CSO Master Plan

Selkirk District Plan

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City of Winnipeg

CSO Master Plan

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1. Selkirk District

1.1 District Description

Selkirk district is located in the northwest section of the combined sewer (CS) area west of the Red River and north of Alexander and Syndicate districts. Selkirk is approximately bounded by the Canadian Pacific Railway (CPR) Winnipeg Yards to the south, Sinclair Street and McPhillips Street to the west, Alfred Avenue to the north, and the Red River to the east.

Selkirk district includes a mix of commercial, industrial, and residential land use. Residential areas are mainly two-family and multi-family. Industrial manufacturing facilities are located primarily south of Dufferin Avenue. A heavy manufacturing land use area located south of Sutherland Avenue includes the CPR Winnipeg Yards. Commercial areas are found along Main Street and Selkirk Avenue. Greenspace areas include the Old Exhibition Grounds and Redwood Park, and various school parks, playgrounds, and community areas throughout the district.

This district is located in proximity to the downtown and has many transportation routes. The CPR Mainline passes through the southern end of Selkirk district. Regional roads in the district include Main Street, Salter Street, McGregor Street, Arlington Street, and McPhillips Street in a north-south direction and Selkirk Avenue and Dufferin Avenue in the east-west direction. Arlington Street includes the Arlington Bridge that extends over the CPR Winnipeg Yards into the Selkirk district.

1.2 Development

There is limited land area available for new development within the Selkirk district. However, some significant redevelopments that could impact the Combined Sewer Overflow (CSO) Master Plan are in the planning stages:

A study has been completed to construct a more improved bridge to replace the Arlington Bridge. The study began in 2014 with construction projected to be completed in 2024. The Arlington bridge is nearing the end of its usable life and plans to construct a more detailed bridge that allows for increased transportation and improvements for walking and cycling were considered in the study. The development of the bridge will have minimal impact on the CSO Master Plan.

There are several areas within the Selkirk CS district which have been identified as a General Manufacturing Lands as part of OurWinnipeg. Focused intensification within these areas is to be promoted in the future, with a particular focus on mixed use development. This is to verify that adequate employment lands are available to support future population growth.

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

1.3 Existing Sewer System

Selkirk district encompasses an area of 310 ha[1] and includes a CS system and a storm relief sewer (SRS) system. This district does not include any areas that may be identified as LDS separated. There is approximately 6 ha (2.0 percent) identifiable as separation-ready and approximately 20 ha of greenspace.

The CS system includes a diversion structure, a flood pump station (FPS), four CS outfalls, and outfall gate chambers. The CS system drains towards the Selkirk outfall and diversion chamber, located at the

[1] City of Winnipeg GIS information relied upon for area statistics. The GIS records may vary slightly from the city representation in the InfoWorks sewer model. Therefore, minor discrepancies in the area values reported in Section 1.3 Existing Sewer System, and in Section 1.8 Performance Estimate may occur.

east end of Selkirk Avenue at the Red River. At the outfall, sewage is diverted to the Main Interceptor or may be discharged by gravity/via the FPS adjacent to the CS outfall into the Red River.

A single sewer trunk collects flow from most of the district and flows east to the diversion chamber on Selkirk Avenue. The main 1600 mm by 2000 mm CS trunk extends from the diversion chamber to McKenzie street. Multiple secondary sewers extend from the main CS trunk along Selkirk Avenue to the north and south to service the entire area. There are also two secondary CS outfalls at the east end of Aberdeen Avenue and Pritchard Avenue respectively. Each of these secondary outfalls provide local relief to the CS laterals on Aberdeen Avenue and Pritchard Avenue. A positive gate alone is constructed on the Pritchard secondary outfall, and there is no flap gate or sluice gates constructed on the Aberdeen secondary outfall. Frequent silting issues are encountered at the Aberdeen secondary outfall, and for periods of time this outfall is not operational. This outfall is to be further investigated and potentially decommissioned if found to not currently be in operation.

During runoff events, the SRS system provides relief to the CS system in the Selkirk district. The SRS system extends throughout the district and has multiple interconnections with the CS system. Most catch basins are still connected to the CS system, so no partial separation has been completed. The SRS system includes a dedicated SRS outfall at Burrows Avenue and discharges directly to the Red River. A flap gate and sluice gate are installed on the Burrows SRS outfall pipe to control backflow into the SRS system under high river level conditions in the Red River.

During dry weather flow (DWF), the SRS is not required; sanitary sewage flows to the diversion chamber and is diverted by the weir to a 600 mm interceptor pipe, where it flows by gravity west to the Main Street interceptor and on to the North End Sewage Treatment Plant (NEWPCC) for treatment.

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

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

- ID23 (S-MA70007427) – Selkirk CS Outfall
- ID26 (S-MA00017914) – Aberdeen CS Outfall
- ID24 (S-MA00017936) – Pritchard CS Outfall
- ID25 (S-MA00017926) – Burrows SRS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Selkirk and the surrounding districts. Each interconnection is shown on Figure 37 and shows locations where gravity flow can cross from one district to another. Each interconnection is listed as follows:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

St Johns

- The 2250 mm Main Interceptor flows by gravity into St. Johns district north on Main Street towards the NEWPCC for treatment:
  - Invert at Selkirk district boundary – 219.83 m (S-MH000162165)

1.3.1.1 Interceptor Connections – Upstream of Primary Weir

Syndicate

- The 2250 mm Main Interceptor pipe flows by gravity north on Main Street into Selkirk district to carry sewage to the NEWPCC for treatment:
  - Invert at Syndicate district boundary 220.13 m (S-TE00005699)

1.3.1.2 District Interconnections

Syndicate

CS to CS

- High sewer overflow:
  - 375 mm CS on Main Street at Dufferin Avenue – 228.52 m (S-MH00012094)

CS To SRS

- High sewer overflow:
  - 500 mm SRS on Euclid Avenue at Lusted Avenue – 228.60 m (S-MA00013582)
  - 250 mm SRS on Austin Street N at Euclid Avenue – 228.62 m (S-MA00013587)

St. Johns

CS to CS

- A 300 mm CS flows north by gravity on Arlington Street into St. Johns district from Selkirk district:
  - Invert at Selkirk district boundary 228.65 m (S-MA00014590)
- A 300 mm CS flows by gravity northbound on Aikins Street into St. Johns district:
  - Invert at Selkirk district boundary 227.20 m (S-MA00015124)
- A 300 mm CS flows by gravity north on Main Street and connects to the CS network in St. Johns district at the intersection of Main Street and Redwood Avenue:
  - Invert at Selkirk district boundary 227.60 m (S-MA00015398)
- High point manhole:
  - 300 mm CS on Selkirk Avenue – 229.19 m (S-MH00008778)
  - 300 mm CS on McGregor Street – 228.33 m (S-MH00013219)

CS to SRS

- High sewer overflow:
  - 450 mm SRS on Artillery Street – 229.34 m (S-MH00012613)
  - 250 mm SRS on Alfred Avenue – 229.84 m (S-MH00012868)

SRS to SRS

- A 2150 mm SRS flows by gravity eastbound on Burrows Avenue from St. Johns district into Selkirk district:
  - Invert at Selkirk district boundary 223.64 m (S-MA00014318)
- A 2150 mm SRS flows by gravity northbound on Arlington Street into St. Johns district:
  - Invert at Selkirk district boundary 223.57 m (S-MA00014588)

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

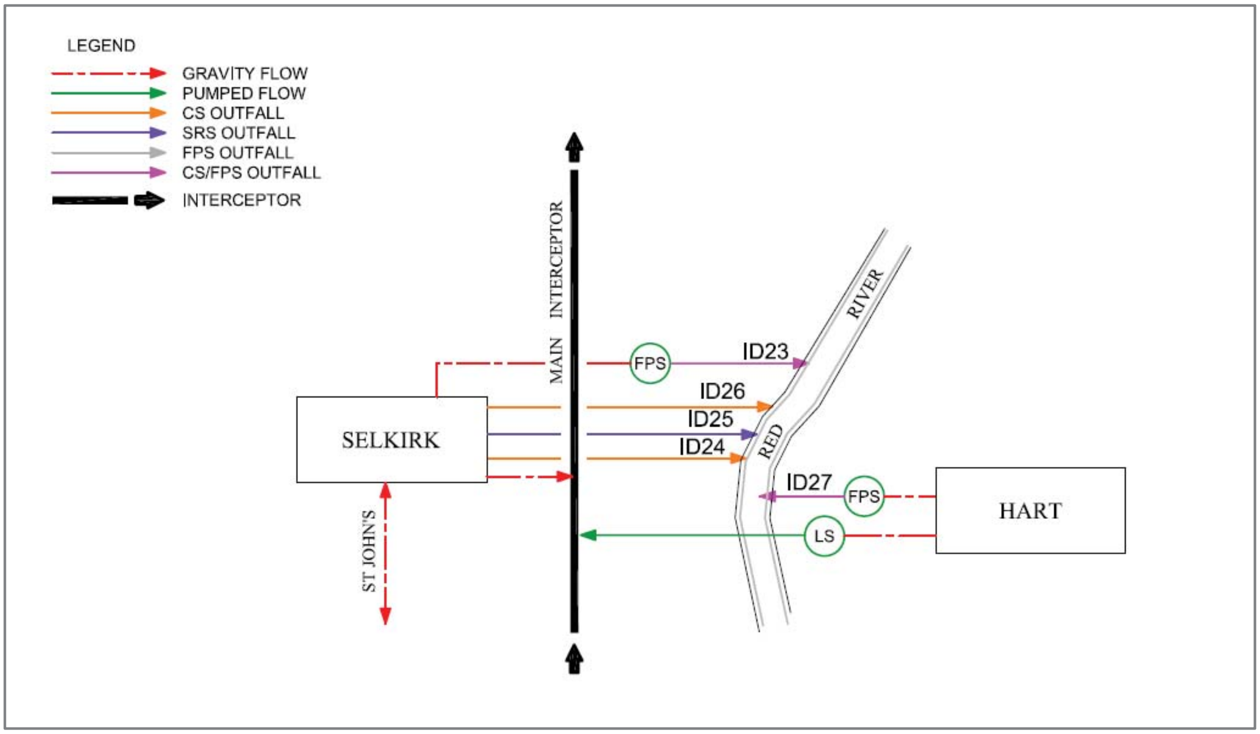


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 37 and listed in Table 1-1.

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Combined Sewer Outfall (ID23)	S-CO70003073.1	S-MA70007427	1800 mm	Red River Invert: 221.80 m
Flood Pumping Outfall (ID23)	S-CO70003073.1	S-MA70007427	1800 mm	Red River Invert: 221.80 m
Other Overflows (ID24 & ID26))	S-MH00012354.1 S-MH00014696.1	S-MA00017936 S-MA00017914	250 mm 200 mm	Invert: 222.99 m Invert: 223.29 m
Main Trunk	S-MH00012339.1	S-MA00013835	1600 x 2000 mm	Main CS that flows east on Selkirk Avenue Egg-shaped Invert: 223.67 m
SRS Outfalls (ID25)	S-BE00007701.1	S-MA00017926	2400 mm	Invert: 221.03 m
SRS Interconnections	N/A	N/A	N/A	54 SRS - CS
Main Trunk Flap Gate	S-AC70007831.1	S-CG00000997	1525 mm	Invert: 223.90 m
Main Trunk Sluice Gate	SELKIRK_GC.1	S-CG00001065	1600 x 1600 mm	Invert: 223.70 m
Off-Take	N/A	S-MA70049021	600 mm	Invert: 223.70 m
Dry Well	N/A	N/A	N/A	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Total Capacity	N/A	S-MA70049021 [(1)]	600 mm [(1)]	0.57 m^3/s [(1)]
ADWF	N/A	N/A	0.0316 m^3/s	
Lift Station Force Main	N/A	N/A	N/A	
Flood Pump Station Total Capacity	N/A	N/A	3.84 m^3/s	2 x 0.52 m^3/s 2 x 1.40 m^3/s
Pass Forward Flow – First Overflow	N/A	N/A	0.474 m^3/s	

Notes:

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

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

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
1	Normal Summer River Level	Selkirk – 223.69 Burrows – 223.69 Pritchard – 223.69 Aberdeen – 223.69
2	Trunk Invert at Off-Take	223.68
3	Top of Weir	224.38
4	Relief Outfall Invert at Flap Gate (Burrows SRS Outfall)	221.71
5	Low Relief Interconnection (S-MH00012136)	225.24
6	Sewer District Interconnection (St Johns)	223.57
7	Low Basement	228.90
8	Flood Protection Level (Selkirk)	229.20

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

Table 1-3 provides a summary of the district status in terms of data capture and study. The most recent study completed in Selkirk was the *Sewer Relief Study: Selkirk Combined Sewer District* (I.D. Engineering Canada Inc., 1993). The study's purpose was to develop sewer relief options that provide a 5-year level of protection against basement flooding and to develop alternatives for reducing and eliminating pollutants from CSOs. No other work has been completed on the district sewer system since that time.

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

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Planned Completion
37 – Selkirk	1993	Future Work	2013	Study Complete	N/A

Source: Report on *Sewer Relief Study: Selkirk Combined Sewer District*, 1993

1.5 Ongoing Investment Work

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

1.6 Control Option 1 Projects

1.6.1 Project Selection

The Selkirk district has latent storage, in-line storage via control gate, floatable control via screening, gravity flow control and green infrastructure (GI) projects proposed to meet CSO Control Option 1. Table 1-4 provides an overview of the control options included in the 85 percent capture in a representative year option.

Table 1-4. District Control Option

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

Notes:

- = not included
✓ = included

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

The Selkirk district discharges to the interceptor by gravity; therefore, it will also require a method of flow control to optimize and control the discharge rate to the interceptor for future dewatering RTC controls. Refer to Section 3.3.5 of Part 2 of the CSO Master Plan for discussion on the interaction of the gravity control on the system for all gravity discharge locations.

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

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

1.6.1 Latent Storage

Latent storage is proposed as a control option for the Selkirk district. Latent storage will use the Burrows SRS outfall and associated SRS system. The latent storage level in the system is controlled by the river level on the Red River, which has been modelled as the NSWL for the 1992 representative year, and the resulting backpressure of the river level on the Burrows SRS outfall flap gate, as explained in Part 3C. The latent storage design criteria are identified in Table 1-5.

Table 1-5. Latent Storage Conceptual Design Criteria

Item	Elevation/Dimension	Comment
Invert Elevation	Burrows – 221.84 m	Flap Gate invert
NSWL	223.69 m	
Trunk Diameter	2400 mm	
Design Depth in Trunk	1846 mm	
Maximum Storage Volume	1680 m^3	
Force main	100 mm	
Flap Gate Control	N/A	
Lift Station	Yes	
Nominal Dewatering Rate	0.015 m^3/s	Based on 24 hour emptying requirement
RTC Operational Rate	TBD	Future RTC/ dewatering assessment

Note:

NSWL - normal summer water level

RTC – Real Time Control

Latent storage is readily accessible and has lower risk for implementation than other combined sewage temporary storage means. In order to facilitate an operational latent system, a latent pump station and interconnecting pipes will be required to access the storage. The latent storage pumping system would connect to the SRS outfall chamber and discharge back to the CS system once capacity allows. A conceptual layout for the pump station and force main is shown on Figure 37-02. The pump station will be located adjacent to the SRS outfall gate chamber at the edge of Burrows Avenue. The latent force main will pump the stored combined sewage back into the Selkirk CS system via the upstream manhole on the CS lateral on Burrows Avenue immediately adjacent to the SRS outfall (S-MH00012329). The pump station will operate to dewater the SRS system in preparation for the next runoff event, the requirement for the system to be ready for the next event within a 24-hour period after completion of the previous event.

Figure 37 identifies the extent of the SRS system within Selkirk district that would be used for latent storage. The maximum storage level is directly related to the NSWL under the 1992 representative year conditions, and the size and depth of the SRS system. Once the level in the SRS exceeds the river level, the flap gate opens, and the combined sewage is discharged to the river. At this point the latent storage in the system is no longer utilized.

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

1.6.2 In-Line Storage

In-line storage is proposed as a CSO control for the Selkirk district. The in-line storage will require the installation of a control gate at the CS outfall. The gate will increase the storage level in the existing CS and provide an overall higher volume capture. The control gate installation will also provide the necessary additional hydraulic head for screening operations.

A standard design was assumed for the control gate, as described in Part 3C. A standard approach was used for conceptual gate sizing by assuming it to be the lesser of the height of half of the site-specific trunk diameter or the maximum height of the gate available. The design criteria for the in-line storage are listed in Table 1-6.

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

Item	Elevation/Dimension	Comment
Invert Elevation	223.69 m	Downstream invert of lowest pipe at diversion chamber
Trunk Diameter	1600 x 2000 mm	Egg shaped sewer
Gate Height	0.41 m	Gate height based on half trunk diameter assumption
Top of Gate Elevation	224.79 m	
Bypass Weir Level	224.69 m	
Maximum Storage Volume	287 m^3	
Nominal Dewatering Rate	0.57 m^3/s	Based on minimum pass forward rate for gravity discharge district
RTC Operational Rate	TBC	Future RTC / dewatering

The proposed control gate will cause combined sewage to back-up within the collection system to the extent shown on Figure 37. The extent of the in-line storage and volume is related to the top elevation of the bypass side weir. The level of the top of the bypass side weir and adjacent control gate level are determined in relation to the critical performance levels in the system for basement flooding protection: when the system level increases above the bypass weir crest and proceeds above the top of the control gate during high flow events, the control gate drops out of the way. At this point, the district will only provide its original interception capacity via the primary weir for the district, and all ecess CS would flow over the weir and discharge to the river. After the sewer levels in the system drops back below the bypass side weir critical performance level, the control gate moves back to its original position to capture the receding limb of the WWF event. The existing DWF diversion will continue with its current operation, with all DWF being diverted to the Main Interceptor.

Figure 37-01 provides an overview of the conceptual location and configuration of the control gate and screening chambers. The proposed control gate will be installed in a new chamber within the existing trunk sewer alignment and located west of the Selkirk FPS. The dimensions of a new chamber to provide an allowance for a side weir for floatables control are 5.0 m in length and 3.0 m in width to accommodate the gate, with an allowance for a longitudinal overflow weir. The existing sewer configuration may have to be modified to allow the installation of the in-line gate and screening chambers. The physical requirements for the off-take and station sizing for a modification to pumping capacity have not been considered in detail, but they will be required in the future as part of an RTC program or FPS rehabilitation or replacement project.

The nominal rate for dewatering is determined by the performance of the existing pipe capacity as the district is a gravity discharge district. As such the flows will vary over the duration of a rainfall event and has been nominated for a gravity flow control device. Any future consideration for RTC improvements would be completed with spatial rainfall as any reduction to the existing pipe capacity/operation for large events will adversely affect the overflow at this district. The control device would be set to a rate similar to the existing pipe full capacity to allow the set limit to be known. This would allow the future RTC control the ability to capture and treat more volume for localized storms in other districts by using the excess interceptor capacity made available by restricting the pass forward flows through the control device where the runoff is less.

1.6.3 Gravity Flow Control

Selkirk district does not include a lift station (LS) and discharges directly to the Main Interceptor by gravity. A flow control device will be required to control the diversion rate for future RTC and dewatering assessment. A standard flow control device was selected as described in Part 3C. This has been taken as part of the City's future vision to develop a fully integrated CS system network and will be needed to review flows during spatial rainfall WWF scenarios. The CSO Master Plan assessment utilized a uniform rainfall event and no further investigative work has been completed within the CSO Master Plan.

The flow controller would be installed at an optimal location on the connecting sewer between the diversion chamber and the Main Interceptor pipe on Selkirk Avenue. Figure 37-01 identifies a conceptual location for flow controller installation. A small chamber or manhole with access for cleaning and maintenance will be required. The flow controller will operate independently and require minimal operation interaction. The diversion weir at the CS outfall may have to be adjusted to match the hydraulic performance of the flow controller.

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

1.6.4 Floatables Management

Floatables management will require installation of a screening system to capture floatable materials. The off-line screens would be designed to maintain the current level of basement flooding protection. The overflows which would normally discharge over the existing primary weir will be directed to the screens via a new side overflow weir located in a new screening chamber, with screened flow discharged to the downstream side of the weir chamber to the river.

The type and size of screens depend on the LS and the hydraulic head available for operation. A standard design was assumed for screening and is described in Part 3C. The design criteria for screening with gate control implemented, are listed in Table 1-7.

Table 1-7. Floatables Management Conceptual Design Criteria

Item	Elevation/Dimension/Rate	Comment
Top of Gate	224.79 m	
Bypass Weir Crest	224.69 m	
NSWL	223.69 m	
Maximum Screen Head	1.00 m	
Peak Screening Rate	1.00 m3/s	
Screen Size	1.5 m x 1.0 m	Modelled Screen Size

The proposed side overflow weir and screening chamber will be located adjacent to the existing combined trunk sewer, as shown on Figure 37-01. The screens will operate once levels within the sewer surpassed the bypass side weir elevation. The side weir will be located upstream of the control gate and will direct the overflow to the screens located in the new screening chamber, with screened flow discharged to the downstream side of the gate to the river. The screening chamber would include screenings pumps with a discharge returning the screened material back to the interceptor and on to the NEWPCC for removal.

The dimensions for the screen chamber to accommodate influent from the side weir, the screen area, and the routing of discharge downstream of the gate are 3.3 m in length and 3.1 m in width. The existing sewer configuration may have to be modified to accommodate the new chamber**.**

1.6.5 Green Infrastructure

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

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

1.6.6 Real Time Control

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

1.7 System Operations and Maintenance

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

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

In-line storage will impact the existing sewer and will require the addition of a new chamber and a moving gate at the outfall. In-line storage dewatering will be controlled with the existing Clifton CS LS, which will require more frequent and longer duration pump run times. Lower velocities will occur in the CS trunk in the vicinity of the control gate due to lower pass forward flows, and may create additional debris deposition requiring cleaning. Additional system monitoring, and level controls will be installed, which will require regular scheduled maintenance.

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

Floatable control with outfall screening will require the addition of another chamber with screening equipment installed. The chamber will be installed adjacent to the control gate chamber and will operate in conjunction with it. Screening operation will occur during WWF events that surpass the in-line storage control level. WWF will be directed from the main CS trunk, over the side weir in the control gate chamber and through the screens to discharge into the river. The screens will operate intermittently during wet weather events and will likely require operations review and maintenance after each event. The frequency of a screened event will correlate to the number overflows identified for the district. Having the screenings pumped back to the interceptor system via a small LS and force main will be required. The screenings return will require O&M inspection after each event to assess the performance of the return pump system.

1.8 Performance Estimate

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

Table 1-8. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added to Model
2013 Baseline	256	256	10,500	70	N/A
2037 Master Plan – Control Option 1	256	256	10,500	70	Lat St, IS, SC

Notes:
Lat St = Latent Storage

IS = In-line Storage

SC = Screening

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

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

The performance results listed in Table 1-9 are for the hydraulic model simulations using the year-round 1992 representative year. The table lists the results for the Baseline, for each individual control option and for the proposed CSO Master Plan – Control Option 1. The Baseline and Control Option 1 performance numbers represent the comparison between the existing system and the proposed control options. The table also includes overflow volumes specific to each individual control option: these are listed to provide an indication of benefit gained only and are independent volume reductions.

Table 1-9. Performance Summary – Control Option 1

Control Option	Preliminary Proposal	Master Plan			
	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow [b]
Baseline (2013)	159,995	172,507	-	21	0.537 m^3/s
Latent Storage	143,086	157,563 [b]	14,944	18	0.537 m^3/s
In-Line Storage & Latent Storage		150,161	22,346	18	0.540 m^3/s
Latent, In-line & Off-line Storage	29,210	N/A[d]	N/A[d]	N/A[d]	N/A[d]
Control Option 1	**29,210**	**150,161**	**22,346**	**18**	**0.540 m^3/s**

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

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

[c] In-line and Off-line storage not assessed independently during the Preliminary Proposal

[d] Off-line storage removed as recommendation during Master Plan assessment.

The percent capture performance measure is not included in Table 1-9, as it is applicable to the entire CS system and not for each district individually. It is noted that the location and gravity discharge nature of the Selkirk district are affected by the control options selected for both the upstream and downstream districts. The improvement or worsening of this district's performance will be affected and once all Control Option 1 recommended works are implemented will the overflow volumes be achieved.

The selection of an off-line storage tank during Preliminary Proposal has been reconsidered during the CSO Master Plan phase as it was found to not be required to meet the Control Option 1 limit.

1.9 Cost Estimates

The CSO Master Plan cost estimates have been prepared for each control option, with overall program costs summarized and described in Section 3.4 of Part 3A. The cost estimate for each control option relevant to the district as determined in the Preliminary Proposal and updated for the CSO Master Plan are identified in Table 1-10Table 1-10. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 to plus 100 percent.

Table 1-10. Cost Estimate – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance Cost (Over 35-year Period)
Latent Storage	$1,290,000	$1,830,000	$70,000	$1,510,000
In-Line Storage	$- [a]	$2,460,000 [b]	$43,000	$930,000
Screening		$3,030,000 [c]	$53,000	$1,130,000
Gravity Flow Control	N/A	$1,280,000	$34,000	$740,000
Off-Line Storage	$13,450,000	N/A [d]	N/A [d]	N/A [d]
Subtotal	**$14,740,000**	**$8,600,000**	**$201,000**	**$4,310,000**
Opportunities	N/A	$860,000	$20,000	$430,000
District Total	**$14,740,000**	**$9,460,000**	**$221,000**	**$4,740,000**

[a] Solutions developed as refinement to Preliminary Proposal work following submission of Preliminary Proposal costs. Preliminary Proposal recommended in-line storage and screening for CO1 PP. Costs for these items of work found to be $4,520,000 in 2014 dollars

[b] Cost associated with new off-take construction, as required, to accommodate control gate and screening chambers in location and allow intercepted CS flow to reach Selkirk gravity discharge interceptor was not included in Master Plan

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

[d] Off-line storage removed as recommendation during Master Plan assessment.

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

- Capital costs and O&M costs are reported in terms of present value.
- A fixed allowance of 10 percent has been included for GI, with no additional cost for RTC. This has been listed as part of the Opportunities costs.
- The Preliminary Proposal capital cost is in 2014 dollar values.
- The CSO Master Plan capital cost is based on the control options presented in this plan and in 2019 dollar values.

- The 2019 Total Annual Operations and Maintenance (over 35-year period) cost component is the present value costs of each annual O&M cost under the assumption that each control option was initiated in 2019.
- The 2019 Annual Operations and Maintenance Costs were based on the estimated additional O&M costs annually for each control option in 2019 dollars.
- Future costs will be inflated to the year of construction.

Cost estimates were prepared during the development of the Preliminary Proposal and updated for Phase 3 during the CSO Master Plan development. The differences identified between the Preliminary Proposal and the CSO Master Plan are accounting for the progression from an initial estimate used to compare a series of control options, to an estimate focusing on a specific level of control for each district. Any significant differences between the Preliminary Proposal and CSO Master Plan estimates are identified in Table 1-11.

Table 1-11. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	In-Line Storage	A control gate was not included in the preliminary proposal estimate.	Added for the MP to further reduce overflows and optimize in-line.
	Screening	Not included in the preliminary proposal estimate.	Added in conjunction with the In-Line Storage Control Gate.
	Gravity Flow Control	A flow controller was not included in the preliminary proposal estimate	Added for the Master Plan to control and monitor pass forward flows
	Removal Of Off-Line Tank Storage	Removed from the Master Plan assessment	Not needed to achieve 85 percent capture target.
Opportunities	A fixed allowance of 10 percent has been included for program opportunities.	Preliminary Proposal estimate did not include a cost for GI opportunities.	
Lifecycle Cost	The lifecycle costs have been adjusted to 35 years.	City of Winnipeg Asset Management approach.	
Cost escalation from 2014 to 2019	Capital Costs have been inflated to 2019 values based on an assumed value of 3 percent per for construction inflation.	Preliminary Proposal estimates were based on 2014 dollar values.	

1.10 Meeting Future Performance Targets

The regulatory process requires consideration for upgrading Control Option 1 to another higher-level performance target. For the purposes of this CSO Master Plan, the future performance target is 98 percent capture for the representative year measured on a system-wide basis. This target will permit the number of overflows and percent capture to vary by district to meet 98 percent capture. Table 1-12 provides a description of how the regulatory target adjustment could be met by building off the proposed work identified in Control Option 1.

Overall the Selkirk district would be classified as a low potential for implementation of complete sewer separation as the only feasible approach to achieve the 98 percent capture future performance target in the representative year. However, opportunistic sewer separation within a portion of the district may be completed in conjunction with other major infrastructure work to address future performance targets. In addition, green infrastructure and off-line tank or tunnel storage may be utilized in key locations to provide additional storage and increase capture volume to meet future performance targets.

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

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

The Selkirk district has been aligned to meet the 85 percent capture on a system wide basis. The applicability of the listed migration options will also be dependent on other district options as these interact and would be required to be assessed on a system wide basis rather than individual district option basis.

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

1.11 Risks and Opportunities

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

The CSO Master Plan has considered risks and opportunities on a program and project delivery level, as described in Section 5 of Part 2 of the CSO Master Plan. A Risk And Opportunity Control Option Matrix covering the district control options has been developed and is included as part of Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-13.

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

Risk Number	Risk Component	Latent Storage / Flap Gate Control	In-line Storage / Control Gate	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
1	Basement Flooding Protection	R	R	-	-	-	-	-	-
2	Existing Lift Station	-	R	-	-	-	-	R	-
3	Flood Pumping Station	-	-	-	-	-	-	-	-
4	Construction Disruption	-	-	-	-	-	-	-	-
5	Implementation Schedule	-	-	-	-	-	-	R	-
6	Sewer Condition	R	R	-	-	-	-	-	-
7	Sewer Conflicts	R	R	-	-	-	-	-	-
8	Program Cost	O	O	-	-	-	-	-	O
9	Approvals and Permits	-	-	-	-	-	R	-	-

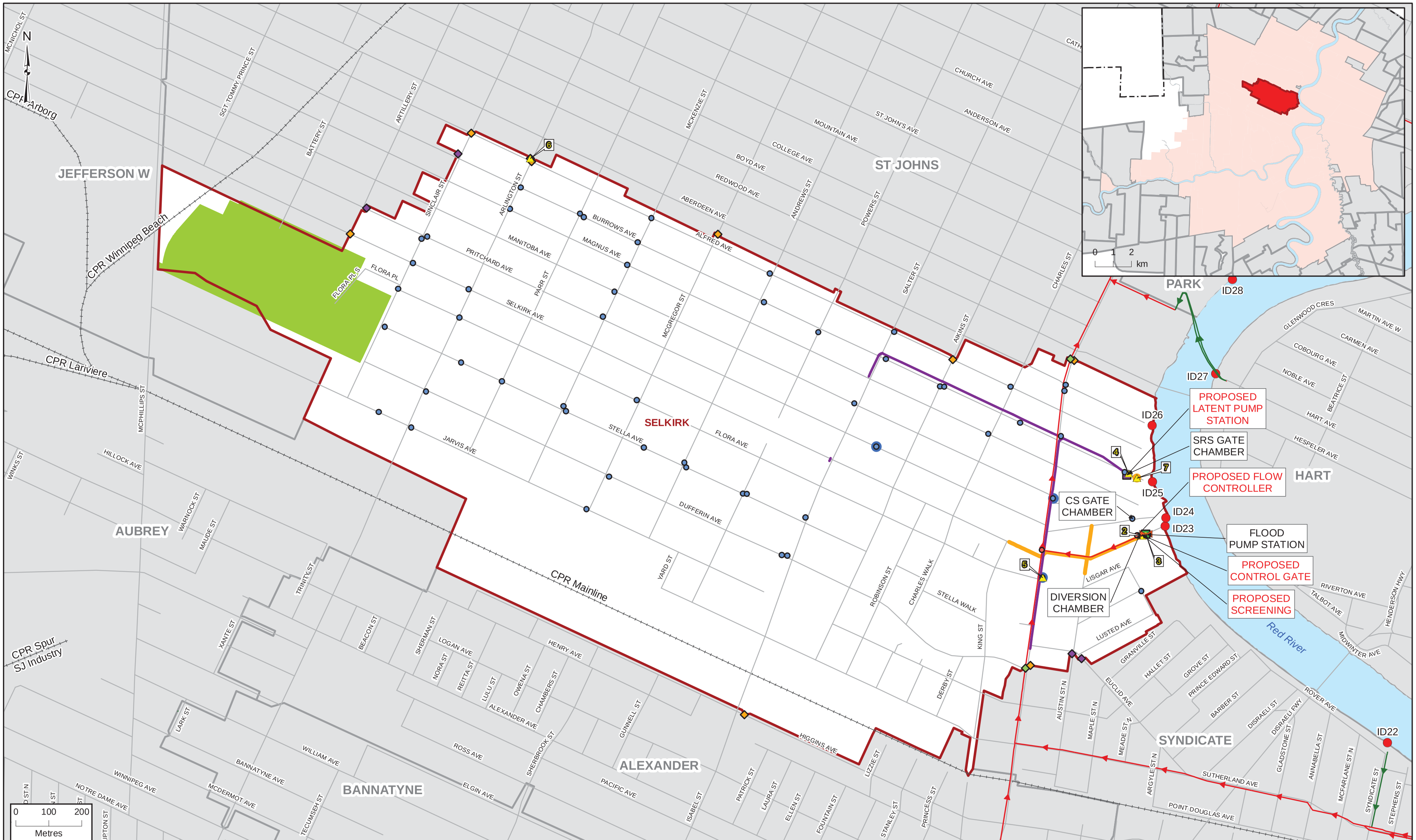
Table 1-13. Control Option 1 Significant Risks and Opportunities

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

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

1.12 References

I.D. Engineering Canada Inc. 1993. *Sewer Relief Study: Selkirk Combined Sewer District*. Prepared for the City of Winnipeg, Waterworks, Waster and Disposal Department. July.



LEGEND

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

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

District Boundary Crossing
- CS
- SRS
- WWS

- Interceptor Sewer
- Force Main
- Street
- Railway

- District Boundary
- Watercourse
- Greenspace

CSO MASTER PLAN PROPOSED SOLUTIONS

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

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

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

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 37
District Overview Map
Sewer District: Selkirk
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
- SRS

Control Structure Type
- Gate Chamber

Pump Station Type
- Diversion Chamber
- Flood Pump Station

CSO MASTER PLAN
PROPOSED SOLUTIONS
- Control Gate
- Screening
- Flow Controller

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

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

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 37-01
Control Gate, Screening, and Flow Control
Sewer District: Selkirk
City of Winnipeg
Combined Sewer Overflow Master Plan

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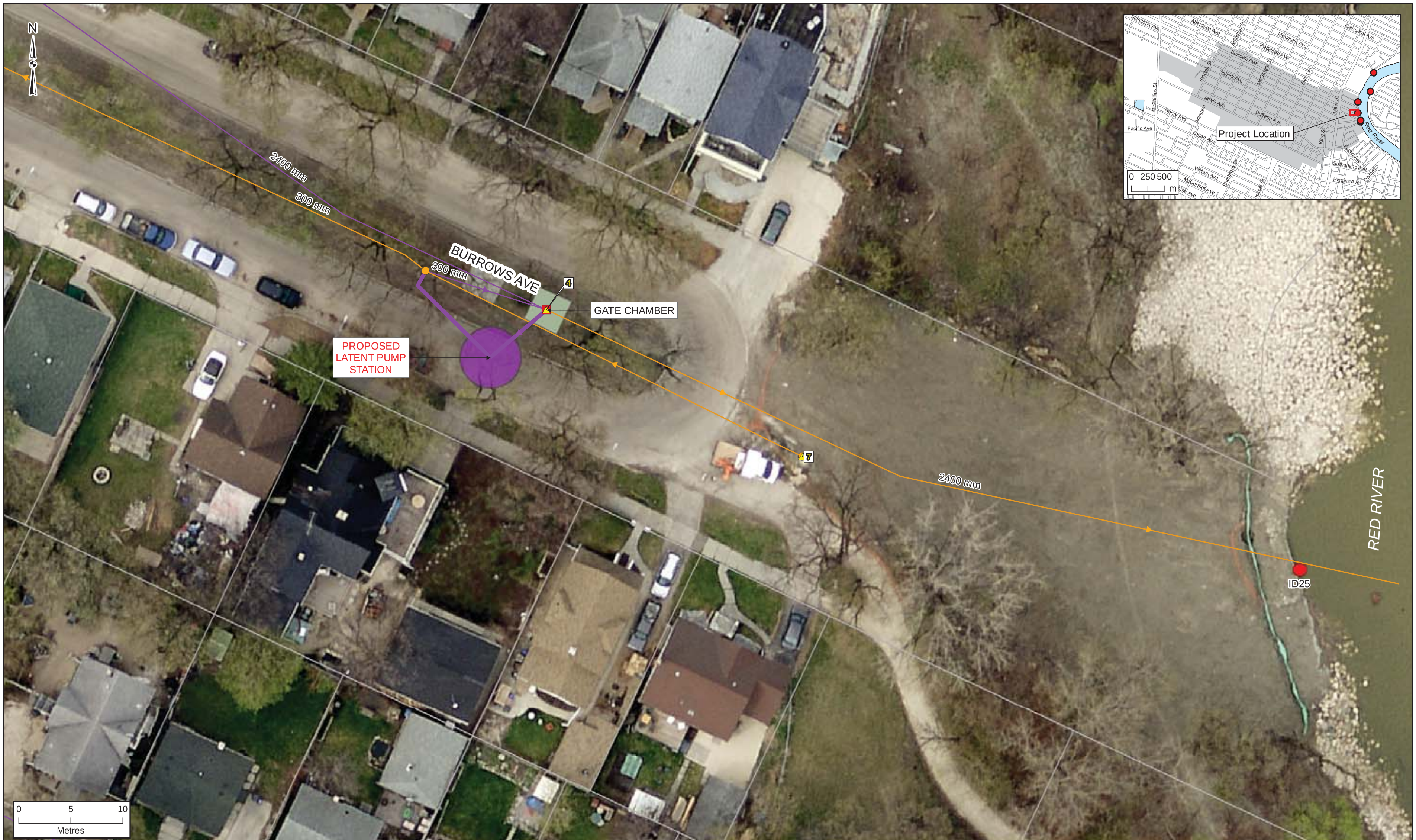

LEGEND

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

CSO MASTER PLAN
PROPOSED SOLUTIONS

- Proposed Latent Force Main
- Latent Pump

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

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

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

FIGURE 37-02
Latent SRS Control
Sewer District: Selkirk
City of Winnipeg
Combined Sewer Overflow Master Plan

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