CSO Master Plan

Munroe District Plan

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City of Winnipeg

CSO Master Plan

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3	08/20/2019	Final Submission For CSO Master Plan	MF	MF	SG

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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

[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.

Avenue, from Panet Street at the east limit to Henderson Highway as the west limit. Multiple secondary 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)

1.3.1.2 District Interconnections

Roland

SRS to SRS

- 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:

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)

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.

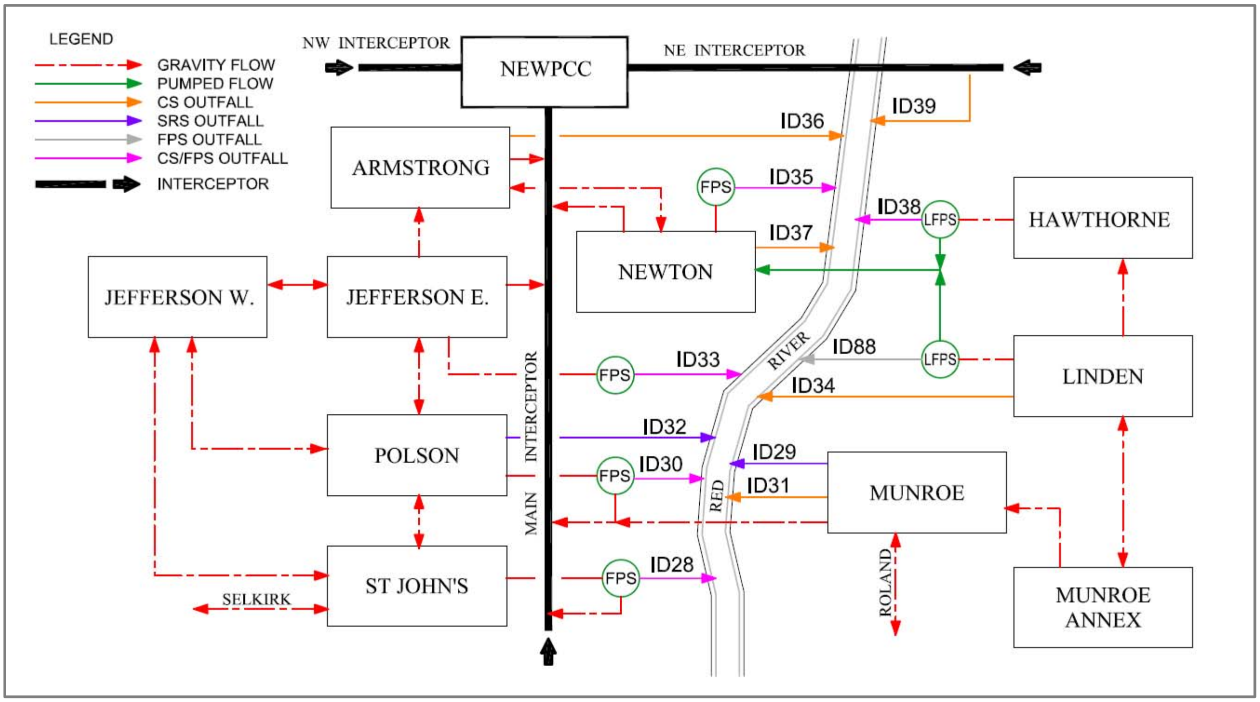


Figure 1-1. District Interconnection Schematic

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

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Off-Take	S-TE70027696.1	S-MA70017177	450 mm	Invert: 223.60 m
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.

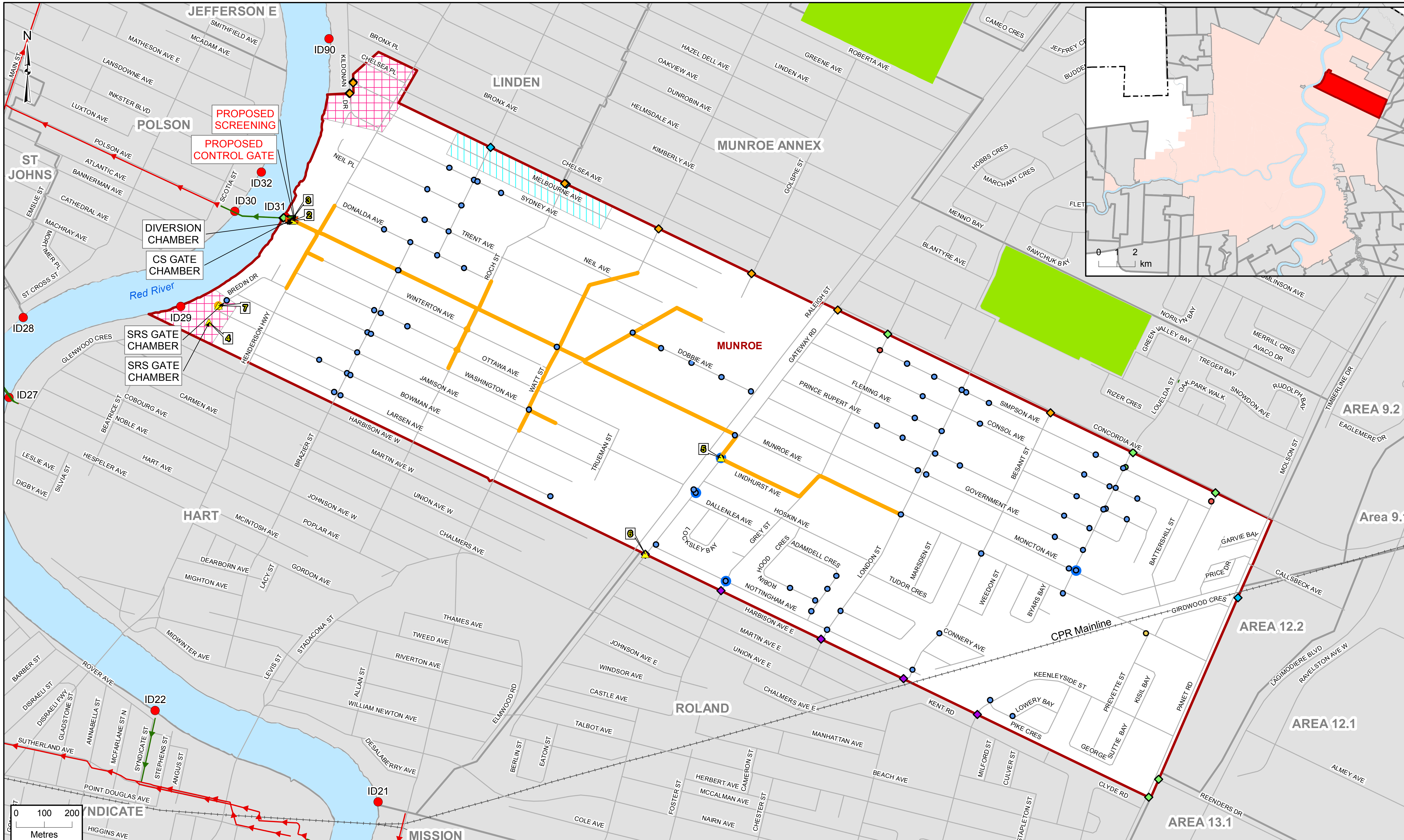
Table 1-12. Control Option 1 Significant Risks and Opportunities

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

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 29
District Overview Map
Sewer District: Munroe
City of Winnipeg
Combined Sewer Overflow Master Plan

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

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