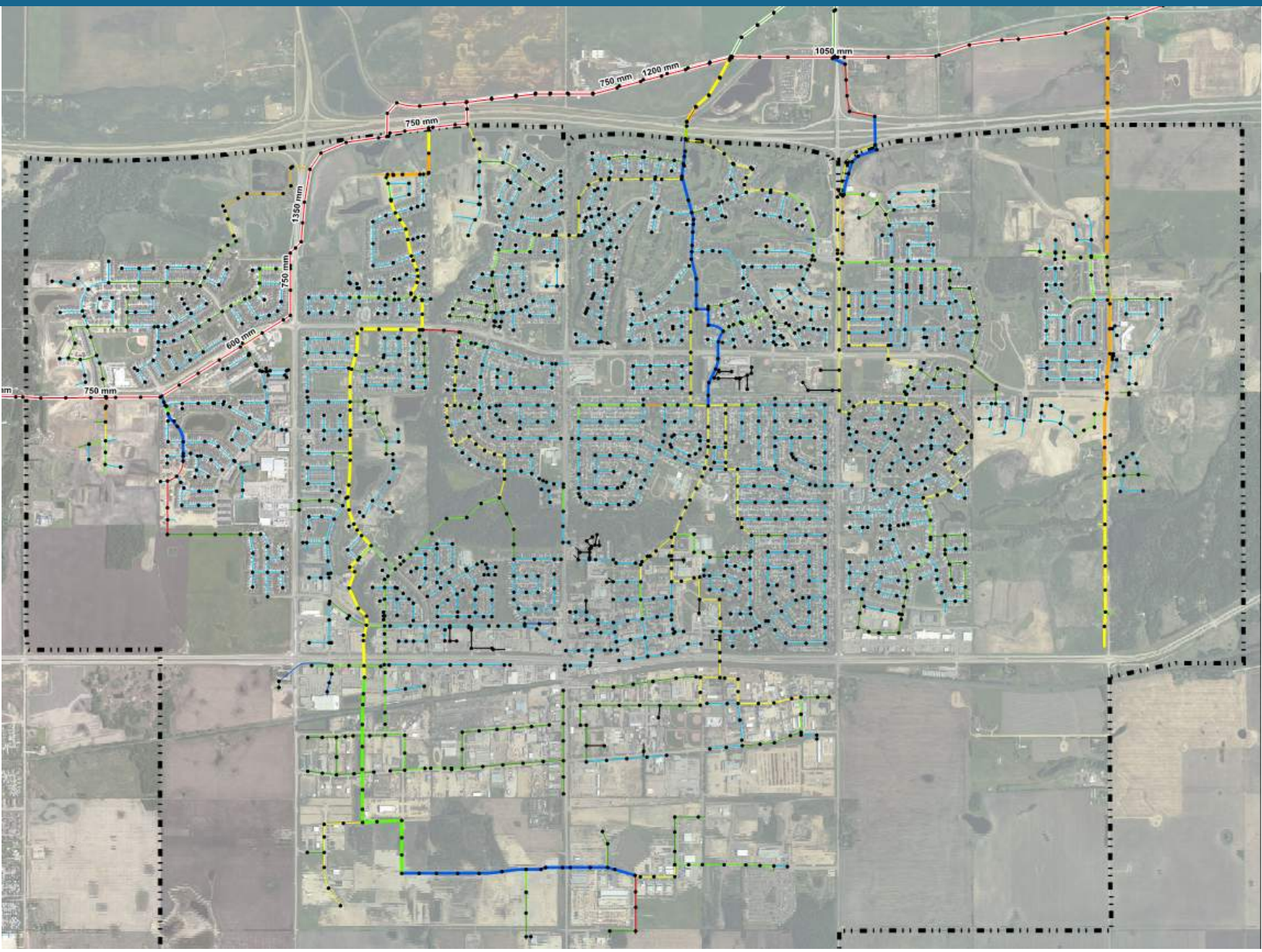

SANITARY SEWER MASTER PLAN UPDATE

City of Spruce Grove

Final Report
April 2022

ISL Engineering and Land Services Ltd. Is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.

Proudly certified as a leader in quality management under Engineers and Geoscientists BC’s OQM Program from 2014 to 2021.

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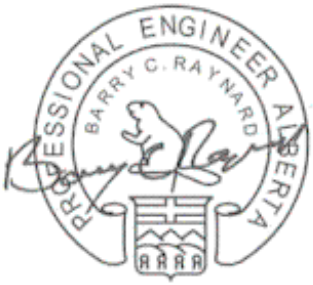
Corporate Authorization

This document entitled “Sanitary Sewer Master Plan Update” has been prepared by ISL Engineering and Land Services Ltd. (ISL) for the use of City of Spruce Grove. The information and data provided herein represent ISL’s professional judgment at the time of preparation. ISL denies any liability whatsoever to any other parties who may obtain this report and use it, or any of its contents, without prior written consent from ISL.



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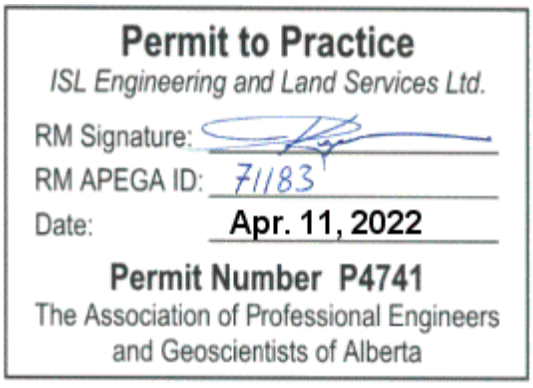
Barry Raynard, M.Eng., P.Eng.
Lead, Water Planning



1.0 Introduction

1.1 Authorization

The City of Spruce Grove (the City) has retained ISL Engineering and Land Services Ltd. (ISL) to undertake the Spruce Grove Sanitary Master Plan Update. The focus of the study was to review existing infrastructure and the model to ensure it was updated based on the most recent GIS database, develop a growth plan that is consistent with projected densities and land use plans as described in the 2020 Spruce Grove Off-Site Levy, and to evaluate the wastewater sewer system and provide recommendations for existing system upgrades and future system expansion to support growth. The analysis of existing and future sanitary sewer systems was completed using the PCSWMM modeling software (Version 7.4). This study will inform decision making processes for Engineering staff and City Council on capital projects, and will provide solutions for efficient, economic, and sustainable municipal services to residents.

1.2 Scope of Work

The scope of work for this project included:

- A detailed background review to update the existing wastewater collection model including new sewers constructed since the 2012 Master Plan, changes to the existing sewer generation rates in the model, updates to current design standards and an existing infrastructure condition review.
- A review of the City of Spruce Grove's projected growth rates to develop a future growth plan that was consistent with the City's projected land uses and density targets over the 25-year growth horizon as described in the 2020 Spruce Grove Off-Site Levy.
- An evaluation of the existing wastewater collection system and a prioritized project list of upgrades with cost estimates required for existing system deficiencies.
- Evaluation of the future wastewater collection system with a prioritized project list of upgrades with cost estimates for future system upgrades required to support growth and development within the City.
- Cost estimates for future development have been prepared and presented for future areas that would fall under the Offsite Levy Bylaw.

2.0 Background

2.1 Existing Wastewater System

GIS data was provided by the City and is summarized on **Figures 2.1** through **2.3** for pipe diameter, material, and pipe installation year, respectively.

2.2 2012 Sanitary Sewer Master Plan

In 2012, a Sanitary Sewer Master Plan was developed for the City of Spruce Grove. It included the development of a wastewater system model using PCSWMM software and incorporated pipe data from the City's GIS database. The model also included the Alberta Capital Region Wastewater Commission's (ACRWC) Parkland Trunk that runs through the north part of the City. The model was calibrated utilizing extensive rainfall and flow monitoring data, including:

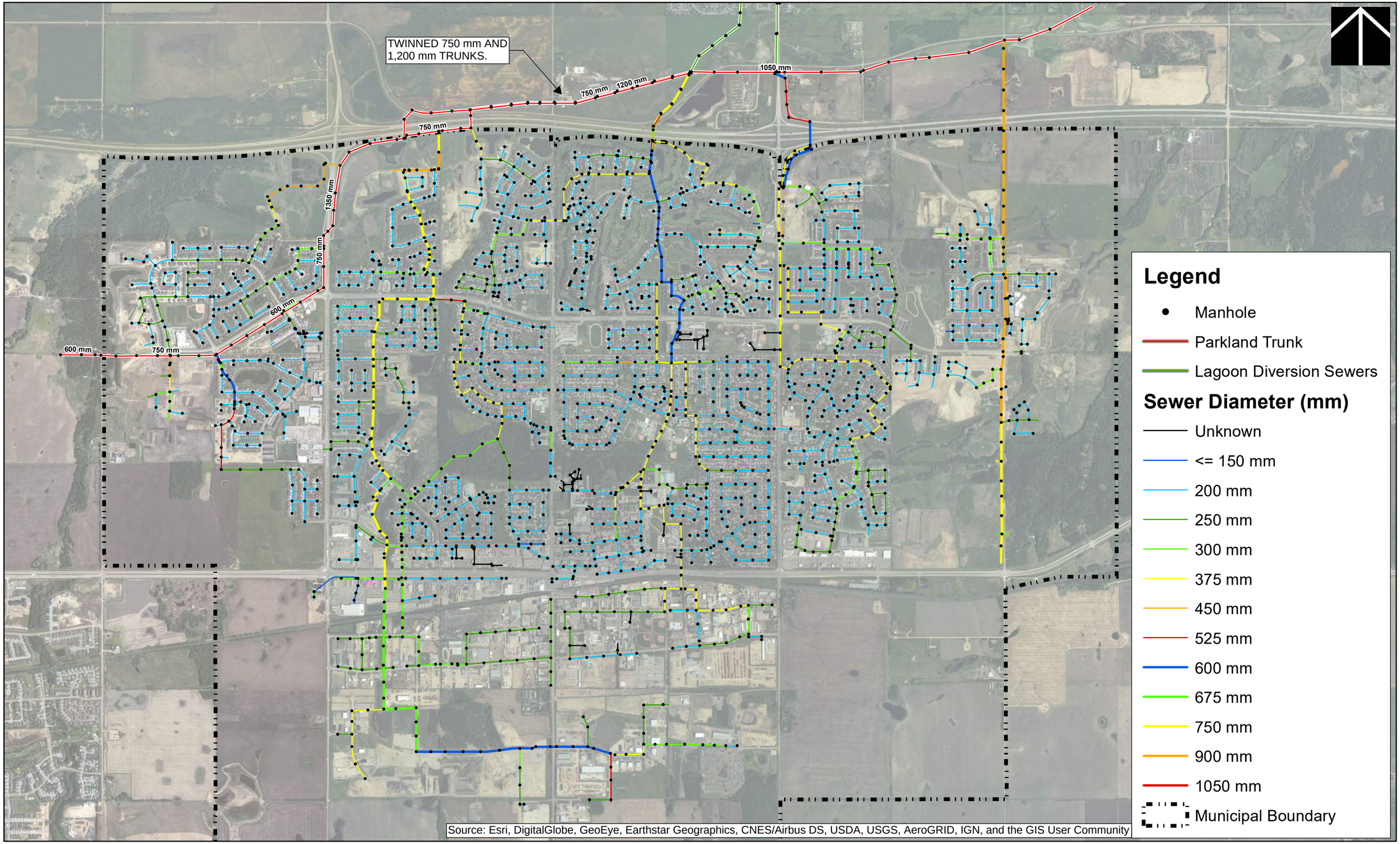
- On-going rainfall monitoring at the City Hall (operated by the ACRWC);
- 2006 to 2011 flow monitoring on the East and Central Trunks plus a small residential area; and
- 2012 flow monitoring of upstream commercial, industrial areas and residential areas.

The 2012 wastewater model along with locations of flow monitors and rain gauges used in model calibration are shown on **Figure 2.4**. This shows the sewers that were constructed prior to 2012 and the location of flow monitoring data used for the 2012 calibration which included commercial sewersheds along Highway 16A, industrial sewersheds south of Highway 16A, and residential neighbourhoods with and without weeping tiles.

The 2012 master plan assessed the hydraulic capacity of the existing sewer network and recommended a series of upgrades to the City's sewer system as well as recommendations to the ACRWC for upgrading its Parkland Trunk. Both the 1:25-year and 1:100-year events were considered when developing upgrading options. The master plan recommended that the ACRWC re-route its Parkland Trunk around the northwest corner of Spruce Grove to service Stony Plain, thus freeing up the existing ACRWC along Jennifer Heil Way and Grove Drive for servicing the City of Spruce Grove. Other upgrades recommended included:

1. Upgrading the existing 250 mm sewer to 375 mm within the Brookwood neighbourhood along Blairmore Street and Oatway Street;
2. Twinning the existing 375 mm East Trunk from Vanderbilt Common to Highway 16 along the east right-of-way (ROW) of Century Road with a 450 / 600 mm sewer; and
3. Upgrading the existing 200 mm / 300 mm sewer within the Woodhaven neighbourhood along Windermere Drive and Windsor Street, subject to future flow monitoring.

The master plan also assessed the long-term wastewater servicing needs based on the 2010 Municipal Development Plan which projected the future City boundary extending south to Highway 628. The future system analysis projected upgrading requirements within the City's sewers plus the ACRWC Parkland Trunk to accommodate this growth. The Pioneer Trunk, which was partially completed at that time, was proposed to service a large area of east and southeast Spruce Grove.



ISL

SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

EXISTING SANITARY SEWER NETWORK - DIAMETER

FIGURE 2.1

1:25,000

0 162.5 325 650 975 1,300 Meters

1050 mm
750 mm
1200 mm
750 mm
1350 mm
750 mm
600 mm
600 mm
750 mm

Legend

- Manhole
- Parkland Trunk
- Lagoon Diversion Sewers

Sewer Material

- Unknown
- Concrete
- HDPE
- PVC
- Steel
- VCT
- Municipal Boundary

ISL

SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

EXISTING SANITARY SEWER NETWORK - MATERIAL

FIGURE 2.2

1:25,000

0 162.5 325 650 975 1,300 Meters

1050 mm
750 mm
1200 mm
750 mm
1350 mm
750 mm
600 mm
600 mm
750 mm

Legend

- Manhole
- Parkland Trunk
- Lagoon Diversion Sewers

Sewer Year Installed

- Unknown
- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s
- 2010s
- Municipal Boundary

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

ISL

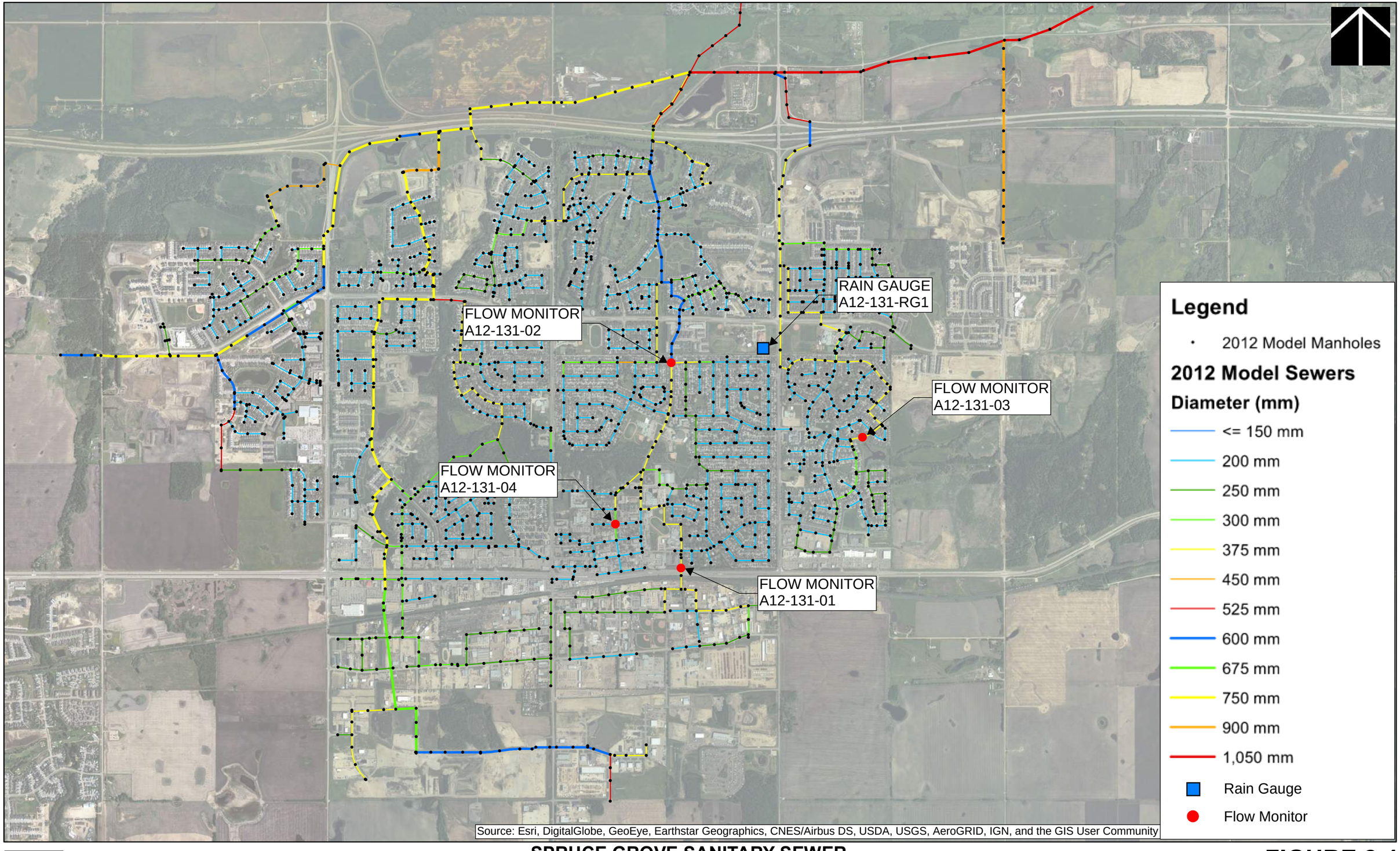
SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

EXISTING SANITARY SEWER NETWORK - PIPE INSTALL DATE

FIGURE 2.3

1:25,000

0 162.5 325 650 975 1,300 Meters



SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

2012 SANITARY SEWER SYSTEM
EXISTING PCSWMM MODEL

FIGURE 2.4

1:25,000

0 162.5 325 650 975 1,300 Meters

2.3 ACRWC Parkland Trunk Upgrading

Following the 2012 Master Plan, the ACRWC conducted an extensive planning study for its entire Parkland system. This study determined that it was not technically feasible to re-route the ACRWC Parkland Trunk around Spruce Grove and recommended upgrading the trunk between the Stony Plain boundary at Grove Drive and Century Road. Concept and preliminary design studies considered a range of trunk alignments, staging options and diversion concepts to the former Spruce Grove lagoons.

The recommended staging concept included twinning along Jennifer Heil Way and Highway 16 initially, with future twinning planned along Grove Drive from Jennifer Heil Way to Boundary Road.

As the ACRWC Parkland Trunk is only marginally lower than the City of Spruce Grove connecting sewers, hydraulic modeling carefully considered the impacts of growth in both Spruce Grove and Stony Plain on the Parkland Trunk upgrading design. The ACRWC modeling determined hydraulic grade line (HGL) elevations for the design events at all connection points to the City of Spruce Grove. Subsequent hydraulic modeling was conducted using the City of Spruce Grove's PCSWMM model (by ISL) to check the backwater impacts on the City's sewer system.

In 2018, the ACRWC upgraded the existing 750 mm trunk along Jennifer Heil Way (north of Grove Drive) to 1,350 mm and twinned along Highway 16 to west of Century Road with a 1,200 mm trunk.

Concept planning work for twinning upstream of Jennifer Heil Way has been completed under the design criteria of a 1:25-year design storm.

2.4 Wastewater Upgrades Completed to Date and System Expansion

The City has completed some of, but not all the system upgrading proposed in the 2012 Master Plan. As shown in the attached **Figure 2.5**, upgrades #1 and #2 have been completed, while upgrade #3 has not yet been completed. This figure also shows the new sewers that have been constructed between 2012 and 2021.

2.5 City of Spruce Grove Growth Study and Annexation

In 2015 the City of Spruce Grove initiated a growth study to determine the City's projected future growth and options for accommodating the growth. The study included a review of the City's existing and proposed wastewater infrastructure based on the 2012 master plan. The growth study resulted in a more modest annexation than that projected in the 2010 Municipal Development Plan. On January 1, 2021 the City annexed approximately eight quarter sections of land from Parkland County.

ACRWC Parkland Trunk upgrading has been completed from Jennifer Heil Way (replacement with 1,350 mm) to West Diversion Sewer (twinning 750 mm with 1,200 mm)

1050 mm
750 mm
1200 mm
750 mm
1350 mm
750 mm
600 mm
600 mm
750 mm

Upgrade #2 from Master Plan, 2013

Upgrade #3 from Master Plan, 2013 has not been completed

Upgrade #1 from Master Plan, 2013

Legend

- Manhole
- Parkland Trunk
- Lagoon Diversion Sewers

New Sewers

Year Installed

- Up to 2011
- 2012 - 2020
- Municipal Boundary

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

2012 MASTER PLAN EXISTING SYSTEM UPGRADE RECOMMENDATIONS COMPLETED TO DATE

FIGURE 2.5

1:25,000

0 162.5 325 650 975 1,300 Meters

2.6 Tri-Municipal Regional Plan

In 2019, Parkland County, Spruce Grove and Stony Plain initiated a Tri-Municipal Regional Plan that will enable the partners to strategically align land use, services, and infrastructure to achieve mutual benefit through aligned operational deployment.

The Transportation, Utility and Infrastructure component of the regional plan determined the wastewater servicing needed to support up to 40 years of growth. The projected 40-year growth only utilizes about half of the recently annexed lands. This is presumably due to differences in the projected growth rates for the City.

3.0 Population and Growth Projections

3.1 Introduction

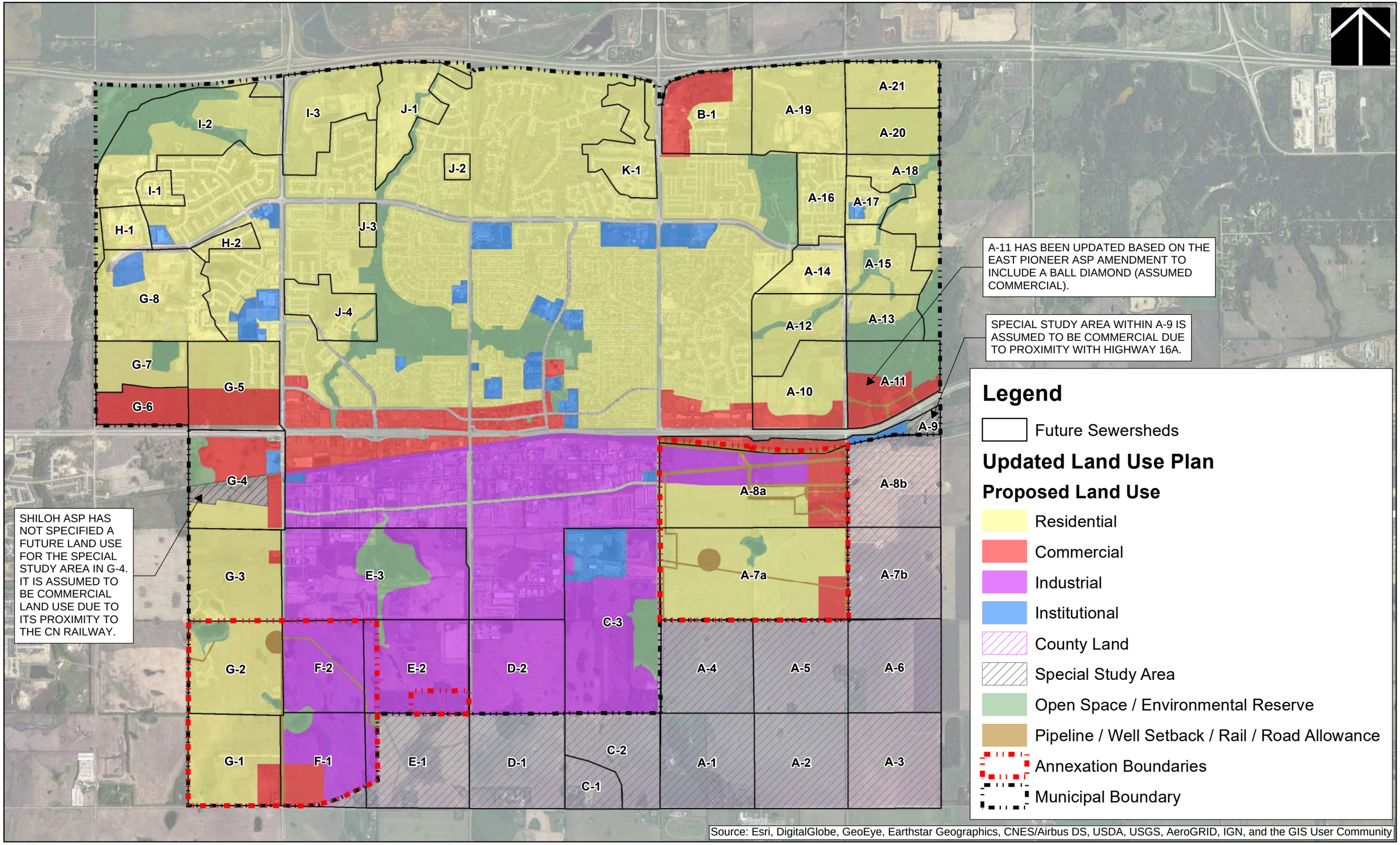
Proposed growth within Spruce Grove has considered the following:

- Land use, net developable areas, and population projections for approximately eight quarter sections of annexed lands have been studied as part of the 2019 Growth Study Addendum;
- Information from the 2019 Tri-Municipal Regional Study was reviewed and used as applicable and regional cooperation was considered when reviewing the potential for future growth outside of the current City boundary;
- Land use polygons from the 2020 Municipal Development Plan (MDP) were adapted for use in projecting future growth outside of the annexation areas, but within the current municipal boundaries;
- The growth sewersheds from the 2012 Master Plan were updated based on land use and population projections from the annexation growth study and 2020 MDP.

3.2 Growth Plan

The proposed growth plan for Spruce Grove is summarized on **Figure 3.1** and shows growth within the annexation areas and growth outside of the annexation areas but still within the municipal boundaries of Spruce Grove. The future wastewater system model will be based on full build out within the current City limits which includes the eight recently annexed quarter sections.

It is noted that the 2012 Master Plan was based on aggressive assumptions for future growth and included servicing to Highway 628. Thus, some trunks may have been sized for growth beyond the 2021 annexation boundary. The City of Spruce Grove has directed ISL to size the upstream extensions to these trunks for potential future growth beyond the annexation boundary to utilize the available capacity in the downstream trunk. The rationale for this is that the oversizing costs are nominal compared to the potential future upgrading costs if these trunk sections were downsized to service only the current (annexed) City lands. The capacity could be used by either the City of Spruce Grove to service future annexed lands or by Parkland County to service lands to the south or south east on an interim or permanent basis. This is in keeping with the spirit of regional cooperation in the Tri-Municipal Regional Plan.



ISL

SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

CITY OF SPRUCE GROVE
GROWTH PLAN

FIGURE 3.1

1:30,000

0 195 390 780 1,170 1,560 Meters

Table 3.1 summarizes the growth plan the City of Spruce Grove. Green cells below indicate sewersheds that are within Parkland County and have been included in the future growth analysis as a separate scenario if the City or the County develops these lands, and they are serviced by City Trunks. For more information, see **Appendix A**.

Table 3.1: Proposed City of Spruce Grove Growth Plan

Sewershed Name	Res. Area (ndha)	ICI Area (ndha)	ASP?	G_{Res} (L/c/d)	G_{ICI} (L/s/ha)	Lot Density (du/ndha)	Population Per Dwelling (c/du)	Population Density (c/ha)	ADWF (L/s)
A-1	54.1	0.0	No	300	0.2	35	2.5	87.5	16.4
A-2	53.6	0.0	No	300	0.2	35	2.5	87.5	16.3
A-3	53.6	0.0	No	300	0.2	35	2.5	87.5	16.3
A-4	52.1	0.0	No	300	0.2	35	2.5	87.5	15.8
A-5	53.1	0.0	No	300	0.2	35	2.5	87.5	16.1
A-6	52.6	0.0	No	300	0.2	35	2.5	87.5	16.0
A-7a	114.4	8.5	No	300	0.2	35	2.5	87.5	36.5
A-7b	51.5	0.0	No	300	0.2	35	2.5	87.5	15.7
A-8a	44.5	49.5	No	300	0.2	35	2.5	87.5	23.4
A-8b	50.5	0.0	No	300	0.2	35	2.5	87.5	15.3
A-9	0.0	10.1	East Pioneer	300	0.2	38	2.5	95.0	2.0
A-10	24.0	10.3	East Pioneer	300	0.2	38	2.5	95.0	10.0
A-11	0.0	22.3	East Pioneer	300	0.2	38	2.5	95.0	4.5
A-12	34.8	0.0	East Pioneer	300	0.2	38	2.5	95.0	11.5
A-13	8.5	0.0	East Pioneer	300	0.2	38	2.5	95.0	2.8
A-14	9.0	0.0	East Pioneer	300	0.2	38	2.5	95.0	3.0
A-15	19.0	0.0	East Pioneer	300	0.2	38	2.5	95.0	6.3
A-16	0.0	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	0.0
A-17	0.0	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	0.0
A-18	26.7	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	6.4
A-19	40.3	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	9.7
A-20	26.2	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	6.3
A-21	26.7	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	6.4
B-1	17.3	4.3	Pioneer	300	0.2	27.8	2.5	69.5	5.0

Sewershed Name	Res. Area (ndha)	ICI Area (ndha)	ASP?	G_{Res} (L/c/d)	G_{ICI} (L/s/ha)	Lot Density (du/ndha)	Population Per Dwelling (c/du)	Population Density (c/ha)	ADWF (L/s)
			Lands						
C-1	0.0	15.3	No	300	0.2	35	2.5	87.5	3.1
C-2	0.0	39.5	No	300	0.2	35	2.5	87.5	7.9
C-3	0.0	60.9	South Century	300	0.2	0	2.5	0.0	12.2
D-1	0.0	51.6	No	300	0.2	35	2.5	87.5	10.3
D-2	0.0	51.5	South Century	300	0.2	0	2.5	0.0	10.3
E-1	0.0	59.2	No	300	0.2	35	2.5	87.5	11.8
E-2	0.0	53.2	Railway Avenue Area	300	0.2	0	2.5	0.0	10.6
E-3	0.0	67.2	Railway Avenue Area	300	0.2	0	2.5	0.0	13.4
F-1	0.0	49.7	No	300	0.2	35	2.5	87.5	9.9
F-2	0.0	45.2	No	300	0.2	35	2.5	87.5	9.0
G-1	56.9	7.3	No	300	0.2	35	2.5	87.5	18.7
G-2	55.0	0.0	No	300	0.2	35	2.5	87.5	16.7
G-3	48.1	0.0	Shiloh	300	0.2	28.77	2.5	71.9	12.0
G-4	13.6	40.8	Shiloh	300	0.2	28.77	2.5	71.9	11.6
G-5	15.7	23.6	West Central	300	0.2	36.2	2.5	90.5	9.7
G-6	0.0	20.3	West Central	300	0.2	36.2	2.5	90.5	4.1
G-7	26.3	0.0	West Central	300	0.2	36.2	2.5	90.5	8.2
G-8	36.9	0.0	West	300	0.2	28.99	2.5	72.5	9.3
H-1	9.6	0.0	West	300	0.2	28.99	2.5	72.5	2.4
H-2	2.7	0.0	West	300	0.2	28.99	2.5	72.5	0.7
I-1	0.0	0.0	West	300	0.2	28.99	2.5	72.5	0.0
I-2	58.9	0.0	West	300	0.2	28.99	2.5	72.5	14.8
I-3	35.9	0.0	North Central	300	0.2	25.27	2.5	63.2	7.9
J-1	28.9	0.0	North Central	300	0.2	25.27	2.5	63.2	6.3
J-2	2.8	0.0	North Central	300	0.2	25.27	2.5	63.2	0.6
J-3	0.0	0.0	Senior's Co-op Housing	300	0.2	16.6	2.5	41.5	0.0

Sewershed Name	Res. Area (ndha)	ICI Area (ndha)	ASP?	G_{Res} (L/c/d)	G_{ICI} (L/s/ha)	Lot Density (du/ndha)	Population Per Dwelling (c/du)	Population Density (c/ha)	ADWF (L/s)
J-4	10.1	0.0	Heritage Estates	300	0.2	36	2.5	90.0	3.1
K-1	11.5	0.0	North Central	300	0.2	25.27	2.5	63.2	2.5

Notes:

1. Areas outside of approved ASP boundaries assume higher lot density targets (35 lots / ndha) based on recommendations from the EMRB.
2. For areas with approved ASPs, the lot densities are taken from the ASP document.
3. Area A-11 has been updated based on the recent East Pioneer Amendment to include the proposed baseball diamond and surrounding commercial development.
4. ASP designated “Special Study Areas” have been assumed to be commercial development based on adjacent land uses.

4.0 Review of Design Standards and Guidelines

A comparison of current Spruce Grove Municipal Development Standards (2015) with adjacent municipalities is shown in **Table 4.1**. The design standards are compared to the Town of Stony Plain and Parkland County and are shown to be relatively similar, although have higher non-residential generation rates.

Table 4.1: Comparison of Spruce Grove Design Standards

Design Parameter		Municipality		
		City of Spruce Grove	Town of Stony Plain	Parkland County
Dry Weather Flow Generation	Residential (L/c/d)	300	300	350
	Commercial (L/ha/d)	17,280[1]	11,100[2]	-
	Institutional (L/ha/d)	17,280[1]	11,100[2]	-
	Industrial (L/ha/d)	17,280[1]	9,000[2]	6,170
Peaking Factors	Residential (-)	Harmon <= 3.5[3]	Harmon <= 3.8[3]	Harmon >= 2.5[3]
	Non-Residential (-)	3.5	Equivalent Harmon <= 3.8[4]	>= 3.0
Inflow / Infiltration	I/I Rate (L/s/ha)	0.28	0.28	0.28
	Existing Roof Leader / Weeping Tile Connection Allowance (L/s/ha)	-	0.60	-
	I/I Rate at Sag Manholes (L/s)	-	0.40	0.40
Maximum Manhole Spacing (m)		150	120 - 150[5]	120 - 150[6]

Notes:

1. Based on 0.2 L/s/ha. Higher values are to be used in anticipation of high-water users.
2. Based on equivalent populations of 37 ec/ha for commercial / institutional land uses and 30 ec/ha for industrial land uses.
3. Harmon Equation: 1+14/(4+P^0.5) where P = pop. / 1,000.
4. Equivalent Harmon Equation is based on back-calculation of an equivalent ec/ha value.
5. 120 m spacing for sewers smaller than 600 mm and 150 m spacing for sewers greater than or equal to 600 mm.
6. 120 m spacing for sewers smaller than or equal to 600 mm and 150 m spacing for sewers greater than 600 mm.

The 2015 design standards have also been compared to the recommendations of the 2012 Sanitary Sewer Master Plan which is shown in **Table 4.2**. The 2015 design standards reflect most of the recommendations from the 2012 Master Plan but are slightly more conservative in generation rates for residential and non-residential land uses.

Table 4.2: Comparison of Spruce Grove Design Standards and 2012 Master Plan Recommendations

Parameter	2012 Master Plan Recommendations			2015 Design Standards		
	Residential	Commercial	Industrial	Residential	Commercial	Industrial
Domestic Flows (L/c/d)	280	-	-	300	-	-
Equivalent Population (c/ha)	60	-	-	60	-	-
ADWF (L/s/ha)	0.19	0.16	0.13	0.21	0.2	0.2
Peaking Factor	3.5	3.5	3.5	Harmon ≤ 3.5	3.5	3.5
PDWF (L/s/ha)	0.68	0.55	0.44	0.73	0.70	0.70
Weeping Tile Flow (L/s/ha)	0.00	0.00	0.00	0.00	0.00	0.00
I/I (L/s/ha)	0.28	0.28	0.28	0.28	0.28	0.28
Inflow - Sag MH (L/s/ha)	0.00	0.00	0.00	0.00	0.00	0.00
Total Flow (L/s/ha)	0.96	0.83	0.72	1.01	0.98	0.98
Factor of Safety	1.20	1.20	1.20	1.20	1.20	1.20
Total Flow with F.S. (L/s/ha)	1.15	1.00	0.86	1.21	1.18	1.18

Based on the comparison of the 2015 Spruce Grove Municipal Development Standards with other municipalities and with the recommendations from the 2012 Sanitary Sewer Master Plan, **Table 4.3** summarizes the recommended design and development standards for sanitary sewer design.

It should be mentioned that water usage records indicate that overall water consumption within Spruce Grove is dropping and 300 L/c/d is a conservative estimate for use in design standards for sizing of wastewater sewers. Thus, water use and flow monitoring records should be monitored on an on-going basis, and if they indicate overall water usage / wastewater generation is consistently lower than design values, then these recommendations should be revised in a few years to reflect changing conditions. More information regarding water usage in Spruce Grove is discussed in Section 5.0.

Table 4.3: Recommended Design Standards

Design Parameter		Recommended Value
Dry Weather Flow Generation	Residential (L/c/d)	300
	Commercial (L/ha/d)	17,280
	Institutional (L/ha/d)	17,280
	Industrial (L/ha/d)	17,280
Peaking Factors	Residential (-)	Harmon <= 3.5[3]
	Non-Residential (-)	3.5
Inflow / Infiltration	I/I Rate (L/s/ha)	0.28
	Roof Leader / Weeping Tile Allowance (L/s/ha)	-
	I/I Rate at Sag Manholes (L/s)	0.4
Maximum Manhole Spacing (m)		150

5.0 Existing Sanitary System Review and Model Update

5.1 Existing System

The existing system is shown on **Figures 2.1** through **2.3** for diameter, material, and pipe installation year, respectively. **Table 5.1** summarizes the distribution of pipe diameters, materials, and installation year for the existing sanitary sewer network. As shown, the majority of Spruce Grove consists of 200 mm PVC pipe and the City experienced the most significant growth in the 2000s and 2010s.

Table 5.1: Spruce Grove Pipe Sizes, Material, and Installation Years

Diameter (mm)	Length (km)	Pipe Material	Length (km)	Pipe Installation Year	Length (km)
Unknown	2.7	Unknown	2.5	Unknown	2.6
75	0.4	Concrete	20.0	1950s	2.6
100	0.1	HDPE	0.3	1960s	8.3
150	0.6	PVC	110.0	1970s	36.6
200	96.3	VTC	31.4	1980s	9.4
250	20.1			1990s	22.5
300	11.5			2000s	40.9
350	0.1			2010s	41.2
375	14.5				
400	0.1				
450	1.5				
500	0.2				
525	1.8				
600	4.2				
675	1.6				
750	5.3				
900	3.2				

5.2 ACRWC – Parkland Sanitary Trunk Sewer

Updated GIS data and record drawings for the twinning / upgrading along the Parkland Sanitary Trunk Sewer was also added to the GIS database and is shown on **Figures 2.1 – 2.3**. The twinning / upgrading along the trunk is shown in more detail on **Figure 5.1** with text showing the ACRWCs future plans for the Spruce Grove lagoon diversion project. The details of this project are summarized below:

- A diversion structure, located at the southwest corner of Township Road 532A and Century Road, will accept flows from the existing 1,050 mm trunk from the west. This trunk conveys flows from Stony Plain and some of Spruce Grove.
- The diversion structure will consist of two real-time controlled gates and two stop log weirs for emergency overflows, if needed. The proposed initial design will be operator controlled at the ACRWC

treatment plant; however, the long-term plans indicate that real-time control will be designed and implemented.

- The gates consist of:
  - A 600 mm x 600 mm rectangular gate which can be opened / closed and allows flows to be diverted north towards the lagoons; and
  - A 1,200 mm x 1,200 mm rectangular gate that can be opened / closed and allows flows to continue to flow east towards the Parkland Pump Station (PLPS).
- The overflow weirs will be adjustable for future flow conditions to protect Spruce Grove trunks from surcharging and to allow wastewater to spill northwards towards the lagoon or eastwards towards the PLPS.
- The overflow weirs have the following characteristics:
  - The overflow weir to the Spruce Grove lagoon is 1.5 m;
  - The overflow weir to the Parkland Pump Station is 2.0 m wide; and
  - The maximum elevation of these overflow weirs is 691.245 m to protect Spruce Grove from basement flooding.
- The existing west diversion pipe is to be re-lined and re-used for wet weather flow (WWF) overflows.
- The existing east diversion pipe is to include 317 m of newly re-graded pipe at the upstream end and the downstream end will be re-lined.
- A new pump station and 450 mm forcemain will be constructed for pumping stored WWF back into the Parkland trunk post-event.

5.3 Model Update and Dry-Weather Flow Review

5.3.1 Model Update

The existing system model from the 2012 Master Plan was created in PCSWMM and had to be updated for new sewers constructed since 2012. New sewersheds were then delineated and using the previously calibrated 2012 sewage generation rates, an updated existing system average dry weather flow (ADWF) was added to the model. The updated model was then compared to 2021 flow monitoring data to confirm the accuracy of the existing system dry weather flow (DWF). **Figure 5.2** summarizes the updates to the existing system model and show new areas of development, upgrades along the Parkland Trunk and the locations where flow monitoring data was reviewed.

After adding in new sewers and manholes, new sewersheds had to be delineated for areas of new development using existing Spruce Grove Parcel and Road Network layers.

Areas of new development were assigned generation rates according to their land uses. These values are based on the 2012 Master Plan DWF calibration:

- Residential: 0.094 L/s/ha;
- Commercial: 0.186 L/s/ha; and
- Industrial: 0.123 L/s/ha.

Legend

- Proposed Diversion Structure
- Proposed Lift Station
- Proposed Forcemain
- Manhole

Sewer Diameter (mm)

- Unknown
- <= 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- 675 mm
- 750 mm
- 900 mm
- 1,050 mm
- 1,200 mm
- 1,350 mm

PROPOSED LIFT STATION

EXISTING DIVERSION SEWERS TO BE RE-LINED

PROPOSED 450 mm FORCEMAIN

NOTE: LOCATIONS OF SPRUCE GROVE LAGOON DIVERSION UPGRADING IS SCHEMATIC AND DOES NOT REPRESENT EXACT LOCATIONS / ALIGNMENTS.

PROPOSED NEW GRAVITY SEWER

1050 mm

PROPOSED DIVERSION STRUCTURE

TWINNED PARKLAND TRUNK SECTION (750 AND 1,200 mm)

750 mm

1200 mm

750 mm

RECENTLY UPGRADED TO 1,350 mm

1350 mm

750 mm

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

ACRWC PARKLAND TRUNK AND SPRUCE GROVE LAGOON DIVERSION FUTURE PLANS

FIGURE 5.1

1:12,500

0 80 160 320 480 640 Meters

Legend

Updated 2021 Existing Manholes

- Manholes
- Parkland Trunk Twinning
- East Trunk Twinning
- Brookside Upgrades
- New Manholes
- Created Nodes

Updated 2021 Existing Sewers

- Sewers
- Parkland Trunk Twinning
- Brookside Upgrades
- East Trunk Twinning
- New Sewers

Flow Monitor

- Stony Plain Flow Meter
- Spruce Ridge Rd
- YHT Connection West
- West Diversion
- East Diversion
- Spruce Grove Flow Meter
- Municipal Boundary

NOTE:
CREATED NODES ARE REQUIRED IN PCSWMM AT LOCATIONS WHERE TWO SEWERS MEET WITHOUT A MANHOLE. THESE GREY NODES IN THE MAP DO NOT REPRESENT PHYSICAL MANHOLES BUT ARE REQUIRED IN THE MODEL.

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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

UPDATED 2021 EXISTING SEWER SYSTEM MODEL

FIGURE 5.2

1:25,000

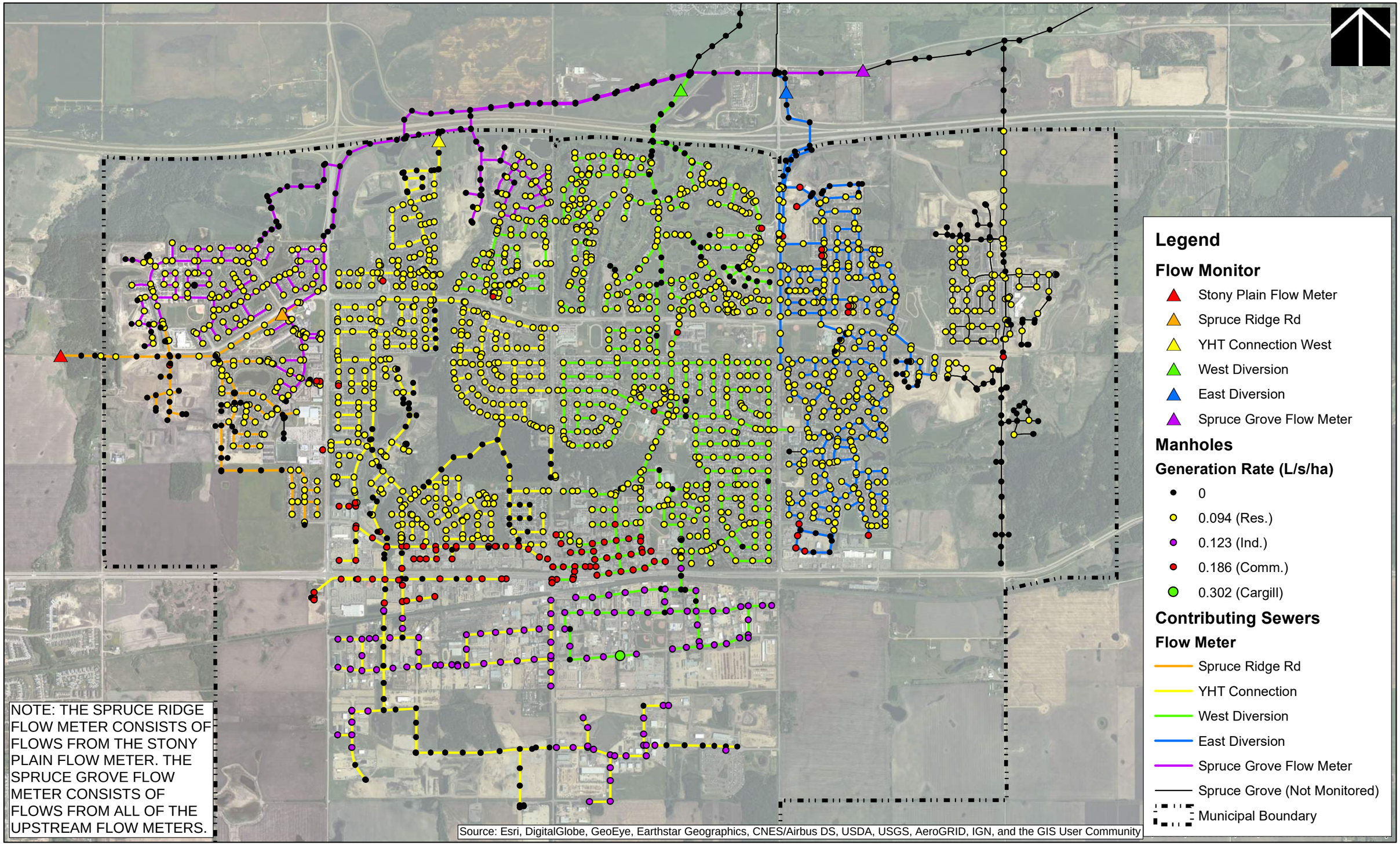
0 162.5 325 650 975 1,300 Meters

5.3.2 Review of Model Dry-Weather Flow with ACRWC Flow Monitoring Data

Existing model calibration was not part of the original scope of work; however, ISL reviewed the updated DWF against existing flow monitoring data from 2021 ACRWC flow monitors. These locations are summarized below and are shown on **Figure 5.2**:

1. Stony Plain Flow Meter
    a. Used to ensure the DWF boundary condition at Stony Plain was accurate and represented actual 2021 conditions.
2. Spruce Ridge Rd Flow Meter
    a. Located at Spruce Ridge Road, this flow meter is on the ACRWC Parkland Trunk and measures flows from Stony Plain as well as some of the most western connections to the Parkland Trunk.
    b. This flow meter monitors some of the neighbourhoods west of Jennifer Heil Way and will eventually monitor future flows from the proposed Boundary Trunk.
3. YHT Connection West Flow Meter
    a. Located offline of the Parkland Trunk, this flow meter is located at the downstream end of the West Trunk and monitors flows from most of the development in between Jennifer Heil Way and Calahoo Road as well as the furthest southeast industrial development east of Golden Spike Road.
4. West Diversion Flow Meter
    a. Located offline of the Parkland Trunk, this flow meter is located at the downstream end of the Central Trunk and monitors flows from most development in between Calahoo Road and Century Road.
5. East Diversion Flow Meter
    a. Located offline of the Parkland Trunk, this flow meter is located at the downstream end of the East Trunk and services development from Century Road to one quarter section east of Century Road.
6. Spruce Grove Flow Meter
    a. The Spruce Grove Flow Meter is located on the Parkland Trunk and monitors flows from the East Trunk and upstream, including flows from Stony Plain.
    b. The difference between the Spruce Grove and Stony Plain flow meters will yield the sewage generation of Spruce Grove (and Parkland Village), excluding the Pioneer Trunk which is located approximately 1 km downstream.

The flow monitors, their contributing sewers, and the generation rates at each manhole in the model are shown on **Figure 5.3**. As shown, there are a few areas, namely a small area near Spruce Ridge Road, most of the neighbourhood north of Grove Drive and west of Jennifer Heil Way and the neighbourhood east of the YHT Connection flow meter that are not monitored until the furthest downstream Spruce Grove Flow Meter. Existing and new development within the Pioneer Trunk sewershed is not currently monitored within the City.



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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

FLOW MONITOR CONTRIBUTING SEWERS AND 2012 CALIBRATED GENERATION RATES

FIGURE 5.3

1:25,000

0 162.5 325 650 975 1,300 Meters

Two periods of extended DWF (February 2021 and April 1 – 15, 2021) were reviewed and are summarized in **Appendix B**. Based on a review of these periods, it was determined that April 2021 would be used to evaluate the updated existing system model DWF. The model was run from April 2 – 9, 2021 with results presented from April 3 onwards. **Figure 5.4** below shows the flow monitoring from April 3 – 10, 2021.

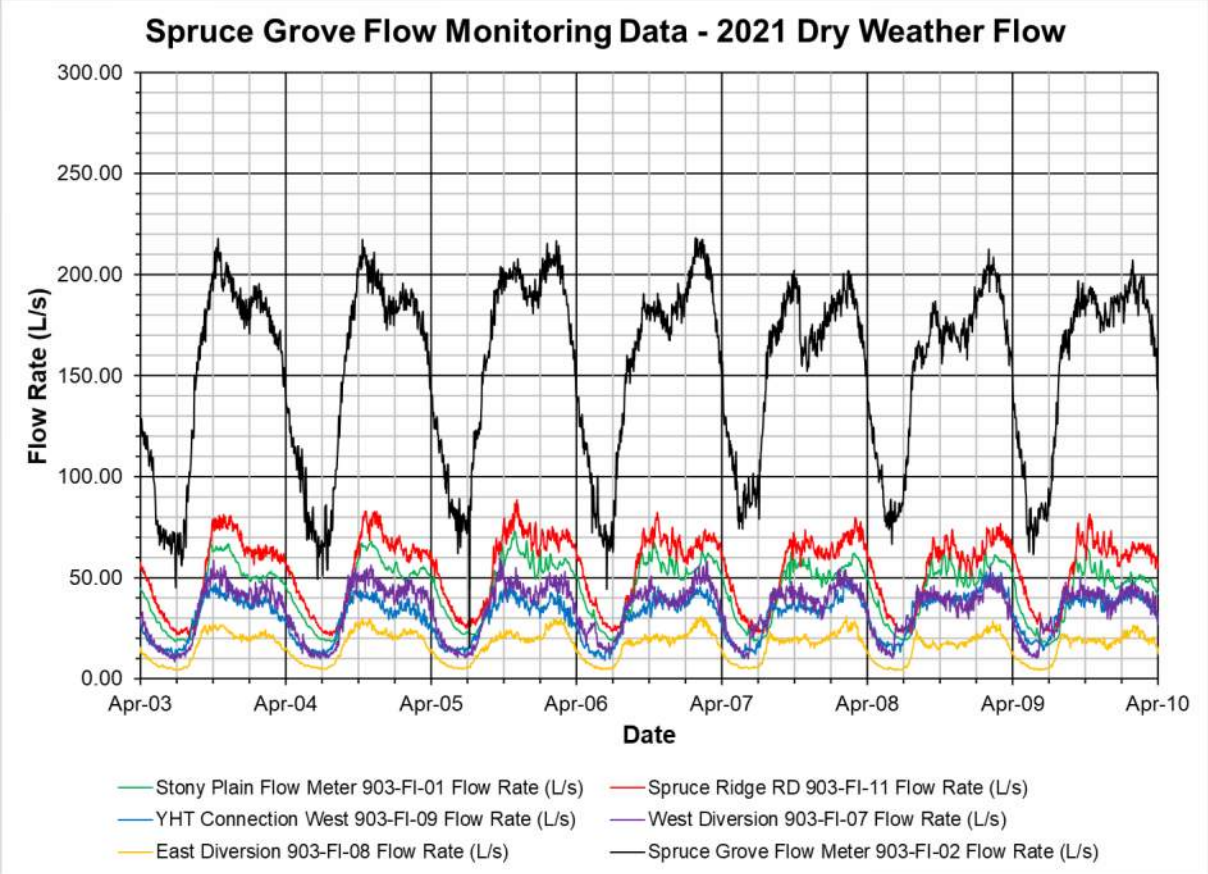

Figure 5.4: Flow Monitoring Data from April 3 – 10, 2021

In addition to flow monitoring data, the City of Spruce Grove provided water consumption data for reference, which is summarized in **Table 5.2**. As shown, the total water usage (including non-residential) has decreased in recent years to as low as 189 L/c/d, which is a drop of 19% relative to 2012.

Table 5.2: Water Consumption Data (2012 and 2017 – 2021)

Parameter	2012	2017	2018	2019	2020	2021
Total Volume	2,421,000	2,692,594	2,715,160	2,654,864	2,733,084	2,854,570
Population	28,468	36,634	37,744	38,392	38,951	-
Water Use (L/c/d)	233	201	197	189	192	-
Change (%)	-	-14%	-15%	-19%	-17%	-

From preliminary modeling runs, the existing system model conservatively overestimates the flow monitoring data. Based on this, as well as the water consumption data showing an average drop in total water usage of about 20%, ISL has evaluated three scenarios as described below:

1. Scenario 0: 2012 Existing System Model (from 2012 Master Plan).
2. Scenario 1: 2021 Existing System Model (Using 2012 Calibrated DWF Generation Rates).
3. Scenario 2: 2021 Existing System Model with Water Conservation:
    a. 10% DWF reduction in established areas (pre – 2012); and
    b. 30% DWF reduction in new development (2012 – 2021).

Figure 5.5 summarizes the flow monitoring and modeling hydrographs for each of the above scenarios at the furthest downstream flow meter, the Spruce Grove Flow Meter, located south of Parkland RV Storage near the intersection of Range Road 272 and Township Road 532A. For more information regarding the DWF model review, see **Appendix B**.

From **Figure 5.5**, it can be seen that:

- Scenario 0 (2012 Master Plan model) already overpredicts the flow at this flow meter;
- Scenario 1 overpredicts the flow monitoring data further due to the increase in flows from new development from 2012 through 2021; and
- Scenario 2 reduces the overestimation by a reasonable amount while still maintaining realistic sewage generation rates.

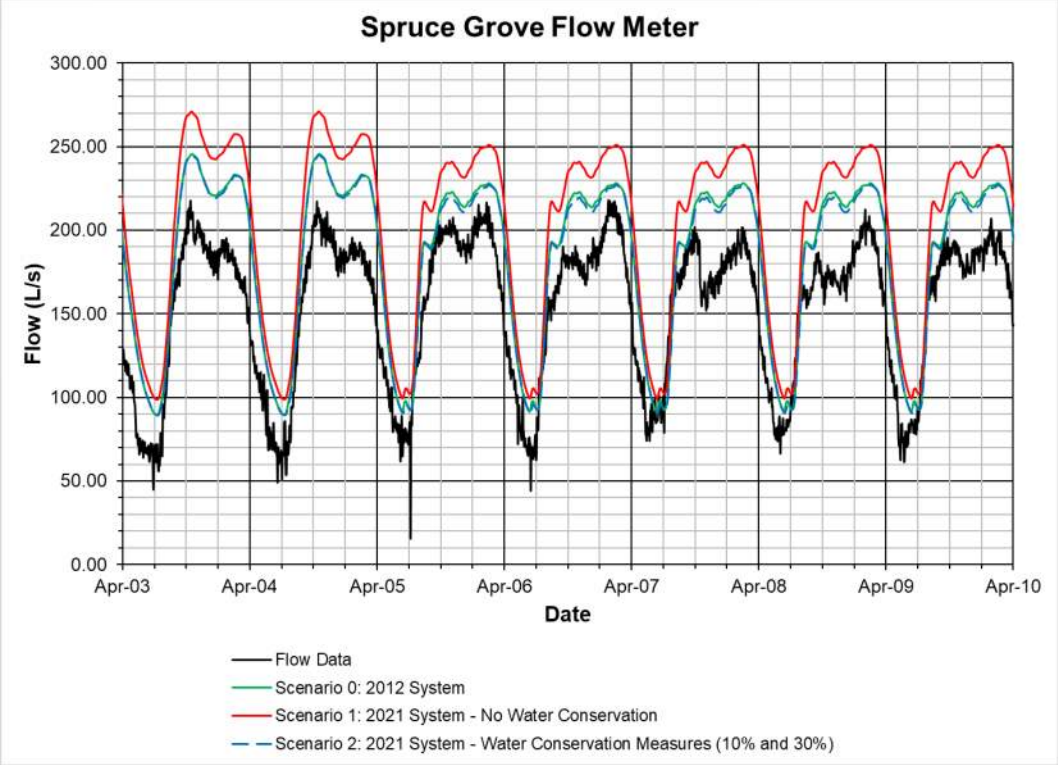

Figure 5.5: Spruce Grove Flow Meter – Flow Data and Modeling Results

Since the water consumption reports show that total water usage per capita has dropped by approximately 20% from since 2012, using the water conservation scenario is appropriate as it better represents the overall flow monitoring data from Spruce Grove and reasonably matches the water consumption reduction in recent years.

Thus, Scenario 2: 2021 Existing System with Water Conservation measures will be used as a DWF basis when evaluating the existing system performance of the Spruce Grove sanitary sewer network.

6.0 Existing Sanitary Sewer Assessment

6.1 Criteria for Existing Sanitary Sewer System Evaluation

The 2021 existing updated model (existing system) will be evaluated using the following design storms:

1. 1:25-year, 24-hour Huff Distribution City of Edmonton Design Storm (25-year); and the
2. 1:100-year, 24-hour Huff Distribution City of Edmonton Design Storm (100-year).

While the 25-year event is typical when evaluating a sanitary sewer network, the City of Spruce Grove showed interest in evaluating the 100-year storm as well to determine opportunities for providing a higher level of service. The design storms are summarized on **Figure 6.1**.

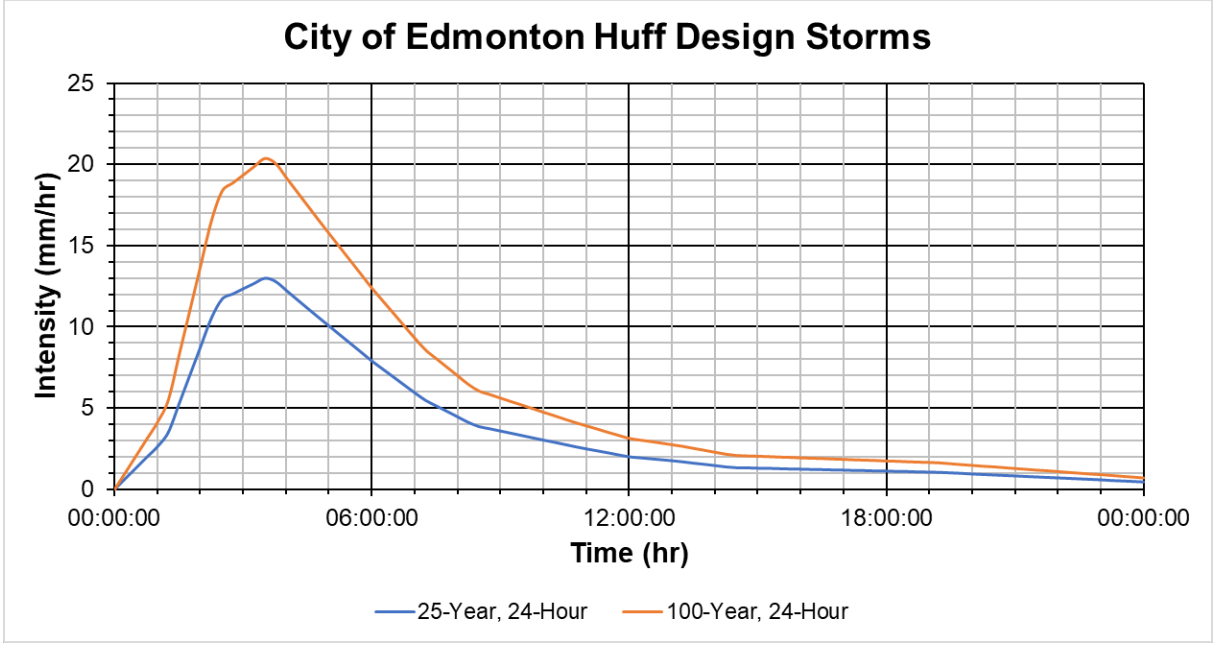

Figure 6.1: 25-Year and 100-Year, 24-Hour Huff Distribution City of Edmonton Design Storms

While the City is being evaluated at the 25-year and 100-year design storms, the boundary condition from Stony Plain has been fixed as a 25-year hydrograph assuming a 25-year event from Stony Plain. This boundary condition hydrograph is shown on **Figure 6.2** and is based on the 2016 Parkland Gravity Sewer (PLGS) Upgrades and Lagoon Diversion Structure Concept Design Report. Since 2016, the ACRWC has indicated that no new flow projections for Stony Plain have been projected for use as boundary conditions for modeling of the Parkland Trunk.

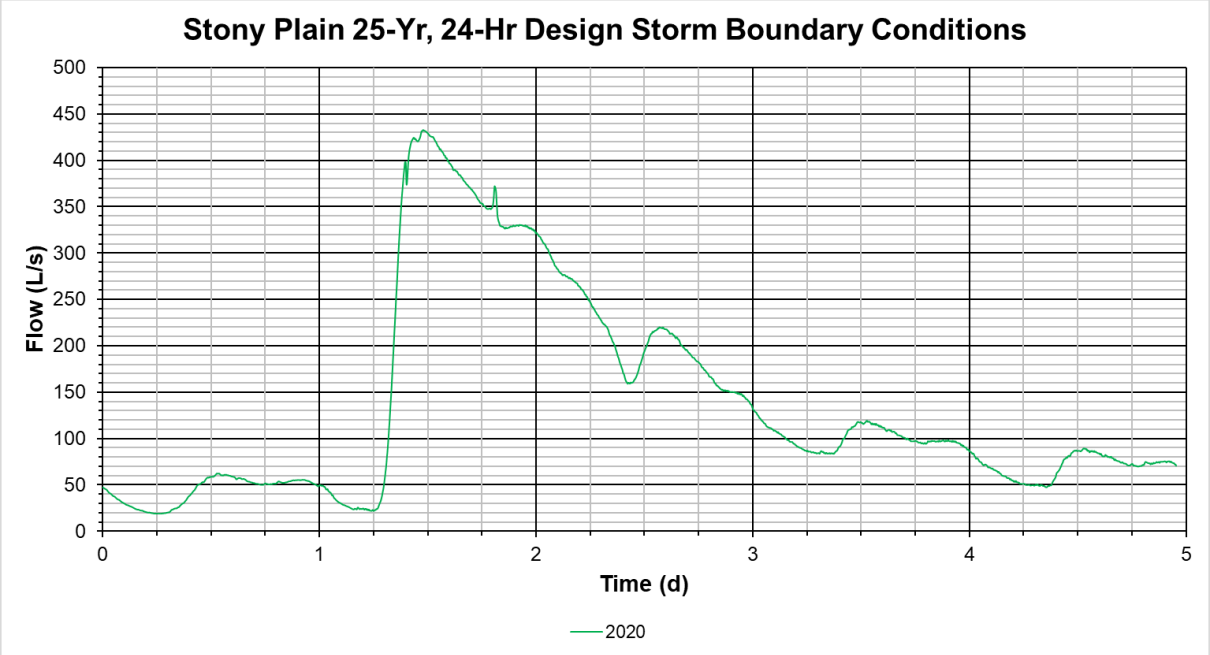

Figure 6.2: Stony Plain 1:25-Year, 24-Hour Flow Hydrograph Boundary Condition

The existing sanitary collection system was analyzed under both design storms listed above and the performance of the existing network was assessed in terms of two relationships as follows:

- **Maximum Hydraulic Grade Line (HGL) Elevation Relative to the Ground** – the amount of freeboard between the maximum water elevation and ground elevation at each manhole at the moment when maximum flow passes through. A depth to peak HGL of 1.5 – 2.5 m is a typical threshold used when assessing the risk of potential basement flooding. A depth of 1.5 m to the HGL implies a high risk or likelihood of basement flooding, whereas a depth of 2.5 m indicates a moderate risk of basement flooding.
- **Peak Discharge Relative to Pipe Capacity** – indicates the ratio peak flow to pipe capacity in wet weather conditions; as a corollary to this, the data can be interpreted to indicate the amount of spare capacity during peak flows. This is calculated by taking a ratio of a modelled flow in a pipe and its corresponding capacity. Pipes with ratios higher than one are considered to have no spare capacity, thus indicating a section of trunk that might require upgrading, particularly where the length of the section is long enough to cause surcharge conditions immediately in the upstream reach.

Hence, the Maximum HGL Elevation Relative to the Ground with a value of:

- Greater than 0.0 m is denoted as a red dot – indicating a surcharge/back-up to surface;
- Between -1.5 m and 0.0 m is denoted as an orange dot – maximum HGL is within the ground surface and 1.5 m deep indicating the basement flooding is likely;
- Between -2.5 m and -1.5 m is denoted as a yellow dot – maximum HGL peaks between 1.5 and 2.5 meters below the ground indicating possible basement back-ups; and
- Less than -2.5 m is denoted as a blue dot – maximum HGL peaks below 2.5 meters below the ground.

Likewise, the Peak Discharge Relative to Pipe Capacity with a ratio of:

- Greater than 1.5 is denoted as a red line – there is no spare capacity, and the pipe is likely experiencing significant surcharge conditions;
- Between 1.0 and 1.5 is denoted as an orange line – there is no spare capacity, and the pipe is likely experiencing some minor to moderate surcharge conditions;
- Between 0.8 and 1.0 is denoted as a yellow line – less than 20% of spare capacity available; and
- Less than 0.8 is denoted as a blue line – spare capacity available.

Both relationships should be looked at in conjunction to pinpoint any potential capacity deficiencies in the system. For example:

- The ***Maximum HGL Elevation Relative to the Ground*** with a value that is between -1.5 m and 0.0m (an orange dot) may indicate a location with a possible basement back-up, however the Peak Discharge Relative to Pipe Capacity ratio at the same location could have a value of less than 0.8 (a blue line), indicating the pipe is not surcharged. This could suggest a relatively shallow sewer.

6.2 ACRWC Operating Conditions

For the existing system assessment, the diversion structure has been assumed to operate at the following conditions during WWF:

1. The East Gate will be closed assuming no additional flow is allowed downstream to the PLPS;
2. The North Gate will be opened to allow WWF to spill northwards towards the lagoon for WWF storage;
3. The East Gate overflow weir will be set at the maximum allowable elevation of 661.245 m to protect Spruce Grove against basement flooding; and
4. The North Gate overflow weir will be set to 660.500 m and is based on design drawings from the ISL preliminary design report and detailed design report by Stantec.

6.3 Existing System Performance During a 25-Year, 24-Hour Design Storm

The results of the existing system analysis during the 25-year design storm are shown on **Figures 6.3** for pipe capacity utilization. For more details regarding the existing system analysis, see **Appendix C** for additional HGL profiles along major trunks within the City.

Notes regarding the 25-year existing system performance are shown below:

1. The upstream ACRWC Parkland Trunk (upstream of the recently upgraded 1,350 mm trunk) is nearing capacity and there is some surcharging within the sewers within 1.5 – 2.5 m of the ground surface. While the trunk is shallow in this location, the trunk itself is showing capacity utilization in range of 80% to over 150%, which implies that certain branches are over capacity.
2. Both the west and east diversion sewers are nearing capacity during a 25-year event and the west diversion surcharges to within 1.5 m of the ground surface during a 25-year event. This location of surcharging is within an undeveloped field in between Township Road 532A and Parkland Village.
3. During the 25-year event, the overflow weir to the east is overtopped and flows continue downstream towards the PLPS.
4. The commercial area northeast of the intersection of Highway 16A and Calahoo Road shows shallow sewers are present in the area, but the sewers themselves have sufficient capacity and the flows are contained within the pipe.
5. The Central Trunk from Agrena Road to Brookwood Drive is nearing capacity during a 25-year design event but the flows remain contained within the trunk.

OUTLET TO SPRUCE GROVE LAGOONS.

WEST DIVERSION DOES NOT HAVE SUFFICIENT CAPACITY AND SURCHARGES WITHIN 1.5 m OF THE GROUND SURFACE.

DIVERSION STRUCTURE OPERATING PHILOSOPHY:
1. 1,200 mm X 1,200 mm GATE TO PLPS CLOSED.
2. 600 mm X 600 mm GATE TO LAGOON OPEN.
3. OVERFLOW WEIR TO PLPS SET TO 661.245 m (MAX ALLOWABLE ELEVATION).
4. OVERFLOW WEIR TO LAGOON SET TO 660.500 m.

ACRWC PARKLAND TRUNK CONTINUES TO PARKLAND LIFT STATION.

OVERFLOW WEIR MAXIMUM ELEVATION IS EXCEEDED AND SPILLS TOWARDS PLPS.

UPSTREAM PARKLAND TRUNK IS NEARING CAPACITY AND SURCHARGES SLIGHTLY. THE TRUNK IS SHALLOW IN THIS LOCATION.

FIGURE 6.6: OATWAY, BRISTOW & KING PROFILE

FIGURE 6.5: WINDERMERE PROFILE

SHALLOW SEWER IN THIS LOCATION.

SHALLOW SEWERS ARE PRESENT IN THIS COMMERCIAL AREA BUT THE SEWERS DO NOT SURCHARGE.

CENTRAL TRUNK IS NEARING CAPACITY ALONG KING STREET FROM AGRENA ROAD TO SOUTH OF BROOKSIDE AVENUE.

Legend

Existing Manholes

Depth to HGL (m)

- Flooding to Surface
- 0 < HGL <= 1.5 m Deep
- 1.5 m < HGL <= 2.5 m Deep
- HGL > 2.5 m Deep
- Outfalls

Existing Sewers

Max Flow / Capacity Ratio (Q/Cap)

- Q/Cap <= 0.8
- 0.8 < Q/Cap <= 1.0
- 1.0 < Q/Cap <= 1.5
- Q/Cap > 1.5
- Municipal Boundary

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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

25-YEAR, 24-HOUR EXISTING SYSTEM MODELING RESULTS - LAGOON WWF STORAGE

FIGURE 6.3

1:30,000

0 195 390 780 1,170 1,560 Meters

6.4 Existing System Performance During a 100-Year, 24-Hour Design Storm

The results of the existing system analysis during the 100-year design storm are shown on **Figures 6.4** for pipe capacity utilization. For more details regarding the existing system analysis, see **Appendix C** for additional HGL profiles along major trunks within the City.

Notes regarding the 100-year existing system performance are shown below:

1. There is surcharging within 1.5 m of the ground surface along Windermere Drive during a 100-year event (shown in profile below). The Windermere Drive sewer has a level of service greater than the 25-year event; but less than the 100-year event.
2. Due to heavy surcharging in the Central Trunk along King Street between Agrena Road and Brookwood Drive, there is upstream surcharging (King's Street Mall parking lot and Oatway Street) and flooding to the ground surface (along Bristow Crescent). This shows that the Central Trunk has a level of service somewhere between a 25-year and 100-year event.
3. The upstream Parkland Trunk is surcharging within 1.5 m of the ground surface. While the trunk is shallow in this location, the trunk itself is showing capacity utilization in range of 80% to over 150% showing that certain branches are over capacity.
4. The west and east diversion sewers surcharge during the 100-year event and the west diversion trunk floods to the ground surface within the undeveloped field between Township Road 532A and Parkland Village.
5. During the 100-year event, the overflow weir to the east is overtopped and flows continue downstream towards the PLPS.

Profiles have been prepared to show the two locations of surcharging within Spruce Grove:

1. **Figure 6.5**: Existing 200 mm sewer along Windermere Crescent.
2. **Figure 6.6**: Existing 200 – 300 mm local sewer along Oatway Street and Bristow Crescent and the 375 mm existing trunk along King Street (from Agrena Street to just south of Brookside Avenue).

As a final check, both gates were closed assuming the diversion structure fails to determine the impact on the upstream Spruce Grove trunks during a 25-year design event. The max flow over capacity and depth to maximum HGL is shown for this scenario on **Figure 6.7**. Since the overflow weir to the PLPS is overtopped during all scenarios, the gates failing does not worsen the conditions in the model since flows are already by-passing the limited capacity of the diversion sewers and the 600 x 600 mm gate to the lagoon.

OUTLET TO SPRUCE GROVE LAGOONS.

WEST DIVERSION DOES NOT HAVE SUFFICIENT CAPACITY AND FLOODS TO THE GROUND SURFACE.

DIVERSION STRUCTURE OPERATING PHILOSOPHY:
1. 1,200 mm X 1,200 mm GATE TO PLPS CLOSED.
2. 600 mm X 600 mm GATE TO LAGOON OPEN.
3. OVERFLOW WEIR TO PLPS SET TO 661.245 m (MAX ALLOWABLE ELEVATION).
4. OVERFLOW WEIR TO LAGOON SET TO 660.500 m.

CURRENT DIVERSION STRUCTURE CAUSES BACKWATER CONDITIONS IN TWINNED PARKLAND TRUNK SECTIONS.

ACRWC PARKLAND TRUNK CONTINUES TO PARKLAND LIFT STATION.

OVERFLOW WEIR MAXIMUM ELEVATION IS EXCEEDED AND SPILLS TOWARDS PLPS.

UPSTREAM PARKLAND TRUNK IS NEARING CAPACITY AND SURCHARGES SLIGHTLY. THE TRUNK IS SHALLOW IN THIS LOCATION.

FIGURE 6.6: OATWAY, BRISTOW & KING PROFILE

FIGURE 6.5: WINDERMERE PROFILE

COMBINATION OF SHALLOW SEWERS (<2.5 m DEEP) AND MINOR SURCHARGING IN THE PIPE. THE DEPTH TO PEAK HGL REACHES 1.5 m BELOW GRADE.

SURCHARGING WITHIN 1.5 m OF GROUND SURFACE ALONG WINDERMERE DRIVE.

FLOODING TO THE GROUND SURFACE WITHIN RESIDENTIAL NEIGHBOURHOOD ALONG BRISTOW CRESCENT CAUSED BY SURCHARGING IN CENTRAL TRUNK ALONG KING STREET FROM AGRENA ROAD TO SOUTH OF BROOKSIDE AVENUE.

Legend

Existing Manholes

Depth to HGL (m)

- Flooding to Surface
- 0 < HGL <= 1.5 m Deep
- 1.5 m < HGL <= 2.5 m Deep
- HGL > 2.5 m Deep
- Outfalls

Existing Sewers

Max Flow / Capacity Ratio (Q/Cap)

- Q/Cap <= 0.8
- 0.8 < Q/Cap <= 1.0
- 1.0 < Q/Cap <= 1.5
- Q/Cap > 1.5
- Municipal Boundary

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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

100-YEAR, 24-HOUR EXISTING SYSTEM MODELING RESULTS - LAGOON WWF STORAGE

FIGURE 6.4

1:30,000

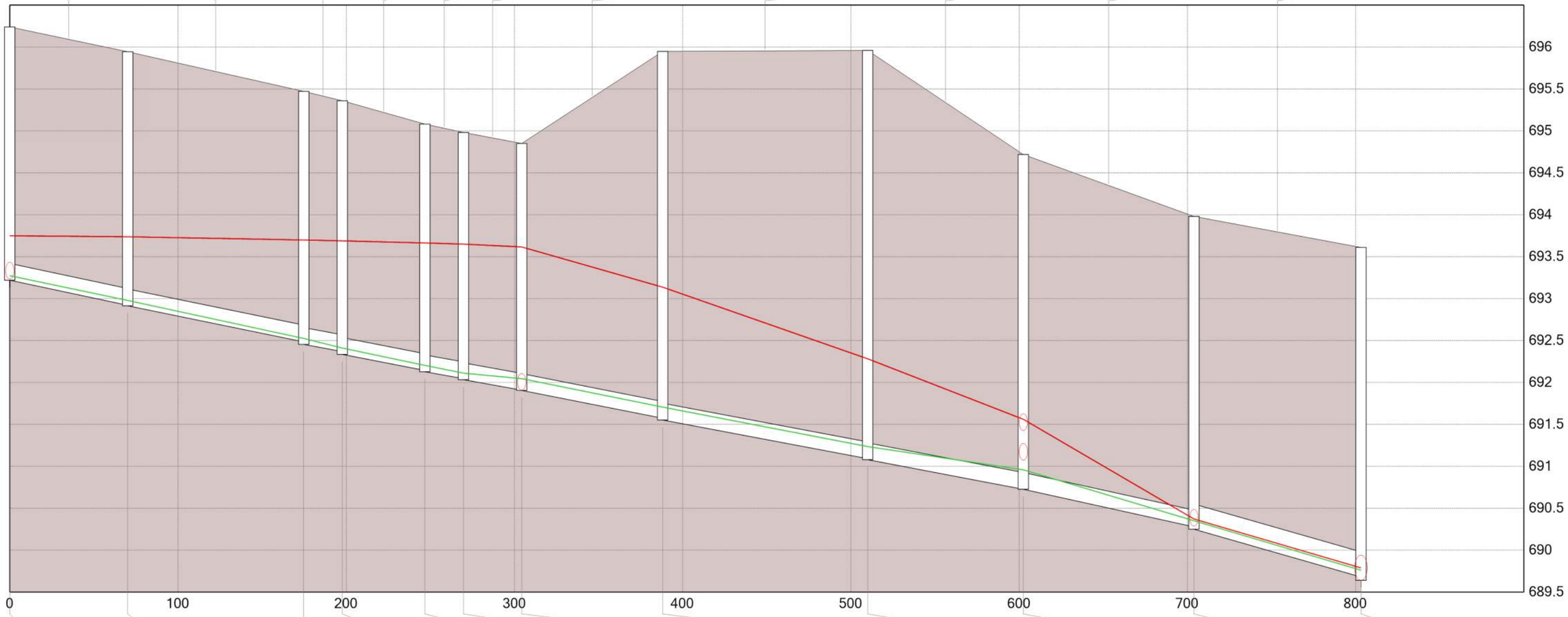
0 195 390 780 1,170 1,560 Meters

Sewer Along Windermere Drive

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H — Spruce Grove Existing System Assessment 25Y24H — Peak values

Links:	P-MH-660	P-MH-659	P-MH-658	P-MH-657	P-MH-656	P-MH-655	P-MH-654	P-MH-653	P-MH-700	P-MH-699	P-MH-698
	L=70.078 m	L=104.65 m	L=22.941 m	L=49.054 m	L=22.976 m	L=34.599 m	L=83.788 m	L=121.874 m	L=92.51 m	L=101.419 m	L=99.286 m
	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.3 m
	S=0.00427 m/m	S=0.00411 m/m	S=0.00375 m/m	S=0.00391 m/m	S=0.00361 m/m	S=0.00361 m/m	S=0.00396 m/m	S=0.00378 m/m	S=0.00382 m/m	S=0.00442 m/m	S=0.00574 m/m
	I1=693.219 m	I1=692.914 m	I1=692.454 m	I1=692.335 m	I1=692.128 m	I1=692.033 m	I1=691.905 m	I1=691.552 m	I1=691.079 m	I1=690.726 m	I1=690.25 m
	I2=692.92 m	I2=692.484 m	I2=692.368 m	I2=692.143 m	I2=692.045 m	I2=691.908 m	I2=691.573 m	I2=691.091 m	I2=690.726 m	I2=690.278 m	I2=689.68 m



Nodes:	MH-660	MH-659	MH-658	MH-657	MH-656	MH-655	MH-654	MH-653	MH-700	MH-699	MH-698	MH-697
	M=693.7491 m	M=693.7371 m	M=693.6986 m	M=693.6883 m	M=693.6633 m	M=693.6494 m	M=693.6157 m	M=693.1361 m	M=692.2818 m	M=691.5606 m	M=690.3716 m	M=689.7883 m
	R=696.239 m	R=695.944 m	R=695.471 m	R=695.359 m	R=695.081 m	R=694.981 m	R=694.85 m	R=695.947 m	R=695.959 m	R=694.718 m	R=693.98 m	R=693.61 m
	I=693.219 m	I=692.914 m	I=692.454 m	I=692.335 m	I=692.128 m	I=692.033 m	I=691.905 m	I=691.552 m	I=691.079 m	I=690.726 m	I=690.25 m	I=689.64 m

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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

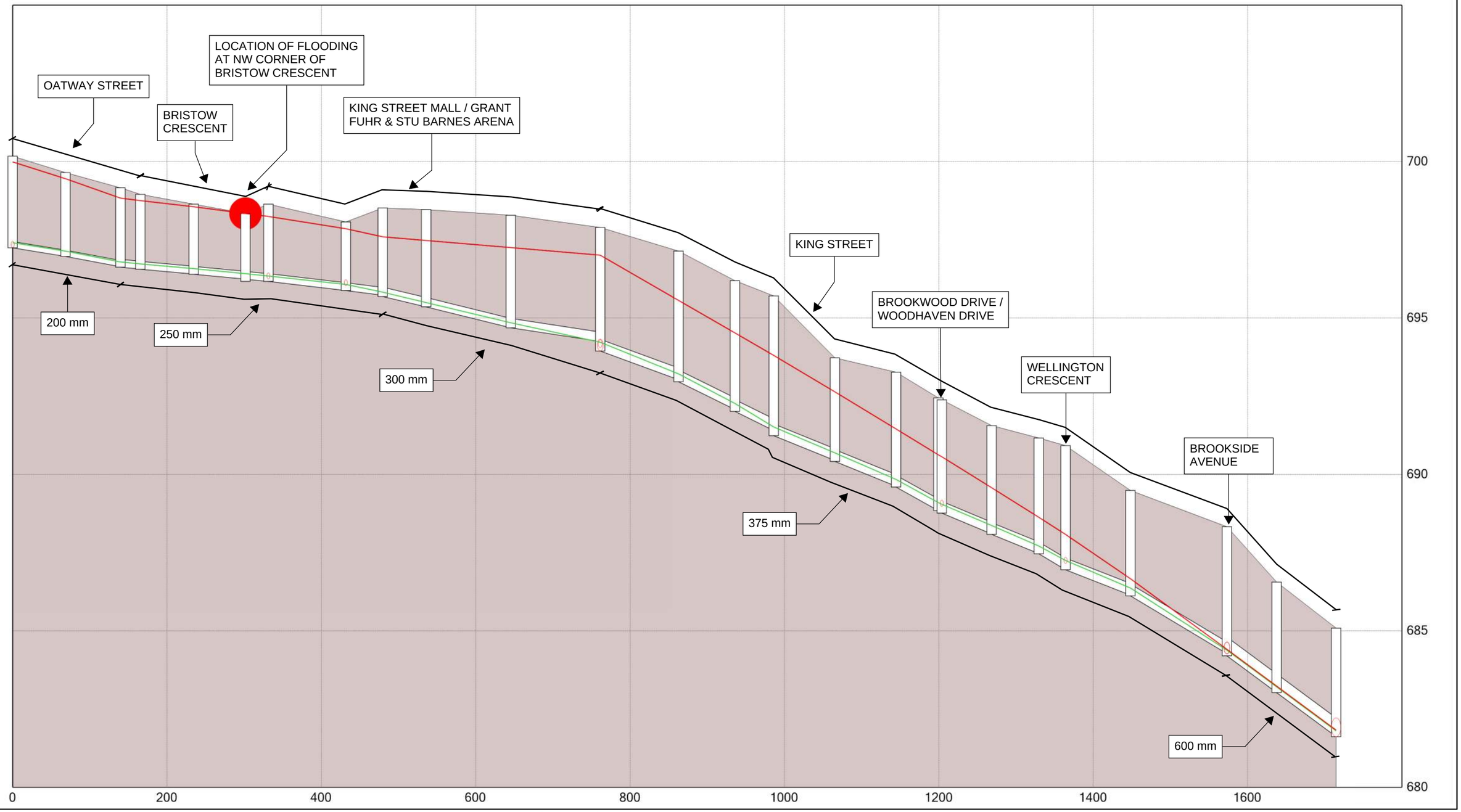
EXISTING SYSTEM PROFILE ALONG WINDERMERE DRIVE

FIGURE 6.5

Sewer Along Oatway Street, Bristow Crescent, then King Street

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H — Spruce Grove Existing System Assessment 25Y24H — Peak values



SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

EXISTING SYSTEM PROFILE ALONG OATWAY CRESCENT, BRISTOW CRESCENT, AND KING STREET

FIGURE 6.6

OUTLET TO SPRUCE GROVE LAGOONS.

WEST DIVERSION DOES NOT HAVE SUFFICIENT CAPACITY AND FLOODS TO THE GROUND SURFACE.

DIVERSION STRUCTURE OPERATING PHILOSOPHY:
1. 1,200 mm X 1,200 mm GATE TO PLPS **CLOSED (FAILURE)**.
2. 600 mm X 600 mm GATE TO LAGOON **CLOSED (FAILURE)**.
3. OVERFLOW WEIR TO PLPS SET TO 661.245 m (MAX ALLOWABLE ELEVATION).
4. OVERFLOW WEIR TO LAGOON SET TO 660.500 m.

CURRENT DIVERSION STRUCTURE CAUSES BACKWATER CONDITIONS IN TWINNED PARKLAND TRUNK SECTIONS.

ACRWC PARKLAND TRUNK CONTINUES TO PARKLAND LIFT STATION.

OVERFLOW WEIR MAXIMUM ELEVATION IS EXCEEDED AND SPILLS TOWARDS PLPS.

UPSTREAM PARKLAND TRUNK IS NEARING CAPACITY AND SURCHARGES SLIGHTLY. THE TRUNK IS SHALLOW IN THIS LOCATION.

FIGURE 6.6: OATWAY, BRISTOW & KING PROFILE

FIGURE 6.5: WINDERMERE PROFILE

COMBINATION OF SHALLOW SEWERS (<2.5 m DEEP) AND MINOR SURCHARGING IN THE PIPE. THE DEPTH TO PEAK HGL REACHES 1.5 m BELOW GRADE.

SURCHARGING WITHIN 1.5 m OF GROUND SURFACE ALONG WINDERMERE DRIVE.

FLOODING TO THE GROUND SURFACE WITHIN RESIDENTIAL NEIGHBOURHOOD ALONG BRISTOW CRESCENT CAUSED BY SURCHARGING IN CENTRAL TRUNK ALONG KING STREET FROM AGRENA ROAD TO SOUTH OF BROOKSIDE AVENUE.

Legend

Existing Manholes

Depth to HGL (m)

- Flooding to Surface
- 0 < HGL <= 1.5 m Deep
- 1.5 m < HGL <= 2.5 m Deep
- HGL > 2.5 m Deep
- Outfalls

Existing Sewers

Max Flow / Capacity Ratio (Q/Cap)

- Q/Cap <= 0.8
- 0.8 < Q/Cap <= 1.0
- 1.0 < Q/Cap <= 1.5
- Q/Cap > 1.5
- Municipal Boundary

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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

100-YEAR, 24-HOUR EXISTING SYSTEM MODELING RESULTS - DIVERSION GATES FAIL

FIGURE 6.7

1:30,000

0 195 390 780 1,170 1,560 Meters

6.5 Proposed Upgrades for Existing System Performance

Based on the results in Sections 6.3 and 6.4, no upgrading is required for the 25-year design event. However, if considering the 100-year event as a level of service, then two upgrades are shown on **Figure 6.8** for consideration and are summarized below:

1. Upgrading 101 m of 200 mm sewer into 300 mm sewer along Windermere Crescent.
2. To improve the surcharging and flooding to ground surface within Bristow Crescent, two segments of upgrading were considered on the Central Trunk along King Street:
    a. Upgrading 174 m of 375 mm sewer into 600 mm sewer directly downstream of the King Street Mall parking lot sewer when it turns north onto King Street; and
    b. Upgrading 180 m of 375 mm sewer into 600 mm sewer near Brookwood Park / Wellington Crescent.

The HGL profiles comparing the 25-year existing system, 100-year existing system, and 100-year upgraded systems are shown on **Figures 6.9** and **6.10** for Windermere Drive and Oatway Street / Bristow Crescent / King Street, respectively.

300 mm

WINDERMERE
POTENTIAL UPGRADE:
101 m of 300 mm

600 mm

600 mm

KING ST POTENTIAL
UPGRADE #1:
180 m OF 600 mm

600 mm

600 mm

KING ST POTENTIAL
UPGRADE #2:
174 m OF 600 mm

KEY MAP

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Potential Upgrading Locations

Upgraded System Manholes

Depth to HGL (m)

- Flooding to Surface
- 0 < HGL <= 1.5 m Deep
- 1.5 m < HGL <= 2.5 m Deep
- HGL > 2.5 m Deep
- Outfalls

Upgraded System Sewers

Max Flow / Capacity Ratio (Q/Cap)

- Q/Cap <= 0.8
- 0.8 < Q/Cap <= 1.0
- 1.0 < Q/Cap <= 1.5
- Q/Cap > 1.5
- Municipal Boundary

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

100-YEAR, 24-HOUR EXISTING SYSTEM
POTENTIAL UPGRADING LOCATIONS

FIGURE 6.8

1:5,000

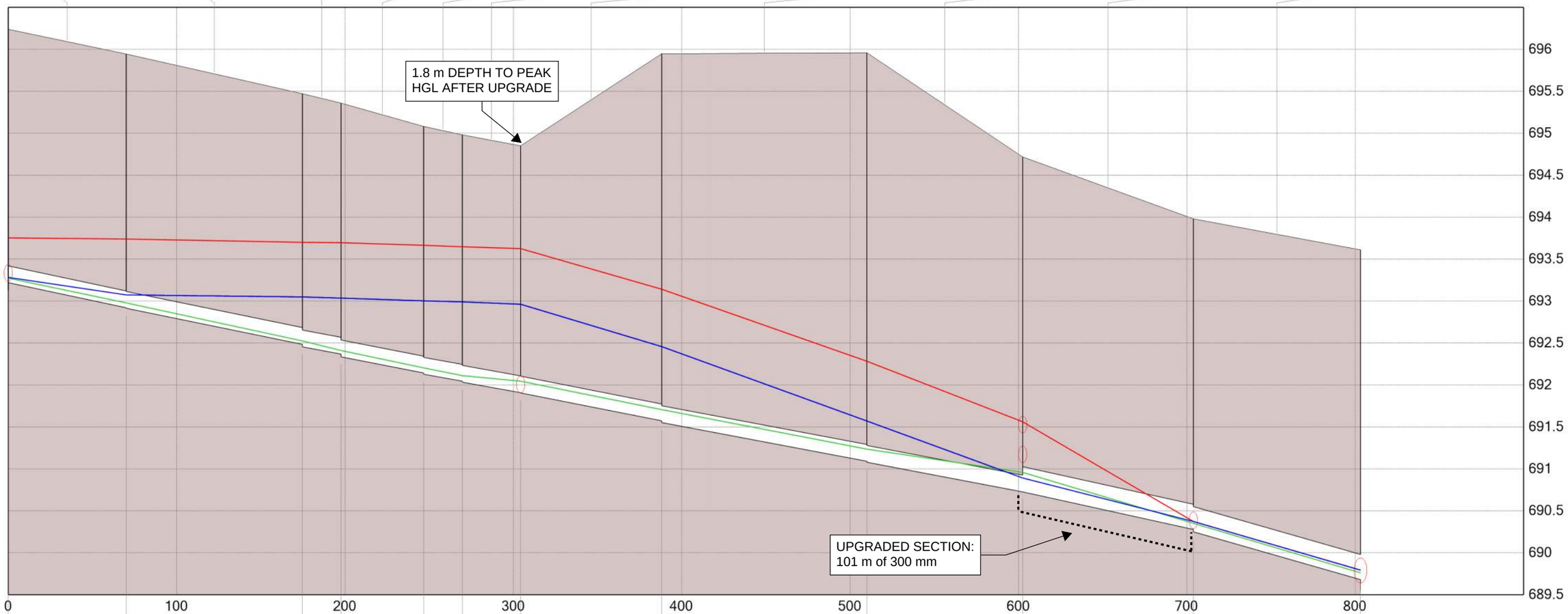
0 30 60 120 180 240 Meters

Sewer Along Windermere Drive

Upgraded System Modeling Results

Spruce Grove Existing System Upgrades 100Y24H — Spruce Grove Existing System Assessment 25Y24H — Spruce Grove Existing System Assessment 100Y24H — Peak values

Links:	P-MH-660	P-MH-659	P-MH-658	P-MH-657	P-MH-656	P-MH-655	P-MH-654	P-MH-653	P-MH-700	P-MH-699	P-MH-698
	L=70.078 m	L=104.65 m	L=22.941 m	L=49.054 m	L=22.976 m	L=34.599 m	L=83.788 m	L=121.874 m	L=92.51 m	L=101.419 m	L=99.286 m
	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.3 m	D=0.3 m
	S=0.00427 m/m	S=0.00411 m/m	S=0.00375 m/m	S=0.00391 m/m	S=0.00361 m/m	S=0.00361 m/m	S=0.00396 m/m	S=0.00378 m/m	S=0.00382 m/m	S=0.00442 m/m	S=0.00574 m/m
	I1=693.219 m	I1=692.914 m	I1=692.454 m	I1=692.335 m	I1=692.128 m	I1=692.033 m	I1=691.905 m	I1=691.552 m	I1=691.079 m	I1=690.726 m	I1=690.25 m
	I2=692.92 m	I2=692.484 m	I2=692.368 m	I2=692.143 m	I2=692.045 m	I2=691.908 m	I2=691.573 m	I2=691.091 m	I2=690.726 m	I2=690.278 m	I2=689.68 m



Nodes:	MH-660	MH-659	MH-658	MH-657	MH-656	MH-655	MH-654	MH-653	MH-700	MH-699	MH-698	MH-697
	M=693.282 m	M=693.0729 m	M=693.0491 m	M=693.035 m	M=693.0023 m	M=692.9903 m	M=692.9619 m	M=692.457 m	M=691.5704 m	M=690.8914 m	M=690.3731 m	M=689.7938 m
	R=696.239 m	R=695.944 m	R=695.471 m	R=695.359 m	R=695.081 m	R=694.981 m	R=694.85 m	R=695.947 m	R=695.959 m	R=694.718 m	R=693.98 m	R=693.61 m
	I=693.219 m	I=692.914 m	I=692.454 m	I=692.335 m	I=692.128 m	I=692.033 m	I=691.905 m	I=691.552 m	I=691.079 m	I=690.726 m	I=690.25 m	I=689.64 m

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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

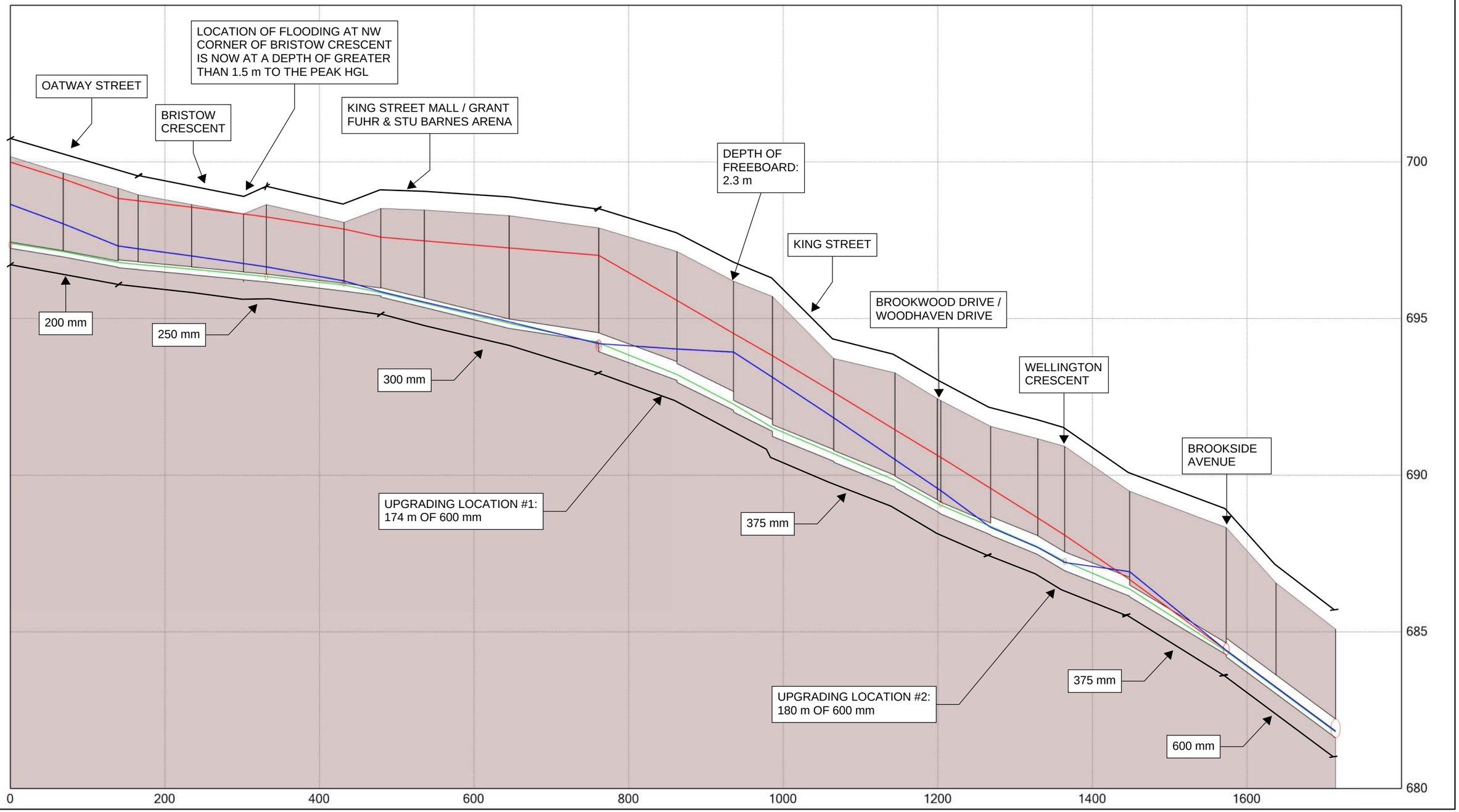
UPGRADED SYSTEM PROFILE ALONG WINDERMERE DRIVE

FIGURE 6.9

Sewer Along Oatway Street, Bristow Crescent, then King Street

Upgraded System Modeling Results

Spruce Grove Existing System Upgrades 100Y24H — Spruce Grove Existing System Assessment 25Y24H — Spruce Grove Existing System Assessment 100Y24H — Peak values



SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

UPGRADED SYSTEM PROFILE ALONG OATWAY CRESCENT, BRISTOW CRESCENT, AND KING STREET

FIGURE 6.10

7.0 Future Sanitary Sewer Assessment

7.1 Future System Model Build and Assumptions

The future system model assumes the growth plan that is summarized in **Section 3.0** and in **Appendix A**. In addition to growth within the City of Spruce Grove, it is assumed that Stony Plain will continue to develop. Based on growth projections from the Parkland Sanitary Trunk Upgrade project, the upstream boundary condition in the model has been updated to reflect future growth in Stony Plain during a 25-year, 24-hour design event. A 25-year design storm is used since this is the standard design criteria for the evaluation of sanitary sewers. The future 2055 Stony Plain 25-year WWF boundary condition is shown on **Figure 7.1** and is based on the 2016 Parkland Gravity Sewer (PLGS) Upgrades and Lagoon Diversion Structure Concept Design Report. This boundary condition is considered conservative as the ACRWC are encouraging its member municipalities to reduce I/I.

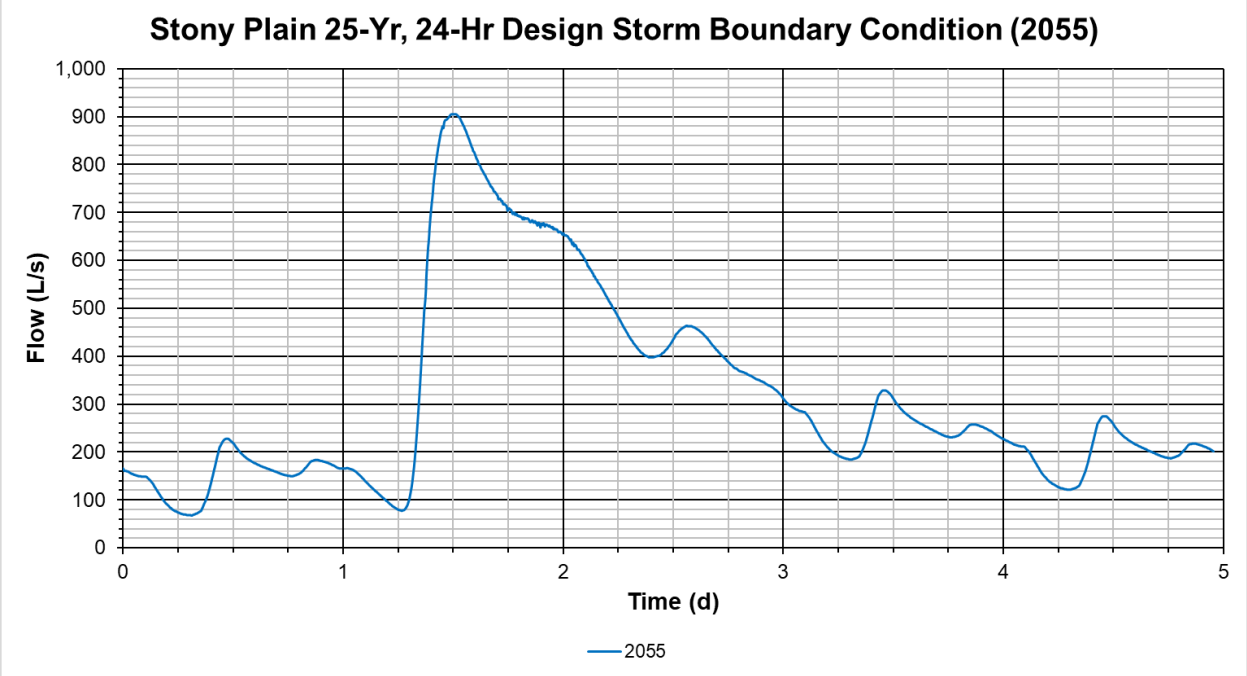


Figure 7.1: Stony Plain Future 25-Year, 24-Hour Wet Weather Flow Boundary Condition

As part of the future system analysis, it is known that the Parkland Trunk will be upgraded as needed in the future to protect homes in Spruce Grove against basement flooding. There are a few locations in the future system modeling where Parkland Trunk upgrades are assumed:

1. The Parkland Trunk has been upgraded to 1,350 mm from the boundary of Stony Plain to the existing 1,350 mm Parkland Trunk along Jennifer Heil Way;
2. The Parkland Trunk has been upgraded from 1,050 mm to 1,500 mm downstream of the existing 750 mm and 1,200 mm twinning, in between the west diversion and east diversion trunks; and
3. The west and east diversion trunks have both been upgraded to 1,200 mm.

It should be noted that these three upgrades are conceptual and are subject to further refinement. The upgrades protect both Parkland and City trunks from excessive surcharging and backwater conditions as well as reducing the amount of wastewater spilling over the weir towards the PLGS during WWF conditions. The locations of these conceptual upgrades are shown on **Figure 7.2**.
Evaluation of the future system has considered two potential scenarios:

1. Future development up to the current Spruce Grove municipal boundary which included the recently annexed lands; and
2. Consideration of potential future City or County development south to Highway 628 that could be serviced via existing and proposed Spruce Grove trunks.

It should be noted that Scenario #2 considers potential future development by either the County or the City outside of the existing municipal boundary which would be serviced through proposed City trunks. Intermunicipal servicing of this nature is in theme with the Tri-Municipal Regional Study which is why it has been included within this master plan for consideration.

The sewersheds and their servicing connections, and the proposed pipe diameters required to service future growth for both scenarios is summarized on **Figures 7.2** and **7.3**, respectively. In both figures, the network is shown all the way to Highway 628, which is not required if only considering development up to the municipal boundary. In that case, the proposed trunks can terminate at the furthest upstream sewershed connection. It was assumed that future sewers and trunk would be PVC (with an assumed roughness of 0.009 which was carried over from the 2012 model).

It is assumed that the proposed existing system upgrades are pursued in the future system models. Since these upgrades are local and not along any of the major trunks that service future growth, these upgrades will not impact the capacity of future trunks to service growth.

7.2 Criteria for Future System Assessment

The future sewers and trunks within Spruce Grove have been evaluated based on the following criteria:

1. No significant surcharging within future sewers / trunks during the 25-year, 24-hour design storm; and
2. No surcharging within 1.5 m of ground during the 100-year, 24-hour design storm.

It was assumed that some minor surcharging during the 100-year design event would be considered acceptable assuming that the risk of basements flooding is low. The figures in the following sections use the same system capacity symbology as defined in **Section 6.1**.

The future Spruce Grove sanitary network is shown in detail in **Appendix D**, and includes:

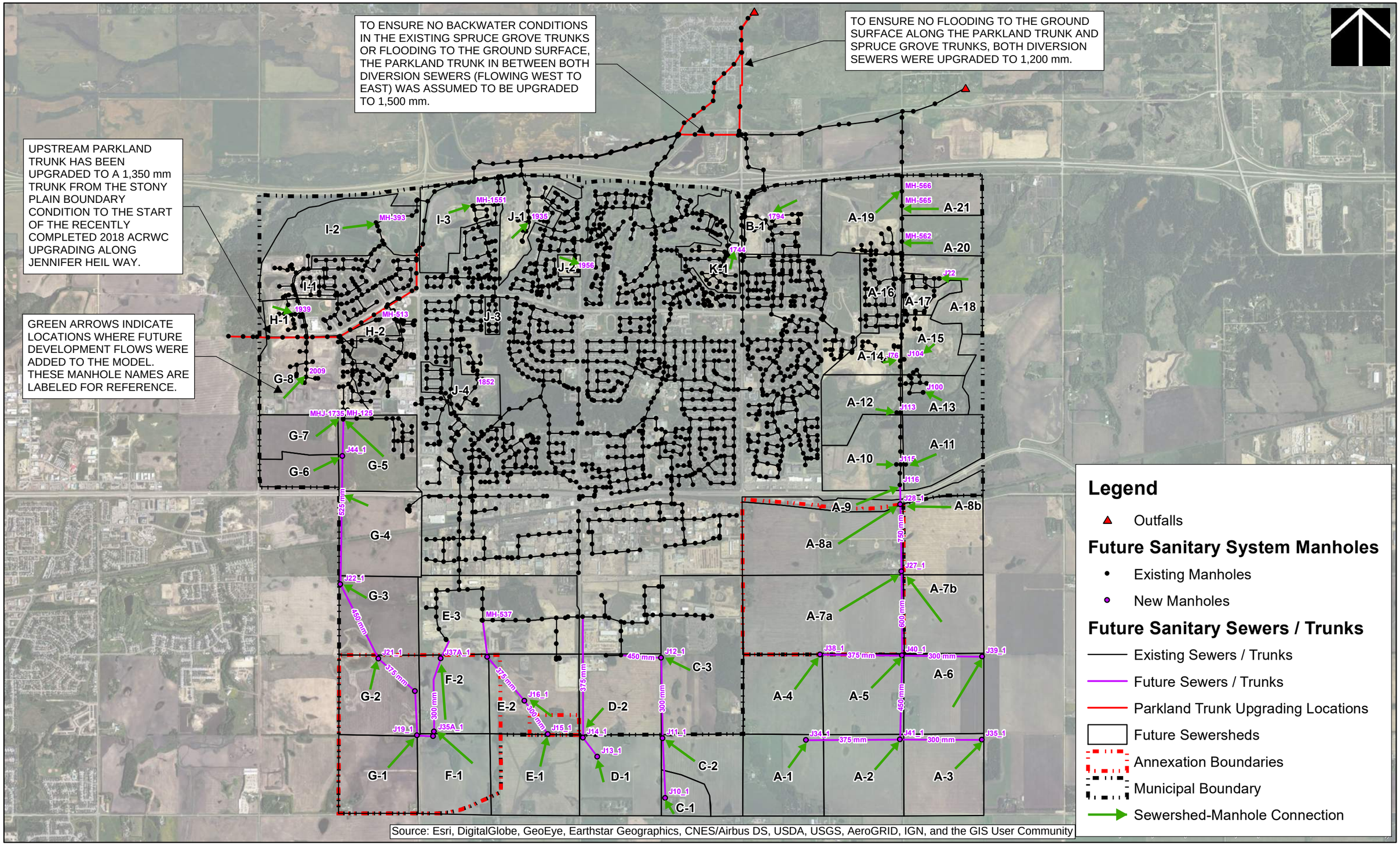
- A plan view map with annotated inverts, rim elevations and manhole names; and
- Profiles of the future Boundary Trunk and Pioneer Trunk.

TO ENSURE NO BACKWATER CONDITIONS IN THE EXISTING SPRUCE GROVE TRUNKS OR FLOODING TO THE GROUND SURFACE, THE PARKLAND TRUNK IN BETWEEN BOTH DIVERSION SEWERS (FLOWING WEST TO EAST) WAS ASSUMED TO BE UPGRADED TO 1,500 mm.

TO ENSURE NO FLOODING TO THE GROUND SURFACE ALONG THE PARKLAND TRUNK AND SPRUCE GROVE TRUNKS, BOTH DIVERSION SEWERS WERE UPGRADED TO 1,200 mm.

UPSTREAM PARKLAND TRUNK HAS BEEN UPGRADED TO A 1,350 mm TRUNK FROM THE STONY PLAIN BOUNDARY CONDITION TO THE START OF THE RECENTLY COMPLETED 2018 ACRWC UPGRADING ALONG JENNIFER HEIL WAY.

GREEN ARROWS INDICATE LOCATIONS WHERE FUTURE DEVELOPMENT FLOWS WERE ADDED TO THE MODEL. THESE MANHOLE NAMES ARE LABELED FOR REFERENCE.



Legend

- Outfalls

Future Sanitary System Manholes

- Existing Manholes
- New Manholes

Future Sanitary Sewers / Trunks

- Existing Sewers / Trunks
- Future Sewers / Trunks
- Parkland Trunk Upgrading Locations
- Future Sewersheds
- Annexation Boundaries
- Municipal Boundary
- Sewershed-Manhole Connection

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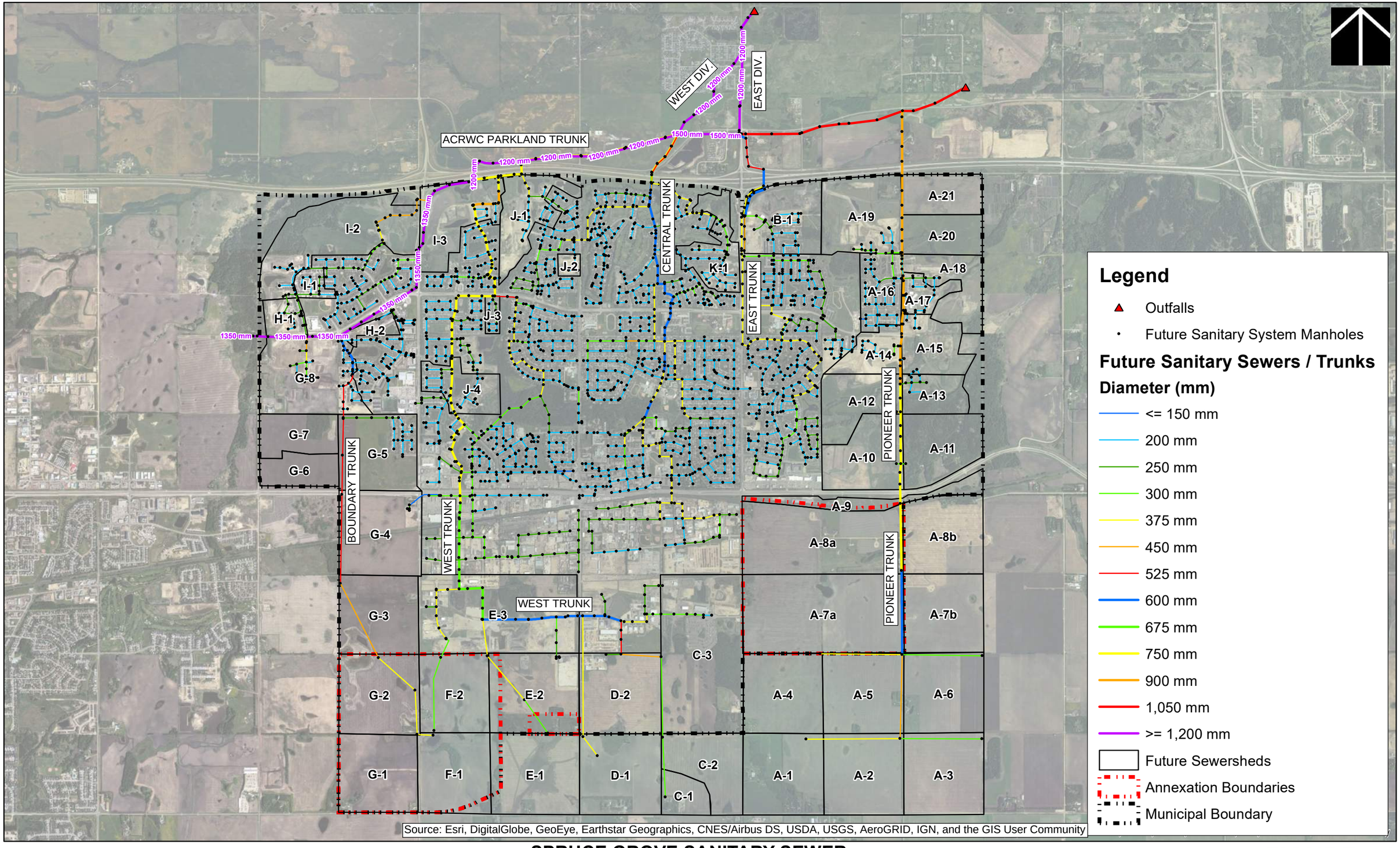
SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

FUTURE SYSTEM MODEL LAYOUT, SEWERSHEDS AND PARKLAND TRUNK UPGRADES

FIGURE 7.2

1:35,000

0 225 450 900 1,350 1,800 Meters



Legend

- Outfalls
- Future Sanitary System Manholes

Future Sanitary Sewers / Trunks

Diameter (mm)

- <= 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- 675 mm
- 750 mm
- 900 mm
- 1,050 mm
- >= 1,200 mm

- Future Sewersheds
- Annexation Boundaries
- Municipal Boundary

SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

FUTURE SANITARY SEWER SYSTEM DIAMETERS

FIGURE 7.3

1:35,000

0 225 450 900 1,350 1,800 Meters

7.3 Future System Performance During a 25-Year, 24-Hour Design Storm

7.3.1 Future Development Up to the Existing Municipal Boundary

The results of the future system analysis up to the municipal boundary during the 25-year design storm are shown on **Figure 7.4**.

Notes regarding the 25-year existing system performance are shown below:

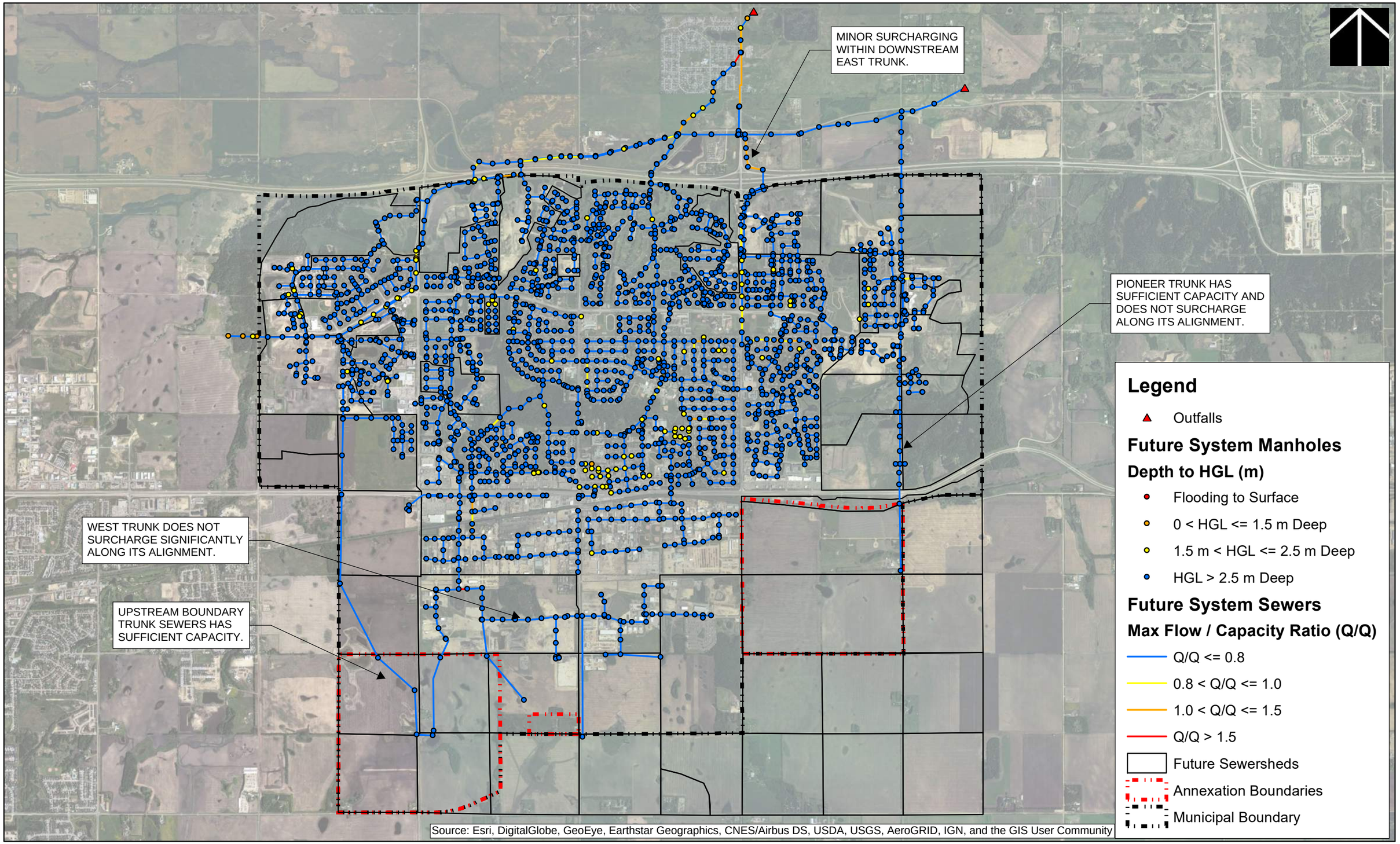
1. New development within the annexation areas and the areas south of the existing industrial development show no negative impacts to the Boundary Trunk, West Trunk, or Pioneer Trunk systems.
2. The upstream end of the Boundary trunk is shown to have sufficient capacity during the 25-year design storm. It should be noted that the growth plan is conservative and using 300 L/c/d and 0.2 L/s/ha is likely higher than what will be experienced in this trunk.
3. The West Trunk has sufficient capacity to convey the increase in flows from future development. The depth to the peak HGL remains deeper than 2.5 m below ground surface implying there is minimal risk of basement flooding.
4. Similarly, the Pioneer Trunk is adequately sized to handle the increase in flows from the east annexation area and the peak HGL remains deeper than 2.5 m along the entire trunk alignment.

7.3.2 Future Development Including County Lands South to Highway 628

The results of the future system analysis, including development of County land south to Highway 628, during the 25-year design storm are shown on **Figure 7.5**.

Notes regarding the 25-year existing system performance are shown below:

1. The West Trunk does not experience significant surcharging with the addition of future growth beyond the current municipal boundaries. In total, there are approximately three additional quarter sections being serviced by the West Trunk.
2. Most of the future development beyond the municipal boundary south to Highway 628 would be serviced by the Pioneer Trunk, which is shown to be adequately sized for this level of growth during a 25-year design event. There are a few trunk segments north of Highway 16A that are within 20% of the design capacity; however, the peak HGL remains deeper than 2.5 m below the ground surface during the simulation implying a low risk of basement flooding.



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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

25-YEAR, 24-HOUR FUTURE SYSTEM MODELING RESULTS - UP TO MUNICIPAL BOUNDARY

FIGURE 7.4

1:35,000

0 225 450 900 1,350 1,800 Meters

MINOR SURCHARGING WITHIN DOWNSTREAM EAST TRUNK.

SOME TRUNKS ALONG THE PIONEER TRUNK ARE WITHIN 20% OF DESIGN CAPACITY.

WEST TRUNK DOES NOT SURCHARGE SIGNIFICANTLY ALONG ITS ALIGNMENT.

UPSTREAM BOUNDARY TRUNK SEWERS HAS SUFFICIENT CAPACITY.

Legend

- Outfalls

Future System Manholes

Depth to HGL (m)

- Flooding to Surface
- 0 < HGL <= 1.5 m Deep
- 1.5 m < HGL <= 2.5 m Deep
- HGL > 2.5 m Deep

Future System Sewers

Max Flow / Capacity Ratio (Q/Q)

- Q/Q <= 0.8
- 0.8 < Q/Q <= 1.0
- 1.0 < Q/Q <= 1.5
- Q/Q > 1.5
- Future Sewersheds
- Annexation Boundaries
- Municipal Boundary

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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

25-YEAR, 24-HOUR FUTURE SYSTEM MODELING RESULTS - INCLUDING COUNTY LAND TO HWY 628

FIGURE 7.5

1:35,000

0 225 450 900 1,350 1,800 Meters

7.4 Future System Performance During a 100-Year, 24-Hour Design Storm

7.4.1 Future Development Up to the Existing Municipal Boundary

The results of the future system analysis up to the municipal boundary during the 100-year design storm are shown on **Figure 7.6**.

Notes regarding the 100-year existing system performance are shown below:

1. The boundary trunk has three trunk segments that are within 20% of the design capacity during a 100-year event and the HGL remains within the obvert of the pipe. This implies the Boundary Trunk has sufficient design capacity for the 100-year event.
2. There are no capacity concerns with the West Trunk during the 100-year event.
3. The Pioneer Trunk is adequately sized to service development within the Spruce Grove municipal boundary during the 100-year event.

7.4.2 Future Development Including County Lands South to Highway 628

The results of the future system analysis, including development of County land south to Highway 628, during the 100-year design storm are shown on **Figure 7.7**.

Notes regarding the 100-year existing system performance are shown below:

1. Three additional quarter sections during the 100-year event does not cause significant surcharging within the West Trunk.
2. Eight additional quarter sections of development during the 100-year event causes some minor surcharging of trunk segments along the Pioneer Trunk; however, the peak HGL remains more than 2.5 m below the ground surface and is therefore not a risk for basement flooding. The two west branches at the upstream end of the Pioneer Trunk were upsized from 300 mm to 375 mm (300 mm was recommended in the 2012 Master Plan) due to the growth plan using more conservative generation rates for future growth.

MINOR SURCHARGING WITHIN DOWNSTREAM EAST TRUNK.

PIONEER TRUNK HAS SUFFICIENT CAPACITY AND DOES NOT SURCHARGE ALONG ITS ALIGNMENT.

WEST TRUNK DOES NOT SURCHARGE SIGNIFICANTLY ALONG ITS ALIGNMENT.

UPSTREAM BOUNDARY TRUNK WITHIN 20% OF DESIGN CAPACITY DURING 100-YEAR EVENT.

Legend

- Outfalls

Future System Manholes

Depth to HGL (m)

- Flooding to Surface
- 0 < HGL <= 1.5 m Deep
- 1.5 m < HGL <= 2.5 m Deep
- HGL > 2.5 m Deep

Future System Sewers

Max Flow / Capacity Ratio (Q/Q)

- Q/Q <= 0.8
- 0.8 < Q/Q <= 1.0
- 1.0 < Q/Q <= 1.5
- Q/Q > 1.5
- Future Sewersheds
- Annexation Boundaries
- Municipal Boundary

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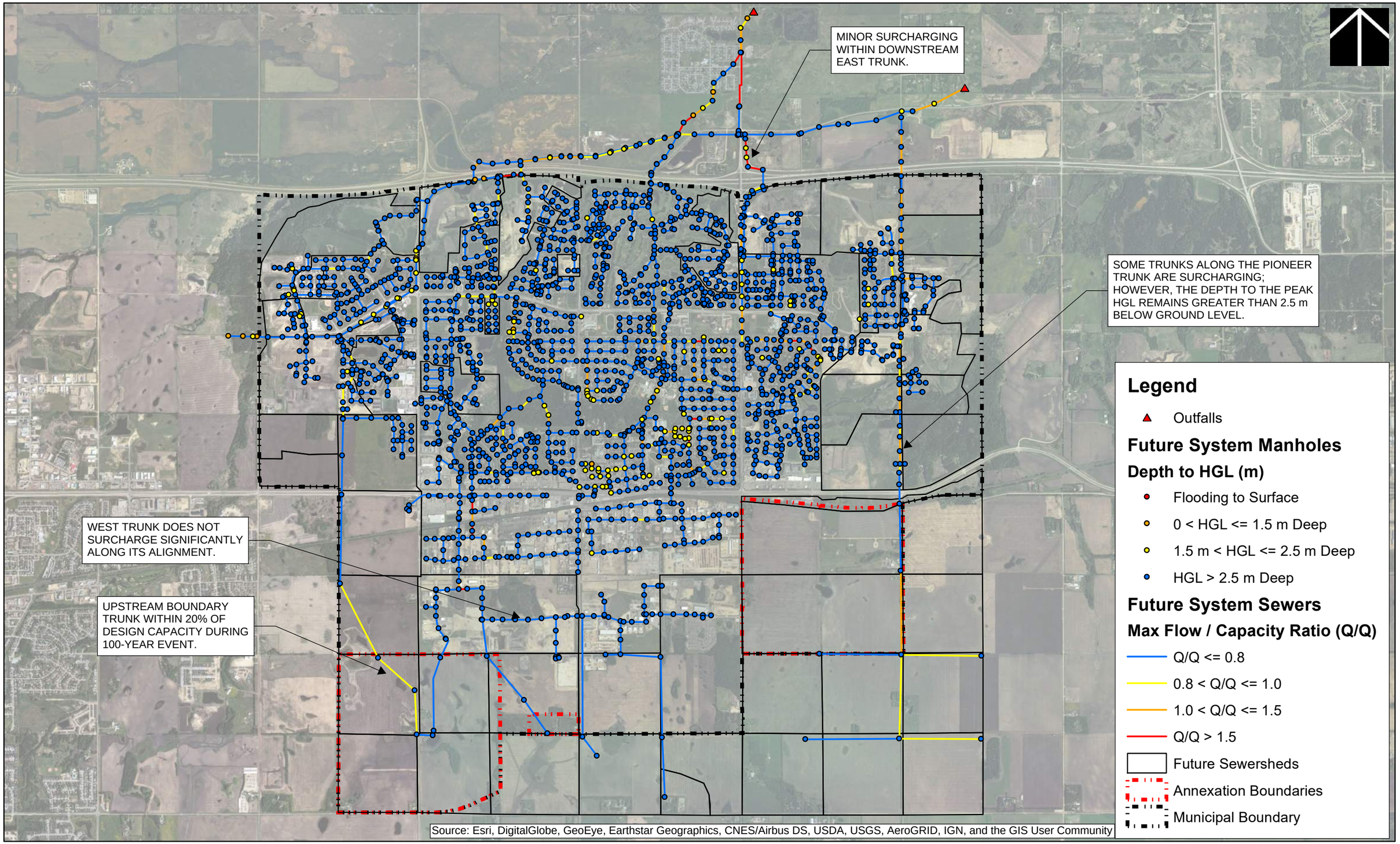
SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

100-YEAR, 24-HOUR FUTURE SYSTEM MODELING RESULTS - UP TO MUNICIPAL BOUNDARY

FIGURE 7.6

1:35,000

0 225 450 900 1,350 1,800 Meters



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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

100-YEAR, 24-HOUR FUTURE SYSTEM MODELING RESULTS - INCLUDING COUNTY LAND TO HWY 628

FIGURE 7.7

1:35,000

0 225 450 900 1,350 1,800 Meters

8.0 Cost Estimates and Off-Site Levy Considerations

Cost estimates for the optional existing system upgrades and the future system expansion have been provided in **Appendix E** and are summarized in **Table 8.1**.

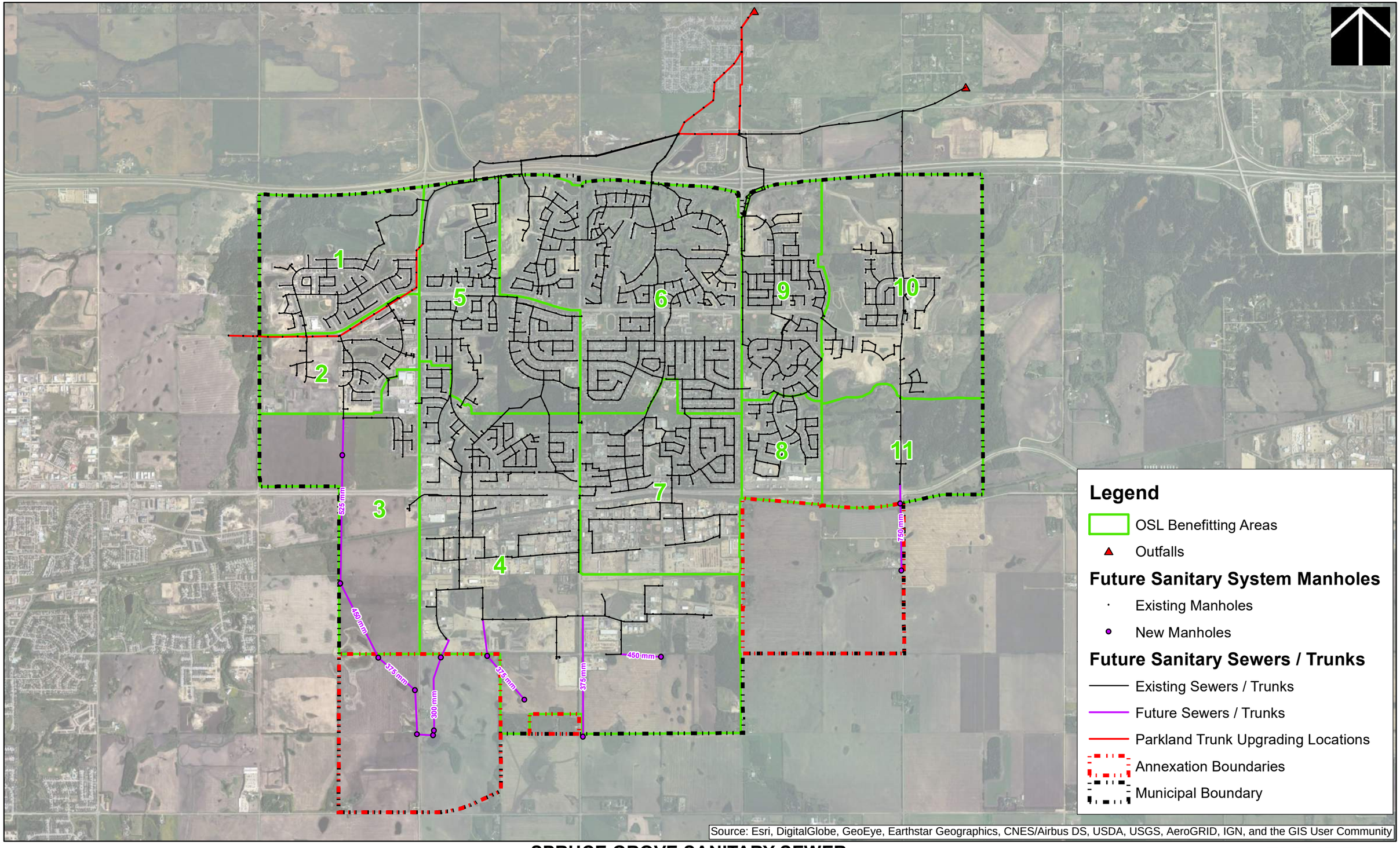
Table 8.1: Cost Estimate Summary

Time Frame	Description	Capital Cost ($)	Engineering 15% ($)	Contingency 30% ($)	Total Cost ($)
Existing[1]	600 mm upgrade along King Street	$ 931,000	$ 140,000	$ 280,000	$ 1,351,000
	300 mm upgrade along Windermere Boulevard	$ 223,000	$ 34,000	$ 67,000	$ 324,000
	TOTAL ($)	**$ 1,154,000**	**$ 174,000**	**$ 347,000**	**$ 1,675,000**
Future Development Withing Municipal Boundaries	Boundary Trunk Extension	$ 4,989,000	$ 748,000	$ 1,497,000	$ 7,234,000
	West Trunk Southern Branches	$ 3,681,000	$ 552,000	$ 1,104,000	$ 5,337,000
	Pioneer Trunk Extension	$ 2,189,000	$ 328,000	$ 657,000	$ 3,174,000
	TOTAL ($)	**$ 10,859,000**	**$ 1,628,000**	**$ 3,258,000**	**$ 15,745,000**
Future Development Including County Lands to Highway 628	West Trunk Southern Branches	$ 1,948,000	$ 292,000	$ 585,000	$ 2,825,000
	Pioneer Trunk Expansion	$ 5,547,000	$ 832,000	$ 1,665,000	$ 8,044,000
	TOTAL ($)	**$ 7,495,000**	**$ 1,124,000**	**$ 2,250,000**	**$ 10,869,000**

Notes:

1. Existing system upgrades are only needed for the 1:100-year, 24-hour design storm. The sewers in these areas function adequately during a 25-year, 24-hour design storm.
2. Existing system upgrading unit prices are based on both projects tendered at the same time. If the total length of existing system upgrading is reduced, higher unit prices would apply.

For the purposes of updating off-site levies, **Figure 8.1** summarizes the current Spruce Grove off-site levy benefitting areas, the newly annexed areas, and the future system expansion to the current municipal boundary. The extension of the Boundary Trunk, Pioneer Trunk, and West Trunk to the municipal boundaries are oversized to potentially service future City / County land that develops south of the municipal boundary up to Highway 628. Off-site levies within the annexation areas should reflect the future sewer trunks being oversized for potential future development within Parkland County.



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SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

FUTURE SYSTEM EXPANSION AND OSL BENEFITTING AREAS

FIGURE 8.1

1:35,000

0 225 450 900 1,350 1,800 Meters

9.0 Conclusions and Recommendations

9.1 Conclusions

Conclusions from this master plan study include the following:

- The existing sewer model was updated with new sewers and dry weather flows (DWF) based on new development from the years 2012-2021 and calibrated generation rates from the 2012 Master Plan.
- Recent flow monitoring and water consumption data verified that the model overpredicts DWF; thus, the model's DWF was reduced slightly to better represent actual conditions.
- Modeling analysis of the Spruce Grove lagoon control structure assumed conservative operation with the east gate closed with WWFs being diverted to the lagoon.
- The model checked the worst-case scenario in which the control structure failed with both gates in the closed position. Results showed that no City trunks or homes were flooded, and WWFs spilled over the overflow weir as designed.
- Existing system performance showed no concerns with the City sewers or trunks during a 25-year design event; however, there was surcharging along Windermere Drive and flooding along Bristow Crescent during the 100-year design event.
- Growth within Spruce Grove considered both future development up to the Municipal boundary and potential future development by the City / County to Highway 628, which if serviced by City trunks, is in keeping with the spirit of regional cooperation in the Tri-Municipal Regional Plan.
- Future sanitary sewer trunks were conservatively oversized to provide operational flexibility in the future if additional lands outside of the current Municipal boundary were to develop.

9.2 Recommendations

Recommendations from this master plan include the following:

- The existing flow monitoring data should be used as a basis for future sewer model calibration, particularly flow monitoring data along City trunks that will service future growth.
- New flow monitors along the downstream end of Boundary Trunk and Pioneer Trunk should be installed to monitor flows as future annexation areas develop. A few notes:
  - These flow monitors would be required in the medium- to long-term since these trunks will not experience significant flows for many years; and
  - The flow monitor on Pioneer Trunk should be installed first since there are already areas that have developed along this trunk.
- Water consumption and flow monitoring data should be reviewed regularly to ensure that sewer design standards are not overly conservative. If consistently lower, then recommended sanitary sewer design criteria should be revised in the future to reflect monitored conditions.
- The City should evaluate the potential existing sewer system upgrades along King Street and Windermere Drive to determine if there are any opportunities to integrate these into future City projects.
- The City should continue to collaborate with the ACRWC so that Parkland Trunk upgrading requirements can be planned for in advance of future development within Spruce Grove.
- Future sewer trunks have been oversized to service additional development south to Highway 628; thus, off-site levies should be prepared with cost-sharing arrangements that reflect the benefitting areas for each trunk.

APPENDIX A
Detailed Growth Plan

Table A.1: Proposed Growth Plan Table

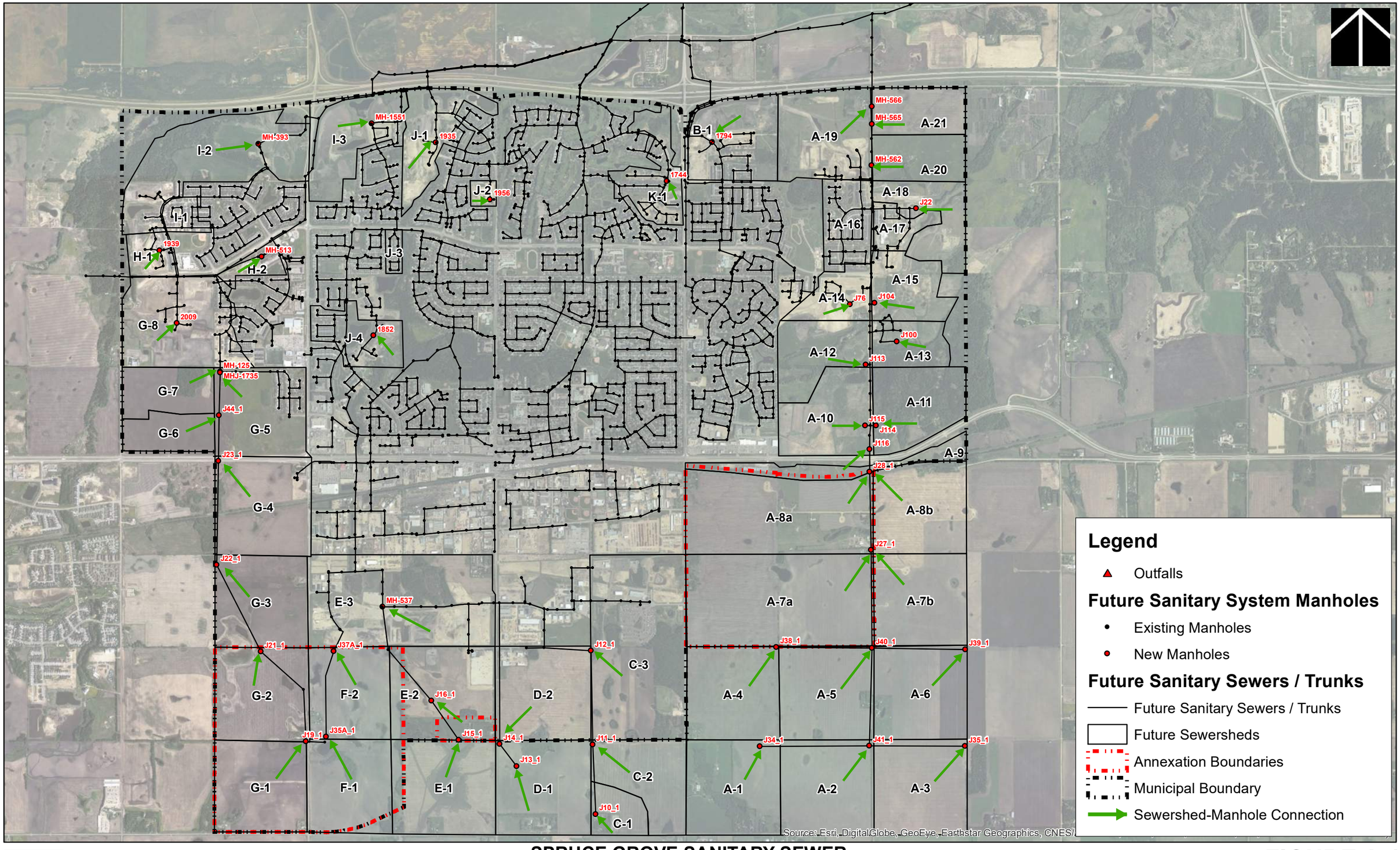
Sewershed Name	MH ID	GIS Area (Ha)	Percent Developed	Gross Developable Area (ha)	Percent Net	Net Developable Area (ha)	Land Use	Net Developable Res. Area (ndha)	Net Developable Comm./Ind. Area (ndha)	Area Structure Plan?	Residential Generation Rate (L/c/d)	Non Residential Generation Rate (L/s/ha)	Lot Density (du/ndha)	Population Per Dwelling (c/du)	Population Density (c/ha)	ADWF (L/s)
A-1	J34_1	67.7	0%	67.7	80%	54.1	Residential	54.1	0.0	No	300	0.2	35	2.5	87.5	16.4
A-2	J41_1	67.0	0%	67.0	80%	53.6	Residential	53.6	0.0	No	300	0.2	35	2.5	87.5	16.3
A-3	J35_1	67.0	0%	67.0	80%	53.6	Residential	53.6	0.0	No	300	0.2	35	2.5	87.5	16.3
A-4	J38_1	65.1	0%	65.1	80%	52.1	Residential	52.1	0.0	No	300	0.2	35	2.5	87.5	15.8
A-5	J40_1	66.4	0%	66.4	80%	53.1	Residential	53.1	0.0	No	300	0.2	35	2.5	87.5	16.1
A-6	J39_1	65.7	0%	65.7	80%	52.6	Residential	52.6	0.0	No	300	0.2	35	2.5	87.5	16.0
A-7a	J27_1	130.3	0%	130.3	-	122.9	Res. (114.4) Comm. (8.5)	114.4	8.5	No	300	0.2	35	2.5	87.5	36.5
A-7b	J27_1	64.4	0%	64.4	80%	51.5	Residential	51.5	0.0	No	300	0.2	35	2.5	87.5	15.7
A-8a	J28_1	110.7	0%	110.7	-	94.0	Res. (44.5) Comm. (17.6) Ind. (31.9)	44.5	49.5	No	300	0.2	35	2.5	87.5	23.4
A-8b	J28_1	63.2	0%	63.2	80%	50.5	Residential	50.5	0.0	No	300	0.2	35	2.5	87.5	15.3
A-9	J116	25.3	20%	20.3	50%	10.1	Commercial	0.0	10.1	East Pioneer	300	0.2	38	2.5	95.0	2.0
A-10	J115	52.8	0%	52.8	65%	34.3	Res. / Comm. (70/30)	24.0	10.3	East Pioneer	300	0.2	38	2.5	95.0	10.0
A-11	J114	43.1	0%	51.6	-	22.3	Commercial	0.0	22.3	East Pioneer	300	0.2	38	2.5	95.0	4.5
A-12	J113	43.5	0%	43.5	80%	34.8	Residential	34.8	0.0	East Pioneer	300	0.2	38	2.5	95.0	11.5
A-13	J100	26.1	35%	16.9	50%	8.5	Residential	8.5	0.0	East Pioneer	300	0.2	38	2.5	95.0	2.8
A-14	J76	25.8	50%	12.9	70%	9.0	Residential	9.0	0.0	East Pioneer	300	0.2	38	2.5	95.0	3.0
A-15	J104	36.2	25%	27.1	70%	19.0	Residential	19.0	0.0	East Pioneer	300	0.2	38	2.5	95.0	6.3
A-16	-	31.8	100%	0.0	80%	0.0	Residential	0.0	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	0.0
A-17	-	16.2	100%	0.0	80%	0.0	Residential	0.0	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	0.0
A-18	J22	39.5	10%	35.6	75%	26.7	Residential	26.7	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	6.4
A-19	MH-566	63.0	20%	50.4	80%	40.3	Residential	40.3	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	9.7
A-20	MH-562	32.7	0%	32.7	80%	26.2	Residential	26.2	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	6.3
A-21	MH-565	33.3	0%	33.3	80%	26.7	Residential	26.7	0.0	Pioneer Lands	300	0.2	27.8	2.5	69.5	6.4
B-1	1794	53.9	50%	27.0	80%	21.6	Res. / Comm. (80/20)	17.3	4.3	Pioneer Lands	300	0.2	27.8	2.5	69.5	5.0
C-1	J10_1	19.2	0%	19.2	80%	15.3	Industrial	0.0	15.3	No	300	0.2	35	2.5	87.5	3.1
C-2	J11_1	49.3	0%	49.3	80%	39.5	Industrial	0.0	39.5	No	300	0.2	35	2.5	87.5	7.9
C-3	J12_1	133.9	35%	87.0	70%	60.9	Industrial	0.0	60.9	South Century	300	0.2	0	2.5	0.0	12.2
D-1	J13_1	67.9	5%	64.5	80%	51.6	Industrial	0.0	51.6	No	300	0.2	35	2.5	87.5	10.3
D-2	J14_1	67.7	5%	64.3	80%	51.5	Industrial	0.0	51.5	South Century	300	0.2	0	2.5	0.0	10.3
E-1	J15_1	74.0	0%	74.0	80%	59.2	Industrial	0.0	59.2	No	300	0.2	35	2.5	87.5	11.8
E-2	J16_1	73.8	10%	66.4	80%	53.2	Industrial	0.0	53.2	Railway Avenue Area	300	0.2	0	2.5	0.0	10.6
E-3	MH-537	129.2	20%	103.4	65%	67.2	Industrial	0.0	67.2	Railway Avenue Area	300	0.2	0	2.5	0.0	13.4
F-1	J35A_1	60.0	0%	60.0	-	49.7	Comm. (12.3) Ind. (37.4)	0.0	49.7	No	300	0.2	35	2.5	87.5	9.9
F-2	J37A_1	56.4	0%	56.4	-	45.2	Industrial	0.0	45.2	No	300	0.2	35	2.5	87.5	9.0
G-1	J19_1	64.2	0%	64.2	-	64.2	Res. (56.9) Comm. (7.3)	56.9	7.3	No	300	0.2	35	2.5	87.5	18.7
G-2	J21_1	66.3	0%	66.3	-	55.0	Residential	55.0	0.0	No	300	0.2	35	2.5	87.5	16.7
G-3	J22_1	64.2	0%	64.2	75%	48.1	Residential	48.1	0.0	Shiloh	300	0.2	28.77	2.5	71.9	12.0

Table A.1: Proposed Growth Plan Table

Sewershed Name	MH ID	GIS Area (Ha)	Percent Developed	Gross Developable Area (ha)	Percent Net	Net Developable Area (ha)	Land Use	Net Developable Res. Area (ndha)	Net Developable Comm./Ind. Area (ndha)	Area Structure Plan?	Residential Generation Rate (L/c/d)	Non Residential Generation Rate (L/s/ha)	Lot Density (du/ndha)	Population Per Dwelling (c/du)	Population Density (c/ha)	ADWF (L/s)
G-4	J23_1	71.6	5%	68.0	80%	54.4	Res. / Comm. (25/75)	13.6	40.8	Shiloh	300	0.2	28.77	2.5	71.9	11.6
G-5	MHJ-1735	61.5	20%	49.2	80%	39.4	Res. / Comm. (40/60)	15.7	23.6	West Central	300	0.2	36.2	2.5	90.5	9.7
G-6	J44_1	25.4	0%	25.4	80%	20.3	Commercial	0.0	20.3	West Central	300	0.2	36.2	2.5	90.5	4.1
G-7	MH-125	32.8	0%	32.8	80%	26.3	Residential	26.3	0.0	West Central	300	0.2	36.2	2.5	90.5	8.2
G-8	2009	76.8	40%	46.1	80%	36.9	Residential	36.9	0.0	West	300	0.2	28.99	2.5	72.5	9.3
H-1	1939	15.1	20%	12.1	80%	9.6	Residential	9.6	0.0	West	300	0.2	28.99	2.5	72.5	2.4
H-2	MH-513	8.5	60%	3.4	80%	2.7	Residential	2.7	0.0	West	300	0.2	28.99	2.5	72.5	0.7
I-1	-	9.5	100%	0.0	80%	0.0	Residential	0.0	0.0	West	300	0.2	28.99	2.5	72.5	0.0
I-2	MH-393	92.1	20%	73.7	80%	58.9	Residential	58.9	0.0	West	300	0.2	28.99	2.5	72.5	14.8
I-3	MH-1551	52.8	15%	44.9	80%	35.9	Residential	35.9	0.0	North Central	300	0.2	25.27	2.5	63.2	7.9
J-1	1935	42.4	15%	36.1	80%	28.9	Residential	28.9	0.0	North Central	300	0.2	25.27	2.5	63.2	6.3
J-2	1956	4.9	30%	3.5	80%	2.8	Residential	2.8	0.0	North Central	300	0.2	25.27	2.5	63.2	0.6
J-3	-	5.5	100%	0.0	80%	0.0	Residential	0.0	0.0	Senior's Co-op Housing	300	0.2	16.6	2.5	41.5	0.0
J-4	1852	31.5	60%	12.6	80%	10.1	Residential	10.1	0.0	Heritage Estates	300	0.2	36	2.5	90.0	3.1
K-1	1744	35.9	60%	14.4	80%	11.5	Residential	11.5	0.0	North Central	300	0.2	25.27	2.5	63.2	2.5
Within Municipal Boundary					**Total (ha)**	**1,329.0**									**Total (L/s)**	**328.1**
Including County Land Down to Highway 628					**Total (ha)**	**1,915.7**									**Total (L/s)**	**489.1**

Notes:

1. Percent net developable assumes 80% unless there are open areas / wetlands present.
2. Land uses have been updated in annexation areas.
3. Lot densities of 35 lots/ndha based on EMRB Growth Plan.
4. Other lot densities are blended rates from ASPs.
5. A-11 has been updated to include the latest baseball diamond amendment from East Pioneer Amendment.
6. ASP designated "Special Study Areas" have been assumed to be commercial development based on adjacent land uses.



ISL

SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

FUTURE SEWERSHED AND MANHOLE CONNECTIONS

FIGURE A.1

1:30,000

0 195 390 780 1,170 1,560 Meters

APPENDIX B
Flow Monitoring Information

Appendix B Flow Monitoring and Dry-Weather Flow Review

B.1 Introduction

This appendix summarizes the dry-weather flow (DWF) monitoring data, available water consumption data, and how it was reviewed to update the DWF modeling parameters in the existing model.

B.2 Available Flow Monitoring Data

B.2.1 Flow Monitoring Data

Available flow monitoring data for six Alberta Capital Region Wastewater Commission (ACRWC) flow monitors was acquired from FlowWorks during the year 2021. From this time period, two DWF periods were considered:

1. February 1 – 28, 2021; and
2. April 2 – 10, 2021.

From these, the February DWF hydrographs showed some irregularity as flows increased and decreased on a weekly cycle. Because of this, April 2 – 10, 2021 was used for the analysis of DWF accuracy in the existing model.
The six flow monitors reviewed are summarized in **Table B.1**.

Table B.1 Flow Monitoring Locations

Name	ID	Online / Offline of Parkland Trunk	Location
Stony Plain Flow Meter	903-FI-01	Online	Located upstream of Spruce Grove west of Range Road 275
Spruce Ridge Rd	903-FI-11	Online	At Spruce Ridge Road and Grove Drive
YHT Connection West	903-FI-09	Offline (West Trunk)	Located North of Dillworth Crescent just before Highway 16
West Diversion	903-FI-07	Offline (Central Trunk)	Just west of Township Road 532A and North of Highway 16
East Diversion	903-FI-08	Offline (East Trunk)	Along Township Road 532 east of Range Road 272
Spruce Grove Flow Meter	903-FI-02	Online	At Township Road 532A and Range Road 272 (south of Parkland RV Storage)

The flow monitoring data for February 2021 and April 2 – 10, 2021 is shown on **Figures B.1** and **B.2**, respectively.

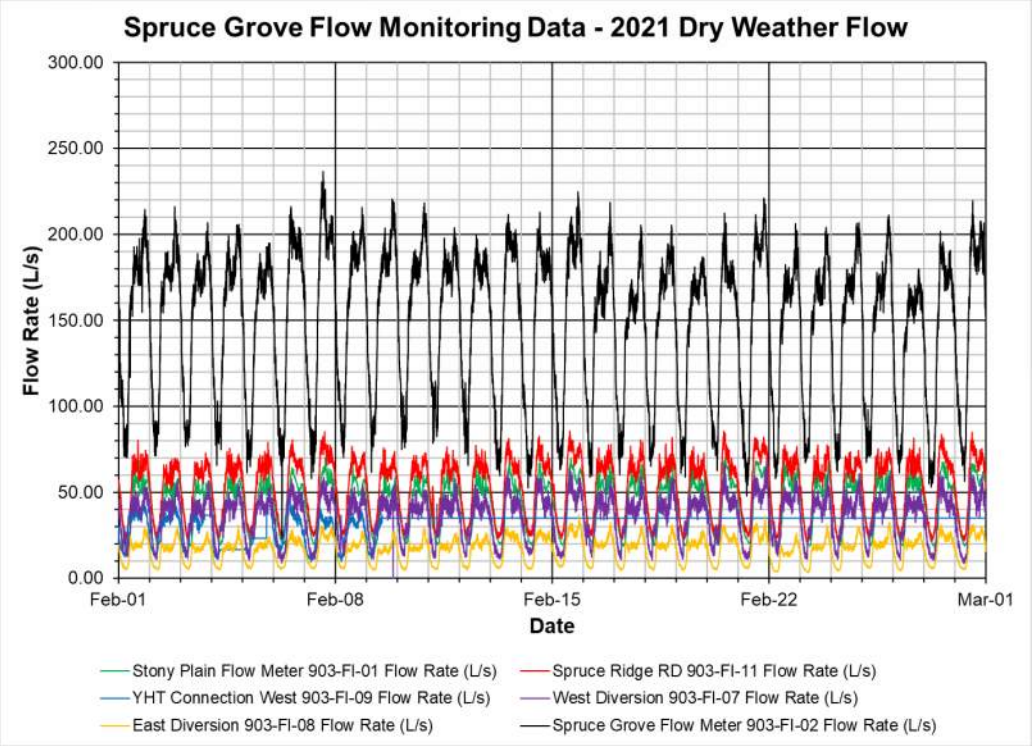


Figure B.1 February 2021 Flow Monitoring Data

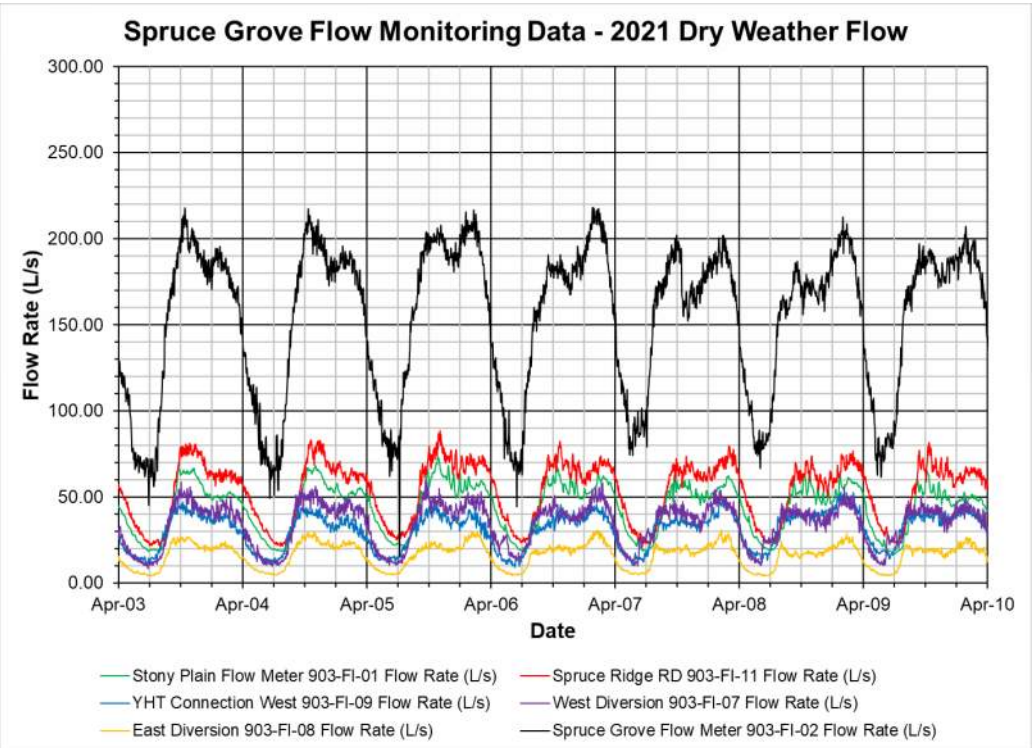


Figure B.2 April 2021 Flow Monitoring Data

B.2.2 Water Consumption Data

Water consumption data from the City of Spruce Grove was also reviewed as part of this project and is summarized in **Table B.2**. The data from 2012 is from the Spruce Grove Community Water Conservation Program (2016 – 2020) whereas the 2017 – 2021 data was provided by the City of Spruce Grove directly. A few conclusions regarding the data are listed below:

1. Overall water volumes and populations have increased from 2012 to 2021.
2. Calculated as a total water use per capita (including non-residential), the consumption rate shows a decreasing trend in recent years as low as 189 L/c/d. Compared to 2012 (233 L/c/d), this is nearly a 20% decrease in per capital total water usage.

Table B.2 Water Consumption Data

Water Billing Volumes 2017-2021	2012	2017	2018	2019	2020	2021
January	-	191,454	200,286	197,412	200,552	201,342
February	-	197,387	198,175	204,688	199,112	204,715
March	-	216,083	203,280	208,140	231,645	221,096
April	-	197,794	224,537	232,534	221,624	223,361
May	-	252,694	267,737	248,892	225,861	247,285
June	-	244,216	249,701	214,814	245,560	283,274
July	-	262,266	249,323	226,023	234,405	289,664
August	-	231,763	235,053	221,937	243,882	270,626
September	-	215,861	206,963	226,537	225,355	217,206
October	-	227,705	227,953	217,442	224,549	210,728
November	-	212,977	202,820	204,627	227,757	228,799
December	-	240,379	249,332	251,820	252,782	256,475
Total Volume	**2,421,000**	**2,692,594**	**2,715,160**	**2,654,864**	**2,733,084**	**2,854,570**
Population	**28,468**	**36,634**	**37,744**	**38,392**	**38,951**	**-**
Water Use (L/c/d)	**233**	**201**	**197**	**189**	**192**	**-**
% Change	**-**	**-14%**	**-15%**	**-19%**	**-17%**	**-**

Notes:

1. 2012 total volume was taken from the Spruce Grove Water Conservation Report (2016 – 2020).
2. The percent change in water use is based on the water use in L/c/d relative to the year 2012.

B.3 Updating the Stony Plain Boundary Condition

To better represent the contributions from Stony Plain during DWF conditions, several days of flow monitoring data was averaged at the Stony Plain Flow Meter to get an average DWF curve which was input into the existing system model as an upstream boundary condition for DWF. **Figure B.3** shows the model boundary condition in red compared to a sample of flow monitoring data from April 3 – 10, 2021. The boundary condition is smooth and does not feature the same peaks and troughs as the flow monitoring data due to being averaged over several days of data.

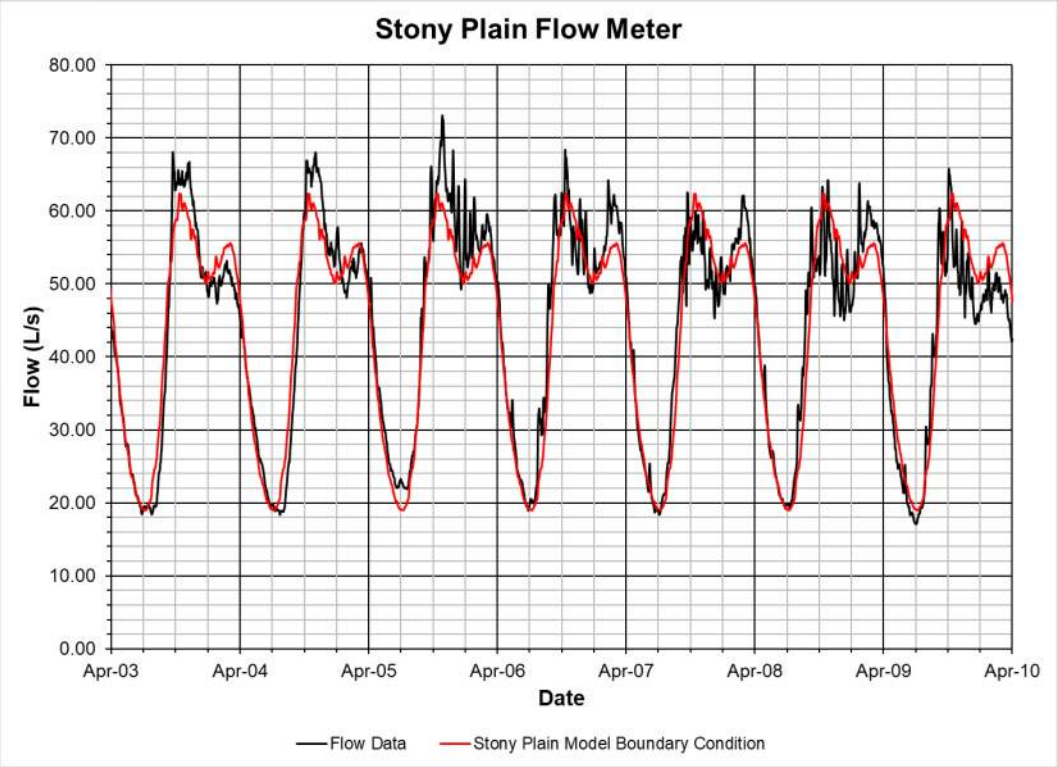


Figure B.3 Stony Plain Flow Monitoring Data and Modeling Boundary Condition

B.4 Scenario Analysis

B.4.1 Scenario Descriptions

From preliminary modeling runs, the existing system model conservatively overestimates the flow monitoring data. Based on this, as well as the water consumption data showing an average drop in total water usage of about 20%, ISL has evaluated three scenarios as described below:

1. Scenario 0: 2012 Existing System Model (from 2012 Master Plan).
2. Scenario 1: 2021 Existing System Model (Using 2012 Calibrated DWF Generation Rates).
3. Scenario 2: 2021 Existing System Model with Water Conservation:
   a. 10% DWF reduction in established areas (pre – 2012); and
   b. 30% DWF reduction in new development (2012 – 2021).

Table B.3 summarizes the DWF generation rates used for each scenario as well as the latest year of development.

Table B.3 DWF Scenario Summary

Scenario	Name	Year of Development	Residential G (L/s/ha)	Commercial G (L/s/ha)	Industrial (L/s/ha)
0	2012 Existing System Model	Up to 2012	0.094	0.186	0.123
1	2021 Existing Updated Model	Up to 2021	0.094	0.186	0.123
2	2021 Existing Water Conservation	Pre-2012	0.085	0.167	0.111
		2012-2021	0.066	0.130	0.086

B.4.2 Scenario Results and Hydrographs

The hydrographs at each of the five flow monitoring sites (excluding Stony Plain) are shown below on **Figures B.4** through **B.9**. Key conclusions from the scenario analysis are listed below and are summarized on **Table B.4**:

- The Spruce Ridge Rd Flow Meter shows that the model is slightly non-conservative and underestimates the flows in the upstream end of the City (10 – 20 L/s). The water conservation scenario does not worsen the results much since most of the flows are from the Stony Plain boundary condition and there are only a few Spruce Grove connections upstream of this flow meter.
- The Yellowhead Trail Connection and West Diversion Flow Meters have the largest discrepancy between modeled flow and the flow monitoring data. The model over predicts the flow monitoring data by 20 – 40 L/s. The water conservation scenario improves the results reasonably while still maintaining realistic generation rates.
- The East Diversion Flow Meter is well represented by the model on average, although it appears as though the diurnal curve has changed recently and match the diurnal curve built into the model. It is possible that there has been changes to the diurnal curves due to lifestyle changes during the pandemic (e.g. working from home).
- Near the downstream end of the City, the Spruce Grove Flow Meter is overestimated by the model on the order of approximately 30 – 50 L/s on average which is conservative.

Table B.4 Summary of ADWF for Each Flow Monitor and Scenario

System	Average Dry-Weather Flow, ADWF (L/s)					
	Stony Plain Flow Meter	Spruce Ridge RD	YHT Connection West	West Diversion	East Diversion	Spruce Grove Flow Meter
	903-FI-01	903-FI-11	903-FI-09	903-FI-07	903-FI-08	903-FI-02
Scenario 0: 2012 System	43.4	48.2	53.2	52.7	17.3	183.9
Scenario 1: 2021 System – No Water Conservation	43.4	50.1	60.2	56.0	21.0	202.2
Scenario 2: 2021 System – Water Conservation	43.4	48.9	52.7	49.7	18.1	182.7
Flow Data	43.8	53.5	31.2	34.3	16.3	152.3

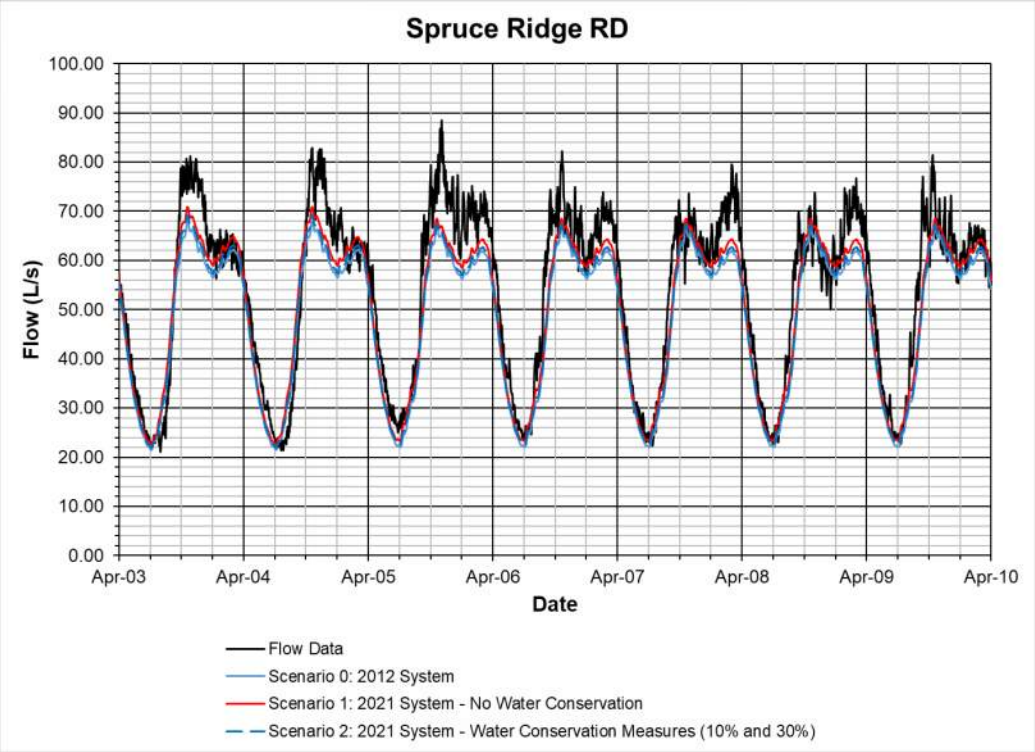


Figure B.4 Spruce Ridge Rd – Flow Monitoring and Modeling Results

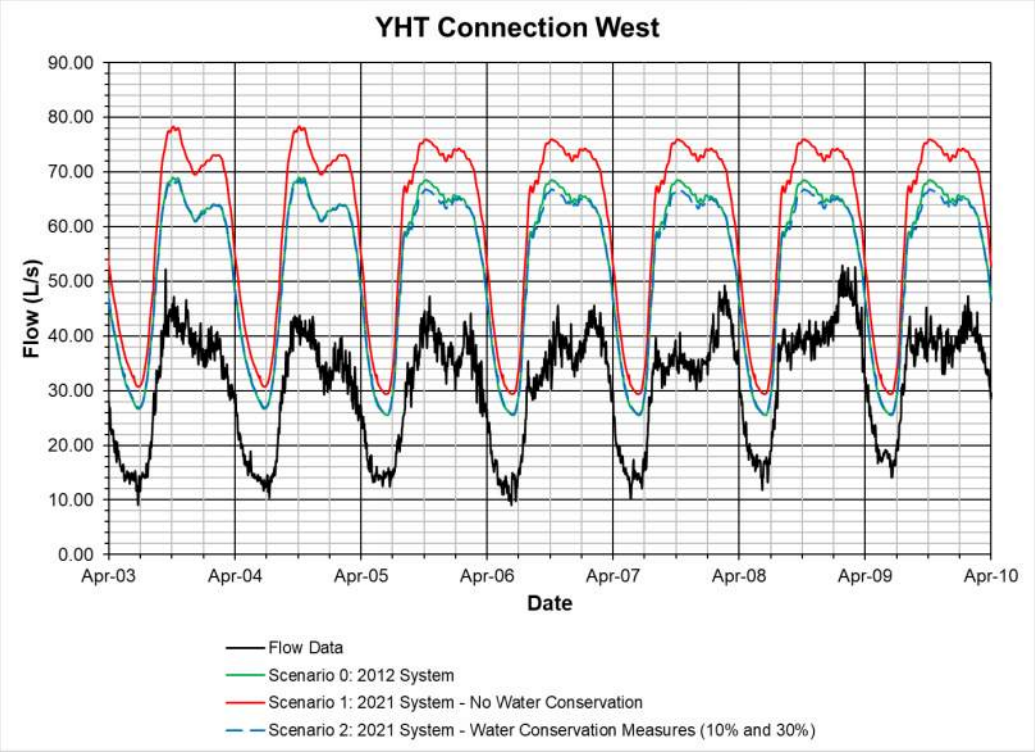


Figure B.5 YHT Connection West – Flow Monitoring and Modeling Results

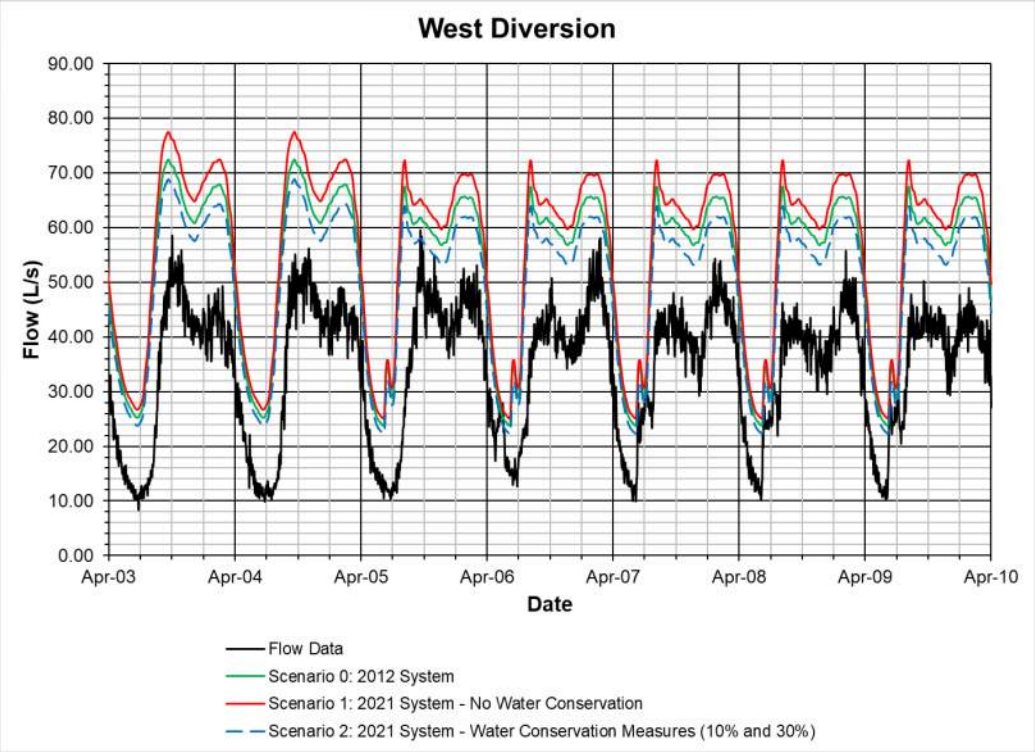


Figure B.6 West Diversion – Flow Monitoring and Modeling Results

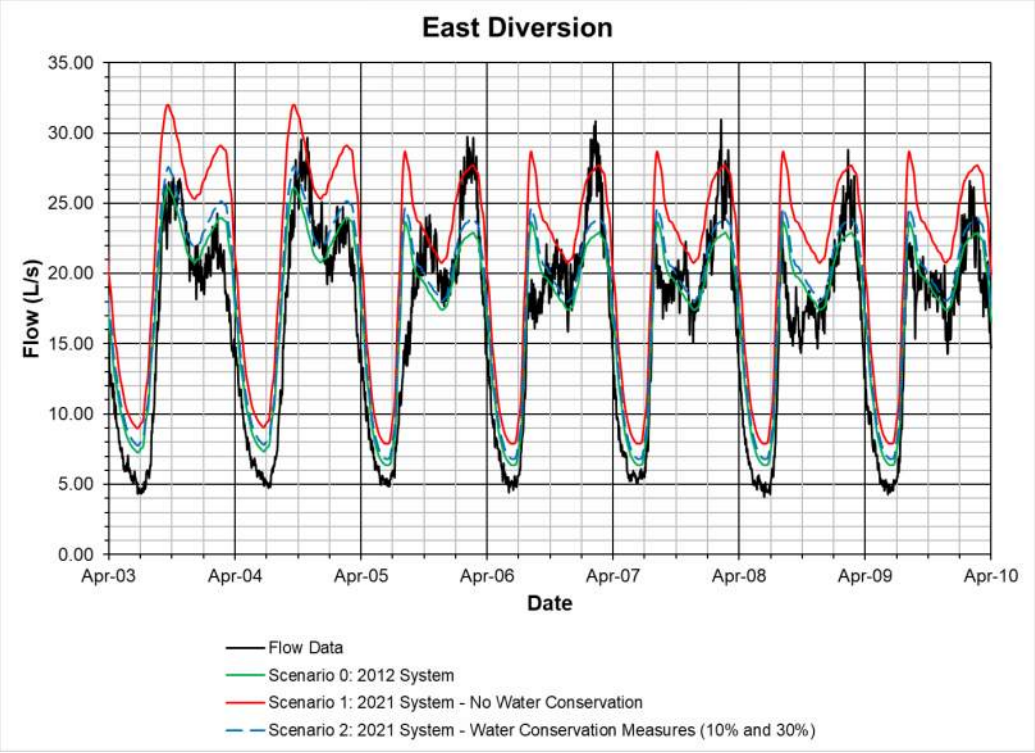


Figure B.7 East Diversion – Flow Monitoring and Modeling Results

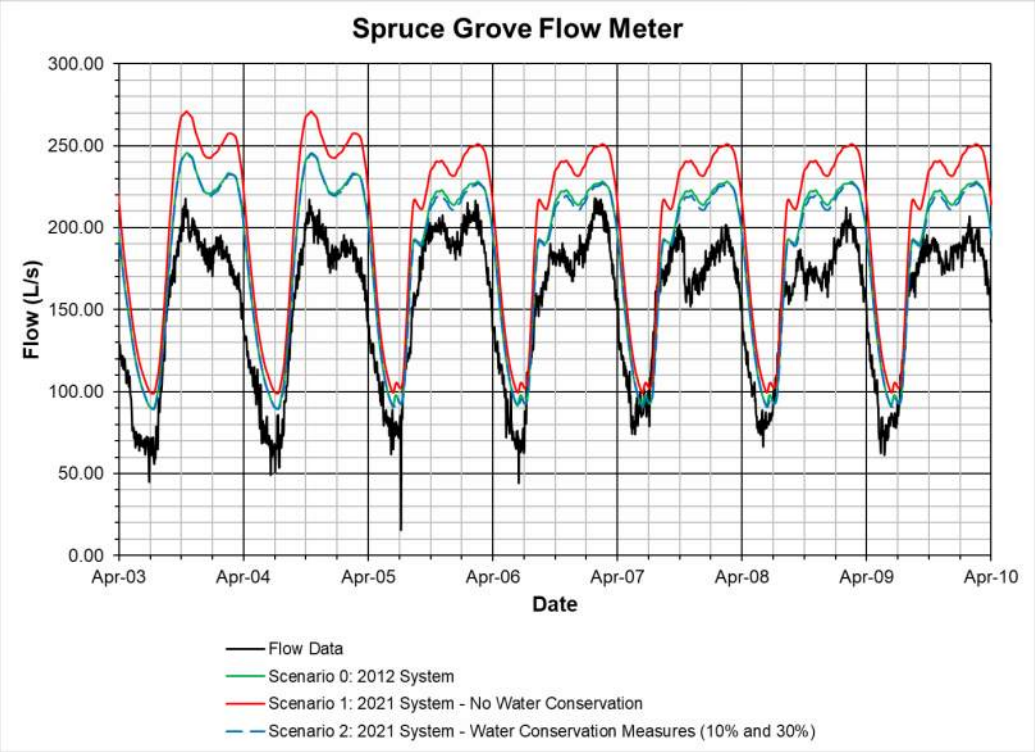


Figure B.8 Spruce Grove Flow Meter – Flow Monitoring and Modeling Results

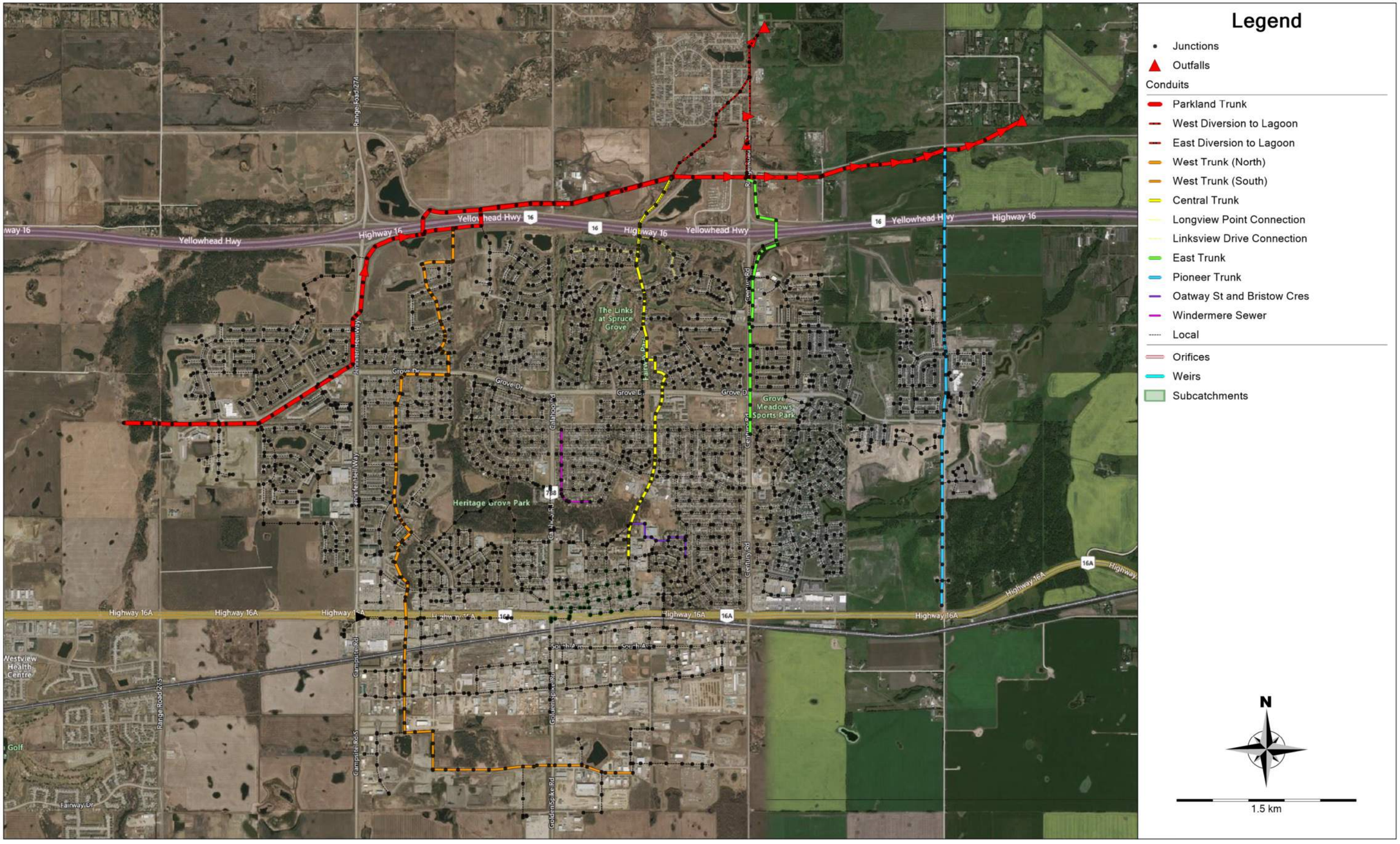
B.5 Recommendations

Based on the conclusions from Sections 2.2, 3.0, and 4.2, the following recommendations have been made regarding the existing system model:

1. Use the updated Stony Plain boundary condition that was constructed as an average of several days of dry weather flow from the Stony Plain Flow Meter. This best represents the DWF from Stony Plain.
2. It is recommended that Scenario 2: 2021 Existing System with Water Conservation is used as the DWF basis for existing system assessment.

Since the water consumption reports show that the total water usage per capita has dropped by 20% from 2012 to 2020, using the water conservation scenario is appropriate and conservative since it assumes a 10% DWF reduction in established areas (pre – 2012) and a 30% reduction in new development areas (2012 – 2021). This is conservative since the established sewer network is much larger than new development from 2012 onwards; thus, the average generation rate reduction is closer to 10% than it is 30%.

APPENDIX C
Existing System Assessment – HGL Profiles


Legend
Junctions
Outfalls
Conduits
Parkland Trunk
West Diversion to Lagoon
East Diversion to Lagoon
West Trunk (North)
West Trunk (South)
Central Trunk
Longview Point Connection
Linksview Drive Connection
East Trunk
Pioneer Trunk
Oatway St and Bristow Cres
Windermere Sewer
Local
Orifices
Weirs
Subcatchments
N
1.5 km
Yellowhead Hwy
Highway 16
Highway 16A
Range Road 274
Jennifer Heil Way
Grove Dr
Grove L.
Grove D
The Links at Spruce Grove
Heritage Grove Park
Grove Meadows Sports Park
Century Rd
Gainsborough Rd
Campsite Rd
Golden Spike Rd
Range Road 275
Westview Health Centre
Golf
Fairway Dr

ACRWC Parkland Trunk

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H

Spruce Grove Existing System Assessment 25Y24H

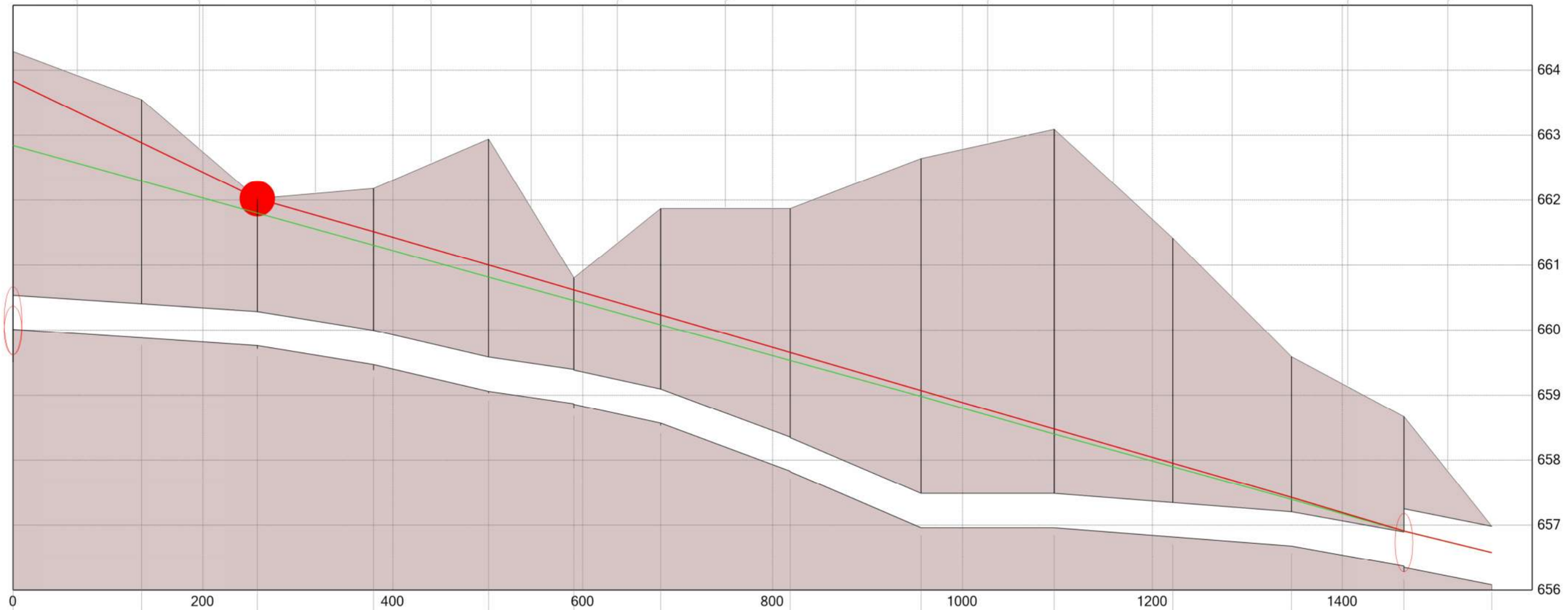
Peak values

West Diversion to Lagoon

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H — Spruce Grove Existing System Assessment 25Y24H — Peak values

Links:	P-MH-1226B	P-MH-1	P-MH-450	P-MH-451	P-MH-452	P-MH-453	P-MH-454	P-MH-455	P-MH-456	P-MH-449	P-MH-448	P-MH-447	P-MH-446
	L=135.452 m	L=121.823 m	L=122.453 m	L=121.114 m	L=89.863 m	L=91.378 m	L=136.415 m	L=137.823 m	L=140.293 m	L=124.921 m	L=124.921 m	L=118.454 m	L=92.56 m
	D=0.525 m	D=0.525 m	D=0.525 m	D=0.525 m	D=0.525 m	D=0.525 m	D=0.525 m	D=0.525 m	D=0.525 m	D=0.525 m	D=0.525 m	D=0.525 m	D=0.9 m
	S=0.00096 m/m	S=0.00099 m/m	S=0.00237 m/m	S=0.00339 m/m	S=0.00211 m/m	S=0.00317 m/m	S=0.00542 m/m	S=0.00624 m/m	S=0.002 m/m	S=0.00112 m/m	S=0.00112 m/m	S=0.00262 m/m	S=0.0029 m/m
	I1=660.01 m	I1=659.88 m	I1=659.76 m	I1=659.47 m	I1=659.06 m	I1=658.86 m	I1=658.57 m	I1=657.82 m	I1=656.96 m	I1=656.96 m	I1=656.82 m	I1=656.68 m	I1=656.35 m
	I2=659.88 m	I2=659.76 m	I2=659.47 m	I2=659.06 m	I2=658.87 m	I2=658.57 m	I2=657.83 m	I2=656.96 m	I2=656.96 m	I2=656.82 m	I2=656.68 m	I2=656.37 m	I2=656.082 m



Nodes:	903-MH-080	MH-1	MH-450	MH-451	MH-452	MH-453	MH-454	MH-455	MH-456	MH-449	MH-448	MH-447	MH-446	MH-445
	M=663.8329 m	M=662.8828 m	M=662.023 m	M=661.516 m	M=661.0042 m	M=660.619 m	M=660.2341 m	M=659.6548 m	M=659.0723 m	M=658.4794 m	M=657.9514 m	M=657.4249 m	M=656.9108 m	M=656.5813 m
	R=664.285 m	R=663.55 m	R=662.023 m	R=662.178 m	R=662.94 m	R=660.806 m	R=661.87 m	R=661.87 m	R=662.64 m	R=663.09 m	R=661.416 m	R=659.59 m	R=658.67 m	R=656.982 m
	I=659.62 m	I=659.88 m	I=659.709 m	I=659.383 m	I=659.032 m	I=658.798 m	I=658.53 m	I=657.82 m	I=656.96 m	I=656.96 m	I=656.82 m	I=656.68 m	I=656.28 m	I=656.082 m

East Diversion to Lagoon

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H — Spruce Grove Existing System Assessment 25Y24H — Peak values

Conduit C5_3
Length = 34.1 m
Depth = 0.6 m
Slope = 0.0088 m/m
Invert1 = 659.16 m
Invert2 = 658.996 m

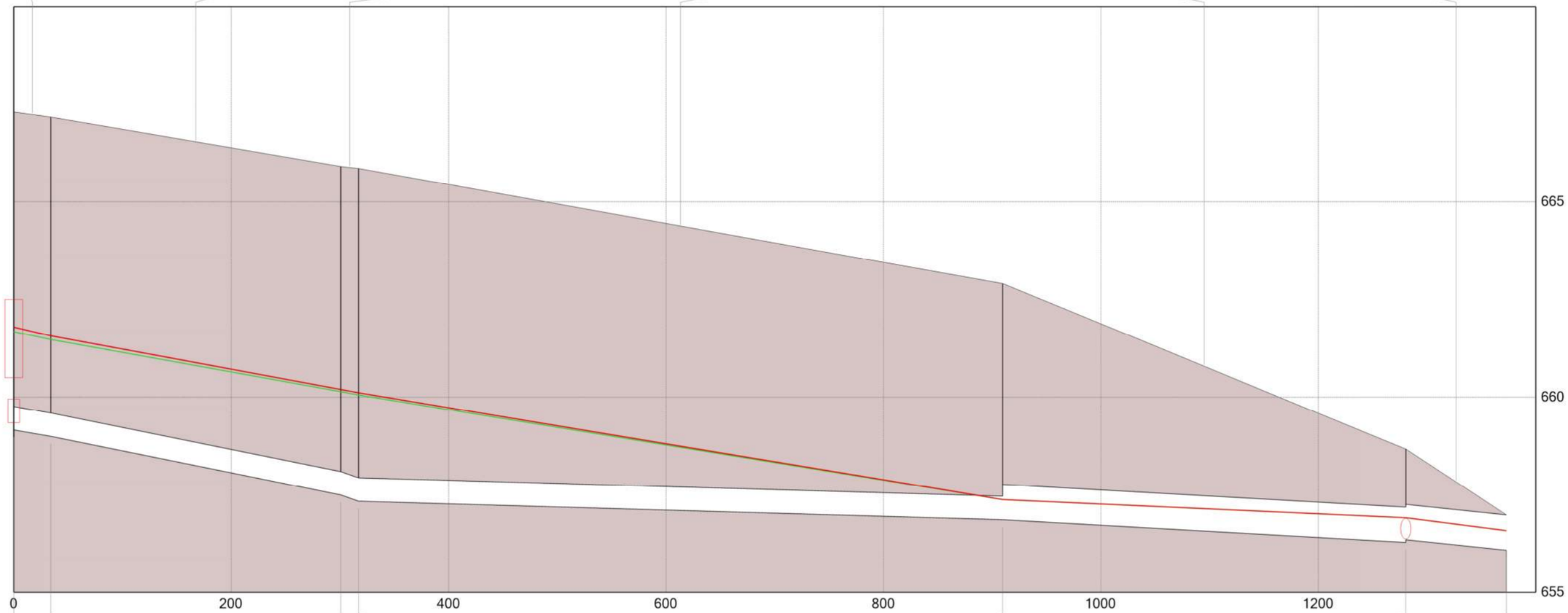
Conduit C5_1
Length = 266.7 m
Depth = 0.6 m
Slope = 0.00491 m/m
Invert1 = 658.996 m
Invert2 = 657.49 m

Conduit C5_5
Length = 16.3 m
Depth = 0.6 m
Slope = 0.00982 m/m
Invert1 = 657.49 m
Invert2 = 657.33 m

Conduit C5_2
Length = 592.454 m
Depth = 0.6 m
Slope = 0.00079 m/m
Invert1 = 657.33 m
Invert2 = 656.86 m

Conduit C6
Length = 370.84 m
Depth = 0.9 m
Slope = 0.00156 m/m
Invert1 = 656.86 m
Invert2 = 656.28 m

Conduit P-MH-446
Length = 92.56 m
Depth = 0.9 m
Slope = 0.0029 m/m
Invert1 = 656.35 m
Invert2 = 656.082 m



Junction E_Div_1
Max. CWSEL = 661.7888 m
Rim Elev. = 667.3 m
Invert Elev. = 659.16 m
04-03-2021 12:20PM

Junction J101
Max. CWSEL = 661.566 m
Rim Elev. = 667.171 m
Invert Elev. = 658.996 m
04-03-2021 12:20PM

Junction J102
Max. CWSEL = 660.1987 m
Rim Elev. = 665.906 m
Invert Elev. = 657.49 m
04-03-2021 12:20PM

Junction J75
Max. CWSEL = 660.1142 m
Rim Elev. = 665.855 m
Invert Elev. = 657.33 m
04-03-2021 12:20PM

Junction E_Div_2
Max. CWSEL = 657.3724 m
Rim Elev. = 662.91 m
Invert Elev. = 656.86 m
04-03-2021 12:25PM

Junction MH-446
Max. CWSEL = 656.9108 m
Rim Elev. = 658.67 m
Invert Elev. = 656.28 m
04-03-2021 12:20PM

Outfall MH-445
Max. CWSEL = 656.5813 m
Rim Elev. = 656.982 m
Invert Elev. = 656.082 m
04-03-2021 12:25PM

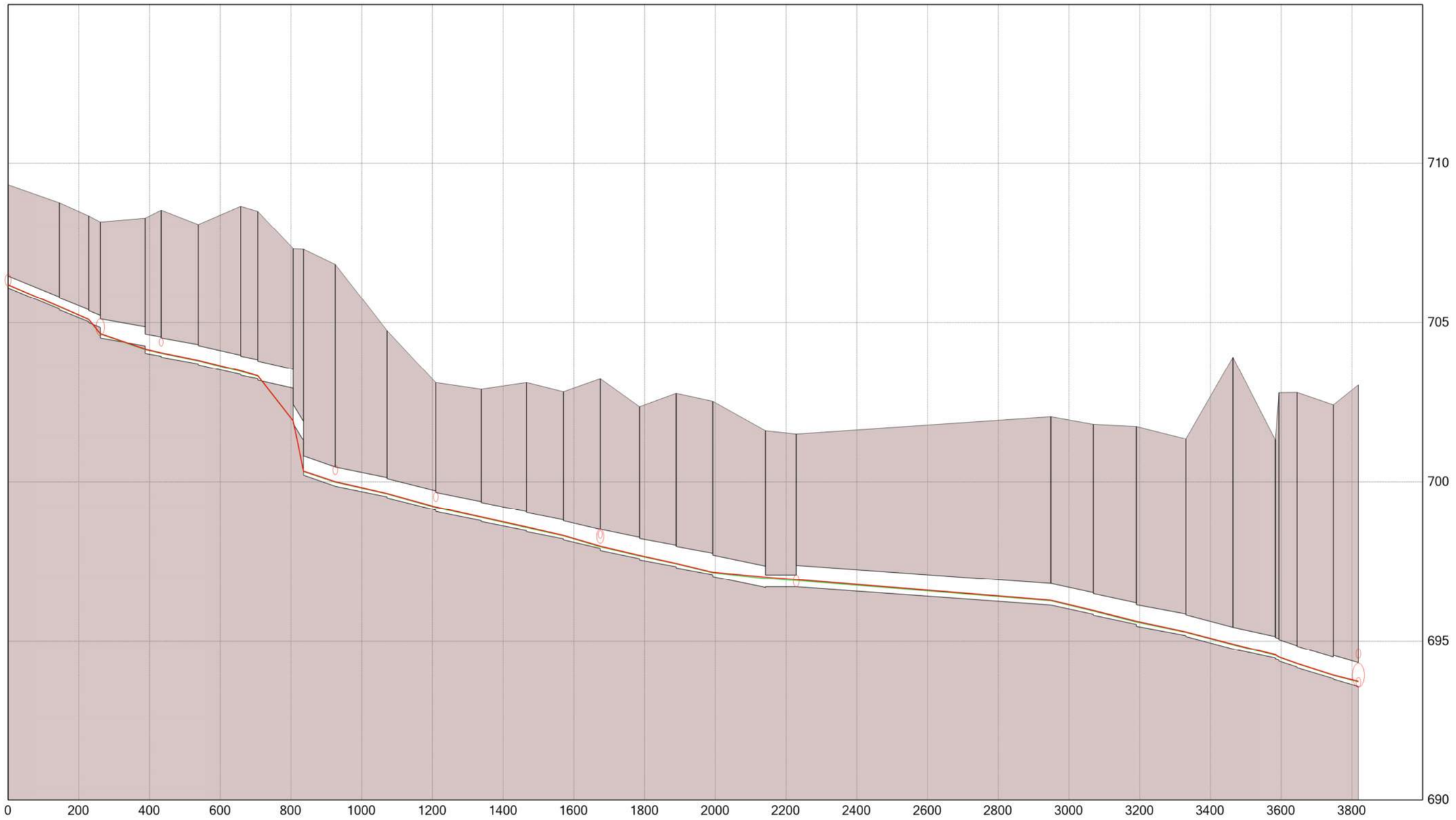
West Trunk (South of Hwy 16A)

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H

Spruce Grove Existing System Assessment 25Y24H

Peak values



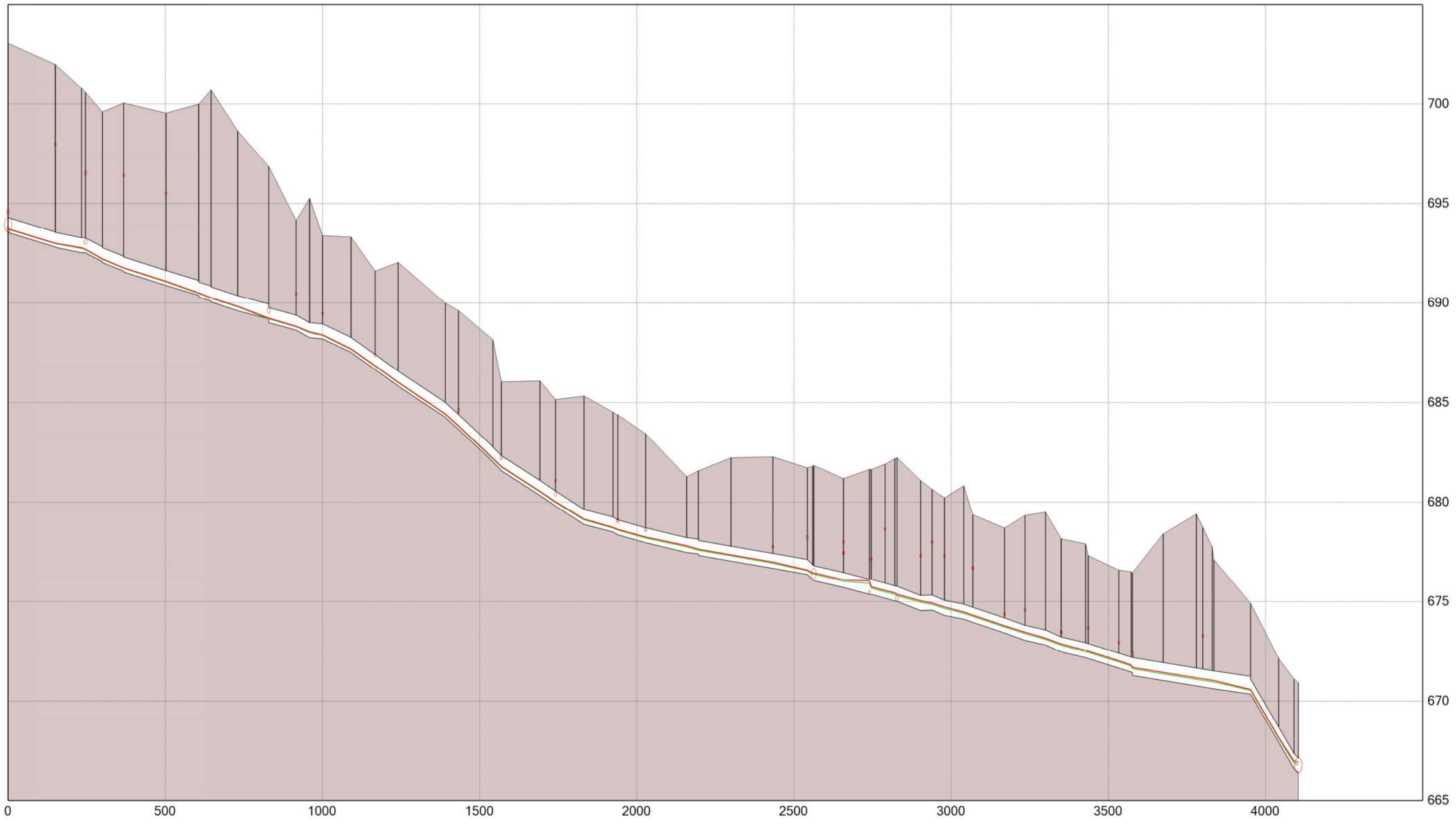
West Trunk (North of Hwy 16A)

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H

Spruce Grove Existing System Assessment 25Y24H

Peak values



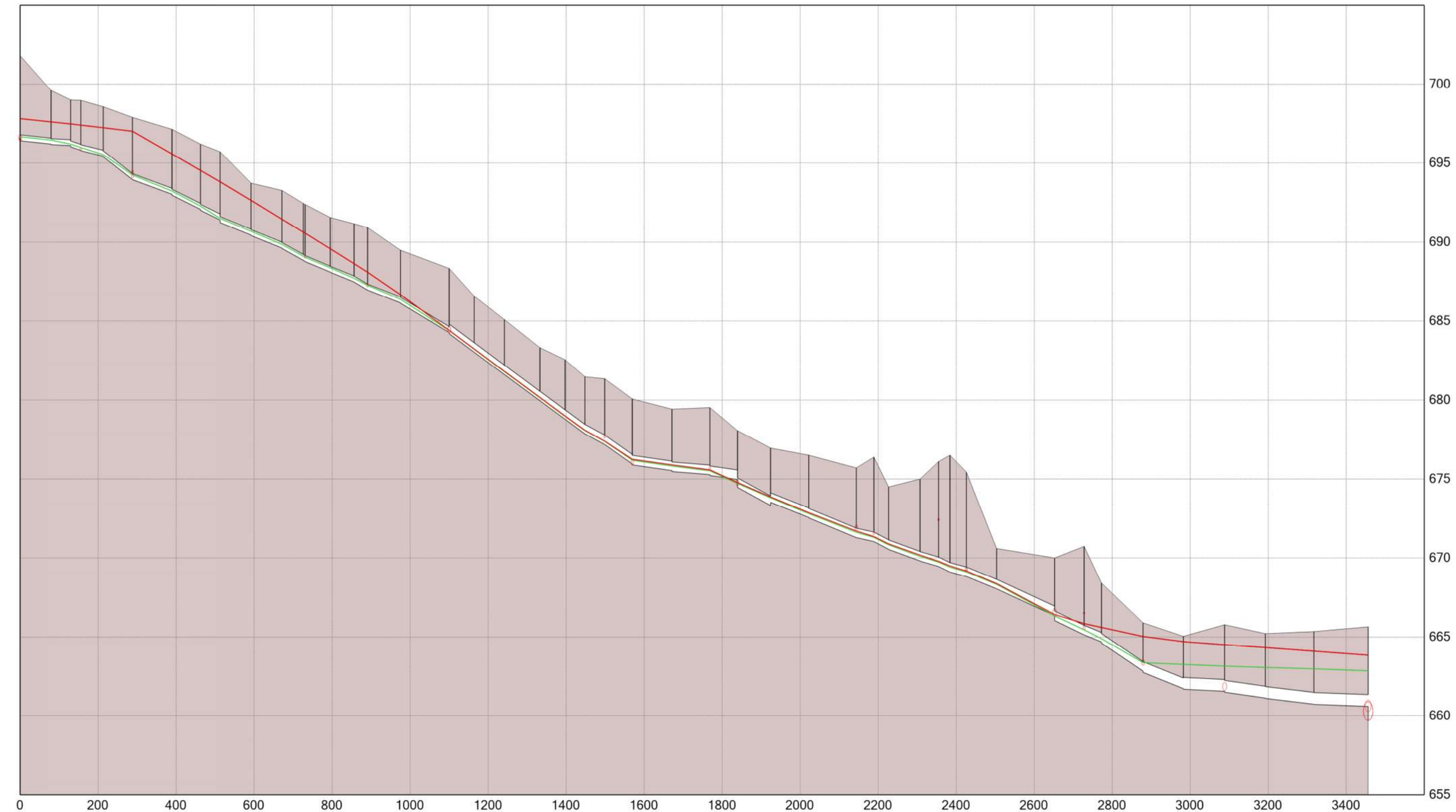
Central Trunk

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H

Spruce Grove Existing System Assessment 25Y24H

Peak values



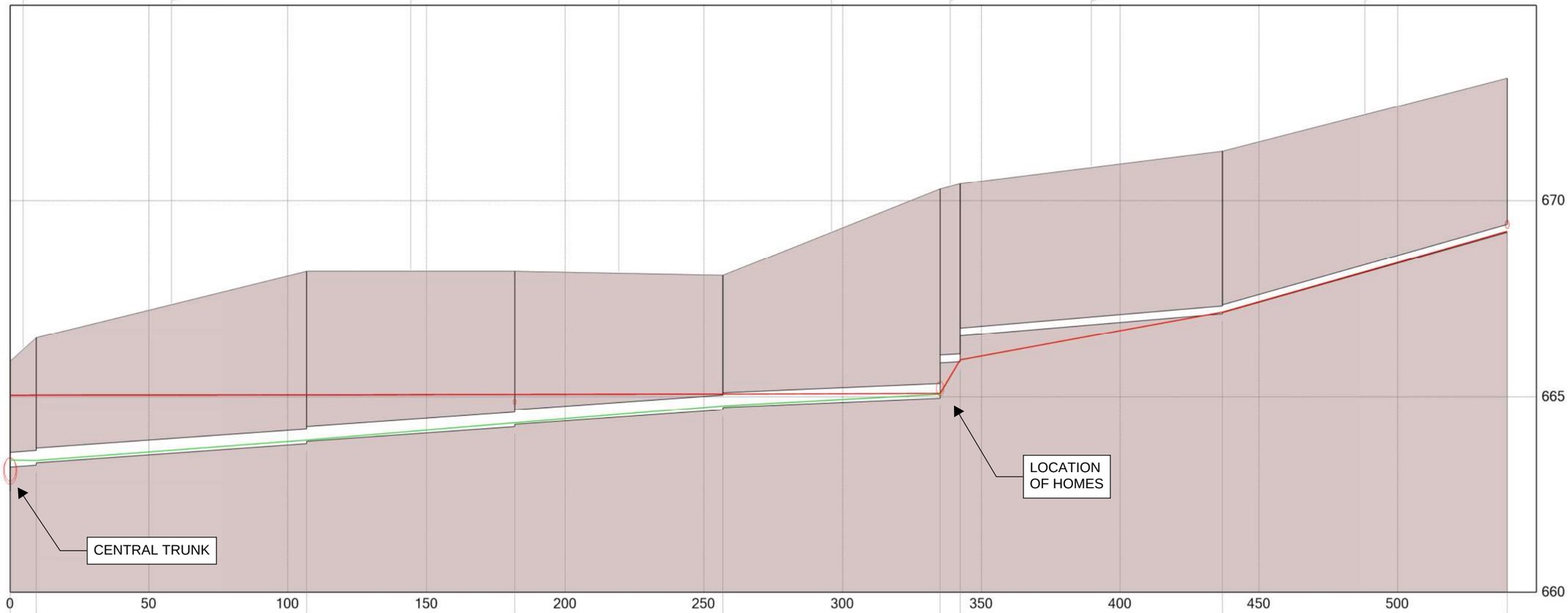
Central Trunk Upstream Connection 1 - Longview Point

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H — Spruce Grove Existing System Assessment 25Y24H — Peak values

Links:

P-MH-217	P-MH-218	P-MH-216	P-MH-215	P-MH-210	P-MH-209	P-MH-208	P-MH-205A
L=9.424 m	L=97.408 m	L=75 m	L=75 m	L=78.27 m	L=7.255 m	L=94.495 m	L=102.627 m
D=0.375 m	D=0.375 m	D=0.375 m	D=0.375 m	D=0.375 m	D=0.2 m	D=0.2 m	D=0.2 m
S=0.00531 m/m	S=0.005 m/m	S=0.005 m/m	S=0.005 m/m	S=0.003 m/m	S=0.004 m/m	S=0.006 m/m	S=0.02 m/m
I1=663.25 m	I1=663.797 m	I1=664.232 m	I1=664.667 m	I1=664.962 m	I1=665.889 m	I1=667.116 m	I1=669.2 m
I2=663.2 m	I2=663.31 m	I2=663.857 m	I2=664.292 m	I2=664.727 m	I2=665.86 m	I2=666.549 m	I2=667.146 m



Nodes:

MH-17	MH-217	MH-218	MH-216	MH-215	MH-210	MH-209	MH-208	MH-205
M=665.0381 m	M=665.0446 m	M=665.048 m	M=665.0613 m	M=665.0689 m	M=665.088 m	M=665.9365 m	M=667.1588 m	M=669.2274 m
R=665.9 m	R=666.5 m	R=668.2 m	R=668.2 m	R=668.1 m	R=670.3 m	R=670.435 m	R=671.271 m	R=673.138 m
I=662.76 m	I=663.25 m	I=663.797 m	I=664.232 m	I=664.667 m	I=664.962 m	I=665.889 m	I=667.116 m	I=669.2 m

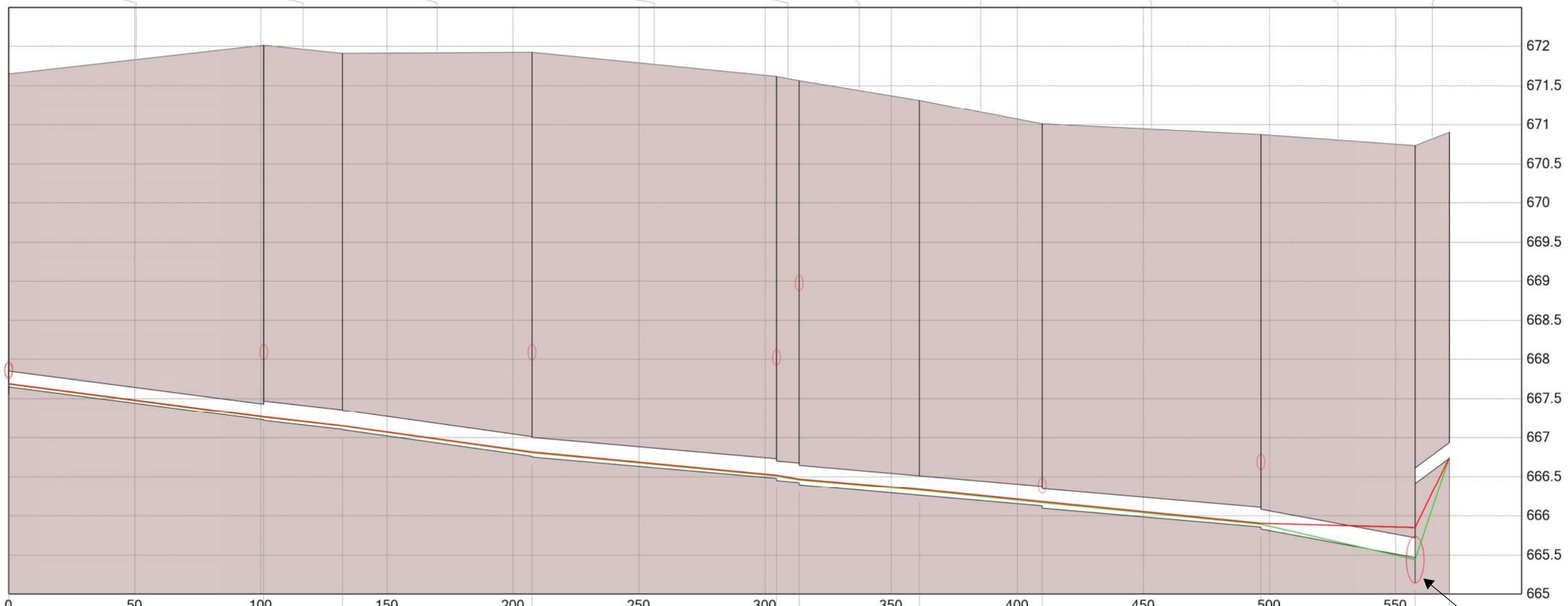
Central Trunk Upstream Connection 2 Linksview Drive

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H — Spruce Grove Existing System Assessment 25Y24H — Peak values

Links:

P-MH-104	P-MH-101	P-MHJ-1645	P-MH-303	P-MH-304	P-MH-305	P-MHJ-1669	P-MH-313	P-MH-314	P-MH-316
L=101.137 m	L=31.244 m	L=75.142 m	L=96.965 m	L=8.995 m	L=47.705 m	L=48.672 m	L=86.722 m	L=61.173 m	L=13.601 m
D=0.2 m	D=0.25 m	D=0.25 m	D=0.25 m	D=0.25 m	D=0.25 m	D=0.25 m	D=0.25 m	D=0.25 m	D=0.2 m
S=0.00415 m/m	S=0.00365 m/m	S=0.00452 m/m	S=0.00281 m/m	S=0.00278 m/m	S=0.00281 m/m	S=0.00277 m/m	S=0.00276 m/m	S=0.0059 m/m	S=0.0238 m/m
I1=667.65 m	I1=667.22 m	I1=667.102 m	I1=666.752 m	I1=666.45 m	I1=666.395 m	I1=666.261 m	I1=666.096 m	I1=665.832 m	I1=666.736 m
I2=667.23 m	I2=667.106 m	I2=666.762 m	I2=666.48 m	I2=666.425 m	I2=666.261 m	I2=666.126 m	I2=665.857 m	I2=665.471 m	I2=666.413 m



Nodes:

MH-104	MH-101	MHJ-1645	MH-303	MH-304	MH-305	MHJ-1669	MH-313	MH-314	MH-315	MH-316
M=667.6906 m	M=667.2682 m	M=667.1518 m	M=666.8176 m	M=666.52 m	M=666.4694 m	M=666.3375 m	M=666.1804 m	M=665.9043 m	M=665.8511 m	M=666.7445 m
R=671.65 m	R=672.014 m	R=671.91 m	R=671.924 m	R=671.619 m	R=671.565 m	R=671.314 m	R=671.012 m	R=670.875 m	R=670.734 m	R=670.904 m
I=667.65 m	I=667.22 m	I=667.102 m	I=666.752 m	I=666.45 m	I=666.395 m	I=666.261 m	I=666.096 m	I=665.832 m	I=665.141 m	I=666.736 m

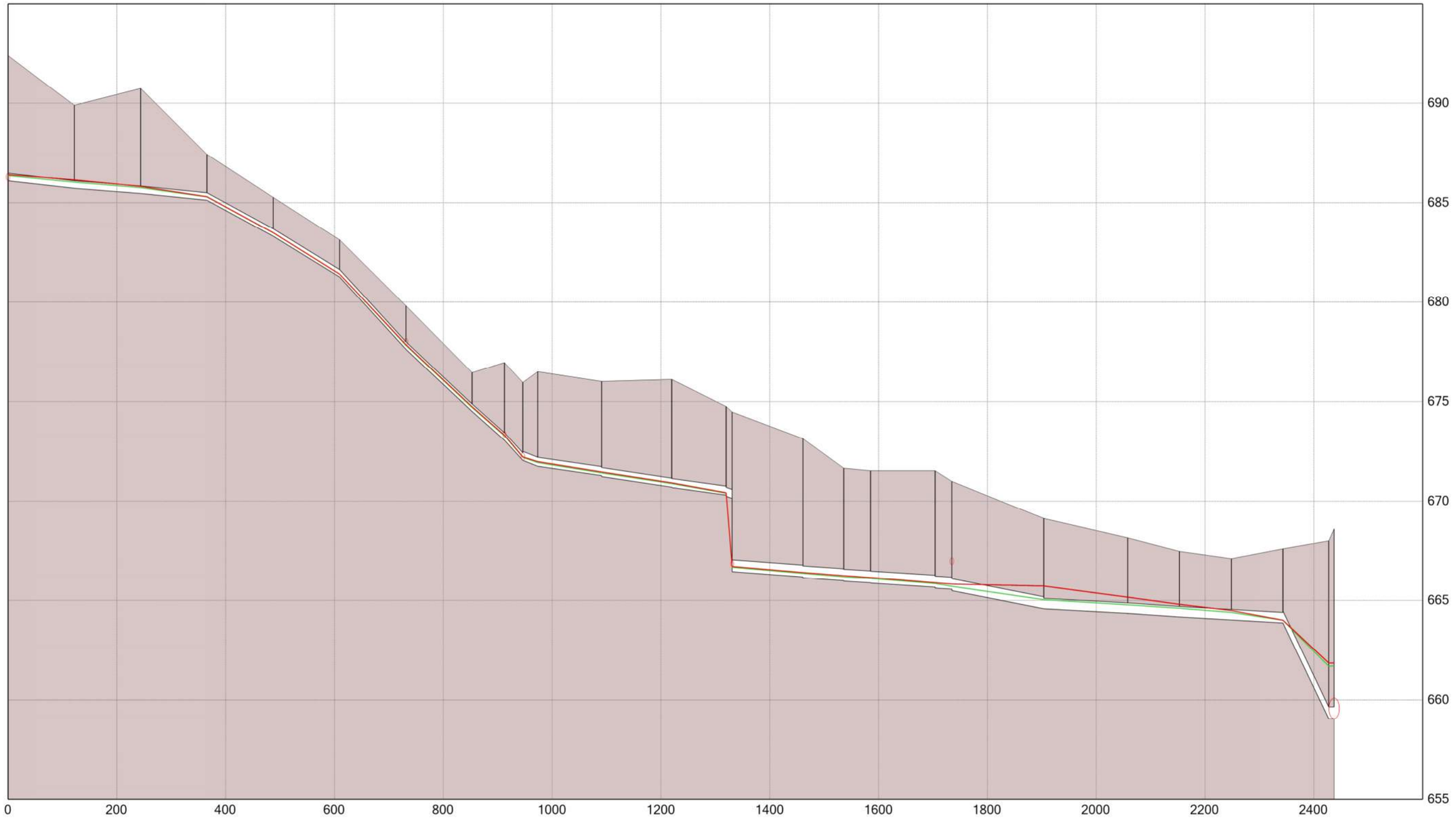
East Trunk (Twinned Section)

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H

Spruce Grove Existing System Assessment 25Y24H

Peak values



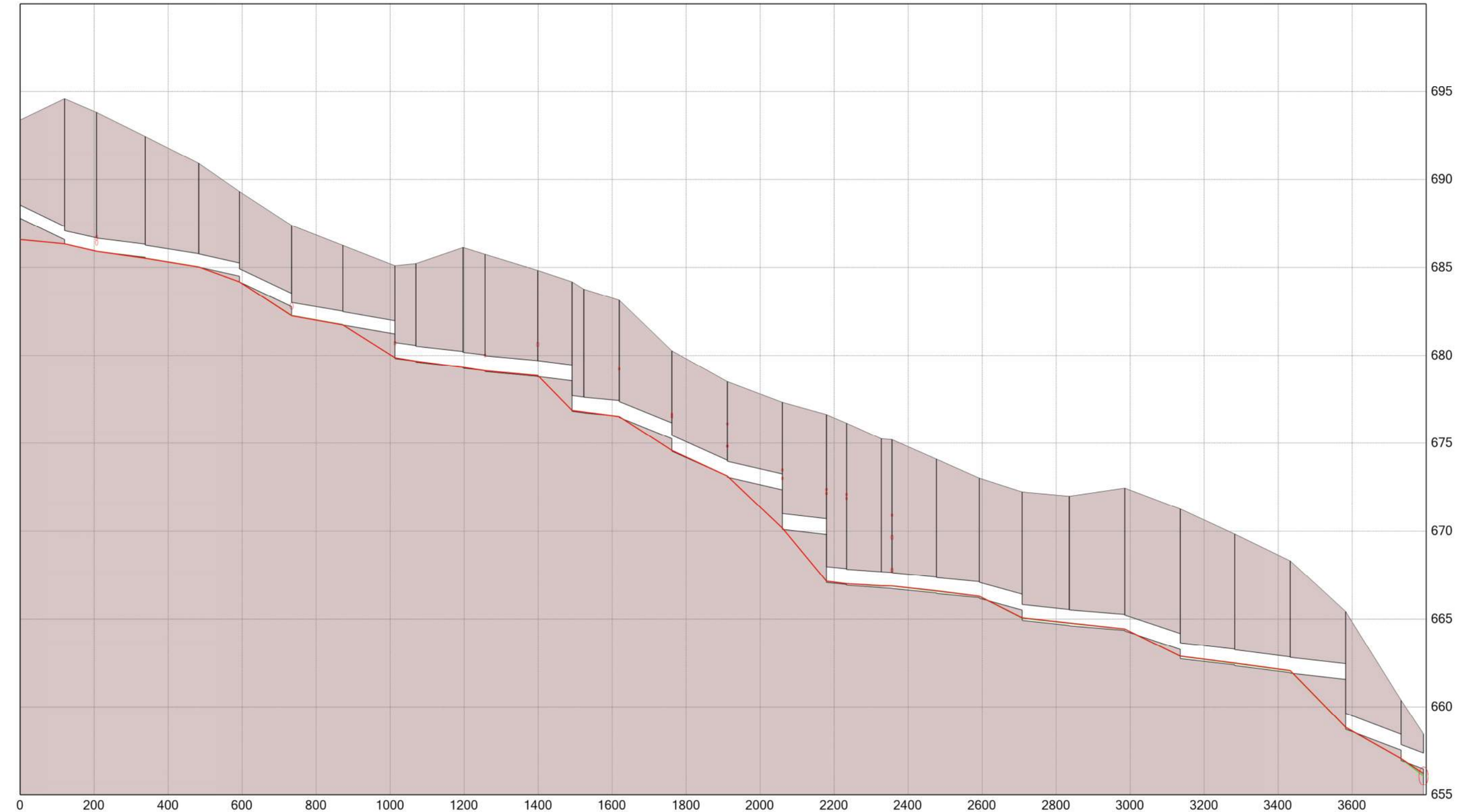
Pioneer Trunk

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H

Spruce Grove Existing System Assessment 25Y24H

Peak values

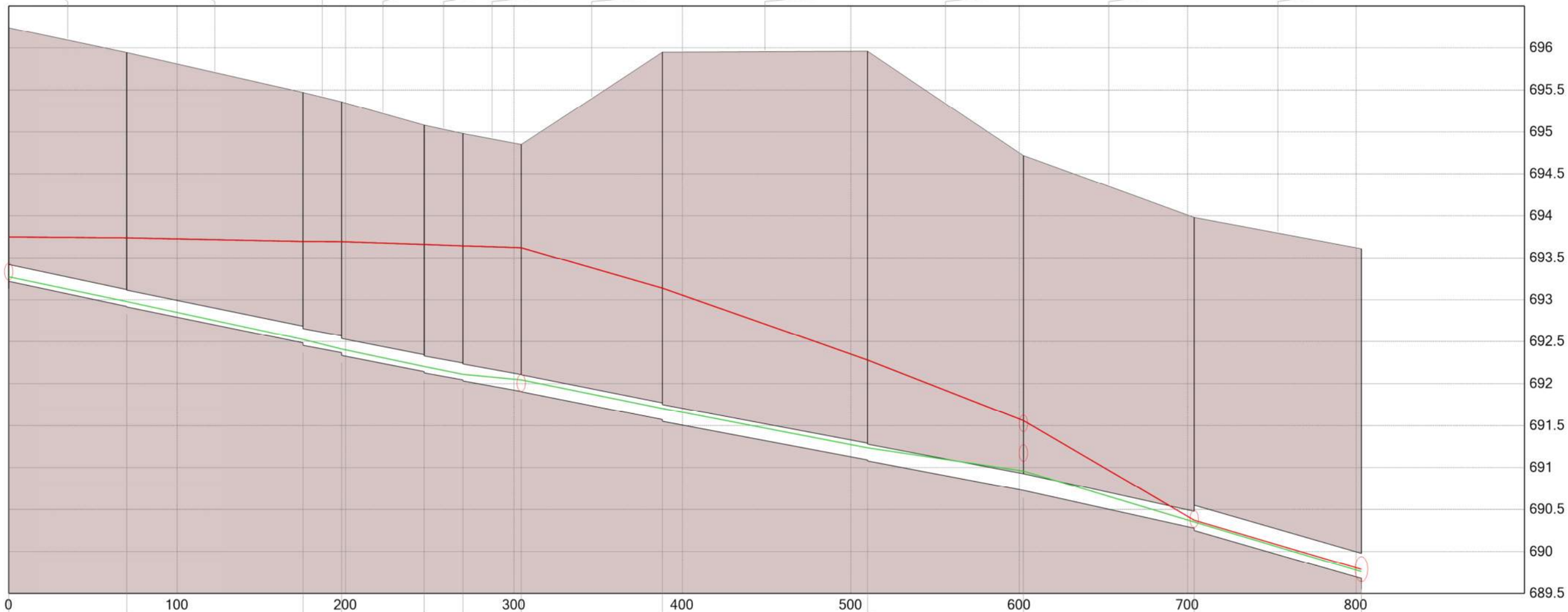


Sewer Along Windermere Drive

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H — Spruce Grove Existing System Assessment 25Y24H — Peak values

Links:	P-MH-660	P-MH-659	P-MH-658	P-MH-657	P-MH-656	P-MH-655	P-MH-654	P-MH-653	P-MH-700	P-MH-699	P-MH-698
	L=70.078 m	L=104.65 m	L=22.941 m	L=49.054 m	L=22.976 m	L=34.599 m	L=83.788 m	L=121.874 m	L=92.51 m	L=101.419 m	L=99.286 m
	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.2 m	D=0.3 m
	S=0.00427 m/m	S=0.00411 m/m	S=0.00375 m/m	S=0.00391 m/m	S=0.00361 m/m	S=0.00361 m/m	S=0.00396 m/m	S=0.00378 m/m	S=0.00382 m/m	S=0.00442 m/m	S=0.00574 m/m
	I1=693.219 m	I1=692.914 m	I1=692.454 m	I1=692.335 m	I1=692.128 m	I1=692.033 m	I1=691.905 m	I1=691.552 m	I1=691.079 m	I1=690.726 m	I1=690.25 m
	I2=692.92 m	I2=692.484 m	I2=692.368 m	I2=692.143 m	I2=692.045 m	I2=691.908 m	I2=691.573 m	I2=691.091 m	I2=690.726 m	I2=690.278 m	I2=689.68 m

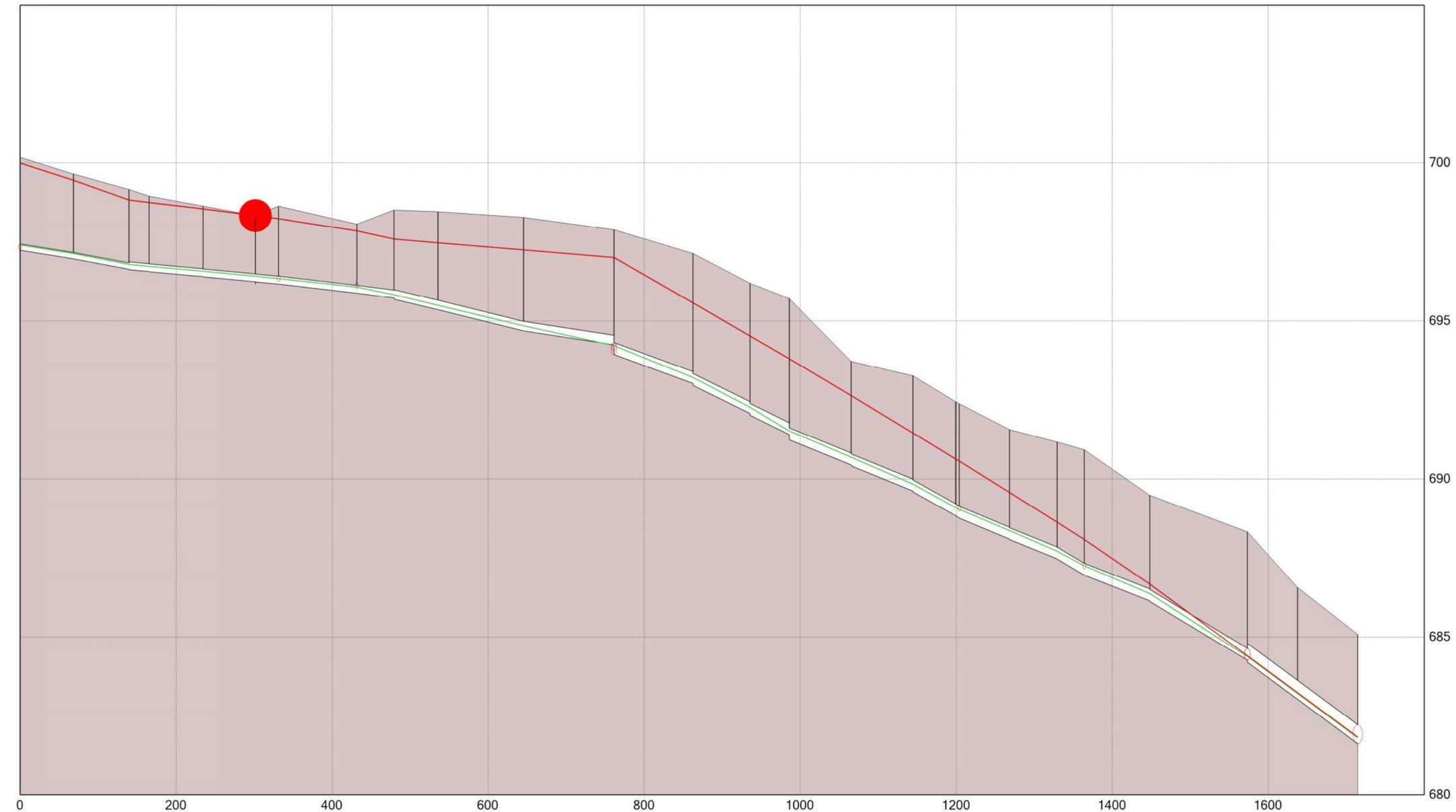


Nodes:	MH-660	MH-659	MH-658	MH-657	MH-656	MH-655	MH-654	MH-653	MH-700	MH-699	MH-698	MH-697
	M=693.7491 m	M=693.7384 m	M=693.6959 m	M=693.6935 m	M=693.6608 m	M=693.6442 m	M=693.6222 m	M=693.1376 m	M=692.2802 m	M=691.5608 m	M=690.3716 m	M=689.7884 m
	R=696.239 m	R=695.944 m	R=695.471 m	R=695.359 m	R=695.081 m	R=694.981 m	R=694.85 m	R=695.947 m	R=695.959 m	R=694.718 m	R=693.98 m	R=693.61 m
	I=693.219 m	I=692.914 m	I=692.454 m	I=692.335 m	I=692.128 m	I=692.033 m	I=691.905 m	I=691.552 m	I=691.079 m	I=690.726 m	I=690.25 m	I=689.64 m

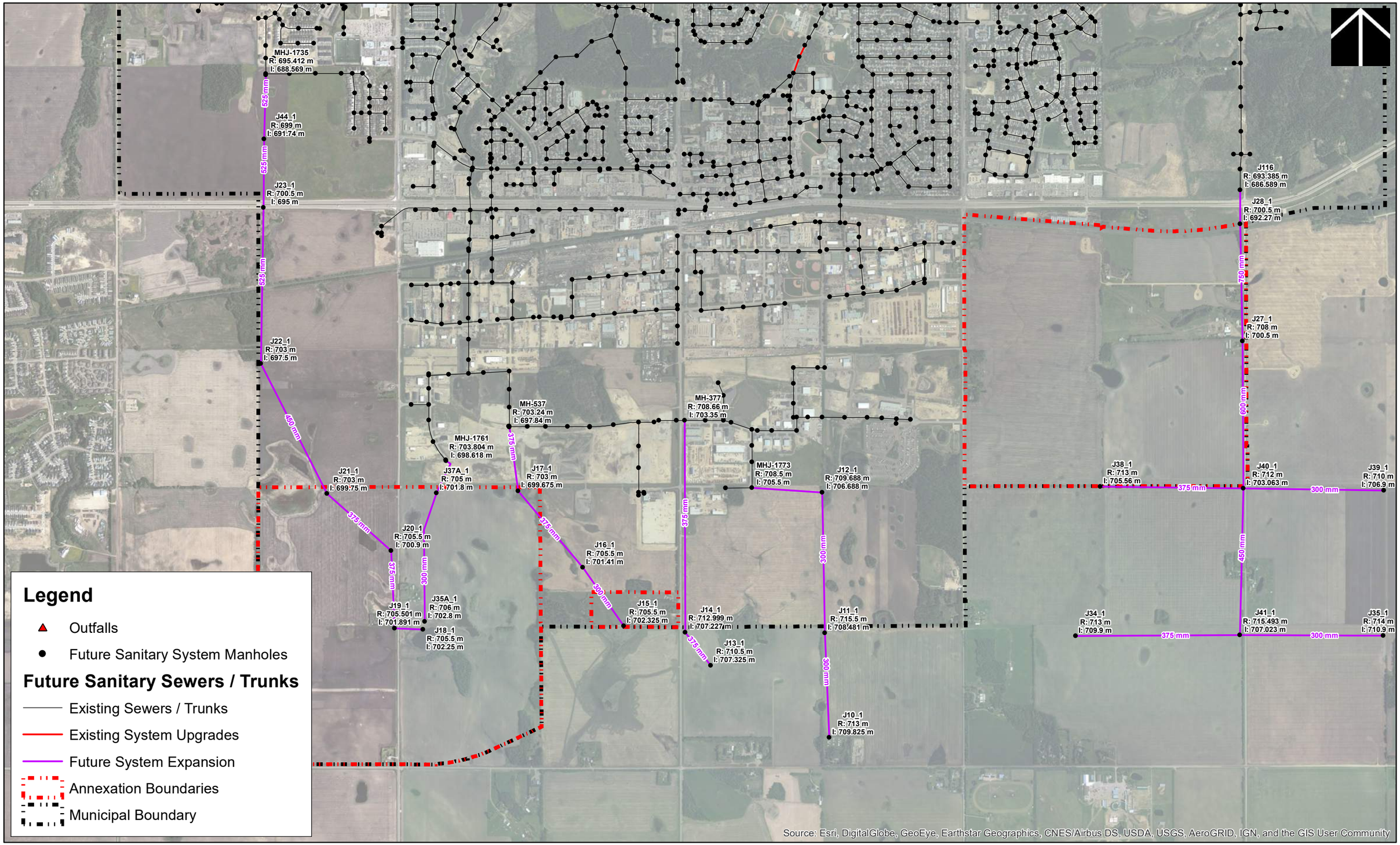
Sewer Along Oatway Street, Bristow Crescent, then King Street

Existing System Modeling Results

Spruce Grove Existing System Assessment 100Y24H — Spruce Grove Existing System Assessment 25Y24H — Peak values



APPENDIX D
Future System Modelling Details



ISL

SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

FUTURE SANITARY SYSTEM INVERTS, RIMS AND SEWER DIAMETERS

FIGURE D.1

1:20,000

0 130 260 520 780 1,040 Meters

Boundary Trunk

Future System to Hwy 628

HGL

Time: 2021-04-02 12:05:00 AM

Conduit C18
Length = 164.79 m
Depth = 0.375 m
Slope = 0.00218 m/m
Invert1 = 702.25 m
Invert2 = 701.891 m

Conduit C19
Length = 448.42 m
Depth = 0.375 m
Slope = 0.00221 m/m
Invert1 = 701.891 m
Invert2 = 700.9 m

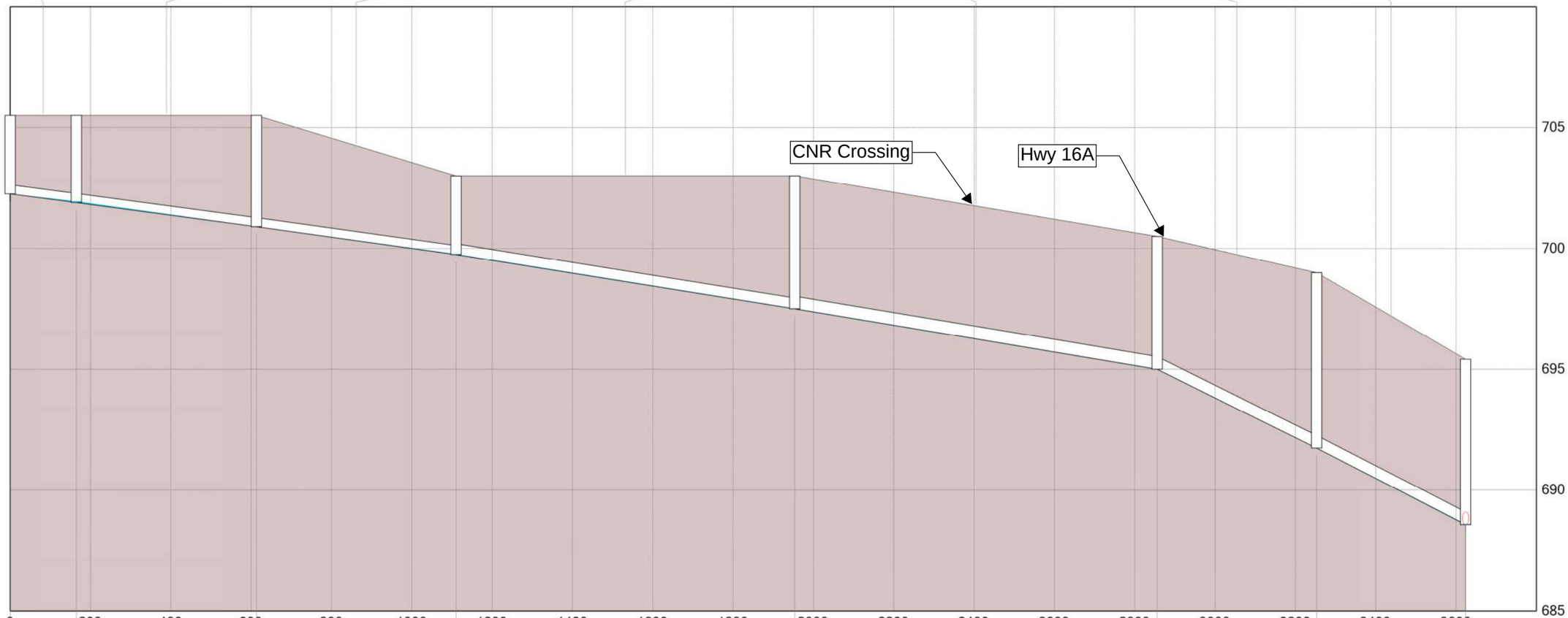
Conduit C20
Length = 496.78 m
Depth = 0.375 m
Slope = 0.00231 m/m
Invert1 = 700.9 m
Invert2 = 699.75 m

Conduit C21
Length = 843.35 m
Depth = 0.45 m
Slope = 0.00267 m/m
Invert1 = 699.75 m
Invert2 = 697.5 m

Conduit C22
Length = 902.44 m
Depth = 0.525 m
Slope = 0.00277 m/m
Invert1 = 697.5 m
Invert2 = 695 m

Conduit C23
Length = 396.85 m
Depth = 0.525 m
Slope = 0.00821 m/m
Invert1 = 695 m
Invert2 = 691.74 m

Conduit C44
Length = 371.04 m
Depth = 0.525 m
Slope = 0.00855 m/m
Invert1 = 691.74 m
Invert2 = 688.569 m



Junction J18_1
Rim Elev. = 705.5 m
Invert Elev. = 702.25 m

Junction J19_1
Rim Elev. = 705.501 m
Invert Elev. = 701.891 m

Junction J20_1
Rim Elev. = 705.5 m
Invert Elev. = 700.9 m

Junction J21_1
Rim Elev. = 703 m
Invert Elev. = 699.75 m

Junction J22_1
Rim Elev. = 703 m
Invert Elev. = 697.5 m

Junction J23_1
Rim Elev. = 700.5 m
Invert Elev. = 695 m

Junction J44_1
Rim Elev. = 699 m
Invert Elev. = 691.74 m

Junction MHJ-1735
Rim Elev. = 695.412 m
Invert Elev. = 688.569 m

Pioneer Trunk

Future System to Hwy 628

HGL

Time: 2021-04-02 12:05:00 AM

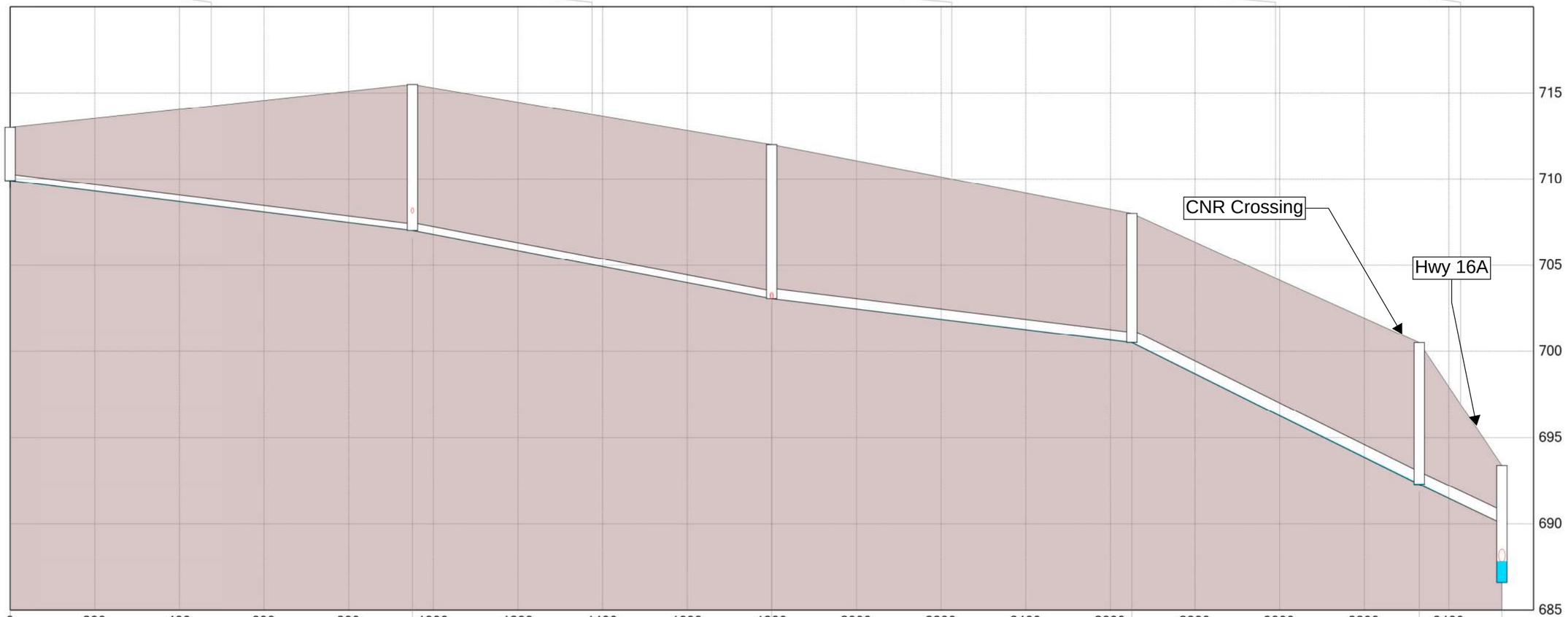
Conduit C34
Length = 950.63 m
Depth = 0.375 m
Slope = 0.00303 m/m
Invert1 = 709.9 m
Invert2 = 707.023 m

Conduit C41
Length = 848.99 m
Depth = 0.45 m
Slope = 0.00466 m/m
Invert1 = 707.023 m
Invert2 = 703.063 m

Conduit C40
Length = 851.15 m
Depth = 0.6 m
Slope = 0.00301 m/m
Invert1 = 703.063 m
Invert2 = 700.5 m

Conduit C27
Length = 679.14 m
Depth = 0.75 m
Slope = 0.0121 m/m
Invert1 = 700.5 m
Invert2 = 692.273 m

Conduit C28
Length = 195.3 m
Depth = 0.75 m
Slope = 0.0115 m/m
Invert1 = 692.273 m
Invert2 = 690.017 m



Junction J34_1
Rim Elev. = 713 m
Invert Elev. = 709.9 m

Junction J41_1
Rim Elev. = 715.493 m
Invert Elev. = 707.023 m

Junction J40_1
Rim Elev. = 712 m
Invert Elev. = 703.063 m

Junction J27_1
Rim Elev. = 708 m
Invert Elev. = 700.5 m

Junction J28_1
Rim Elev. = 700.5 m
Invert Elev. = 692.27 m

Junction J116
Rim Elev. = 693.385 m
Invert Elev. = 686.589 m

APPENDIX E
Detailed Cost Estimates

The City of Spruce Grove Sanitary Sewer Master Plan, 2022 - Detailed Cost Estimates

Project: Spruce Grove Sanitary Sewer Master Plan, 2022
Client: The City of Spruce Grove
Project #: 16110
Date: 2022-03-09

Engineering: 15%
Contingency: 30%

Table E.1 - Existing System Proposed Upgrades

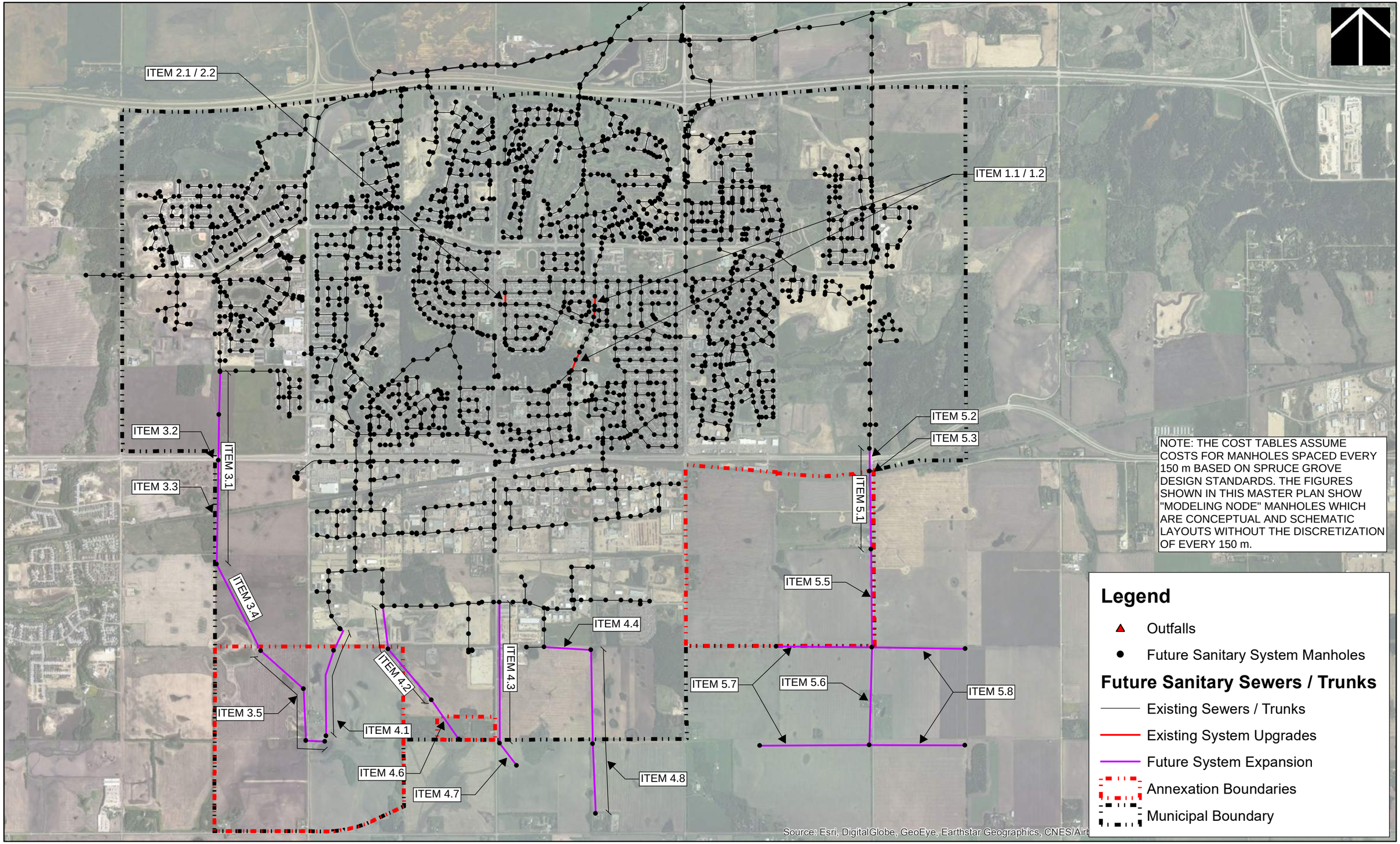
Item	Description	Unit Rate ($/unit)	Unit	Quantity (unit)	Cost Estimate ($)	Engineering ($)	Contingency ($)	Total ($)
1.1	600 mm upgrade along King Street (4 m deep) + Trench & Backfill	2,049	m	354	$ 725,000	$ 109,000	$ 218,000	$ 1,052,000
1.2	Removals (asphalt, underlying gravel / soils and existing pipe)	581	m	354	$ 206,000	$ 31,000	$ 62,000	$ 299,000
				SUB-TOTAL	**$ 931,000**	**$ 140,000**	**$ 280,000**	**$ 1,351,000**
2.1	300 mm upgrade along Windermere Drive (4 m deep) + Trench & Backfill	1,622	m	101	$ 164,000	$ 25,000	$ 49,000	$ 238,000
2.2	Removals (asphalt, underlying gravel / soils and existing pipe)	581	m	101	$ 59,000	$ 9,000	$ 18,000	$ 86,000
				SUB-TOTAL	**$ 223,000**	**$ 34,000**	**$ 67,000**	**$ 324,000**
							GRAND TOTAL ($)	**$ 1,675,000**

Table E.2 - Proposed Future System Expansion to Municipal Boundaries

Item	Description	Unit Rate ($/unit)	Unit	Quantity (unit)	Cost Estimate ($)	Engineering ($)	Contingency ($)	Total ($)
3.1	Boundary Trunk: 1,670 m of 525 mm (6 m deep) + Trench and Backfill	1,155	m	1,670	$ 1,929,000	$ 289,000	$ 579,000	$ 2,797,000
3.2	Boundary Trunk: 525 mm Hwy 16A Crossing	6,825	m	80	$ 546,000	$ 82,000	$ 164,000	$ 792,000
3.3	Boundary Trunk: 525 mm CNR Crossing (1,200 mm Steel Casing)	6,825	m	50	$ 341,000	$ 51,000	$ 102,000	$ 494,000
3.4	Boundary Trunk: 843 m of 450 mm (4 - 5 m deep) + Trench and Backfill	1,082	m	843	$ 912,000	$ 137,000	$ 274,000	$ 1,323,000
3.5	Boundary Trunk: 1,110 m of 375 mm (3 - 4 m deep) + Trench and Backfill	1,040	m	1,110	$ 1,154,000	$ 173,000	$ 346,000	$ 1,673,000
3.6	Boundary Trunk: 1,200 mm Manholes + F-39 Frames and Covers	4,444	ea	24	$ 107,000	$ 16,000	$ 32,000	$ 155,000
				SUB-TOTAL	**$ 4,989,000**	**$ 748,000**	**$ 1,497,000**	**$ 7,234,000**
4.1	West Trunk Extension #1: 972 m of 300 mm (3 - 4 m deep) + Trench and Backfill	893	m	972	$ 868,000	$ 130,000	$ 260,000	$ 1,258,000
4.2	West Trunk Extension #2: 956 m of 375 mm (3 - 4 m deep) + Trench and Backfill	1,040	m	956	$ 994,000	$ 149,000	$ 298,000	$ 1,441,000
4.3	West Trunk Extension #3: 1,226 m of 375 mm (3 - 4 m deep) + Trench and Backfill	1,040	m	1,226	$ 1,274,000	$ 191,000	$ 382,000	$ 1,847,000
4.4	West Trunk Extension #4: 407 m of 450 mm (3 - 4 m deep) + Trench and Backfill	1,082	m	407	$ 440,000	$ 66,000	$ 132,000	$ 638,000
4.5	West Trunk Extensions: 1,200 mm Manholes + F-39 Frames and Covers	4,444	ea	24	$ 105,000	$ 16,000	$ 32,000	$ 153,000
				SUB-TOTAL	**$ 3,681,000**	**$ 552,000**	**$ 1,104,000**	**$ 5,337,000**
5.1	Pioneer Trunk: 874 m of 750 mm (7 m deep) + Trench and Backfill	1,460	m	874	$ 1,276,000	$ 191,000	$ 383,000	$ 1,850,000
5.2	Pioneer Trunk: 750 mm Hwy 16A Crossing	6,825	m	80	$ 546,000	$ 82,000	$ 164,000	$ 792,000
5.3	Pioneer Trunk: 750 mm CNR Crossing (1,200 mm Steel Casing)	6,825	m	50	$ 341,000	$ 51,000	$ 102,000	$ 494,000
5.4	Pioneer Trunk Extensions: 1,200 mm Manholes + F-39 Frames and Covers	4,444	ea	6	$ 26,000	$ 4,000	$ 8,000	$ 38,000
				SUB-TOTAL	**$ 2,189,000**	**$ 328,000**	**$ 657,000**	**$ 3,174,000**
							GRAND TOTAL ($)	**$15,745,000**

Table E.3 - Proposed Future System Expansion Beyond Municipal Boundaries to Highway 628

Item	Description	Unit Rate ($/unit)	Unit	Quantity (unit)	Cost Estimate ($)	Engineering ($)	Contingency ($)	Total ($)
4.6	West Trunk Extension #2: 413 m of 300 mm (3 - 4 m deep) + Trench and Backfill	893	m	413	$ 369,000	$ 55,000	$ 111,000	$ 535,000
4.7	West Trunk Extension #3: 242 m of 375 mm (3 - 4 m deep) + Trench and Backfill	1,040	m	242	$ 252,000	$ 38,000	$ 76,000	$ 366,000
4.8	West Trunk Extension #4: 1,419 m of 300 mm (3 - 4 m deep) + Trench and Backfill	893	m	1,419	$ 1,266,000	$ 190,000	$ 380,000	$ 1,836,000
4.9	West Trunk Extension: 1,200 mm Manholes + F-39 Frames and Covers	4,444	ea	14	$ 61,000	$ 9,000	$ 18,000	$ 88,000
				SUB-TOTAL	**$ 1,948,000**	**$ 292,000**	**$ 585,000**	**$ 2,825,000**
5.5	Pioneer Trunk: 851 m of 600 mm (8 m deep) + Trench and Backfill	1,365	m	851	$ 1,162,000	$ 174,000	$ 349,000	$ 1,685,000
5.6	Pioneer Trunk: 849 m of 450 mm (8 m deep) + Trench and Backfill	1,082	m	849	$ 918,000	$ 138,000	$ 275,000	$ 1,331,000
5.7	Pioneer Trunk Extension: 1,779 m of 375 mm (3 - 8 m deep) + Trench and Backfill	1,040	m	1,779	$ 1,849,000	$ 277,000	$ 555,000	$ 2,681,000
5.8	Pioneer Trunk Extension: 1,643 m of 300 mm (3 - 8 m deep) + Trench and Backfill	893	m	1,643	$ 1,466,000	$ 220,000	$ 440,000	$ 2,126,000
5.9	Pioneer Trunk Extension: 1,200 mm Manholes + F-39 Frames and Covers	4,444	m	34	$ 152,000	$ 23,000	$ 46,000	$ 221,000
				SUB-TOTAL	**$ 5,547,000**	**$ 832,000**	**$ 1,665,000**	**$ 8,044,000**
							GRAND TOTAL ($)	**$10,869,000**



SPRUCE GROVE SANITARY SEWER MASTER PLAN UPDATE

FUTURE UPGRADES, SYSTEM EXPANSION AND BREAKDOWN OF COST LINE ITEMS

FIGURE E.1

1:30,000

0 195 390 780 1,170 1,560 Meters