CSO Master Plan

Armstrong District Plan

August 2019

City of Winnipeg

CSO Master Plan

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1	02/15/2019	DRAFT 2 for City Review	JT	SG	MF
2	08/13/2019	Final Draft Submission	DT	MF	MF
3	18/19/2019	Final Submission For CSO Master Plan	MF	MF	SG

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1. Armstrong District

1.1 District Description

Armstrong district is located in the northern section of the combined sewer (CS) area to the west of the Red River. The district is bounded by Leila Avenue and the Canadian Pacific Railway (CPR) Winnipeg Beach to the north, McPhillips Street to the west, King Sudbury Avenue to the south, and Main Street to the east.

Armstrong district primarily includes residential area with the majority being single-family residential. The residential area is mainly located east of Sinclair Street. This district also includes commercial areas including a section of the Garden City Shopping Centre adjacent to McPhillips Street.

The CPR Winnipeg Beach line passes through the southern end of Armstrong District. Salter Street, McGregor Street, McPhillips Street, and Main Street are regional transportation routes running north to south on either side of the district, with Partridge Avenue and Leila Avenue being regional routes running east to west. Armstrong district has approximately 24 ha of greenspace including Garden City Park, Margaret Park, and Vince Leah Park.

1.2 Development

A portion of Main Street is located within the Armstrong District. Main Street is identified as 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.

One area within the Armstrong combined sewer district, the Garden City Shopping Centre at the intersection of McPhillips Street and Leila Avenue, has been 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 mixed use development.

1.3 Existing Sewer System

Armstrong district encompasses an approximate area of 151 hectares (ha)[1] based on the district boundary and includes a CS system and a storm relief sewer (SRS) system. This district does not include any areas that have separate land drainage sewer (LDS) systems or that could be considered separation ready.

The CS system includes a diversion structure and one CS outfall. All system flows collected are routed to the diversion structure located at the intersection of Main Street and Armstrong Avenue. A 2700 mm circular CS trunk collects combined sewage from all the areas west of Main Street within the Armstrong district. There is a 600 mm CS servicing the north part of the district between Main Street to Aikins Street.

During dry weather flow (DWF), sanitary sewage from the Armstrong district flows into the diversion chamber upstream of the CS outfall. Flows are diverted by the primary weir to a 600 mm secondary offtake pipe which reduces to 525 mm before it flows into the Main Interceptor and to the North End Sewage Treatment Plant (NEWPCC) for treatment.

During wet weather flow (WWF), flows that exceed the diversion capacity overtops the weir and is discharged into the river through the outfall. Sluice and flap gates are installed on the outfall to prevent river water from backing up into the CS system when the Red River levels are particularly high. However

[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.

not only does the flap gate prevent river water intrusion, but it also prevents gravity discharge from the Armstrong CS outfall. Under these conditions of high river level the excess flow is pumped by the Newton FPS to a point in the Armstrong CS Outfall downstream of the flap gate, where it can be discharged to the river by gravity. Temporary flood pumps are to be installed in the Armstrong district based on the flood manual high river level triggers to deal with situations such as this.

An interconnection with the Newton district is present near the diversion to allow flow from Armstrong to flow into Newton immediately upstream of the primary weir for the Armstrong district. This provides the operational ability to utilize the Newton flood pump station (FPS) to dewater Armstrong during WWF and high river level conditions when gravity discharge through the Armstrong CS outfall is not possible. This connect is kept closed and currently only used by operations for maintenance activities.

A portion of the separate sewer districts west of the Armstrong district are serviced by the Leila CS trunk sewer, and are ultimately intercepted by the Armstrong CS system This includes the entire Maples residential neighbourhood, and the Leila-McPhillips Triangle Shopping Centre/residential area. The LDS trunk sewers from these separate sewer districts connect directly to the Leila CS trunk at two locations. A 1350 mm diameter, 525 mm diameter, and 2700 mm diameter LDS sewer each connect at the intersection of Leila Avenue and Watson Street. A 1200 mm LDS sewer then connects at the intersection of McPhillips Street and Leila Avenue. A number of smaller diameter LDS systems connect into the CS trunk along Leila from the north. The wastewater from these separate sewer districts is conveyed to treatment via the Northwest Interceptor system.

The one outfall to the Red River (CS) is as follows:

- ID36 (S-MA00017633) – Armstrong CS Outfall

1.3.1 District-to-District Interconnections

There are several district-to-district interconnections between Armstrong and the surrounding districts. Each interconnection is shown on Figure 2 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

Riverbend Park (Area 9 NW)

- The 2250 mm Main Interceptor pipe flows north by gravity on Main Street from the Armstrong district to the Riverbend Park) district:
  - Invert at Armstrong district boundary 215.85 m (S-MH00000791)

1.3.1.2 Interceptor Connections – Upstream of Primary Weir

Newton

- The 2250 mm Interceptor pipe flows north by gravity on Main Street into the Armstrong district to the NEWPCC:
  - Invert at Newton district boundary 216.61 m (S-MA00000807)

1.3.1.3 District Interconnections

Maples (Area 3 [NW])

<u>LDS to CS</u>

- The 2700 mm LDS main sewer trunk flows by gravity east on Leila Avenue into the Armstrong district:
  - Invert at the Maples (Area 3 (NW)) district boundary 226.54 m (S-MA00002447)

Templeton (Area 6 (NW))

LDS to CS

- The 1500 mm LDS pipe flows south by gravity on Garden Park Drive into the Armstrong district:
  - Invert at the Armstrong district boundary 226.29 m (S-MA00001940)
- The 1350 mm LDS pipe flows south by gravity on Sinclair Street into the Armstrong district:
  - Invert at the Armstrong district boundary 226.22 m (S-MA70031211)
- The 1200 mm LDS pipe flows south by gravity on McGregor Street into the Armstrong district:
  - McGregor Street at Miravista Drive – 225.75 m (S-MH00001441)
- The 900 mm LDS pipe flows south by gravity on Diplomat Drive into the Armstrong district:
  - Invert at the Armstrong district boundary 225.85 m (S-MA00001592)
- The 525 mm LDS pipe flows south by gravity on Ambassador Row into the Armstrong district:
  - Invert at the Armstrong district boundary 226.54 m (S-MA00001635)
- The 450 mm LDS pipe flows south by gravity on Monsey Street into the Armstrong district:
  - Invert at the Armstrong district boundary 226.50 m (S-MA00001439)

Newton

CS to CS

- The 2700 mm CS main sewer trunk flows east on Armstrong Avenue out of the Armstrong district towards the Armstrong CS outfall located at the far end of Armstrong Avenue:
  - Invert at the Armstrong district boundary 223.58 m (S-MA00000802)
- The 1350 mm CS pipe diverts south onto Main Street into Newton district and connects to the Newton CS network (this connection is normally kept closed and only used for operational maintenance):
  - Invert at the Armstrong district boundary 225.03 m (S-MA00000789)
- The 600 mm CS pipe flows south by gravity on Main Street into the Armstrong district:
  - Invert at the Armstrong district boundary 224.64 m (S-MA00000784)
- The 450 mm CS pipe flows south by gravity on Main Street into the Armstrong district:
  - Invert at the Armstrong district boundary 225.55 m (S-MA00000779)
- The 450 mm CS pipe flows south by gravity on Main Street out of the Armstrong district:
  - Invert at the Armstrong district boundary 225.55 m (S-MA00000930)
- The 600 mm CS pipe flows east by gravity though Beeston Drive onto Main Street into the Newton district:
  - Invert at the Newton district boundary 225.67 m (S-MA00000869)

Jefferson East

CS to CS

- The 300 CS pipe flows south by gravity on Powers Street into the Armstrong district:
  - Invert at the Jefferson East district boundary 227.31 (S-MA00001541)

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

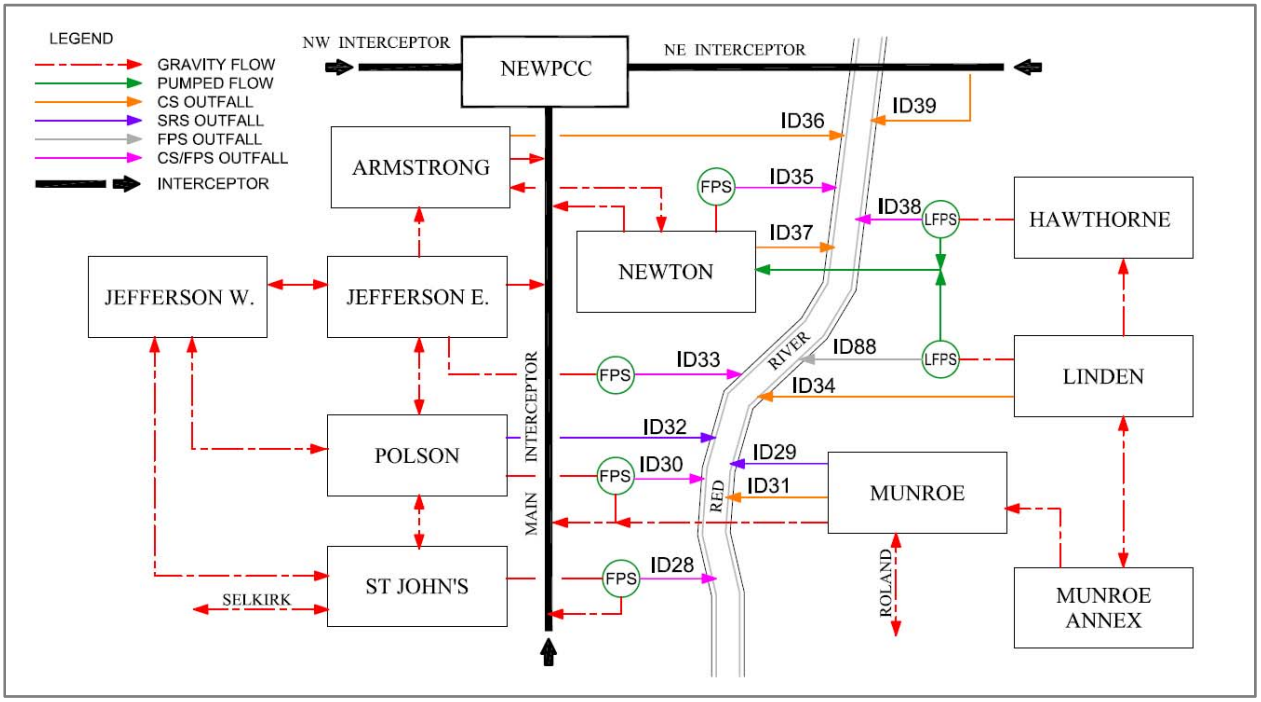

Figure 1-1. District Interconnection Schematic

1.3.2 Asset Information

The main sewer system features for the district are shown on Figure 02 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 (ID36)	S-MH00002352.1	S-MA00017633	2700 mm	Red River Invert: 221.79 m
Flood Pumping Outfall	N/A	N/A	N/A	No Flood Pump Station in this district.
Other Overflows	N/A	N/A	N/A	
Main Trunk	S-TE00000258	S-MA00000755	2700 mm	Main CS that flows east on Armstrong Avenue Circular Invert: 223.58 m
SRS Outfalls	N/A	N/A	N/A	No SRS within this district.
SRS Interconnections	N/A	N/A	N/A	No SRS within this district.
Main Trunk Flap Gate	S-CG00000773.1	S-CG00000773	1800 mm	Invert: 222.74 m Circular
Main Trunk Sluice Gate	S-CG00000772.1	S-CG00000772	1800 mm	Invert: 222.42 m Square
Off-Take / Diversion	S-MH00000681.2	S-MA70021108	600 mm	Invert: 223.58 m
Dry Well	N/A	N/A	N/A	No lift station within Armstrong.
Lift Station Total Capacity	N/A	S-MA70021108 (1)	600 mm (1)	0.57 m3/s (1)
ADWF	N/A	N/A	0.011 m^3/s	

Lift Station Force Main	N/A	N/A	N/A	
Flood Pump Station Total Capacity	N/A	N/A	N/A	No Flood Pump Station in this district.
Pass Forward Flow – First Overflow	N/A	N/A	0.172 m^3/s	

Notes:

(1) – Gravity diversion pipe replacing Lift Station as Armstrong is a gravity discharge district

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

The critical system elevations relevant to the development of the Combined Sewer Overflow (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	Armstrong – 223.65
2	Trunk Invert at Off-Take / Diversion	223.58
3	Top of Weir	223.98
4	Relief Outfall Invert at Flap Gate	N/A
5	Low Relief Interconnection	N/A
6	Sewer District Interconnection (Newton)	225.03
7	Low Basement	228.24
8	Flood Protection Level (Armstrong)	228.78

[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 Armstrong was the *Sewer Relief Study: Armstrong Combined Sewer District Conceptual Report* (IDE, 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 CSO study or system design 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 Armstrong Combined Sewer 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	Expected Completion
02 – Armstrong	1993	2016 Summer Flow Monitoring Campaign Completed	2013	Conceptual Study Completed	TBD

Note:
TBD = To Be Determined

1.5 Ongoing Investment Work

There is ongoing maintenance and calibration of permanent instruments installed within the primary outfall within the Armstrong 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 Armstrong sewer district are listed in Table 1-4. The proposed CSO control projects will include complete sewer separation. 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% Capture in a Representative Year	-	-	-	-	-	-	-	✓	✓	✓	-

Notes:

- = not included
✓ = included

Armstrong district has been identified as an early priority action for the CSO Master Plan. The upstream separate area LDS system connects directly into the CS trunk and contributes dramatically to the WWF received in the CS district. WWFs from these separated areas are utilizing capacity in the CS trunk for the Armstrong district. A complete sewer separation scheme which removes these LDS ties from the Armstrong CS system and instead directs them to a river outfall is proposed to deal with this issue. The existing CS main trunk is proposed to be an LDS pipe, which will outfall at the existing CS outfall. A new wastewater sewer (WWS) trunk along Leila and interconnecting WWS to service all properties is then proposed.

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

The complete sewer separation project for Armstrong district will provide immediate benefits to the CSO program when implemented. The work is recommended to include installation of a WWS system to collect sanitary sewage and foundation drainage. The new WWS system will include a trunk sewer along Leila Avenue connecting into the Main Interceptor, new secondary and lateral sewers and wastewater service reconnections to all properties. The existing CS trunk sewer is then recommended to be converted to an LDS sewer. Collected stormwater runoff from the separate sewer districts to the west of Armstrong, along with within the Armstrong district itself, will continue to be routed through the existing CS trunk sewer and ultimately to the Red River via the Armstrong CS outfall. At this point the diversion structure

currently utilized for the Armstrong district could be decommissioned. The approximate area of sewer separation is shown on Figure 02.

The flows to be collected after the Armstrong complete separation will be as follows:

- DWF will be collected in the new WWS and will consist of sanitary sewage combined with foundation drainage.
- WWF will flow through the converted CS system to an outfall to the Red River.

This will result in a significant reduction in WWF directed to the main interceptor after the separation project is complete. The WWS separation project will eliminate overflows from the district.

It is proposed that future post construction flow monitoring of the district is completed to verify sewer system performance.

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 the most applicable GI controls.

Armstrong has been classified as a high GI potential district. Land use in Armstrong is mostly single and double family residential with large areas of commercial land use. This means the district would be an ideal location for bioswales, permeable paved roadways, cisterns/rain barrels, and rain gardens. The commercial areas in the west end of the district would be an ideal location for green roofs.

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 create additional sewer pipes to maintain, minimal operator involvement will be required to maintain the new WWS system and additional LDS elements. This will result in additional maintenance costs over the long term, but operational costs will be minimal. There will be continued maintenance of the system required for the management of WWF in the separated sanitary sewer system. There will be potential O&M reductions as a result of the decommissioning of the diversion structure and other components of the current CS outfall arrangement. These components will no longer be necessary once the CS outfall is converted to a dedicated LDS outfall.

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 WWS system) extent within the Armstrong district.

1.8 Performance Estimate

An InfoWorks CS hydraulic model was created as part of the CSO Master Plan development. An individual model was created to represent the sewer system baseline as represented in the year 2013 and a model for the CSO Master Plan with the control options implemented in the year 2037. A summary of relevant model data is summarized in Table 1-5.

Table 1-5. InfoWorks CS District Model Data

Model Version	Total Area (ha)	Contributing Area (ha)	Population	% Impervious	Control Options Added To Model
2013 Baseline	863	863	3,759	60	N/A
2037 Master Plan – Control Option 1	127	66	3,628	12	SEP

Notes:

SEP = 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 applied uniformly. 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 1-6. 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
Baseline (2013)	710,537	749,622	-	23	0.172 m^3/s [b]
LDS Separation	0	N/A	N/A	N/A	N/A
WWS Separation	N/A [a]	0	749,622	0	0.345 m3/s [c]
Control Option 1	**0**	**0**	**749,622**	**0**	**0.345 m3/s [c]**

[a] LDS trunk not simulated independently during the Preliminary Proposal assessments including offline storage tank.

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

[c] Discharge into outfall pipe for 5-year design event but no overflow to river

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 relevant 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 1-7. The cost estimates are a Class 5 planning level estimate with a level of accuracy range of minus 50 percent to plus 100 percent.

Table 1-7. Cost Estimates – Control Option 1

Control Option	2014 Preliminary Proposal Capital Cost	2019 CSO Master Plan Capital Cost [b]	2019 Annual Operations and Maintenance Cost	2019 Total Operations and Maintenance Cost (Over 35-year period) [b]
Sewer Separation	- [a]	$61,080,000	$57,000	$1,220,000
In-line Control Gate	$7,680,000	N/A	N/A	N/A
Screening		N/A	N/A	N/A
Off-line Storage Tank	$4,700,000	N/A	N/A	N/A
Tunnel	$75,200,000	N/A	N/A	N/A
Subtotal	**$87,580,000**	**$61,080,000**	**$57,000**	**$1,220,000**
Opportunities	$0	$6,110,000	$6,000	$120,000
District Total	**$87,580,000**	**$67,190,000**	**$63,000**	**$1,340,000**

[a] Tunnel storage taken as sewer separation of upstream district draining to Armstrong district

[b] WWS complete separation control option selected as part of 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 opportunities, with no additional costs for RTC (depending on future monitoring of post separation WWF impacts).
- 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	Added as a result of Master Plan assessment. Initial costs based LDS separation in conjunction with a long tunnel, subsequently changed to WWS separation.	
	Control Gate	Removed from Master Plan	No longer required with complete separation work.
	Screening	Removed from Master Plan	No longer required with complete separation work.
	Off-line Storage	Removed from Master Plan	No longer required with complete separation work.
	Tunnel	Removed from Master Plan	No longer required with complete separation work.
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 proposed complete separation of the Armstrong 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 developed as part of the CSO Master Plan 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 1-9.

Table 1-9. 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	-	-	-	-	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	-
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

I.D. Engineering Canada Inc (IDE). 1993. *Sewer Relief Study: Armstrong Combined Sewer District Conceptual Report*. Prepared for the City of Winnipeg. September.

AREA 2(NW)

AREA 4(NW)

AREA 3(NW)

AREA 5

AREA 6

AREA 9.1

JEFFERSON E

ARMSTRONG

NEWTON

NEWPCC

DIVERSION CHAMBER

PROPOSED FLOW CONTROLLER

CPR Winnipeg Beach

Red River

ID35

ID36

ID37

BLUNDELL BAY

NURGITZ BAY

BIRCHBARK BAY

SWAILES AVE

SAPHIRE PL

BEECHER AVE

SOVEREIGN COVE

FERRIER ST

NIKKI LANE

COURT AVE

MCPHILLIPS ST

WATSON ST

HOLIDAY PL

DRAMES PL

YANOFSKY WAY

MEREDITH BAY

FARLINGER BAY

GARDEN PARK DR

TULLY RD

DURWARD ST

AMANDA CRES

GOVERNOR'S CRT

HUTTON ST

TEMPLETON AVE

ARROWHEAD CRT

ENVOY PL

ENVOY CRES

AMBASSADOR ROW

CONSULATE RD

MATHIAS AVE

DIPLOMAT DR

ATTACHE DR

MIRAVISTA DR

LEILA AVE

SINCLAIR ST

TANOAK PARK DR

HILLHOUSE RD

DOUG MCKAY PL

EMBASSY LANE

LAUREL BAY

KINGSBURY AVE

WOODCREST DR

LINCREST RD

ROYAL CRES

MCGREGOR ST

PARTRIDGE AVE

SALTER ST

NEWTON AVE

ARMSTRONG AVE

WEINBERG RD

CORK AVE

SLY DR

HANNA ST

TANNER ST

MAIN ST

SOUTHALL DR

MARGARET AVE

AIKINS ST

SEAFORTH AVE

BESTON DR

PEGUIS DR

HIGHLAND AVE

JOHN BLACK AVE

CHIEF PEGUIS TRAIL

LORD SELKIRK DR

RAINBOW DR

MCKAY DR

RIVERVIEW DR

SCOTIA ST

ROYAL AVE

FORREST AVE

BURRIN AVE

POWERS ST

ANDREWS ST

SEMPLE AVE

KILBRIDE AVE

BELMONT AVE

HARTFORD AVE

MCKENZIE ST

PARR ST

ST ANTHONY AVE

PERTH AVE

BALLARD CRES

MARYMOUND WAY

GILIA DR

PEONY AVE

PE LUNA ST

BUTTERCUP AVE

VIOLA ST

NOLAN ST

MORRISON ST

IRIS ST

VERBENA ST

CANNA BLVD

ARROWWOOD DR N

ARROWWOOD DR S

CORALBERRY AVE

AIRLIES ST

ASHBURY BAY

SWEETWOOD BAY

KIMWOOD BAY

MERRIWOOD AVE

FOREST PARK DR

GRANDCREST ST

TULIP RD

FIR ST

RICHARDSON AVE

MACKLIN AVE

MCCURDY ST

JEFFERSON AVE

VANIER DR

MONTCALM CRES

DAFFODIL ST

TEAKWOOD AVE

BLUEBELL AVE

0 100 200 Metres

0 1 2 km

LEGEND

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

CSO MASTER PLAN PROPOSED SOLUTIONS

- Sewer Separation - Planning

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 02
District Overview Map
Sewer District: Armstrong
City of Winnipeg
Combined Sewer Overflow Master Plan

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LEGEND

- Primary Weir
- Critical Elevation
- Manhole

Sewer By Type
- CS
- WWS

Pump Station Type
- Diversion Chamber

CSO MASTER PLAN
PROPOSED SOLUTIONS
- 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 02-01
Control Gate
Sewer District: Armstrong
City of Winnipeg
Combined Sewer Overflow Master Plan

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