CSO Master Plan

Tylehurst District Plan

August 2019

City of Winnipeg

CSO Master Plan

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1	02/15/2019	DRAFT 2 for City Review	SB	MF	MF
2	08/14/2019	Final Draft Submission	DT	MF	MF
3	08/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

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1. Tylehurst District

1.1 District Description

Tylehurst district is located on the western side of the combined sewer (CS) area. It stretches from Bangor Avenue and Notre Dame Avenue in the north to the Assiniboine River in the south and is bounded by the Canadian Pacific Railway (CPR) Lariviere and Midland railway to the east and St. James Street to the west.

Tylehurst includes several rail lines that pass through the district, as follows:

- CPR Lariviere rail line
- Midland rail line
- Canadian National Railway (CNR) Oak Point

Land use in Tylehurst is primarily commercial and industrial with light manufacturing facilities located in the northern section of the district between Wellington Avenue and Notre Dame Avenue. Large commercial businesses are located throughout the district, the most significant being the Polo Park Shopping Mall Complex located just north of Portage Avenue. Tylehurst also includes a small area of residential homes and greenspace. Approximately 24 ha of the district is classified as greenspace. The residential area is found south of Portage Avenue and consists of mostly single- and two-family homes; the greenspace is Westview Park located on Wellington Avenue. Omand's Creek is a major waterway which flows through the district.

Tylehurst has a number of major transportation routes throughout the district. Empress Street and St. James Street are regional roadways that run north-south through the district. Portage Avenue, St. Matthews Avenue, Ellice Avenue, Sargent Avenue, Wellington Avenue and Dublin Avenue are regional roadways that run east-west through the district.

1.2 Development

The Tylehurst district is already considered dense industrial and commercial land use. However, significant developments that would impact the Combined Sewer Overflow (CSO) Master Plan are expected and are listed below.

Empress Street Overpass Reconstruction and Rehabilitation Project:

> This project includes the renewal of the following roads: Empress Street, Empress Street East, Eastway, Westway, and St. John Ambulance Way between Portage Avenue and St. Matthews Avenue. The project will improve the infrastructure of the area and impact the drainage. The construction began in August 2018 and will continue until completion in mid-summer 2020. This project will have impacts on the proposed separation work to Tylehurst and will be implemented in coordination with the CSO Master Plan.

Former Winnipeg Blue Bombers Canad Inns Stadium Site:

> The site in which the Canad Inns football stadium has been demolished, and development of this site into a shopping/entertainment/mixed-use centre is ongoing.

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

One area within the Tylehurst combined sewer district, the Polo Park Shopping Centre and surrounding areas, are identified as a Regional Mixed-Use Centre as part of OurWinnipeg. As such, focused intensification within this Mixed Used Centre is to be promoted in the future, with a particular focus on

[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

mixed use development blending housing with the commercial and light industrial uses already prevalent in the area.

1.3 Existing Sewer System

Tylehurst encompasses an area of 213 ha[1] based on the district boundary extending from Notre Dame Avenue to the Assiniboine River and includes a combined sewer (CS), wastewater sewers (WWS), and land drainage sewer (LDS). As shown in Figure 42, there is approximately 15.5 percent (33 ha) already separated along Omand's Creek. There are no separation ready areas.

The Tylehurst sewer system includes a lift station (CS LS), and a CS outfall gate chamber. The CS system drains towards the Tylehurst outfall, located at the southern end of Tylehurst Street and Wolseley Avenue at the Red River. Sewage flows collected in Tylehurst district converge to the main CS trunk sewer that flows southbound through the centre of the district. The main CS trunk begins as a 1350 mm diameter pipe and flows southbound starting at the upstream end at Bangor Avenue and crosses under Omand's Creek. The trunk increases in diameter as it flows south toward the CS outfall eventually up to 1950 mm diameter at Ellice Avenue as it flows further south along Milt Stegall Drive, Cactus Jacks Place, and directly beneath Polo Park Mall. A 750 mm sewer main flowing east on Portage Avenue and a 2150 mm sewer main flowing west on Portage Avenue interconnect with the main CS trunk at Portage Avenue and Tylehurst Street where they flow into a 2080 mm by 2690 mm egg-shaped trunk. Immediately prior to the Tylehurst CS outfall a 375 mm lateral connection representing the small Wolseley West residential area ties into the main CS trunk sewer.

During dry weather flow (DWF), CS is diverted by the primary weir within the main trunk sewer immediately upstream of the CS outfall. The weir diverts the intercepted flows by gravity through the 525 mm off-take pipe to the Tylehurst CS LS, where it is pumped to the Portage Interceptor pipe along Portage Avenue. The interceptor pipe carries flows to a siphon located under Omand's Creek, and eventually to the North End Sewage Treatment Plan (NEWPCC) for treatment.

During wet weather flow (WWF), flow that exceeds the diversion capacity overtops the weir and is discharged to the river via the CS outfall. A flap gate and a sluice gate are installed on the CS outfall to restrict back-up from the Assiniboine River into the CS system during high river levels. When the river level is high this flap gate structure prevents gravity discharge of excess flow through the outfall, the excess flow in this case will continue to surcharge within the main trunk sewer district.. Temporary flood pumps are installed in Tylehurst based on the flood manual high river level triggers to deal with situations such as this. There is no flood pump station at this primary outfall.

LDS networks are found on the eastern portion of the district to relieve surface runoff from parking lots at commercial and industrial facilities. A 600 mm to 750 mm LDS network is located on Empress Street and discharges surface runoff directly to Omand's Creek. It services western Empress Street from Eastway to Jack Blick Place. Where these facilities front Empress Street the LDS network drain directly to Omand's Creek via local outfalls. Elsewhere in the district, these LDS pipes connect back into to the CS system for the district.

The single CS outfall to the Assiniboine River is as follows:

- ID52 (S-MA20020018) – Tylehurst CS Outfall

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

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Tylehurst and the surrounding districts. Each interconnection is shown on Figure 42 and shows locations where gravity and pumped flow can cross from one district to another. Each interconnection is included in the following list:

1.3.1.1 Interceptor Connections – Downstream of Primary Weir

Clifton

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

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Riverbend

- The 900 mm WWS Main interceptor sewer flows by gravity eastbound on Portage Avenue from Riverbend into Tylehurst district:
  - Invert at manhole on Portage Avenue at Tylehurst district boundary –229.94 m (S-MH20010407)

1.3.1.3 District Interconnections

Brooklands

WWS to CS

- A 450 mm WWS is pumped from Notre Dame CS LS in Brooklands southbound and connects to the Tylehurst CS system at the intersection of Notre Dame Avenue and St. James Street:
  - Invert at manhole on St. James Street at Tylehurst district boundary – 231.17 m (S-MH20010779)

LDS to CS

- A 450 mm LDS flows westbound by gravity along Notre Dame Avenue from Brooklands district into the Tylehurst CS system at the intersection of Notre Dame Avenue and St. James Street:
  - Invert at manhole on Notre Dame Avenue at Tylehurst district boundary –230.35 m (S-MH20010748)

Clifton

CS to CS

- A 200 mm CS flows eastbound by gravity along Sargent Avenue from Tylehurst district into the Clifton CS system at the intersection of Sargent Avenue and Sanford Street:
  - Invert at manhole on Sargent Avenue at Clifton district boundary – 228.92 m (S-MH20009103)

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

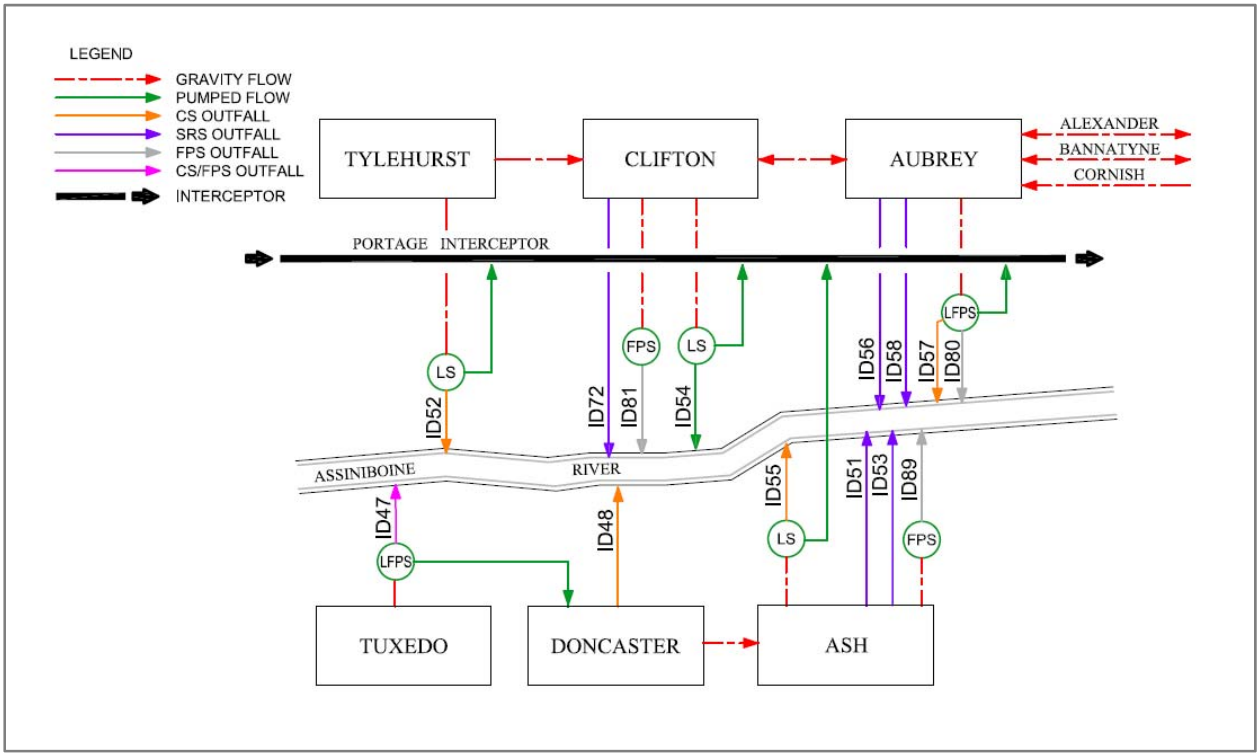


Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 42 and are listed in Table 1-1.

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Combined Sewer Outfall (ID52)	S-RE70008619.1	S-MA20020018	2080 x 2690 2300 mm	Invert: 224.35 m
Flood Pumping Outfall (ID52)	S-RE70008619.1	S-MA20020018	2080 x 2690 2300 mm	Invert: 224.35 m
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-TE20007540.1	S-MA20020018	2080 x 2690 mm	Egg-shaped Invert: 225.04 m
SRS Outfalls	N/A	N/A	N/A	No SRS within the district.
SRS Interconnections	N/A	N/A	N/A	No SRS within the district.
Main Trunk Flap Gate	S-CG00000920.1	S-CG00000920	2300 mm	Invert: 225.09 m
Main Trunk Sluice Gate	S-CG00000921.1	S-CG00000921	1600 x 1600 mm	Invert: 225.06 m
Off-Take	S-TE70008606.1	S-MA70018463	525 mm	Circular Invert: 225.04 m
Dry Well	N/A	N/A	N/A	
Lift Station Total Capacity	Tylehurst PS.1 Tylehurst PS.2 Tylehurst PS.3	N/A	0.424 m^3/s	1 x 0.158 m^3/s 1 x 0.131 m^3/s 1 x 0.135 m^3/s
Lift Station ADWF	N/A	N/A	0.081 m^3/s	

Table 1-1. Sewer District Existing Asset Information

Asset	Asset ID (Model)	Asset ID (GIS)	Characteristics	Comments
Lift Station Force Main	S-RE70008604.1	S-MA70018459	375 mm	Invert: 229.5
Flood Pump Station Total Capacity	N/A	N/A	N/A	No FPS at the Tylehurst primary outfall.
Pass Forward Flow – First Overflow	N/A	N/A	0.183 m^3/s	

Notes:

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

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

Table 1-2. Critical Elevations

Reference Point	Item	Elevation (m)[a]
1	Normal Summer River Level	Tylehurst – 224.01
2	Trunk Invert at Off-Take	225.04 m
3	Top of Weir	225.23
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection (S-MH20009801)	229.86
6	Sewer District Interconnection (Clifton)	226.50
7	Low Basement	231.34
8	Flood Protection Level	230.30

[a] City of Winnipeg Data, 2013

1.4 Previous Investment Work

Table 1-3 provides a summary of the district status in terms of data capture and study. The most recent study completed for Tylehurst was in 1993 with the *Sewer Relief for Tylehurst Combined Sewer District Conceptual Report* (UMA Engineering LTD, 1993). This study discussed the optimum relief strategy and upgrading the service levels concerning the Tylehurst CS district.

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

Table 1-3. District Status

District	Most Recent Study	Flow Monitoring	Hydraulic Model	Status	Expected Completion
42 – Tylehurst	1993 - Conceptual	Future Work	2013	Study Complete	N/A

Source: *Sewer Relief for Tylehurst Combined Sewer District Conceptual Report*, 1993

1.5 Ongoing Investment Work

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

1.6 Control Option 1 Projects

1.6.1 Project Selection

The proposed projects selected to meet Control Option 1 – 85 Percent Capture in a Representative Year for the Tylehurst district are listed in Table 1-4. The proposed CSO control projects will include sewer separation only. Program opportunities including green infrastructure (GI) and real time control (RTC) will also be included as applicable.

Table 1-4. District Control Option

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

Notes:
- = not included
✓ = included

The Tylehurst district was identified during the Phase 2 work as high potential for future sewer separation based on the City's provided information. The district is not part of the currently planned Basement Flooding Relief (BFR) program but was taken forward for complete separation in the Control Option No.1 proposals. The cost-effectiveness of complete separation of the Tylehurst district in particular should be re-evaluated as part preliminary design of solutions in this district. The complete separation solution life cycle costs should be compared to alternative solutions, such as In-Line Storage via control gate construction.

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

1.6.2 Sewer Separation

Complete sewer separation is proposed for the Tylehurst district. This sewer separation will result in a reduction of the runoff and will reduce the pass forward flow to the interceptor and contribution of flow to NEWPCC. Sewer separation in Tylehurst would provide immediate benefits to the CSO program when complete. It would remove all CSO occurrences from the district as it will now be considered a separate district. The work would include the installation of an independent LDS system to separate the surface runoff from the CS system. Collected stormwater would be routed to a separate LDS outfall discharging to either Omand's Creek or Assiniboine River. It is envisaged that the separation would follow the existing separation arrangement where local streets are diverted to the adjacent Omand's Creek at multiple locations rather than a single large collection pipe and outfall location.

The flows to be collected after Tylehurst separation will be as follows:

- Dry weather flows will remain the same for Tylehurst district.
- Tylehurst wet weather flow (WWF) will consist of sanitary sewage combined with foundation drainage.

Potential drawbacks of sewer separation include the high construction cost and the wide-spread disruption to the neighbouring residential homes.

It is proposed that future monitoring of the district is completed to verify that the sewer separation is fully compliant with the modelled simulated elimination of all CSO overflows. A static weir elevation increase may be necessary at the CS diversion to eliminate the occurrence of all CSOs. Any weir elevation raise will also be evaluated in terms of existing basement flood protection to ensure the existing level of basement flood protection remains.

1.6.3 Green Infrastructure

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

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

1.6.4 Real Time Control

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

1.7 System Operations and Maintenance

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

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

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

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. Two versions of the sewer system model were created and used to measure system performance. The 2013 Baseline model represents the sewer system baseline in the year 2013 and the 2037 Master Plan – Control Option 1 model, which includes the proposed control options in the year 2037. A summary of relevant model data is provided in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Included in Model
2013 Baseline	461	461	4,149	56	N/A
2037 Master Plan – Control Option 1	461	461	4,149	0	SEP

Notes:

SEP – Sewer Separation

No change to the future population was completed as from a wastewater generation perspective from the update to the 2013 Baseline Model to the 2037 Master Plan Model. The population generating all future wastewater will be the same due to Clause 8 of Environment Act Licence 3042 being in effect for the CS district. While this district is to be separated and as a result Clause 8 of Licence No. 3042 will not be in effect, the wet weather response of the district overall will still need to be assessed.

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

The performance results listed in Table 1-6 are for the hydraulic model simulations using the year-round 1992 representative year. This table lists the results for the Baseline, for each individual control option and for the proposed CSO Master Plan - Control Option 1. The Baseline and Control Option 1 performance numbers represent the comparison between the existing system and the proposed control options. Table 1-6 also includes overflow volumes specific to each individual control option; these are listed to provide an indication of benefit gained only and are independent volume reductions.

Table 1-6. District Performance Summary – Control Option 1

Control Option	Preliminary Proposal	Master Plan			
	Annual Overflow Volume (m^3)	Annual Overflow Volume (m^3)	Overflow Reduction (m^3)	Number of Overflows	Pass Forward Flow at First Overflow (L/s) [a]
Baseline (2013)	182,607	206,812	-	18	0.183 m^3/s
Separation	0	0	206,812	0	TBD
Control Option 1	**0**	**0**	**206,812**	**0**	**TBD**

[a] Pass forward flows assessed up to 5-year design rainfall event. Possible overflow for larger design events to be confirmed.

The percent capture performance measure is not included in Table 1-6, as it is applicable to the entire CS system and not for each district individually. However, the proposed elimination of CSO overflow results in 100 percent capture at this district.

1.9 Cost Estimates

Cost estimates were prepared during the development of the Preliminary Proposal and have been updated for the CSO Master Plan. The CSO Master Plan cost estimates have been prepared for each control option, with overall program costs summarized and described in Section 3.4 of Part 3A. The cost estimate for each control option relevant to the district as determined in the Preliminary Proposal and

updated for the CSO Master Plan are identified in **Error! Reference source not found.**. The cost estimates are a Class 5 planning level estimates with a level of accuracy of minus 50 percent to plus 100 percent.

Table 1-7. District Cost Estimate – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance (Over 35-year period)
Separation	N/A [a]	$86,670,000	$52,000	$1,110,000
Subtotal	**$-**	**$86,670,000**	**$52,000**	**$1,110,000**
Opportunities	N/A	$8,670,000	$5,000	$110,000
District Total	**N/A [a]**	**$95,340,000**	**$57,000**	**$1,220,000**

[a] Solution development as refinement to Preliminary Proposal costs, Revised cost for the sewer separation work found to be $48,100,000 in 2014 dollars.

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

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

Cost estimates were prepared during the development of the Preliminary Proposal and updated for Phase 3 during the CSO Master plan development. The differences identified between the Preliminary Proposal and the CSO Master Plan are accounting for the progression from an initial estimate used to compare a series of control options, to an estimate focusing on a specific level of control for each district. Any significant differences between the Preliminary Proposal and CSO Master Plan estimates are identified in Table 1-8.

Table 1-8. Cost Estimate Tracking Table

Changed Item	Change	Reason	Comments
Control Options	Sewer Separation	Separation was not included in the initial Preliminary Proposal costs.	Costs updated to match the Control Option proposals.
Opportunities	A fixed allowance of 10 percent has been included for program opportunities	Preliminary Proposal estimate did not include a cost for GI opportunities	

Lifecycle Cost	The lifecycle costs have been adjusted to 35 years.	City of Winnipeg Asset Management approach.	
Cost escalation from 2014 to 2019	Capital Costs have been inflated to 2019 values based on an assumed value of 3 percent per for construction inflation	Preliminary estimates were based on 2014-dollar values	

1.10 Meeting Future Performance Targets

The proposed complete separation of the Tylehurst district will achieve the 100 percent capture figure and no further work will be required to meet the future performance target. It is recommended to complete post separation modelling to confirm the target is fully achieved.

1.11 Risks and Opportunities

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

The CSO Master Plan has considered risks and opportunities on a program and project delivery level, as described in Section 5 of Part 2 of the CSO Master Plan. A Risk And Opportunity Control Option Matrix covering the district control options has been development and is included as Appendix D in Part 3B. The identification of the most significant risks and opportunities relevant to this district are provided in Table 1-9.

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

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

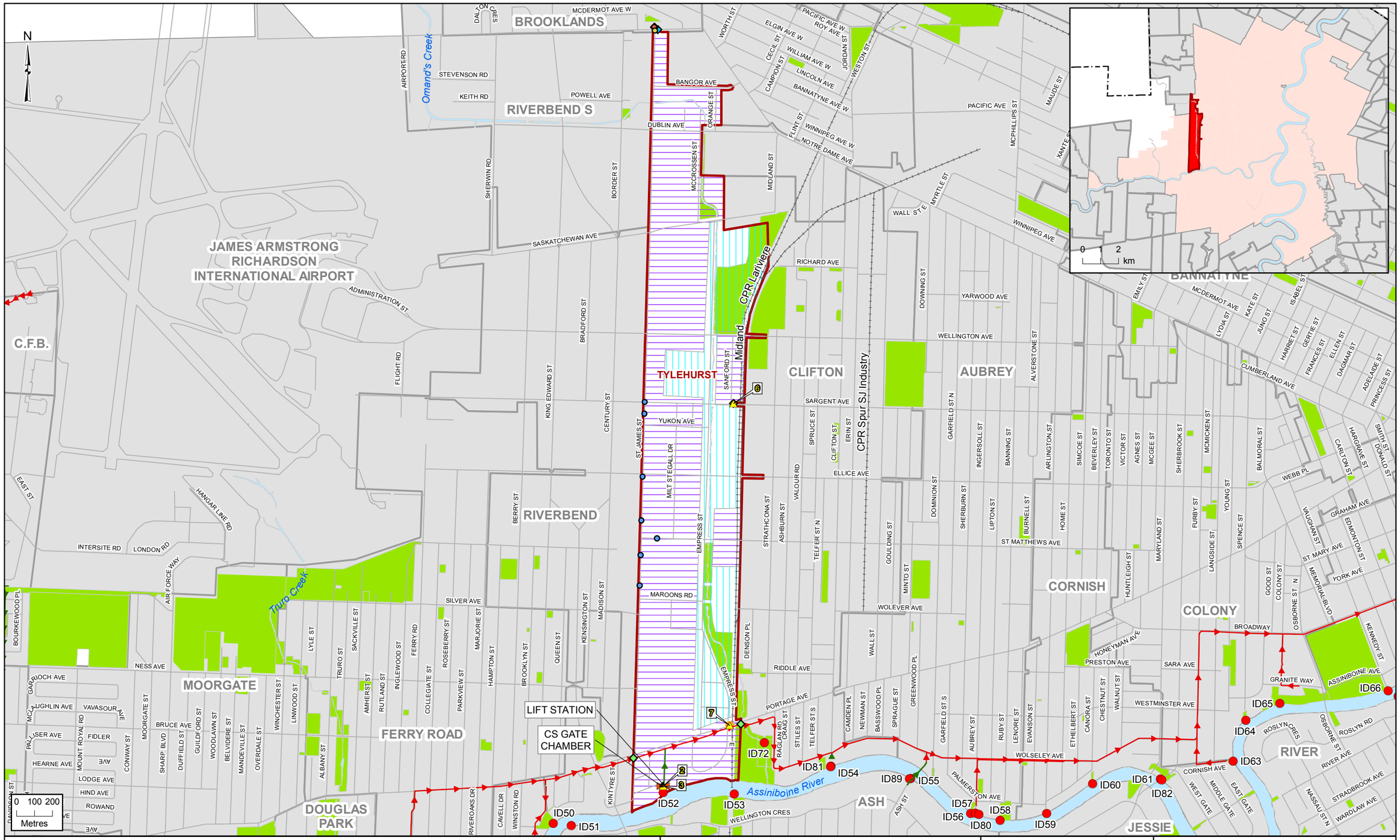
Table 1-9. Control Option 1 Significant Risks and Opportunities

ID Number	Component	Latent Storage / Flap Gate Control	In-line Storage / Control Gate	Off-line Storage Tank	Off-line Storage Tunnel	Sewer Separation	Green Infrastructure	Real Time Control	Floatable Management
13	Volume Capture Performance	-	-	-	-	-	O	O	-
14	Treatment	-	-	-	-	O	O	O	-

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

1.12 References

UMA Engineering Ltd. 1993. *Sewer Relief for Tylehurst Combined Sewer District Conceptual Report*. Prepared for the City of Winnipeg Water and Waste Department. July.



LEGEND

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

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Planning
- Sewer Separation - Complete

ALL PROPOSED SOLUTIONS SHOWN IN RED TEXT

JACOBS

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

Winnipeg **THE CITY OF WINNIPEG**
WATER AND WASTE DEPARTMENT

FIGURE 42
District Overview Map
Sewer District: Tylehurst
City of Winnipeg
Combined Sewer Overflow Master Plan

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