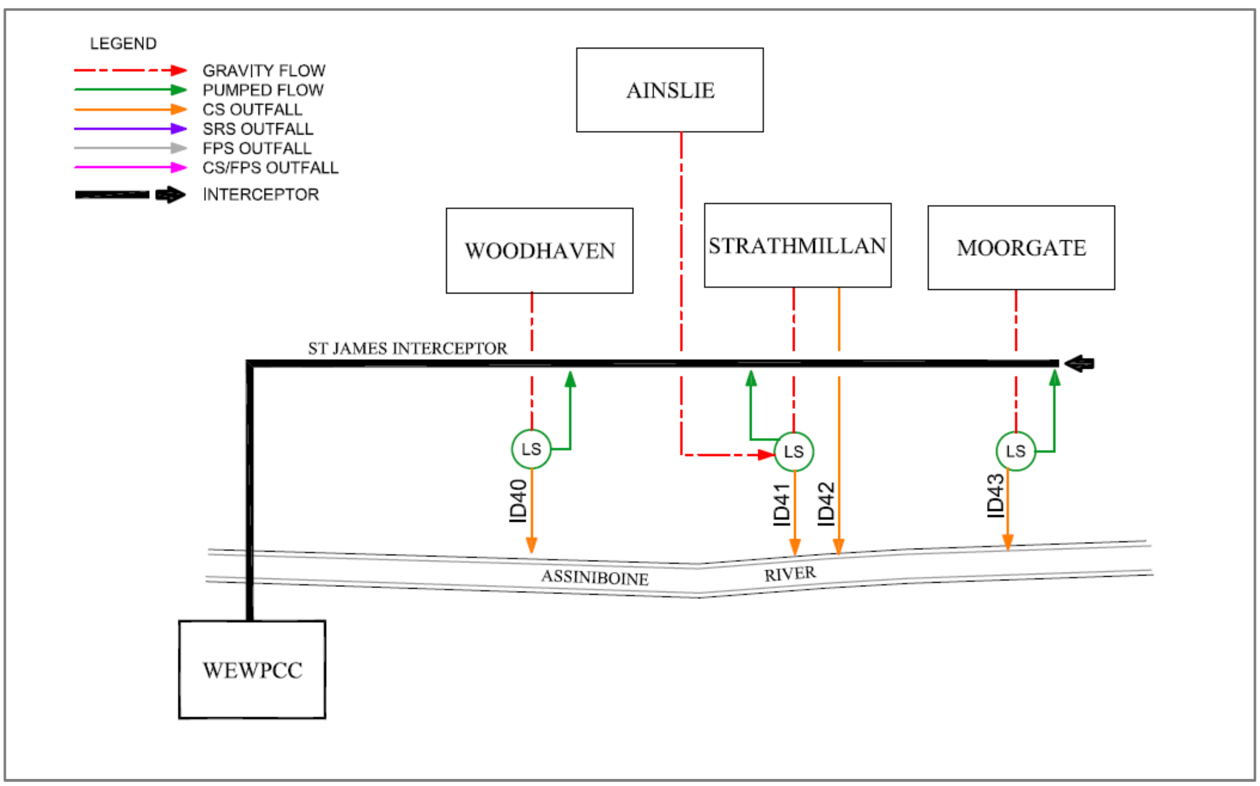


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 43 and are listed in Table 1-1.

JACOBS

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Combined Sewer Outfall (ID40)	S-MH70021569.1	S-MA70019662	900 x 1200 mm	Egg-shaped Invert: 229.59 m
Flood Pumping Outfall	N/A	N/A	N/A	No flood pumping station in this district.
Other Overflows	N/A	N/A	N/A	
Main Sewer Trunk	S-TE20000744.2	S-MA70019661	900 x 1200 mm	Egg-shaped Invert: 229.82 m
Storm Relief Sewer Outfalls	N/A	N/A	N/A	No SRS within district.
Storm Relief Sewer Interconnections	N/A	N/A	N/A	No SRS within district.
Main Trunk Flap Gate	N/A	N/A	N/A	No flap gate constructed on primary outfall.
Main Trunk Sluice Gate	N/A	N/A	N/A	No sluice gate constructed on primary outfall.
Off-Take	S-TE20000744.1	S-MA70019650	300 mm	Invert 229.85 m
Wet Well	Woodhaven PS	S-PS00000294	3.5 m^2 chamber area	
Lift Station Total Capacity	N/A	N/A	0.054 m^3/s	2 x 0.027 m^3/s pumps
Lift Station ADWF	N/A	N/A	0.004 m^3/s	
Lift Station Force Main	WoodhavenPS_RM.1	S-MA20005021	150 mm	Connects to St. James Interceptor Invert: 230.48 m
Flood Pump Station Total Capacity	N/A	N/A	N/A	No flood pumping station in this district.
Pass Forward Flow – First Overflow	N/A	N/A	0.054 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	Woodhaven – 226.92
2	Trunk Invert at Off-Take	229.85
3	Top of Weir	230.28
4	Relief Outfall Invert at Flap Gate [b,c]	N/A
5	Low Relief Interconnection [b]	N/A
6	Sewer District Interconnection (Interceptor at Ainslie district)	Invert at district boundary: 43-01 = 228.90

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
7	Low Basement	231.98
8	Flood Protection Level	231.43

[a] City of Winnipeg Data, 2013

[b] There is no SRS system in Woodhaven. The Woodhaven CS outfall does not have a positive gate or flap gate.

[c] The normal summer water level (NSWL) is low relative to the CS outfall, so a flap gate is not required to prevent back-up of water from the river.

1.4 Previous Investment Work

Table 1-3 provides a summary of the district status in terms of data capture and study. No work has been completed on the district sewer system since the 1986 Basement Flood Relief Study (Girling,1986).

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 Woodhaven 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
43 - Woodhaven	1986	Future Work	2013	Study Complete	N/A

Source: Report on Basement Flooding Relief Program, 1986

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Woodhaven 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 Woodhaven sewer district are listed in Table 1-4. The proposed CSO control projects will include 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 1-4. District Control Option

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

Notes:

- = not included
✓ = included

The Woodhaven district plan includes implementing floatable control and in-line storage to meet the CSO Control Option 1 performance target.

Floatable management will be necessary to capture floatables in the sewage. The primary CS overflow for the district is to be screened under the current CSO control plan to address the floatables management requirements. The installation of a control gate at the primary CS outfall will be required for the screen operation in the Woodhaven district. This control gate installation will also provide the mechanism for capture of minor additional in-line storage. It should be noted however that in-line storage for the Woodhaven district is not a cost-effective solution, specifically for additional volume capture. The control gate installation is recommended primarily to provide the necessary hydraulic head for screen operations. Should the screening no longer be required in the Woodhaven district, it is recommended that alternative measures to in-line storage such as off-line storage be investigated in the Woodhaven district to provide the additional volume capture required to meet the 85 percent capture target in a more cost effective manner.

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. RTC is not included in detail within each plan and is described further in Section 3 of Part 3A.

1.6.2 In-Line Storage

In-line storage has been proposed as a CSO control for Woodhaven district. The in-line storage will require the installation of a control gate at the CS outfall. The control gate will primarily be used to maximize the available hydraulic head in the district CS system, such that screening can be effectively operated. The gate will also provide a secondary benefit in a minor increase in the storage level in the existing CS to provide an slight increase to the volume capture. The lack of a flap gate at the Woodhaven outfall was also evaluated and found to not impact the in-line storage arrangement recommended in any way.

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	229.82 m	
Trunk Diameter	900 x 1200 mm	
Gate Height	0.24 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	230.52 m	
Maximum Storage Volume	19 m^3	Option has small storage volume as by-product of screening installation requirement
Nominal Dewatering Rate	0.05 m^3/s	Based on capacity of existing CS LS
RTC Operational Rate	To Be Determined	Future RTC/dewatering review on assessment

Notes:

NSWL – normal summer water level
RTC = Real Time Control

The proposed control gate will cause combined sewage to back-up in the collection system to the extent shown on Figure 43. 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 and adjacent control gate level are determined in relation to the critical performance level 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 43-01 provides an overview of the ideal 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 upstream of the existing CS LS. The dimensions of the chamber will be 5 m in length and 2 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. Due to the physical location of the existing infrastructure within the boulevard of Assiniboine Avenue, this does not fully allow the control gate and screening chambers to be located adjacent to the existing off-take (located within residential driveway) and CS LS. Therefore, to accommodate the two chambers, the conceptual location is upstream on the existing sewer on Woodhaven Boulevard. This would require the diversion of the two existing sewers (from east and west along Assiniboine Avenue) to upstream of the proposed control gate chamber, to ensure they are still intercepted. This would increase the construction activities in this area, the work required for the control gate construction is located within a residential street with minor disruptions expected. Further optimization of the gate chamber size may be provided if the decision is made not to include screening.

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 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. Any future considerations, for RTC improvements, would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflows at this district. Similar basis for the rate matching the LS philosophy of two times nominal dewatering rate could be adopted. This future RTC control will provide the ability to capture and treat more volume for localized storms by using the excess interceptor capacity where the runoff is less.

1.6.3 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The 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	230.52 m	
Bypass Weir Crest	230.42 m	
Normal Summer River Level	226.92 m	
Maximum Screen Head	0.52 m	
Peak Screening Rate	0.3 m^3/s	
Screen Size	1.5 m x 1 m	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 43-01. The screens will operate when the sewer levels surpass the bypass weir elevation. A side bypass weir upstream of the gate will direct initial 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 may include screenings pumps with a discharge returning the screened material to the CS LS for routing to the WEWPCC for removal. The provision of screening pumps is dependent on final level assessment within the existing infrastructure and the Woodhaven trunk. This will be confirmed during future assessment stage.

The dimensions for the screen chamber to accommodate influent from the side weir, the screen area, and the routing of the discharge piping downstream of the gate are 2.5 m in length and 3 m in width. The existing sewer configuration including the off-take, and the CS LS force main will have to be modified to accommodate the new chambers as the control gate will also be located in this location.

If an alternative floatables management approach is pursued in this district, both the control / screening chambers would not be required. This control gate chamber will only provide minor additional volume capture for the district, and has been primarily recommended to provide the necessary hydraulic head for screening operation.

1.6.4 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.

Woodhaven has been classified as a high GI potential district, the land use mainly consists of single family residential land use, meaning it would be an ideal location for permeable paved roadways, cisterns/rain barrels, and rain gardens. Woodhaven already has a ditch and culvert land drainage system in place that could potentially be further used for bioswale projects further increasing the GI potential.

1.6.5 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 system 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 Woodhaven CS LS, which may 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. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options 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 Added To Model
2013 Baseline	43	43	984	37	N/A
2037 Master Plan – Control Option 1	43	43	984	37	IS, SC

Notes:

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)	12,321	12,117	-	18	0.052 m^3/s
In-line Storage	12,874	11,900	217	17	0.054 m^3/s
Control Option 1	**12,874**	**11,900**	**217**	**17**	**0.054 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.

The Woodhaven district has an extensive ditch drainage system, that although not specifically modelled for the CSO Master Plan performance assessment, would be an ideal area for improvement to the hydraulic model when assessing the impact of green infrastructure with a selected district. This would require additional survey, monitoring and modelling to ensure that the parameters are closely matched for conditions prior to and following GI infrastructure construction.

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 Control Gate	N/A [a]	$2,190,000 [b]	$39,000	$840,000
Screening		$1,840,000 [b c]	$48,000	$1,040,000
Subtotal	**$0**	**$4,030,000**	**$87,000**	**$1,880,000**
Opportunities	N/A	$400,000	$9,000	$190,000
District Total	**$0**	**$4,430,000**	**$96,000**	**$2,070,000**

[a] In-Line and Screening not assessed in this district for the Preliminary Proposal. Solution developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Costs for these items of work found to be $1,290,000 in 2014 dollars

[b] Cost associated with the new off-take construction, and re-routing of existing sewers to accommodate control gate and screening chamber location s proposed was not included in Master Plan cost assessments for control gate or screening chamber work.

[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 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 Options	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 Woodhaven district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the future performance targets. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume.

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 use of GI • Opportunistic Separation • Off-line Storage (Tank / Tunnel)

The control options selected for the Woodhaven district has been aligned for the requirement to provide screening on each of the primary outfalls and not specifically 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 involve a system wide basis analysis to be completed to determine the next phase for the relatively small district of Woodhaven.

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 part of 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	-	-	-	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-

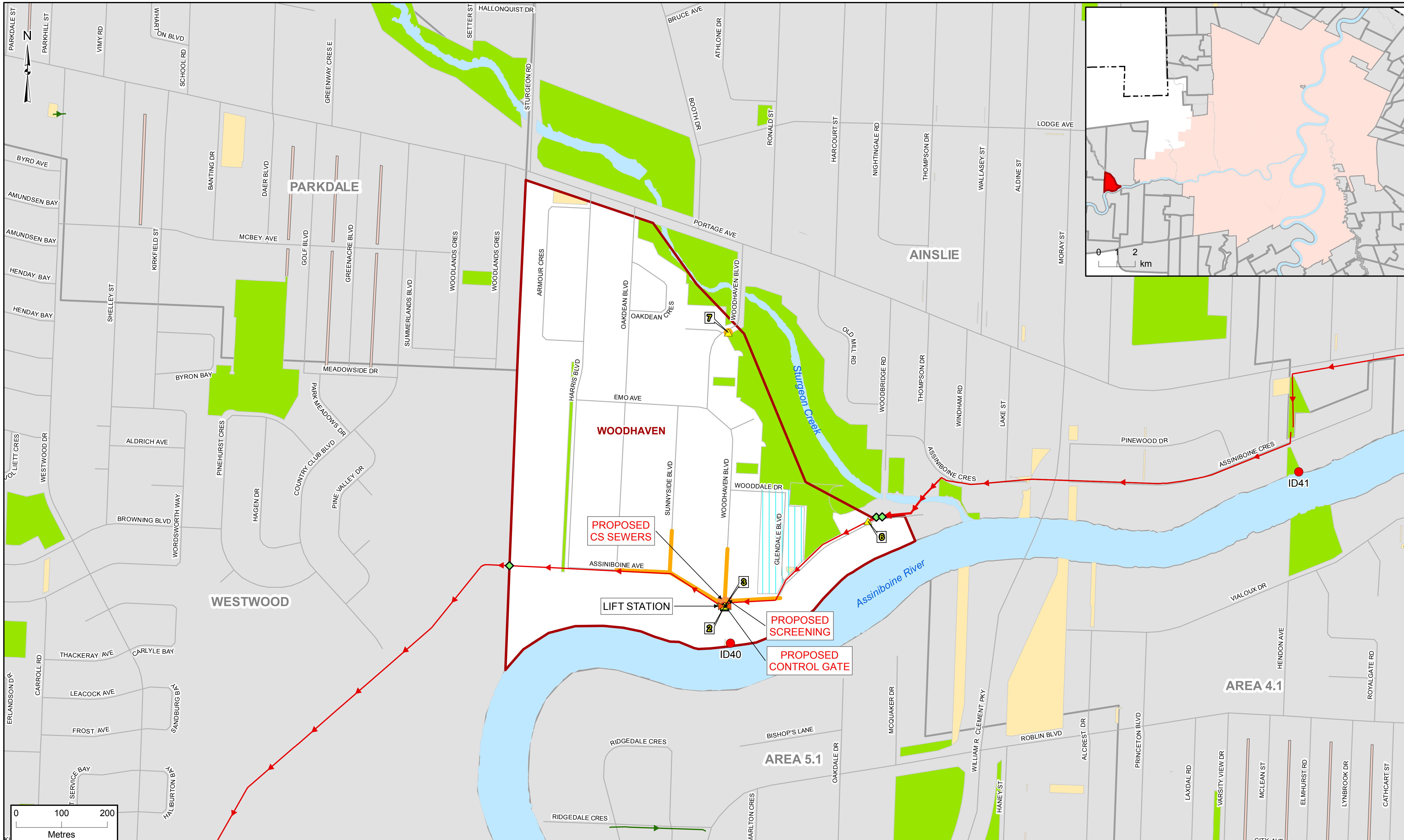
Table 1-12. Control Option 1 Significant Risks and Opportunities

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
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

Girling, R.M. 1986. *Basement Flooding Relief Program Review – 1986*.



LEGEND

Primary Weir	Inter-System Connection	District Boundary Crossing	Interceptor Sewer	District Boundary
Critical Elevation	CS - WWS	WWS	Force Main	Watercourse
CSO Outfall			Street	Greenspace
Low CS Manhole				City Owned Land

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

Winnipeg
THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 43
District Overview Map
Sewer District: Woodhaven
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\WOODHAVEN\WOODHAVEN_DISTRICT_OVERVIEW_MAP.MXD SBEGG1 7/24/2019 9:00:14 AM

LEGEND

Primary Weir
Critical Elevation
CSO Outfall
Manhole
Pump Location
Force Main
Sewer By Type
CS
WWS
Pump Station Type
Lift Station
Land Parcel

CSO MASTER PLAN
PROPOSED SOLUTIONS

Proposed Manhole
Proposed CS Sewer
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 43-01
Control Gate and Screening
Sewer District: Woodhaven
City of Winnipeg
Combined Sewer Overflow Master Plan

\\WPGFSP01\PROJ\WINNIPEGCITYOF\470010MASTERPLANCSO\500DESIGNWORKFILES\503STUDIES\MASTER PLAN CONCEPTUAL DEVELOPMENT\MAPPING\MAPS\PACKAGE2\WOODHAVEN\WOODHAVEN_DISTRICT_DETAIL.MXD SBEGG1 7/24/2019 9:07:32 AM