CSO Master Plan

Assiniboine District Plan

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City of Winnipeg

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CSO Master Plan

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1. Assiniboine District

1.1 District Description

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

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

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

1.2 Development

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

1.3 Existing Sewer System

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

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

During dry weather flow (DWF), the SRS is not required, and sanitary sewage flows to the diversion chamber upstream of the Assiniboine CS outfall and is diverted by the primary weir to a 1120 mm

[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.

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

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

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

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

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

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Assiniboine and the surrounding districts. Each interconnection is shown on Figure 04 and shows locations where gravity flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Bannatyne

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

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Colony

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

1.3.1.3 District Interconnections

Colony

<u>CS to CS</u>

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

<u>SRS to SRS</u>

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

<u>SRS to CS</u>

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

Bannatyne

<u>CS to CS</u>

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

<u>SRS to CS</u>

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

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

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

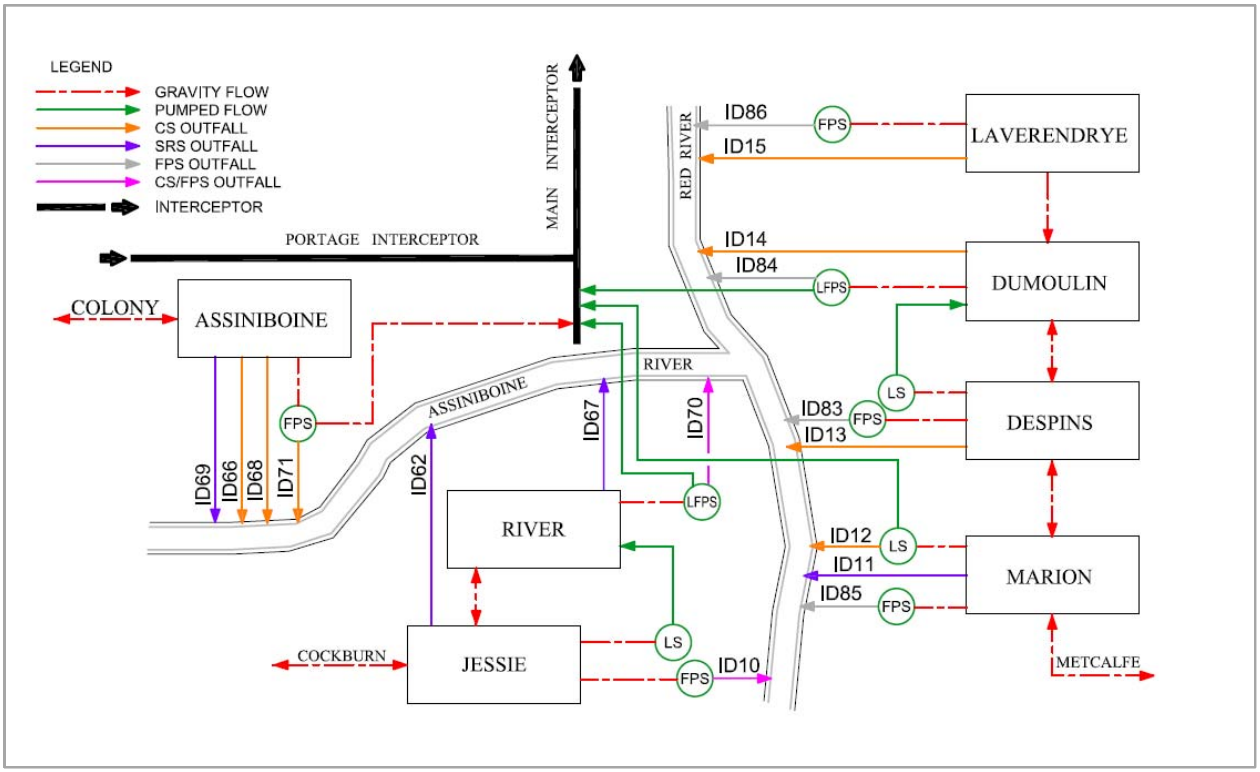


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 04 and listed in Table 1-1

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Combined Sewer Outfall (ID71)	S-RE70003466.1	S-MA70008123	1400 mm	Assiniboine River Invert: 222.04 m
Flood Pumping Outfall (ID71)	S-RE70003466.1	S-MA70008123	1400 mm	Assiniboine River Invert: 222.04 m
Other Overflows (ID66 & ID68)	S-AC70028554.1	S-MA70068974	750 mm	Invert: 222.43 m

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

Notes:

ADWF = average dry-weather flow
GIS = geographic information system
ID = identification
N/A = not applicable
(1) – Gravity pipe replacing Lift Station as Assiniboine is a gravity discharge district

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

Table 1-2. Critical Elevations

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

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

Table 1-3 provides a summary of the district status in terms of data capture and study. The most recent study completed in Assiniboine was the *Conceptual Design of Combined Sewer Relief for Assiniboine Sewer District* (Comeau, 1989). The study's purpose was to assess the level of protection against basement flooding and to provide appropriate methods for providing relief to the district. No other work has been completed on the district sewer system since that time.

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

Table 1-3. District Status

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

1.5 Ongoing Investment Work

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

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

1.6 Control Option 1 Projects

1.6.1 Project Selection

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

Table 1-4. District Control Option

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

Notes:

- = not included
✓ = included

The height of the existing weir is sufficient that it negates the need to add a control gate to provide in-line storage. The existing height of the weir provides an existing storage of 143 m^3. Since this district already has an existing high level weir, this has been taken as acceptable for basement flooding protection.

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

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

Floatable control will be necessary to capture any undesirable floatables in the sewage. Floatables will be captured with all implemented control options to some extent, but screening may be added as required to reach the desired capture level.

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

1.6.2 Latent Storage

Latent storage is proposed as a control option for Assiniboine district. The latent storage level in the system is controlled by the river level on the Assiniboine River, and the resulting backpressure of the river level on the SRS outfall flap gate, as explained in Part 3C. The latent storage design criteria are identified in Table 1-5. The storage volumes indicated in Table 1-5are based on the NSWL for the 1992 representative year.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	Donald – 222.44 m	Flap gate invert
NSWL	223.83 m	
Trunk Diameter	1950 mm	
Design Depth in Trunk	1390 mm	
Maximum Storage Volume	420 m^3	
Force Main	150 mm	
Flap Gate Control	N/A	Flap gate control was established as not required for this work.
Lift Station	Yes	
Nominal Dewatering Rate	0.03 m^3/s	Based on 24 hour emptying requirement
RTC Operational Rate	TBD	Future RTC / dewatering review on performance

Note:

NSWL – normal summer water level RTC – Real Time Control

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

The LSPS would connect to the SRS outfall chamber and discharge back to the CS system once capacity allows. This SRS outfall chamber is currently being upgraded to include a flap gate to allow latent storage to be utilized, see Section 1.5 above. Figure 04 identifies the extent of the SRS system within

Assiniboine district that would be used for latent storage. The maximum storage level is directly related to the 1992 representative year NSWL and the size and depth of the SRS system. Once pressure from the level in the SRS exceeds the river level backpressure, the flap gate opens, and the combined sewage is discharged to the river.

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

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

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

1.6.3 Gravity Flow Control

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

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

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

1.6.4 Floatables Management

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

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

Table 1-6. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	226.42 m	Existing weir level
Bypass Weir Crest	N/A	In-line screening
NSWL	223.83 m	
Maximum Screen Head	2.59 m	
Peak Screening Rate	0.91 m^3/s	
Screen Size	1.5 m wide x 1 m high	Modelled Screen Size

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

1.6.5 Green Infrastructure

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

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

1.6.6 Real Time Control

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

1.7 Systems Operations and Maintenance

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

The latent storage will take advantage of the SRS infrastructure already in place; therefore, minimal additional maintenance will be required for the sewers. The proposed LSPS will require regular maintenance that would depend on the frequency of operation. Additional system monitoring, and level controls will be installed which will require regular scheduled maintenance.

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

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

1.8 Performance Estimate

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

Table 1-7. InfoWorks CS District Model Data

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

Notes:

Lat St = Latent Storage
SC = Screening

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

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

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

Table 1-8. Performance Summary – Control Option 1

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

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

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

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

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

1.9 Cost Estimates

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

Table 1-9. Cost Estimates – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance (Over 35-year period)
Latent Storage	$1,790,000	$2,580,000	$74,000	$1,600,000
Off-line Storage Tank	- [a]	N/A [c]	N/A	N/A
Screening	- [a]	$2,910,000 [d]	$34,000 [d]	$740,000
Gravity Flow Control	N/A [b]	$1,300,000	$34,000	$740,000
Subtotal	**$1,790,000**	**$6,790,000**	**$143,000**	**$3,080,000**
Opportunities	N/A	$680,000	$14,000	$310,000
District Total	**$1,790,000**	**$7,470,000**	**$158,000**	**$3,390,000**

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

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

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

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

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

- Capital costs and O&M costs are reported in terms of present value.

- A fixed allowance of 10 percent has been included for GI, with no additional costs for RTC. This has been listed as part of the Opportunities costs.
- The Preliminary Proposal capital cost is in 2014 dollar values.
- The CSO Master Plan capital cost is based on the control options presented in this plan and in 2019 dollar values.
- The 2019 Total Annual Operations and Maintenance (over 35-year period) cost component is the present value costs of each annual O&M cost under the assumption that each control option was initiated in 2019.
- The 2019 Annual Operations and Maintenance Costs were based on the estimated additional O&M costs annually for each control option in 2019 dollars.
- Future costs will be inflated to the year of construction.

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

Table 1-10. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Latent Storage	Unit cost updates	
	Screening	Screening was not included in the preliminary estimate	
	Removal Of Off-line Storage Tank	Off-line storage not taken forward as a Master Plan Control Option 1 solution, not considered cost effective to meet CO1 target.	
	Gravity Flow Control	A flow controller was not included in the preliminary estimate	Added for the Master Plan to optimize existing static in-line performance.
Opportunities	A fixed allowance of 10 percent has been included for program opportunities	Preliminary Proposal estimate did not include a cost for GI opportunities	
Lifecycle Cost	The lifecycle costs have been adjusted to 35 years	City of Winnipeg Asset Management Approach	
Cost escalation from 2014 to 2019	Capital Costs have been inflated to 2019 values based on an assumed value of 3 percent per for construction inflation.	Preliminary Proposal estimates were based on 2014-dollar values.	

1.10 Meeting Future Performance Targets

The regulatory process requires consideration for upgrading Control Option 1 to another higher-level performance target. For the purposes of this CSO Master Plan, a future performance target of 98 percent capture for the representative year measured on a system-wide basis was evaluated. This target will permit the number of overflows and percent capture to vary by district to meet 98 percent capture. Table 1-11 provides a description of how the regulatory target adjustment could be met by building off the proposed work identified for Control Option 1.

Overall the Assiniboine district would be classified as low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture in the representative year future performance target. The increased volume capture via the inclusion of a flap gate on the latent storage infrastructure could potentially be achieved. In addition, green infrastructure and off-line storage tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume. Opportunistic separation of portions of the district may be achieved with synergies with other major infrastructure work to address future performance targets.

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

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

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

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

1.11 Risks and Opportunities

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

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

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

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

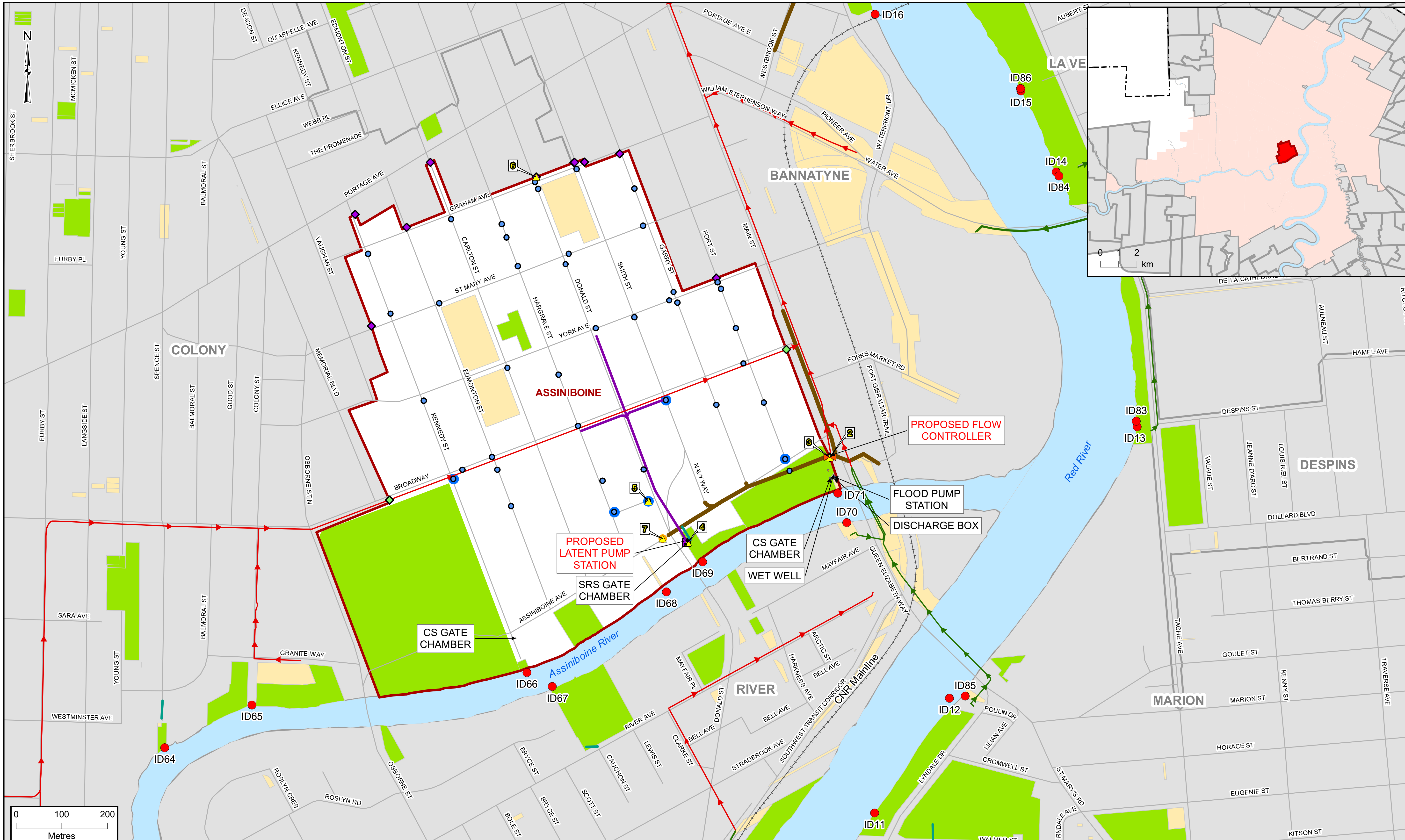
Table 1-12. Control Option 1 Significant Risks and Opportunities

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

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

1.12 References

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



LEGEND

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

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

District Boundary Crossing
- CS
- SRS
- WWS

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

- District Boundary
- Watercourse
- Greenspace
- City Owned Land

CSO MASTER PLAN PROPOSED SOLUTIONS

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

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

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

Winnipeg

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WATER AND WASTE DEPARTMENT

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

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LEGEND

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

Sewer By Type
- CS
- WWS

Control Structure Type
- Gate Chamber

Pump Station Type
- Discharge Box
- Flood Pump Station
- Wet Well

CSO MASTER PLAN
PROPOSED SOLUTIONS
- Screening
- Flow Controller

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

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

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

LEGEND

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

CSO MASTER PLAN
PROPOSED SOLUTIONS

- Proposed Latent Force Main
- Latent Pump

ALL PROPOSED SOLUTIONS
SHOWN IN RED TEXT

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

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