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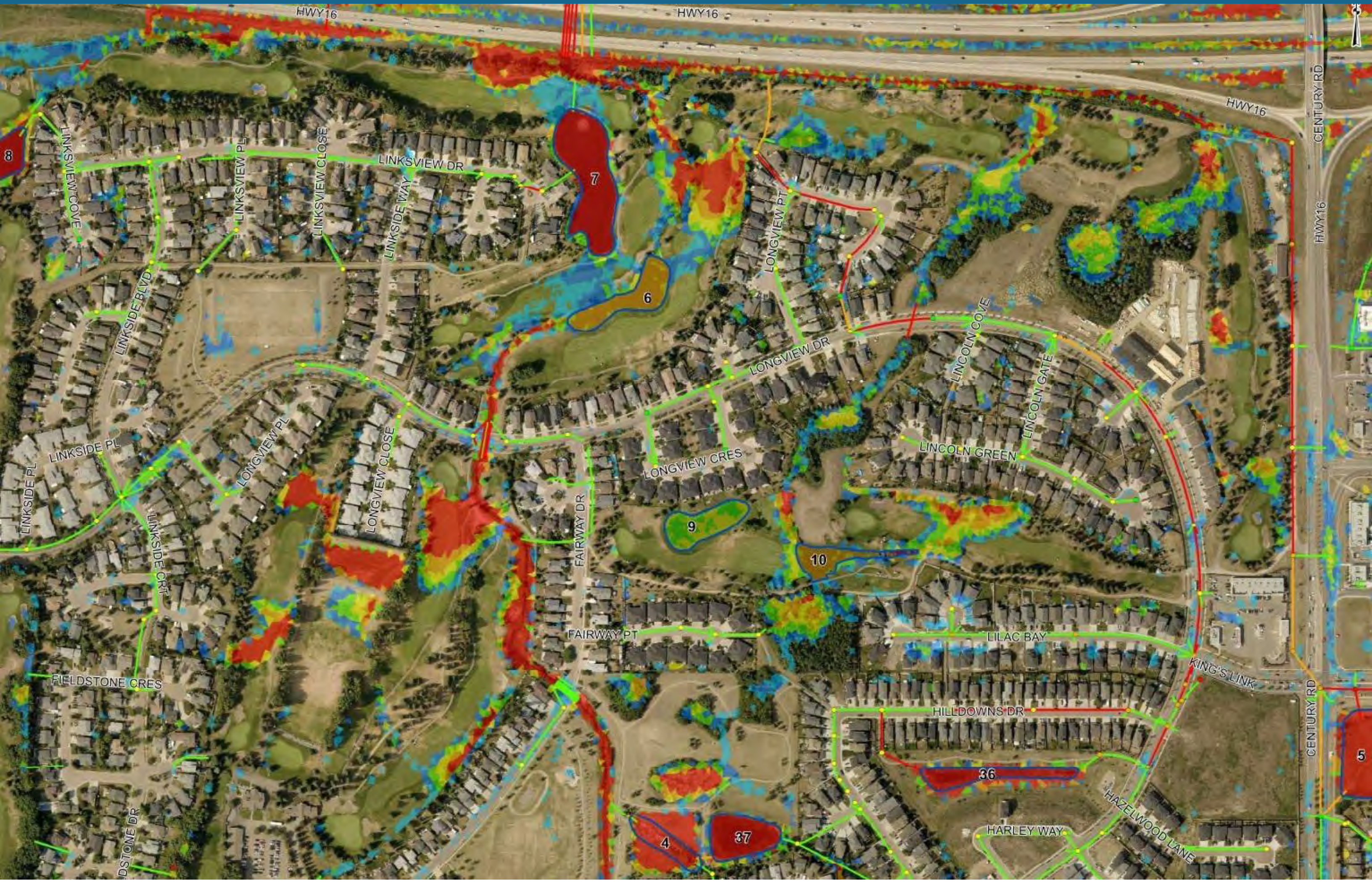

THE CITY OF SPRUCE GROVE STORMWATER MASTER PLAN

The City of Spruce Grove

FINAL REPORT

August 2024

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.

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PROFESSIONAL ENGINEER ALBERTA
SARAH BARBOSA
August 13 2024

Sarah Barbosa, P. Eng., ENV SP
Lead, Municipal Infrastructure Planning

PROFESSIONAL ENGINEER ALBERTA
JEREMY SHINBINE
ID 210789
2024-08-12

Jeremy Shinbine, P.Eng.
Water Resources Engineer

PROFESSIONAL ENGINEER ALBERTA
BARRY C. RAYNARD
2024-08-13
32905

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

Permit to Practice
ISL Engineering and Land Services Ltd.
RM Signature:
RM APEGA ID: 66731
Date: 2024 August 13
Permit Number P4741
The Association of Professional Engineers and Geoscientists of Alberta

Geoffrey Schulmeister, P. Eng., SCPM
Director / General Manager, Water and Environment

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ACRONYMS

Acronym	Full Name
1D	1-dimensional
2D	2-dimensional
AT	Alberta Transportation
C	Runoff Coefficient
CBOD	Carbonaceous Biochemical Oxygen Demand
CCTV	Closed Circuit Television
CNR	Canadian National Railway
E&SC	Erosion and Sediment Control
EMRB	Edmonton Metropolitan Regional Board
ER	Environmental Reserve
Fb	Freeboard
GEV	Generalized Extreme Value
GIS	Geographic Information System
HGL	Hydraulic Grade Line
HWL	High Water Level
IDF	Intensity-Duration-Frequency
ISL	ISL Engineering and Land Services Ltd.
LID	Low Impact Development
LiDAR	Light Detection and Ranging
MDP	Municipal Development Plan
n	Manning Roughness Coefficient
NWL	Normal Water Level
O&M	Operations and Maintenance
RCP	Representative Concentration Pathway
SWMF	Stormwater Management Facility
SWMP	Stormwater Master Plan
the City	The City of Spruce Grove
TSS	Total Suspended Solids

1.0 Introduction

1.1 Background

The City of Spruce Grove (the City) has retained ISL Engineering and Land Services Ltd. (ISL) to undertake the 2023 Spruce Grove Stormwater Master Plan (SWMP). The previous SWMP was completed in 2015 and the City has experienced rapid growth due to development and land annexation which triggered the need for this project. The current population is approximately 40,000 with a projected growth to over 98,000 by 2059 – an approximate growth rate of 1,650 per year.

The previous SWMP was last updated in 2015 using PCSWMM Version 7.4 and proposed numerous updates to the Municipal Development Standards, which have been recently updated in 2023; therefore, this SWMP will incorporate any revisions reflected in the most current document. In 2019, ISL completed a technical modelling analysis of the Spruce Grove industrial storm network south of Highway 16A. From this work, several upgrades have been proposed and implemented to improve drainage conditions within the industrial area and will be incorporated into this SWMP.

The SWMP focuses on the use of stormwater management facilities (SWMF) to ensure water quantity is controlled and released at acceptable rates, and that sufficient attenuation is provided to ensure acceptable water quality through settling of solids within the ponds. The use of SWMFs will protect local and regional watersheds by improving the water quality that is released from the City and is consistent with the overarching policies found within the most recent Municipal Development Plan (MDP).

1.2 Purpose of Study

The purpose of the Spruce Grove Stormwater Master Plan was to achieve the following goals:

- Review the existing PCSWMM model and GIS database to identify and fill in data gaps and enable the development of an integrated 1D-2D stormwater model in InfoWorks ICM.
- Delineate catchments to better understand overland drainage patterns within the City.
- Recommend Closed Circuit Television (CCTV) locations to inspect the condition of different pipe materials and ages and provide rehabilitation recommendations as needed.
- Assess the existing drainage conditions and identify any hydraulic deficiencies or constraints based on the updated Municipal Development Standards.
- Recommend required upgrades based on flood risk prioritization, municipal needs, and future growth requirements.
- Comment on possible staging options of upgrades for optimal implementation and coordination of infrastructure projects.
- Develop stormwater infrastructure plans, including SWMF sizing, to manage increased and redirected runoff from future development.
- Provide commentary on potential short-, medium-, and long-term phasing of future capital projects to ensure strategic and sustainable development.
- Provide cost estimates for infrastructure upgrades and new capital infrastructure projects that will inform the City's off-site levy bylaw.
- Consider the impact of climate change on drainage systems as part of the evaluation and test the resiliency of recommended upgrades and future stormwater infrastructure.

2.0 Study Area

2.1 Location

Spruce Grove is situated approximately 30 km west of Edmonton within Parkland County with Stony Plain to the west and Acheson to the east. Spruce Grove is bounded by Highway 16 to the north and as far south as Highway 628. The City has recently annexed just over 8 quarter sections of land south of Highway 16A into its municipal boundary. **Figure 2.1** shows the current extents of the Municipal Boundary as well as the recently annexed areas to the south.

2.2 Existing Land Use

Existing and future land uses within the City are shown in **Figure 2.2** and is based on land use GIS information from the 2020 MDP and the 2019 Growth Study Addendum. Most of the City is projected to develop with residential land uses north of Highway 16A and mostly industrial land use south of Highway 16A (some residential), with highway commercial along the Highway.

2.3 Growth Horizons

The proposed growth plan for Spruce Grove is summarized in **Table 2.1** and **Figure 2.3** and is based on the work completed as part of the 2022 Spruce Grove Sanitary Sewer Master Plan. Additional potential growth is shown all the way to Highway 628 south of the current municipal boundaries. It is assumed that any potential future development beyond the current municipal boundaries will be mostly industrial development based on adjacent land use. It should be noted that the growth projections, anticipated land uses, and estimated populations are dynamic and change with the adoption of new planning policies. While the growth projections used for this study have been updated throughout the life of the project, they were kept the same as the 2022 Spruce Grove Sanitary Sewer Master Plan to maintain some level of consistency between both documents. While the land use plan and growth projections may change, the impact on the overall future stormwater concept will not change drastically.

The previous 2015 SWMP projected growth beyond the current 2021 annexation boundary and developed stormwater management concepts all the way to Highway 628. The City has directed ISL to account for this potential growth beyond the municipal boundary when assessing future infrastructure sizing. The rationale is that upsizing SWMF outfall trunks 1 – 2 sizes to account for potential development outside the municipal boundaries is nominal compared to the potential future upgrading costs if large trunks did not account for potential upstream development. This additional capacity can be used to service future annexed lands or by Parkland County to service lands to the south on an interim or permanent basis, which is in keeping with the spirit of regional cooperation as per recommendations from the Tri-Municipal Regional Plan.

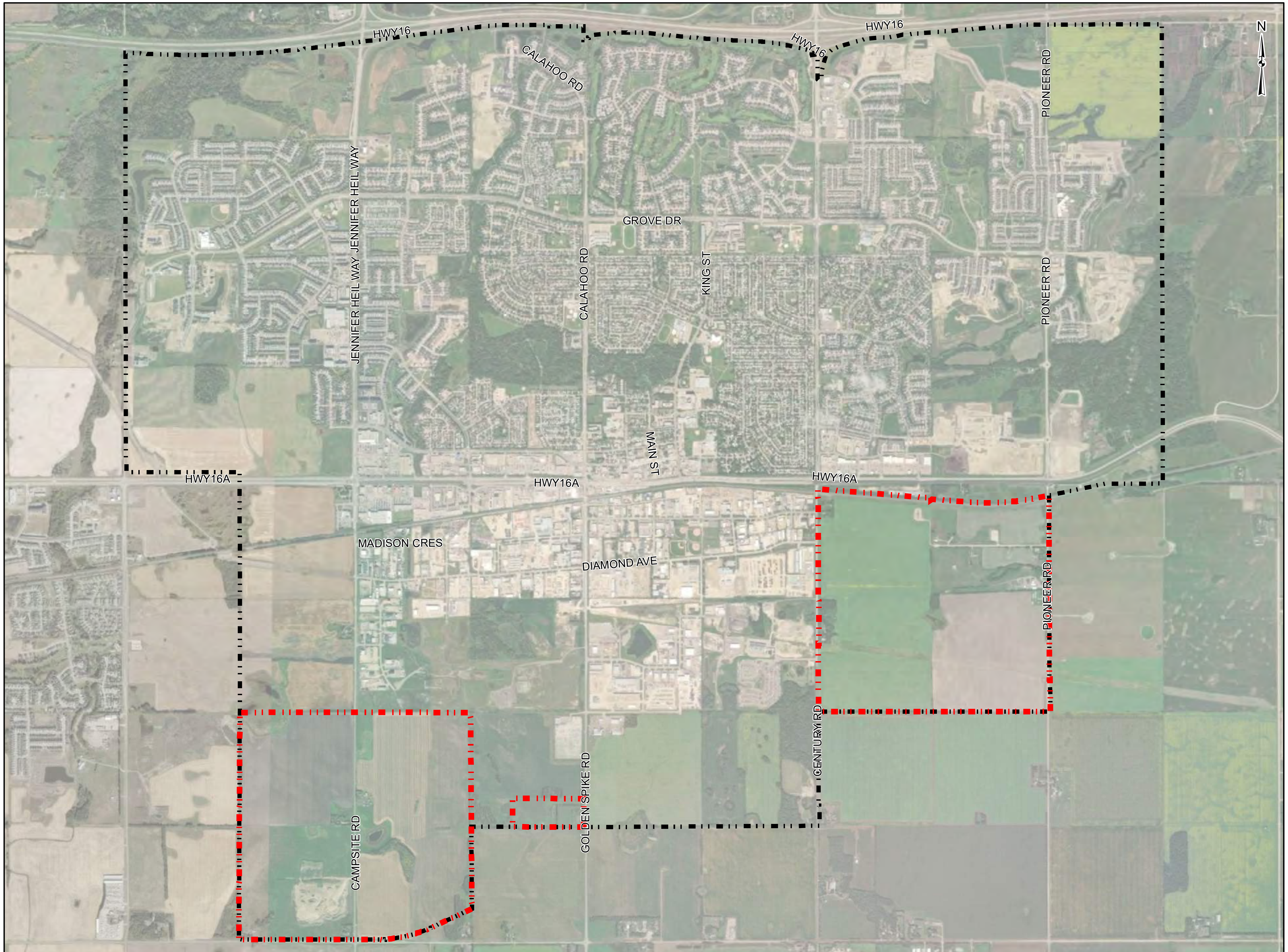
Table 2.1: Growth Projections

Area Name	Area Structure Plan	Areas (ha)								
		Residential	Commercial	Industrial	Institutional	Open Space / Env. Reserve	Pipe / Well Setback / Rail / Road Allowance	Special Study Area	County Land	Total
A-1	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.7	67.7
A-2	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.0	67.0
A-3	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.9	66.9
A-4	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.9	63.9
A-5	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.4	66.4
A-6	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.4	65.4
A-7a	N/A	109.9	8.4	0.0	0.0	3.2	8.5	0.0	0.0	130.0
A-7b	N/A	0.0	0.0	0.0	0.0	0.0	0.2	0.0	63.8	64.0
A-8a	N/A	44.4	17.6	31.7	0.0	0.0	16.7	0.0	0.0	110.5
A-8b	N/A	0.0	0.0	0.0	0.0	0.0	0.3	0.0	62.7	63.1
A-9	East Pioneer	0.0	10.9	0.0	3.4	0.0	5.3	5.2	0.0	24.8
A-10	East Pioneer	37.7	11.5	0.0	0.0	0.0	0.0	0.0	0.0	49.2
A-11	East Pioneer	0.0	23.5	0.0	0.0	25.8	1.8	0.0	0.0	51.1
A-12	East Pioneer	37.9	0.0	0.0	0.0	4.3	0.0	0.0	0.0	42.2
A-13	East Pioneer	12.6	0.0	0.0	0.0	12.1	0.0	0.0	0.0	24.7
A-14	East Pioneer	22.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.7
A-15	East Pioneer	30.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	35.2
A-16	Pioneer Lands	30.8	0.0	0.0	0.0	0.7	0.0	0.0	0.0	31.5
A-17	Pioneer Lands	11.4	0.0	0.0	2.0	2.8	0.0	0.0	0.0	16.2
A-18	Pioneer Lands	34.9	0.0	0.0	0.0	4.5	0.0	0.0	0.0	39.4
A-19	Pioneer Lands	62.8	0.0	0.0	0.0	0.1	0.0	0.0	0.0	62.9
A-20	Pioneer Lands	32.5	0.0	0.0	0.0	0.1	0.0	0.0	0.0	32.7
A-21	Pioneer Lands	33.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.2
B-1	Pioneer Lands	28.7	24.7	0.0	0.0	0.0	0.0	0.0	0.0	53.4
C-1	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.2	19.2
C-2	N/A	0.0	0.0	0.1	0.0	0.0	0.0	0.0	49.1	49.2
C-3	South Century	0.3	0.0	94.3	21.8	12.9	0.0	0.0	0.0	129.3
D-1	N/A	0.0	0.0	0.1	0.0	0.0	0.0	0.0	67.2	67.4
D-2	South Century	0.0	0.0	65.4	0.0	0.0	0.0	0.0	0.0	65.4
E-1	N/A	0.0	0.0	5.9	0.0	0.6	0.3	0.0	65.8	72.6
E-2	Railway Avenue Area	0.0	0.0	72.3	0.0	1.2	0.3	0.0	0.0	73.8
E-3	Railway Avenue Area	0.1	0.0	102.9	0.0	23.5	0.0	0.0	0.0	126.6
F-1	N/A	0.2	12.4	37.4	0.0	3.8	2.1	0.0	3.9	59.9
F-2	N/A	0.0	0.0	53.7	0.0	0.8	2.1	0.0	0.0	56.5
G-1	N/A	55.9	7.3	0.0	0.0	0.0	0.0	0.0	0.0	63.2
G-2	N/A	55.0	0.0	0.0	0.0	7.3	4.0	0.0	0.0	66.3
G-3	Shiloh	63.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	64.2
G-4	Shiloh	15.8	25.5	0.0	2.5	6.4	0.0	13.1	0.0	63.4
G-5	West Central	32.9	25.0	0.0	0.0	0.0	0.0	0.0	0.0	57.9
G-6	West Central	0.3	25.1	0.0	0.0	0.0	0.0	0.0	0.0	25.4
G-7	West Central	27.5	0.0	0.0	0.0	5.3	0.0	0.0	0.0	32.8

Area Name	Area Structure Plan	Areas (ha)								
		Residential	Commercial	Industrial	Institutional	Open Space / Env. Reserve	Pipe / Well Setback / Rail / Road Allowance	Special Study Area	County Land	Total
G-8	West	67.5	0.0	0.0	6.3	0.1	0.0	0.0	0.0	73.9
H-1	West	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3
H-2	West	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4
I-1	West	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
I-2	West	60.0	0.0	0.0	0.0	30.9	0.0	0.0	0.0	90.9
I-3	North Central	48.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.0
J-1	North Central	40.9	0.0	0.0	0.0	1.5	0.0	0.0	0.0	42.4
J-2	North Central	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9
J-3	Senior's Co-op Housing	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5
J-4	Heritage Estates	29.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	31.0
K-1	North Central	35.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.8

Notes:

1. Land uses are based on most recent land use planning from the Spruce Grove MDP.
2. A-11 has been updated to include the latest baseball diamond amendment from East Pioneer Amendment.
3. Area Structure Plan (ASP) designated "Special Study Areas" have been assumed to be commercial development based on adjacent land uses.
4. Future potential development up to Hwy 628 outside the current municipal boundary is assumed to be industrial development.



LEGEND

Annexation Boundaries

Municipal Boundaries

TITLE

FIGURE 2.1 - STUDY AREA AND ANNEXATION AREA

PROJECT

SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT

THE CITY OF SPRUCE GROVE

DATA SOURCES

- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION

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FIGURE	2.1
DATE	2024-05-29
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AUTHOR	JS

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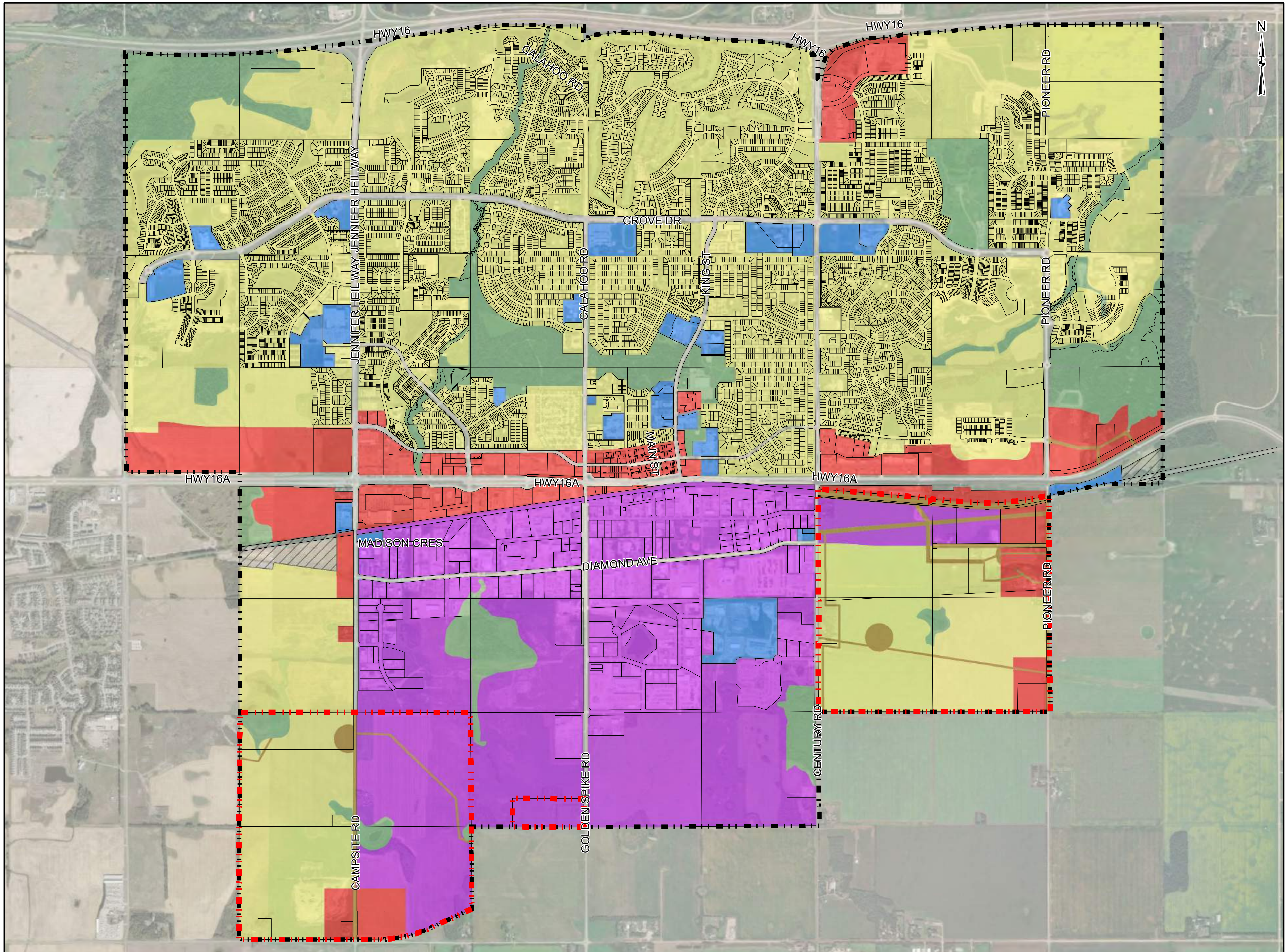

LEGEND

- Annexation Boundaries
- Municipal Boundaries
- Parcel

Land Use

- Residential
- Commercial
- Industrial
- Institutional
- Special Study Area
- Open Space / Environmental Reserve
- Pipeline / Well Setback / Rail / Road Allowance

TITLE
FIGURE 2.2 - LAND USE

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN
CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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PROJECT NO.	16462
AUTHOR	JS

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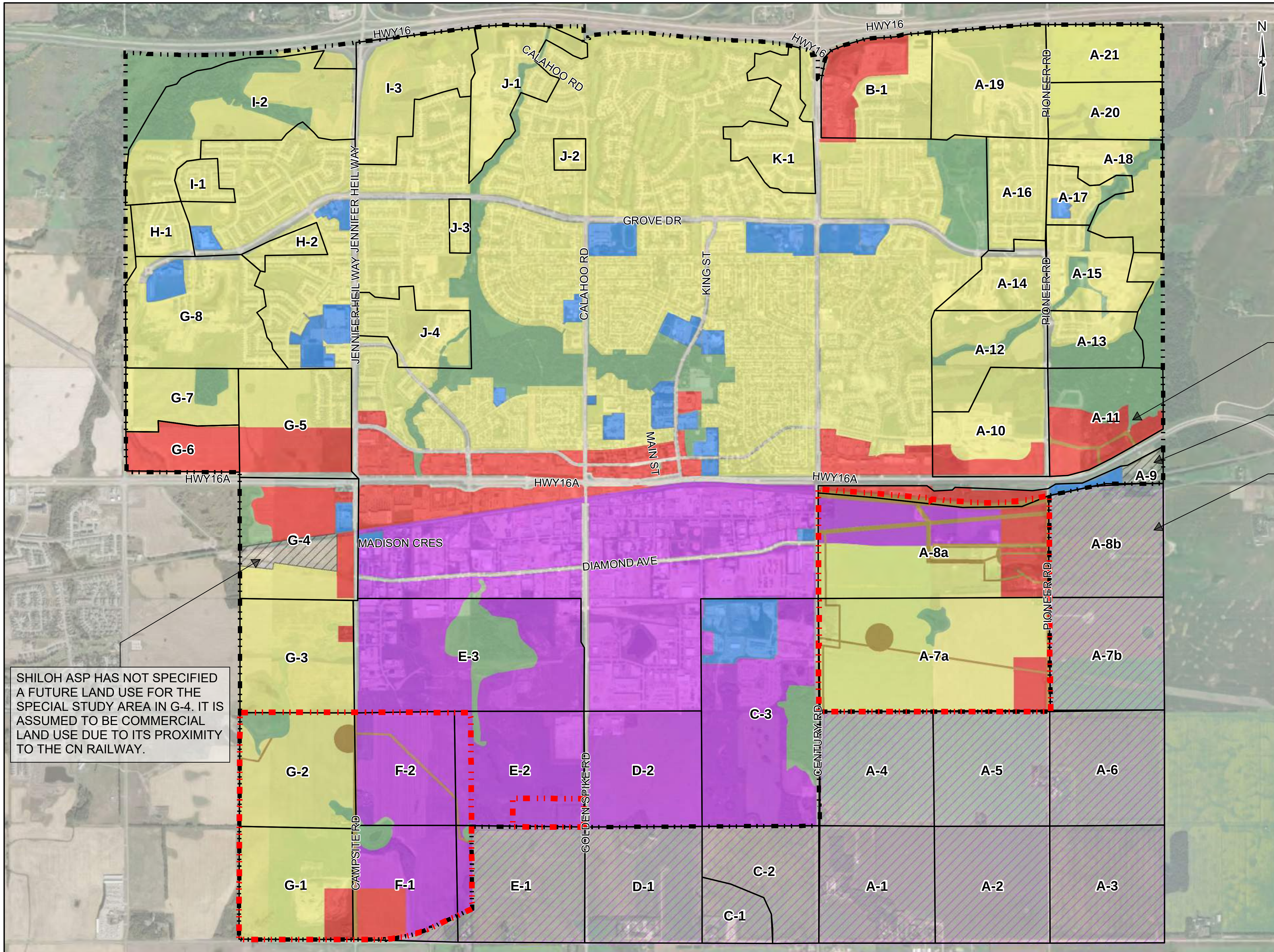

LEGEND

- Annexation Boundaries
- Municipal Boundaries
- Future Growth Areas

Land Use

Proposed Land Use

- Residential
- Commercial
- Industrial
- Institutional
- County Land
- Special Study Area
- Open Space / Environmental Reserve
- Pipeline / Well Setback / Rail / Road Allowance

A-11 HAS BEEN UPDATED BASED ON THE EAST PIONEER ASP AMENDMENT TO INCLUDE A BALL DIAMOND (ASSUMED COMMERCIAL).

SPECIAL STUDY AREA WITHIN A-9 IS ASSUMED TO BE COMMERCIAL DUE TO PROXIMITY WITH HIGHWAY 16A.

COUNTY LAND ASSUMED TO BE INDUSTRIAL DEVELOPMENT.

TITLE
FIGURE 2.3 - GROWTH PROJECTIONS

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION
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FIGURE	2.3
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

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3.0 Existing Stormwater System

Stormwater management within Spruce Grove consists of both major and minor drainage systems. The major system consists of any overland drainage and conveys stormwater runoff that exceeds the minor system capacity. The minor system consists of any underground infrastructure, including the piped network and any of its associated features.

The major system consists of the following types of drainage components:

- Surface (overland drainage)
- Roads
- Ditches
- Swales
- Stormwater management facilities (SWMF) including wet ponds and dry ponds
- Trap lows (sag locations where runoff can pool)
- Culverts
- Gutters
- Roof Leaders

The minor system consists of the follow types of drainage infrastructure:

- Storm sewers
- Catchbasins
- Catch basin leads
- Manholes
- Outfalls

Drainage within the City generally consists of curb and gutter overland drainage, with collection to storm sewer systems that discharge to one of the many SWMFs within the City that store the runoff and release it at lower rates, dictated by unit area release rates that generally equal predevelopment rates. These controlled releases help protect downstream stormwater systems including Dog Creek and Atim Creek against erosion. South of Highway 16A, within the industrial area, there is a ditch and culvert system that conveys runoff to the Canadian National Railway (CNR) culvert crossing near Madison Crescent and into Dog Creek, or eastwards along the CNR ditch.

3.1 Minor Stormwater System

The existing stormwater conveyance system is shown on **Figures 3.1** through **3.3** for pipe diameter, material, and age of installation, respectively. SWMFs are also labelled on these figures for reference and are discussed in **Section 3.2**.

Tables 3.1 through **3.3** summarize the storm sewers (minor system) and culverts (major system) in terms of diameter, material, and age of installation, respectively. Overall, there are approximately 145 km of storm sewers within the city and nearly 10 km of culverts, largely concentrated within the industrial area south of Highway 16A. For more detailed information regarding the stormwater system, see **Appendix A**.

Table 3.1: Storm Sewer and Culvert Diameter

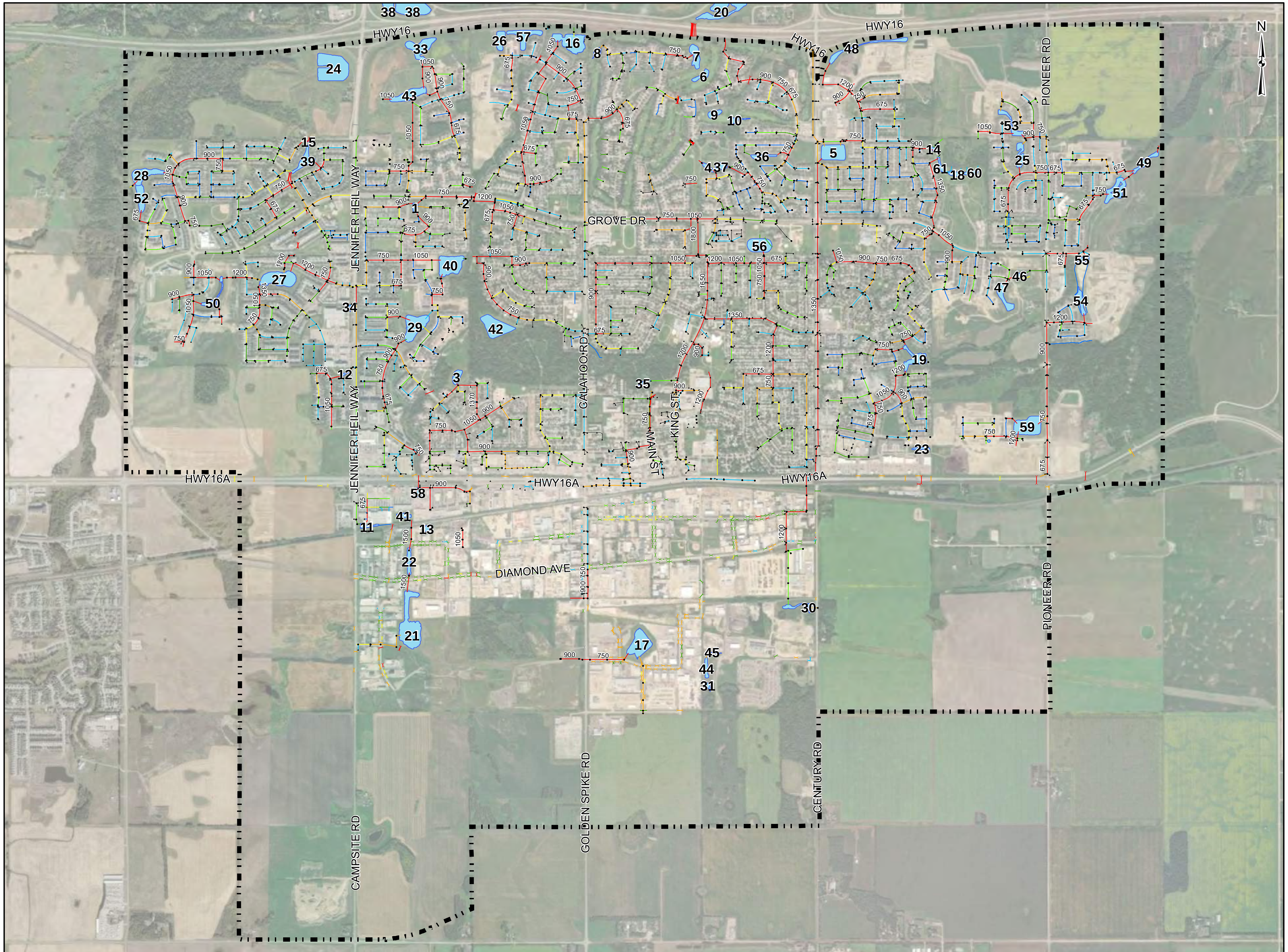
Diameter (mm)	Length (km)	
	Storm Sewers	Culverts
Unknown	0.4	0.7
50	0.0	0.0
100	0.1	0.0
150	2.9	0.0
200	9.5	0.0
250	1.3	0.0
300	32.0	0.5
350	0.1	0.1
375	17.3	0.1
400	0.1	2.4
450	16.4	0.5
475	0.1	0.0
500	0.0	0.5
525	12.5	0.2
550	0.0	0.1
600	15.4	2.3
660	0.0	0.0
675	4.3	0.0
750	7.9	0.1
800	0.0	0.1
825	0.1	0.0
900	9.1	0.2
1000	0.0	0.1
1050	5.7	0.0
1200	4.3	1.7
1350	4.3	0.0
1370	0.2	0.0
1375	0.0	0.0
1500	0.5	0.1
1650	0.4	0.0
1800	0.4	0.0
2400	0.0	0.0
Total	**145.4**	**9.9**

Table 3.2: Storm Sewer and Culvert Material

Material	Length (km)	
	Storm Sewers	Culverts
Unknown	2.1	0.5
Steel	0.0	1.0
CMP	0.0	8.2
Concrete	96.3	0.1
PVC	46.2	0.0
HDPE	0.8	0.0
Total	**145.4**	**9.9**

Table 3.3: Storm Sewer and Culvert Age

Installation Period	Length (km)	
	Storm Sewers	Culverts
Unknown	4.7	9.9
1950s	1.5	0.0
1960s	1.2	0.0
1970s	23.9	0.0
1980s	8.1	0.0
1990s	14.0	0.0
2000s	42.3	0.0
2010s	43.6	0.0
2020s	6.1	0.0
Total	**145.4**	**9.9**



LEGEND

- Manholes
- Catch Basin
- Catch Basin Leads
- SWMF
- Municipal Boundaries

Sewer Size (mm)

- Unknown
- <= 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- >= 675 mm

Culvert Size (mm)

- Unknown
- <= 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- >= 675 mm

TITLE
FIGURE 3.1 - STORMWATER SYSTEM (DIAMETER)

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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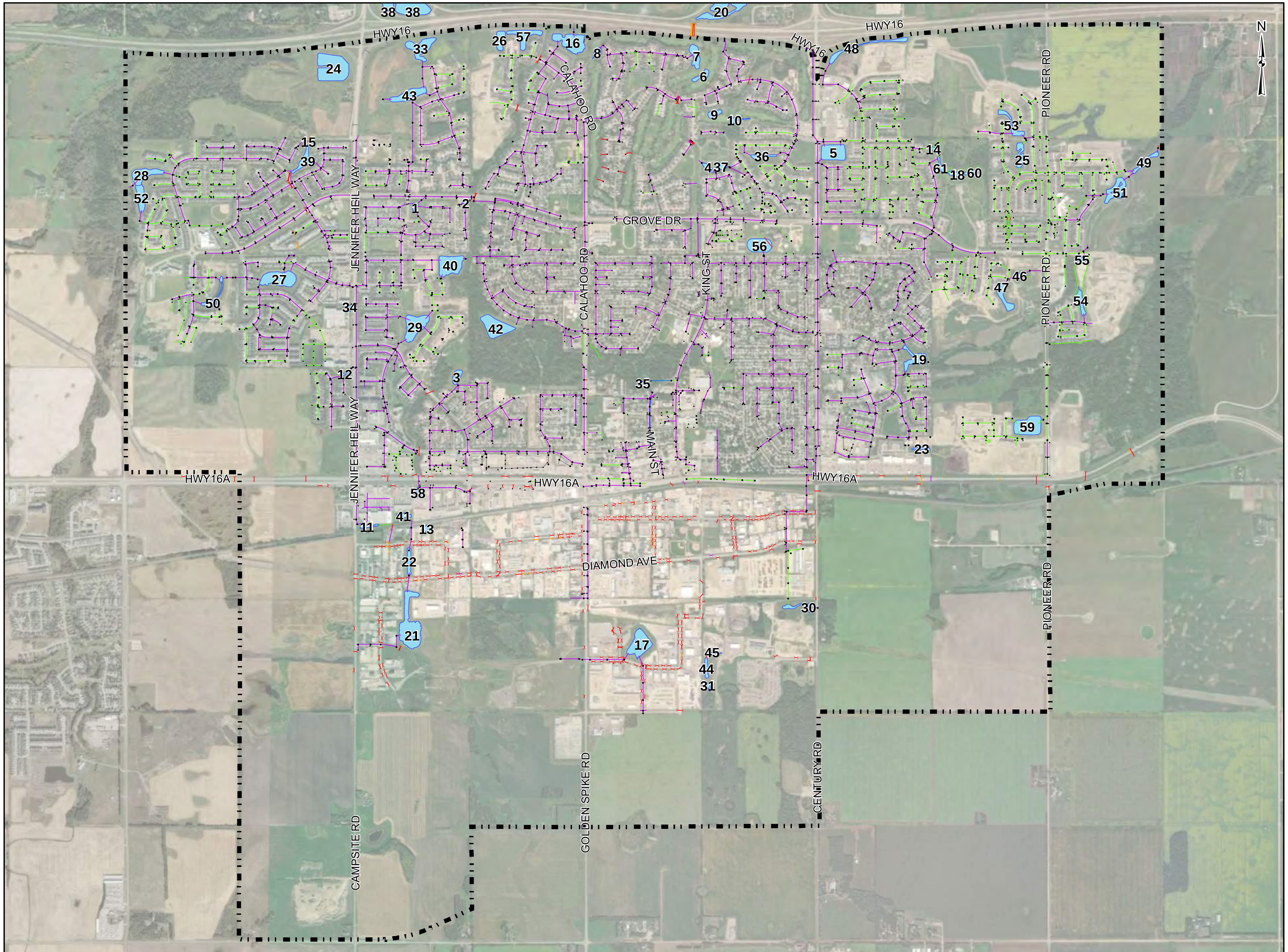
FIGURE	3.1
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

Document Path: M:\JeremyS\16462 - Spruce Grove Stormwater Master Plan\01_GIS\Figure 3.1 - Existing Stormwater System (Diameter).mxd



LEGEND

- Manholes
- Catch Basin
- SWMF
- Municipal Boundaries

Catch Basin Lead Material

- Unknown
- Concrete
- PVC
- HDPE

Sewer Material

- Unknown
- Concrete
- PVC
- HDPE
- CMP
- Steel

Culvert Material

- Unknown
- Concrete
- PVC
- CMP
- Steel

TITLE

FIGURE 3.2 - STORMWATER SYSTEM (MATERIAL)

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

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DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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FIGURE	3.2
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

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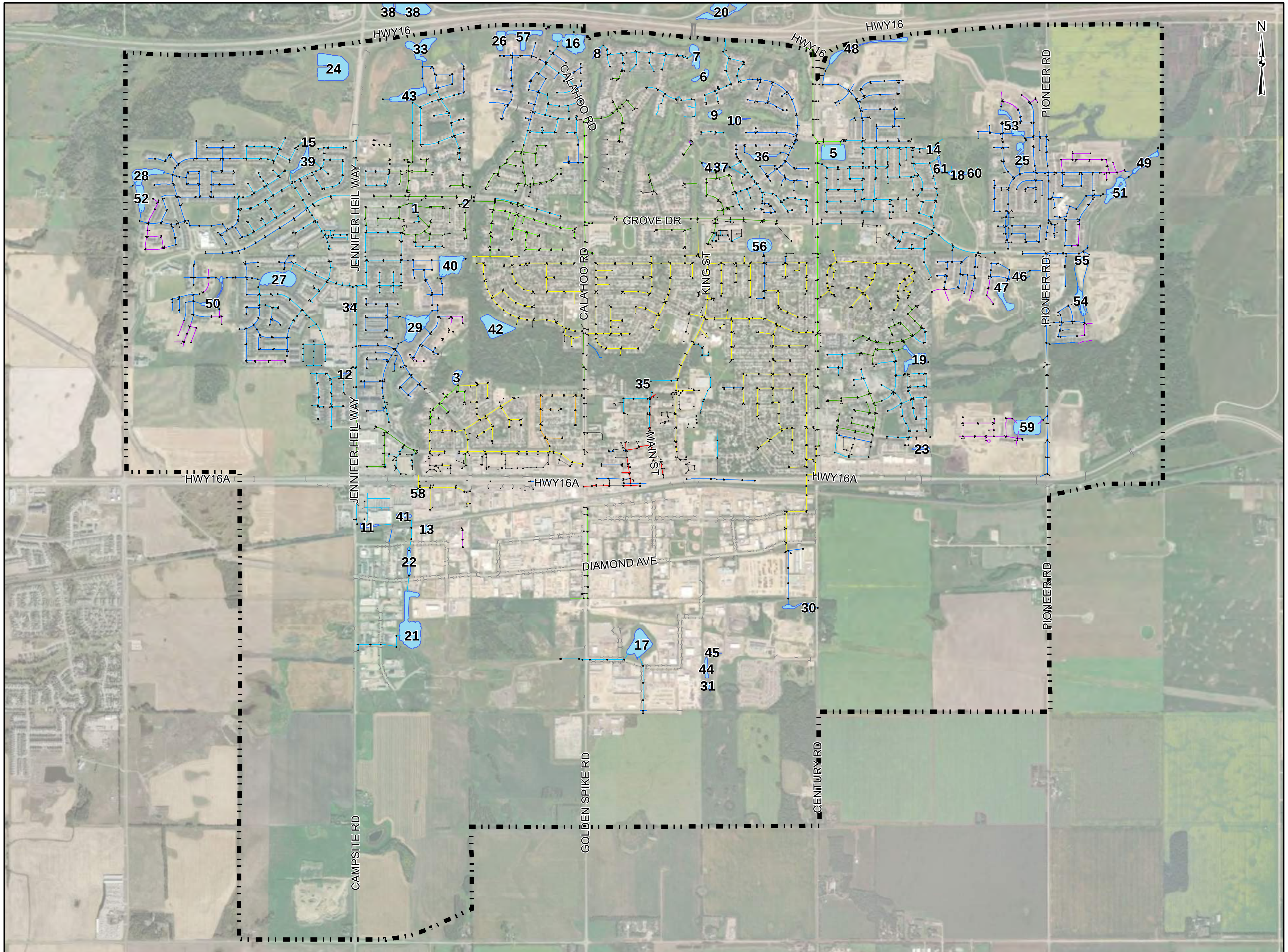


LEGEND
- Manholes
- Catch Basin
- SWMF
- Municipal Boundaries
- Catch Basin Leads

Sewer Age
- Unknown
- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s
- 2010s
- 2020s

Culvert Age
- Unknown
- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s
- 2010s
- 2020s

TITLE
FIGURE 3.3 - STORMWATER SYSTEM (AGE)

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION
NAD 1983 CSRS 3TM 114

0 195 390 780
1:27,500 Meters

FIGURE	3.3
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

Document Path: M:\JeremyS\16462 - Spruce Grove Stormwater Master Plan\01_GIS\Figure 3.3 - Existing Stormwater System (Age).mxd

3.2 Major Stormwater System

Spruce Grove topography consistently slopes downhill from south to north and consists of a few major water courses, including:

- Atim Creek along the western municipal boundary;
- Dog Creek which flows through the City between Jennifer Heil Way and Calahoo Road; and
- And an unnamed tributary draining from STMPND-19 (Lakeview SWMF) towards Atim Creek, crossing Pioneer Road, and continuing northeast.

Topography within the City is shown on **Figure 3.4** which shows both the primary drainage channels and SWMFs within the municipal boundary. **Figure 3.5** shows the delineation of subcatchments within the City boundary and **Figure 3.6** shows upstream drainage basins that contribute flows to the upstream end of the municipal boundary.

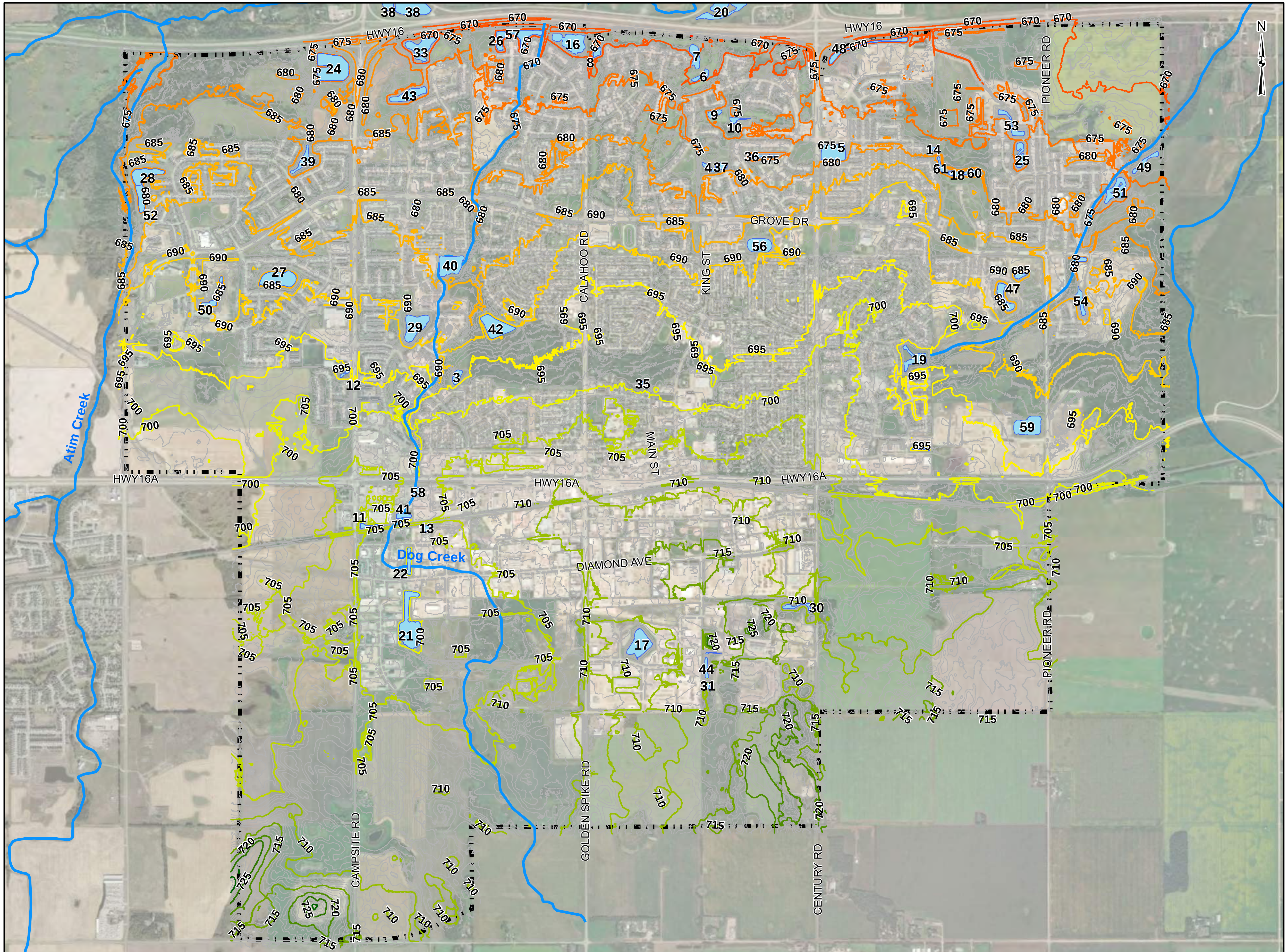
Most of the upstream basins contribute flows to Dog Creek and the industrial area is highly susceptible to the flows entering the City from Highway 628 culverts. The City is aware of future transportation planning work at Highway 628 and should be involved in this work since any upgrading of Highway 628 culverts will have a significant hydraulic impact within the City, particularly within the industrial area, where there are known hydraulic constraints due to the CNR ditch and culverts.

While the industrial area is hydraulically constrained by existing issues within the CNR culverts and ditches, there have been recent upgrades within the industrial area to address some concerns. While the CNR constraint exists, the upgrades within the industrial section will be limited. Upgrades from 2020 and 2021 include:

- Ditch upgrades and regrading along the back-of-lot of several private properties south of Diamond Avenue on the west and east side of Golden Spike Road;
- Remove and replace the existing 500 mm culvert crossing Railway Avenue with a 600 mm culvert, and clear and grub the existing ditch to the north that drains into the existing CNR ditch in between the Blacksmith Towing and Lakeside Roofing lots;
- Remove and replace the existing 450 mm culverts along Diamond Avenue crossing the east driveway of Cargill and the west driveway of the Alberta Fish and Wildlife building with 500 mm culverts;
- Remove and replace the existing 500 mm culvert crossing South Avenue with a 600 mm culvert and clear and grub the downstream ditch from South Avenue to Railway Avenue east of 65 South Avenue;
- Regrade and upgrade existing swale on the north side of Canada Post and west of Saskatchewan Avenue that drains towards STMPND-00017;
- Remove and replace existing 400 – 600 mm culverts along and crossing Madison Crescent west of STMPND-00020 with 600 mm culverts;
- Regrade the existing ditch crossing the BKE Transportation Services parking lot and replace the existing 600 mm culvert;
- Remove and replace the existing 300 mm culverts with 2x400 mm and 600 mm culverts in the west and east driveways of Cam Tran Co. Ltd, respectively;
- Remove and replace existing 400 mm culverts along Alberta Avenue with 2x400 mm culverts on the south side of the road in front of the SLB Canada – ALS and Frontline Benefits Inc buildings, and regrade the ditch section in between the culvert upgrades;

- Remove and replace the existing culvert along Railway Avenue with a new 300 mm culvert and regrade adjacent ditch sections in front of Spruce Grove Feeds and Blacksmith Towing; and
- Remove and replace the existing ditch and culvert on the Grove Auto & Truck Parts lot with a 1,050 mm minor system with F51 catch basins to collect surface drainage.

Additional ditch regrading design work has been completed for the ditch section just south of the recently completed work in the Grove Auto & Truck Parks lot.



LEGEND

- SWMF
- Water Courses

Major Contours (5 m)

- 730
- 725
- 720
- 715
- 710
- 705
- 700
- 695
- 690
- 685
- 680
- 675
- 670
- 665
- Minor Contours (1 m)
- Municipal Boundaries

TITLE

FIGURE 3.4 - TOPOGRAPHY

PROJECT

SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT

THE CITY OF SPRUCE GROVE

DATA SOURCES

- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION

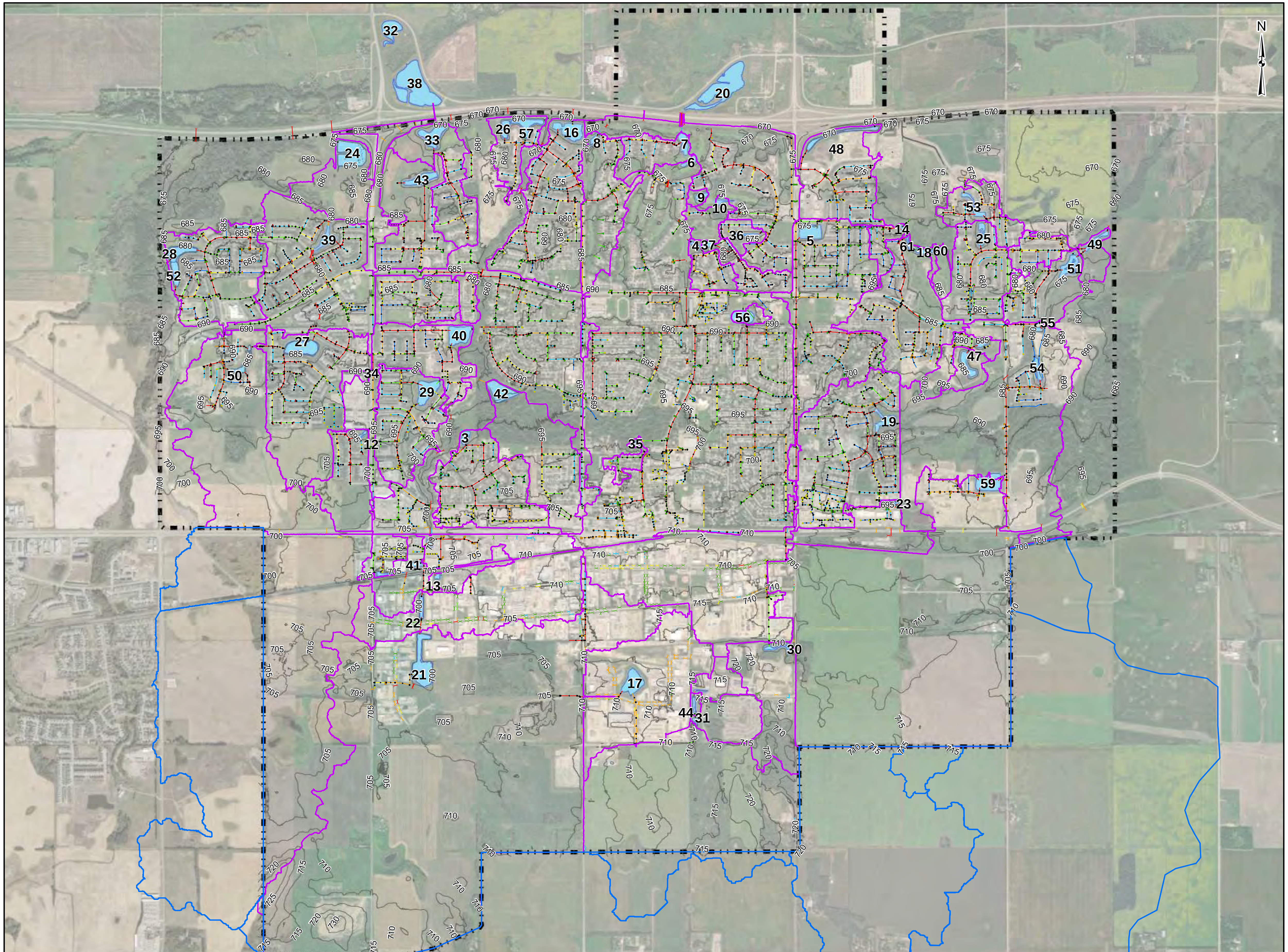
NAD 1983 CSRS 3TM 114

0 195 390 780

1:27,500 Meters

FIGURE	3.4
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

Document Path: M:\JeremyS\16462 - Spruce Grove Stormwater Master Plan\01_GIS\Figure 3.4 - Topography.mxd



LEGEND

- Subcatchments
- Upstream Basins
- Major Contours (5 m)
- Minor Contours (1 m)
- SWMF
- 2D Modelling Zone

Manhole and Catchbasins

- F33
- F36
- F38
- F51
- K7
- Manhole

Storm Sewer Diameter (mm)

- <= 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- >= 675 mm

TITLE

FIGURE 3.5 - SUBCATCHMENTS

PROJECT

SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT

THE CITY OF SPRUCE GROVE

DATA SOURCES

- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION

NAD 1983 CSRS 3TM 114

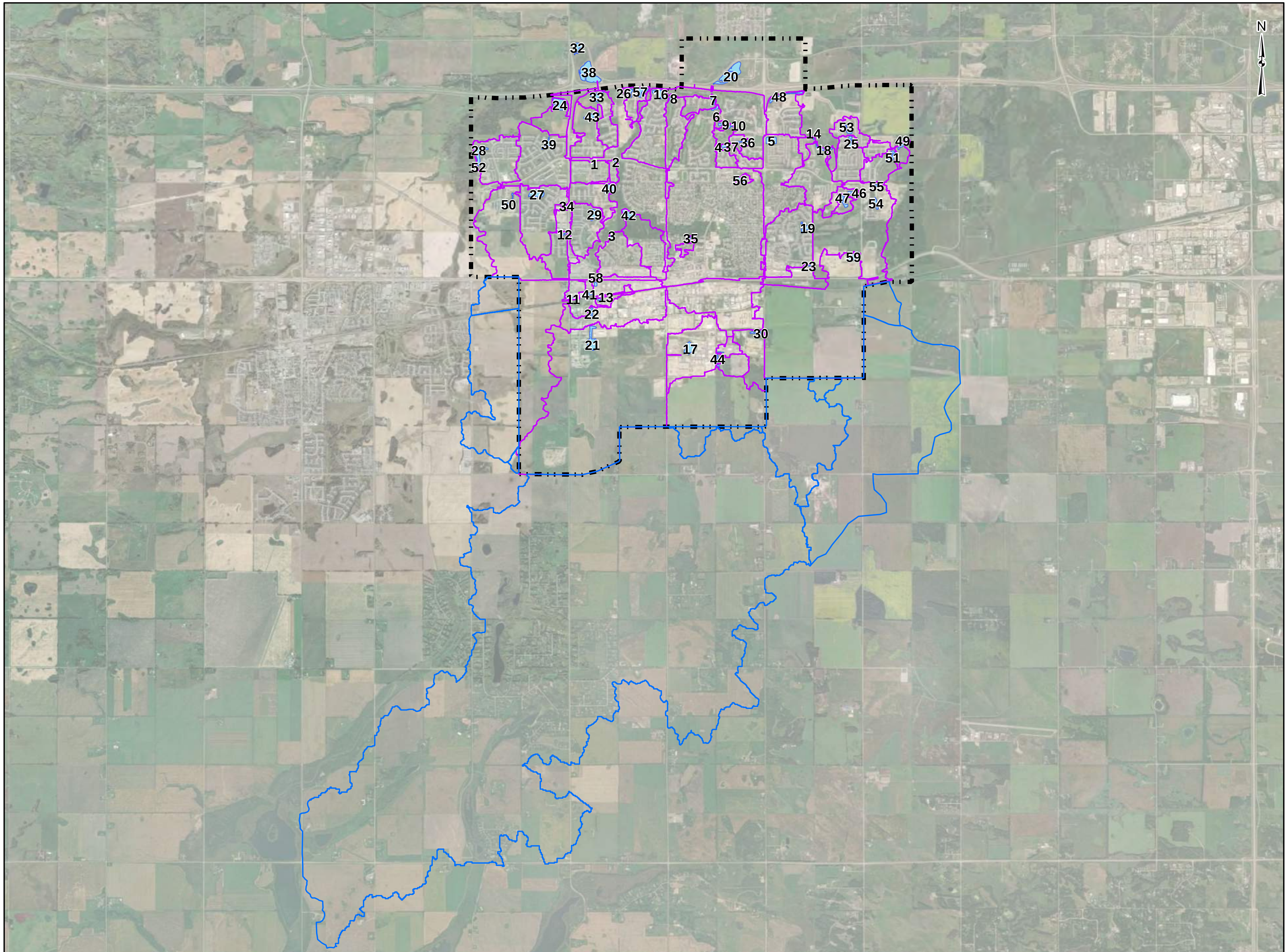
0 212.5 425 850

1:30,000 Meters

ISL

FIGURE	3.5
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

Document Path: M:\JeremyS\16462 - Spruce Grove Stormwater Master Plan\01_GIS\Figure 3.5 - Subcatchments.mxd



TITLE
FIGURE 3.6 - UPSTREAM DRAINAGE BASINS

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION
NAD 1983 CSRS 3TM 114

FIGURE	3.6
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

Document Path: M:\JeremyS\16462 - Spruce Grove Stormwater Master Plan\01_GIS\Figure 3.6 - Upstream Drainage Basins.mxd

3.3 Stormwater Management Facilities

SWMFs within the City have been reviewed in extensive detail and their properties are summarized in **Tables 3.4** and **3.5**. Sources of information are listed below:

- Record drawings were used as the primary source of information; however, some of the SWMFs located on private sites include information from site drawings instead.
- Data gaps were filled using the 2015 SWMP, PCSWMM model and/or GIS information.
- SWMF storage capacity is shown based on reported values from record drawings and/or site drawings. Where this was not explicitly stated, it was estimated from the drawings using measurement tools.
- Catchment area is based on existing topography and may change significantly as areas to the south develop. The catchment areas are estimated to include the gross upstream drainage basins from south of the City.

Deer Park North and South ponds (STMPND-00033 and STMPND-00043) have recently undergone design changes to account for existing concerns at the Alberta Transportation (AT) owned STMPND-00038. STMPND-00038 is furthest downstream and receives controlled runoff from the Deer Park ponds and originally controlled runoff entering Atim Creek north of Highway 16. In 2012, STMPND-00038 was found to be flooding and AT originally suspected that a plugged exfiltration gallery was the cause. Pond flooding reaches the Highway 16 ditches and AT adopted emergency measures and breached the STMPND-00038 berm, allowing the pond to drain uncontrolled. To date, it is believed that this breach has not been rectified yet; thus, Deer Park North (STMPND-00033) outlet controls were revised to account for the lack of downstream attenuation and control. These changes are reflected in **Table 3.4**.

Based on the condition of STMPND-00038, ISL recommends that the City collaborate with AT to reinstate the breached berm to restore the functionality of STMPND-00038. Since STMPND-00038 is not functioning as a SWMF at this point and is not owned by the City of Spruce Grove, it was not included in the modelling assessment.

STMPND-00015 and STMPND-00039 are known to have storage capacity issues due to excessive sedimentation within the ponds. The City is currently working to rehabilitate these ponds in order to restore the capacity. It is understood that the existing 280 mm orifice is being removed and replaced with a 900 mm outfall (engineering work for this upgrade was carried out concurrent to this study).

STMPND-00020, north of Highway 16, was previously owned by AT but has recently transferred under the City’s control during 2023. The City completed a recent inspection and found the following:

- Perimeter fencing is in poor condition and requires correction along the entire perimeter.
- The SWMF outlet pipe has heaved on the pond side, has become separated and there are washouts and voids. The road currently owned by Parkland County could be compromised and could fail at any time. Rehabilitation of the pond outlet and road should be pursued as soon as possible.
- On the north side of the road, the outlet pipe is heavily silted and required cleaning.
- The SWMF is overgrown with an invasive species of weeds and the condition of the lined ditch spillway cannot be determined until the overgrowth is eliminated. Due to the invasive weed species, the City is obligated to remove the overgrowth.
- The culvert in the road ditch near the northeast corner of the SWMF has a flap gate within it to prevent the SWMF from backing up into adjacent property during a significant storm event. This flap gate is not currently accessible to be exercised due to the overgrowth of vegetation.

- The inlet at the southwest corner of the property is also vastly overgrown with vegetation and silt and require the inlet pipes to fill substantially before they can outflow over the overgrowth and into the pond.
- Capacity of the SWMF is compromised due to heavy amounts of silt deposition within the pond.

Due to the condition assessment of STMPND-00020, ISL recommends that the City work with AT to fix the deficiencies of the pond as soon as possible. Since this pond recently transferred ownership in 2023 from AT to the City, it has been included as part of the modelling assessment and the model assumes that the storage functionality and outlet control has been resolved.

The following are additional comments regarding **Tables 3.4** and **3.5**:

- STMPND-00002: The orifice size has been estimated based on an equivalent diameter.
- STMPND-00004/37: Pond 37 spills into Pond 4 overland at an elevation of 677.6 m with no other apparent outlet. The volume shown only accounts for the reported storage within Pond 4.
- STMPND-00005: Release rates have been estimated based on 2 x 600 mm storm sewers.
- STMPND-00007: The ultimate HWL is noted to be 669.0 m based on record drawings.
- STMPND-00018/60: Orifice sizes are not known and were estimated as 100 mm in size.
- STMPND-00022: The freeboard elevation is estimated based on LiDAR (Light Detection and Ranging) information.
- STMPND-00025: The outlet structure has a 1.5 m spill weir at 674.500 m.
- STMPND-00027: The outlet structure has a 1.2 m spill weir at 685.520 m.
- STMPND-00033: The interim and ultimate HWLs are set to 669.180 and 668.570 m, respectively. The interim and ultimate storage capacities are 8,600 and 48,000 m^3, respectively. The additional storage was proposed due to the breaching of STMPND-00038's berm.
- STMPND-00034: Pond levels are not explicitly stated in the drawings and the volume is estimated from LiDAR.
- STMPND-00035: Release rates based on downstream 300 mm storm sewer.
- STMPND-00042: Elevations are estimated based on LiDAR.
- STMPND-00043: Interim and ultimate storage capacities are 27,600 and 33,500 m^3, respectively. The outlet structure has a 2.0 m spill weir at 674.000 m.
- STMPND-00046/47: Release rate is estimated based on downstream 450 mm sewer.
- STMPND-00049: The outlet structure has a 2.4 m spill weir at 672.300 m.
- STMPND-00050: The outlet structure has a 1.3 m spill weir at 686.900 m (which is notably 0.4 m below HWL).
- STMPND-00053: The outlet structure has a 1.5 m spill weir at 672.500 m.
- STMPND-00055: The outlet structure has a 3.0 m spill weir at 681.700 m.
- STMPND-00058: Release rate estimated based on 100-year, 24-hour peak flow within 1,200 mm culvert crossing Highway 16A while accounting for the total gross upstream basin area.
- STMPND-00059: The outlet structure has a 3.0 m spill weir at 691.500 m.

Table 3.4: Summary of Stormwater Management Facilities

Facility ID	Name	Type	Fb (m)	HWL (m)	NWL (m)	Bottom (m)	Storage (m³)
STMPND-00001	Heatherglen	Dry	681.94	681.94	-	678.91	13,300
STMPND-00002	Grove Senior Village	Dry	680.75	680.71	-	678.70	3,000
STMPND-00003	West Grove	Wet	694.60	694.60	694.10	691.70	4,800
STMPND-00004	Hilldowns	Dry	678.00	677.97	-	677.00	5,600
STMPND-00037		Wet	678.00	677.97	-	-	
STMPND-00005	Century Road	Dry	678.00	678.00	-	674.40	115,000
STMPND-00006	Links (3)	Wet	670.00	669.00	668.21	-	4,000
STMPND-00007	Links (2)	Wet	669.00	668.60	667.95	-	26,500
STMPND-00008	Links (1)	Wet	668.89	668.80	667.57	665.62	4,200
STMPND-00009	Links (4)	Wet	674.69	674.00	673.00	-	-
STMPND-00010	Links (5)	Wet	673.72	672.50	672.17	-	-
STMPND-00011	Walmart	Wet	704.20	704.20	701.19	-	7,000
STMPND-00012	Legacy Park	Wet	696.10	695.50	693.00	690.60	3,600
STMPND-00013	Madison Industrial Area (1)	Wet	702.50	-	-	-	-
STMPND-00014	Jubilee Park Northwest	Wet	677.80	677.28	675.60	673.10	2,200
STMPND-00015	Harvest Ridge Secondary Sediment Pond	Wet	678.85	678.25	676.50	676.23	54,920
STMPND-00039	Harvest Ridge	Wet	678.85	678.25	676.50	676.20	
STMPND-00016	Jesperdale East	Wet	669.85	669.35	668.00	665.00	42,000
STMPND-00017	Spruce Grove Industrial	Wet	707.90	707.34	704.90	702.90	64,200
STMPND-00018	Middle Jubilee Park	Wet	680.40	679.90	678.20	675.70	16,400
STMPND-00060	Jubilee Park East	Wet	680.40	679.90	678.20	675.70	
STMPND-00061	Jubilee Park West	Wet	680.40	679.90	678.20	675.70	
STMPND-00019	Lakewood	Wet	694.00	694.00	691.70	689.70	66,800
STMPND-00020	Century Road Regional	Wet	666.00	665.80	662.63	660.50	260,000
STMPND-00021	East Campsite Industrial Stage (1)	Wet	701.50	701.00	699.20	696.20	56,000
STMPND-00022	Madison Industrial Area (2)	Wet	701.80	701.05	699.25	696.75	11,900
STMPND-00023	Century Crossing Commercial	Wet	696.00	695.40	693.50	-	10,400
STMPND-00024	Harvest Ridge Offsite	Wet	676.80	676.50	674.50	674.20	82,300
STMPND-00025	Greenbury Village	Wet	674.80	674.50	672.50	-	22,300
STMPND-00026	Jesperdale West	Wet	670.25	669.75	668.70	-	21,100
STMPND-00057	North Aspenglen (Part of 26)	Wet	670.25	669.75	668.70	-	
STMPND-00027	Spruce Ridge	Wet	686.52	685.52	684.13	-	39,600
STMPND-00028	Harvest Ridge West	Wet	681.80	681.30	679.30	677.10	62,700
STMPND-00052	West Harvest Ridge (Part of 28)	Wet	681.80	681.30	679.30	677.10	
STMPND-00029	McLaughlin	Wet	688.65	688.15	686.50	684.00	36,400
STMPND-00030	Northeast Public Works	Wet	710.50	709.25	707.50	706.50	25,600
STMPND-00031	Public Works Snow Dump	Wet	711.50	711.50	709.50	707.00	43,700
STMPND-00044		Wet	713.10	712.50	709.50	707.50	
STMPND-00045			713.10	712.50	709.50	709.00	
STMPND-00032	Campsite Road Regional	Wet	-	667.00	666.00	663.00	-
STMPND-00038			-	668.00	666.50	663.00	-
STMPND-00033	Deer Park North	Wet	670.50	669.180[6]	667.00	-	48,000
STMPND-00034	Trans Alta Tri Leisure Centre	Wet	691.30	691.10	690.05	689.00	1,600
STMPND-00035	Mohr Avenue	Wet	698.00	698.00	695.30	695.00	5,500
STMPND-00036	Hilldowns	Wet	675.40	674.43	672.40	672.10	13,700

Facility ID	Name	Type	Fb (m)	HWL (m)	NWL (m)	Bottom (m)	Storage (m^3)
STMPND-00040	Hawthorne	Wet	683.48	682.98	681.75	-	29,600
STMPND-00041	St. Matthews	Wet	702.30	701.90	-	700.50	7,000
STMPND-00042	Marlboro Off-Leash Park (Mobile City Estates)	Dry	689.80	-	-	687.00	18,100
STMPND-00043	Deer Park South	Wet	675.00	674.00	672.00	669.50	33,500
STMPND-00046	Tonewood Northeast	Wet	686.80	685.30	683.50	-	28,500
STMPND-00047	Tonewood Southeast	Wet	687.40	685.30	683.50	-	
STMPND-00048	North Westwind	Wet	671.50	671.00	669.00	666.50	30,100
STMPND-00049	Northeast Prescott	Wet	673.70	673.20	671.20	668.70	50,400
STMPND-00051	East Prescott	Wet	673.70	673.20	671.20	668.70	
STMPND-00050	Southeast Copperhaven	Wet	687.80	687.30	685.00	682.50	43,200
STMPND-00053	Greenbury North Garneau Gate	Wet	673.00	672.50	670.00	667.50	25,200
STMPND-00054	Fenwyck	Wet	682.20	681.70	680.00	678.00	58,000
STMPND-00055		Wet	682.20	681.70	679.70	677.70	
STMPND-00056	St. Thomas School	Dry	688.91	688.87	687.50	686.04	19,900
STMPND-00058	St. Matthews North	Dry	702.50	701.90	-	700.50	5,900
STMPND-00059	Easton	Wet	692.00	691.50	689.50	688.00	47,400

Notes:

1. Fb = freeboard.
2. HWL = high water level.
3. NWL = normal water level.

Table 3.5: Summary of Stormwater Management Facility Outlet Control

Facility ID	Name	Orifice		
		Level (m)	Cross Section	Size (mm)
STMPND-00001	Heatherglen	678.87	Circular	250
STMPND-00002	Grove Senior Village	678.12	Diamond	150
STMPND-00003	West Grove	691.52	Rectangular	70
STMPND-00004	Hilldowns	675.96	Circular	225
STMPND-00037		-	-	-
STMPND-00005	Century Road	-	-	-
STMPND-00006	Links (3)	-	-	-
STMPND-00007	Links (2)	667.95	Circular	80
STMPND-00008	Links (1)	667.57	Circular	45
STMPND-00009	Links (4)	-	-	-
STMPND-00010	Links (5)	-	-	-
STMPND-00011	Walmart	701.20	Circular	55
STMPND-00012	Legacy Park	693.00	Circular	109
STMPND-00013	Madison Industrial Area (1)	-	-	-
STMPND-00014	Jubilee Park Northwest	675.68	Circular	76
STMPND-00015	Harvest Ridge Secondary Sediment Pond	-	-	-
STMPND-00039	Harvest Ridge	676.50	Circular	280
STMPND-00016	Jesperdale East	668.00	Circular	238
STMPND-00017	Spruce Grove Industrial	704.90	Circular	392
STMPND-00018	Middle Jubilee Park	678.20	Circular	3x100
STMPND-00060	Jubilee Park East	678.20	Circular	100
STMPND-00061	Jubilee Park West	676.19	Circular	215
STMPND-00019	Lakewood	691.70	Rectangular	290x200 450x315
STMPND-00020	Century Road Regional	-	-	-
STMPND-00021	East Campsite Industrial Stage (1)	-	-	-
STMPND-00022	Madison Industrial Area (2)	-	-	-
STMPND-00023	Century Crossing Commercial	-	-	-
STMPND-00024	Harvest Ridge Offsite	674.50	Circular	340
STMPND-00025	Greenbury Village	672.50	Circular	158
STMPND-00026	Jesperdale West	-	-	-
STMPND-00057	North Aspenglen (Part of 26)	668.70	Circular	187
STMPND-00027	Spruce Ridge	684.13	Circular	214
STMPND-00028	Harvest Ridge West	679.30	Circular	220
STMPND-00052	West Harvest Ridge (Part of 28)	-	-	-
STMPND-00029	McLaughlin	686.50	Circular	100
STMPND-00030	Northeast Public Works	707.50	Circular	131
STMPND-00031	Public Works Snow Dump	709.52	Circular	171
STMPND-00044		708.21	Circular	82
STMPND-00045		-	-	-
STMPND-00032	Campsite Road Regional	-	-	-
STMPND-00038		-	-	-
STMPND-00033	Deer Park North	664.00	Circular	245
STMPND-00034	Trans Alta Tri Leisure Centre	689.17	Circular	50

Facility ID	Name	Orifice		
		Level (m)	Cross Section	Size (mm)
STMPND-00035	Mohr Avenue	-	-	-
STMPND-00036	Hilldowns	672.27	Circular	125
STMPND-00040	Hawthorne	681.75	Circular	270
STMPND-00041	St. Matthews	699.90	Circular	50
STMPND-00042	Marlboro Off-Leash Park (Mobile City Estates)	-	-	-
STMPND-00043	Deer Park South	672.00	Rectangular	375x275
STMPND-00046	Tonewood Northeast	-	-	-
STMPND-00047	Tonewood Southeast	-	-	-
STMPND-00048	North Westwind	668.92	Circular	168
STMPND-00049	Northeast Prescott	671.20	Circular	214
STMPND-00051	East Prescott	-	-	-
STMPND-00050	Southeast Copperhaven	685.00 685.50	Circular Box	350 700x300
STMPND-00053	Greenbury North Garneau Gate	670.00	Circular	210
STMPND-00054	Fenwyck	-	-	-
STMPND-00055		679.70	Rectangular	750x750
STMPND-00056	St. Thomas School	-	-	-
STMPND-00058	St. Matthews North	-	-	-
STMPND-00059	Easton	689.50	Rectangular	500x250

3.4 Wetland Conservation and Protection

There are numerous existing wetlands within undeveloped parts of the City that are part of the hydrologic system. Most wetlands are located south of Highway 16A in the large undeveloped areas within the annexation area and contribute towards storing runoff from the uncontrolled and undeveloped lands to the south and reducing the peak runoff rate experienced at the south side of the City. In addition to peak flow reduction and runoff storage, wetlands provide sediment and nutrient retention, and permanent wetlands can provide habitat for various native plant communities, waterfowl, shorebirds, amphibians, and invertebrate species.

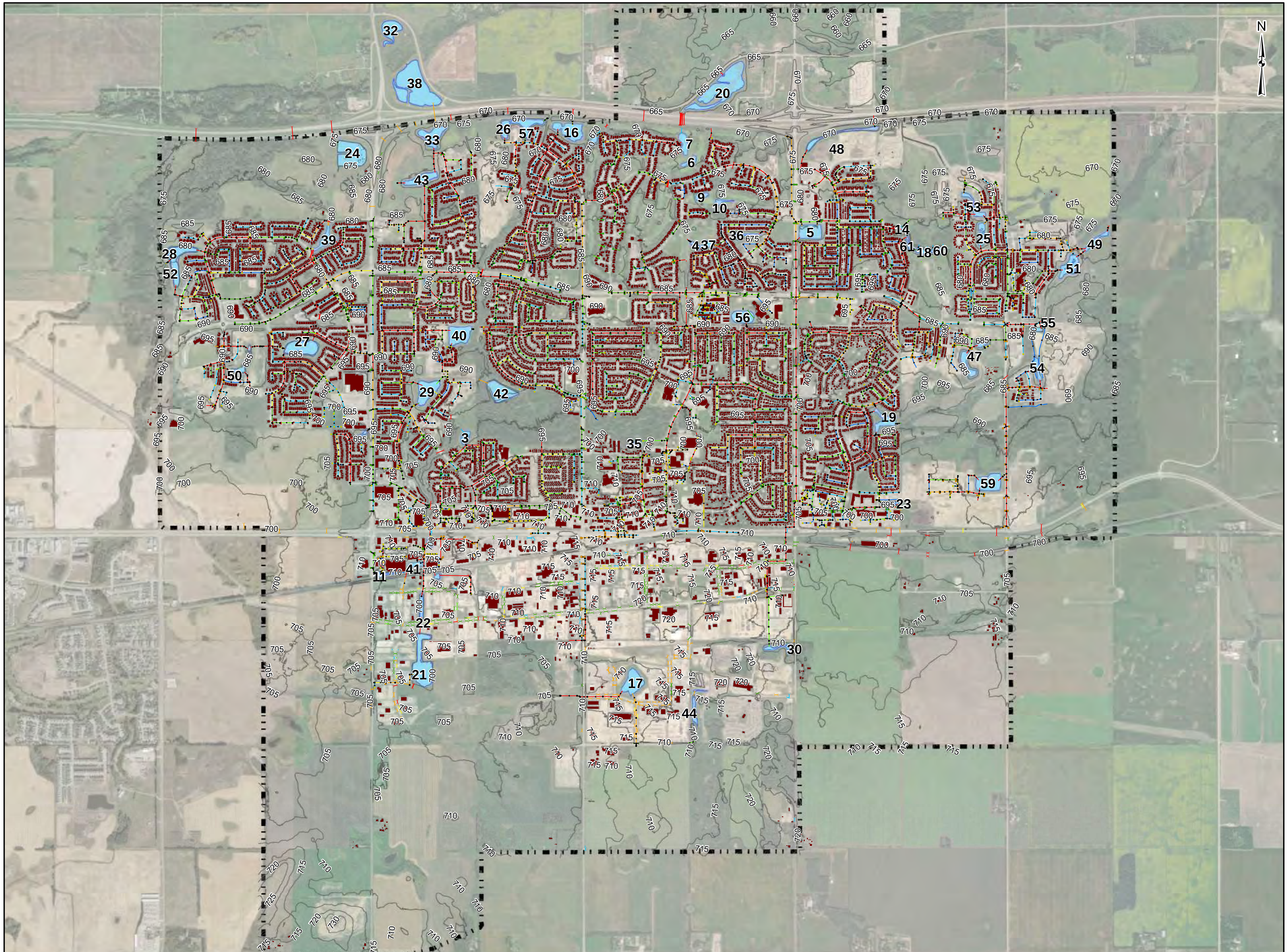
4.0 Hydraulic Model Development

4.1 1D-2D Integrated Stormwater Model Summary

The computer simulation modelling software package used for this master plan was InfoWorks ICM, which was selected for its advanced 2D modelling capabilities. The Spruce Grove model is a 1D-2D integrated stormwater model which refers to how the minor and major systems have been modelled. The storm sewer network is represented by a 1-dimensional (1D) network of links that connect manhole to manhole, and catchbasin to manhole. The overland major drainage system is modelled using a “2D mesh” network created by the LiDAR surface. Thus, water can travel in two dimensions across the surface, governed by the shape of the surface. Catchbasin and manhole locations are connection points between the 2D overland model and the 1D pipe network. The inlet rate from the 2D mesh into the 1D sewer network has been modelled as a stage-discharge curve based on catchbasin properties from the GIS (Geographic Information System) database, thus providing inlet controls in direct relation to actual site conditions. This means that water exceeding catchbasin inlet capacity will pond on the surface and potentially overflow downstream when the surface sag storage capacity is reached, all as defined by the surface configuration. Catchbasin inlet flows are then impacted by surface water ponding depths as defined by the stage-discharge curves.

The 2D model has parameters built in for the overland roughness and infiltration parameters. The surface was discretized into different ground types where each ground type was assigned representative overland parameters. The 2D mesh was also modelled to include buildings to ensure that overland drainage would flow around buildings and not through them.

The stormwater model was constructed using City LiDAR information and the stormwater GIS database. There were data gaps identified in the GIS database which were then filled using a combination of record drawings, design reports, the previous 2015 PCSWMM model, and engineering assumptions when needed. **Figure 4.1** summarizes both the overland 2D mesh and 1D minor stormwater system.



LEGEND

- Building Footprints
- Major Contours (5 m)
- Minor Contours (1 m)
- SWMF
- 2D Modelling Zone

Manhole and Catchbasins

- F33
- F36
- F38
- F51
- K7
- Manhole

Storm Sewer Diameter (mm)

- <= 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- >= 675 mm

Culvert Diameter (mm)

- Unknown
- <= 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- >= 675 mm

TITLE
FIGURE 4.1 - MODEL SET UP

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION
NAD 1983 CSRS 3TM 114

0 212.5 425 850
1:30,000 Meters

ISL

FIGURE	4.1
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

Document Path: M:\JeremyS\16462 - Spruce Grove Stormwater Master Plan\01_GIS\Figure 4.1 - Model Set Up.mxd

4.2 Minor System Modelling Details

Some of the missing information and modelling solutions are summarized below for the 1D system:

- As shown in **Tables 3.1** through **3.3**, there is a small percentage of missing diameters, materials (which dictate manning roughness), and sewer ages (not used in the model). Missing diameters and materials were acquired from record drawings or the 2015 PCSWMM model where available, and if necessary, inferred from adjacent pipe diameters/materials.
- Manhole sump elevations were estimated to be at the lowest connecting pipe invert elevation and rim elevations were validated using the LiDAR surface.
- Manhole sizes were set based on the available information in the GIS database and unknown values were assumed based on connected storm sewer sizes and approach angle as shown in **Table 4.1**.
- Catchbasin sumps and catchbasin lead inverts were back calculated based on City guidelines for minimum lead slopes, based on the adjacent storm sewer inverts.
- Catchbasin types were assigned using the GIS curb and gutter layer, which described whether a given curb was rolled face or straight face. With this information, and Google Maps Street View, ISL was able to discern catch basin types and assign them for every catchbasin within the City. Catchbasin types that were modelled included F33, F36, F38, F51 (grate and side inlet variations) and K7 models. Catch basin inlet capacity curves are summarizes in **Figure 4.2**. Manhole rim elevations were assumed to be sealed based on the knowledge that most stormwater will flood out of the catchbasins, and only a small portion will flow through the manhole lid pick holes.
- Catch basin lead diameters were set based on the available GIS database and assumed to be 250 mm where unknown.
- Many sewers within the GIS network featured pipe breaks where no manholes, catchbasins or other physical structures were present. To ensure the model would function, “dummy nodes” were added at these locations to ensure each pipe had an upstream and downstream connection to a node within the model. Dummy nodes were “sealed” in the model to prevent flow from entering or leaving the sewers at these locations.

Table 4.1: Manhole Diameter Sizes Based on Connected Storm Sewers

Diameter	Max Pipe Size for Straight Through Installation	Max Pipe Size for Right Angle Installation
mm	mm	mm
1,200	600	450
1,500	750	600
1,800	1,050	750
2,100	1,200	900
2,400	1,500	1,050
3,000	1,800	1,500

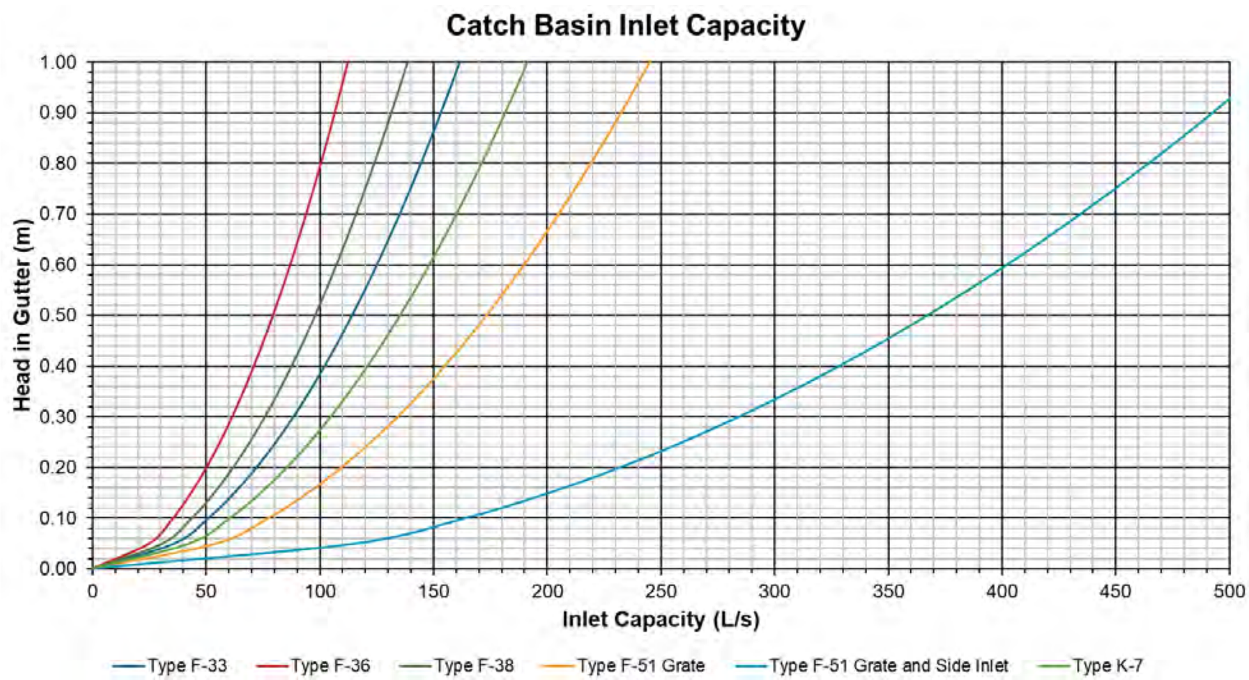


Figure 4.2: Catchbasin Inlet Capacity Curves

4.3 2D Overland Drainage Modelling Details

The major system consists of all overland drainage components listed in **Section 3.0**. For the City of Spruce Grove, the following information has been developed to develop a 2D mesh which represents the overland drainage system:

- 2D zone,
- mesh zones,
- roughness zones,
- infiltration zones, and
- building footprints.

The 2D zone represents the boundary in which the 2D analysis will occur. The 2D zone was digitized as a simplified version of the municipal boundary (where excess vertices were removed). The mesh created within this boundary represents the overland topography by triangulation, where each triangle is referred to as a mesh element, each with their own unique elevation. Each triangle approximates local topography by having its own unique elevation value, ultimately making each mesh element flat. Together with other mesh elements, a surface is formulated, and the total number of mesh elements has a significant impact on the overall simulation run times.

The mesh zone specifies different mesh element densities for various zones, to either increase or decrease the resolution of a zone depending on its importance. For example, to capture pertinent features such as road crowns or the impacts of curbs and gutters, roadways are generally defined by denser, smaller elements. Alternatively, green fields that do not impact existing developments could be defined with lower resolution (larger mesh element size) to optimize the run times where changes in elevation are more naturalized and gradual.

The roughness zone allows for the definition of Manning's n roughness values for different areas of the mesh. A roughness value is assigned to each mesh element depending on which roughness zone that mesh element is a part of. The roughness zone allows for a more accurate representation of different surfaces within the model.

The infiltration zone allows for various infiltration parameters across the mesh, depending on the different surfaces that are apparent within the mesh. Each infiltration zone is designated an infiltration surface, where an infiltration type can be specified. The four infiltration types that can be selected include:

- Fixed
  - Fixed runoff coefficient
- Horton
  - Horton Initial
  - Horton Limiting
  - Horton Decay
  - Horton Recovery
- Constant Infiltration
  - Fixed Runoff Coefficient
  - Infiltration Loss Coefficient
- Green-Ampt
  - Green-Ampt Suction
  - Green-Ampt Conductivity
  - Green-Ampt Deficit

In the Spruce Grove model, impervious surfaces are represented through a fixed runoff coefficient, while pervious surfaces are represented by the Horton Infiltration type.

Default mesh, roughness, and infiltration parameters were defined in the 2D zone to represent impervious areas such as roadways and buildings. These default parameters are stipulated below in **Tables 4.2**, **4.3**, and **4.4**. Additionally, the option to "Apply rainfall directly to mesh" was selected to allow the design storms to fall directly onto the surface to allow the most accurate representation of runoff. The "Terrain-sensitive meshing" option was also selected to better represent overland topography when generating the mesh.

The mesh, roughness, and infiltration zones were generated through the geospatial development type information, on order to be able to specify different criteria depending on the development type. It is noted that the physical boundaries of each mesh, roughness, and infiltration zone polygons are identical; however, the parameters vary depending on the type of polygon (i.e. mesh parameters include element density, roughness specifies n values, and infiltration specifies runoff coefficients or Horton parameters). Maintaining identical polygon extents between each polygon layer ensured no errors regarding overlaps between the different polygon layers. The polygons are differentiated based on land use as shown on **Figure 2.2** and are discretized based on the parcel GIS layer.

The parameters applied per development type are specified in **Tables 4.2**, **4.3**, and **4.4** below for the mesh, roughness, and infiltration zones, respectively. The mesh zone parameters are based on ISL's past experience using InfoWorks ICM, finding an optimal balance between both model simulation time and 2D model resolution. The roughness zone parameters are based on engineering best practices and are consistent with past projects completed by ISL and with the City of Spruce Grove design standards. The infiltration zone parameters are based on a combination of the runoff coefficients stipulated in the City of Spruce Grove Municipal Development Standards and engineering best practices.

Table 4.2: Mesh Zone Parameters Per Land Use Type

Land Use	Maximum Triangle Area	Minimum Triangle Area
	m^2	m^2
Residential LD	50	25
Residential MD	50	25
Residential HD	50	25
Industrial	100	50
Commercial	100	50
Institutional	50	25
Pond	10	5
Open Space	600	300
Rural	600	300

Table 4.3: Roughness Zone Parameters Per Land Use Type

Land Use	Roughness Coefficient
Residential LD	0.0258
Residential MD	0.0258
Residential HD	0.0258
Industrial	0.0167
Commercial	0.0181
Institutional	0.0195
Pond	0.0125
Open Space	0.0300
Rural	0.0300

Table 4.4: Infiltration Zone Parameters Per Land Use Type

Land Use	Infiltration Type	Fixed Runoff Coefficient	Horton Initial	Horton Limiting	Horton Decay	Horton Recovery
			mm/hr	mm/hr	1/hour	1/hour
Impermeable	Fixed	0.95	-	-	-	-
Residential LD	Fixed	0.55	-	-	-	-
Residential MD	Fixed	0.60	-	-	-	-
Residential HD	Fixed	0.65	-	-	-	-
Industrial	Fixed	0.70	-	-	-	-
Commercial	Fixed	0.90	-	-	-	-
Institutional	Fixed	0.55	-	-	-	-
Pond	Fixed	0.95	-	-	-	-
Open Space	Horton	-	75	2.5	4.14	0.006
Rural	Horton	-	75	2.5	4.14	0.006

5.0 Design Criteria

5.1 Predevelopment Runoff Rate Analysis

Stormwater runoff is collected via major overland drainage pathways (typically along roadways) and in storm sewers and conveyed to SWMFs where runoff is stored and released at predevelopment release rates. Allowable SWMF release rates are:

- 1.8 L/s/ha for areas discharging into Dog Creek south of Highway 16A; and
- 2.5 L/s/ha elsewhere.

5.2 Design Rainfall Event

The City of Edmonton Chicago and Huff distribution design storms are shown on **Figures 5.1** and **5.2**. The City of Spruce Grove utilizes the City of Edmonton Intensity-Duration-Frequency (IDF) curve data for sizing their stormwater system as summarized below:

- The minor system is designed to convey the City of Edmonton 1:5-year, 4-hour Chicago distribution design storm;
- The major overland drainage system is designed to convey the City of Edmonton 1:100-year, 4-hour Chicago distribution design storm; and
- Stormwater management facilities are sized to store the runoff from the City of Edmonton 1:100-year, 24-hour Huff distribution design storm.

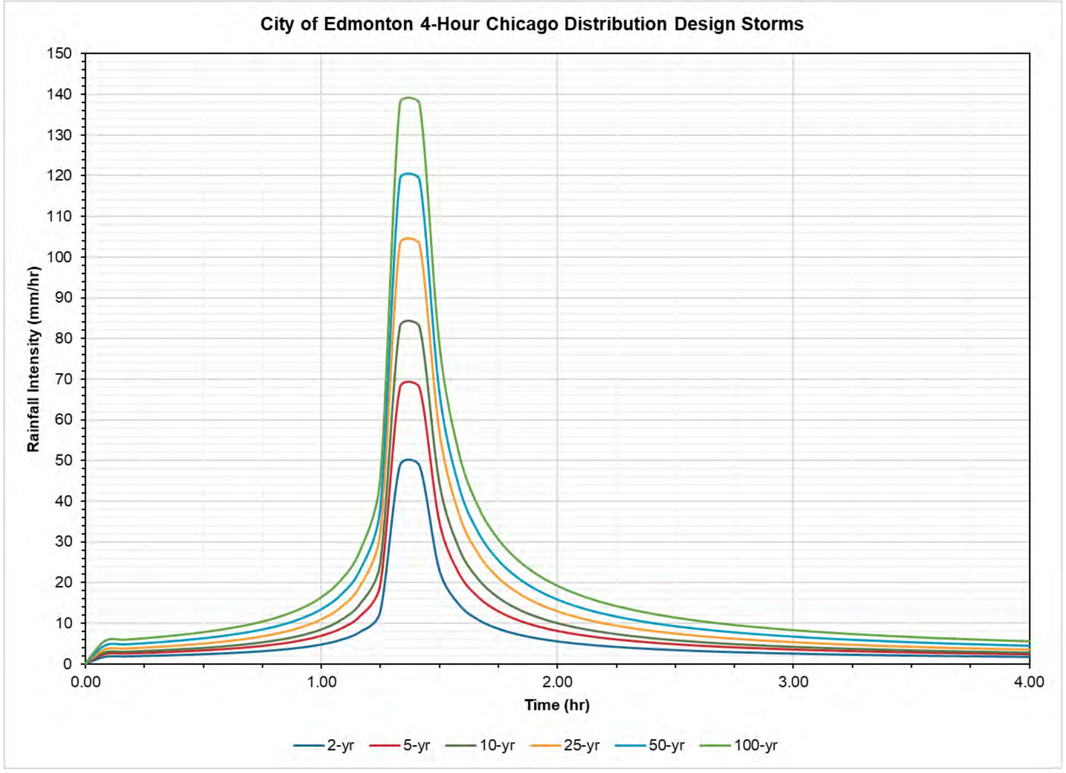


Figure 5.1: City of Edmonton 4-Hour Chicago Distribution Design Storms

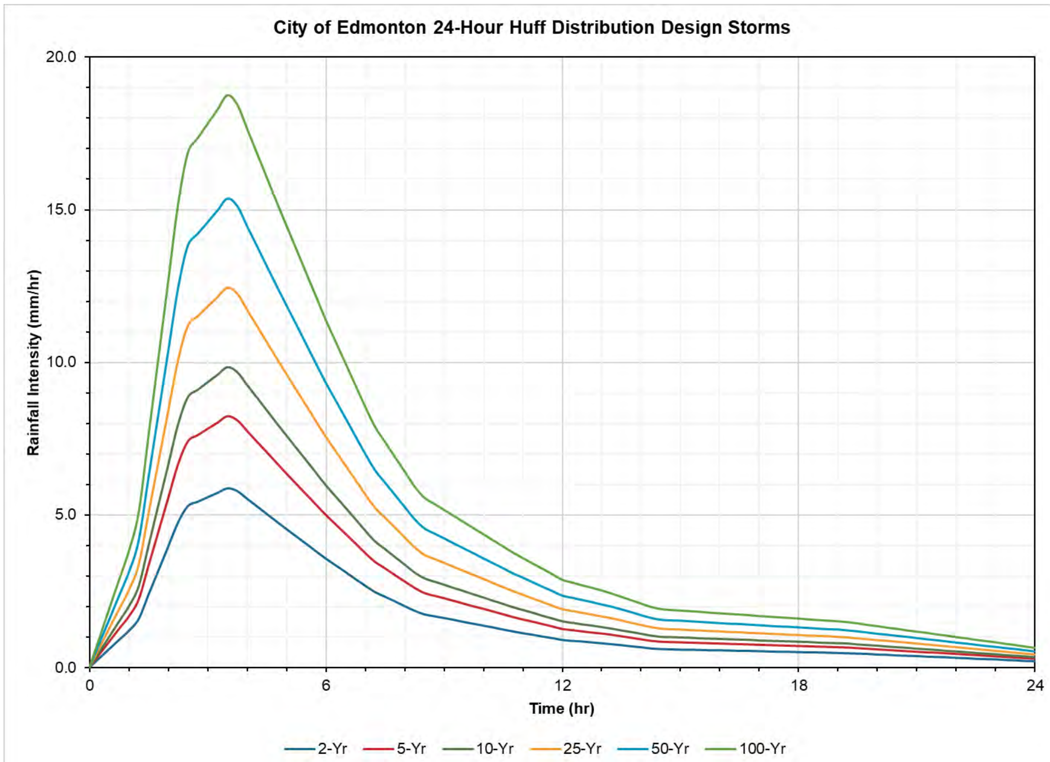


Figure 5.2: City of Edmonton 24-Hour Huff Distribution Design Storms

5.3 Assessment Criteria

To increase public safety, the Province of Alberta has stipulated permissible depths for submerged objects in relation to water velocity. This guideline, Stormwater Management Guidelines for the Province of Alberta, 1999, was implemented to ensure that a 20 kg child would be able to withstand the force of moving water, thus preventing possible tragedies. **Figure 5.3** indicates these requirements.

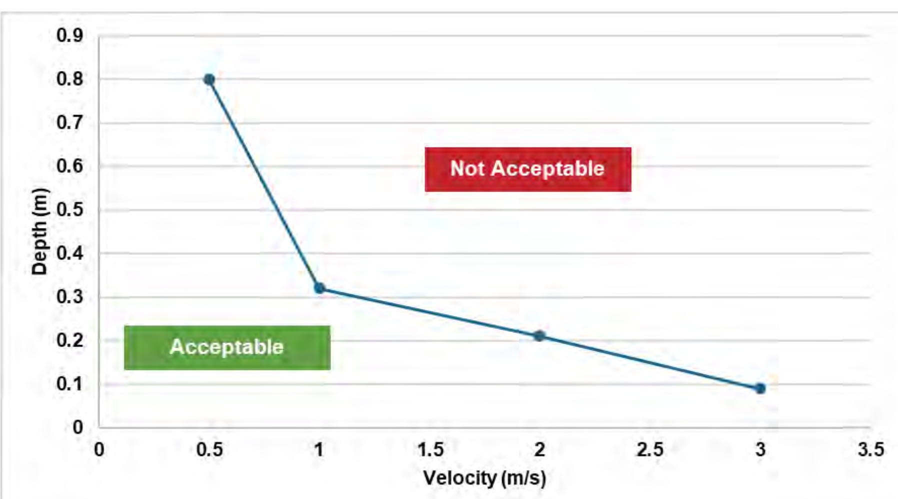


Figure 5.3: Permissible Depths for Submerged Objects

5.4 Stormwater Management Design Guidelines

Other relevant design criteria are summarized in **Table 5.1**.

Table 5.1: City of Spruce Grove Stormwater Management Design Guidelines

Overland Runoff Coefficient (C)		
Grassed Area, Parks		0.10
Single Family Homes		0.55
Duplex Homes		0.60
Multi-Family Residential		0.65
Industrial		0.70
Neighbourhood and Large Commercial		0.90
Pavement Roof Areas		0.95
Storm Sewer Design		
Velocity (m/s)		0.75 - 3.00
Depth of Bury (m)		1.80
Minimum Pipe Slopes	300 mm	0.30%
	375 mm	0.22%
	450 mm	0.18%
	525 mm	0.10%
	600 mm	0.10%
	Evaluation Criteria	No ponding during a 5-year return period
Maximum Manhole Spacing (m)		150
Manhole and Catchbasin Manhole Size (mm)		1,200
Catchbasin Size (mm)		900
Maximum Catchbasin Lead Length (m)		30
Single Catchbasin Lead Minimum Size (mm)		250
Double Catchbasin Lead Minimum Size (mm)		300
Catchbasin Lead Minimum Slope (%)		2.0
Major System Design		
Maximum Ponding Depth (m)		0.30
Dry Pond	Active Storage Depth (m)	≤ 1.5 m
	Side Slopes (m/m)	5:1
	Freeboard (m)	≥ 0.5 m
	Minimum Building Entrance Elevations	≥ 0.5 m above Freeboard
Wet Pond	Permanent Pond Depth (m)	≥ 2.0 m
	Active Storage Depth (m)	≤ 2.0 m
	Side Slopes (m/m)	4:1 above HWL 5:1 between NWL and HWL
	Freeboard (m)	≥ 0.5 m
	Minimum Building Entrance Elevations	≥ 0.5 m above Freeboard
Constructed Wetland	Active Storage Depth (m)	0.3 m with 1.0 m deep zones for flow redistribution
	Side Slopes (m/m)	4:1
	Freeboard (m)	≥ 0.5 m
	Minimum Building Entrance Elevations	≥ 0.5 m above Freeboard

6.0 Existing System Assessment and Upgrades

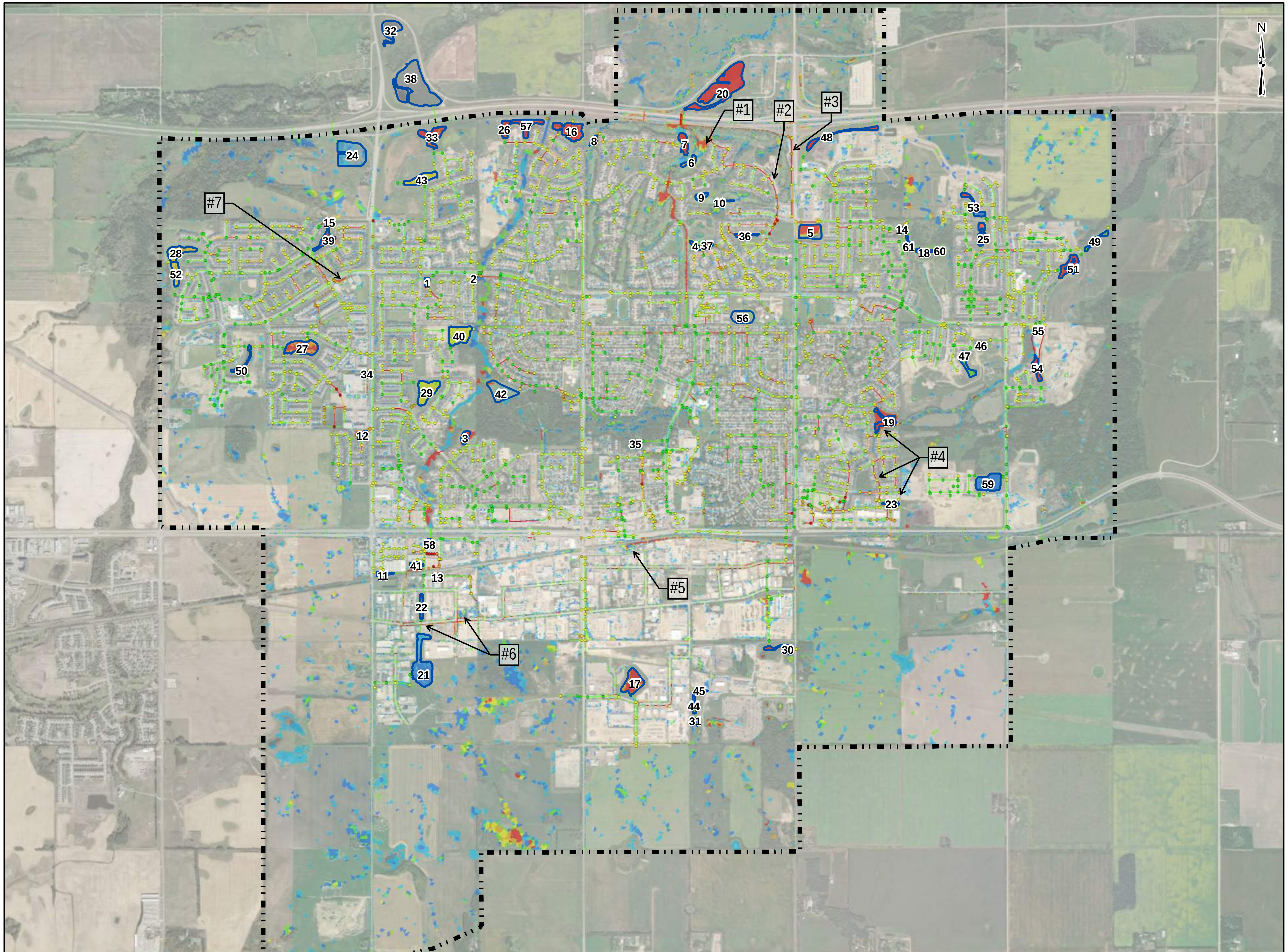
The existing system was assessed using the design criteria stipulated in **Section 5.0**. The 1:5-year, 4-hour Chicago distribution design event was simulated to assess the minor piped system and the 1:100-year, 4-hour Chicago and 24-hour Huff distribution design event were simulated to assess the major overland system and the stormwater management facilities. Simulation results for each of the design events are summarized in **Sections 6.1** and **6.2**, respectively. **Section 6.3** summarizes the CCTV assessment for the stormwater network and highlights areas where pipe conditions may warrant further investigation, upgrading and rehabilitation. **Sections 6.4** and **6.5** summarize the flood risk assessment and prioritization of upgrades, respectively. Lastly, **Sections 6.6**, **6.7**, and **6.8** summarize cost estimates for existing system upgrades, regional flood risk, and climate change resiliency, respectively.

6.1 1:5-Year, 4-Hour Design Event Result Summary

The results for the 1:5-year, 4-hour Chicago distribution design storm are shown on **Figure 6.1** and in more detail within **Appendix B**. A summary of the results is discussed below and labelled on **Figure 6.1**:

1. **Linkside Golf Course** – Overland ponding more than 0.5 m floods out several of the greens. This ponding is due to culvert capacity constraints at Longview Drive and at Highway 16.
2. **Hilldowns** – Sewer surcharging along King Street and Longview Drive causes flooding to the ground surface which is exacerbated by downstream capacity constraints at the golf course and STMPND-00020.
3. **Spruce Village** – Sewer surcharging along Century Road may be causing longer attenuation within STMPND-00005 and ponding in the commercial area. The Highway 16 ditch downstream of the sewer is known to have poor ditch definition/grading and is overgrown which limits available downstream capacity.
4. **Century Crossing/Lakewood** – Sewer surcharging in these areas causes minor ponding. STMPND-00019/23 have limited capacity to store runoff and cannot store additional uncontrolled runoff from south of Highway 16A.
5. **CNR Ditch** – The CNR ditch floods private property along Railroad Avenue between Golden Spike Road and Shep Street. The ditch is currently overgrown and lacks proper grading and definition.
6. **Industrial Area** – Several culverts surcharge and flood roadways and private lots. Recent work in the industrial area has also noted several maintenance issues including ditch overgrowth and culvert sedimentation/damage/burial.
7. **Spruce Ridge** – Ponding more than 0.5 m within the school field of Living Waters Christian Academy near the portable buildings. There is sewer surcharging downstream that leads to STMPND-00015/39.

Note that pond locations tend to have peak overland depths greater than 0.5 m in depth which show up as red on the modelling result figures. This is normal and not considered an overland flooding risk, since the ponding is typically contained to the SWMF and shows that most of the ponds are functioning as intended.



LEGEND

- 2D Modelling Zone
- SWMF

Maximum HGL Relative to Ground

- Less than -3.0m
- -3.0m to -1.2m
- -1.2m to 0.0m
- Greater than 0.0m

Peak Flow Relative to Capacity

- Less than 86%
- 86% to 100%
- Greater than 100%

Maximum Depth (m)

- <= 0.1 m
- 0.1 - 0.2 m
- 0.2 - 0.3 m
- 0.3 - 0.4 m
- 0.4 - 0.5 m
- > 0.5 m

TITLE

FIGURE 6.1 - EXISTING STORMWATER SYSTEM 5-YR, 4-HR MODELLING ASSESSMENT

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION
NAD 1983 CSRS 3TM 114

0 212.5 425 850
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FIGURE	6.1
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

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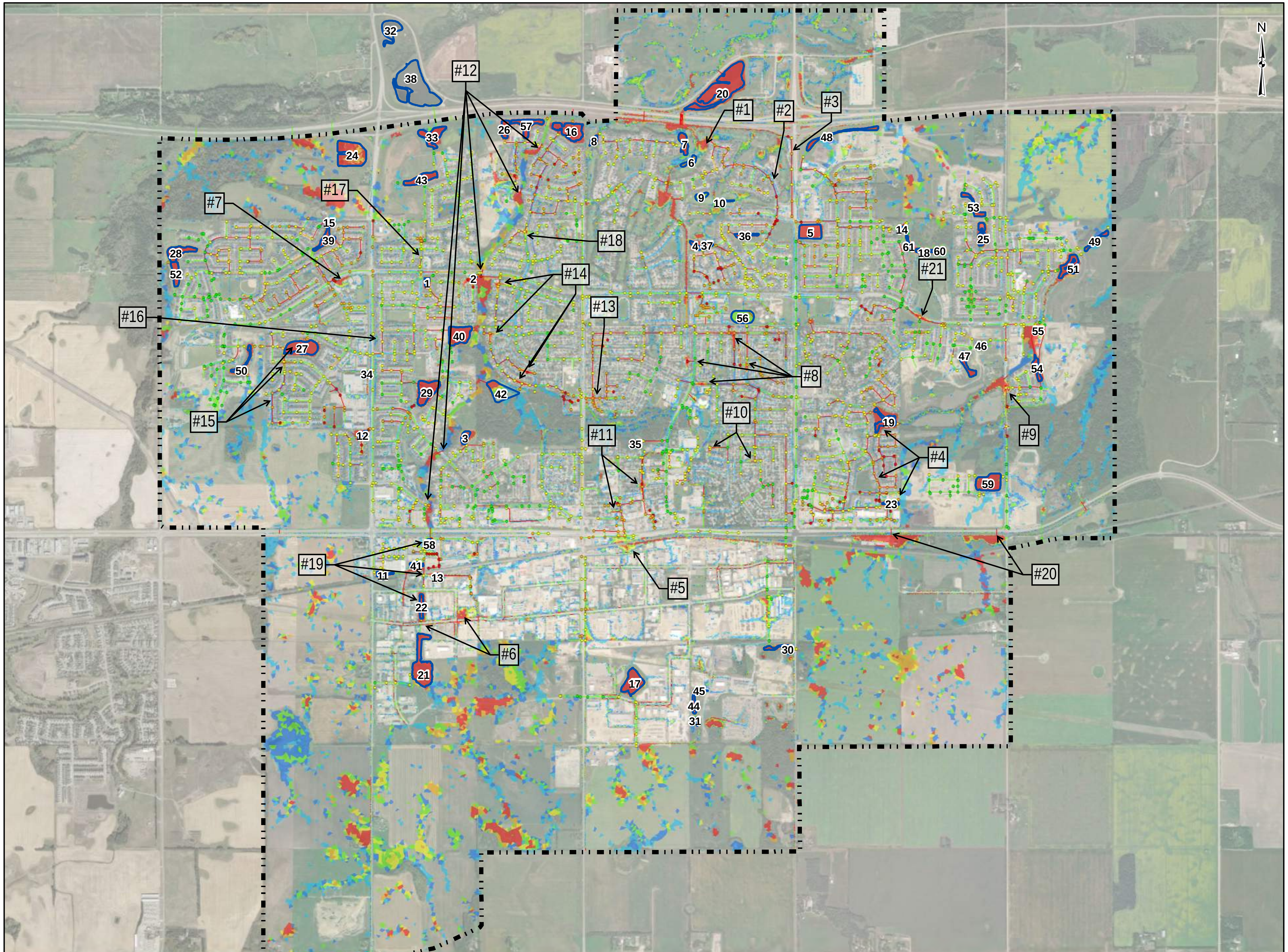
6.2 1:100-Year, 4-Hour and 24-Hour Design Event Result Summary

The results for the 1:100-year, 4-hour Chicago distribution design storm are shown on **Figure 6.2** and in more detail within **Appendix C**. Similarly, the results for the 1:100-year, 24-hour Huff distribution design storm are shown on **Figure 6.3** and in more detail within **Appendix D**. In addition to the concerns listed above in **Section 6.1**, a summary of the 100-year results is discussed below and labelled on the figures:

8. **Brookwood** – Limited capacity within the storm sewer system leaves an overland flooding risk that routes through private property. Recent upgrades included construction of a surge pond at St. Thomas Aquinas Catholic School has offloaded some of the flooding risk located along Brantford Street and Balmoral Drive. There is also overland ponding > 0.5 m in depth at Wellington Crescent, and at King Street and Brookwood Drive.
9. **Pioneer Road** – Insufficient culvert capacity contributes to flooding at the Fenwyck Boulevard traffic circle. Additionally, existing model results show that the existing Pioneer Trunk sewer is surcharged due to uncontrolled runoff from south of Highway 16A. The City has acknowledged that similar flooding extents are seen during snow melt in the spring.
10. **Broxton Park** – There is overland ponding > 0.5 m at Bristow Crescent and at Linthorpe Road.
11. **Downtown** – Sewer surcharging along Main Street, Church Road, and Queen Street causes overland ponding risk at the intersection of Main Street and Jespersen Avenue (> 0.5 m deep) and at the alley south of Church Road and west of Queen Street (up to 0.5 m deep).
12. **Dog Creek** – there is insufficient culvert capacity causing flooding risks at Aspenglen, Grove Senior's Village (Grove Drive), and within Westgrove (McLeod Avenue and Nelson Drive).
13. **Windermere Drive** – overland ponding exceeding 0.5 m that inundates private property caused by downstream sewer surcharging and insufficient catchbasin inlet capacity.
14. **Millgrove** – There is overland ponding exceeding 0.5 m in depth at Morel Drive, Marlboro Drive and Miller Avenue, Marlboro Drive and Morris Street, and Marmot Avenue and Morris Street. Sewer capacity constraints are noted along Marlboro Drive and Marmot Avenue.
15. **Spruce Ridge** – STMPND-00027 is limited by a 214 mm orifice, which when accounting for the entire upstream area (including uncontrolled and undeveloped areas to the south), releases at less than 2.5 L/s/ha. There are sewer capacity constraints along Spring Link and Springbrook Wynd resulting in overland ponding greater than 0.5 m in depth.
16. **Heatherglen** – Overland ponding within the treed area east of Jennifer Heil Way and north of Hawthorne Gate has historically caused flooding of backyards along Highland Way.
17. **Deer Park** – North of, and at the intersection of Grove Drive and Deer Park Drive, there is overland ponding up to 0.5 m in depth.
18. **Aspenglen** – Overland ponding at Aspenglen Drive and Creekside Close greater than 0.5 m in depth.
19. **Industrial Area** – There is insufficient SWMF capacity at STMPND-00011/21/22/41/58 and SWMF outfall capacity (1,500 mm trunk sewer downstream of STMPND-00022 and 1,200 mm culvert crossing Highway 16A) cause overland flooding risks within the industrial area south of Highway 16A. Flooding risks are further exacerbated by uncontrolled runoff from the upstream Dog Creek basin.
20. **East Highway 16A** – existing culverts at Highway 16A do not have sufficient capacity and cause overland flooding at the Big Greenhouse and near Highway 16A and Pioneer Road. There is a lack of capacity within STMPND-00019/23 and overland runoff routes through the Century Crossing and Lakewood neighbourhoods along major roadways (based on its original design). Controlling runoff from south of Highway 16A is critical to reducing the flood risk in this area.
21. **Grove Drive** – overland ponding along Grove Drive (south of Jubilee Park) is greater than 0.5 m in depth and blocks most lanes.



LEGEND

2D Modelling Zone

SWMF

Maximum HGL Relative to Ground

- Less than -3.0m
- -3.0m to -1.2m
- -1.2m to 0.0m
- Greater than 0.0m

Peak Flow Relative to Capacity

- Less than 86%
- 86% to 100%
- Greater than 100%

Maximum Depth (m)

- <= 0.1 m
- 0.1 - 0.2 m
- 0.2 - 0.3 m
- 0.3 - 0.4 m
- 0.4 - 0.5 m
- > 0.5 m

TITLE

FIGURE 6.2 EXISTING STORMWATER SYSTEM 100-YR, 4-HR MODELLING ASSESSMENT

PROJECT

SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT

THE CITY OF SPRUCE GROVE

DATA SOURCES

- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION

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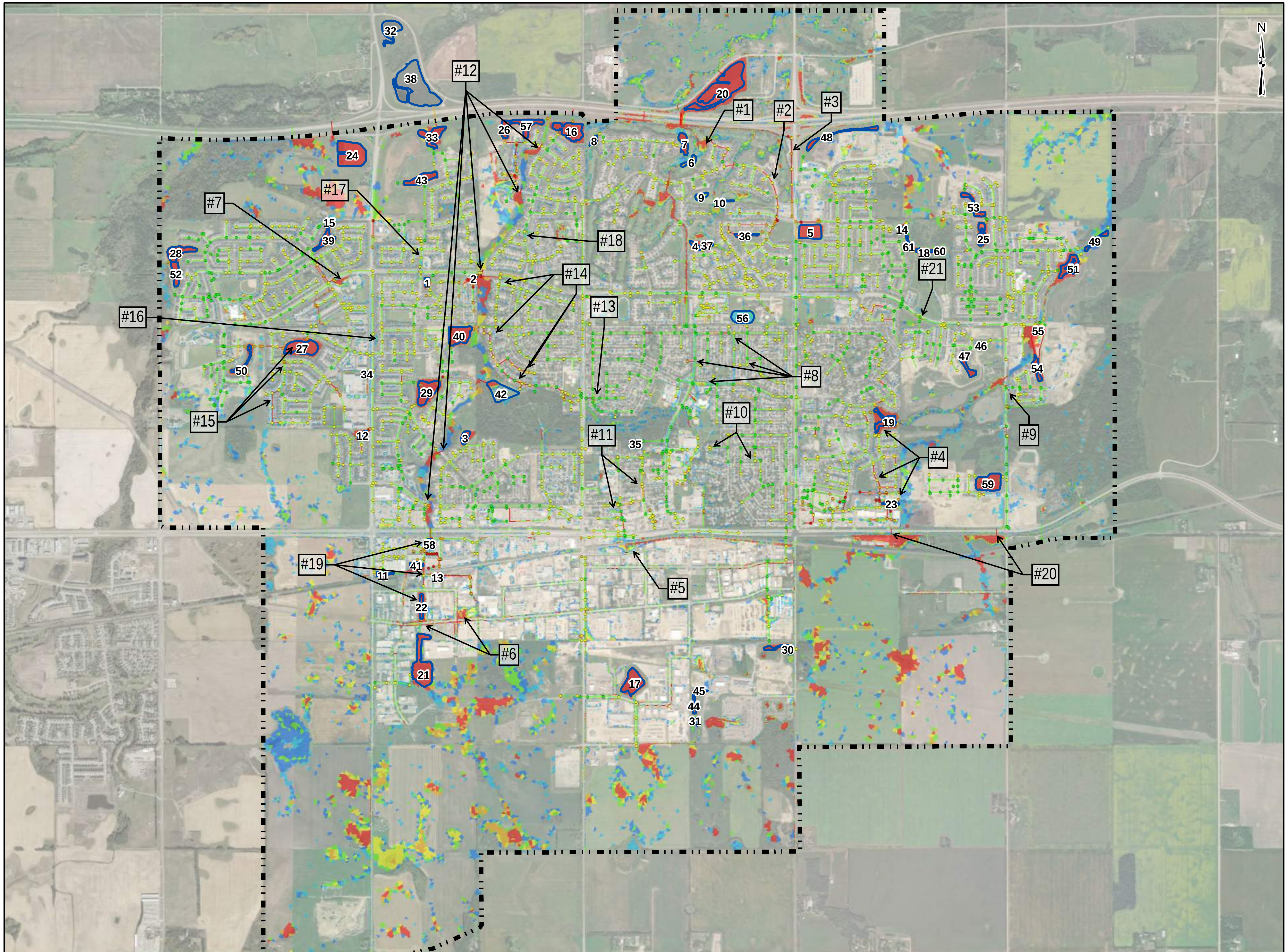
FIGURE	6.2
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

Document Path: M:\JeremyS\16462 - Spruce Grove Stormwater Master Plan\01_GIS\Figure 6.2 - 100Y4H Existing System Assessment.mxd



LEGEND

- 2D Modelling Zone
- SWMF

Maximum HGL Relative to Ground

- Less than -3.0m
- -3.0m to -1.2m
- -1.2m to 0.0m
- Greater than 0.0m

Peak Flow Relative to Capacity

- Less than 86%
- 86% to 100%
- Greater than 100%

Maximum Depth (m)

- <= 0.1 m
- 0.1 - 0.2 m
- 0.2 - 0.3 m
- 0.3 - 0.4 m
- 0.4 - 0.5 m
- > 0.5 m

TITLE

FIGURE 6.3 - EXISTING STORMWATER SYSTEM 100-YR, 24-HR MODELLING ASSESSMENT

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION
NAD 1983 CSRS 3TM 114

0 212.5 425 850
1:30,000 Meters

FIGURE	6.3
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

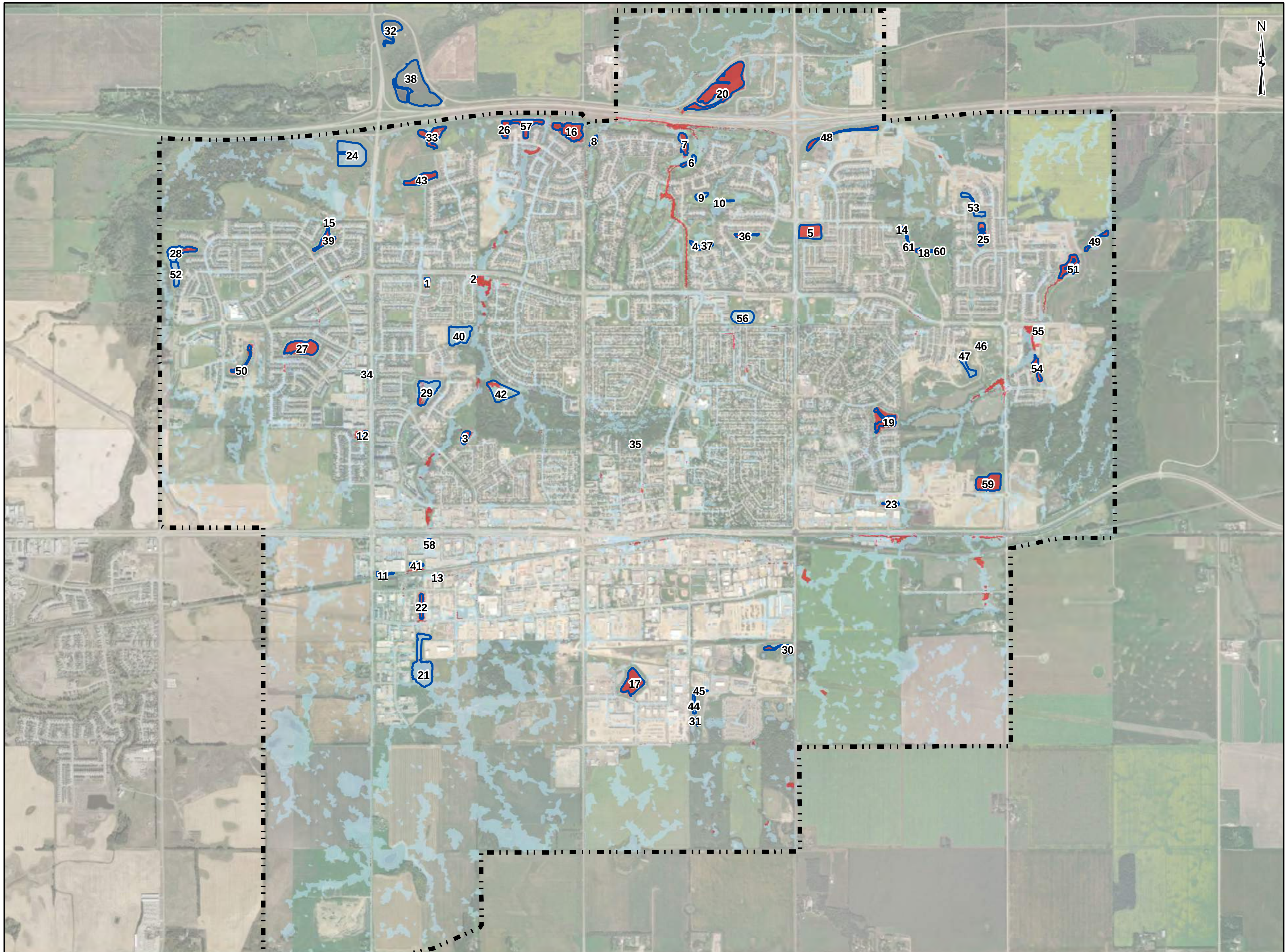
Document Path: M:\JeremyS\16462 - Spruce Grove Stormwater Master Plan\01_GIS\Figure 6.3 - 100Y24H Existing System Assessment.mxd

The 100-year, 4-hour event is used for the sizing of major system conveyance. To assess overland drainage conveyance, model results were exported at the maximum for both water depth relative to the LiDAR surface and surface flow velocity. It is noted that the maxima represent the peak depth/velocity value of each mesh element at a specific point in time. That said, the time stamps for each mesh element do not necessarily overlap, and each occurrence is independent of the next. In conclusion, this means that any comparison between the maximum depth and maximum velocity values will be conservative and will overestimate the areas that exceed the guidelines slightly.

Based on the depth/velocity criteria shown on **Figure 5.3**, the maximum velocities and depths were compared to determine if they exceeded the criteria and the results are shown on **Figure 6.4** and are summarized in **Table 6.1**. The severity of these velocity/depth criteria exceedances has been accounted for in the prioritization of upgrading recommendations and considerations discussed in **Section 6.5**.

Table 6.1: 100-Year, 4-Hour Design Storm Maximum Velocity/Depth Analysis

Area	Maximum Depth (m)	Maximum Velocity (m/s)	Description of Exceedances
High Severity			
Spruce Ridge	1.22	1.13	Adjacent to the Living Waters Christian Academy school field
Brookwood	1.26	1.73	Adjacent to private property along Balmoral Drive, Brantford Street, and Brookside Avenue
Downtown	0.87	1.42	Adjacent to private property along Main Street and Jespersen Avenue
Millgrove	0.65	1.66	Adjacent to private property along Morel Drive
Southeast Industrial	1.79	1.87	Inundates private property south of Highway 16A (The Big Greenhouse) and along Highway 16A and Pioneer Road
Medium Severity			
Linkside Golf Course	2.06	3.63	Contained within ditches and ponds adjacent to golf greens and walking trails
Pioneer Road	0.89	2.09	Located at the west side of the traffic circle near a pedestrian walkway
Millgrove	0.62	1.51	Adjacent to private property along Marlboro Drive and Marmot Avenue (covers a small area)
Spruce Ridge	0.76	1.81	Adjacent to private property along Spring Link (only covers a small area)
Low Severity			
CNR Ditch	1.35	0.98	Contained within the CNR ditch
Diamond Avenue	1.16	1.13	Contained to the Madison Crescent and Diamond Avenue ditches
Madison Crescent	2.21	0.93	Contained to the CNR ditch and private drainage channel



LEGEND

2D Modelling Zone

SWMF

Exceeds Maximum V/d Guidelines

Yes

No

TITLE

FIGURE 6.4 - EXISTING STORMWATER 100-YR, 4-HR MODELLING RESULTS: MAX OVERLAND DEPTH AND VELOCITY ASSESSMENT

PROJECT

SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT

THE CITY OF SPRUCE GROVE

DATA SOURCES

- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION

NAD 1983 CSRS 3TM 114

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FIGURE	6.4
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

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Lastly, the existing SWMFs were assessed based on the maximum 2D overland depths that were located within the SWMF GIS shapefile. A comparison of live storage depths, freeboard depths, and maximum depths were assessed in **Table 6.2**. It should be noted that the LiDAR at the SWMF facilities generally represents the NWL; however, the level of penetration in the water is dependent on several environmental factors; thus, these results should be considered with this in mind. Additionally, modelling assumptions were required at a couple of ponds where information was missing including at STMPND-00002, STMPND-00018, STMPND-00060, and STMPND-00061.

Table 6.2: Existing SWMF Model Results – 100-Year, 24-Hour Event

Facility ID	Fb Depth	Live Depth	Max Model Depth	Status	Comments
	m	m	m		
STMPND-00001	0.00	3.03	2.61	Good	-
STMPND-00002	0.04	2.01	3.11	Flooding	Heavy surcharging in pond outfall/orifice assumptions
STMPND-00003	0.00	0.50	1.64	Flooding	Green space
STMPND-00004	0.03	0.97	1.24	Flooding	Green space
STMPND-00037	-	-	0.82	Unknown	Green space
STMPND-00005	0.00	3.60	2.77	Good	Heavy surcharging in downstream sewers
STMPND-00006	1.00	0.79	0.49	Good	-
STMPND-00007	0.40	0.65	1.04	Surcharged	STMPND-00020/Hwy 16 culvert capacity constraints
STMPND-00008	0.09	1.23	1.07	Good	-
STMPND-00009	0.69	1.00	0.37	Good	-
STMPND-00010	1.22	0.33	0.53	Surcharged	Green space
STMPND-00011	0.00	3.01	1.86	Good	-
STMPND-00012	0.60	2.50	1.95	Good	-
STMPND-00013	-	-	1.25	Unknown	-
STMPND-00014	0.52	1.68	2.30	Flooding	Flooding spills to downstream green space
STMPND-00015	0.60	1.75	2.38	Flooding	Capacity restoration planned for summer 2024
STMPND-00039	0.60	1.75	2.10	Surcharged	
STMPND-00016	0.50	1.35	1.88	Flooding	Hwy 16 ditch ponding
STMPND-00017	0.56	2.44	1.78	Good	-
STMPND-00018	0.50	1.70	1.76	Surcharged	Green space/orifice assumptions
STMPND-00060	0.50	1.70	1.76	Surcharged	
STMPND-00061	0.50	1.70	1.76	Surcharged	
STMPND-00019	0.00	2.30	2.18	Good	-
STMPND-00020	0.20	3.17	4.17	Flooding	Flooding downstream in County
STMPND-00021	0.50	1.80	1.31	Good	-
STMPND-00022	0.75	1.80	3.09	Flooding	Due to uncontrolled runoff from Dog Creek basin
STMPND-00023	0.60	1.90	2.22	Surcharged	Due to uncontrolled runoff from south of Hwy 16A
STMPND-00024	0.30	2.00	0.97	Good	-
STMPND-00025	0.30	2.00	2.24	Surcharged	Sufficient freeboard depth
STMPND-00026	0.50	1.05	1.77	Flooding	Hwy 16 and Dog Creek ponding
STMPND-00057	0.50	1.05	1.77	Flooding	
STMPND-00027	1.00	1.39	2.58	Flooding	Due to uncontrolled runoff from Atim Creek basin
STMPND-00028	0.50	2.00	1.31	Good	-

Facility ID	Fb Depth	Live Depth	Max Model Depth	Status	Comments
	m	m	m		
STMPND-00052	0.50	2.00	1.37	Good	-
STMPND-00029	0.50	1.65	1.82	Surcharged	Sufficient freeboard depth
STMPND-00030	1.25	1.75	1.85	Surcharged	Sufficient freeboard depth
STMPND-00031	0.00	2.00	0.49	Good	-
STMPND-00044	0.60	3.00	1.43	Good	-
STMPND-00045	0.60	3.00	1.33	Good	-
STMPND-00032	-	-	-	Unknown	SWMF breached
STMPND-00038	-	-	-	Unknown	
STMPND-00033	1.32	2.18	1.60	Good	-
STMPND-00034	0.20	1.05	1.39	Flooding	Minor ponding in ditch and parking lot
STMPND-00035	0.00	2.70	1.58	Good	-
STMPND-00036	0.97	2.03	1.35	Good	-
STMPND-00040	0.50	1.23	1.42	Surcharged	Sufficient freeboard depth
STMPND-00041	0.40	1.40	1.61	Surcharged	Local capacity constraints exacerbated by uncontrolled Dog Creek basin runoff
STMPND-00042	-	-	2.17	Unknown	-
STMPND-00043	1.00	2.00	1.37	Good	-
STMPND-00046	1.50	1.80	1.07	Good	-
STMPND-00047	2.10	1.80	0.96	Good	-
STMPND-00048	0.50	2.00	1.27	Good	-
STMPND-00049	0.50	2.00	1.71	Good	Flooding at Prescott spills over emergency spill weir to green space due to undersized existing orifice
STMPND-00051	0.50	2.00	3.30	Flooding	
STMPND-00050	0.50	2.30	3.43	Flooding	Due to uncontrolled runoff from Atim Creek basin
STMPND-00053	0.50	2.50	1.96	Good	-
STMPND-00054	0.50	1.70	1.74	Surcharged	Due to uncontrolled runoff from south of Hwy 16A. Sufficient freeboard depth
STMPND-00055	0.50	2.00	2.14	Surcharged	
STMPND-00056	0.04	1.37	0.07	Good	-
STMPND-00058	0.60	1.40	3.79	Flooding	Local capacity constraints exacerbated by uncontrolled Dog Creek basin runoff
STMPND-00059	0.50	2.00	1.86	Good	Conditions worsened due to uncontrolled runoff from south of Hwy 16A

6.3 Storm Sewer Pipe Condition Assessment

As part of the project scope, several storm sewers within Spruce Grove were televised to evaluate pipe condition throughout the City. A range of neighbourhoods (residential versus industrial), pipe materials, and installation dates were selected to ensure a variety of conditions could be evaluated. The results of the CCTV analysis are summarized on **Figure 6.5** and are summarized below:

- Most sewers that were televised within the City had rankings between 1.0 and 2.0 implying that the structures were in good shape and there were minor O&M requirements.
- The sewers along Golden Spike Road were blocked with fines/gravel and were therefore assigned rankings of 5.0.
- The storm sewer along Grove Drive near the Grove Senior's Village is filled with significant debris. It is likely that the culverts crossing Grove Drive are also blocked and may be restricting Dog Creek.

The results of the CCTV analysis are also summarized in **Table 6.3**.

Table 6.3: CCTV Summary

Item	U/S Manhole D/S Manhole	Diameter	Length	Age	Material	Assessment	Structural Rank	O&M Rank	Overall Rank
		mm	m						
1	STMMH-00959 STMMH-00932	900	52.7	1957	Concrete	Fair; Ratings 1 - 3; Multiple cracks	2.1	1.8	2.0
2	STMMH-00932 STMMH-00937	900	82.0	1957	Concrete	Several longitudinal cracks; Encrustation	2.0	2.0	2.0
3	STMMH-00933 STMMH-00959	900	46.5	1957	Concrete		2.0	2.0	2.0
4	STMMH-00936 STMMH-00943	900	84.6	1957	Concrete		2.0	2.0	2.0
5	STMMH-00937 STMMH-00936	900	18.5	1957	Concrete	Some longitudinal cracks; one 'alignment left' (deflection)	2.0	3.0	2.2
6	STMMH-00974 STMMH-00933	600	62.4	1957	Concrete	Fair / poor; Reinforcement visible; Hole; Multiple cracks	2.6	1.8	2.0
7	STMMH-00896 STMMH-00920	1,050	50.3	1974	Concrete	Some longitudinal cracks; Encrustation	2.0	2.0	2.0
8	STMMH-00896 STMMH-00920	1,050	30.9	1974	Concrete	Some longitudinal cracks; Encrustation	2.0	2.0	2.0
9	STMMH-00372 STMMH-00373	375	62.2	1975	Concrete	Good; Ratings 1 & 2; Some encrustation, some longitudinal cracks	1.8	1.7	1.7
10	STMMH-00373 STMMH-00374	900	60.7	1975	Concrete	Good; Ratings 1 & 2	0.0	1.9	1.9
11	STMCB-02359 STMMH-01397	1,350	50.6	1977	Concrete	Fair/good; Ratings 1 - 3; Longitudinal cracks; tap break-in	2.0	1.4	1.5
12	STMCB-02359 STMMH-01397	1,350	48.1	1977	Concrete	Fair/good; Ratings 1 - 3; Longitudinal cracks; tap break-in	2.0	1.4	1.5
13	STMMH-01390 STMCB-02359	1,350	83.7	1977	Concrete	Good; Longitudinal crack	2.0	0.0	2.0

Item	U/S Manhole D/S Manhole	Diameter	Length	Age	Material	Assessment	Structural Rank	O&M Rank	Overall Rank
		mm	m						
14	STMMH-00695 STMMH-00696	450	56.0	1978	Concrete	Ratings 1 & 2; Circumferential & longitudinal cracks	1.5	1.8	1.8
15	STMMH-00696 STMMH-00694	600	121.0	1978	Concrete	Fair / poor; Ratings 1 - 4; With 4 broken pieces	2.5	1.6	1.7
16	STMMH-00670 STMMH-00671	300	115.2	1986	Concrete	Pipe 80%+ full of fines; Could only televise 0.5 m D/S of STMMH-00670	0.0	5.0	5.0
17	STMMH-00672 STMMH-00670	300	44.7	1986	Concrete		0.0	5.0	5.0
18	STMMH-00601 STMMH-00598	1,200	147.3	1992	Concrete	Significant debris – stopped CCTV	0.0	2.0	2.0
19	STMMH-00853 STMMH-00852	900	54.2	2011	Concrete	Very good; Some encrustation	0.0	2.0	2.0
20	STMMH-00854 STMMH-00853	900	92.2	2011	Concrete	Good; Some longitudinal cracks and encrustation	2.0	2.0	2.0
21	STMMH-00590 STMMH-01572	675	28.8	2014	PVC	Good; Ratings 1 & 2; Circumferential & longitudinal cracks; Debris bottom of pipe	1.8	2.0	1.8
22	STMMH-00590 STMMH-01572	675	45.6	2014	PVC		1.8	2.0	1.8
23	STMMH-01572 STMMH-01573	750	74.7	2014	PVC	Fair; Ratings 1 - 4; Several 'tap break-in & infiltration runner joint'	2.0	3.0	2.7

LEGEND

— Storm Sewers

CCTV Rankings

- Rank: 0.0 - 2.0 (Low Priority)
- Rank: 2.1 - 3.0 (Low/Moderate Priority)
- Rank: 3.1 - 4.0 (Moderate/High Priority)
- Rank: 4.1 - 5.0 (High Priority)

TITLE

FIGURE 6.5 - STORMWATER SYSTEM CCTV ASSESSMENT

PROJECT

SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT

THE CITY OF SPRUCE GROVE

DATA SOURCES

- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION

NAD 1983 CSRS 3TM 114

0 105 210 420

1:15,000 Meters

FIGURE	6.5
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

6.4 Flood Risk Assessment and Prioritization

To better evaluate the risk of each flooding location, ISL developed a Flood Hazard Analysis Tool. The purpose of the tool is to identify and prioritize flooding areas based on key criteria listed below:

- Extent of area flooded;
- Proximity of flooding to critical structures such as schools, hospitals, and emergency services;
- Number of non-critical buildings that are impacted by the flooding;
- Extent of flooding to various road classifications (flooding is considered more critical if it impacts an arterial road compared to a local road); and
- Depth of area flooded.

A point scoring system was then established for the criteria to determine the weight of importance of each item, with the intent that more critical criteria would be assigned higher point values and thus increase the score of the ponding location. This scoring then allowed for a quantified prioritization of flooding areas that required upgrading. It should be noted that the scoring criteria was based on internal discussions with the City and can be considered subjective; therefore, the absolute risk score does not perfectly predict the highest priority items and in some cases, the prioritization of upgrades was shifted based on historical flooding knowledge and background knowledge from the City. The scoring for buildings, roads and railways are summarized in **Table 6.4**.

Table 6.4: Building, Road, and Railway Risk Scores

Building Class Score		Road/Railway Footprint Score	
Description	**Score**	**Description**	**Score**
Lots of greenfield, low population	1	Alleyway, private, ramp	1
Commercial, industrial, storage	3	Local	2
Residential, critical commercial/industrial	10	Collector	3
Institutional facilities	50	Arterial, minor arterial, major collector	4
Critical facilities	200	Highway, major arterial, railway	5
Emergency response	500	-	-

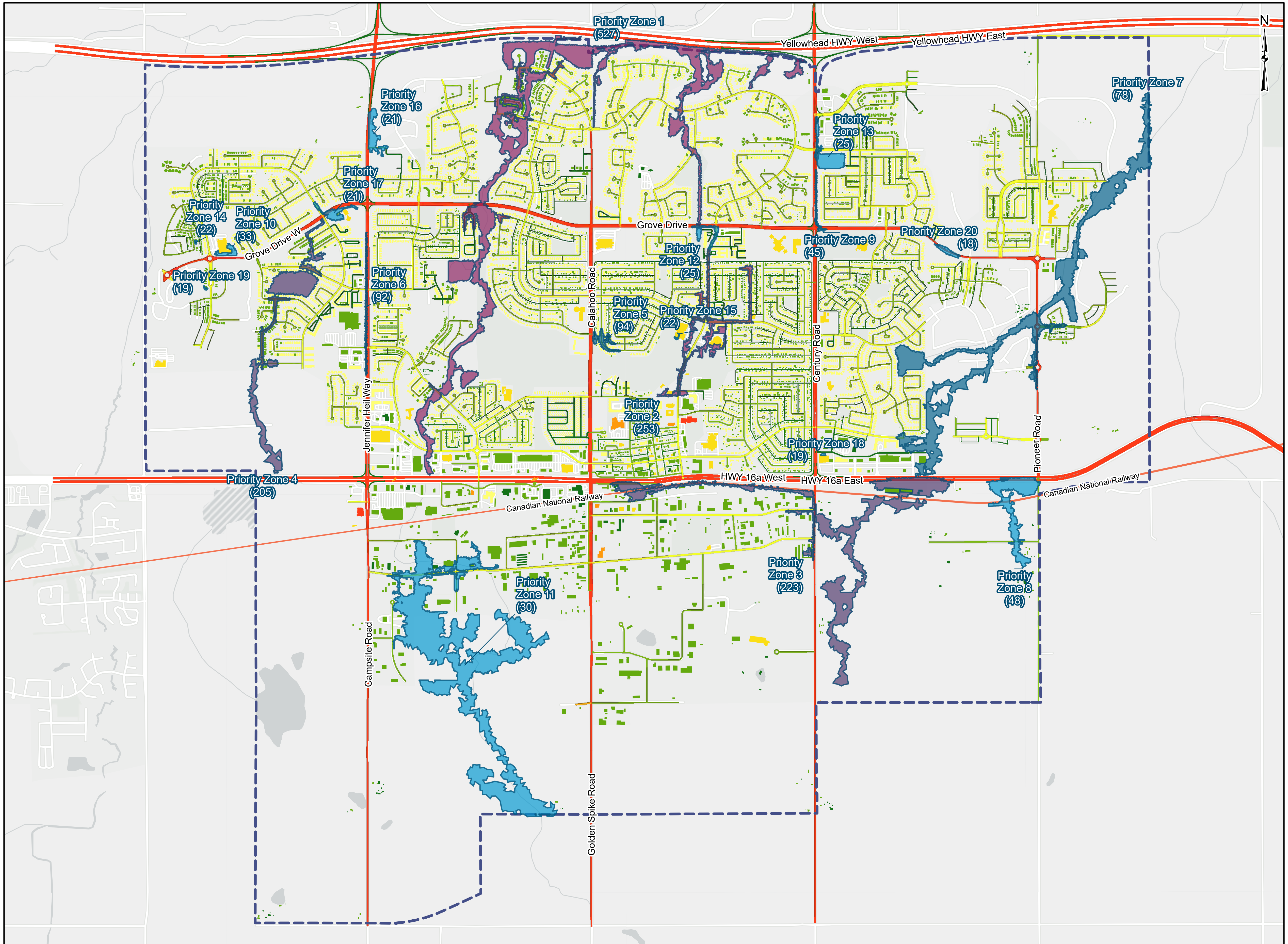
With the scoring criteria established, the final risk score is calculated based on **Equation 6.1**. For each building, b, and for each roadway/railway, r, the total risk score is the summation of inundated buildings (based on a ratio of flooded perimeter to total perimeter), and flooded roadways (based on flooded area). Thus, the flooding areas with the highest depths, velocities, and flooded buildings and roads will score the highest.

Equation 6.1: Flood Hazard Scoring Equation

$$Risk\ Score = \sum_{m=1}^{b} Building\ Score * (1 + Depth + Velocity) * \frac{Inundated\ Footprint\ Perimeter}{Building\ Footprint\ Perimeter} + \sum_{n=1}^{r} Road\ Score * (1 + Depth + Velocity) * \frac{Inundated\ Road\ Area}{1000}$$

The overall flood risk results are shown in plan view on **Figure 6.6** along with the scoring results. A map book of more detailed results is shown in **Appendix E**. Some conclusions regarding the flood hazard mapping are listed below:

- **Priority Zone 1** – Several cascading flooding issues make up this zone and are caused primarily by STMPND-00020 and Highway 16 culvert capacity constraints that cause flows to back up into Dog Creek and Linkside Golf Course. Culvert capacity constraints along Dog Creek create local flooding risks as well.
- **Priority Zone 2** – Local flooding risks along King Street and within the Brookwood area are caused by downstream capacity constraints, an older storm sewer system that was not designed to intercept the overland flow paths, and some missing private storm sewer systems that likely worsen the flooding risk results within non-residential private lots.
- **Priority Zone 3** – CNR ditch and Highway 16A culvert capacity constraints create ponding risks within the industrial area and near the Big Greenhouse south of Highway 16A.
- **Priority Zone 4** – Uncontrolled runoff from south of Highway 16A creates ponding risks within STMPND-00027 and Spruce Ridge. As downstream areas develop, the flooding risks will lessen.
- **Priority Zone 5** – Windermere Drive overland flooding risk to private property.
- **Priority Zone 6** –While the ponding takes up a large area of Jennifer Heil Way lengthwise, being less than 0.3 m in depth and only impacting 1 lane makes this area not a high risk.
- **Priority Zone 7** – Overland ponding near Century Crossing and Pioneer Road is caused by large areas of uncontrolled runoff from south of Highway 16A, Pioneer Road culvert and downstream SWMF capacity constraints.
- **Priority Zone 8** – Ponding is due to uncontrolled runoff from south of Highway 16A and insufficient culvert capacity at Highway 16A.
- **Priority Zone 9** – Related to Priority Zone 13.
- **Priority Zone 10** – Missing private storm sewer information makes ponding appear worse.
- **Priority Zone 11** – Ponding within industrial area is due to SWMF and outlet capacity restrictions.
- **Priority Zone 12** – Caused by downstream capacity constraints.
- **Priority Zone 13** – Highway 16 ditch and Century Road sewer capacity constraints cause ponding along Century Road, STMPND-00005, and the adjacent commercial area.
- **Priority Zone 14** – Local ponding in newly developing areas is likely due to out-of-date LiDAR.
- **Priority Zone 15** – Missing private storm sewer information makes ponding appear worse.
- **Priority Zone 16** – Ponding is mostly contained to ditch and does not significantly impact the Co-op.
- **Priority Zone 17** – Ponding inundates near school portables which are raised ~1 m.
- **Priority Zone 18** – Ponding near Save-On Foods near loading dock.
- **Priority Zone 19** – Ponding in newly developing areas is likely due to out-of-date LiDAR.
- **Priority Zone 20** – Ponding along Grove Drive inundates the entire road width.



LEGEND

Building Class Score
- 1 - Lots of greenfield, little population
- 3 - Commercial/industrial facilities/ storage
- 10 - Residential and more critical commercial/institutional
- 50 - Institutional facilities
- 200 - Critical facilities
- 500 - Emergency response

Road Footprint Score
- 1 - Alleyway, Private, Ramp
- 2 - Local
- 3 - Collector
- 4 - Arterial, Minor Arterial, Major Collector
- 5 - Highway, Major Arterial, Railway

Municipal Boundary

Priority Zone	Building Weighted Score	Road Weighted Score	Total Weighted Score
1	421	106	527
2	142	111	253
3	52	170	223
4	162	43	205
5	82	11	93
6	0	91	91
7	4	74	77
8	0	48	48
9	0	44	44
10	33	0	33
11	9	21	30
12	0	25	25
13	0	25	25
14	21	0	21
15	21	0	21
16	0	21	21
17	4	17	21
18	19	0	19
19	19	0	19
20	0	18	18

TITLE
FIGURE 6.6 - FLOOD RISK REVIEW

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Elevation data captured in 2012
- Parkland County, Esri Canada, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, US Census Bureau, USDA, NRCan, Parks Canada

PROJECTION
NAD 1983 3TM 114

0 400 800
1:28,000 Meters

FIGURE 6.6
DATE 2024-02-29
PROJECT NO. 16462
AUTHOR TDaSilva

6.5 Proposed Upgrades for the Existing Stormwater System

Based on the results of the flood hazard assessment, and the results from **Sections 6.1** through **6.3**, the following existing system upgrading priority considerations are shown in **Table 6.5** and on **Figure 6.7**. The following notes are made regarding the upgrading considerations and priority ranking:

1. Some upgrades in the priority ranking list are noted to be not recommended at this time but are listed for consideration. In these cases, it is recommended that these areas are flagged and monitored during heavy rainfall events to determine the severity of flooding risks before any upgrading is pursued.
2. Orifice upgrades are shown using orifice diameters rounded to the nearest mm and may require custom orifice plates designed to match these details. Typical orifice sizes could be used, although the release rates will be moderately impacted depending on if the orifice size is rounded up or down.
3. Where upgrades mention “or equivalent” implies that consideration should be given to cost effectiveness and constructability of different potential upgrading scenarios such as twinning versus replacement/upsizing.
4. Catch basin upgrades are conceptual and the number and type of catch basin should be refined further during detailed design for any upgrading projects that are pursued.

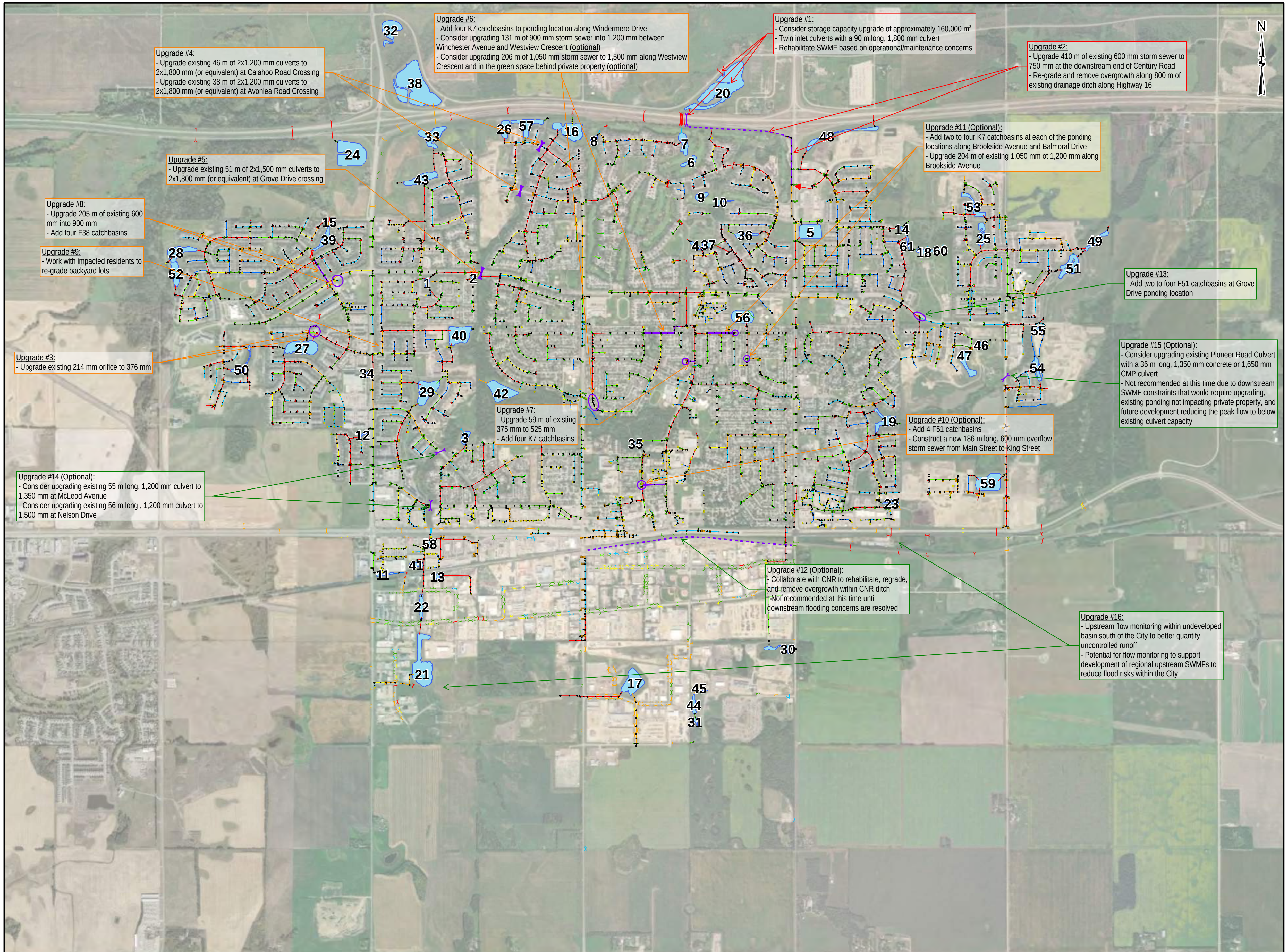
Table 6.5: Existing System Upgrading Consideration Priorities

Priority	Description of Potential Upgrade
High Priority Upgrading Considerations	

1	• Consider a **storage capacity upgrade** on the order of **160,000 m³** to lessen flooding risks upstream within the City. It is noted that there is insufficient space for SWMF expansion, and this would likely require land acquisition and construction of an additional stormwater management cell.
	• **Twin** the six existing inlet culverts crossing Highway 16 with at least a **90 m** long, **1,800 mm culvert** (assumed 0.4% slope based on adjacent culverts).
	• Implement the following maintenance upgrades (as described in Section 3.2):
	  • Replace perimeter fencing as it is in poor condition;
	  • Rehabilitate the compromised road bordering the northern side of the SWMF;
	  • Rehabilitate or replace the damaged 800 mm culvert that has become separated;
	  • Remove the overgrowth of invasive weeds growing in the SWMF;
	  • Rehabilitate NE culvert flap gate to prevent backflow to adjacent landowner;
	  • Southwest inlet channel is heavily overgrown and requires rehabilitation; and
	  • Dredge silt deposits within SWMF that reduce effective storage capacity.

2	• Upgrade the north **410 m** of 600 mm storm sewer to **750 mm** (or equivalent) along Century Road downstream of the No-Frills Surge Pond outfall trunk along Century Road. • Rehabilitate and **re-grade 800 m** of Highway 16 ditch from outfall to Highway 16 culvert crossing. • This is a high priority historical flood risk area that was noted by the City.
Medium Priority Upgrading Considerations	
3	• The existing 214 mm orifice can discharge an effective area of 43.2 ha at 2.5 L/s/ha. Based on the existing 121.2 ha catchment within Spruce Ridge and Copperhaven (not accounting for upstream undeveloped and uncontrolled runoff from the south), **upgrade the orifice to 376 mm** to provide 2.5 L/s/ha for the current level of development. Once development commences within the Atim Creek basin, this orifice will require periodic upsizing to account for upstream development to the south. • The existing Copperhaven catchment (51.5 ha) upstream of STMPND-00027 to the west is currently outfitted with an existing 350 mm orifice at NWL, a 700x300 mm concrete opening at 0.5 m above NWL, and a concrete cut 1.3 m weir set at 0.4 m below HWL. Thus, the release rate of this pond at HWL relative to its catchment area appears to be on the order of 30 L/s/ha (based on the 350 mm and 700 x 300 mm openings acting as orifices, the 1.3 x 0.4 m concrete cut acting as a weir, and a water depth at HWL) which may impose some potential risks downstream if the pond ever fills to HWL. • Considering the upstream undeveloped land to the south, the potential area increases to approximately 519 ha. If the pond then fills to HWL with the two openings acting as orifices, and the concrete cut section acting as a weir, the release rate is estimated to be on the order of 3.3 L/s/ha. • Thus, based on the above two points, it is recommended that the outlet control structure at Copperhaven (STMPND-00050) be verified, and the design assumptions be reviewed to ensure that the pond is controlled to 2.5 L/s/ha. • This upgrade requires that planned capacity upgrades at STMPND-00015/39 are completed first.
4	• Upgrade existing **46 m** of 2x1,200 mm culverts to **2x1,800 mm** (or equivalent) along Dog Creek at Calahoo Road crossing. • Upgrade existing **38 m** of 2x1,200 mm culverts to **2x1,800 mm** (or equivalent) along Dog Creek at Avonlea Road crossing.
5	• Upgrade existing **51 m** of 2x1,500 mm culverts to **2x1,800 mm** (or equivalent) along Dog Creek at Grove Drive crossing. • Confirm the STMPND-00002 control structure outlet orifice size and release rate since the pond appears overloaded during the 100-year, 24-hour design storm.
6	• Add **four K7 catchbasins** within the flooding location along Windermere Drive to increase inlet capacity and reduce ponding depths. • Consider upgrading **131 m** of 900 mm storm sewer into **1,200 mm** (or equivalent) between Winchester Avenue and Westview Crescent. • Consider upgrading **206 m** of 1,050 mm storm sewer to **1,500 mm** (or equivalent) along Westview Crescent and in the green space behind private property. • Downstream sewer upgrading will be difficult due to proximity to private property and limited access space. Sewer capacity is sufficient during the 5-year, 4-hour and 100-year, 24-hour design events; thus, the sewer upgrading is of lower priority compared to adding additional catch basin capacity. • Thus, **sewer upgrading downstream is not recommended at this time**.
7	• Upgrade **59 m** of existing 375 mm storm sewer to **525 mm** (or equivalent) along the exit from Wellington Crescent just west of King Street. • Add **four K7 catchbasins** within three-way entrance intersection to increase inlet capacity to storm sewer.
8	• Ponding adjacent to Living Waters Christian Academy creates a high flood risk for the school. • Upgrade **205 m** of 600 mm storm sewer into **900 mm** (or equivalent) along Harvest Ridge Drive. • Add an **additional four F38 catchbasins** within the low point adjacent to the school portables to capture additional runoff.

Priority	Description of Potential Upgrade
9	• It is recommended that the City engage with impacted landowners (east of Jennifer Heil Way and north of Hawthorne Gate) to discuss the potential ponding risk, validate if action is needed by confirming any historical ponding from the residents, and coordinate if the residents would like to re-grade their backyards to reduce the flooding risks to their property. • This recommendation is considered more cost-effective and easily implemented compared to the alternative options which include: • Regrading in between private property and Jennifer Heil Way which would require a significant amount of tree/vegetation removal (requiring public engagement due to loss of tree buffer between private lots and the major arterial roadway). • Interception of overland flows by installing additional catch basins and sewers routed northwards to Grove Drive (> 560 m). There is insufficient grade to connect a proposed sewer to the nearby manhole on Jennifer Heil Way. • This is a high priority historical flood risk area that was noted by the City.
10	• Construct four F51 catchbasins within the intersection of Main Street and Jespersen Avenue to improve inlet capacity. • Construct a new 186 m long, 600 mm overflow storm sewer that drains eastwards along Jespersen Avenue into the King Street storm sewer which will begin to overflow only when the existing sewer along Main Street begins to surcharge. • This area is part of the older City and upgrading shows only marginal improvements to the flooding risks. Additionally, this upgrade worsens surcharging along the King Street sewer. • This upgrade is not recommended currently unless flooding is observed in this location and poses substantial risks to private property.
11	• Upgrade **204 m** of existing 1,050 mm storm sewer to **1,200 mm** (or equivalent) along Brookside Avenue. • Add **four K7 catchbasins** at each of the ponding locations along Brookside Avenue and Balmoral Drive. • This is an older neighbourhood and upgrading shows only marginal improvements and is therefore **not recommended currently** unless flooding is observed and poses substantial risks to private property.
Low Priority Upgrading Considerations	
12	• The existing CNR ditch is poorly graded and is overgrown with vegetation which causes flooding of lay-down yards in the industrial area. • Collaboration with CNR to remove vegetation, regrade, and restore capacity to the CNR ditch (1,600 m length) along the south side of the tracks will improve flooding risks to lots adjacent to the CNR. • There is minimal working space and access issues making it difficult to implement ditch upgrades. Additionally, downstream flooding risks at The Big Greenhouse discourage capacity upgrades since additional conveyance capacity will worsen downstream flooding risks. • This upgrade is **not recommended at this time**.
13	• Overland ponding along Grove Drive is severe but does not impact private property; therefore, is considered to have low risk. • **Four additional F51 catch basins** could be installed at this low point to capture additional flow during the 100-year, 24-hour Huff distribution event.
14	• The existing culverts along Dog Creek that cross Nelson Drive and McLeod Avenue are heavily surcharged and cause minor road ponding at these crossings. • The existing culvert at McLeod Avenue could be upgraded from 1,200 mm to **1,350 mm** (or equivalent) and the culvert along Nelson Drive could be upgraded from 1,200 mm to **1,500 mm** (or equivalent) to reduce the level of surcharging and prevent road ponding. • These culvert upgrades are **not recommended at this time** since flooding risks are relatively minor; however, upgrading could be pursued in the future as the Dog Creek basin begins to develop if flooding becomes high risk. Since Dog Creek is controlled to 1.8 L/s/ha, which is lower than the upstream uncontrolled runoff rate, it is unlikely that conditions at these culverts will worsen.
15	• The Pioneer Road culvert surcharges during existing conditions due to uncontrolled runoff from the south. Consider upgrading the existing 900x1,200 mm box culvert with a **36 m** long, **1,350 mm culvert (concrete), 1,650 mm culvert (CMP), or equivalent** to improve capacity and prevent ponding. • Interim upgrading to reduce ponding along Pioneer Road also require additional SWMF upgrades at Fenwyck and Prescott (orifice and storage upsizing) to ensure flooding is not pushed to downstream bottlenecks. A manual gate along the downstream end of the culvert could also be designed to control runoff entering the Fenwyck and Prescott SWMFs. • **These upgrades are not recommended at this time** since future development will control runoff from upstream basins to much lower rates and the future system analysis shows sufficient culvert capacity. Additionally, flooding risks are contained to the traffic circle and road ROW along Pioneer Road and does not inundate private property.
16	• **Additional flow monitoring** of the upstream watershed south of the City is recommended to better quantify the uncontrolled runoff that flows through the City. • If additional flow monitoring confirms that upstream predevelopment flows are a risk to the City, then additional study is recommended to design and construct regional upstream SWMFs to reduce the flood risk within the City. • Additional conveyance capacity upgrades are not recommended due to downstream capacity constraints and flooding risks that will be worsened if predevelopment uncontrolled runoff is allowed to flow through the City at increased flow rates.



LEGEND

SWMF

Manhole and Catchbasins
- F33
- F36
- F38
- F51
- K7
- Manhole

Storm Sewer Diameter (mm)
- <= 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- >= 675 mm

Culvert Diameter (mm)
- Unknown
- <= 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- >= 675 mm

- Low Priority Upgrade
- Medium Priority Upgrade
- High Priority Upgrade
- Storm Sewer Upgrade Location
- Culvert Upgrade Location
- Ditch Upgrade Location
- Location of Additional Catchbasins

TITLE

FIGURE 6.7 - EXISTING SYSTEM UPGRADING CONSIDERATIONS AND PRIORITIZATION

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION
NAD 1983 CSRS 3TM 114

0 212.5 425 850
1:30,000 Meters

ISL

FIGURE	6.7
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

6.6 Cost Estimates

For each of the priority items discussed in **Table 6.5**, cost estimates have been prepared and are presented in **Table 6.6**. For more detailed costing information, see **Appendix F**.

Table 6.6: Existing System Upgrading Cost Estimates

Upgrading Priority Number	Cost	Engineering (10%)	Contingency (30%)	Total
	($)	($)	($)	($)
1	$ 4,112,000	$ 411,000	$ 1,234,000	$ 5,757,000
2	$ 743,000	$ 74,000	$ 223,000	$ 1,040,000
3	$ 37,000	$ 4,000	$ 11,000	$ 52,000
4	$ 352,000	$ 35,000	$ 106,000	$ 493,000
5	$ 214,000	$ 21,000	$ 64,000	$ 299,000
6	$ 962,000	$ 97,000	$ 289,000	$ 1,348,000
7	$ 155,000	$ 16,000	$ 47,000	$ 218,000
8	$ 480,000	$ 48,000	$ 144,000	$ 672,000
9	$ 102,000	$ 11,000	$ 31,000	$ 144,000
10	$ 337,000	$ 34,000	$ 101,000	$ 472,000
11	$ 555,000	$ 56,000	$ 167,000	$ 778,000
12	$ 161,000	$ 16,000	$ 48,000	$ 225,000
13	$ 80,000	$ 8,000	$ 24,000	$ 112,000
14	$ 194,000	$ 19,000	$ 59,000	$ 272,000
15	$ 70,000	$ 7,000	$ 21,000	$ 98,000
16	$ 140,000	$ 14,000	$ 42,000	$ 196,000
Total	**$ 8,694,000**	**$ 871,000**	**$ 2,611,000**	**$ 12,176,000**

6.7 Regional Flood Risk Assessment Review

In 2023, the Edmonton Metropolitan Regional Board (EMRB) prepared a Regional Flood Risk Assessment as part of the Edmonton Metropolitan Region Stormwater Collaborative. The goal of the assessment was to assess the risk of flooding across the region considering river/creek flooding, stormwater flooding, and sanitary surcharge. The assessment includes a hydrologic analysis to determine the likelihood of flooding, considering multiple rainfall return periods (20-year to-200 year). The flood inundation extents for river and stormwater flooding used Alberta Environment and Parks (now Alberta Environment and Protected Areas) Flood Hazard Identification Program or “JBA Risk Management Flood Hazard Mapping”. These surfaces are (likely) not as accurate as the LiDAR surface used for this master plan.

The assessment also included estimates of the health and safety, social, environmental, and financial consequences of flooding. The model then considered both the likelihood and consequence of flooding to develop an overall flood risk. The EMRB provided three maps to each municipality: Stormwater Flood Risk, River Flood Risk, and Total Risk. The Stormwater Flood Risk and River Flood Risk maps were very detailed, while the Total Risk map summarized the computed risk at a neighborhood scale.

The overall approach used by the EMRB was similar to the Flood Risk Assessment presented in **Section 6.4** above. The hydrologic / hydraulic analysis as part of the 1D-2D modelling is considered to be more accurate than the EMRB assessment due to the use of high-resolution LiDAR data, the detailed review of record drawings and background reports, and the application of state-of-the-art 1D-2D modelling. The EMRB risk quantification appears to be in greater detail than the Flood Risk Assessment in **Section 6.4** based on the more detailed risk-consequence analysis. ISL compared the EMRB Stormwater Flood Risk and River Flood Risk maps with the Flood Risk Review from the 1D-2D modelling in **Figure 6.6**. The comparison is summarized in **Table 6.7**.

Table 6.7: Comparison of EMRB Flood Risk Maps and 1D-2D Modelling Results

EMRB Flood Risk Mapping	ISL 1D-2D Modelling (Figure 6.6)	Comments	Recommendations
River Flood Risk map shows potential Atim Creek flooding in the northwest corner of Harvest Ridge.	No flooding indicated.	The EMRB modeling may not have the latest ground surface due to ongoing development. Most of the affected area is at SWMF locations.	City should consider Atim Creek HWL in design of developments in the area.
Stormwater Flood Risk map shows potential flooding in the northwest part of Spruce Ridge and the east part of Harvest Ridge.	Similar results for the northwest part of Spruce Ridge. No flooding risk in Harvest Ridge because of the elevation of the control structure overflow relative to adjacent subdivision.	The EMRB analysis may not have the latest SWMF design information.	Refer to proposed upgrades in **Figure 6.7**.
Stormwater Flood Risk map shows potential flooding in the west part of Deer Park.	No flooding indicated.	The EMRB modeling may not have the latest ground surface due to ongoing development. There have also been recent upgrades to the two Deer Park SWMFs due to the breaching of the SWMF north of Highway 16 (STMPND-00032/38).	No action required.
River Flood map shows potential flooding along Dog Creek at numerous locations, especially upstream of CNR and between Grove Drive and Highway 16.	Results are generally similar.	Both methods show similar concerns.	Refer to proposed upgrades in **Figure 6.7**.
Stormwater Flood Risk map shows potential flooding in the Brookwood, Hilldowns, and Stoneshire neighbourhoods.	Some flood risk shown in these areas, but at slightly different locations, and much more linear.	EMRB modeling may not have included recently completed upgrades in Brookwood.	City to consider asking EMRB for more detail on Hilldowns flooding results.
River Flood Risk map shows potential creek flooding downstream of Lakewood SWMF.	Similar results.	Appears to be confined to environmental reserve (ER) lands.	No action required.
Stormwater Flood Risk map shows potential flooding in watercourses south of Highway 16A, within Century Crossing and Easton, and in Fenwyck / Prescott.	Similar results, especially overland flows from south of Highway 16A flooding Easton.	These areas north of Highway 16A are actively developing and infrastructure and ground elevations are changing.	Refer to proposed upgrades in **Figure 6.7** and in **Section 7.0**.

6.8 Climate Change Resiliency

6.8.1 Intensity-Duration-Frequency Impacts of Climate Change

Climate change is expected to increase rainfall intensity in the future, which will negatively impact the existing risk of flooding within existing stormwater drainage systems. To assess the impacts of climate change, ISL used the Computerized Tool for the Development of Intensity-Duration-Frequency Curves under Climate Change – Version 7.0 tool, also known as IDF_CC Tool 7.0. This is a publicly available and web-based tool that has historical rainfall information for 898 Environment and Climate Change rainfall stations. Using this tool, ISL exported the worst-case climate change scenario for review.

ISL selected the Edmonton Blatchford rain gauge, ID: 3012209, due to its proximity to Spruce Grove. A Generalized Extreme Value (GEV) distribution and SSP5.85 model was selected to estimate IDF curves for the year 2100 (RCP8.5). RCP8.5 refers to Representative Concentration Pathway resulting in radiative forcing of 8.5 W/m^2 by 2100, and where radiative forcing continues to rise beyond this year. This scenario provides the most severe climate change impacts compared to other RCP scenarios.

Climate change design storms are summarized below in **Table 6.8** and on **Figures 6.8** and **6.9** for the Chicago and Huff Distributions, respectively.

Table 6.8: Climate Change Scenario Table

Design Event	Parameter	Return Period					
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Chicago	Peak Intensity (mm/hr)	48.8	67.9	82.9	103.2	119.1	137.8
	Precipitation (mm)	24.9	35.8	44.0	56.0	67.2	80.4
Huff	Peak Intensity (mm/hr)	5.9	8.2	9.8	12.5	15.4	18.8
	Precipitation (mm)	39.9	55.9	66.8	84.5	104.3	127.3
SSP5.85 (RCP8.5) Chicago	Peak Intensity (mm/hr)	52.9	76.5	96.4	121.5	140.6	164.3
	Precipitation (mm)	27.0	40.4	51.1	66.0	79.3	92.7
SSP5.85 (RCP8.5) Huff	Peak Intensity (mm/hr)	6.9	10.1	12.6	16.0	18.7	21.7
	Precipitation (mm)	46.9	68.7	85.8	108.4	127.1	147.4

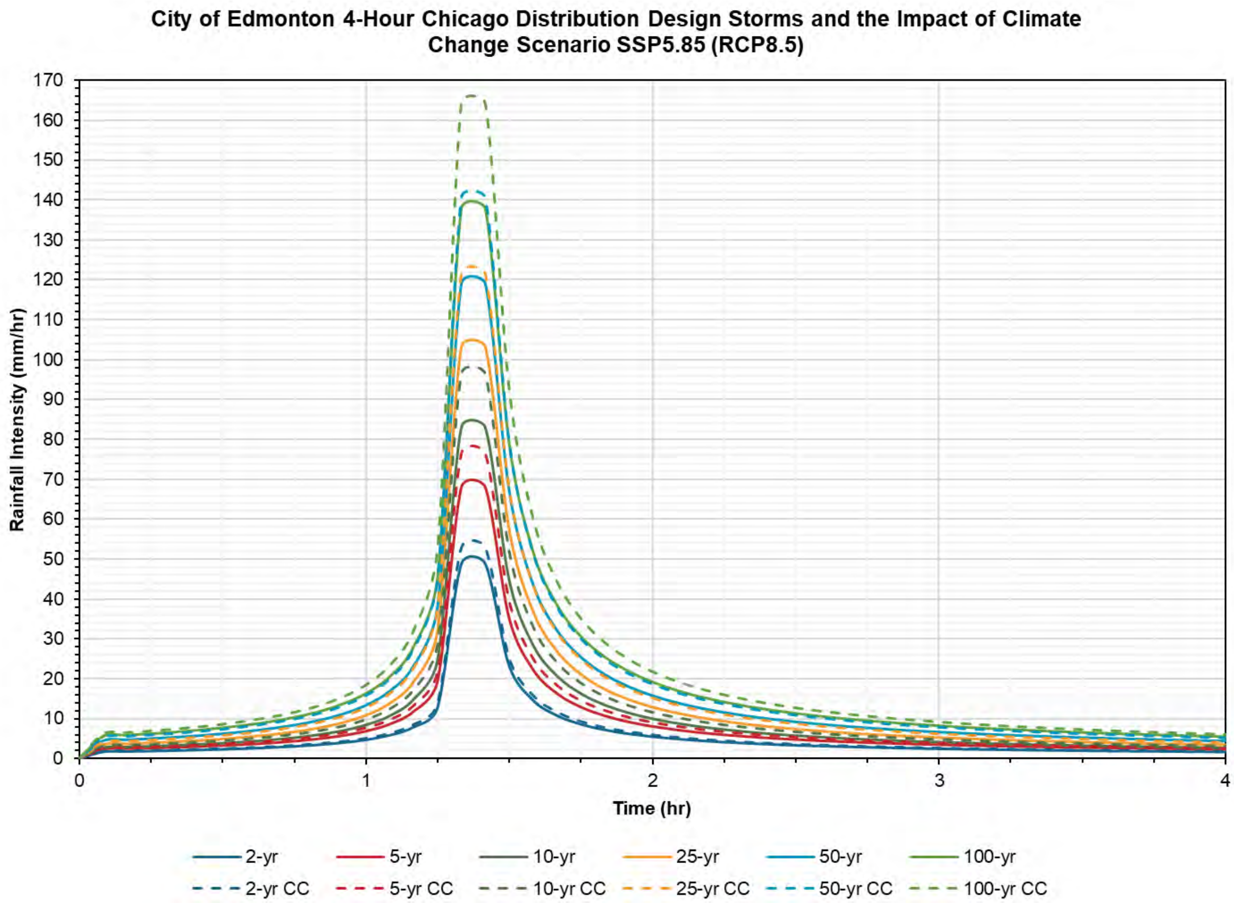


Figure 6.8: City of Edmonton Chicago Distribution Climate Change (CC) Design Storms

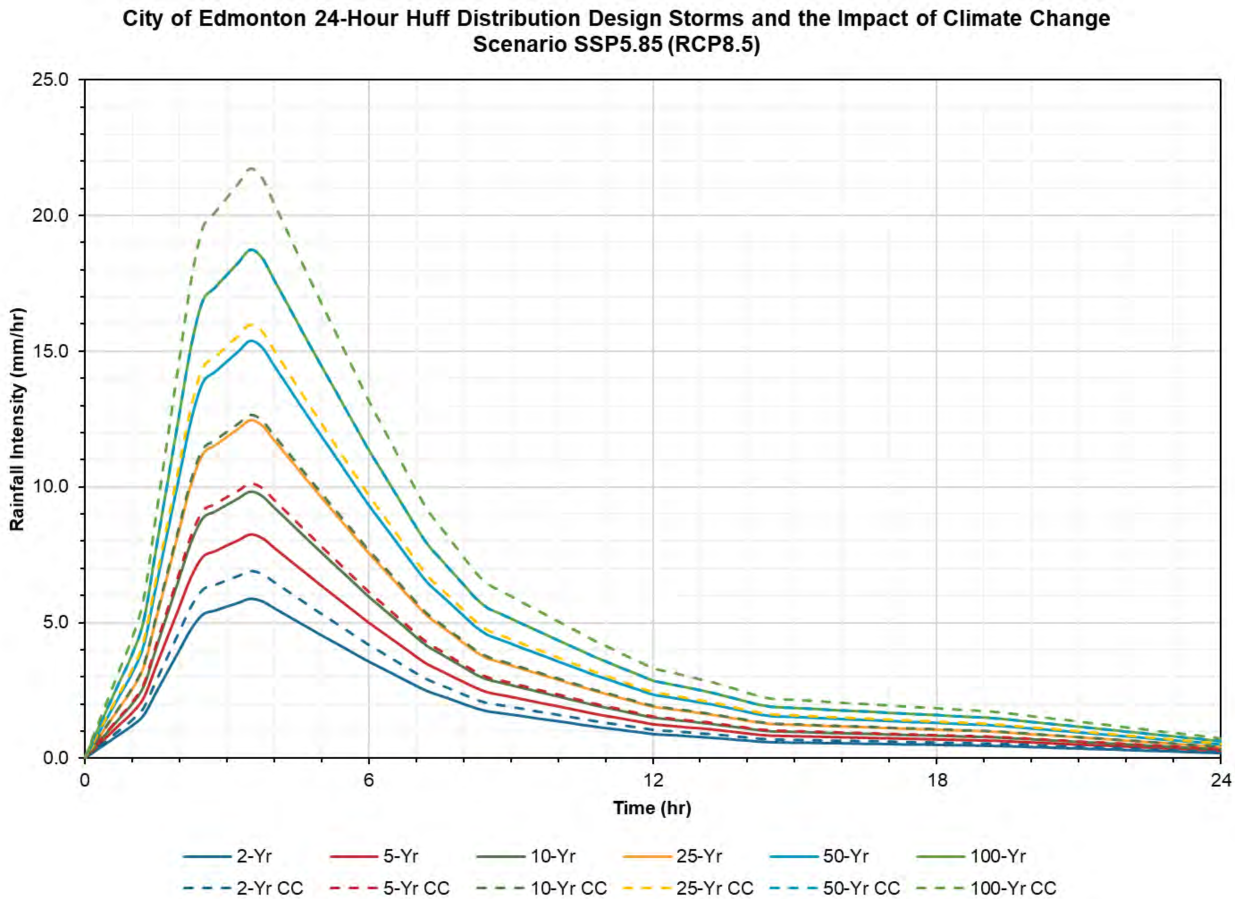


Figure 6.9: City of Edmonton Huff Distribution Climate Change (CC) Design Storms

Based on the SSP5.85 (RCP8.5) scenario, there is an increase in peak intensity and precipitation volumes ranging from 8% to 28% which will impact the conveyance capacity and SWMF storage capacity, respectively. In particular:

- The 5-year, 4-hour Chicago Distribution peak intensity will increase by ~13% which will impact the capacity evaluation of storm sewers;
- The 100-year, 4-hour Chicago Distribution peak intensity will increase by ~19% which will impact the capacity evaluation of overland drainage channels and culverts; and
- The 100-year, 24-hour Huff Distribution total precipitation will increase by ~16% which will impact the SWMF capacity evaluation.

Based on these shifting targets, it is recommended that the City continue to use the InfoWorks ICM model as a tool to evaluate both existing design storms and future climate change scenarios when considering new stormwater management infrastructure. Additionally, it is recommended that the climate change scenarios are updated on a regular basis as they can change as more rainfall data is added to the IDF_CC database.

6.8.2 Other Impacts and Considerations

Another aspect of climate change resiliency to consider is the impact of drought conditions during years of below average rainfall. There is potential for SWMFs to hold back stormwater runoff for water reuse, irrigation purposes, and supplementing existing wetlands during dry years; however, there are several issues that would need to be considered:

- Existing SWMF sites are generally designed for their required storage capacity and do not have space to build additional storage for water reuse;
- Designing future SWMFs for water reuse will increase the storage requirements and costs;
- Significantly reducing the orifice-controlled outlet rates will also impose a risk when the SWMFs are above NWL due to the potential of back-to-back storm events that may cause flooding; and
- Pumping ponds below NWL will have an aesthetic impact to the facilities and could lead to complaints from residents who live near them.

Based on the above challenges, there does not appear to be a case for storing stormwater for drought conditions.

7.0 Future System Assessment and Upgrades

The future growth plan is summarized in **Section 2.3** and **Figure 2.3**.

7.1 Future Drainage Patterns

Future development within the growth area of Spruce Grove is summarized below and the future drainage basins are summarized in **Figure 7.1**.

7.1.1 Basin Descriptions

Atim Creek Basin

The Atim Creek Basin consists of seven subcatchments including Copperhaven and Spruce Ridge, which are still developing. All these areas will drain at 2.5 L/s/ha to STMPND-00050, then east through STMPND-00027, STMPND-00015/39 and into the Harvest Ridge catchment to the north (STMPND-00024). The four quarter sections of land south of Highway 16A, and west of the Spruce Grove municipal boundary are intended to be serviced westwards through Stony Plain as per the Town of Stony Plain Stormwater Master Plan, April 2019. As a conservative measure, the stormwater management piped system accounted for these areas when determining outfall trunk diameters.

Dog Creek Basin

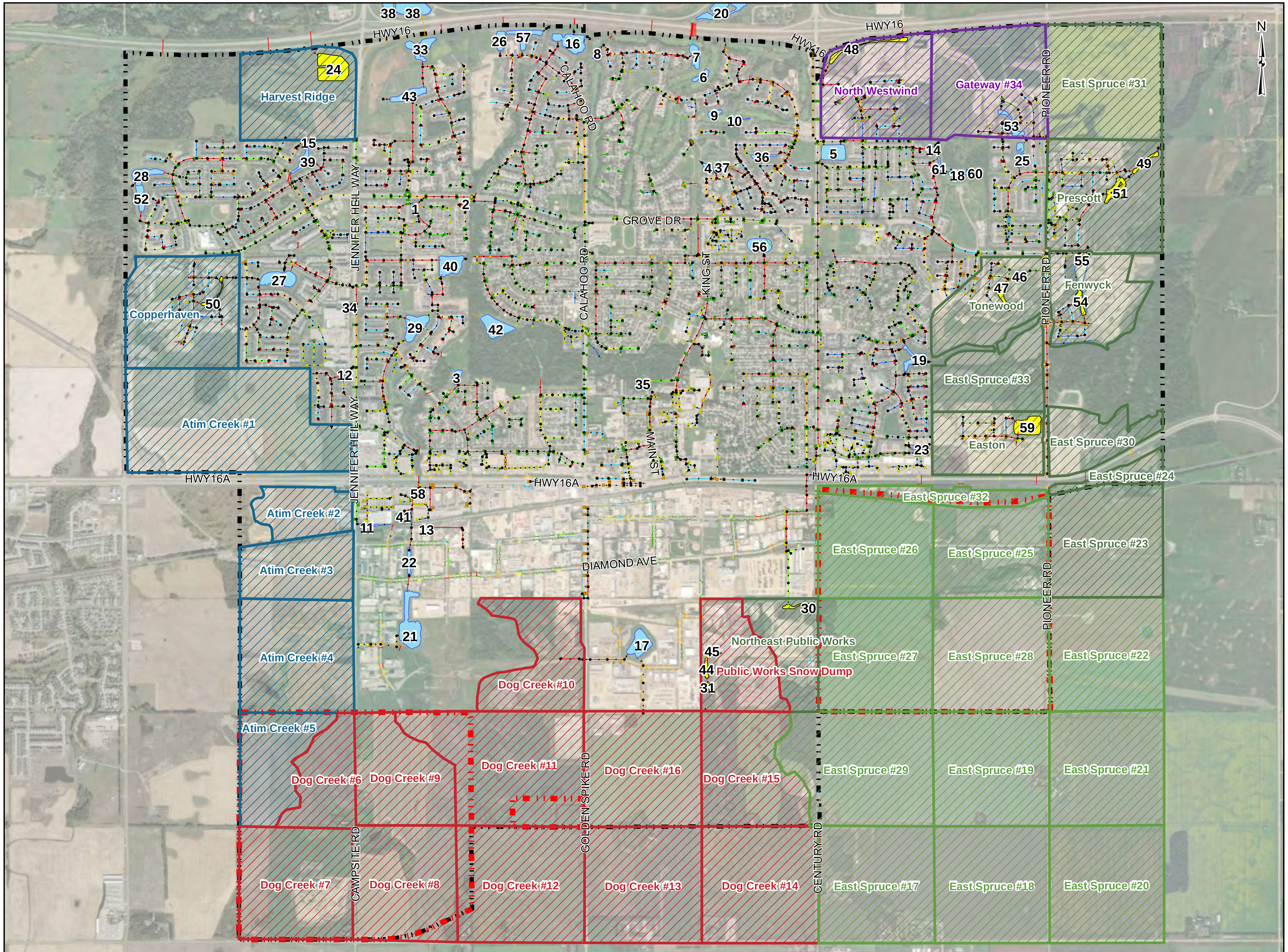
Dog Creek basin consists of 12 catchments and a large upstream basin south of Highway 628 that drains through the industrial area and into Dog Creek. Due to capacity limitations, this basin is restricted to a release rate of 1.8 L/s/ha. The upstream Dog Creek basin south of Highway 628 also flows through this development area, and Highway 628 culverts currently limit the drainage to approximately 2.2 m^3/s, which has been accounted for when sizing outfall trunks.

East Spruce Grove Basin

The East Spruce Grove Basin consists of approximately 12 quarter sections south of Highway 16A that drain across the highway, then through the storm sewer along Pioneer Road or along a natural drainage channel to Fenwyck and Prescott SWMFs. North of Highway 16A includes Easton, Tonewood, Fenwyck, and Prescott which are in the process of developing, and three other catchments that will likely develop prior to the lands south of Highway 16A. The basin south of Highway 16A is proposed to be limited to an allowable release rate of 1.8 L/s/ha due to existing system capacity constraints in the downstream system. The basin area north of Highway 16A is restricted to 2.5 L/s/ha.

Gateway Lands Basin

The Gateway Lands Basin consists of the currently developing North Westwind catchment, and one other quarter section to the east. Both quarter sections were previously designed to flow through the Kenton Outfall across Highway 16, and the design parameters summarized within this section reflect that design. This basin is restricted to a release rate of 2.5 L/s/ha.



LEGEND

Future Subcatchments
- Atim Creek Basin (2.5 L/s/ha)
- Dog Creek Basin (1.8 L/s/ha)
- East Spruce Grove Basin (1.8 L/s/ha)
- East Spruce Grove Basin (2.5 L/s/ha)
- Gateway Lands Basin (2.5 L/s/ha)

Manhole and Catchbasins
- F33
- F36
- F38
- F51
- K7
- Manhole

Storm Sewers
- <= 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- >= 675 mm

Culverts
- Unknown
- <= 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- >= 675 mm

Existing SWMF
- Developed
- Developing
- Annexation Boundaries
- Municipal Boundaries

TITLE
FIGURE 7.1 - FUTURE DRAINAGE CATCHMENTS

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION
NAD 1983 CSRS 3TM 114

0 195 390 780
1:27,500 Meters

ISL

FIGURE	7.1
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

7.1.2 Catchment Runoff

Catchment runoff for the undeveloped catchments shown on **Figure 7.1** is estimated in **Table 7.1**. These maximum flow rates will be used to conceptualize the SWMF outlet control structures and orifice sizes.

Table 7.1: Future Development Catchment Runoff

Catchment ID	Catchment Area	Runoff Coefficient	Catchment Width	Slope	Allowable Release Rate	Max Release Flow	Runoff Storage Required
	ha	(C)	m	%	L/s/ha	L/s	m³
Atim Creek #1	104.8	0.67	1,254	1.15	2.5	262	89,000
Atim Creek #2	22.2	0.78	385	0.81	2.5	56	22,000
Atim Creek #3	34.4	0.71	718	0.79	2.5	86	31,000
Atim Creek #4	64.2	0.60	981	0.87	2.5	161	49,000
Atim Creek #5	36.3	0.51	737	1.98	2.5	91	24,000
Dog Creek #6	29.9	0.52	669	0.97	1.8	54	20,000
Dog Creek #7	63.2	0.62	974	3.84	1.8	114	50,000
Dog Creek #8	59.9	0.66	949	1.68	1.8	108	50,000
Dog Creek #9	46.7	0.66	836	1.20	1.8	84	39,000
Dog Creek #10	44.9	0.70	822	1.90	1.8	81	40,000
Dog Creek #11	83.6	0.69	1,120	1.60	1.8	151	73,000
Dog Creek #12	72.6	0.69	1,053	1.57	1.8	131	64,000
Dog Creek #13	67.4	0.70	1,009	1.50	1.8	121	60,000
Dog Creek #14	68.0	0.70	1,011	1.51	1.8	122	61,000
Dog Creek #15	53.0	0.70	891	1.97	1.8	95	47,000
Dog Creek #16	65.4	0.70	1,009	0.99	1.8	118	58,000
East Spruce #17	67.7	0.70	1,007	2.19	1.8	122	60,000
East Spruce #18	67.0	0.70	1,002	0.71	1.8	121	60,000
East Spruce #19	66.4	0.70	998	0.70	1.8	120	59,000
East Spruce #20	66.9	0.70	1,002	0.78	1.8	120	60,000
East Spruce #21	65.4	0.70	993	1.08	1.8	118	58,000
East Spruce #22	64.3	0.70	984	0.90	1.8	116	57,000
East Spruce #23	63.1	0.70	974	1.87	2.5	158	56,000
East Spruce #24	8.7	0.72	750	2.08	2.5	22	8,000
East Spruce #25	53.1	0.59	893	2.27	1.8	96	40,000
East Spruce #26	57.3	0.58	929	1.32	1.8	103	42,000
East Spruce #27	64.7	0.55	986	1.04	1.8	116	45,000
East Spruce #28	66.5	0.59	995	1.09	1.8	120	50,000
East Spruce #29	76.2	0.63	1,091	1.55	1.8	137	61,000
East Spruce #30	25.3	0.75	616	1.37	2.5	63	24,000
East Spruce #31	65.9	0.60	995	1.14	2.5	165	50,000
East Spruce #32	16.3	0.57	1,480	2.70	1.8	29	12,000
East Spruce #33	36.0	0.60	735	1.25	2.5	90	27,000
Gateway #34	62.8	0.60	971	1.01	2.5	157	48,000

7.2 Future System Concept

7.2.1 Proposed Concept

The future stormwater management servicing concept is shown on **Figure 7.2**. The SWMF sizing is summarized in **Table 7.2** and the orifice sizing is also included in **Table 7.3**. Orifice sizing can be rounded to the nearest commercially available orifice size; however, this may impact the release rates slightly and should be accounted for with pond sizing. Lastly, the pond outfall design is shown in **Table 7.4** which includes the pipe sizing, slopes, inverts, and depths of cover.

The subcatchment Atim Creek #1 is currently being planned for development and there is a second pond proposed just west of the existing tree stand and west of proposed SWMF #1. The Master Plan shows one storage for this catchment, but two SWMFs are also viable given that the storage requirements for the subcatchment are met, and the elevations are designed such that they can drain by gravity to Copperhaven (STMPND-00050) and upstream development can tie into the outfall trunk system as needed.

STMPND-00021 is shallow and there are elevation constraints just south of the pond; thus, engineered fill/insulation may be required near N-10 where there are depth of cover limitations. Additionally, due to the elevation constraints required to drain future development into STMPND-00021, SWMF #11 has been limited to a live storage depth of 1.73 m instead of 2.00 m.

The proposed East Branch of the Dog Creek Basin piped system (N-13 to N-10) accounts for upstream Dog Creek Basin runoff that is controlled by Highway 628 culverts (as per the 2015 SWMP). Thus, it is recommended that the culvert capacities along Highway 628 are maintained and not increased in the future. While runoff from developing catchments in the Dog Creek Basin are assumed to be conveyed via storm sewers, accounting for additional runoff from south of Highway 628 through these sewers will result in oversizing the sections from N-13 through N-10. Thus, developers may prefer to develop the SWMF outfall trunks independent of upstream uncontrolled runoff which would be routed through overland ditches towards STMPND-00021. The cost of constructing a ditch to convey off-site flows in addition to the loss of developable land may end up being more economically feasible than oversizing the proposed stormwater pipes but requires further study at time of development.

Downstream of the proposed SWMFs #15 and #16 is an existing 600 mm storm sewer along Commerce Road; however, this sewer is too shallow to connect to without drastically reducing the live storage depths of these proposed ponds. Thus, this existing 600 mm storm sewer will need to be twinned with a lower sewer as part of future development to ensure no elevation constraints.

As development proceeds, the existing orifice sizes within STMPND-00024, STMPND-00027, STMPND-00054/55, and STMPND-00049/51 will need to be increased to maintain a release rate of 2.5 L/s/ha as additional area is developed within its catchment. The City of Spruce Grove has indicated that STMPND-00015/39 is currently being rehabilitated and its existing orifice is being replaced with a 900 mm outfall.

To address existing system capacity constraints in Easton, Century Crossing, Lakewood, Fenwyck, Prescott, and Pioneer Road trunk, the East Spruce Grove Basin allowable release rate south of Highway 16A has been reduced from 2.5 to 1.8 L/s/ha. This is discussed in more detail in **Section 7.3**.

Table 7.2: Proposed Stormwater Management Facility Design

SWMF ID	Freeboard		HWL		NWL		Bottom		Dead Storage	Live Storage	Freeboard Storage	Total Volume
	Elev.	Area	Elev.	Area	Elev.	Area	Elev.	Area				
	m	ha	m	ha	m	ha	m	ha	m³	m³	m³	m³
SWMF #1	694.99	5.1	694.49	4.9	692.49	4.0	690.49	3.2	72,000	89,000	25,000	186,000
SWMF #2	700.48	1.4	699.98	1.3	697.98	0.9	695.98	0.5	14,000	22,000	7,000	43,000
SWMF #3	702.13	1.9	701.63	1.8	699.63	1.3	697.63	0.8	21,000	31,000	9,000	61,000
SWMF #4	702.49	2.9	701.99	2.8	699.99	2.1	697.99	1.5	37,000	49,000	14,000	100,000
SWMF #5	702.48	1.5	701.98	1.4	699.98	1.0	697.98	0.6	16,000	24,000	7,000	47,000
SWMF #6	705.41	1.3	704.91	1.2	702.91	0.8	700.91	0.5	12,000	20,000	6,000	38,000
SWMF #7	706.08	3.0	705.58	2.8	703.58	2.2	701.58	1.6	38,000	50,000	15,000	103,000
SWMF #8	705.49	3.0	704.99	2.8	702.99	2.2	700.99	1.6	38,000	50,000	15,000	103,000
SWMF #9	704.97	2.4	704.47	2.2	702.47	1.7	700.47	1.2	28,000	39,000	12,000	79,000
SWMF #10	703.26	2.4	702.76	2.3	700.76	1.7	698.76	1.2	29,000	40,000	12,000	81,000
SWMF #11	703.47	4.1	702.97	3.9	701.24	3.2	699.24	2.5	58,000	62,165	20,000	140,000
SWMF #12	705.90	3.7	705.40	3.6	703.40	2.8	701.40	2.2	50,000	64,000	18,000	132,000
SWMF #13	707.79	3.5	707.29	3.4	705.29	2.6	703.29	2.0	46,000	60,000	17,000	123,000
SWMF #14	712.94	3.6	712.44	3.4	710.44	2.7	708.44	2.0	47,000	61,000	17,000	125,000
SWMF #15	709.70	2.8	709.20	2.7	707.20	2.0	705.20	1.5	35,000	47,000	14,000	96,000
SWMF #16	708.99	3.4	708.49	3.3	706.49	2.5	704.49	1.9	44,000	58,000	17,000	119,000
SWMF #17	712.84	3.5	712.34	3.4	710.34	2.6	708.34	2.0	46,000	60,000	17,000	123,000
SWMF #18	713.93	3.5	713.43	3.4	711.43	2.6	709.43	2.0	46,000	60,000	17,000	123,000
SWMF #19	711.61	3.5	711.11	3.3	709.11	2.6	707.11	1.9	45,000	59,000	17,000	121,000
SWMF #20	714.15	3.5	713.65	3.4	711.65	2.6	709.65	2.0	46,000	60,000	17,000	123,000
SWMF #21	710.16	3.4	709.66	3.3	707.66	2.5	705.66	1.9	44,000	58,000	17,000	119,000
SWMF #22	707.81	3.4	707.31	3.2	705.31	2.5	703.31	1.9	44,000	57,000	16,000	117,000
SWMF #23	696.88	3.3	696.38	3.2	694.38	2.4	692.38	1.8	43,000	56,000	16,000	115,000
SWMF #24	697.47	0.6	696.97	0.5	694.97	0.3	692.97	0.1	4,000	8,000	3,000	15,000
SWMF #25	702.03	2.4	701.53	2.3	699.53	1.7	697.53	1.2	29,000	40,000	12,000	81,000
SWMF #26	701.30	2.5	700.80	2.4	698.80	1.8	696.80	1.3	31,000	42,000	12,000	85,000
SWMF #27	705.68	2.7	705.18	2.6	703.18	1.9	701.18	1.4	33,000	45,000	13,000	91,000
SWMF #28	705.69	3.0	705.19	2.8	703.19	2.2	701.19	1.6	38,000	50,000	15,000	103,000
SWMF #29	709.81	3.6	709.31	3.4	707.31	2.7	705.31	2.0	47,000	61,000	17,000	125,000
SWMF #30	696.02	1.5	695.52	1.4	693.52	1.0	691.52	0.6	16,000	24,000	7,000	47,000
SWMF #31	666.44	3.0	665.94	2.8	663.94	2.2	661.94	1.6	38,000	50,000	15,000	103,000
SWMF #32	697.95	0.8	697.45	0.8	695.45	0.4	693.45	0.2	6,000	12,000	4,000	22,000
SWMF #33	688.02	1.7	687.52	1.6	685.52	1.1	683.52	0.7	18,000	27,000	8,000	53,000
SWMF #34	669.81	2.9	669.31	2.7	667.31	2.1	665.31	1.5	36,000	48,000	14,000	98,000

Table 7.3: Proposed Stormwater Management Outlet Orifice Design

SWMF ID	Catchment Area	Allowable Release Rate	Max Release Flow	Live Storage Depth	Conceptual Orifice Size
	ha	L/s/ha	L/s	m	mm
SWMF #1	104.8	2.5	262	2.00	304
SWMF #2	22.2	2.5	56	2.00	138
SWMF #3	34.4	2.5	86	2.00	173
SWMF #4	64.2	2.5	161	2.00	237
SWMF #5	36.3	2.5	91	2.00	177
SWMF #6	29.9	1.8	54	2.00	136
SWMF #7	63.2	1.8	114	2.00	199
SWMF #8	59.9	1.8	108	2.00	193
SWMF #9	46.7	1.8	84	2.00	171
SWMF #10	44.9	1.8	81	2.00	167
SWMF #11	83.6	1.8	151	1.73	239
SWMF #12	72.6	1.8	131	2.00	213
SWMF #13	67.4	1.8	121	2.00	205
SWMF #14	68.0	1.8	122	2.00	206
SWMF #15	53.0	1.8	95	2.00	182
SWMF #16	65.4	1.8	118	2.00	202
SWMF #17	67.7	1.8	122	2.00	206
SWMF #18	67.0	1.8	121	2.00	205
SWMF #19	66.4	1.8	120	2.00	204
SWMF #20	66.9	1.8	120	2.00	204
SWMF #21	65.4	1.8	118	2.00	202
SWMF #22	64.3	1.8	116	2.00	201
SWMF #23	63.1	2.5	158	2.00	235
SWMF #24	8.7	2.5	22	2.00	86
SWMF #25	53.1	1.8	96	2.00	182
SWMF #26	57.3	1.8	103	2.00	189
SWMF #27	64.7	1.8	116	2.00	201
SWMF #28	66.5	1.8	120	2.00	204
SWMF #29	76.2	1.8	137	2.00	218
SWMF #30	25.3	2.5	63	2.00	148
SWMF #31	65.9	2.5	165	2.00	240
SWMF #32	16.3	1.8	29	2.00	100
SWMF #33	36.0	2.5	90	2.00	177
SWMF #34	62.8	2.5	157	2.00	234

Table 7.4: Proposed Stormwater Management Outfall System Design

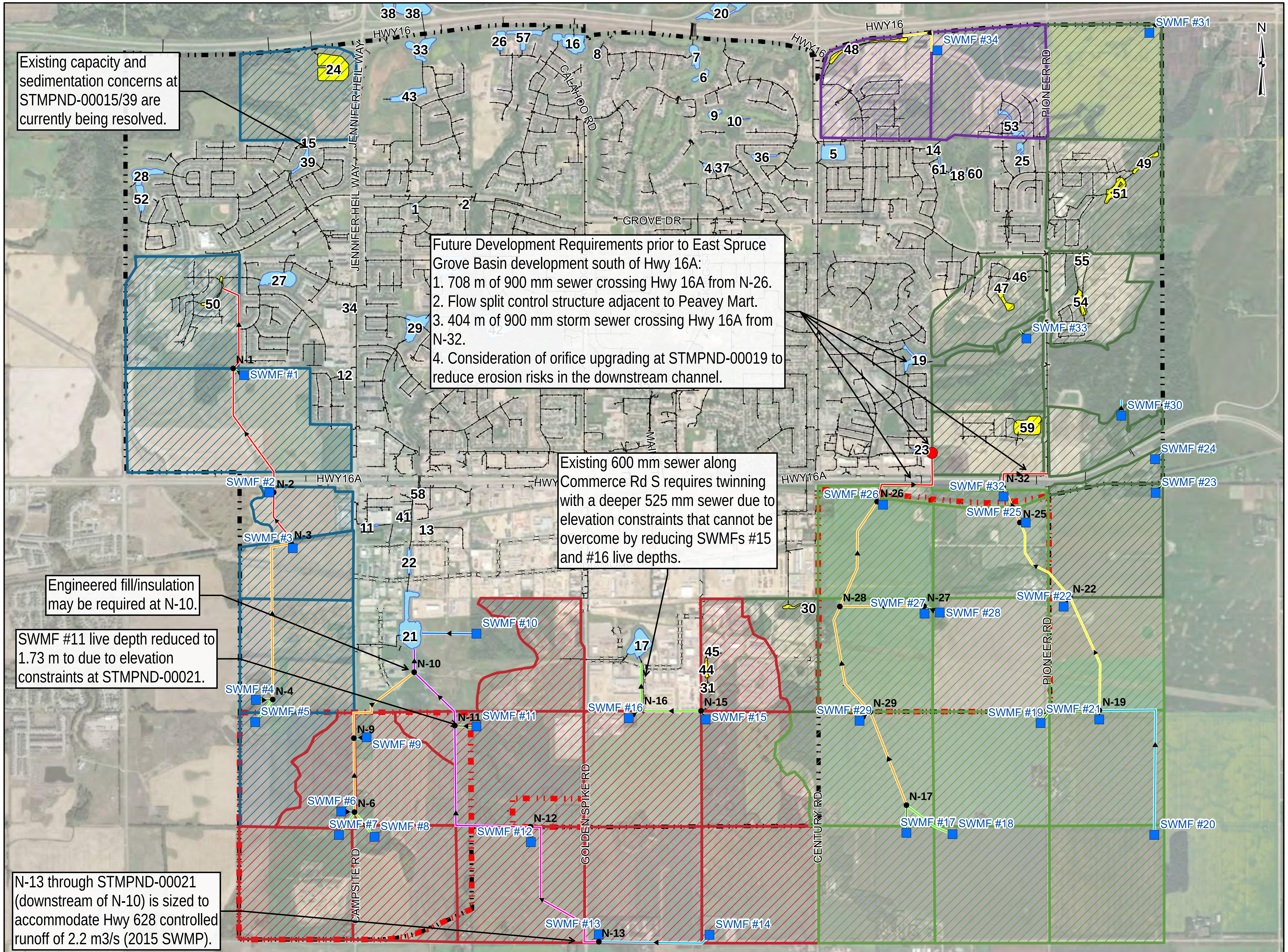
Nodes		Total Design Flow	Sewer Design						Sewer Layout						
									Ground Elevation		Invert Elevation			Depth of Cover	
U/S Node	D/S Node		Length	Diameter	Slope	Capacity	Velocity	Design Flow / Capacity	U/S Node	D/S Node	U/S Node	D/S Node	Invert Drop Across Node	U/S Node	D/S Node
		(L/s)	(m)	(mm)	(%)	(L/s)	(m/s)	(%)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
Atim Creek Basin (2.5 L/s/ha)															
SWMF #5	N-4	91	201	525	0.10	136	0.6	67%	702.48	702.47	698.98	698.78	0.23	2.97	3.17
SWMF #4	N-4	161	121	600	0.10	194	0.7	83%	702.49	702.47	698.99	698.87	0.15	2.90	3.00
N-4	N-3	251	1,220	750	0.10	352	0.8	71%	702.47	703.01	698.55	697.33	0.15	3.17	4.93
SWMF #3	N-3	86	33	525	0.10	136	0.6	63%	702.13	703.01	698.63	698.60	0.38	2.97	3.89
N-3	N-2	337	403	900	0.10	573	0.9	59%	703.01	700.67	697.18	696.78	0.03	4.93	2.99
SWMF #2	N-2	56	31	375	0.15	68	0.6	82%	700.48	700.67	696.98	696.93	0.53	3.13	3.36
N-2	N-1	1,077	969	900	0.65	1,461	2.3	74%	700.67	694.10	696.41	690.11	0.03	3.36	3.09
SWMF #1	N-1	262	90	525	0.85	397	1.8	66%	694.99	694.10	691.49	690.73	0.38	2.97	2.85
N-1	STMPND-00050	1,339	741	900	0.82	1,641	2.6	82%	694.10	684.13	690.08	684.00	-	3.12	-
Dog Creek Basin (1.8 L/s/ha)															
SWMF #6	N-6	54	95	375	0.15	68	0.6	79%	705.41	706.96	701.91	701.77	0.38	3.12	4.82
SWMF #7	N-6	114	196	525	0.10	136	0.6	84%	706.08	706.96	702.58	702.38	0.23	2.98	4.06
SWMF #8	N-6	108	224	525	0.10	136	0.6	79%	705.49	706.96	701.99	701.77	0.23	2.98	4.67
N-6	N-9	275	522	750	0.10	352	0.8	78%	706.96	705.82	701.39	700.87	0.03	4.82	4.20
SWMF #9	N-9	84	87	450	0.12	99	0.6	85%	704.97	705.82	701.47	701.37	0.30	3.05	4.01
N-9	N-10	359	737	750	0.19	491	1.1	73%	705.82	702.02	700.84	699.41	1.05	4.23	1.86
SWMF #14	N-13	122	807	450	0.60	221	1.4	55%	712.94	707.44	709.44	704.60	1.20	3.04	2.39
SWMF #13	N-13	121	53	600	0.10	194	0.7	62%	707.79	707.44	704.29	704.24	1.05	2.90	2.60
N-13	N-12	2,444	1,164	1,650	0.10	2,885	1.3	85%	707.44	705.99	703.19	702.02	0.15	2.60	2.32
SWMF #12	N-12	131	108	600	0.10	194	0.7	67%	705.90	705.99	702.40	702.29	1.20	2.90	3.10
N-12	N-11	2,574	1,232	1,800	0.10	3,639	1.4	71%	705.99	703.99	701.09	699.86	0.03	3.10	2.33
SWMF #11	N-11	151	153	600	0.10	194	0.7	77%	703.47	703.99	700.24	700.09	1.20	2.63	3.30

Nodes		Total Design Flow	Sewer Design						Sewer Layout						
									Ground Elevation		Invert Elevation			Depth of Cover	
U/S Node	D/S Node		Length	Diameter	Slope	Capacity	Velocity	Design Flow / Capacity	U/S Node	D/S Node	U/S Node	D/S Node	Invert Drop Across Node	U/S Node	D/S Node
		(L/s)	(m)	(mm)	(%)	(L/s)	(m/s)	(%)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
N-11	N-10	2,725	496	1,800	0.10	3,639	1.4	75%	703.99	702.02	698.89	698.39	0.03	3.30	1.82
N-10	STMPND-00021	3,084	164	1,800	0.10	3,639	1.4	85%	702.02	699.20	698.36	698.20	-	1.85	-
SWMF #10	STMPND-00021	81	385	375	0.41	112	1.0	72%	703.26	699.20	699.76	698.20	-	3.13	-
SWMF #15	N-15	95	69	525	0.10	136	0.6	70%	709.70	710.24	706.20	706.13	0.03	2.97	3.58
N-15	N-16	95	426	525	0.10	136	0.6	70%	710.24	709.06	706.10	705.68	0.03	3.61	2.86
SWMF #16	N-16	118	109	525	0.10	136	0.6	86%	708.99	709.06	705.49	705.38	0.03	2.98	3.16
N-16	STMPND-00017	213	326	525	0.45	287	1.3	74%	709.06	704.90	705.35	703.90	-	3.19	-
East Spruce Grove Basin (1.8 L/s/ha South of Highway 16A; 2.5 L/s/ha elsewhere)															
SWMF #17	N-17	122	196	600	0.10	194	0.7	63%	712.84	713.46	709.34	709.14	0.15	2.90	3.71
SWMF #18	N-17	121	386	525	0.20	193	0.9	63%	713.93	713.46	710.43	709.66	0.23	2.98	3.27
N-17	N-29	242	707	750	0.10	352	0.8	69%	713.46	712.15	708.99	708.29	0.03	3.71	3.11
SWMF #29	N-29	137	100	600	0.10	194	0.7	71%	709.81	712.15	706.31	706.21	0.15	2.90	5.34
N-29	N-28	380	828	750	0.35	659	1.5	58%	712.15	706.92	706.06	703.16	0.03	5.34	3.01
SWMF #27	N-27	116	49	600	0.10	194	0.7	60%	705.68	705.96	702.18	702.13	0.15	2.90	3.23
SWMF #28	N-27	120	117	600	0.10	194	0.7	62%	705.69	705.96	702.19	702.07	0.15	2.90	3.28
N-27	N-28	236	595	750	0.10	352	0.8	67%	705.96	706.92	701.92	701.33	0.03	3.28	4.85
N-28	N-26	616	808	750	0.50	788	1.8	78%	706.92	700.97	701.30	697.26	0.15	4.88	2.96
SWMF #26	N-26	103	44	450	0.40	180	1.1	57%	701.30	700.97	697.80	697.62	0.45	3.05	2.89
N-26	Outfall 26	719	708	900	0.50	1,285	2.0	56%	700.97	696.37	697.11	693.55	-	2.96	1.92
SWMF #19	N-19	120	463	600	0.10	194	0.7	62%	711.61	710.07	708.11	707.65	0.08	2.90	1.82
SWMF #20	N-19	120	1,278	450	0.25	143	0.9	84%	714.15	710.07	710.65	707.46	0.23	3.05	2.16
SWMF #21	N-19	118	63	525	0.10	136	0.6	86%	710.16	710.07	706.66	706.60	0.15	2.97	2.94
N-19	N-22	358	845	675	0.35	498	1.4	72%	710.07	707.09	706.45	703.49	0.03	2.94	2.93
SWMF #22	N-22	116	80	525	0.10	136	0.6	85%	707.81	707.09	704.31	704.23	0.15	2.97	2.34
N-22	N-25	473	678	675	0.98	833	2.3	57%	707.09	700.47	703.46	696.82	0.08	2.96	2.98
SWMF #25	N-25	96	39	375	4.00	351	3.2	27%	702.03	700.47	698.53	696.97	0.38	3.13	3.13
N-25	N-32	569	273	750	0.98	1,103	2.5	52%	700.47	696.47	696.60	693.92	0.15	3.13	1.80
SWMF #32	N-32	29	67	375	2.20	260	2.4	11%	697.95	696.47	694.45	692.98	0.53	3.13	3.12

Nodes		Total Design Flow	Sewer Design						Sewer Layout						
									Ground Elevation		Invert Elevation			Depth of Cover	
U/S Node	D/S Node		Length	Diameter	Slope	Capacity	Velocity	Design Flow / Capacity	U/S Node	D/S Node	U/S Node	D/S Node	Invert Drop Across Node	U/S Node	D/S Node
		(L/s)	(m)	(mm)	(%)	(L/s)	(m/s)	(%)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
N-32	STMMH-01714	598	404	900	0.15	702	1.1	85%	696.47	697.12	692.45	691.85	0.14	3.12	4.38
STMMH-01714	STMMH-01814	684	116	675	0.07	230	0.6	297%	697.12	694.87	691.71	691.62	-	4.74	2.58
STMMH-01814	STMMH-01766	684	120	750	0.92	1,070	2.4	64%	694.87	694.59	691.62	690.51	-	2.50	3.33
STMMH-01766	STMMH-01767	698	120	750	1.03	1,132	2.6	62%	694.59	692.58	690.51	689.28	-	3.33	2.56
STMMH-01767	STMMH-01815	762	50	750	1.30	1,273	2.9	60%	692.58	692.10	689.28	688.62	-	2.56	2.72
STMMH-01815	STMMH-01769	1,262	70	750	1.21	1,226	2.8	103%	692.10	691.44	688.62	687.78	-	2.72	2.92
STMMH-01769	STMMH-01771	1,376	129	750	1.22	1,231	2.8	112%	691.44	689.56	687.78	686.20	-	2.92	2.61
STMMH-01771	STMMH-01770	1,430	92	750	2.26	1,677	3.8	85%	689.56	688.21	686.20	684.12	-	2.61	3.34
STMMH-01770	STMMH-01772	1,615	72	900	0.21	830	1.3	195%	688.21	687.92	684.12	683.97	-	3.19	3.05
STMMH-01772	STMMH-01765	1,849	154	900	0.82	1,643	2.6	113%	687.92	686.02	683.97	682.70	-	3.05	2.42
STMMH-01765	STMMH-01701	2,231	144	900	0.80	1,622	2.5	138%	686.02	685.58	682.70	681.55	-	2.42	3.13
STMMH-01701	STMMH-01647	3,089	51	1,200	0.91	3,718	3.3	83%	685.58	685.34	681.55	681.09	-	2.83	3.05
STMMH-01647	STMMH-01648	3,089	53	1,200	0.30	2,151	1.9	144%	685.34	685.63	681.09	680.93	-	3.05	3.51
STMMH-01648	STMMH-01649	3,424	80	1,200	0.25	1,937	1.7	177%	685.63	685.46	680.93	680.73	-	3.51	3.53
STMMH-01649	STMMH-01684	3,669	85	1,200	2.74	6,457	5.7	57%	685.46	684.67	680.73	678.40	-	3.53	5.06
STMMH-01684	STMPND-00054	3,685	65	1,200	0.82	3,534	3.1	104%	684.67	677.87	678.40	677.87	-	5.06	-
SWMF #23	Outfall 23	158	-	600	0.10	194	0.7	81%	696.88	-	693.38	-	-	2.90	-
SWMF #24	Outfall 24	22	-	375	0.15	68	0.6	32%	697.47	-	693.97	-	-	3.13	-
SWMF #30	Outfall 30	63	100	450	0.12	99	0.6	64%	696.02	-	692.52	-	-	3.05	-
SWMF #33	Outfall 33	90	100	525	0.10	136	0.6	66%	688.02	-	684.52	-	-	2.98	-
SWMF #31	Outfall 31	165	-	600	0.10	194	0.7	85%	666.44	-	663.94	-	-	1.90	-
Gateway Lands Basin (2.5 L/s/ha)															
SWMF #34	Kenton Outfall	157	373	675	0.08	239	0.7	66%	669.81	671.30	666.31	666.01	-	2.83	4.62

Notes:

1. Atim Creek basin accounts for 684 L/s from the Stony Plain ultimate catchment which will eventually be diverted back into the Stony Plain system (Stony Plain Stormwater Master Plan, 2019).
2. Dog Creek stormwater trunks account for an inflow of 2.2 cms at N-13 as per the Hwy 628 culvert capacity (Spruce Grove Stormwater Master Plan, 2015).
3. Engineered fill/insulation may be required at N-10 due to elevation constraints. SWMF #11 live storage has been reduced to 1.73 m to ensure minimum depth of cover is met.
4. N-15 to N-16 does not account for an approximate 69 L/s from STMPND-00031/44/45 since these drain into the existing ditch system and into the existing 600mm sewer along Commerce Rd S.
5. The existing 600 mm sewer along Commerce Rd S is too shallow to connect to (would require a reduction in live storage depths to 0.28 and 0.80 m at SWMFs #15 and #16, respectively).
6. Based on Note #5, the connection from N-16 to existing STMPND-00017 will require twinning with a deeper sewer along Commerce Rd S.
7. The peak flows along the existing Pioneer Road Trunk are based on existing 100-year model results and assume that Easton is controlled to 455 L/s (as per its orifice design).
8. D/S node elevations at the Kenton Outfall are based on the Kenton Outfall Design Drawings.



LEGEND

- Municipal Boundaries
- Annexation Boundaries
- Existing Storm Sewers
- Existing Culverts

Future Subcatchments

- Atim Creek Basin (2.5 L/s/ha)
- Dog Creek Basin (1.8 L/s/ha)
- East Spruce Grove Basin (1.8 L/s/ha)
- East Spruce Grove Basin (2.5 L/s/ha)
- Gateway Lands Basin (2.5 L/s/ha)
- Proposed SWMF
- Proposed Flow Split Control Structure
- Proposed Nodes

Existing SWMF

- Developed
- Developing

Proposed System Diameter (mm)

- 375 mm
- 450 mm
- 525 mm
- 600 mm
- 675 mm
- 750 mm
- 900 mm
- 1,650 mm
- 1,800 mm

Note: Orifice upgrades to be staged by ultimate development as per Table 8.7 for:
STMPND-00027;
STMPND-00015/39;
STMPND-00024;
STMPND-00054/55; and
STMPND-00049/51.

TITLE
FIGURE 7.2 - FUTURE STORMWATER MANAGEMENT SERVICING CONCEPT

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN
CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION
NAD 1983 CSRS 3TM 114

0 195 390 780
1:27,500 Meters

FIGURE	7.2
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

Document Path: M:\JeremyS\16462 - Spruce Grove Stormwater Master Plan\01_GIS\Figure 7.2 - Future Stormwater Management Servicing Concept.mxd

7.2.2 Existing Ponds within Future Subcatchments

There are also several existing stormwater ponds that are within catchments that are actively developing. **Table 7.5** summarizes the existing pond storage within these areas and compares it to an estimate of runoff storage required.

It should be noted that this calculation is completed at a high level and does not necessarily determine if an existing pond requires storage upgrades or not. For instance, STMPND-00050 and STMPND-00046/47 apparently show a storage deficit of 1,800 m^3 and 500 m^3, respectively. However, the high-level storage calculations do not account for orifice release during the storm event which can free up storage. Thus, these ponds appear to have sufficient capacity based on these high-level calculations.

STMPND-00048 appears to be undersized by approximately 17,000 m^3. The Westwind Stage 2 stormwater management facility is currently being constructed adjacent to STMPND-00048 which will include some of the catchment area from STMPND-00048. The pond is being constructed in the interim with a storage volume of 24,000 m^3, with plans for expansion to an ultimate storage volume of 72,000 m^3.

Therefore, no storage upgrades are anticipated in developing areas with existing SWMFs. The City should review existing SWMF configurations and developer pond reports to verify that adequate storage is being provided.

Table 7.5: Review of Existing SWMF Storage Capacity in Developing Areas

SWMF ID	Catchment Area	Runoff Coefficient (C)	Runoff Storage Required	Existing Storage Within Catchment	Additional Storage Needed
	ha		m^3	m^3	m^3
STMPND-00050	59.5	0.60	45,000	43,200	1,800
STMPND-00024	51.5	0.60	39,000	82,300	0
STMPND-00031 STMPND-00044 STMPND-00045	37.4	0.65	31,000	43,700	0
STMPND-00030	26.3	0.60	20,000	25,600	0
STMPND-00059	35.1	0.67	30,000	47,400	0
STMPND-00046 STMPND-00047	37.3	0.60	29,000	28,500	500
STMPND-00054 STMPND-00055	38.7	0.54	27,000	58,000	0
STMPND-00049 STMPND-00051	64.9	0.54	45,000	50,400	0
STMPND-00048	53.3	0.69	47,000	30,100	16,900

7.3 Downstream System Impacts and Upgrading Requirements

The existing stormwater infrastructure in East Spruce Grove north of Highway 16A was originally designed and constructed without recognition of the most recent estimates for the upstream drainage basins. Current modelling results therefore show that uncontrolled runoff from undeveloped lands south of Highway 16A appears to cause flooding concerns on the east side of the City. ISL worked with the City to develop solutions for stormwater management accounting for this considering that the infrastructure has already been constructed.

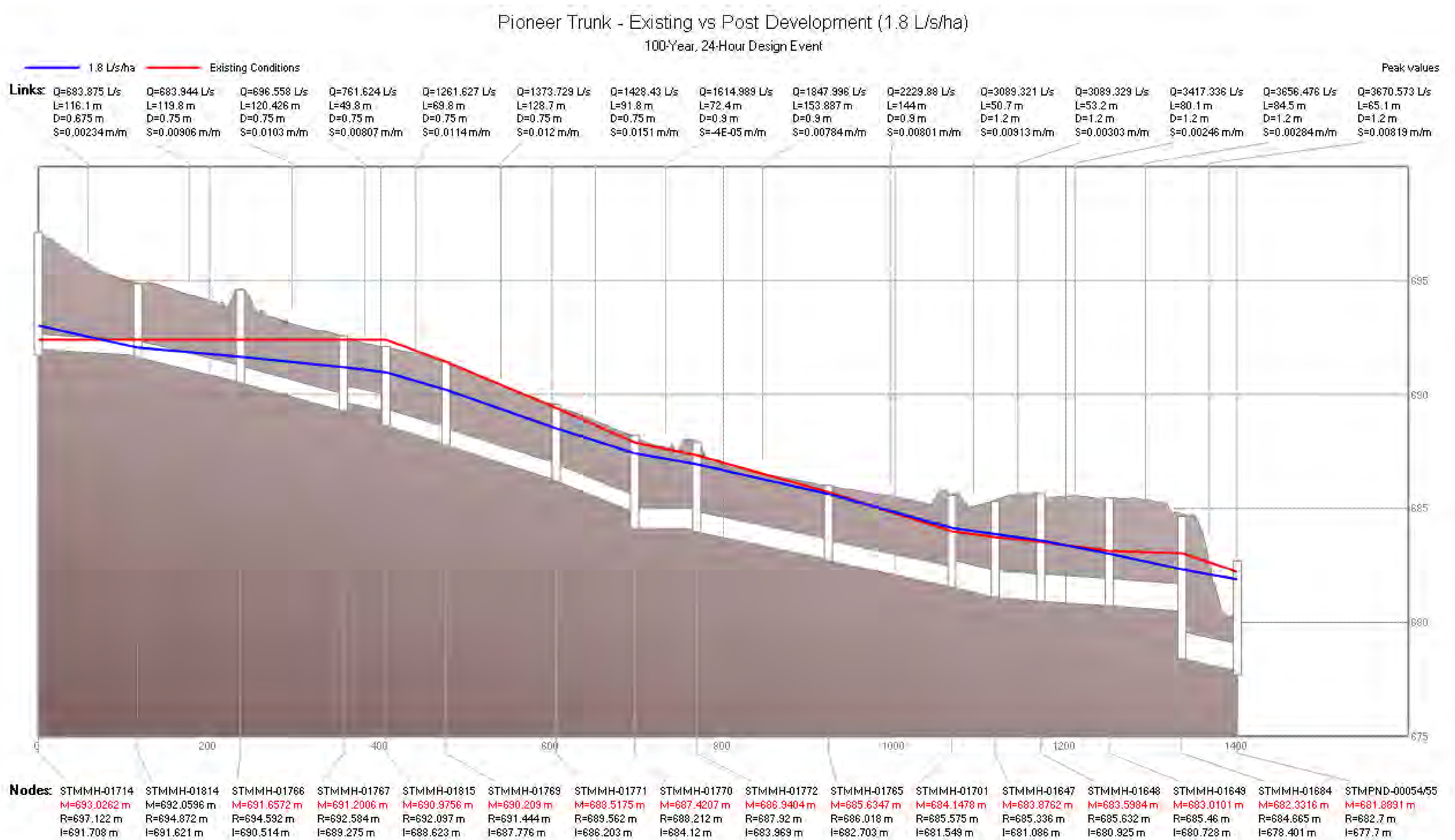
7.3.1 East Spruce Grove Basin – Western Half Considerations

The western portion of the East Spruce Grove basin upstream of Century Crossing, Lakewood, and Easton neighbourhoods (including SWMFs #17, #18, #26, #27, #28, and #29) is proposed to be controlled to 1.8 L/s/ha due to existing capacity constraints north of Highway 16A.

- As per the Spruce Grove – Easton Neighbourhood Preliminary Servicing Concept Design Brief, 2020, the minor system downstream of SM95 and Easton SWMF (STMPND-00059) was designed to account for 341 L/s from 136 ha of undeveloped farmland south of Highway 16A. The pond and orifice structure are designed to outlet to the Pioneer Road Trunk at controlled rates of 2.5 L/s/ha.
- The Century Crossing Commercial Subdivision Stormwater Report, 2010, designed the Century Crossing SWMF (STMPND-00023) to be able to convey a peak flow of 370 L/s, which included 52 L/s from the proposed Century Crossing development (20.9 ha at 2.5 L/s/ha). This would leave approximately 318 L/s of capacity for upstream runoff from undeveloped and uncontrolled subcatchments south of Highway 16A.
- The downstream Lakewood SWMF (STMPND-00019) currently has an orifice capacity of 562 L/s, while the Lakewood major overland flow path (along the roadway as per design) has a capacity greater than 1,000 L/s as per the Century Crossing Commercial Subdivision Stormwater Report.
- Thus, to control the runoff from the area upstream of Highway 16A, which is approximately 403 ha, to the sum of 318 L/s and 341 L/s (659 L/s) would require a release rate of approximately 1.6 L/s/ha.
- For consistency with the Dog Creek Basin upstream of Highway 16A, the availability of major overland system capacity within the Lakewood neighbourhood, and due to the uncertainty regarding actual runoff rates from the undeveloped farmland south of Highway 16A, it is recommended that development connecting to the west branch sewer of the East Spruce Grove basin be controlled to 1.8 L/s/ha with a flow splitting structure adjacent to Peavey Mart that will be designed to ensure 341 L/s is routed through Easton, while the remainder of the design flow is conveyed through Century Crossing and Lakewood.
- At a controlled rate of 1.8 L/s/ha, the design flow will be 719 L/s, and accounting for the 341 L/s contribution to Easton, and the 318 L/s contribution to Century Crossing, a remainder of 60 L/s will flow overland to Lakewood, which is approximately 5% of the major overland route capacity. It should be noted that this is a significant reduction in runoff compared to the existing system assessment which saw a significant amount of predevelopment runoff crossing Highway 16A (approximately 1,700 L/s).

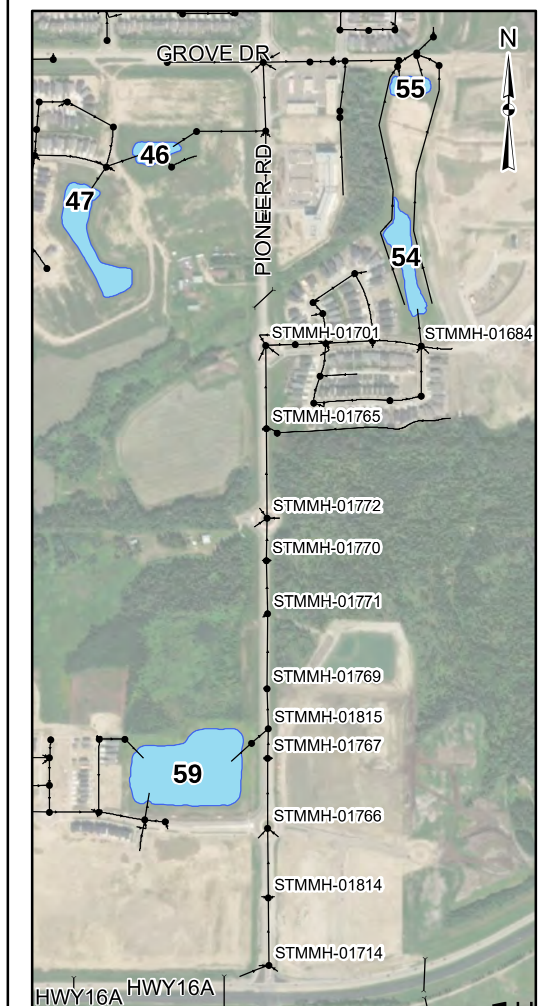
7.3.2 East Spruce Grove Basin – Eastern Half Considerations

The eastern half of the upstream East Spruce Grove Basin includes the subcatchments that drain towards the Pioneer Road Trunk. Due to existing surcharging conditions within the Pioneer Trunk, caused by capacity constraints in the sewers and backwater conditions from Fenwyck SWMF during HWL conditions, the release rate from the eastern portion of the upstream East Spruce Grove Basin (including SWMFs #19, #20, #21, #22, #25, and #32) are also proposed to be controlled to 1.8 L/s/ha instead of 2.5 L/s/ha to maintain consistency with other areas south of Highway 16A and to relieve some of the surcharging conditions in the downstream system. The comparative Hydraulic Grade Line (HGL) profiles along Pioneer Trunk are shown on **Figure 7.3** for both a 2.5 L/s/ha and 1.8 L/s/ha release rate. As shown, the 1.8 L/s/ha release reduces the surcharging substantially (and both post-development scenarios have controlled peak flows that are less than the pre-development uncontrolled runoff indicating a net positive impact).



LEGEND

- Existing System HGL
- Future Concept HGL (1.8 L/s/ha)
- Manhole
- Existing Storm Sewers
- Existing Culverts
- Existing SWMF



TITLE
FIGURE 7.3 - IMPACTS OF FUTURE DEVELOPMENT AT 1.8 L/S/HA ON PIONEER ROAD TRUNK

PROJECT
SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT
THE CITY OF SPRUCE GROVE

DATA SOURCES
- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION
NAD 1983 CSRS 3TM 114

0 190 380 760
1:26,879 Meters

ISL

FIGURE	7.3
DATE	2024-05-29
PROJECT NO.	16462
AUTHOR	JS

Document Path: M:\JeremyS\16462 - Spruce Grove Stormwater Master Plan\01_GIS\Figure 7.3 - Impact of Future Development on Pioneer Road Trunk.mxd

7.3.3 Other Downstream Capacity Constraints

In addition to the comments from **Section 7.3.1 and 7.3.2**, additional downstream capacity constraints and upgrading requirements are summarized in **Table 7.6**. Orifice upgrading staging is summarized in **Section 7.4**.

Table 7.6: Downstream Capacity Impacts and Upgrading Requirements

Location	Catchment	Expected Flow	Existing Size	Existing Capacity	Comments / Required Upgrade
	ha	L/s	mm	L/s	
Atim Creek Basin Downstream Capacity Assessment					
STMPND-00050 Orifice	519.2	1,298	350 700x300 1,300x400	1,296	The control structure was sized for ultimate development and to utilize the smaller orifice for local development and control the elevation in the pond from upstream development using the staged weirs (700 x 300 and 1,300 x 400).
STMPND-00027 Orifice	552.4	1,381	214	108	Stage upgrade to 817 mm diameter orifice (or equivalent) by ultimate development.
STMPND-00027 Outfall	552.4	1,381	1,200	1,238	-
Spruce Ridge Culverts	566.1	1,415	3 x 900 3 x 900 1,800	3,562 186 3,046	Constraints are due to culvert slope. Capacity will increase as culvert headwater increases; therefore, no upgrades are recommended since modelling shows that the culverts can pass the flow.
Harvest Ridge Culverts	633.9	1,585	3 x 1,200 3 x 1,200	6,207 8,799	-
STMPND-00015 & STMPND-00039 Orifice	633.9	1,585	280	208	The existing 280 mm orifice is being replaced by a 900 mm outfall as per ongoing improvements to this pond.
STMPND-00024 Orifice	659.2	1,648	340	326	Stage upgrades to 789 mm diameter orifice (or equivalent) by ultimate development.
Dog Creek Basin Downstream Capacity Assessment					
STMPND-00017 Orifice	244.3	440	392	480	-
STMPND-00017 Outfall	244.3	440	750	496	-
STMPND-00021 Outfall	727.7	3,510	1,500	7,074	-
STMPND-00022 Outfall	797.0	3,635	1,500	2,048	Significant surcharging within STMPND-00022 outfall and downstream Hwy 16A culvert. The total catchment area (852 ha) at 2.5 L/s/ha gives an allowable release rate of 2,130 L/s. Thus, additional capacity cannot be provided without exceeding the allowable release rate. If the upstream 2,200 L/s from Hwy 628 was stored, there would be capacity for the 852 ha of City land with only minor surcharging.
Highway 16A Culvert	852.4	4,331	1,200	1,952	

Location	Catchment	Expected Flow	Existing Size	Existing Capacity	Comments / Required Upgrade
	ha	L/s	mm	L/s	
East Spruce Grove Basin Downstream Capacity Assessment					
Pioneer Road Culvert	525.5	1,032	1,200 x 900	2,375	-
STMPND-00019 Orifice	489.2	655	290 x 200 450 x 315	562	Consider upgrading orifice to 467 mm (or equivalent) by ultimate development. There is an emergency spillway that flows into the eastern drainage channel. Thus, flood risks to private property are low, but there is a chance of increased erosion risks.
STMPND-00054 & STMPND-00055 Orifice	1,298.2	2,730	750 x 750	1,906	Stage upgrades to 1,036 mm diameter orifice (or equivalent) by ultimate development.
STMPND-00049 & STMPND-00051 Orifice	1,339.3	2,833	214	132	Stage upgrades to 1,058 mm diameter orifice (or equivalent) by ultimate development.
Gateway Lands Basin Downstream Capacity Assessment					
Kenton Outfall	116.7	291.8	675	560	-

7.4 Phasing Plan

Future development within Spruce Grove is anticipated to occur in a north to south direction; thus, as quarter sections are developed, their corresponding SWMF will need to be constructed along with the outfall trunks upstream and downstream of their proposed SWMFs up to the quarter section boundary to ensure connectivity to already developed areas and to future developing areas further south. There are a few upgrades that will be required at the onset of development which are summarized in **Table 7.7**.

Table 7.7: Requirements at the Onset of Development

Development Trigger Point	Requirement
Dog Creek Catchments #15 and #16	• Twinning of the existing 600 mm storm sewer along Commerce Road South (too shallow) with a deeper 525 mm sewer that is 326 m long
East Spruce Grove Catchment #26	• Construct 708 m of 900 mm storm sewer that crosses Highway 16A from N-26 to the proposed Easton/Century Crossing flow split control structure • Construct Easton/Century Crossing flow split structure that diverts upstream flows from 0 – 341 L/s into the Easton stormwater network, and anything greater than 341 L/s into the Century Crossing SWMF
East Spruce Grove Catchments #25 / #32	• 404 m of 900 mm storm sewer crossing Highway 16A from N-32 to the existing Pioneer Road Trunk (STMMH-01714 connection)

As areas develop, orifice sizes within existing SWMFs within the City will need to be upsized accordingly to maintain the maximum allowable release rates for the upstream developed land. Development time frames and orifice diameters are summarized in **Table 7.8** as a reference. Developed areas and allowable outflow were determined based on assuming percentages of development over the entire basin. The percentages shown are estimated levels of development within the related upstream basin (e.g. 25% development within Atim Creek relates to the staging of orifices for Ponds 27, 15/39, and 24, but does not relate to the staging of orifice upgrades for Fenwyck or Prescott orifice staging). It should be noted that the Copperhaven control structure (STMPND-00050) was sized for the ultimate area and therefore does not need to be upsized. Field crews should monitor this pond during intense rainfall events in the City to ensure that high outflows do not create flooding risks downstream at STMPND-00027.

STMPND-00027, STMPND-00015/39, and STMPND-00024 all have an additional scenario referred to as Ultimate Stony Plain Conditions, which is based on assumptions in the 2019 Stony Plain SWMP that will divert undeveloped basins away from Spruce Grove, effectively reducing the overall service area (and therefore the orifice sizes). It should be noted that the improvements to STMPND-00015/39 include the installation of a 900 mm outfall (installation in summer 2024), which appears to be reasonably consistent with the ultimate staged orifice size. It is recommended that the downstream system be monitored in the interim to ensure no flooding risks at STMPND-00024.

In the case of Fenwyck and Prescott, STMPND-00054/55 and STMPND-00049/51, respectively, the release rate was not uniform, and the allowable outflow assumed that the northern part of the catchment (at 2.5 L/s/ha) would develop first, then the southern areas (at 1.8 L/s/ha). This distinction is important to ensure that the orifices are not oversized. Fenwyck (STMPND-00054/55) is sufficiently sized for approximately 50% of ultimate development.

Table 7.8: Orifice Upgrade Staging Plan

Time Horizon	Existing SWMF				
	27	15/39	24	54/55	49/51
Existing Conditions	214 mm	280 mm	340 mm	750x750 mm	214 mm
Existing Upgrades	376 mm	-	-	-	-
25% Future Development	389 mm	390 mm	383 mm	750x750 mm	765 mm
50% Future Development	560 mm	560 mm	548 mm	750x750 mm	871 mm
75% Future Development	697 mm	693 mm	678 mm	945 mm	968 mm
Ultimate Conditions	817 mm	809 mm	789 mm	1,037 mm	1,058 mm
+ Ultimate Stony Plain Conditions	611 mm	638 mm	631 mm	-	-

7.5 Green Infrastructure

To reduce the overall runoff produced by developments, and to improve water quality within the local and regional watershed, Green Infrastructure (formerly known as low impact development or LID) may be integrated into the stormwater design. Green Infrastructure generally functions to improve stormwater conditions by providing a combination of peak flow attenuation, water quality improvement, and volume reduction through the promotion of infiltration and evapotranspiration.

Integrating Green Infrastructure into stormwater design of individual sites within the overall development will improve the volumes and quality of water flowing to the proposed SWMFs, resulting in a reduced SWMF size. Additionally, Green Infrastructure implementation can provide reductions in the total loadings to the receiving water course. As such, Green Infrastructure would support the development in adhering to the recommendation to reduce total suspended solids (TSS), carbonaceous biochemical oxygen demand (CBOD), nitrogen, and phosphorus, and thus promote the overall health of the Atim Creek, Dog Creek, East Spruce Grove, and Gateway Lands Basins.

Source control measures are physical measures that are located at the beginning of a drainage system, generally on private properties which may include residential properties, community centers, municipal buildings, places of worship, schools, and parks. It is recommended that the City employ a selection of the technologies in conjunction with the SWMFs in order to achieve an optimal stormwater runoff water quality and volume reduction. Source control options to be considered are summarized in **Table 7.9**.

Table 7.9: Source Control Practice Summary

Source Control Practice	Description	Driving Forces
Stormwater Re-use/ Rainwater Harvesting	Stormwater could be captured in SWMFs or underground storage tanks and used for non-potable uses such as irrigation. This would need to be assessed at the time of development as to whether suitable guidelines for stormwater re-use exist at that stage.	• Potentially significant use of stormwater runoff • Stormwater pollutants retained by storage ponds • Highly applicable to both residential and commercial areas
Bioswales /Vegetated Swales	Stormwater is diverted into surface drainage swales that are vegetated. The net effect is similar to a combination of a grassed swale and an infiltration trench. Significant vegetation is planted to provide additional quality treatment. Subdrains are often installed in soils with infiltration rates below 12.5 mm/hr.	• Provides high amount of volume/rate control • Provides high amount of stormwater pollutant control by retaining pollutants in the swales • Highly applicable to both residential, light commercial, and industrial areas
Absorbent Landscapes	Stormwater runoff is reduced by promoting infiltration into the soil as runoff flows overland. This is often accomplished by designing for significant greenspace. Increased depth of topsoil and reduced soil compaction are also provided for the landscaped areas. This promoted infiltration can allow the soil to work like a sponge to absorb stormwater. Given this technology operates through the promotion of infiltration, soil with a high infiltration rate (low fines content) is recommended. Local geology may limit the effectiveness of this option if a low-permeable soil underlays the added topsoil. A geotechnical report is recommended if this source control is to be implemented.	• Provides high amount of volume/rate control • Highly applicable for low-intensity commercial areas • Somewhat applicable for residential areas • Minimal maintenance required

Source Control Practice	Description	Driving Forces
Green Roofs	Stormwater runoff is reduced by using vegetated roofs. Stormwater is absorbed into soil and is then either evaporated naturally or collected by a subdrain system.	• Works well for roofs of larger buildings (normally commercial and industrial) • Provides high amount of volume/rate control, particularly for small events • Can be used as on-lot stormwater control for commercial/industrial areas
Bioretention Areas	Bioretention areas consist of depressed, landscaped areas utilized to improve water quality, attenuate peak flows to the stormwater minor system, and to reduce overall stormwater volume through promotion of evapotranspiration. Stormwater is absorbed into soil and is then either evaporated naturally or collected by a subdrain system. Plantings are chosen specifically to optimize the uptake of stormwater nutrient loadings (nitrogen, phosphorus) in the geographic location of interest. Municipalities should be mindful that some maintenance of these systems is required when sediment buildup occurs and following the winter frost.	• Works well for most land uses (can be incorporated into parks, roadway medians, parking lots, sidewalk planting strips, etc.) • Can be used as on-lot stormwater control for commercial, residential, and industrial areas. • Provides high amount of volume/rate control, particularly for small events • Provides high amount of stormwater pollutant control by retaining pollutants

Water quality improvements begin with filtration of particulates as runoff flows over the surface of the Green Infrastructure and through vegetation, mulch, soil layers and or aggregate layers. For vegetated practices, soil microbes provide decomposition for pollutants such as hydrocarbons and nutrients. Soils also allow metals and chemicals to sorb to soil particles and compounds within the soil, preventing their release to receiving streams.

Through various pilot studies and research, ISL has characterized that the theoretical reduction in peak flow is greater for small common events and nearly 100% reduction can be expected. During small flood events, such as the 2-year, or 5-year return period, the peak flow reduction can achieve up to 80%. During large flood events, greater than the 25-year return period, the peak flow reduction is expected to be minimal, typically much less than 50%. The literature review analyzed nine Green Infrastructure installations where performance of the Green Infrastructure installation had monitored data. Sites included:

- Site 1 – Quarters Armature (96 Street) – Edmonton, Alberta;
- Site 2 – Central Parkway, Mississauga, Ontario;
- Site 3 – Wilmington, North Carolina;
- Site 4 – Manchester, England;
- Site 5 – Holden Arboretum, Ohio;
- Site 6 – Ursuline College, Ohio;
- Site 7 – Charlotte, North Carolina;
- Site 8 – Connecticut; and
- Site 9 – Australia.

The sites include both soil cell and rain garden installations. As shown in **Figure 7.4**, the monitored performance of the Green Infrastructure systems reduces peak flows up to 60 – 80%.

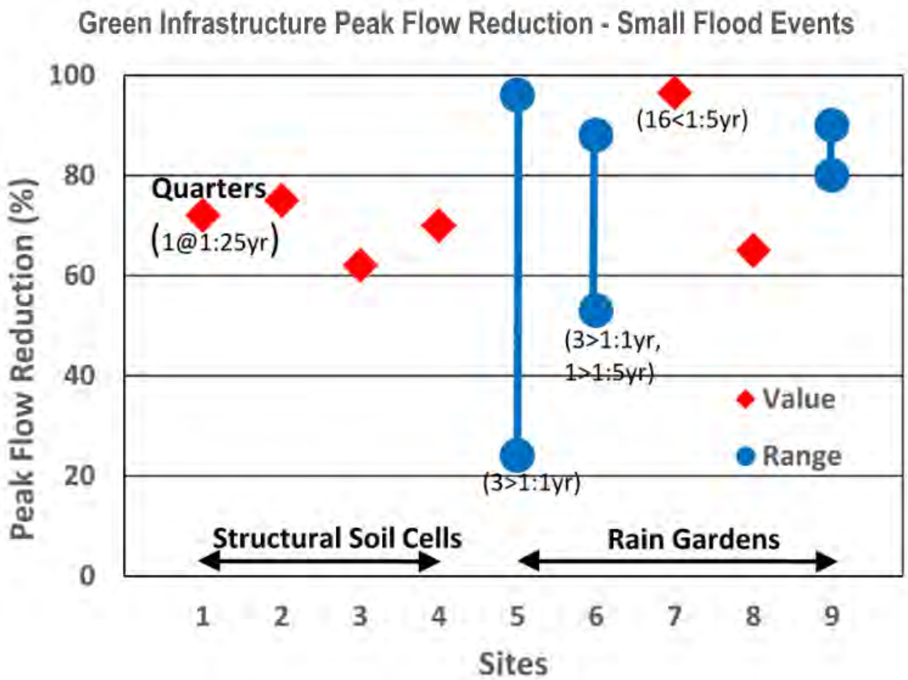


Figure 7.4: Monitored Peak Flow Reductions

Table 7.10 outlines the Green Infrastructure peak flow reduction expectation and performance for various flood events. It is observed that the monitored performance of Green Infrastructure installations generally meet the theoretical peak flow reductions.

Table 7.10: Green Infrastructure Peak Flow Reduction Expectations

Event Size	Peak Flow Reduction Expectation	Literature Review
Small common events (majority in a season)	No outflow (100% reduction)	Confirmed
Typical Summer Storm (a few each year)	High (>95% reduction)	Confirmed
Small flood event (2-year, 5-year)	Moderate (>80% reduction)	60 – 90% (majority)
Large flood event (25-year, 100-year)	Minimal (<50% reduction)	N/A

More recently, EPCOR hosted the EPCOR Design Standards Modernization Workshop for municipalities and select consultants in the Edmonton region in 2023. The purpose of this workshop was to get feedback regarding planned changes to short-term and long-term design standard revisions. EPCORs long-term objective is to promote the installation of “Green Hectares” which is defined as a volume of runoff managed by Green Infrastructure spread evenly over an area of 15 mm of depth. In other words, approximately 150 m^3 of Green Infrastructure storage will equate to one Green Hectare based on a common rainfall event of approximately 15 mm (which is less than a 2-year, 4-hour Chicago design storm).

7.6 Erosion and Sediment Control

The City of Spruce Grove Municipal Development Standards require an Erosion and Sedimentation Control (E&SC) Plan during both construction and all maintenance periods. These guidelines are intended to limit soil disturbance, provide construction details for managing E&SC measures, locations of erosion and sediment control measures being implemented, etc. All phases of development require a detailed E&SC plan detailing the downstream erosion impacts caused by the proposed stormwater discharge and detail how these impacts are being mitigated.

A priority of this master plan is to minimize environmental impacts and support the health of the watersheds in the face of increasing developments. During construction, the removal of topsoil and vegetation will expose subsoils that are more susceptible to erosion since they are not as compacted. Developments which result in an increase of runoff may also contribute to erosion if not properly managed.

Erosive agents, such as wind and water, have the ability of detaching, entraining, and transporting soil particles, thus causing erosion. This process is dependent on the cohesion and texture of the soils, as well as the erosive energy of the agent, such as gravitational and fluid forces. Deposition/sedimentation will occur when the fluid forces of the erosive agent are less than the force of gravity of the soil particles. As the soil particles can no longer be entrained in the air or water, they begin to settle and form depositions. Generally, this is caused by a reduction in flow velocity or turbulence.

If temporary construction and permanent development E&SC practices are not implemented, it can lead to the transport of sediment and other contaminants thus polluting downstream waterbodies. This can result in the following negative impacts:

- Transportation of hydrocarbons, metals, and nutrients with the eroded soils to a water source;
- Destruction of aquatic habitats;
- Sediment deposition in infrastructure and waterbodies;
- Reduced quality of water supply;
- Limitations to the effectiveness of flood control measures; and
- Affects recreational areas.

The most effective and economical method of controlling erosion is at the source. This includes the implementation of methods such as controlling stormwater runoff (generally accomplished by stipulating maximum allowable area release rates) or by stabilizing exposed soils. Potential options to mitigate negative impacts of erosion are outlined below.

7.6.1 Vegetative Check Dams

Vegetative check dams act as low-lying barriers within a drainage ditch or channel to decrease the flow velocity and improve water quality. These control measures are generally used for a combination of erosion and sediment control. The dams sit perpendicular to the direction of flow and only allow a certain amount of water to pass through at a time while also retaining sediment. There are limitations involved with vegetative check dams including a maximum feasible slope for implementation of approximately 8% and a minimum slope of 1% to 2%. However, this erosion mitigation measure serves this purpose and achieves the improved water quality objective.

7.6.2 Erosion Control Blankets

Erosion control blankets are the most appropriate erosion mitigation measure when runoff quantity and velocities are the driving force behind the erosion risk. They offer a typical erosion reduction of 95% to 99%. Two of these types of erosion control measures include:

- Straw Blankets:
  - Ideal for short-term erosion control
- Turf Reinforcement Mats:
  - Synthetic material
  - Recommended for additional shear resistance
  - Promotes longevity of a channel
  - Ideal for more long-term erosion control

A substantial length of erosion control blankets would be required due to the long length of steep sloping channels. This steepness may also create issues with feasibility of installation and considerations for the environmental implications must also be made. The soil characteristics of these existing channels may affect the overall performance of erosion control measures and will also need to be accounted for.

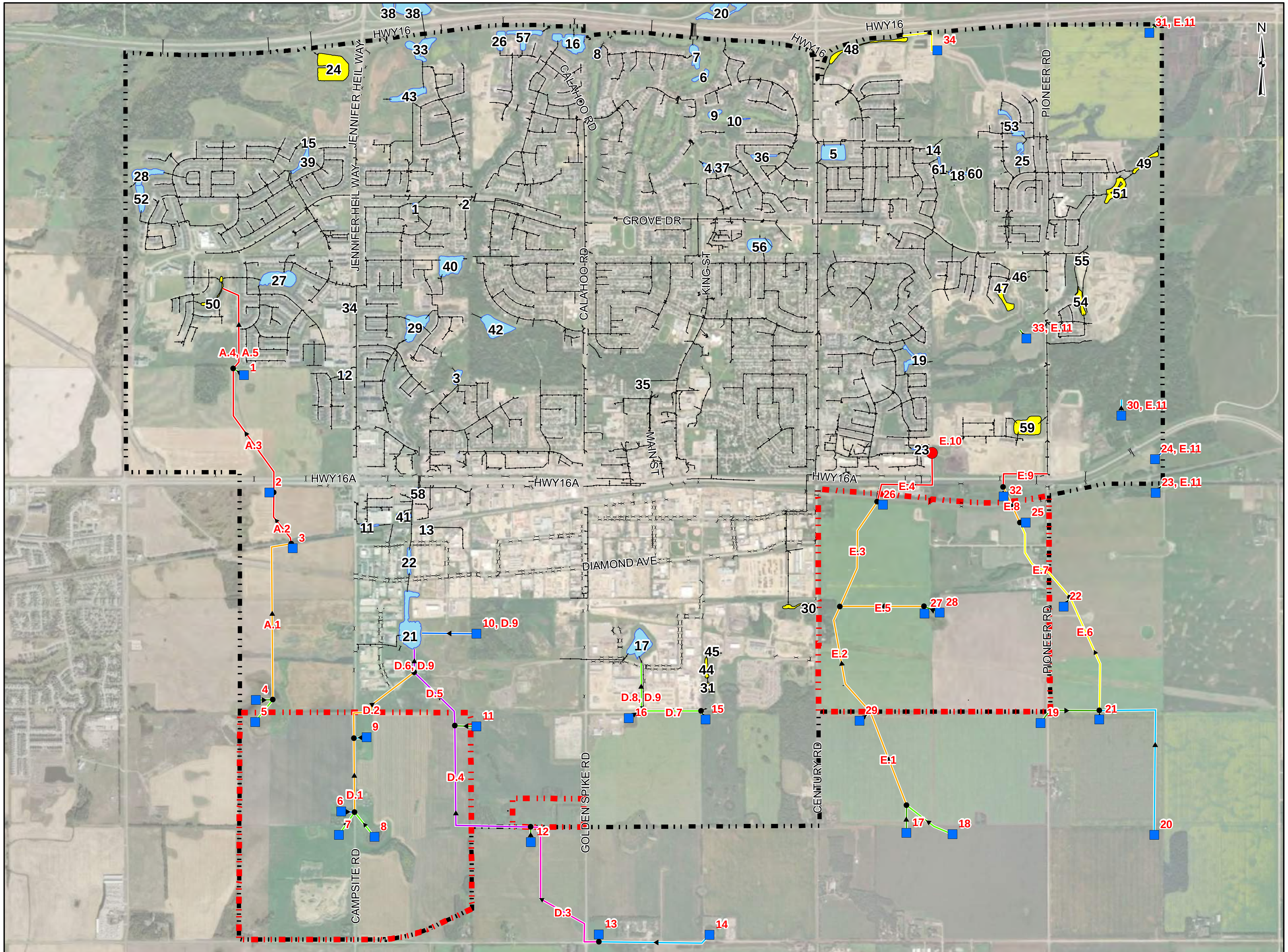
7.7 Cost Estimates

Cost estimates have been prepared for Spruce Grove's proposed stormwater system. The costs for new SWMFs, gravity sewers, and outfall structures are summarized in **Table 7.11**. Refer to **Appendix G** for detailed cost breakdowns. Separate reviews should be prepared to support each subdivision application/development permit to ensure compliance with the overarching SWMP. The costs are annotated on **Figure 7.5**.

Table 7.11: Cost Estimates – Proposed Stormwater Management System

Item	Description	Cost ($)	Engineering (10%) ($)	Contingency (30%) ($)	Total ($)
Atim Creek Basin					
1	SWMF #1	$ 2,133,000	$ 214,000	$ 641,000	$ 2,988,000
2	SWMF #2	$ 636,000	$ 64,000	$ 192,000	$ 892,000
3	SWMF #3	$ 829,000	$ 83,000	$ 248,000	$ 1,160,000
4	SWMF #4	$ 1,297,000	$ 129,000	$ 390,000	$ 1,816,000
5	SWMF #5	$ 823,000	$ 83,000	$ 247,000	$ 1,153,000
A	Atim Creek Trunk	$ 3,772,000	$ 377,000	$ 1,131,000	$ 5,280,000
	Atim Creek Total	**$ 9,433,000**	**$ 944,000**	**$ 2,832,000**	**$ 13,289,000**
Dog Creek Basin					
6	SWMF #6	$ 631,000	$ 63,000	$ 189,000	$ 883,000
7	SWMF #7	$ 1,389,000	$ 138,000	$ 417,000	$ 1,944,000
8	SWMF #8	$ 1,412,000	$ 141,000	$ 424,000	$ 1,977,000
9	SWMF #9	$ 1,044,000	$ 105,000	$ 314,000	$ 1,463,000
10, D.9	SWMF #10	$ 1,304,000	$ 130,000	$ 392,000	$ 1,826,000
11	SWMF #11	$ 1,748,000	$ 174,000	$ 524,000	$ 2,446,000
12	SWMF #12	$ 1,606,000	$ 161,000	$ 482,000	$ 2,249,000
13	SWMF #13	$ 1,471,000	$ 147,000	$ 442,000	$ 2,060,000
14	SWMF #14	$ 1,968,000	$ 198,000	$ 591,000	$ 2,757,000
15	SWMF #15	$ 1,212,000	$ 121,000	$ 363,000	$ 1,696,000
16	SWMF #16	$ 1,477,000	$ 148,000	$ 444,000	$ 2,069,000
D.1, D.2	West Dog Creek Trunk	$ 1,293,000	$ 130,000	$ 388,000	$ 1,811,000
D.3-D.6, D.9	East Dog Creek Trunk	$ 6,078,000	$ 608,000	$ 1,823,000	$ 8,509,000
D.7-D.9	SWMF #15 & #16 Trunk	$ 723,000	$ 72,000	$ 217,000	$ 1,012,000

Item	Description	Cost	Engineering (10%)	Contingency (30%)	Total
		($)	($)	($)	($)
	Dog Creek Total	**$ 23,356,000**	**$ 2,336,000**	**$ 7,010,000**	**$ 32,702,000**
East Spruce Grove Basin					
17	SWMF #17	$ 1,594,000	$ 159,000	$ 478,000	$ 2,231,000
18	SWMF #18	$ 1,746,000	$ 174,000	$ 524,000	$ 2,444,000
19	SWMF #19	$ 1,808,000	$ 181,000	$ 543,000	$ 2,532,000
20	SWMF #20	$ 2,241,000	$ 224,000	$ 673,000	$ 3,138,000
21	SWMF #21	$ 1,439,000	$ 144,000	$ 433,000	$ 2,016,000
22	SWMF #22	$ 1,428,000	$ 143,000	$ 429,000	$ 2,000,000
23, E.11	SWMF #23	$ 1,533,000	$ 154,000	$ 460,000	$ 2,147,000
24, E.11	SWMF #24	$ 489,000	$ 49,000	$ 147,000	$ 685,000
25	SWMF #25	$ 1,027,000	$ 103,000	$ 309,000	$ 1,439,000
26	SWMF #26	$ 1,070,000	$ 108,000	$ 321,000	$ 1,499,000
27	SWMF #27	$ 1,150,000	$ 115,000	$ 346,000	$ 1,611,000
28	SWMF #28	$ 1,327,000	$ 132,000	$ 398,000	$ 1,857,000
29	SWMF #29	$ 1,539,000	$ 155,000	$ 462,000	$ 2,156,000
30, E.11	SWMF #30	$ 821,000	$ 82,000	$ 246,000	$ 1,149,000
31, E.11	SWMF #31	$ 1,413,000	$ 141,000	$ 424,000	$ 1,978,000
32	SWMF #32	$ 441,000	$ 43,000	$ 132,000	$ 616,000
33, E.11	SWMF #33	$ 886,000	$ 88,000	$ 266,000	$ 1,240,000
E.1-E.5, E.10	West Trunk (Easton/Century)	$ 4,077,000	$ 408,000	$ 1,223,000	$ 5,708,000
E.6-E.9	East Trunk (Pioneer Rd)	$ 2,161,000	$ 216,000	$ 649,000	$ 3,026,000
	East Spruce Grove Total	**$ 28,190,000**	**$ 2,819,000**	**$ 8,463,000**	**$ 39,472,000**
Gateway Lands Basin					
34	SWMF #34	$ 1,526,000	$ 153,000	$ 458,000	$ 2,137,000
	Gateway Lands Total	**$ 1,526,000**	**$ 153,000**	**$ 458,000**	**$ 2,137,000**



LEGEND

- Municipal Boundaries
- Annexation Boundaries
- Existing Storm Sewers
- Existing Culverts
- Proposed SWMF
- Proposed Flow Split Control Structure
- Proposed Nodes

Existing SWMF

- Developed
- Developing

Proposed System Diameter (mm)

- 375 mm
- 450 mm
- 525 mm
- 600 mm
- 675 mm
- 750 mm
- 900 mm
- 1,650 mm
- 1,800 mm

TITLE

FIGURE 7.5 - FUTURE STORMWATER MANAGEMENT COST ITEMS

PROJECT

SPRUCE GROVE STORMWATER MASTER PLAN

CLIENT

THE CITY OF SPRUCE GROVE

DATA SOURCES

- Topographic Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PROJECTION

NAD 1983 CSRS 3TM 114

0 195 390 780 Meters

1:27,500

FIGURE	7.5
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AUTHOR	JS

ISL

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8.0 Conclusions and Recommendations

ISL was commissioned by the City to complete a SWMP, including an assessment of the City's current stormwater management infrastructure and the City's future stormwater infrastructure needs. The SWMP was initiated to provide an update to the previous SWMP, which was completed in 2015, and to account for the changes within the City's municipal boundary, as per the recent annexation to the south of the CNR. This document is intended to provide a road map of system infrastructure upgrades that will improve performance of the existing system, as well as new stormwater infrastructure to service proposed development areas.

The objectives of the SWMP included the following:

- Review the existing PCSWMM model and GIS database to identify and fill in data gaps and enable the development of an integrated 1D-2D stormwater model in InfoWorks ICM.
- Delineate catchments to better understand overland drainage patterns within the City.
- Recommend CCTV locations to inspect the condition of different pipe materials and ages and provide rehabilitation recommendations as needed.
- Assess the existing drainage conditions and identify any hydraulic deficiencies or constraints based on the updated Municipal Development Standards.
- Recommend required upgrades based on flood risk prioritization, municipal needs, and future growth requirements.
- Comment on possible staging options of upgrades for optimal implementation and coordination of infrastructure projects.
- Develop stormwater infrastructure plans, including stormwater management facility (SWMF) sizing, to manage increased and redirected runoff from future development.
- Provide commentary on potential short-, medium-, and long-term phasing of future capital projects to ensure strategic and sustainable development.
- Provide cost estimates for infrastructure upgrades and new capital infrastructure projects that will inform the City's off-site levy bylaw.
- Consider the impact of climate change on drainage systems as part of the evaluation and test the resiliency of recommended upgrades and future stormwater infrastructure.

8.1 Conclusions

The City's stormwater system consists of both major and minor drainage systems. In terms of the major system, Spruce Grove topography consistently slopes downhill from south to north and consists of Atim Creek along the western municipal boundary; Dog Creek which flows through the City between Jennifer Heil Way and Calahoo Road; and an unnamed tributary to Atim Creek draining from STMPND-00019 (Lakeview SWMF), crossing Pioneer Road, and continuing northeast. Most of the industrial area south of Highway 16A consists of overland drainage ditches and culverts, which are known to have condition and capacity constraints. The City consists of approximately 60 SWMFs that are largely restricted to a release rate of 2.5 L/s/ha (except for south of the CNR within the Dog Creek Basin, where SWMF release rates are restricted to 1.8 L/s/ha due to limited CNR culvert capacity). The minor system is comprised of gravity sewers, manholes, catchbasins, catchbasin leads, and outfalls, with most of this infrastructure located north of Highway 16A.

An integrated 1D-2D stormwater model was constructed in InfoWorks ICM to assess the City's stormwater system. Development of the model occurred in two distinct phases; the first was to build the minor (1D) portion of the system and the second consisted of generating a mesh to represent the major (2D) portion of the system. This model construction process is described in **Section 4.0**.

Design rainfall events produced from The City of Edmonton's IDF parameters were utilized to assess the City's stormwater drainage system. The minor system was assessed using a 1:5-year, 4-hour Chicago Distribution rainfall distribution, but was also reviewed under the 100-year, 4-hour Chicago and 24-hour Huff distribution design storms where relevant. The major system was evaluated using the 100-year, 4-hour Chicago Distribution and 24-hour Huff Distribution design storms for overland conveyance capacity and stormwater storage in SWMFs, respectively. ISL reviewed climate change scenarios as described in **Section 6.0** and the results show that peak intensity and precipitation volume may increase by 8% to 28% by the year 2100, based on IDF_CC Tool 7.0 projections. A comparison of the impact to the Chicago and Huff distribution design storms is included as well as a literature review of relevant climate change management documents from the EMRB.

The existing system assessment is summarized in **Section 6.0** for each of the design storms. In addition to identifying capacity constraints in storm sewers, and overland ponding risks for each of the design storms, ISL reviewed recently acquired CCTV information to evaluate the condition of the sewers, which largely showed heavy sedimentation within the southern industrial area. A flood risk hazard assessment and prioritization exercise was conducted in GIS to prioritize the flooding locations based on a quantitative evaluation of flooding to private property, roadways, and railways. This evaluation considered the magnitude of flooding impacts against the relative importance of the flooded infrastructure based on land use and building type. Thus, major highways and emergency response buildings were assigned the highest scores, while open spaces and garages were assigned lower values.

Finally, the flood hazard assessment was used to formulate a list of existing system upgrades for the City to consider based on priority. The existing upgrades were prioritized based on historical relevance and impact to future development being the focus. Thus, local flooding issues are not ranked as high as flooding risks that impact future development or large areas in general.

A proposed stormwater system concept was developed for Spruce Grove based on the growth plan summarized in **Section 2.0**. Due to downstream system capacity constraints, areas south of Highway 16A that flow into Pioneer Trunk or towards the Easton/Century Crossing neighbourhoods are proposed to be limited to 1.8 L/s/ha, to help alleviate existing flooding risks. The rest of the proposed stormwater management system is proposed to be controlled at 2.5 L/s/ha, as per City of Spruce Grove Municipal Development Standards.

8.2 Recommendations

Several upgrading priorities were proposed for consideration by the City of Spruce Grove. As described in **Section 6.5**, there are 16 existing system upgrading options for consideration; however, not all of them are recommended at this time. The upgrading considerations are summarized below:

- **Upgrade #1:** Consider additional land acquisition and increasing storage capacity at STMPND-00020 on the order of 160,000 m^3, twin the existing six culvert crossings with an additional 1,800 mm culvert, and implement the maintenance upgrades as described in **Section 3.3**.

- **Upgrade #2:** Upgrade the northern 410 m of the No-Frills Surge Pond outfall trunk along Century Road from 600 mm sewer to 750 mm. Rehabilitate and re-grade 800 m of Highway 16 ditch from this outfall to the Highway 16 culvert crossing.
- **Upgrade #3:** Upgrade the existing STMPND-00027 orifice from 214 mm to 367 mm to achieve 2.5 L/s/ha (after completion of planned upgrades at STMPND-00015/39).
- **Upgrade #4:** Upgrade existing 2x1,200 mm culverts along Dog Creek at Calahoo Road and Avonlea Road to 2x1,800 mm (or equivalent via twinning).
- **Upgrade #5:** Upgrade existing 2x1,200 mm culverts along Dog Creek at Grove Drive to 2x1,800 mm (or equivalent via twinning). It is recommended that the control structure at STMPND-00002 be investigated to confirm the orifice size to verify its discharge rate at 2.5 L/s/ha, since the SWMF appears overloaded.
- **Upgrade #6:** Add four K7 catchbasins to the flooding location along Windermere Drive to reduce ponding. Consider twinning upgrades downstream to reduce sewer surcharging as described in **Section 6.5**.
- **Upgrade #7:** Upgrade 59 m of 375 mm storm sewer to 525 mm (or equivalent via twinning) along the one-way exit from Wellington Crescent onto King Street. Add four K7 catchbasins within three-way entrance intersection to reduce ponding.
- **Upgrade #8:** Upgrade 205 m of 600 mm storm sewer into 900 mm (or equivalent) along Harvest Ridge Drive. Add an additional four F38 catch basins within the low point adjacent to the school portables to capture additional ponded water.
- **Upgrade #9:** Host public engagement sessions and work with affected residents to re-grade backyard lots that are impacted by flooding east of Jennifer Heil Way and north of Hawthorne Gate.
- **Upgrade #13:** Overland ponding at Grove Drive and Jubilee Park does not create a risk to private property, but four additional F51 catch basins could be installed to capture additional flow during the 100-year events.
- **Upgrade #16:** Consider additional stream flow monitoring of the upstream watersheds south of the city to better quantify the uncontrolled runoff that flows through the City. Better understanding this runoff is critical to evaluating system performance, upgrades, and future system concepts in more detail.
- Upgrades not listed here are not recommended at this time but are shown in **Section 6.5** for reference.

ISL recommends that the City collaborate with AT to reinstate the breached berm to restore the functionality of STMPND-00038. Note that the pond is currently owned by AT and is under their responsibility.

As development progresses within the City, the future stormwater management concept from **Section 7.0** is recommended to be used as a reference point for developing stormwater management design reports. Each potential catchment of development is proposed to be controlled to an allowable release rate of 1.8 L/s/ha for areas south of Highway 16A that drain to Pioneer Road, Easton, and Century Crossing, and 2.5 L/s/ha elsewhere. The SWMF storage requirements should be reviewed on an individual basis as areas begin planning development to better quantify the storage requirements and to account for climate change resiliency. It is recommended that additional study be conducted to evaluate the cost feasibility of developing an overland ditch system within the Dog Creek Basin to convey uncontrolled runoff from south of Highway 628 as an alternative to oversizing the proposed outfall trunk system since oversizing this trunk from N-13 to N-10 will be a significant cost. Development should consider Green Infrastructure where applicable and ensure that erosion and sediment control measures are implemented.

As part of the future system development, a few staging and upgrading requirements are summarized:

- At the onset of development with the Atim Creek basin:
  - Begin planning the staging of orifice upgrades at STMPND-00027 and STMPND-00024 to ultimate diameters (or equivalent) of 817 mm and 789 mm, respectively. Monitor STMPND-00015/39 during heavy rainfall events to ensure there is no flooding that occurs downstream at STMPND-00024.
  - As the west basin (within Stony Plain) is developed and managed by Stony Plain stormwater management infrastructure, the ultimate orifice sizes are reduced to 611 mm and 631 mm for STMPND-00027 and STMPND-00024, respectively.
  - It is recommended that the larger control structure of Copperhaven be monitored periodically during heavy rainfall events to ensure that it does not cause significant flooding risks to the downstream STMPND-00027 within Spruce Ridge.
- At the onset of development of Dog Creek Catchments #15 and #16, twin the existing 600 mm storm sewer along Commerce Road South (too shallow) with a deeper 525 mm sewer that is 326 m long.
- At the onset of development south of Highway 16A and upstream of Century Crossing/Easton:
  - Construct 708 m of 900 mm storm sewer that crosses Highway 16A from N-26 to the proposed Easton/Century Crossing flow split control structure; and
  - Construct the Easton/Century Crossing flow split structure that diverts upstream flows from 0 – 341 L/s into the Easton stormwater network, and anything greater than 341 L/s into the Century Crossing SWMF.
  - Consider upgrading the outlet control orifice at STMPND-00019 (Lakewood) to 467 mm (or equivalent) by ultimate development to reduce the erosion risks of flooding overtopping the emergency spillway and into the downstream drainage channel.
- At the onset of development upstream of the Pioneer Road Trunk south of Highway 16A:
  - Construct 404 m of 900 mm storm sewer crossing Highway 16A from N-32 to the existing Pioneer Road Trunk (STMMH-01714 connection); and
  - Begin planning the staging of orifice upgrades at STMPND-00054/55 (Fenwyck) and STMPND-00049/51 (Prescott) to ultimate diameters (or equivalent) of 1,037 mm and 1,058 mm, respectively.
- It is recommended that the culvert capacities along Highway 628 are maintained to ensure additional uncontrolled runoff does not exacerbate existing flooding risks within the City. The City should collaborate with Parkland County and AT if/when there are any Highway 628 roadway upgrades.

It is also recommended that the SWMP should be reviewed and updated after significant periods of growth or every five years to update the hydrodynamic model and analysis with any capital upgrades completed by the City, and the most up-to-date growth plans. The assessment can also be updated to include more up-to-date boundary conditions for the upstream uncontrolled basins south of Highway 628 that have a significant impact on flooding risks within the City.

9.0 References

1. City of Spruce Grove Stormwater Master Plan Update, Associated Engineering 2015.

2. City of Spruce Grove Sanitary Sewer Master Plan Update, ISL Engineering and Land Services 2022.

3. Edmonton Metropolitan Region Board (EMRB) Flood Risk Assessment, EMRB 2022.

4. Climate Change Action Plan, The City of Spruce Grove 2022.

5. The City of Spruce Grove Municipal Development Standards, 2023.

6. The City of Spruce Grove Municipal Development Plan, 2020.

7. Tri-Municipal Regional Study, ISL Engineering and Land Services 2019.

8. Town of Stony Plain Stormwater Master Plan 2018, Sameng Inc. 2019.

9. Spruce Grove – Easton Neighbourhood Preliminary Servicing Concept Design Brief, Select Engineering Consultants Ltd. 2020.

10. Computerized Tool for the Development of Intensity-Duration-Frequency Curves under Climate Change – Version 7.0, IDF_CC Tool 7.0. Computerized IDF CC Tool for the Development of Intensity-Duration-Frequency Curves under a Changing Climate: (idf-cc-uwo.ca)

11. EPCOR Design Standards Modernization Workshop, 2023.