CSO Master Plan

Bannatyne District Plan

August 2019

City of Winnipeg

CSO Master Plan

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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 hospitcal, 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. .

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

[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 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

<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 227.55 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

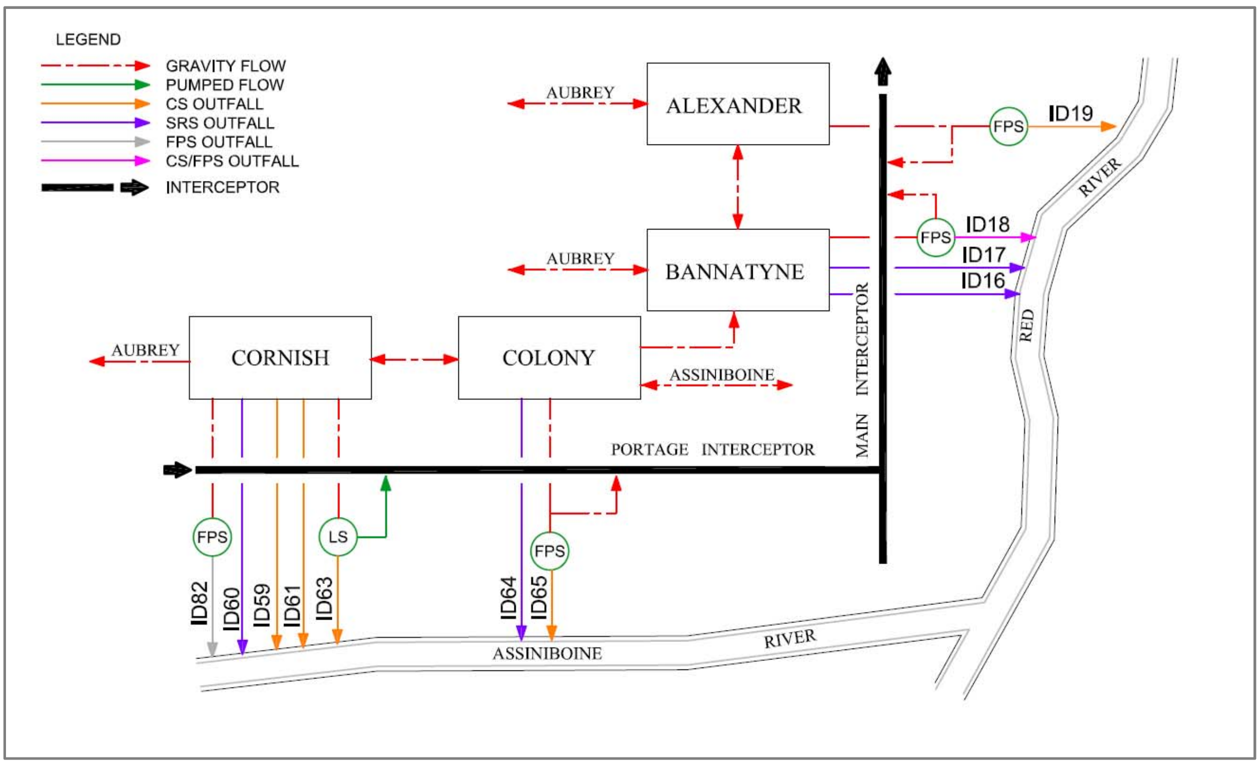


Figure 1-1. The drawing illustrates the collection areas, interconnections, pumping systems, and discharge points for the existing system.

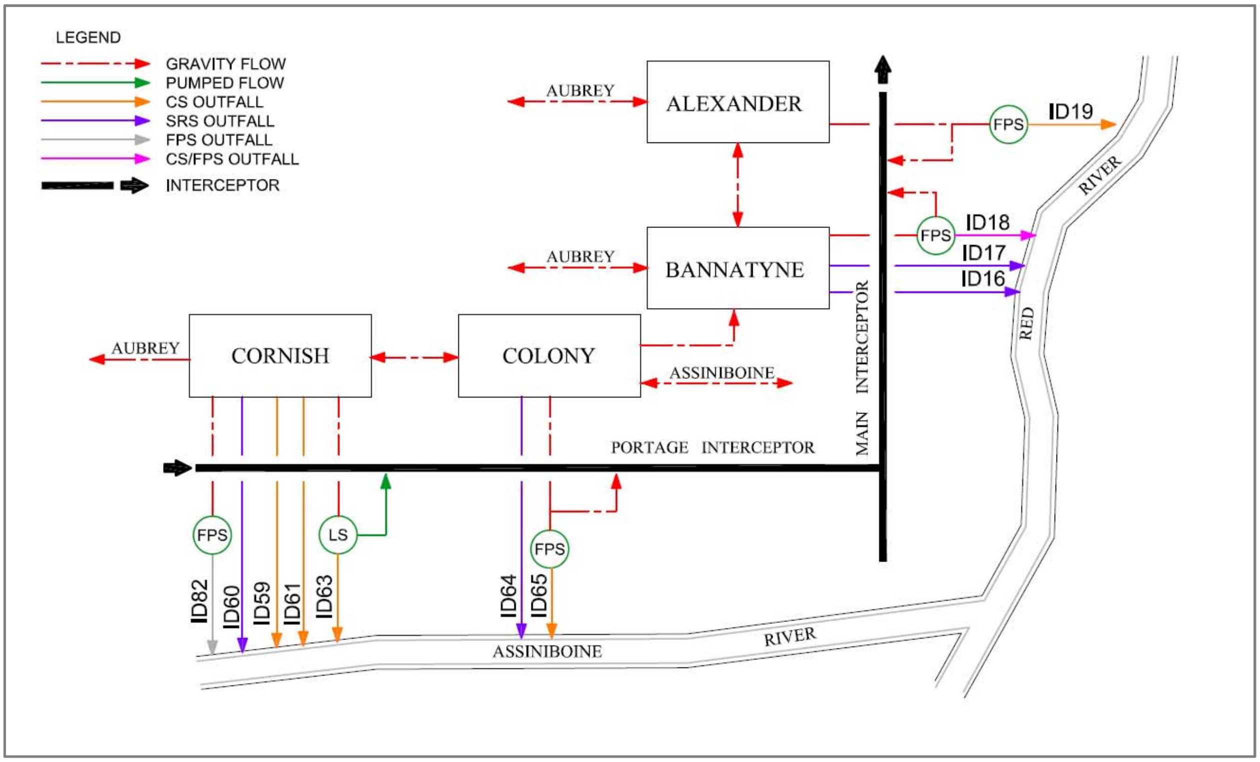


Figure 1-1. District Interconnection Schematic

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 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 **Error! Reference source not found.**. 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	
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 screen 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 1-7, 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 1-9. 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	Preliminary Proposal estimates were based on 2014-dollar values.	

Table 1-10. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
	construction inflation.		

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.

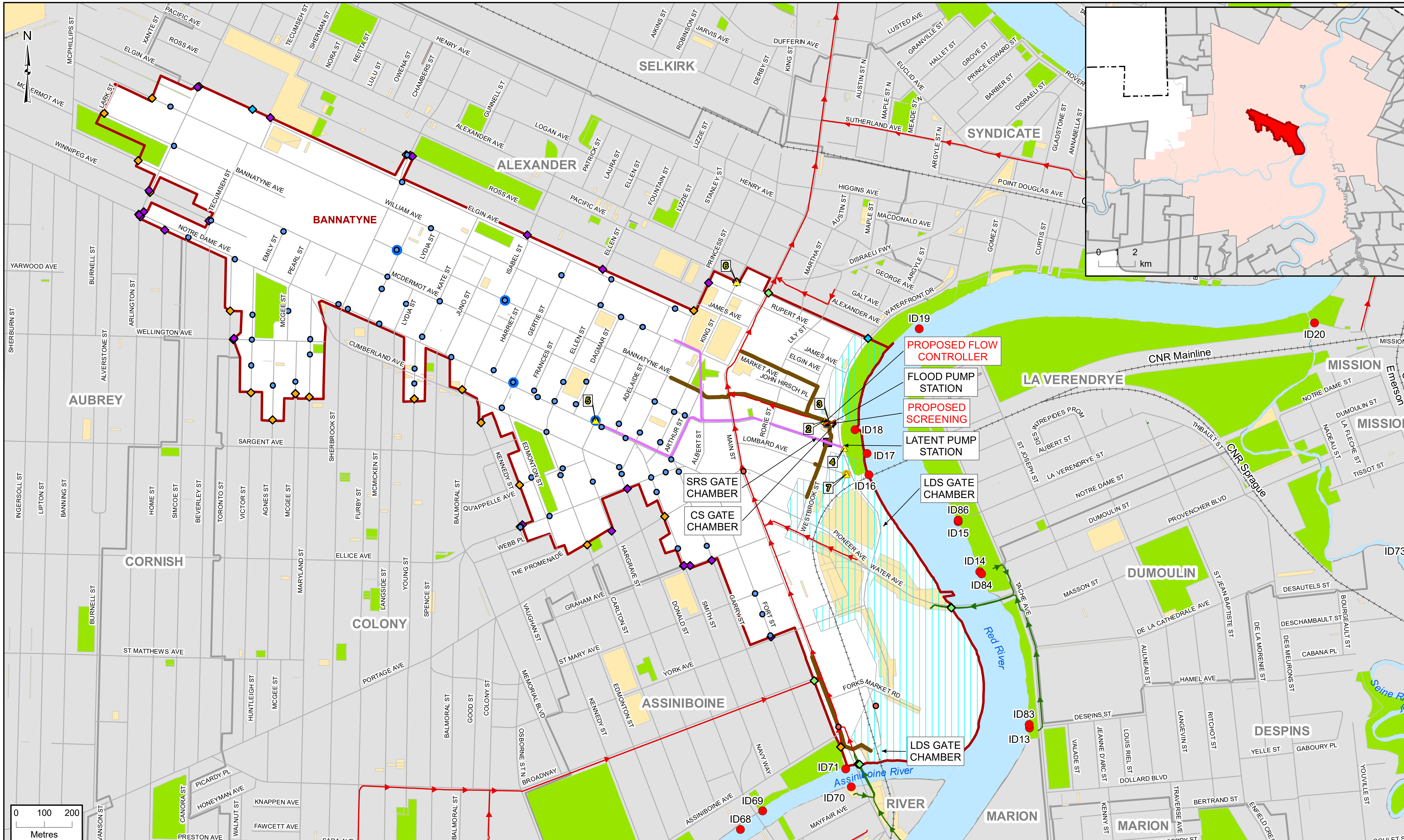
Table 1-12. Control Option 1 Significant Risks and Opportunities

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

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

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

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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

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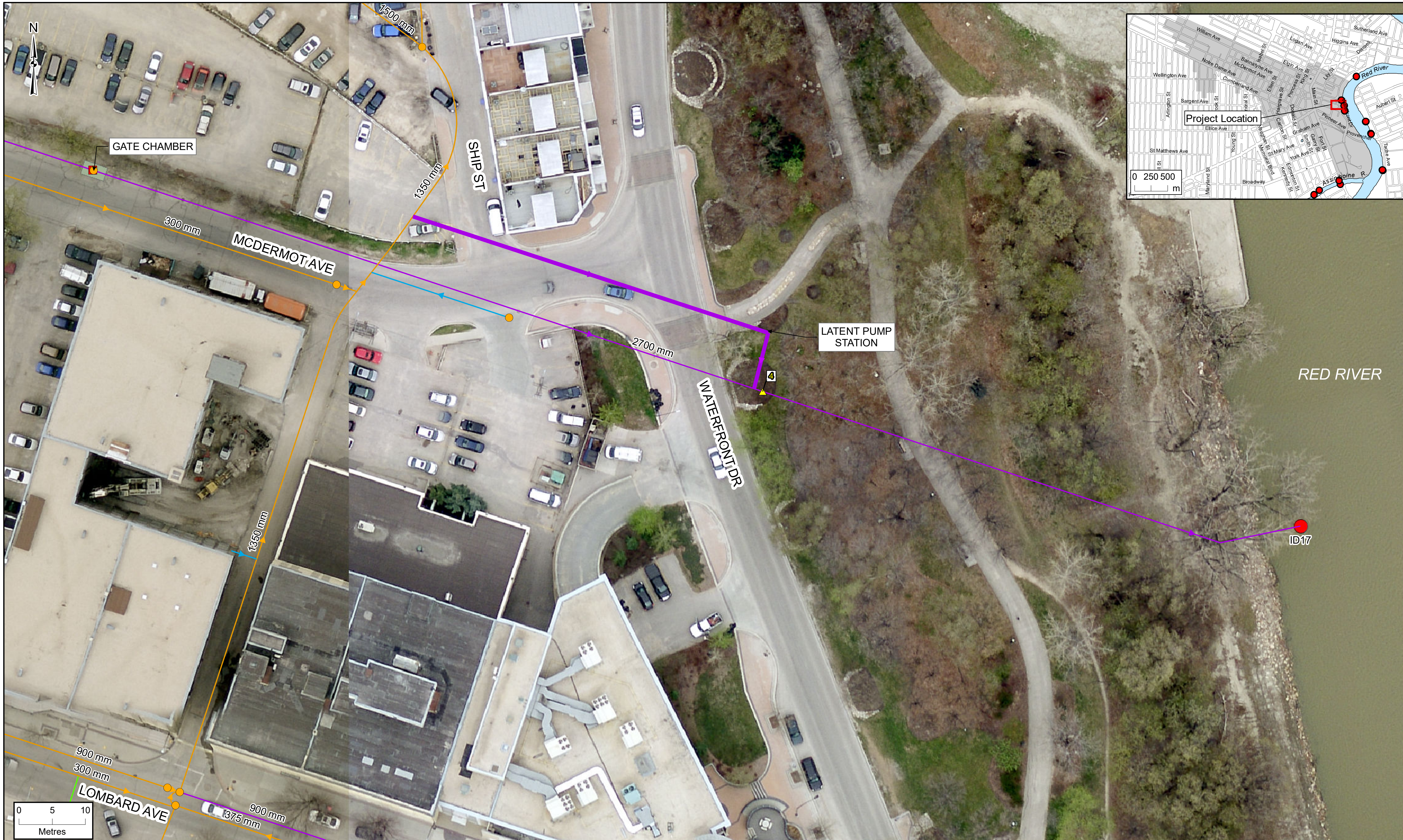

LEGEND

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

CSO MASTER PLAN PROPOSED SOLUTIONS

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

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

Winnipeg

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

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