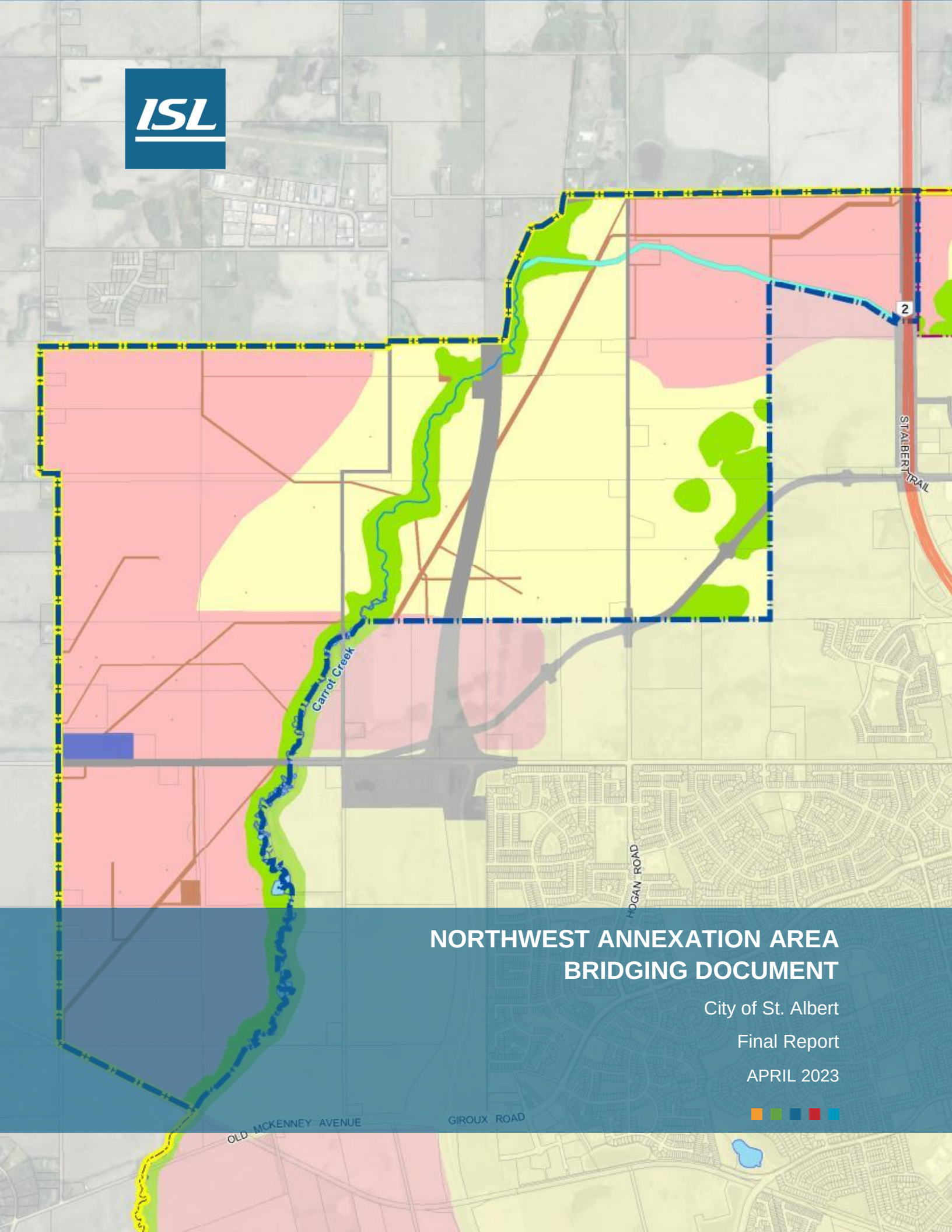

NORTHWEST ANNEXATION AREA BRIDGING DOCUMENT

City of St. Albert

Final Report

APRIL 2023

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

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

Corporate Authorization

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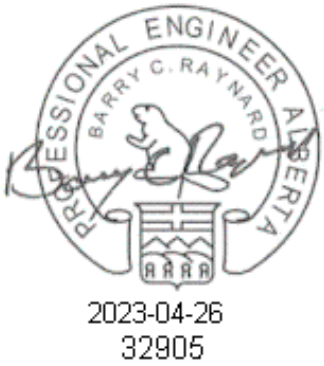

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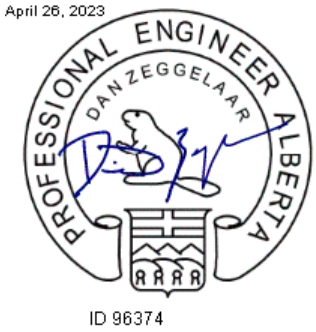

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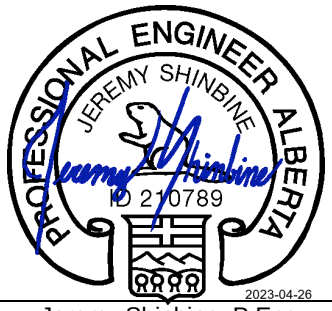

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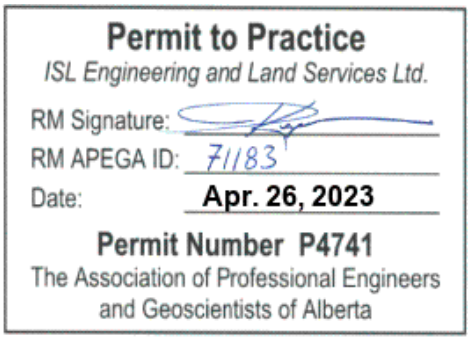


Table of Contents

TABLES

FIGURES

MAPS

Following Page

1.0 Introduction

1.1 Overview

The City of St. Albert submitted its 2020 Annexation Application to the Municipal Government Board (MGB) in late 2020. After the MGB transitioned to the new Land and Property Rights Tribunal (LPRT) in June 2021, the LPRT issued a positive recommendation on the City's submission, and in December 2021 the Provincial Government approved the City's application with an effective date of January 1, 2022. The Annexation Area involves 1,558 hectares (3,850 acres) of land previously within Sturgeon County to the northeast, north, and northwest of the City's pre-annexation boundary. The 2020 Annexation Application was prepared by ISL along with the City of St. Albert Growth Management Study (2020) as several other technical studies. Among the various supporting technical studies were two high-level serviceability studies: the 2020 Transportation Study and 2020 Infrastructure Servicing Study.

With one or more landowners within the northwest portion of the Annexation Area expected to commence Area Structure Plan (ASP) and Neighbourhood Structure Plan (NSP) preparations soon, the City has engaged ISL to develop more detailed transportation, wastewater, and stormwater servicing design briefs in the form of this Northwest Annexation Area Bridging Document to serve an interim guide while more comprehensive updates to the City's infrastructure plans are conducted to include the Annexation Area.

The level of detail of these servicing design briefs aligns with the scope of ASPs as recently re-envisioned by the City. ASPs were previously prepared at the neighbourhood-level, but the City is now envisioning them as a higher-level planning instrument covering vastly more area and providing less level of detail. Subordinate NSPs are being introduced to contain the greater level of detail. The larger new ASPs will require municipal engineering and transportation network design briefs, including overarching servicing concepts and preliminary modelling to determine appropriate infrastructure sizes. The purpose of this document is to fill that gap.

It is assumed that the developer(s) in the northeast portion of the Annexation Area will be preparing a detailed ASP document, thus this area has been excluded from ISL's scope of work.

This report has been divided in the following sections:

- Section 2.0 – Presents an overview of the Annexation Area as well as the land use breakdown, population projections, and employment statistics that were used to inform the transportation and servicing components of this report.
- Section 3.0 – Presents the proposed Annexation Area roadway network, including the roadway classifications, number of lanes, and posted speed limits.
- Section 4.0 – Presents the wastewater system assessment, including the North Interceptor Trunk analysis, wastewater system option evaluation, and the proposed wastewater servicing concept.
- Section 5.0 – Presents the proposed stormwater servicing concept, including proposed locations for stormwater management facilities and outfall trunks connecting to Carrot Creek.
- Section 6.0 – Presents a set of conclusions and recommendations for consideration at the ASP preparation stage for any proposed development in the Northwest Annexation Area.

1.2 Background Documents

Of relevance to this report are several background reports and ASPs that have been referenced as part of the servicing concept analysis which are listed below:

1. Carrot Creek Regional Master Drainage Plan – 95% Draft Report, 2022;
2. City of St. Albert Off-Site Levy Bylaw Amendment, March 2022;
3. Erin Ridge North Sanitary Lift Station – Design Basis Memorandum, 2021;
4. Erin Ridge North Stormwater Lift Station – Design Basis Memorandum, 2021;
5. Jensen Lakes Area Structure Plan Amendment, 2021;
6. Cherot Area Structure Plan Amendment, 2021;
7. Oakmont Area Structure Plan Amendment, 2021;
8. Riverside Area Structure Plan Amendment, 2021;
9. North Ridge Area Structure Plan Amendment, 2020;
10. Erin Ridge Area Structure Plan Amendment, 2014;
11. Erin Ridge North Area Structure Plan Amendment, 2009;
12. Elysian Neighbourhood Area Structure Plan Design Brief Amendment, 2020;
13. City of St. Albert Master Plan Update – Wastewater Collection and Stormwater Management System Utilities Final Report, 2020;
14. City of St. Albert Inflow and Infiltration Assessment Program Final Report, 2019;
15. Neil Ross Road Functional Study (2022);
16. Functional Alignment Study Fowler Way (2018); and
17. Ray Gibbon Drive Functional Planning Study (2009).

2.0 Anticipated Growth

2.1 Annexation Area

The lands recently annexed by the City of St. Albert from Sturgeon County cover an area of 1,558 ha or approximately 24 quarter sections (see **Map 2.1**). Due to the vast extent of the annexation area and the different characteristics of the lands therein, it has been broken down into three different sub-areas:

- Northwest Annexation Area
- Northeast Annexation Area
- East Annexation Area

The analyses presented in this report pertain specifically to the Northwest Annexation Area. However, part of the transportation analysis presented in Section 3.0 of this report encompasses the entirety of the annexation area and some adjacent undeveloped lands within the City's pre-annexation boundary to understand the effects of anticipated development in these areas on the Northwest Annexation Area's road network. As a result, this Section includes an overview of land uses and population projections for the entire annexation area. It is important to note, however, that the East annexation Area does not have any developable lands within, so the land use breakdown and population projections analysis focuses manly on the Northwest and Northeast Annexation Areas.

2.1.1 Northwest Annexation Area

The Northwest Annexation Area is 1,173 ha in size. East of Range Road 261, it extends from the lands adjacent to the intersection of a Canadian National (CN) rail line (Sangudo Subdivision) and Carrot Creek northwards until the southern boundary of the Northern Lights Estates subdivision, and then in an eastern direction until the intersection of Highway 2 and Township Road 544 after a deflection in the vicinity of Carrot Creek.

The most prominent natural feature in the Northwest Annexation Area is Carrot Creek, which defines the southeastern limit of this area and bisects its northern portion in a northeasterly direction. There are several natural areas within the Northwest Annexation Area, most of which are located along Carrot Creek and surrounding the wetlands and water bodies in proximity of the future Fowler Way alignment. [1]

The Northwest Annexation Area is also characterized by the presence of several oil and gas pipelines and facilities, including active and abandoned wells. The lands in the Northwest Annexation Area are predominantly undeveloped, unsubdivided, and in agricultural production, with only a few farmstead subdivisions and a religious assembly development.

[1] Fowler Way is a future arterial road that will connect Villeneuve Road with Highway 2 and beyond. It will start close to the intersection of Villeneuve Road and Ray Gibbon Drive and extend in a northeasterly direction to meet Highway 2 at its intersection with Neil Ross Road.

2.1.2 Northeast Annexation Area

The Northeast Annexation Area is 235 ha in size. It extends from Highway 2 to the east until Range Road 253, and then to the southeast, following the planned alignment of the future 127 Street extension, until the Sturgeon River. This is the portion of the Annexation Area with the most significant elevation changes due to proximity to the Sturgeon River. This poses some geotechnical constraints to development, which is why the City intends to preserve some of these lands in their natural state.

The Northeast Annexation Area has some oil and gas infrastructure located towards its northern boundary, but to a lesser extent than the Northwest Annexation Area. The lands in the Northeast Annexation Area are predominantly undeveloped and unfragmented, however the parcel unit varies from quarter sections in the northwest to river lot configurations in the southeast.

As mentioned above, the Northeast Annexation Area is not the focus of this study, but the growth projections were required for the transportation analysis of the Northwest Annexation Area, presented in Section 3 of this report.

2.1.3 East Annexation Area

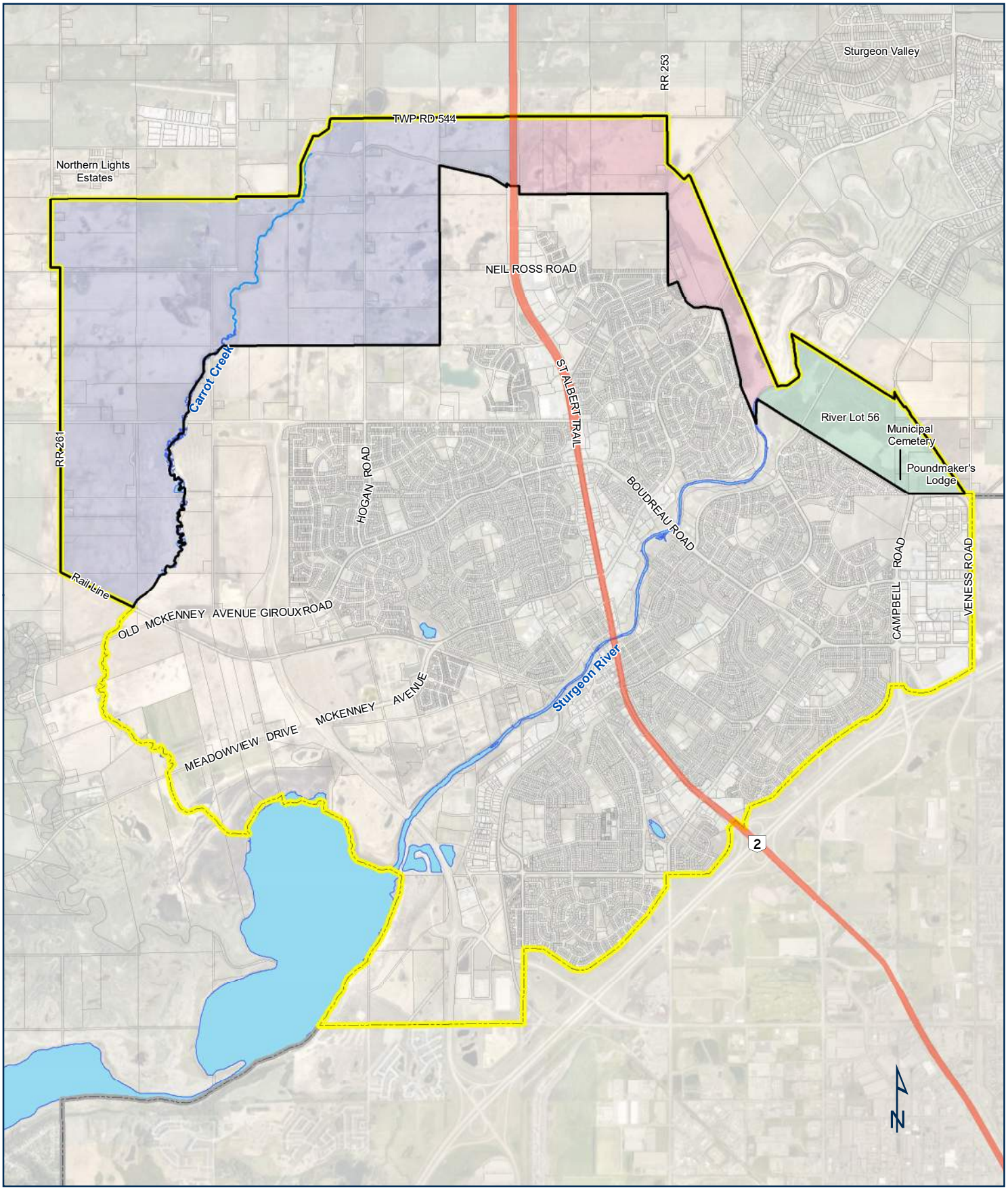
The East Annexation Area is 150 ha in size. It extends southeast from the Sturgeon River to another CN rail line (Westlock Subdivision) east of Veness Road. Most of the East Annexation Area is River Lot 56, a provincially managed and protected natural area with outdoor recreational opportunities. The East Annexation Area also includes the Poundmaker's Lodge Treatment Centre and the St. Albert Municipal Cemetery.

There are no developable lands within the East Annexation Area.

2.2 Land Use Breakdown and Population Projections by Analysis Area

Map 2.2 shows the preliminary land use concept for the Annexation Area and the balance of the City. These land uses mainly observe the Municipal Development Plan (MDP) land use concept (see **Figure 2.1**), while recognizing some of the undevelopable lands that were identified in the *City of St. Albert Growth Management Study (2020)* preliminary land use breakdown (see **Figure 2.2**), such as oil and gas infrastructure and future road alignments. Detailed land uses will be decided at the Area Structure Plan (ASP) stage. Until such ASPs are in place, the MDP is the best guide available for future land uses.

Since the East Annexation Area has no developable land, **Table 2.1** presents the anticipated land use breakdown corresponding to the Developable Annexation Areas (i.e., Northwest and Northeast Annexation Areas) only. The land use breakdown is presented by analysis area, which largely follow the quarter section and river lot configurations of the Annexation Area, with a few exceptions. Similar Analysis Areas were also used in the *2020 Transportation Study* and *2020 Infrastructure Servicing Study* conducted in support of the *2020 Annexation Application*.



Municipal Boundary
City Boundary
Annexation Area
Parcel

Highway
Watercourse
Water Body

Northwest Annexation Area
Northeast Annexation Area
East Annexation Area

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NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 2.1: ANNEXATION AREA CONTEXT

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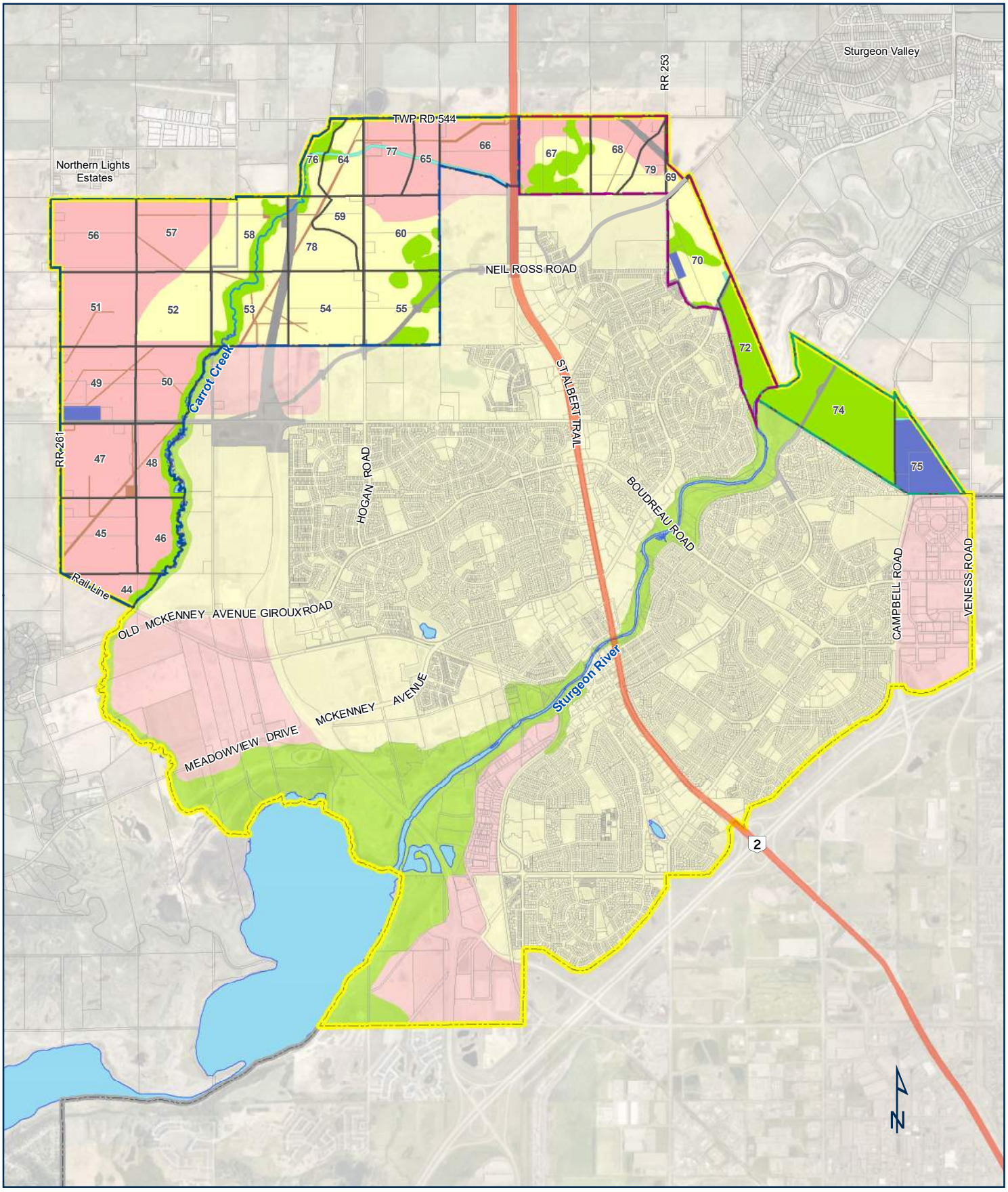

City of St. Albert Cultivate Life

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- Municipal Boundary
- City Boundary
- Parcel
- Highway
- Watercourse
- Water Body
- Analysis Area
- Northwest Annexation Area
- Northeast Annexation Area
- East Annexation Area

Land Use Concept

- Residential
- Employment
- Institutional
- Open Space
- Public Utilities
- Oil and Gas
- Circulation
- Rail

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 2.2: LAND USE BREAKDOWN BY ANALYSIS AREA

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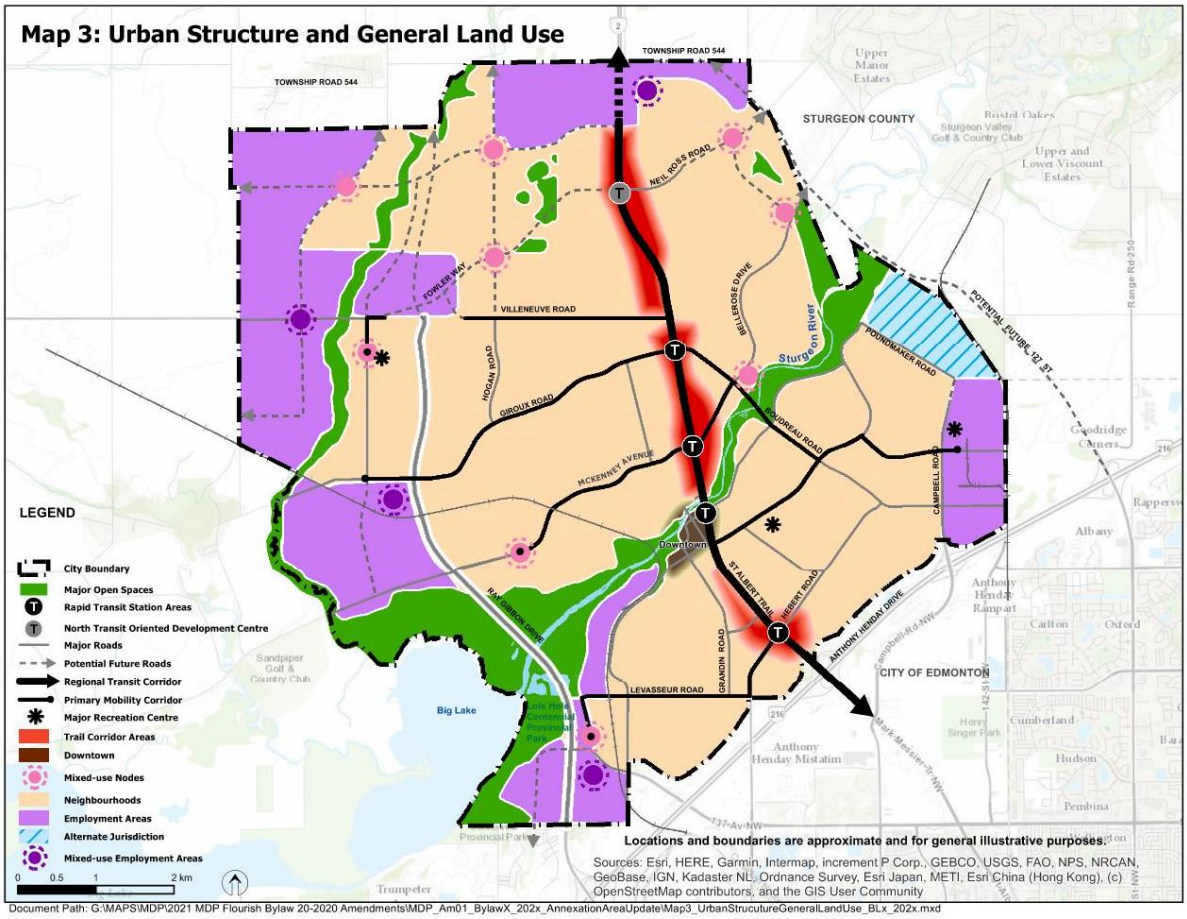


Figure 2.1: St. Albert Municipal Development Plan (2021), Urban Structure and General Land Use

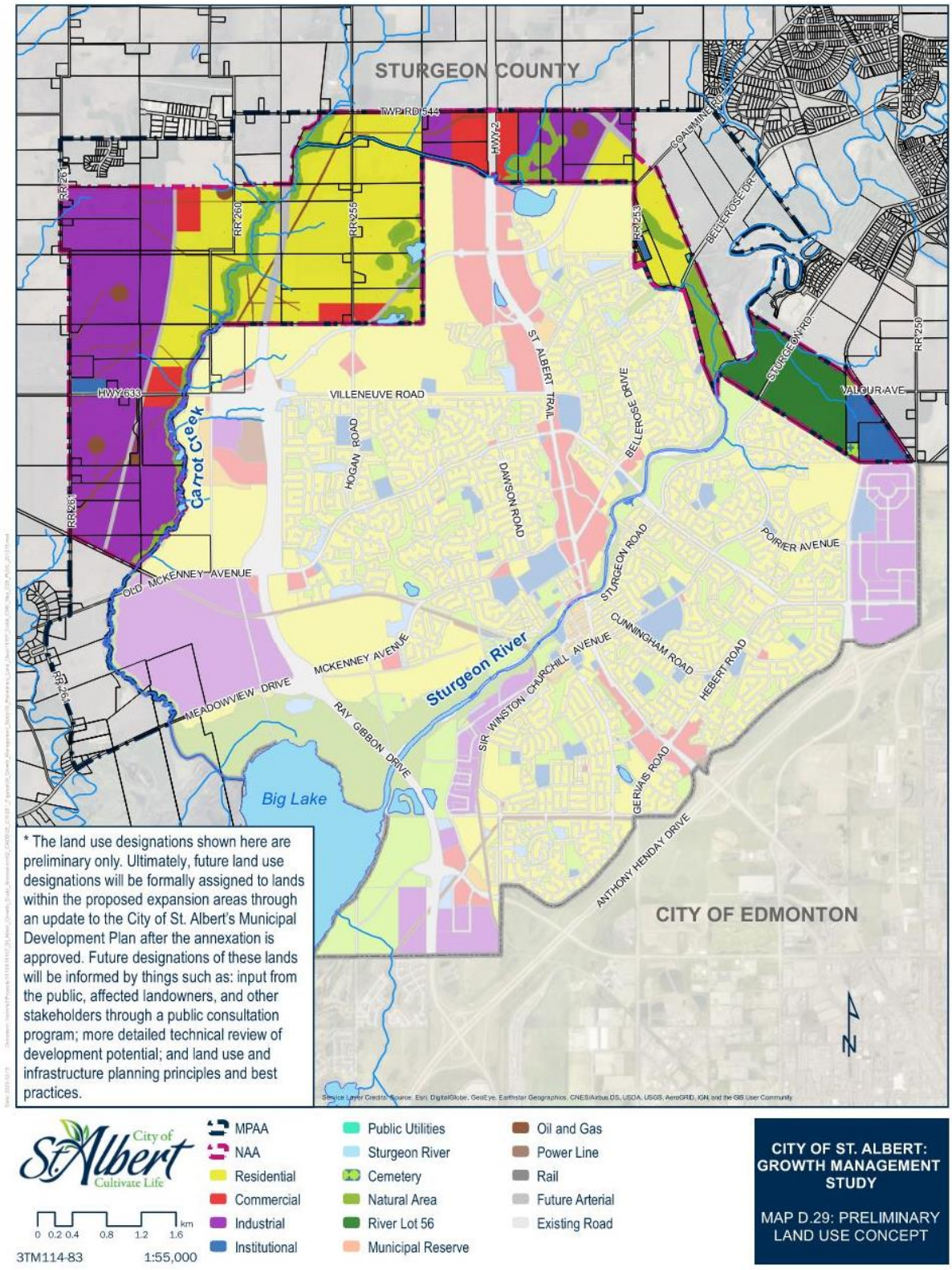


Figure 2.2: St. Albert Growth Management Study (2020), Preliminary Land Use Concept

Table 2.1: Land Use Breakdown by Analysis Area

Annexation Area	Analysis Area No.	Off-Site Levy Area Reference No.	Total Area (ha)	Gross Developable Employment Area (ha)	Gross Developable Residential Area (ha)	Net Developable Employment Area (ha)	Net Developable Residential Area (ha)	Estimated Number of Dwellings	Estimated Population
Northwest	44	44	15.84	15.84	0.00	11.09	0.00	0	0
	45	45	61.32	64.20	0.00	44.94	0.00	0	0
	46	46	27.15	27.15	0.00	19.00	0.00	0	0
	47	47	58.57	62.72	0.00	43.91	0.00	0	0
	48	48	24.56	25.36	0.00	17.75	0.00	0	0
	49	49	53.53	55.91	0.00	39.14	0.00	0	0
	50	50	43.34	45.27	0.00	31.69	0.00	0	0
	51	51	62.92	63.86	0.15	44.70	0.10	4	10
	52	52	16.78	16.78	47.45	11.75	30.84	1,234	3,310
	53	53	1.09	1.28	32.43	0.89	21.08	843	2,262
	54	54	0.15	0.15	64.15	0.11	41.70	1,668	4,475
	55	55	41.45	0.00	59.83	0.00	38.89	1,556	4,173
	56	56	69.41	69.41	0.00	48.59	0.00	0	0
	57	57	54.98	57.48	4.68	40.23	3.04	122	326
	58	58	5.79	6.01	41.65	4.20	27.08	1,083	2,905
	59	59	21.44	0.00	21.44	0.00	13.94	558	1,495
		78	32.91	0.00	32.91	0.00	21.39	856	2,295
	60	60	19.62	19.62	45.14	13.74	29.34	1,174	3,149
	64	64	25.71	0.00	25.71	0.00	16.71	669	1,794
		76	4.41	0.00	4.41	0.00	2.87	115	308
	65	65	23.72	23.72	0.00	16.61	0.00	0	0
		77	38.41	38.41	0.00	26.89	0.00	0	0
	66	66	38.41	41.97	0.00	29.38	0.00	0	0
Northeast	67	67	20.41	21.22	16.50	14.85	10.72	429	1,151
	68	68	18.35	16.99	19.70	11.89	12.81	513	1,374
		79	0	0	0	0	0	0	0
	69	69	2.88	0.00	2.88	0.00	1.87	75	201
	70	70	43.04	0.00	43.04	0.00	27.98	1,119	3,002
TOTAL NORTHWEST				**635.14**	**379.96**	**444.60**	**246.97**	**9,879**	**26,503**
TOTAL NORTHEAST				**46.47**	**92.18**	**32.53**	**59.92**	**2,397**	**6,430**
TOTAL DEVELOPABLE				**681.62**	**472.15**	**477.13**	**306.89**	**12,276**	**32,933**

Based on the land use concept presented in **Map 2.2**, the Northwest Annexation Area has a total of 635.14 ha of gross and 444.60 ha of net employment lands, and 379.96 ha of gross and 246.97 ha of net residential lands. East of Highway 2, the Northeast Annexation Area has a total of 46.47 ha of gross and 32.53 ha of net employment lands, and 92.18 ha of gross and 59.92 ha of net residential lands. For the conversion of gross to net residential areas, an overhead assumption of 35% was used. This assumes 10% for parks and open space, 5% for public utilities, and 20% for circulation. For the conversion of gross to net employment areas, an overhead assumption of 30% was used. This assumes 10% for parks and open space, 5% for public utilities, and 15% for circulation.

The 246.97 ha of net residential lands in the Northwest Annexation Area will result in the development of approximately 9,879 dwellings. In the Northeast Annexation Area, it is estimated that 2,397 dwellings will be built in the 59.92 ha of net residential lands. These estimates assume an average density of 40 dwelling units per net residential hectare (du/nrha), which is the minimum greenfield residential density prescribed by the Edmonton Metropolitan Region Growth Plan (EMRGP).

At full build out, it is estimated that the Northwest Annexation Area will have a population of approximately 26,503 residents, while in the Northeast Annexation Area the estimated population is 6,430 residents. These calculations are based on an average household size of 2.68 persons, which was derived from a weighted average of the average household size by dwelling type presented in the *2018 St. Albert Census*.

In summary, the Developable Annexation Areas have a total of 681.62 ha of gross and 477.13 ha of net employment lands, as well as 472.14 ha of gross and 306.89 ha of net residential land. At full buildout, the Developable Annexation Areas are estimated to have a total of 12,276 dwellings with a population of 32,933.

2.3 Growth in Adjacent Development Areas

For the purposes of the wastewater analysis presented in Section 4.0 of this report, growth projections were also prepared for some areas adjacent to the Northwest Annexation Area to understand their influence on the shared wastewater infrastructure with the Northwest Annexation Area at full buildout. Estimates of the net developable areas for these adjacent development areas are presented in **Table 2.2**.

Table 2.2: Adjacent Development Area Anticipated Growth

Area	Net Residential Area (ha)	Net Non-Residential Area (ha)	Total Net Area (ha)
Avenir	43.4	0.0	43.4
Avenir Amendment Lands	1.1	22.5	23.6
Northern Badger Lands	3.9	16.4	20.3
Erin Ridge Servicing Area #5 (Pump Station #4 Service Area)	32.5	22.6	55.1
East Amendment Area	0.0	6.5	6.5

2.4 Land Use Breakdown by Traffic Zone

For the purposes of the transportation analysis presented in Section 3.0 of this report, a land use breakdown was also prepared by traffic zone as shown in **Map 2.3**. In addition to land uses and population projections, the transportation model required specific employment statistics, such as number of jobs and square footage of commercial retail uses, as well as school enrollment data. This information was prepared for the traffic zones intersecting the Annexation Area, and a few other traffic zones outside of the Annexation Area.

Population projections were based on the same assumptions used in the preparation of the land use breakdown and population projections by analysis area presented in **Section 2.2** above. The assumptions used in the preparation of employment statistics and school enrollment are described below.

Employment Statistics for Traffic Zones Within the Annexation Area

The preparation of these employment statistics was constrained by the lack of detail in the available land use policy for the Annexation Area. As mentioned before, the land use concept prepared for this study was based primarily on the City's urban structure and general land use as conceptualized in the MDP, which only has one category of employment lands. Thus, more detailed assumptions were made in consultation with the City to explore a potential breakdown of these employment lands into different subclasses. The main source of information in making these decisions was the *Industrial Expansion Area Market Assessment (2015)*, containing general employment statistics for the City's current and potential future employment lands. **Table 2.3** presents the results of this exercise.

The *Industrial Area Expansion Market Assessment (2015)* was referenced to determine the land use categories projected for the employment lands in the Annexation Area, and the percentage of lands that are expected to be developed under each of these categories. Based on the findings of this study, the following land use categories and percentage share assumptions are made:

- Major Commercial (e.g., big box, strip malls, etc.): 20% of gross employment lands
- Ancillary Retail (e.g., banking, restaurants, etc.): 5% of gross employment lands
- Light Industrial: 65% of gross employment lands
- Office: 10% of gross employment lands

These percentage shares are not assumed to be uniform across the Annexation Area due to the locational advantages that the different employment areas therein present to any specific type of development. However, the aggregate of employment areas within the Annexation Area will reflect the percentage shares provided above. For instance, the lands adjacent to the St. Albert Trail corridor provide a unique opportunity for the development of highway commercial uses, so it is assumed that 90% of these lands will be developed with major commercial uses, and the remaining 10% with light industrial uses. Since this shift in percentage shares affects the totals for all land use categories, the percentage shares for the balance of the employment areas were adjusted accordingly.

For the conversion of gross to net employment areas, a 25% overhead was assumed. This assumption was derived from the *Industrial Area Expansion Market Assessment (2015),* which observes that in average 25% of the City's existing employment lands has been allocated for overhead uses such as circulation and public utilities. According to this study, a similar overhead is expected in the City's future employment lands.

It is important to note that this 25% net developable overhead for employment areas differs from the 30% overhead used in the land use breakdown and population projections by analysis area presented in **Section 2.2** above. This is because the breakdown presented in Section 2.2 was limited to quantifying net residential and employment areas and estimating population growth and did not include any further employment analyses. Thus, the 30% net developable overhead assumption was based on the *City of St. Albert Growth Management Study (2020),* which also focused on quantifying developable lands to accommodate future growth. However, the employment statistics presented in this section required more specific assumptions to understand the details of future commercial and industrial development in the Annexation Area, such as number of jobs and retail square footage. The most readily available source for these assumptions was the *Industrial Area Expansion Market Assessment (2015),* which is based on the development statistics from existing industrial parks in the City. For accuracy and consistency with this report, all assumptions were derived from it, including the 25% net developable overhead for employment areas.

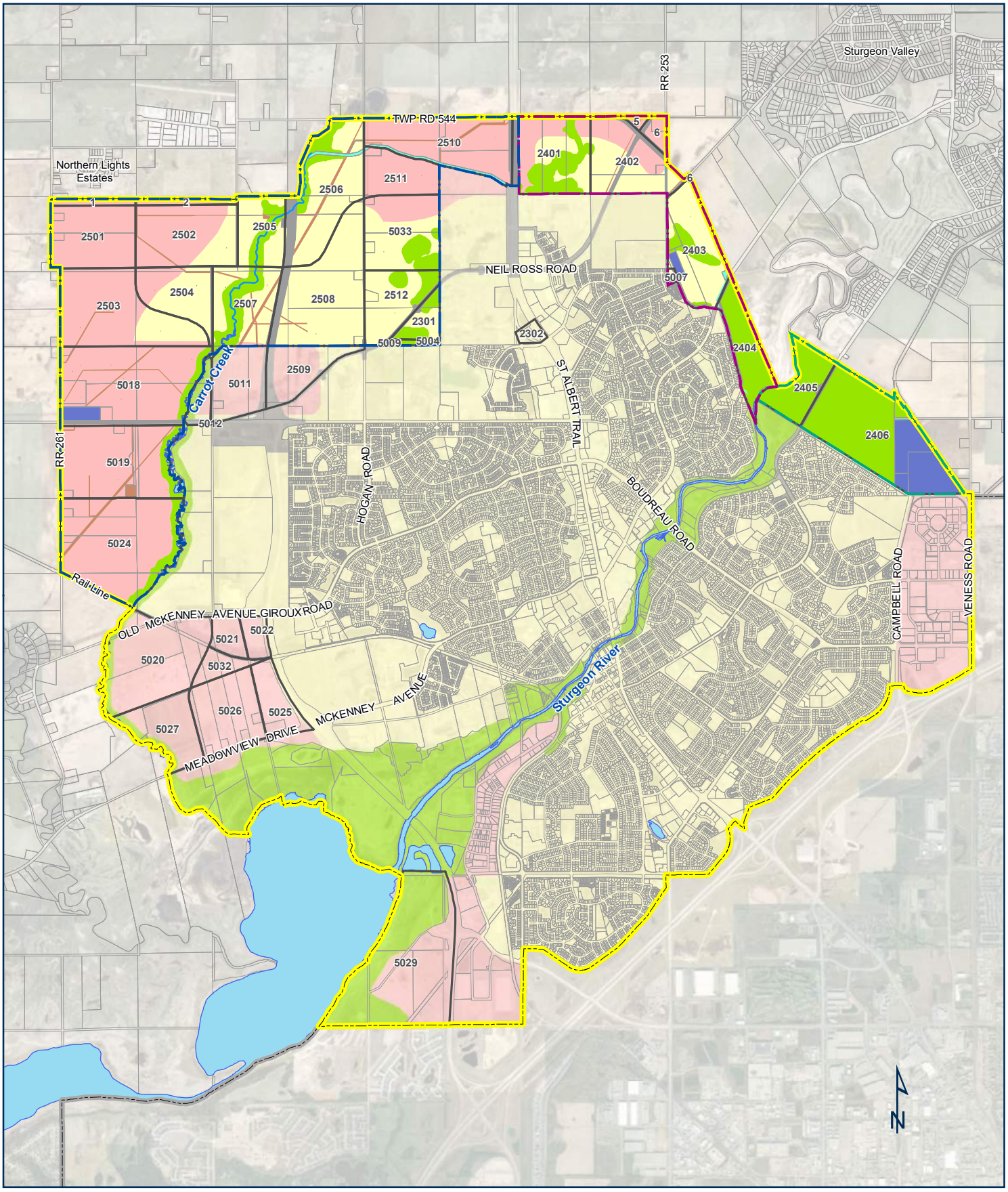
The total number of jobs was calculated based on the following assumptions, provided by the *Industrial Expansion Area Market Assessment (2015)*, for each land use category:

- Major Commercial: 49 jobs per net hectare
- Ancillary Retail: 54 jobs per net hectare
- Light Industrial: 12 jobs per net hectare
- Office: 99 jobs per net hectare

Finally, the developed square footage was projected based on the following assumptions, provided by the *Industrial Expansion Area Market Assessment (2015)*, for each land use category:

- Major Commercial: 26,817 ft^2 per net hectare
- Ancillary Retail: 26,813 ft^2 per net hectare
- Light Industrial: 21,453 ft^2 per net hectare
- Office: 32,181 ft^2 per net hectare

In summary, the Annexation Area will create a total of 15,336 jobs at full buildout, most of which will be concentrated on major commercial areas (33%) and offices (32%), followed by light industrial developments (26%) and ancillary retail uses (9%). The Annexation Area will also have approximately 12,189,938 ft^2 of employment development, most of which will be dedicated to light industrial uses (59%) and major commercial uses (23%), followed by offices (13%) and ancillary retail uses (5%).



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City of St. Albert Cultivate Life

0 0.2 0.4 0.8 1.2 1.6 km

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- Municipal Boundary
- City Boundary
- Parcel
- Watercourse
- Water Body
- Traffic Analysis Zone
- Northwest Annexation Area
- Northeast Annexation Area
- East Annexation Area

Land Use Concept

- Residential
- Employment
- Institutional
- Open Space
- Public Utilities
- Oil and Gas
- Circulation
- Rail

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 2.3: LAND USE BREAKDOWN BY TRAFFIC ANALYSIS ZONE

Table 2.3: Land Use Breakdown and Employment Statistics by Traffic Zone for Employment Lands Within the Annexation Area

Traffic Zone	Estimated Population	Net Major Commercial (ha)	Net Ancillary Retail (ha)	Net Light Industrial (ha)	Net Office (ha)	Number of Jobs: Major Commercial	Number of Jobs: Ancillary Retail	Number of Jobs: Light Industrial	Number of Jobs: Office	Total Number of Jobs	Square Footage: Major Commercial (ft^2)	Square Footage: Ancillary Retail (ft^2)	Square Footage: Light Industrial (ft^2)	Square Footage: Office (ft^2)	Total Square Footage (ft^2)
1	0	0.83	0.23	3.08	0.46	40.57	12.42	36.98	45.54	136	22,203.83	6,166.81	66,116.22	14,802.83	109,289.69
2	34	0.85	0.24	3.16	0.47	41.65	12.75	37.97	46.75	139	22,794.51	6,330.86	67,875.09	15,196.62	112,197.09
5	0	0.20	0.06	0.74	0.11	9.76	2.99	8.90	10.96	33	5,342.06	1,483.68	15,907.01	3,561.44	26,294.19
6	0	0.66	0.18	2.46	0.37	32.40	9.92	29.53	36.36	108	17,730.83	4,924.50	52,797.00	11,820.78	87,273.11
2301	1,003	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
2401	1,154	9.08	0.37	5.78	0.73	444.78	19.81	69.34	72.65	607	243,423.53	9,838.50	123,969.84	23,616.36	400,848.23
2402	2,274	2.54	0.71	9.46	1.41	124.52	38.12	113.51	139.77	416	68,148.43	18,927.30	202,925.21	45,433.14	335,434.08
2403	2,930	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
2404	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
2405	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
2406	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
2501	0	8.08	2.24	30.07	4.49	395.83	121.17	360.82	444.30	1,322	216,630.66	60,166.21	645,059.93	144,423.13	1,066,279.93
2502	1,123	7.48	2.08	27.83	4.15	366.37	112.15	333.97	411.23	1,224	200,510.15	55,688.96	597,057.97	133,675.93	986,933.01
2503	1,386	9.88	2.74	36.76	5.49	483.94	148.14	441.14	543.19	1,616	264,851.90	73,559.00	788,648.04	176,571.22	1,303,630.16
2504	2,038	1.71	0.48	6.38	0.95	84.03	25.72	76.60	94.32	281	45,990.74	12,773.30	136,946.38	30,661.07	226,371.49
2505	1,764	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
2506	4,066	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
2507	2,138	0.16	0.04	0.59	0.09	7.73	2.37	7.04	8.67	26	4,228.83	1,174.50	12,592.16	2,819.27	20,814.77

Traffic Zone	Estimated Population	Net Major Commercial (ha)	Net Ancillary Retail (ha)	Net Light Industrial (ha)	Net Office (ha)	Number of Jobs: Major Commercial	Number of Jobs: Ancillary Retail	Number of Jobs: Light Industrial	Number of Jobs: Office	Total Number of Jobs	Square Footage: Major Commercial (ft^2)	Square Footage: Ancillary Retail (ft^2)	Square Footage: Light Industrial (ft^2)	Square Footage: Office (ft^2)	Total Square Footage (ft^2)
2508	6,633	0.04	0.01	0.13	0.02	1.73	0.53	1.58	1.95	6	949.36	263.67	2,826.91	632.92	4,672.86
2510	0	15.68	2.17	29.93	4.34	768.52	117.07	359.11	429.25	1,674	420,600.60	58,128.09	641,991.04	139,530.82	1,260,250.55
2511	0	4.68	1.30	17.42	2.60	229.36	70.21	209.07	257.44	766	125,524.12	34,862.61	373,772.48	83,684.31	617,843.52
2512	2,932	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
5004	91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
5007	72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
5009	147	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
5018	0	13.94	3.87	51.89	7.74	683.04	209.09	622.63	766.68	2,281	373,816.89	103,822.54	1,113,112.51	249,215.91	1,839,967.85
5019	0	11.63	3.23	43.28	6.46	569.79	174.43	519.40	639.56	1,903	311,840.01	86,609.31	928,564.30	207,897.22	1,534,910.83
5024	0	14.46	4.02	53.81	8.03	708.32	216.83	645.68	795.06	2,366	387,655.26	107,665.96	1,154,318.94	258,441.66	1,908,081.82
5033	3,149	2.64	0.73	9.84	1.47	129.50	39.64	118.05	145.36	433	70,873.02	19,684.01	211,038.21	47,249.56	348,844.81
TOTAL	**32,934**	**104.53**	**24.69**	**332.61**	**49.38**	**5,121.85**	**1,333.37**	**3,991.34**	**4,889.04**	**15,336**	**2,803,114.76**	**662,069.80**	**7,135,519.26**	**1,589,234.19**	**12,189,938.00**

Employment Statistics for Traffic Zones Outside of the Annexation Area

Some traffic zones within the City's pre-annexation boundary were analyzed due to their potential impact on the transportation network in the Northwest Annexation Area. Unlike the Annexation Area, these lands have a more detailed land use concept in place since the City is in the process of developing and adopting the West St. Albert ASP.

The West St. Albert ASP has two employment land use categories:

- Employment Areas: primarily industrial and office, with only some ancillary retail and institutional uses, and
- Mixed-Use Employment Areas: still predominantly industrial and office, but with greater proportion of ancillary retail uses.

In consultation with the City, it was determined that the land use breakdown for these areas would follow the assumptions provided below:

- Employment Areas: 85% light industrial, 10% office, and 5% ancillary retail
- Mixed-Use Employment Areas: 45% light industrial, 30% office, and 25% ancillary retail

Major commercial uses were excluded from the assumptions as the location of these employment lands do not present a valuable opportunity of the development of these uses.

All other assumptions are the same as the ones used in the calculation of employment statistics for employment lands within the Annexation Area. **Table 2.4** presents the results of this exercise.

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Table 2.4: Land Use Breakdown and Employment Statistics by Traffic Zone for Employment Lands Outside of the Annexation Area

Traffic Zone	Estimated Population	Net Major Commercial (ha)	Net Ancillary Retail (ha)	Net Light Industrial (ha)	Net Office (ha)	Number of Jobs: Major Commercial	Number of Jobs: Ancillary Retail	Number of Jobs: Light Industrial	Number of Jobs: Office	Total Number of Jobs	Square Footage: Major Commercial (ft^2)	Square Footage: Ancillary Retail (ft^2)	Square Footage: Light Industrial (ft^2)	Square Footage: Office (ft^2)	Total Square Footage (ft^2)
2302	0	1.84	0.00	0.00	0.00	90.37	0.00	0.00	0.00	90	49,458.82	0.00	0.00	0.00	49,458.82
2509	0	0.00	1.07	18.19	2.14	0.00	57.77	218.25	211.83	488	0.00	28,685.43	390,169.11	68,856.58	487,711.12
5012	0	0.00	0.15	2.49	0.29	0.00	7.91	29.89	29.01	67	0.00	3,928.30	53,431.30	9,429.49	66,789.09
5022	0	0.00	2.20	3.96	2.64	0.00	118.85	47.54	261.46	428	0.00	59,011.37	84,986.68	84,990.64	228,988.69
5027	0	0.00	1.20	20.48	2.41	0.00	65.04	245.71	238.48	549	0.00	32,294.73	439,261.61	77,520.37	549,076.71
5029	0	0.00	2.27	38.61	4.54	0.00	122.64	463.32	449.69	1,036	0.00	60,896.92	828,298.55	146,177.15	1,035,372.62
5032	0	0.00	0.44	7.40	0.87	0.00	23.50	88.76	86.15	198	0.00	11,666.55	158,684.35	28,004.43	198,355.33
TOTAL	**0**	**1.84**	**7.33**	**91.12**	**12.90**	**90.37**	**395.71**	**1,093.46**	**1,276.62**	**2,856**	**49,458.82**	**196,483.31**	**1,954,831.60**	**414,978.65**	**2,615,752.38**

School Enrollment

In consultation with the City, seven new school sites were added to support the Annexation Area population. The number of school-aged children within the Annexation Area was estimated using Statistics Canada's publicly available population by age projections from 2019 to 2046. This resulted in an estimated 6000 school aged children within the Annexation Area at full-buildout, or approximately 840 children enrolled per school.

The new school sites are located at:

- Traffic Zone 2401 – the northern most quarter section east of St. Albert Trail;
- Traffic Zone 5003 – East of Erin Ridge North;
- Traffic Zone 5015 – Cherot, in the south;
- Traffic Zone 2003 – Riverside, north of McKenny Avenue;
- Traffic Zone 2002 – Riverside, south of McKenny Avenue;
- Traffic Zone 2506 – Northeast, west of Ray Gibbon Drive; and
- Traffic Zone 2507 – Northeast, west of Ray Gibbon Drive.

Existing schools are assumed to increase enrollment numbers in proportion to population growth outside of the Annexation Area. This generally only impacts undeveloped areas within the City that are expected to experience growth past the previous EMME model horizon. The following areas experience a school enrollment increase of:

- 20% in Grandin (Traffic Zones 904 and 907). This is the only developed area that will experience notable school enrollment increases, approximately 50 and 270 students respectively;
- 78% in Jensen Lakes (Traffic Zone 2303); and
- 45% in Erin Ridge North (Traffic Zone 5007).

3.0 Transportation

3.1 Future Roadway Network Development

The future roadway network shared in Maps 3.1 – 3.3 shows the City's potential corridors classification, number of lanes, and speed limits when all lands, including the annexation areas, are developed. Existing planning documents informed the network wherever possible.

The proposed annexation area roadway network was developed using the following principles:

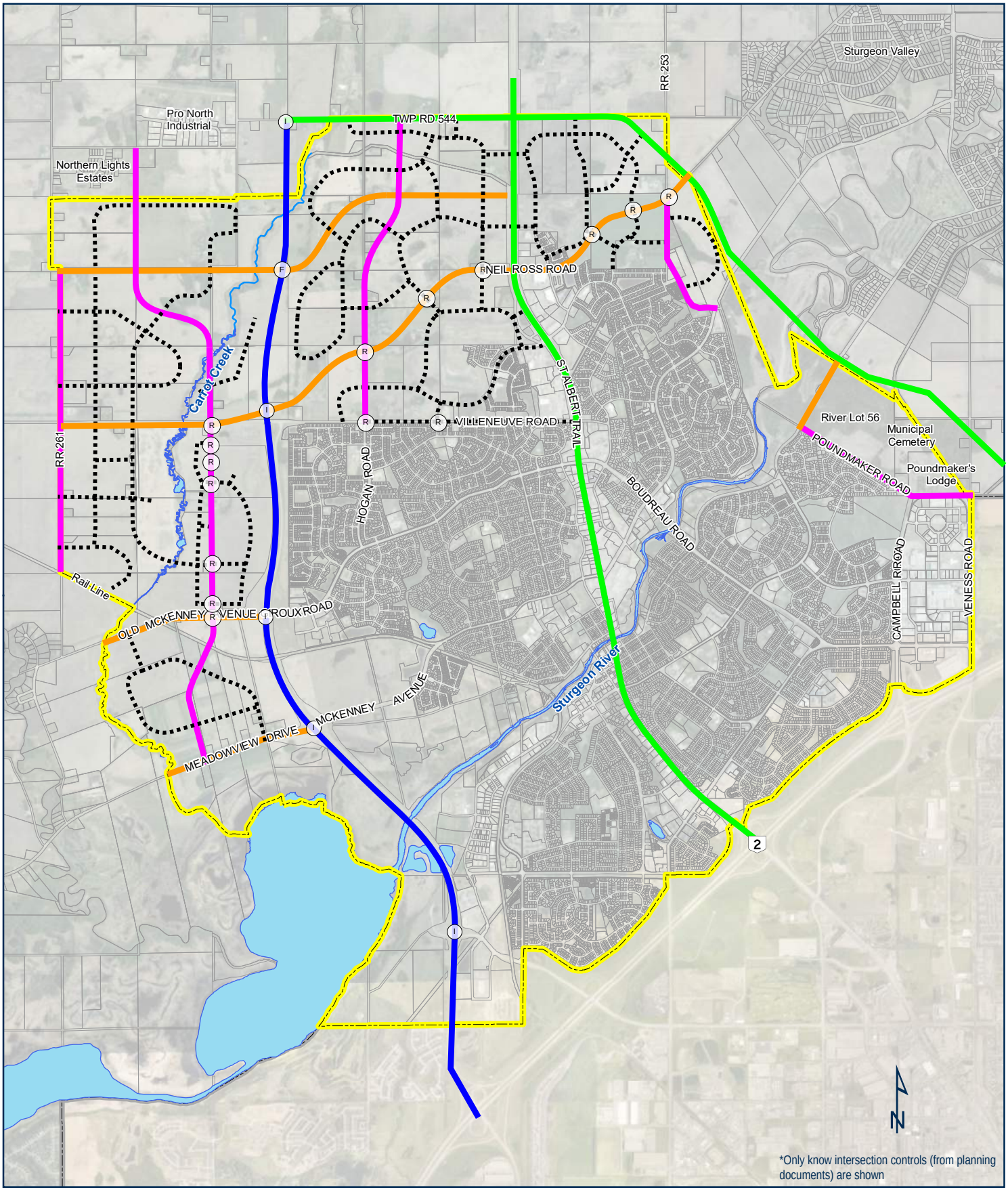
- Boulevard (arterial), Connector (arterial), or Crosstown (arterial) roads spaced no more than 1,600 m apart. Although no new Boulevards are proposed, there is the anticipated extension of Ray Gibbon Drive and the acquisition of an additional length of St. Albert Trail/Highway 2 to the City's new northern boundary. The location of existing or planned roadways such as St. Albert Trail and 127 Street was taken into consideration when planning the annexation area arterial roadway network.
- Neighbourhood (collector) roads every 400 – 800 m.
- Provide a highly connected roadway network with strong north-south and east-west corridors across the City.
- Align with the anticipated land use. Expected residential areas generally have less distance between Neighbourhood Roads than commercial or industrial.

This study assumes the City is fully developed within the annexation boundaries and that, for the purpose of transportation modeling, full development will occur by 2070. The proposed roadway network is the best estimate of future conditions based on the information available today. The proposed roadway alignments in the annexation area are provided as input to the development of future Area Structure Plans and are subject to change as needed.

3.2 Travel Demand Model

The travel demand model development and analysis were completed using EMME 4, a transportation planning software suite. EMME 4 can efficiently estimate changes in travel patterns and utilization of transportation systems in response to changes in land use, population, employment, and transportation infrastructure. It integrates mapping, land use planning, development projections, future traffic demand, and transportation networks to produce realistic traffic forecasts that can be interpreted easily and presented in effective visual format.

The City maintains an EMME model of their transportation network with several different horizons and variations to the transportation network. The City's latest model horizon is 2045 and was used as a basis for developing the ultimate transportation network model for their pre-annexation land uses. The 2021 St. Albert EMME TDM User Guide and 2020 Travel Demand Model Calibration Report were used as a reference for updating the 2045 model to the ultimate model.



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City of St. Albert Cultivate Life

- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Northeast Annexation Area
- Parcel
- Watercourse
- Water Body
- Roundabout
- Interchange
- Fly-over
- Freeway
- Boulevard (Arterial)
- Connector (Arterial)
- Crosstown (Arterial)
- Neighbourhood (Collector)

0 0.2 0.4 0.8 1.2 1.6 km

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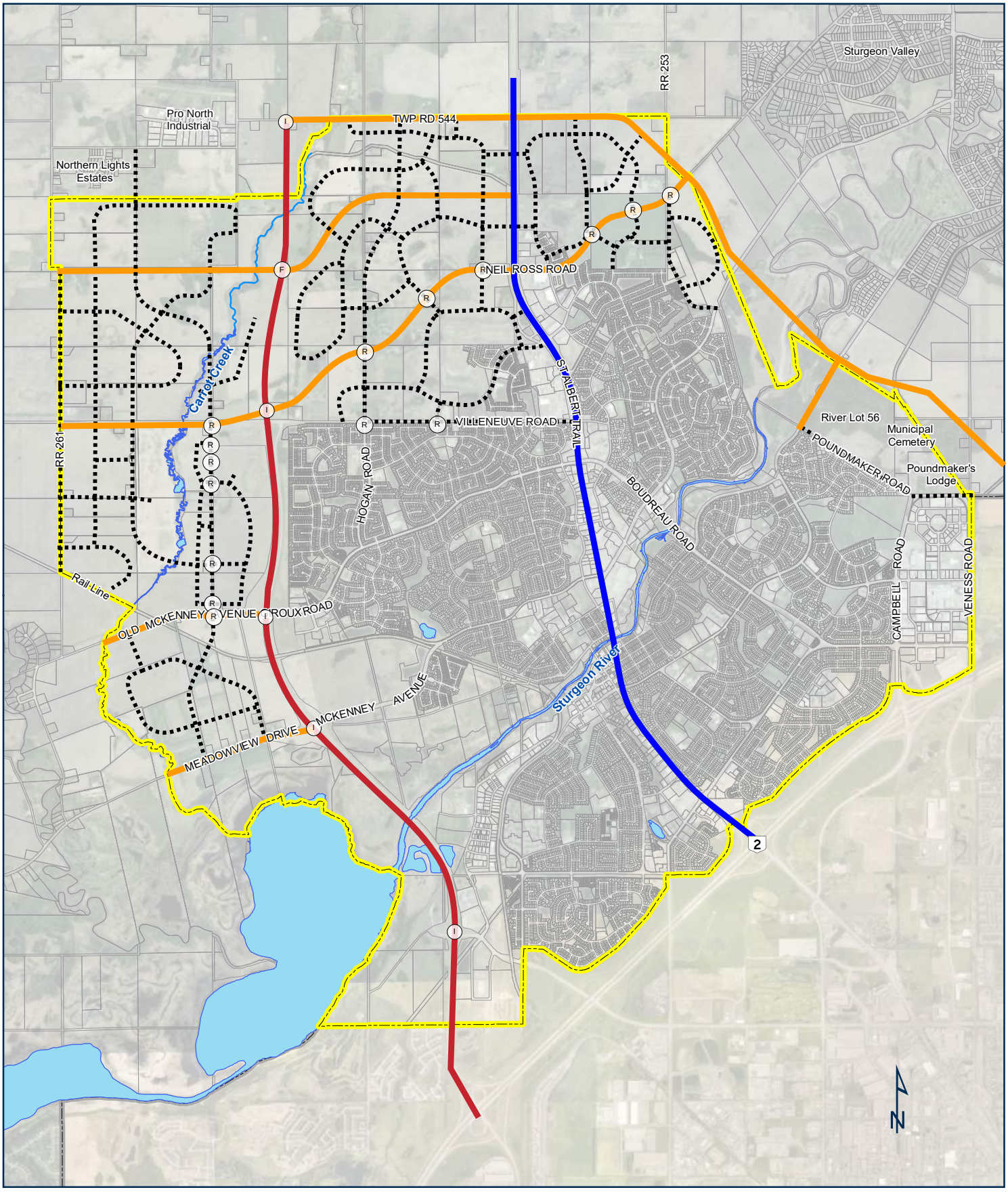
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 3.1: PROPOSED ROADWAY NETWORK



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City of St. Albert Cultivate Life

Municipal Boundary
City Boundary
Northwest Annexation Area
Northeast Annexation Area
Parcel

Watercourse
Water Body
Roundabout
Interchange
Fly-over

Eight Lanes
Six Lanes
Four Lanes
Two Lanes

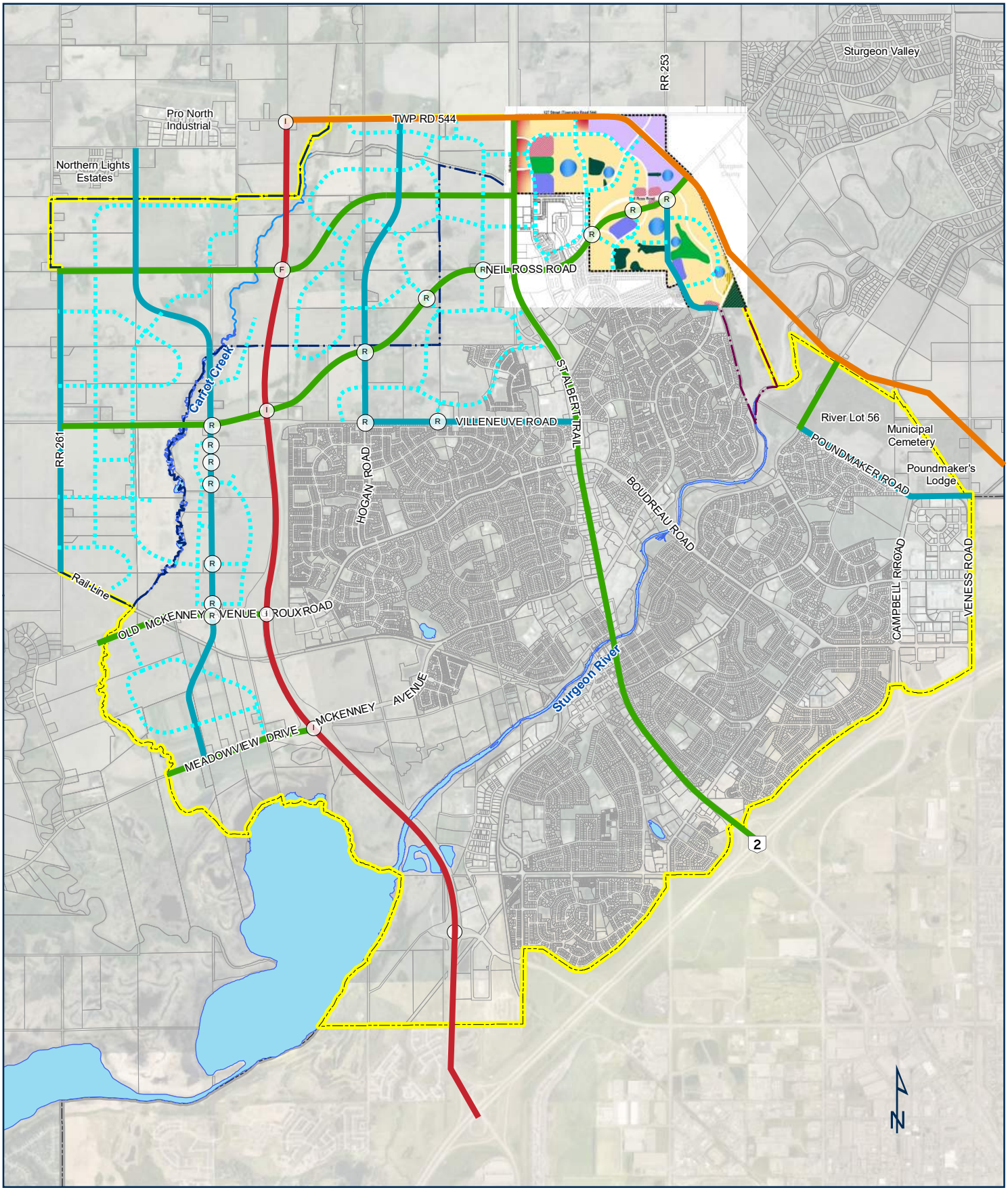
0 0.2 0.4 0.8 1.2 1.6 km

3TM114-83 1:55,000

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

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 3.2: PROPOSED ROADWAY NETWORK NUMBER OF LANES



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City of St. Albert Cultivate Life

- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Northeast Annexation Area
- Parcel
- Watercourse
- Water Body
- Roundabout (R)
- Interchange (I)
- Fly-over (F)
- 40 km/h
- 50 km/h
- 60 km/h
- 70 km/h
- 100 km/h

0 0.2 0.4 0.8 1.2 1.6 km

3TM114-83 1:55,000

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

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 3.3: PROPOSED ROADWAY SPEED LIMITS

The traditional four-step travel demand modelling process was used to model expected traffic patterns in EMME for the ultimate transportation network as follows:

- **Trip Generation** – residential, commercial, industrial, and institutional land uses are used to determine the number of peak hour trips being generated for the study area;
- **Trip Distribution** – zone-to-zone trip distribution is based on the road network impedance (i.e., travel time) and determines a zone-to-zone origin-destination (OD) trip matrix;
- **Mode Split** – the OD trip matrix is split into various travel modes, such as driving, walking, and transit;
- **Trip Assignment** – the estimated OD trip matrix is assigned onto the established road network to get link volumes for the existing and future traffic scenarios;

Figure 3.1: Traditional Four-Step Travel Demand Modelling Process

The City's 2020 travel demand model was used for calibration purposes. The 2020 model captures the City's current traffic patterns, with trips and travel patterns generated from existing land uses calibrated against existing traffic volumes. The calibrated trip patterns and trip rates were then applied to the ultimate travel demand model to forecast the future traffic volumes based on the future land uses and transportation network. The future model provides St. Albert with a scalable, flexible platform that can be readily adapted over time to include additional scenarios or transportation complexity as St. Albert grows and intensifies. It may also be used to assess any changes proposed to the transportation network as future ASPs are developed

3.2.2 Ultimate Transportation Network Modeling

The ultimate travel demand model road network includes the entire City of St. Albert, part of Edmonton, and part of Surgeon County. Each roadway is coded with the classification, number of lanes, capacities, speed limits, and turn restrictions (if any). Characteristics of roadways from the 2045 Emme model were generally maintained. Ray Gibbon Drive was updated to an 8-lane freeway per the Functional Planning Study. Planned and proposed roads in the annexation area and zones within the City that were undeveloped in the 2045 model were added to the transportation network. These new roads were either coded based on reference documents or assuming similar design standards to the 2045 network. Notable new roads and major upgrade to existing roads are summarized below:

- **Freeway**: Ray Gibbons Drive becomes an 8-lane Grade-separated Freeway with a speed limit of 100 kph within the expanded City Boundary.
- **Arterials**:
  - Fowler Way, a new 4-lane Arterial at 60 km/h connecting Villeneuve Road west of Ray Gibbon Drive and Neil Ross Road at Hogan Road.
  - A 2-lane extension of Hogan Road at 60 km/h from Villeneuve Road to Township Road 544.

- A new 4-lane east-west Arterial at 60 km/h connecting Township Road 543 at Range Road 261 to St. Albert Trail.
- A new 4-lane Arterial at 70 km/h extending 127 Street NW to Township Road 544 at St. Albert Trail.

- **Collectors:** Many new 2-lane Collectors at 40 kph service new development in the Annexation Area.

Roadway capacities within the Annexation Area were generalized based on classifications since intersection types and turn lanes were not established. The roadway capacities used in the updated road network are summarized in the table below.

Table 3.1: Roadway Capacities

Road Classification	Capacity (vehicles/hr/lane)
Freeway	1,600
Arterial	1,200
Collector	800

3.2.3 Transit Mode Split

Transit ridership for the 2045 model and ultimate model was calculated based on data from the 2015 Edmonton and Region Household Travel Survey (HTS). According to the HTS, transit accounted for one percent (1%) of all trips weekday daily trips completed within St. Albert (internal) and six percent (6%) between St. Albert and Edmonton. These percentages are based on an individual person's mode choice, and includes car driver, car passenger, walking, transit, school bus, cycling, and other. Transit trips are represented differently in the EMME travel demand models. The mode share is based on the PM peak hour rather than daily and the model only differentiates between vehicle and transit trips rather than the mode of an individual user. As such, the transit mode share in the context of the EMME travel demand models is the proportion of trips completed by transit rather than a personal vehicle.

The 2045 model transit share was previously calculated by converting the weekday daily transit mode share from the HTS to a PM Peak hour mode share between personal vehicles and transit. New routes were designed to ensure all new development areas in the 2045 model were connected to a bus route. As a result, the 2045 model has an overall PM peak hour transit mode split of 4.3% while transit mode share on St. Albert Trail for trips destined to or originating from Edmonton is 16.3%.

New transit routes serving the annexation area were not created in the ultimate travel demand model due to the high-level nature of this study. Instead, the trips generated from the annexation area were reduced by a factor that represents estimated proportion of trips completed using transit. St. Albert's Municipal Development Plan supports a shift to more sustainable transportation but does not provide a specific transit mode share target. The ultimate travel demand model assumes transit accounts for two percent (2%) of all individual daily internal St. Albert trips and six percent (6%) of all St. Albert trips. The mode share assumptions were determined through discussions with the City. The daily individual mode share rates were converted to PM peak hour vehicle trips using a similar methodology to the 2045 model, resulting in a PM peak hour transit mode split of 5.8% for all St. Albert Trips and 16.9% on St. Albert Trail.

The PM peak hour transit mode split for the travel demand model horizons are compared in the table below.

Table 3.2: Travel Demand Model Transit Mode Share Comparison

	2020	2045	2070
All Trips Transit Mode Percentage	4.2	4.3	5.8
Trips on St. Albert Trail into and out of Edmonton Transit Percentage	14.8	16.3	16.9

The 2070 model assumes that the City does not have LRT. St. Albert Trail remains a 6-lane Arterial at 60 kph.

3.3 Ultimate Road Network Performance

The 2070 PM peak hour traffic volumes on the roadway network were estimated using the EMME model, provided in Map 3.4. The volumes were then related to each road's capacity to calculate the volume to capacity (v/c) ratio, provided in Map 3.5. The v/c ratio is a typical performance measure for high-level network planning. It indicates traffic congestion based on the relationship between the actual traffic volumes on a road and the number of vehicles a lane can accommodate. A v/c ratio of 0 means no vehicles are using the road while a v/c ratio of 1.0 represents a lane or movement at full capacity and cannot accommodate additional traffic. The City's Traffic Impact Guidelines state that the maximum v/c ratio shall be 0.85 for the intersection overall, and 0.90 for any individual movement. The v/c ranges from the EMME model are defined in the table below.

Table 3.3: Volume-to-Capacity Ratio Ranges

Colour	v/c Ratio	Notes
Blue	0.60 – 0.70	Effective operations
Green	0.70 – 0.80	Effective operations
Yellow	0.80 – 0.90	At or near maximum performance thresholds
Orange	0.90 – 1.00	At or near capacity
Red	>1.00	Above capacity

The following is observed based on the 2070 PM peak hour traffic volume and v/c plots:

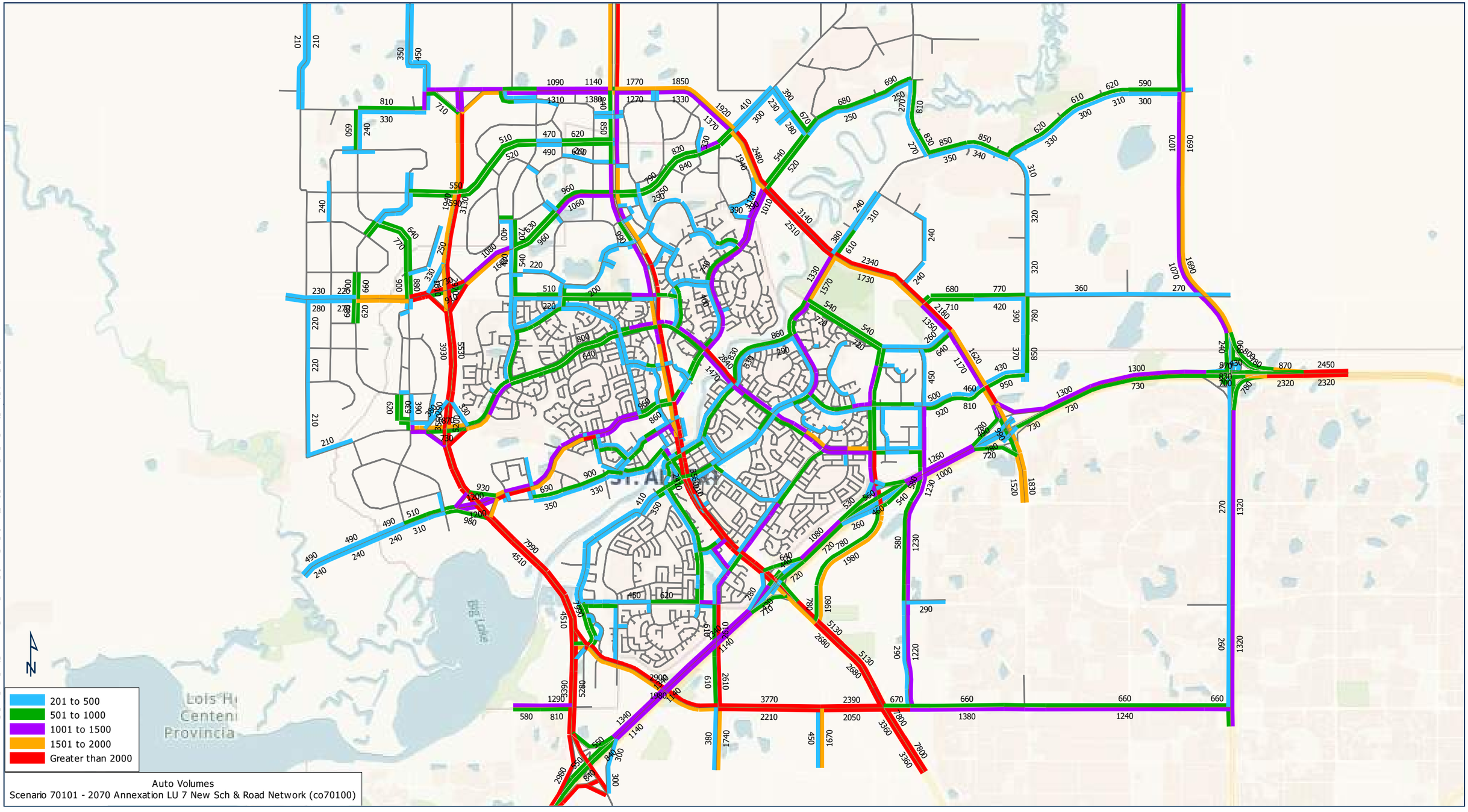
- The proposed roadway network within the annexation area is expected to operate well, with most roadways expected to have a v/c less than 0.6.
  - Some congestion is expected at the north-south neighbourhood collector west of Carrot Creek, however traffic volumes along the corridor remain below 1000 so no change in classification is recommended.
- Much of the City's primary north-south corridors are expected to be over capacity. This includes:
  - **Ray Gibbon Drive**: the northbound lanes are over capacity between McKenny Avenue and Anthony Henday Drive. Ray Gibbon Drive is ultimately classified as a freeway which implies a higher quality of service for drivers and less delay than a typical arterial road. The travel demand model results indicate that the corridor may not be able to operate as intended. The City may want to review the future for Ray Gibbon Drive to ensure sufficient capacity is provided, although options are limited as the corridor is already planned to be 8-lanes.

- **127 Street:** between Sturgeon Road and Old Coal Mine Road. This is likely not due to traffic from the northwest annexation area as St. Albert Trail and Ray Gibbon Drive provide much more convenient routes to most of the area.
- **St. Albert Trail:** The six lanes on St. Albert Trail appears to be able to accommodate the expected traffic along most of the corridor, however this may be a result of the built capacity rather than sufficient capacity. It is possible that trips were diverted to other routes as St. Albert Trail reached capacity. This may be one of the reasons Ray Gibbon Drive is expected to be over capacity in the ultimate scenario.

- The three new Carrot Creek crossings in the northwest appear to be sufficient in the PM peak hour, as the v/c ratios on those roadways are 0.6 or less.
  - The proposed new crossing connecting to the Cherot neighbourhood appears to be underutilized during the PM peak hour with less than 200 trips per direction. This indicates that a crossing may not be needed at this location based on vehicle demand alone; the true value of this crossing would be increased connectivity. The Cherot crossing adds redundancy to the network which can protect against emergency response delays due to congestion or a train blocking the Old McKenny Avenue connection. The proposed bridge also reduces the travel distance between the western employment area and the Sturgeon Community Hospital.
- Two lanes appear to be sufficient for most of the proposed east-west crosstown roadways within the northwest annexation area. Most of these roadways have a v/c less than 0.6 and expected PM peak hour traffic less than 500. This can easily be accommodated by a two-lane road given an assumed 1200 vehicle capacity per lane per hour. It is recommended that four-lane segments on the east-west arterials be maintained directly west of Ray Gibbon Drive where traffic volumes may exceed 1200 during the PM peak hour.
- A significant portion of Anthony Henday Drive is over capacity. It should be noted that, since Anthony Henday Drive is outside the City boundary, the model does not reflect real-world traffic condition on this facility. As such, traffic movements related to Anthony Henday Drive may not be accurate.

The proposed roadway network map has been updated based on the ultimate travel demand model outputs. The recommended roadway network is provided in Map 3.6.

The modeling results show that, while the annexation area is expected to operate well with the proposed roadway network, the future network does not seem to provide sufficient north-south capacity to meet the vehicle demand. Options to increase roadway capacity is limited as right-of-way along St. Albert Trail is limited, and Ray Gibbon Drive is already planned to be an eight-lane freeway. A large portion of the City's population works outside of St. Albert and use the north-south corridors in their daily commute. Shifting some of these commuters to transit riders would alleviate the expected congestion issues. It is recommended the City review options to increase future commuter transit ridership.



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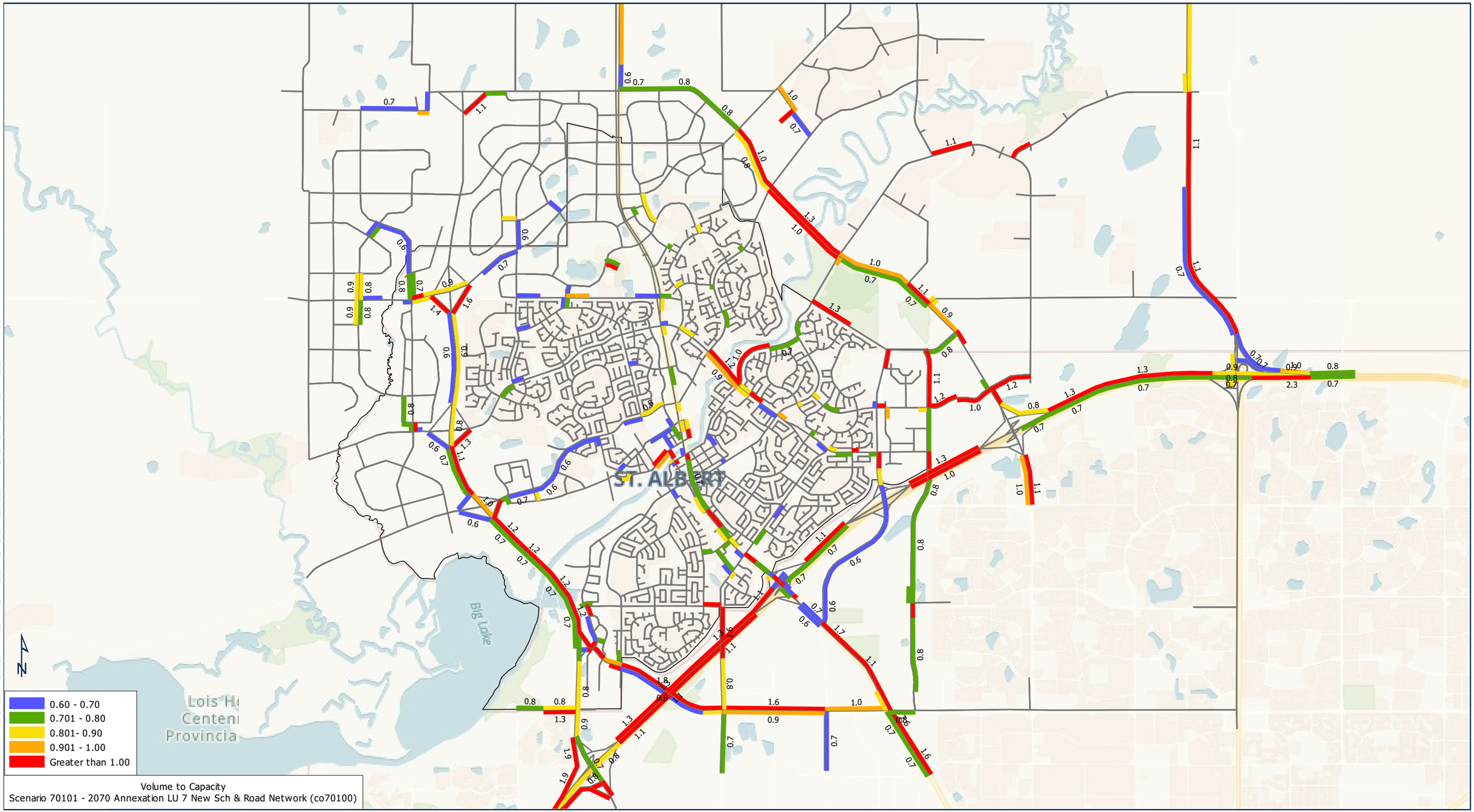
NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 3.4:
Full Buildout (2070) PM Peak Hour Traffic Volumes



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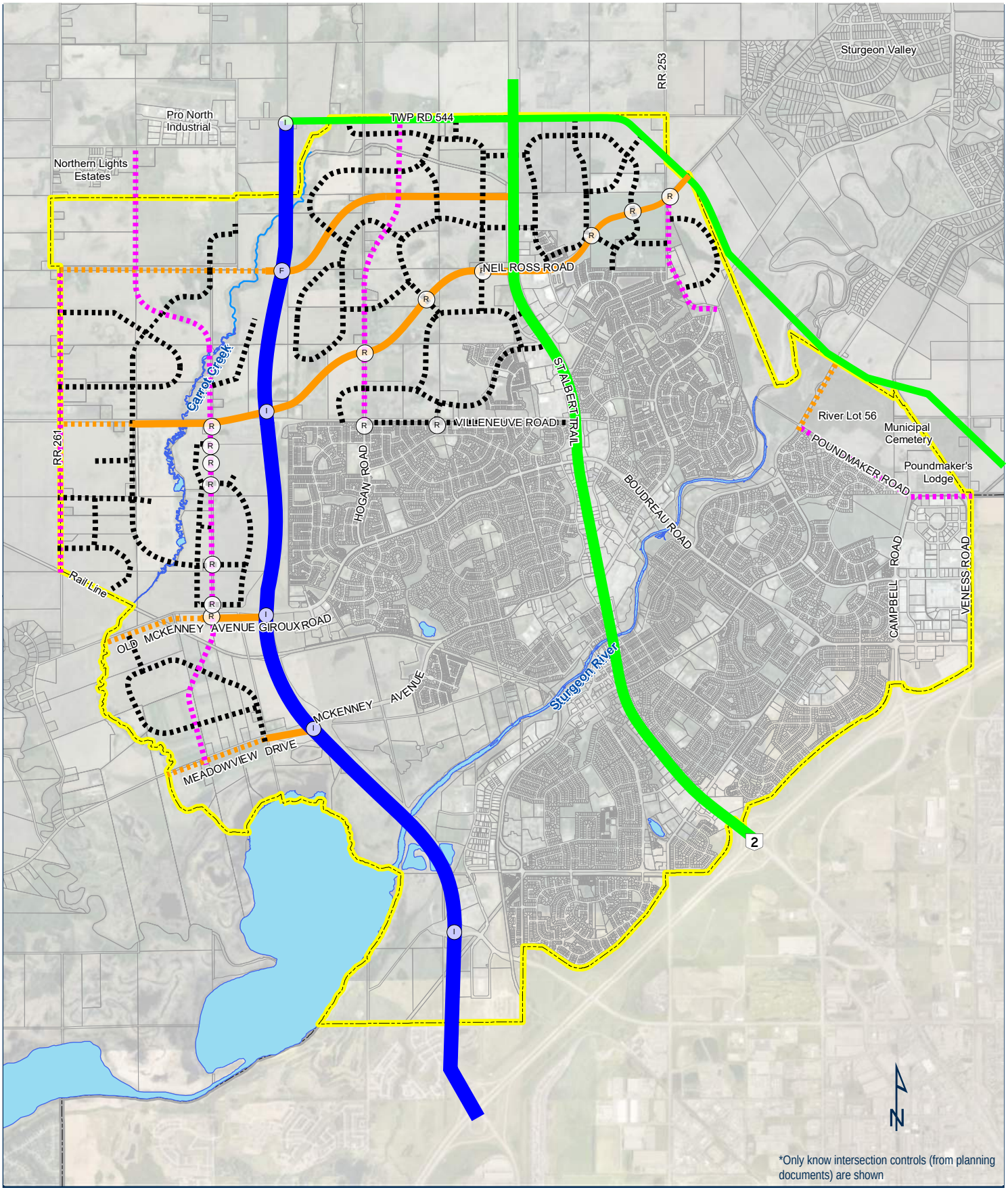
NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 3.5:
Full Buildout (2070) PM Peak Hour Volume to Capacity Ratios



City of St. Albert Cultivate Life

Municipal Boundary
City Boundary
Northwest Annexation Area
Northeast Annexation Area
Parcel

Watercourse
Water Body
Roundabout
Interchange
Fly-over

Freeway
Boulevard (Arterial)
Connector (Arterial)
Crosstown (Arterial)
Neighbourhood (Collector)

Eight Lanes
Six Lanes
Four Lanes
Two Lanes

0 0.2 0.4 0.8 1.2 1.6 km

3TM114-83 1:55,000

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

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 3.6: RECOMMENDED ROADWAY NETWORK

3.4 Conclusion and Recommendations

The following is concluded based on the travel demand modeling results:

- Overall, the recommended annexation area roadway network appears to be able to support the expected 2070 traffic during the PM peak hour. The capacity analysis indicated that most of the area would be sufficiently supported with two-lane arterial roads and the recommended roadway network has subsequently been updated.
- High congestion levels are expected on the City's north-south corridors, specifically Ray Gibbon Drive, St. Albert Trail, and 127 Street.
- The proposed Carrot Creek crossing at the Cherot neighbourhood does not appear to be warranted based on traffic demand alone; however, it provides redundancy to the network which may be valuable for emergency response.

The following is recommended based on the travel demand analysis:

- The City implement the recommended annexation area roadway network into future transportation plans.
  - Modifications to the roadway alignments may be made to suit future development. It is recommended that the City maintain certain characteristics of the proposed roadway network, such as arterial and collector spacing, number of lanes, and speed limits unless analysis finds these characteristics will not meet the future needs of the area.

3.5 Areas of Further Study

This review identified the following areas for further study:

- Ways to increase transit ridership, particularly for commuters. Increased transit ridership will reduce the demand on over-capacity corridors.
- The City consider completing additional study of the highly congested corridors noted in this study, including Ray Gibbon Drive, St. Albert Trail and 127 Street.

4.0 Wastewater

4.1 Introduction

The wastewater assessment focuses on the Northwest Annexation Area. As the Northeast Annexation Area and the northeast part of the Northwest Annexation Area will be serviced through the Erin Ridge North Pump Station, this study focuses on the lands that will not be serviced through this pump station. The key objectives for the wastewater part of the study include:

- Developing a preferred wastewater servicing concept for the remainder of the Northwest Annexation Area (i.e., not serviced to Erin Ridge North)
- Defining the service area boundary between the Erin Ridge North Pump Station and the North Interceptor Trunk (NIT)
- Determining if the lands east of Carrot Creek should be serviced through the existing Avenir Neighbourhood or through a separate trunk west of Carrot Creek
- Analyzing the NIT to confirm its capability to service the Northwest Annexation Area.

4.2 Existing Wastewater Collection Network

The existing wastewater network in shown on **Map 4.1**, with sewers colour-coded by diameter. This map also illustrates the North Interceptor Trunk (NIT) and NIT orifices sizes.

The NIT was completed in 2020 through the north-central part of the City. It operates as a combination storage/conveyance facility that intercepts wastewater flows in the northwest part of the City and discharges them at a controlled rate to the Alberta Capital Region Wastewater Commission (ACRWC) St. Albert Pump Station (SAPS). The upstream NIT will be used as a service connection for the Northwest Annexation Area. To date minimal wastewater planning has been carried out for the Northwest Annexation Area west of Carrot Creek.

Table 4.1 summarizes key design information regarding the NIT.

Table 4.1: North Interceptor Trunk Design Information

Property		Value
Diameter (mm)		1,200
Total Length (m)		8,510
Orifice Sizes (mm)	1	240
	2	240
	3	220
	4	250
	5	390
	6	375
	7	325

Notes:

1. Total length estimated from southeast of the intersection of Old McKenney Avenue and CN's Sangudo Subdivision Railway. The total length does not include the branch that extends north into Cherot/Avenir.

The existing SAPS has a capacity of 1,800 L/s but there are plans to upgrade the station to its ultimate capacity of 2,400 L/s. When evaluating the capacity of the existing system to convey the wastewater flow from the northwest annexation area, it is critical that the ultimate flow capacity at SAPS is not exceeded.

4.3 Design Standards

The City of St. Albert Municipal Engineering Standards and Implementation Strategy (May 2021) provides details on required sanitary servicing standards for new development. **Table 4.2** summarizes some of the relevant design standards used to develop sanitary servicing concepts for the northwest annexation area.

Table 4.2: Select City of St. Albert Sanitary Sewer Design Standards

Standard		Value
Generation Rate	Residential (L/c/d)	280
	ICI (L/ha/d)	6,170
Peaking Factor	Residential	$1 + \frac{14}{4 + P^{\frac{1}{2}}}$ where P = population in 1,000s
	ICI	≥ 3.0
Inflow/Infiltration (I/I)	General Allowance (L/s/ha)	0.28
	At Sag Manholes (L/s)	0.40
Required Sewer Capacity (L/s)		Design Flow / 0.86
Minimum Depth of Cover to Top of Pipe (m)		2.6
Maximum Manhole Spacing (m)		135

Notes:

1. ICI = Industrial, commercial and institutional development.

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Carrot Creek

750 mm

NEIL ROSS ROAD

1200 mm

900 mm

ST. ALBERT TRAIL

ST. ALBERT PUMP STATIONS (SAPS)

HOGAN ROAD

Sturgeon River

BOUDREAU ROAD

325 mm Orifice

1050 mm

1500 mm

675 mm

CAMPBELL ROAD

375 mm Orifice

250 mm Orifice

390 mm Orifice

1200 mm

1200 mm

900 mm

OLD MCKENNEY AVENUE

GIROUX ROAD

1,200 mm NORTH INTERCEPTOR TRUNK (NIT)

240 mm Orifice

240 mm Orifice

220 mm Orifice

MCKENNEY AVENUE

MEADOWVIEW DRIVE

N

Date: 2023-01-11 Document: J:\15100\15167_St_Albert_Growth_Study_Annexation\02_CAD\25_GIS\251_Figures\12_SC3_Engineering_Design_Brief\Map 4.1.mxd

City of St. Albert Cultivate Life

0 0.1 0.2 0.4 0.6 0.8 km

3TM114-83 1:30,000

- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Parcel
- Watercourse
- Water Body

- Sanitary Lift Station
- NIT Orifices

Sanitary Sewer

Diameter (mm)

- <= 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- > 600 mm

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 4.1:
EXISTING SANITARY SEWER SYSTEM IN ST. ALBERT AND NIT SYSTEM ORIFICES

4.4 Proposed Flow Generation

4.4.1 Annexation Area

Wastewater flows were estimated for the Northwest Annexation Area based on the land use projections in **Table 2.1** with the areas shown in **Map 2.2**.

To avoid an overly conservative wastewater plan, the City of St. Albert requested that a sensitivity analysis be carried out for a range of residential and non-residential (industrial, commercial and institutional) flow generation rates. The wastewater flow generation rates in the design standards (Table 4.2 above) are appropriate for local subdivision designs. However, when applied over several quarter sections of development, they are known to be overly conservative.

Table 4.3 summarizes a sensitivity analysis for residential and non-residential generation rates and how they impact the overall annexation area demand. Based on discussions with the City of St. Albert, available flow monitoring data and recent sanitary modelling calibration work completed in the I/I study, the City requested ISL project wastewater demands within the annexation area using the following generation rates:

- Residential Generation Rate: 200 L/c/d; and
- ICI Generation Rate: 7,400 L/ha/d.

Table 4.3: Generation Rate Sensitivity Analysis

Average Dry-Weather Flow (L/s) Sensitivity Analysis				
ICI Generation Rate (L/ha/d)	Residential Generation rates (L/c/d)			
	180	200	220	250
7,400	72.9	77.4	81.8	88.5
9,250	81.2	85.6	90.0	96.7
12,000	93.4	97.9	102.3	109.0
15,000	106.8	111.2	115.7	122.3

Based on the anticipated growth shown in **Section 2.0**, **Table 4.4** summarizes the sanitary sewer flow projections in average dry-weather flow (ADWF) for the northwest annexation area. It should be noted that the net developable employment area, net developable residential area and anticipated population shown below are based on the areas contributing to the northwest annexation area sewershed. Along the east edge of the annexation area are lands that are already part of the Erin Ridge North servicing area, thus, have not been duplicated. More specifically:

1. Off-Site Levy Areas 55, 60, 65 and 66 are serviced through the Erin Ridge North Service Area and will ultimately be serviced to the Erin Ridge North Sanitary Lift Station;
2. Off-Site Levy Areas 59, 64 and 77 are part of the Pump Station #4 Servicing Area (Erin Ridge North) and have potential to be diverted into the NW annexation area sewershed; and
3. Off-Site Levy Areas 76 and 78 are west of the Pump Station #4 Servicing Area (Erin Ridge North) and remain within the northwest annexation area sewershed.

Table 4.4: Annexation Area Sanitary Flow Projections

Analysis Area	Off-Site Levy Area Ref. No.	Employment Area (ndha)	Residential Area (ndha)	Pop. (c)	ADWF (L/s)
44	44	11.1	0.0	0	0.9
45	45	44.9	0.0	0	3.8
46	46	19.0	0.0	0	1.6
47	47	43.9	0.0	0	3.8
48	48	17.8	0.0	0	1.5
49	49	39.1	0.0	0	3.4
50	50	31.7	0.0	0	2.7
51	51	44.7	0.1	10	3.9
52	52	11.7	30.8	3,310	8.7
53	53	0.9	21.1	2,262	5.3
54	54	0.1	41.7	4,475	10.4
55	55	0.0	0.0	0	0.0
56	56	48.6	0.0	0	4.2
57	57	40.2	3.0	326	4.2
58	58	4.2	27.1	2,905	7.1
59	59	0.0	13.9	1,495	3.5
	78	0.0	21.4	2,295	5.3
60	60	0.0	0.0	0	0.0
64	64	0.0	16.7	1,794	4.2
	76	0.0	2.9	308	0.7
65	65	0.0	0.0	0	0.0
	77	26.9	0.0	0	2.3
66	66	0.0	0.0	0	0.0
TOTAL		**384.9**	**178.7**	**19,181**	**77.4**

4.4.2 Adjacent Development Areas

Adjacent development areas that have the potential to be serviced with the northwest annexation area to the NIT have had flow projections generated based on available background information from ASP documents, servicing studies and assumptions from the annexation area flow projection analysis. **Table 4.5** summarizes the ADWF from the adjacent development areas summarized in **Section 2.3**.

Table 4.5: Adjacent Development Area Sanitary Flow Projections

Area	Net Residential Area (ha)	Net Non-Residential Area (ha)	Total Net Area (ha)	ADWF (L/s)
Avenir	43.4	0.0	43.4	10.8
Avenir Amendment Lands	1.1	22.5	23.6	2.2
Northern Badger Lands	3.9	16.4	20.3	2.4
East Amendment Area	0.0	6.5	6.5	0.6

Notes:

1. Pump Station #4 servicing area has not been included in this table as its flow projections are included as part of the northwest annexation area flow projections.
2. Residential areas were projected into ADWF using an assumed lot density of 40 du/ha and an average household size of 2.68 c/du based on the analysis completed in **Section 2.0**.
3. Generation rates were assumed to be similar to the northwest annexation area (200 L/c/d and 7,400 L/ha/d).

4.5 North Interceptor Trunk Analysis

4.5.1 Introduction and Background

As previously mentioned, the NIT currently acts as a combination storage/conveyance facility that intercepts wastewater flows in the northwest part of the City and discharges them at a controlled rate to the Alberta Capital Region Wastewater Commission (ACRWC) St. Albert Pump Station (SAPS). The upstream NIT will be used as a service connection for the northwest annexation area. Of critical concern for wastewater servicing of the annexation area is refining the anticipated sewershed boundaries, calculating expected peak design flows and modelling the NIT to ensure there is sufficient capacity and storage for the annexation area west of Carrot Creek.

4.5.2 Discussion

The results of the NIT orifice optimization modelling is shown in **Appendix A**. **Figure 4.1** shows the peak hydraulic grade line (HGL) profiles from the upstream NIT (near CN's Sangudo Subdivision and Old McKenney Avenue at the left side of the profile) to the SAPS (right side of profile). The red HGL profile represents ultimate development of the pre-annexation area plus the northwest annexation area that connects to the NIT with the current orifice configurations. The blue HGL profiles is the same ultimate development but with the orifice opening optimized.

The profiles show that using the existing orifice configuration will result in excessive surcharging and flooding to the ground surface. By adjusting the orifice sizes, the peak HGL has been reduced to acceptable levels that do not risk significant surcharging or flooding of basements.

Additionally, several model simulations in **Appendix A** show that the increase in total flow to the SAPS is 1,707 L/s for the proposed orifice configuration which has been minimized and does not exceed the ultimate capacity 2,400 L/s.

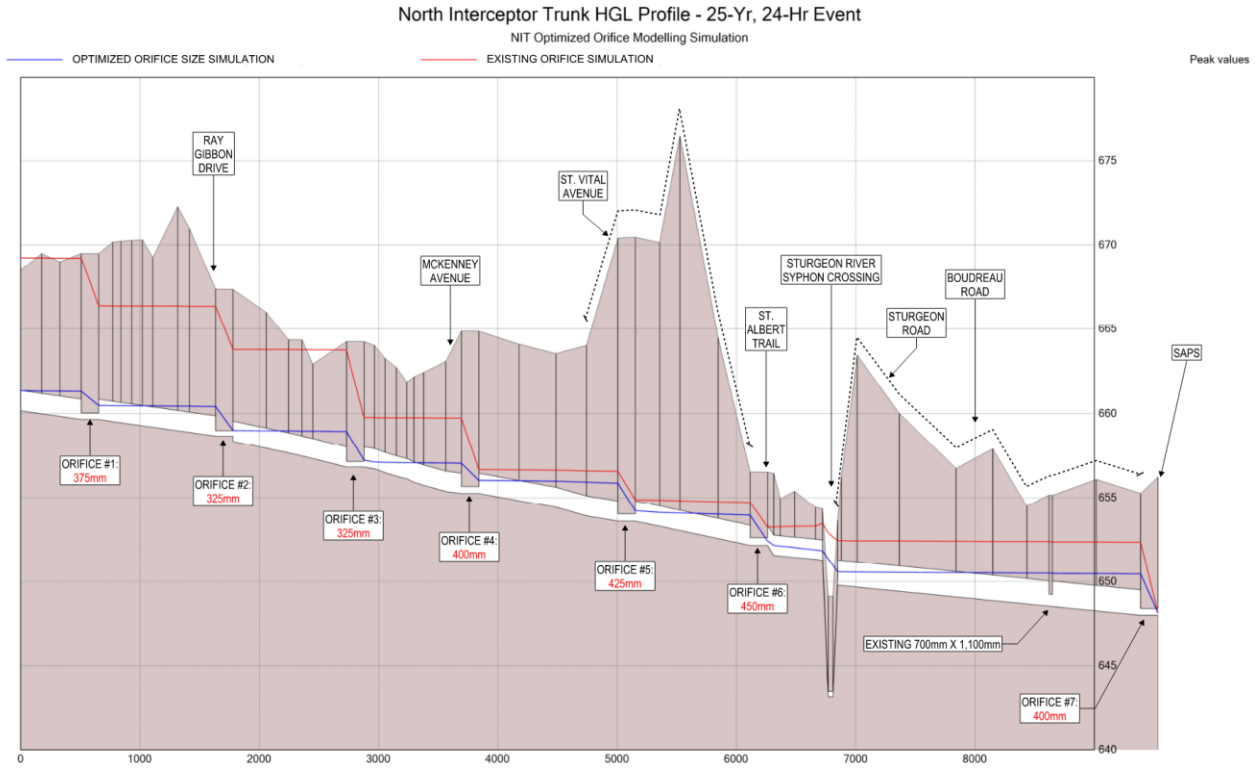

Figure 4.1: Optimized orifices modelling simulation – 25-year, 24-hour design event

The NIT modelling analysis showed that by altering the orifice sizes, the northwest annexation area can be serviced by the NIT without overwhelming the ultimate capacity at SAPS. Additionally, the adjacent development areas have been included which shows that the P.S. #4 service area from the Erin Ridge North Sanitary Lift Station Design Memorandum can be serviced by NIT if diverted south through the annexation area.

The final recommended orifice sizes for servicing of the northwest annexation area are summarized in **Table 4.6**.

Table 4.6: NIT Recommended Orifice Sizes

Orifice #	Location	Existing Size (mm)	Proposed Size (mm)
1	W of Rge Rd 255A along Railroad	240	375
2	E of Ray Gibbon Dr along Railroad	240	325
3	S of Legacy Terrace SWMF along Railroad	220	325
4	E of McKenney Avenue along Railroad	250	400
5	Intersection of Malmo Ave and St. Vital Ave	390	425
6	Intersection of St. Vital Ave and St. Albert Trail	375	450
7	At St. Albert Pump Station (SAPS)	325	400

4.6 On-Site Sanitary Sewer System Options

Two on-site wastewater servicing options were developed for the Northwest Annexation Area:

- Option 1 – Avenir Sub Trunk Oversized to Service Annexation Area East of Carrot Creek
- Option 2 – NW Annexation Area Serviced via Trunk West of Carrot Creek

Each of these options included two sub-options for how the north part of the Northeast Annexation Area east of Carrot Creek (Erin Ridge Pump Station #4 service area) will be serviced, either to the Erin Ridge North system (as current planned) or to the NIT through the Northwest Annexation Area. It should be noted that the diversion of the Erin Ridge Pump Station #4 service area into the Northwest Annexation Area will impact the design of the downstream Erin Ridge system and the off-site levy costs for the remaining benefitting areas within Erin Ridge.

It should be mentioned that the Pump Station #4 service area has been analyzed as being serviced fully by gravity to the south (as in this sub-Options 1A and 2A) or fully to the lift station eastwards (as in sub-Options 1B and 2B). It is possible that a portion of this service area be diverted south by gravity while the remaining area continues eastwards via Pump Station #4. In this scenario, it is likely that lands up to the hill could be serviced via gravity sewers southwards, while areas on the north side of the hill are more easily serviced through the Erin Ridge North network.

4.6.1 Option 1 – Avenir Sub Trunk Oversized to Service Annexation Area East of Carrot Creek

Sanitary Option 1 will involve oversizing a trunk within the Avenir development to convey flows from the northwest annexation area that is east of Carrot Creek. This provides flexibility in development since the area east of the creek will not require the west area to be serviced with trunk sewers first before it can develop. Areas east of the creek will include the Avenir ASP area, the Avenir ASP amendment area, the east amendment area (east of the Avenir ASP amendment area), Badger Lands North and the P.S. #4 service area from the Erin Ridge North Sanitary Lift Station Design Memorandum. The P.S. #4 area is included within Option 1A and is excluded from Option 1B to compare the difference in costs and sewer configuration to determine the feasibility of diverting this area away from the Erin Ridge North lift station.

On the west side of Carrot Creek are two sewers, one on the west edge of the annexation area and the other adjacent to Carrot Creek, that are required due to a ridge that bisects the annexation area west of the creek. Midway, these two sewers converge into one primary sanitary sewer trunk that follows the proposed road ROW along the quarter section line southwards. On the east side of Carrot Creek, the sewer trunk tends to align parallel to the Creek with branches that pick up sewershed areas to the east.

This option includes a lift station (1W Lift Station) at the southwest corner with a design flow of approximately 30 L/s and a 150 mm forcemain to the NIT. This lift station is required since the elevations are too low for a gravity sewer to cross Carrot Creek and still be able to get into the NIT. The service area for the 1W Lift Station includes only the two sewersheds that are serviced to 2W and to 1W directly. To minimize the service area of the lift station, the main trunk west of Carrot Creek will need to be diverted across Carrot Creek from manhole 3W to 2E by a syphon. This requires the trunk within Avenir to be oversized even further but will reduce the cost of the 1W lift station.

Option 1A – Service Area #5 Gravity Servicing through On-Site Annexation System

Option 1A includes the gravity servicing of the Pump Station #4 service area into the northwest annexation area sanitary sewer system. Option 1A is shown on **Maps 4.2** and **4.3** (north and south viewports). With the inclusion of Pump Station #4, the sewer depths within the east trunk are deepened by the long trunk extension that diverts around large hills within the service area. **Table 4.7** shows the detailed sewer design table for Option 1A.

Option 1B – Service Area #5 Lift Station and Forcemain Servicing to Erin Ridge North

Option 1B is similar to Option 1A except the gravity trunk servicing the P.S. #4 area has been removed since this area is assumed to be serviced through Erin Ridge North. As a result, the east side sewers and depths are shallower and require smaller sizes since the servicing area has decreased. See **Maps 4.4** and **4.5** for more details on the sewer alignment and sizing. **Table 4.8** shows the detailed sewer design table for Option 1B.

SEWERSHED AREAS SHOW NET DEVELOPABLE AREAS

OPTION 1A:
1. EAST SIDE SERVICED VIA OVERSIZED AVENIR SUB TRUNK

2. P.S. #4 SERVICE AREA INCLUDED IN ANNEXATION AREA SERVICING (DIVERTED SOUTH BY GRAVITY SEWERS)

Res. 0 ha ICI 12.6 ha
Res. 0 ha ICI 17.1 ha
Res. 2 ha ICI 17.1 ha
Res. 0 ha ICI 12.7 ha
Res. 0 ha ICI 12.1 ha
Res. 0.1 ha ICI 14.2 ha
Res. 8.1 ha ICI 1.1 ha
Res. 0 ha ICI 28.3 ha
Res. 11.5 ha ICI 6.3 ha
Res. 16.7 ha ICI 2.1 ha
Res. 2.7 ha ICI 21.9 ha
Res. 2.6 ha ICI 8.9 ha
Res. 0 ha ICI 12.5 ha
Res. 0 ha ICI 17.8 ha
Res. 0 ha ICI 31.4 ha
Res. 0 ha ICI 26.2 ha
Res. 7.4 ha ICI 0 ha
Res. 5.7 ha ICI 0 ha
Res. 5.2 ha ICI 0 ha
Res. 5.3 ha ICI 0 ha
Res. 6.8 ha ICI 0.6 ha
Res. 0 ha ICI 4.3 ha
Res. 0 ha ICI 9.5 ha
Res. 0.6 ha ICI 4 ha
Res. 0.5 ha ICI 9 ha
Res. 0 ha ICI 2.5 ha
Res. 5.7 ha ICI 9.8 ha
Res. 11.6 ha ICI 0 ha
Res. 0 ha ICI 12.8 ha
Res. 15.2 ha ICI 0 ha
Res. 12.9 ha ICI 0 ha
Res. 9.1 ha ICI 0 ha
Res. 0 ha ICI 4.2 ha
Res. 22.1 ha ICI 0 ha
Res. 8.4 ha ICI 0.1 ha
Res. 9.3 ha ICI 0 ha
Res. 3.9 ha ICI 16.4 ha

Carrot Creek
NEIL ROSS ROAD
ST. ALBERT TRAIL
ERLS
PS2

City of St. Albert — Cultivate Life

0 0.05 0.1 0.2 0.3 0.4 km

3TM114-83 1:15,000

- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Northeast Annexation Area
- Parcel
- Watercourse
- Water Body
- Proposed Road Concept
- Ray Gibbon Dr ROW
- Proposed Manholes

Proposed Sewers

- Gravity
- Forcemain
- Sewersheds
- Contours (2.5 m)
- Contours (0.5 m)
- Proposed Lift Station

Erin Ridge Development

- Proposed Node
- Proposed Lift Station
- Forcemain
- Gravity Sewer

Surrounding Areas

- Cherot / Avenir ASP Area
- Amendment Area
- East Amendment Area
- Badgerlands North
- NW Annexation (E of Carrot Creek)
- Erin Ridge Service Area
- P.S. #4 Service Area
- Sanitary Lift Station
- Sanitary Manhole
- Sewershed Connections

Existing Sewers

- <= 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- > 600 mm

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 4.2: SANITARY SEWER OPTION 1A NORTHSIDE VIEWPORT

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SEWERSHED AREAS SHOW NET DEVELOPABLE AREAS

OPTION 1A:
1. EAST SIDE SERVICED VIA OVERSIZED AVENIR SUB TRUNK

2. P.S. #4 SERVICE AREA INCLUDED IN ANNEXATION AREA SERVICING (DIVERTED SOUTH BY GRAVITY SEWERS)

PROPOSED 1W LIFT STATION (30 L/s CAP.)

Res. 2.7 ha ICI 21.9 ha
Res. 11.5 ha ICI 6.3 ha
Res. 16.7 ha ICI 2.1 ha
Res. 2.6 ha ICI 8.9 ha
Res. 0 ha ICI 12.5 ha
Res. 0 ha ICI 17.8 ha
Res. 0 ha ICI 31.4 ha
Res. 0 ha ICI 26.2 ha
Res. 0 ha ICI 30.7 ha
Res. 0 ha ICI 22.5 ha
Res. 0 ha ICI 27.2 ha
Res. 0 ha ICI 27 ha
Res. 0 ha ICI 9.5 ha
Res. 0 ha ICI 4.3 ha
Res. 0.6 ha ICI 4 ha
Res. 0.5 ha ICI 9 ha
Res. 0 ha ICI 2.5 ha
Res. 13.4 ha ICI 0 ha
Res. 15 ha ICI 0 ha
Res. 0.8 ha ICI 0.6 ha
Res. 8.4 ha ICI 0.1 ha
Res. 22.1 ha Res. ICI 0 ha 9.3 ha ICI 0 ha
Res. 3.9 ha ICI 16.4 ha

Carrot Creek
PS2
HOGAN ROAD
GIROUX ROAD
S.T. ALBERT TRAIL
OLD MCKENNEY AVENUE
N-INT-165
N-INT-150

City of St. Albert Cultivate Life

0 0.05 0.1 0.2 0.3 0.4 km

3TM114-83 1:15,000

- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Northeast Annexation Area
- Parcel
- Watercourse
- Water Body
- Proposed Road Concept
- Ray Gibbon Dr ROW
- Proposed Manholes

Proposed Sewers
- Gravity
- Forcemain
- Sewersheds

- Contours (2.5 m)
- Contours (0.5 m)
- Proposed Lift Station

Erin Ridge Development
- Proposed Node
- Proposed Lift Station
- Forcemain

- Gravity Sewer

Surrounding Areas
- Cherot / Avenir ASP Area
- Amendment Area
- East Amendment Area
- Badgerlands North
- NW Annexation (E of Carrot Creek)
- Erin Ridge Service Area
- P.S. #4 Service Area

- Sanitary Lift Station
- Sanitary Manhole
- Sewershed Connections

Existing Sewers
- <= 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- > 600 mm

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 4.3: SANITARY SEWER OPTION 1A SOUTHSIDE VIEWPORT

Date: 2023-01-11 Document: J:\15\100\15167_St. Albert_Growth_Study_Annexation\02_CAD\26_GIS\251_Figures\12_SC3_Engineering_Design_Brief\Map 4.3.mxd

SEWERSHED AREAS SHOW NET DEVELOPABLE AREAS

OPTION 1B:
1. EAST SIDE SERVICED VIA OVERSIZED AVENIR SUB TRUNK

2. P.S. #4 SERVICE AREA EXCLUDED FROM ANNEXATION AREA SERVICING (SERVICED EASTWARDS BY P.S. #4)

Res. 0 ha ICI 12.6 ha
Res. 0 ha ICI 17.1 ha
Res. 2 ha ICI 17.1 ha
Res. 5.7 ha ICI 9.8 ha
Res. 0 ha ICI 12.8 ha
Res. 11.6 ha ICI 0 ha
Res. 5.7 ha ICI 0 ha
Res. 15.2 ha ICI 0 ha
Res. 0 ha ICI 12.7 ha
Res. 0 ha ICI 12.1 ha
Res. 0.1 ha ICI 14.2 ha
Res. 8.1 ha ICI 1.1 ha
Res. 5.2 ha ICI 0 ha
Res. 5.3 ha ICI 0 ha
Res. 12.9 ha ICI 0 ha
Res. 9.1 ha ICI 0 ha
Res. 22.1 ha ICI 0 ha
Res. 7.4 ha ICI 0 ha
Res. 0 ha ICI 28.3 ha
Res. 11.5 ha ICI 6.3 ha
Res. 16.7 ha ICI 2.1 ha
Res. 5 ha ICI 0 ha
Res. 2.7 ha ICI 21.9 ha
Res. 6.8 ha ICI 0.6 ha
Res. 8.4 ha ICI 0.1 ha
Res. 9.3 ha ICI 0 ha
Res. 2.6 ha ICI 8.9 ha
Res. 0 ha ICI 12.5 ha
Res. 0 ha ICI 9.5 ha
Res. 0 ha ICI 4.3 ha
Res. 3.9 ha ICI 16.4 ha
Res. 0 ha ICI 17.8 ha
Res. 0 ha ICI 31.4 ha
Res. 0 ha ICI 26.2 ha
Res. 0.6 ha ICI 4 ha
Res. 0.5 ha ICI 9 ha
Res. 0 ha ICI 2.5 ha

PS4
PS2
ERLS
Carrot Creek
NEIL ROSS ROAD
ST. ALBERT TRAIL

City of St. Albert — Cultivate Life

0 0.05 0.1 0.2 0.3 0.4 km

3TM114-83 1:15,000

- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Northeast Annexation Area
- Parcel
- Watercourse
- Water Body
- Proposed Road Concept
- Ray Gibbon Dr ROW
- P.S. #4 Manholes to Erin Ridge
- P.S. #4 Sewers to Erin Ridge

Proposed Sewers

- Gravity
- Forcemain
- Proposed Lift Station
- Sewersheds

Erin Ridge Development

- Proposed Node
- Proposed Lift Station
- Forcemain
- Gravity Sewer
- Contours (2.5 m)
- Contours (0.5 m)

Surrounding Areas

- Cherot / Avenir ASP Area
- Amendment Area
- East Amendment Area
- Badgerlands North
- NW Annexation (E of Carrot Creek)
- Erin Ridge Service Area
- P.S. #4 Service Area
- Sanitary Lift Station
- Sanitary Manhole
- Sewershed Connections

Existing Sewers

- <= 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- > 600 mm

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 4.4: SANITARY SEWER OPTION 1B NORTHSIDE VIEWPORT

Date: 2023-01-11 Document: J:\15\10\15167_St_Albert_Growth_Study_Annexation\02_CAD\25_GIS\251_Figures\12_SC3_Engineering_Design_Briefs\Map 4.4.mxd

SEWERSHED AREAS SHOW NET DEVELOPABLE AREAS

OPTION 1B:
1. EAST SIDE SERVICED VIA OVERSIZED AVENIR SUB TRUNK

2. P.S. #4 SERVICE AREA EXCLUDED FROM ANNEXATION AREA SERVICING (SERVICED EASTWARDS BY P.S. #4)

PROPOSED 1W LIFT STATION (30 L/s CAP.)

Res. 2.7 ha ICI 21.9 ha
Res. 11.5 ha ICI 6.3 ha
Res. 16.7 ha ICI 2.1 ha
Res. 2.6 ha ICI 8.9 ha
Res. 0 ha ICI 12.5 ha
Res. 0 ha ICI 17.8 ha
Res. 0 ha ICI 31.4 ha
Res. 0 ha ICI 26.2 ha
Res. 0 ha ICI 30.7 ha
Res. 0 ha ICI 22.5 ha
Res. 0 ha ICI 27.2 ha
Res. 0 ha ICI 27 ha
Res. 0 ha ICI 9.5 ha
Res. 0 ha ICI 4.3 ha
Res. 0.6 ha ICI 4 ha
Res. 0.5 ha ICI 9 ha
Res. 0 ha ICI 2.5 ha
Res. 13.4 ha ICI 0 ha
Res. 15 ha CI 0 ha
Res. 6.8 ha ICI 0.6 ha
Res. 8.4 ha ICI 0.1 ha
Res. 22.1 ha Res. ICI 0 ha 9.3 ha ICI 0 ha
Res. 3.9 ha ICI 16.4 ha

Carrot Creek
HOGAN ROAD
GIROUX ROAD
OLD MCKENNEY AVENUE
ST. ALBERT TRAIL
PS2

16W 15W 11E 9E 8E 9W 8W 7W 7E 6W 6E 5W 5E 4W 4E 3W 3E 2W 2E 1W 1E
N-INT-165 N-INT-150

375 mm 450 mm 525 mm 600 mm 675 mm 900 mm 1200 mm 250 mm 400 mm

N

0 0.05 0.1 0.2 0.3 0.4 km

3TM114-83 1:15,000

- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Northeast Annexation Area
- Parcel
- Watercourse
- Water Body
- Proposed Road Concept
- Ray Gibbon Dr ROW
- P.S. #4 Manholes to Erin Ridge
- P.S. #4 Sewers to Erin Ridge

Proposed Sewers

- Gravity
- Forcemain
- Proposed Lift Station
- Sewersheds

Erin Ridge Development

- Proposed Node
- Proposed Lift Station
- Forcemain
- Gravity Sewer
- Contours (2.5 m)
- Contours (0.5 m)

Surrounding Areas

- Cherot / Avenir ASP Area
- Amendment Area
- East Amendment Area
- Badgerlands North
- NW Annexation (E of Carrot Creek)
- Erin Ridge Service Area
- P.S. #4 Service Area
- Sanitary Lift Station
- Sanitary Manhole
- Sewershed Connections

Existing Sewers

- <= 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- > 600 mm

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 4.5: SANITARY SEWER OPTION 1B SOUTHSIDE VIEWPORT

Date: 2023-01-11 Document: J:\15100\15167_St_Albert_Growth_Study_Annexation\02_CAD\05_GIS\35_Figures\12_SC3_Engineering_Design_Briefs\Map 4.5.mxd

Table 4.7 - Sanitary Sewer Flow Calculations and Sewer Design

Project: 15167 - St. Albert NW Annexation Area Engineering Design Brief
Client: City of St. Albert
Date: 2022-10-11
Scenario: Option 1A - Avenir Trunk with P.S. #4 Service Area Included

ISL Engineering and Land Services

Nodes		Residential Peak DWF						Non-Residential Flows					I/I		Design Flows		Sewer Design						Sewer Layout						
								Non-Res Area		Non-Res Peak DWF													Ground Elevation		Invert Elevation			Depth of Cover to Invert	
U/S Node	D/S Node	Added Area	Cumulative Total Res Area	Cumulative Design Pop	Cumulative Average Flow	Pf	Cumulative Peak Flow	Added Area	Cumulative Total Non-Res Area	Total Average Non-Res Flow	Pf	Cumulative Peak Flow	Total Area	Cumulative Total I/I Allowance	Cumulative Total Peak Flow	**Qdesign (86% Full)**	Length of Pipe	Pipe Diameter	Slope	Pipe Capacity	Velocity (0.6 - 3.0 m/s)	Design Capacity/Pipe Capacity	U/S Node	D/S Node	U/S End	D/S End	Invert Drop Across D/S Node	U/S Node	D/S Node
		(ha)	(ha)	(persons)	(L/s)		(L/s)	(ha)	(ha)	(L/s)		(L/s)	(ha)	(L/s)	(L/s)	**(L/s)**	(m)	(mm)	(%)	(L/s)	(m/s)	(%)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
14W	13W	0.00	0.00	0	0.0	4.5	0.0	12.59	12.59	1.1	3.0	3.2	12.59	3.5	7	**8**	363	250	0.40	38	0.77	20.9	686.00	684.89	680.54	679.09	0.050	5.46	5.81
13W	11W	0.00	0.00	0	0.0	4.5	0.0	12.69	25.28	2.2	3.0	6.5	25.28	7.1	14	**16**	321	300	0.22	45	0.64	34.8	684.89	686.00	679.04	678.33	0.050	5.86	7.67
12W	11W	0.00	0.00	0	0.0	4.5	0.0	17.12	17.12	1.5	3.0	4.4	17.12	4.8	9	**11**	365	250	0.40	38	0.77	28.4	687.07	686.00	682.87	681.41	0.050	4.20	4.59
11W	10W	0.00	0.00	0	0.0	4.5	0.0	12.13	54.52	4.7	3.0	14.0	54.52	15.3	29	**34**	456	300	0.22	45	0.64	75.1	686.00	683.54	678.28	677.28	0.075	7.72	6.26
10W	9W	0.02	0.02	2	0.0	4.5	0.0	28.28	82.80	7.1	3.0	21.3	82.82	23.2	44	**52**	394	375	0.15	68	0.61	76.2	683.54	682.99	677.20	676.61	0.075	6.33	6.38
9W	8W	2.68	2.70	290	0.7	4.1	2.7	21.85	104.66	9.0	3.0	26.9	107.36	30.1	60	**69**	403	450	0.35	169	1.06	41.2	682.99	681.00	676.54	675.13	0.108	6.45	5.87
8W	7W	0.00	2.70	290	0.7	4.1	2.7	17.84	122.49	10.5	3.0	31.5	125.20	35.1	69	**81**	397	450	0.12	99	0.62	81.6	681.00	681.93	675.02	674.54	0.075	5.98	7.39
24W	23W	5.71	5.71	612	1.4	3.9	5.6	0.00	0.00	0.0	3.0	0.0	5.71	1.6	7	**8**	302	300	0.22	45	0.64	18.4	681.77	681.92	677.52	676.86	0.012	4.25	5.06
23W	19W	5.16	10.87	1,166	2.7	3.8	10.1	0.00	0.00	0.0	3.0	0.0	10.87	3.0	13	**15**	295	300	0.22	45	0.64	33.8	681.92	682.65	676.85	676.20	0.012	5.07	6.45
19W	18W	0.00	10.87	1,166	2.7	3.8	10.1	0.00	0.00	0.0	3.0	0.0	10.87	3.0	13	**15**	729	300	0.22	45	0.64	33.8	682.65	683.45	676.19	674.58	0.075	6.47	8.87
22W	20W	1.99	1.99	213	0.5	4.1	2.0	17.09	17.09	1.5	3.0	4.4	19.08	5.3	12	**14**	371	250	0.40	38	0.77	36.4	686.00	685.83	681.80	680.32	0.012	4.20	5.51
21W	20W	0.07	0.07	8	0.0	4.4	0.1	14.15	14.15	1.2	3.0	3.6	14.23	4.0	8	**9**	393	250	0.40	38	0.77	23.8	685.24	685.83	681.04	679.46	0.050	4.20	6.37
20W	18W	8.10	10.16	1,090	2.5	3.8	9.5	1.15	32.39	2.8	3.0	8.3	42.55	11.9	30	**35**	554	250	0.40	38	0.77	92.0	685.83	683.45	679.41	677.20	0.125	6.42	6.25
18W	16W	7.39	28.42	3,050	7.1	3.4	24.3	0.00	32.39	2.8	3.0	8.3	60.81	17.0	50	**58**	123	375	0.15	68	0.61	84.9	683.45	681.56	674.51	674.32	0.075	8.94	7.24
17W	16W	11.54	11.54	1,239	2.9	3.7	10.7	6.29	6.29	0.5	3.0	1.6	17.84	5.0	17	**20**	449	250	0.55	44	0.90	45.7	684.76	681.56	680.56	678.08	0.200	4.20	3.48
16W	15W	16.67	56.63	6,077	14.1	3.2	44.5	2.09	40.77	3.5	3.0	10.5	97.40	27.3	82	**96**	656	450	0.12	99	0.62	96.9	681.56	679.36	674.25	673.46	0.075	7.31	5.89
15W	7W	0.00	56.63	6,077	14.1	3.2	44.5	12.53	53.30	4.6	3.0	13.7	109.93	30.8	89	**103**	497	525	0.10	136	0.63	76.1	679.36	681.93	673.39	672.89	0.050	5.97	9.05
7W	6W	2.56	61.90	6,642	15.4	3.1	48.1	8.89	184.68	15.8	3.0	47.5	246.58	69.0	165	**191**	414	525	0.60	333	1.54	57.5	681.93	675.73	672.84	670.36	0.012	9.10	5.37
6W	5W	0.00	61.90	6,642	15.4	3.1	48.1	31.37	216.06	18.5	3.0	55.5	277.95	77.8	181	**211**	377	525	0.85	396	1.83	53.2	675.73	670.98	670.34	667.14	0.075	5.38	3.83
5W	4W	0.00	61.90	6,642	15.4	3.1	48.1	26.22	242.27	20.7	3.0	62.2	304.17	85.2	196	**227**	431	600	0.40	388	1.37	58.5	670.98	669.12	667.07	665.34	0.012	3.91	3.78
4W	3W	0.00	61.90	6,642	15.4	3.1	48.1	30.69	272.96	23.4	3.0	70.1	334.86	93.8	212	**247**	200	600	0.40	388	1.37	63.5	669.12	667.30	665.33	664.53	0.075	3.79	2.76
3W	2E	0.00	61.90	6,642	15.4	3.1	48.1	22.48	295.44	25.3	3.0	75.9	357.33	100.1	224	**261**	597	675	0.10	266	0.74	98.0	667.30	667.59	664.46	662.36	0.225	2.84	5.22
2W	1W	0.00	0.00	0	0.0	4.5	0.0	27.24	27.24	2.3	3.0	7.0	27.24	7.6	15	**17**	828	250	0.40	38	0.77	45.2	665.67	663.07	661.47	658.15	0.050	4.20	4.92
1W	Lift	0.00	0.00	0	0.0	4.5	0.0	26.99	54.24	4.6	3.0	13.9	54.24	15.2	29	**34**	10	300	0.22	45	0.64	74.7	663.07	663.07	658.10	658.08	0.012	4.97	4.99
20E	19E	5.69	5.69	610	1.4	3.9	5.6	9.82	9.82	0.8	3.0	2.5	15.51	4.3	12	**14**	401	300	0.22	45	0.64	31.8	682.36	683.42	678.86	677.98	0.050	3.50	5.43
19E	18E	0.00	5.69	610	1.4	3.9	5.6	12.85	22.67	1.9	3.0	5.8	28.35	7.9	19	**22**	94	300	0.22	45	0.64	49.5	683.42	683.83	677.93	677.72	0.012	5.48	6.10
18E	17E	11.55	17.24	1,850	4.3	3.6	15.5	0.00	22.67	1.9	3.0	5.8	39.90	11.2	32	**38**	761	300	0.22	45	0.64	83.2	683.83	683.12	677.71	676.04	0.075	6.12	7.09
17E	16E	15.22	32.45	3,483	8.1	3.4	27.3	0.00	22.67	1.9	3.0	5.8	55.12	15.4	49	**56**	256	375	0.15	68	0.61	83.2	683.12	682.62	675.96	675.58	0.075	7.16	7.04
16E	15E	12.86	45.32	4,863	11.3	3.3	36.7	0.00	22.67	1.9	3.0	5.8	67.98	19.0	62	**72**	178	450	0.12	99	0.62	72.4	682.62	683.02	675.50	675.29	0.050	7.12	7.73
15E	13E	9.10	54.42	5,840	13.5	3.2	43.0	0.00	22.67	1.9	3.0	5.8	77.08	21.6	70	**82**	326	450	0.12	99	0.62	82.9	683.02	682.32	675.24	674.85	0.050	7.78	7.47
14E	13E	5.32	5.32	571	1.3	3.9	5.2	0.00	0.00	0.0	3.0	0.0	5.32	1.5	7	**8**	297	250	0.40	38	0.77	20.7	679.78	682.32	676.28	675.09	0.200	3.50	7.23
13E	12E	0.00	59.74	6,411	14.8	3.1	46.6	0.00	22.67	1.9	3.0	5.8	82.41	23.1	76	**88**	264	450	0.12	99	0.62	88.9	682.32	681.05	674.80	674.48	0.012	7.52	6.56
12E	8E	4.95	64.70	6,942	16.1	3.1	50.0	0.00	22.67	1.9	3.0	5.8	87.36	24.5	80	**93**	401	450	0.12	99	0.62	94.5	681.05	682.01	674.47	673.99	0.150	6.57	8.02
10E	9E	22.05	22.05	2,367	5.5	3.5	19.3	0.00	0.00	0.0	3.0	0.0	22.05	6.2	26	**30**	559	250	0.40	38	0.77	78.8	685.79	685.24	681.59	679.35	0.125	4.20	5.89
11E	9E	9.33	9.33	1,002	2.3	3.8	8.8	0.04	0.04	0.0	3.0	0.0	9.37	2.6	11	**13**	528	250	0.40	38	0.77	35.4	685.91	685.24	681.71	679.60	0.125	4.20	5.64
9E	8E	8.37	39.76	4,267	9.9	3.3	32.7	0.15	0.18	0.0	3.0	0.0	39.94	11.2	44	**51**	459	375	0.15	68	0.61	75.2	685.24	682.01	679.22	678.54	0.225	6.01	3.47
8E	7E	6.75	111.21	11,934	27.6	2.9	79.5	0.62	23.46	2.0	3.0	6.0	134.67	37.7	123	**143**	840	600	0.10	194	0.69	73.8	682.01	679.43	673.84	673.00	0.050	8.17	6.43
7E	6E	0.00	111.21	11,934	27.6	2.9	79.5	13.76	37.23	3.2	3.0	9.6	148.44	41.6	131	**152**	297	600	0.50	434	1.54	35.0	679.43	675.69	672.95	671.47	0.012	6.48	4.22
6E	4E	4.45	115.66	12,412	28.7	2.9	82.2	27.85	65.08	5.6	3.0	16.7	180.74	50.6	150	**174**	483	600	0.80	549	1.94	31.7	675.69	670.70	671.46	667.59	0.050	4.23	3.11
5E	4E	0.55	0.55	59	0.1	4.3	0.6	3.98	3.98	0.3	3.0	1.0	4.54	1.3	3	**3**	195	250	0.40	38	0.77	8.9	672.23	670.70	668.30	667.52	0.350	3.93	3.18
4E	3E	0.00	116.21	12,471	28.9	2.9	82.5	0.00	69.06	5.9	3.0	17.7	185.28	51.9	152	**177**	248	600	0.70	514	1.82	34.4	670.70	668.93	667.17	665.43	0.050	3.53	3.50
3E	2E	13.37	129.59	13,906	32.2	2.8	90.5	0.00	69.06	5.9	3.0	17.7	198.65	55.6	164	**191**	624	600	0.30	336	1.19	56.7	668.93	667.59	665.38	663.51	0.300	3.55	4.07
2E	1E	14.96	206.45	22,154	51.3	2.6	133.7	0.00	364.50	31.2	3.0	93.7	570.95	159.9	387	**450**	912	900	0.10	572	0.90	78.7	667.59	668.23	662.14	661.22	0.050	5.45	7.00
1E	N-INT 165	14.96	221.40	23,759	55.0	2.6	141.8	0.00	364.50	31.2	3.0	93.7	585.90	164.1	399	**464**	164	900	0.10	572	0.90	81.1	668.23	667.73	661.17	661.01	0.300	7.05	6.72

Table 4.8 - Sanitary Sewer Flow Calculations and Sewer Design

Project: 15167 - St. Albert NW Annexation Area Engineering Design Brief
Client: City of St. Albert
Date: 2022-10-11
Scenario: Option 1B - Avenir Trunk with P.S. #4 Service Area Excluded

ISL Engineering and Land Services

Nodes		Residential Peak DWF						Non-Residential Flows					I/I		Design Flows		Sewer Design						Sewer Layout						
								Non-Res Area		Non-Res Peak DWF													Ground Elevation		Invert Elevation			Depth of Cover to Invert	
U/S Node	D/S Node	Added Area (ha)	Cumulative Total Res Area (ha)	Cumulative Design Pop (persons)	Cumulative Average Flow (L/s)	Pf	Cumulative Peak Flow (L/s)	Added Area (ha)	Cumulative Total Non-Res Area (ha)	Total Average Non-Res Flow (L/s)	Pf	Cumulative Peak Flow (L/s)	Total Area (ha)	Cumulative Total I/I Allowance (L/s)	Cumulative Total Peak Flow (L/s)	**Qdesign (86% Full) (L/s)**	Length of Pipe (m)	Pipe Diameter (mm)	Slope (%)	Pipe Capacity (L/s)	Velocity (0.6 - 3.0 m/s) (m/s)	Design Capacity/Pipe Capacity (%)	U/S Node (m)	D/S Node (m)	U/S End (m)	D/S End (m)	Invert Drop Across D/S Node (m)	U/S Node (m)	D/S Node (m)
14W	13W	0.00	0.00	0	0.0	4.5	0.0	12.59	12.59	1.1	3.0	3.2	12.59	3.5	7	**8**	363	250	0.40	38	0.77	20.9	686.00	684.89	680.54	679.09	0.050	5.46	5.81
13W	11W	0.00	0.00	0	0.0	4.5	0.0	12.69	25.28	2.2	3.0	6.5	25.28	7.1	14	**16**	321	300	0.22	45	0.64	34.8	684.89	686.00	679.04	678.33	0.050	5.86	7.67
12W	11W	0.00	0.00	0	0.0	4.5	0.0	17.12	17.12	1.5	3.0	4.4	17.12	4.8	9	**11**	365	250	0.40	38	0.77	28.4	687.07	686.00	682.87	681.41	0.050	4.20	4.59
11W	10W	0.00	0.00	0	0.0	4.5	0.0	12.13	54.52	4.7	3.0	14.0	54.52	15.3	29	**34**	456	300	0.22	45	0.64	75.1	686.00	683.54	678.28	677.28	0.075	7.72	6.26
10W	9W	0.02	0.02	2	0.0	4.5	0.0	28.28	82.80	7.1	3.0	21.3	82.82	23.2	44	**52**	394	375	0.15	68	0.61	76.2	683.54	682.99	677.20	676.61	0.075	6.33	6.38
9W	8W	2.68	2.70	290	0.7	4.1	2.7	21.85	104.66	9.0	3.0	26.9	107.36	30.1	60	**69**	403	450	0.35	169	1.06	41.2	682.99	681.00	676.54	675.13	0.108	6.45	5.87
8W	7W	0.00	2.70	290	0.7	4.1	2.7	17.84	122.49	10.5	3.0	31.5	125.20	35.1	69	**81**	397	450	0.12	99	0.62	81.6	681.00	681.93	675.02	674.54	0.075	5.98	7.39
24W	23W	5.71	5.71	612	1.4	3.9	5.6	0.00	0.00	0.0	3.0	0.0	5.71	1.6	7	**8**	302	300	0.22	45	0.64	18.4	681.77	681.92	677.52	676.86	0.012	4.25	5.06
23W	19W	5.16	10.87	1,166	2.7	3.8	10.1	0.00	0.00	0.0	3.0	0.0	10.87	3.0	13	**15**	295	300	0.22	45	0.64	33.8	681.92	682.65	676.85	676.20	0.012	5.07	6.45
19W	18W	0.00	10.87	1,166	2.7	3.8	10.1	0.00	0.00	0.0	3.0	0.0	10.87	3.0	13	**15**	729	300	0.22	45	0.64	33.8	682.65	683.45	676.19	674.58	0.075	6.47	8.87
22W	20W	1.99	1.99	213	0.5	4.1	2.0	17.09	17.09	1.5	3.0	4.4	19.08	5.3	12	**14**	371	250	0.40	38	0.77	36.4	686.00	685.83	681.80	680.32	0.012	4.20	5.51
21W	20W	0.07	0.07	8	0.0	4.4	0.1	14.15	14.15	1.2	3.0	3.6	14.23	4.0	8	**9**	393	250	0.40	38	0.77	23.8	685.24	685.83	681.04	679.46	0.050	4.20	6.37
20W	18W	8.10	10.16	1,090	2.5	3.8	9.5	1.15	32.39	2.8	3.0	8.3	42.55	11.9	30	**35**	554	250	0.40	38	0.77	92.0	685.83	683.45	679.41	677.20	0.125	6.42	6.25
18W	16W	7.39	28.42	3,050	7.1	3.4	24.3	0.00	32.39	2.8	3.0	8.3	60.81	17.0	50	**58**	123	375	0.15	68	0.61	84.9	683.45	681.56	674.51	674.32	0.075	8.94	7.24
17W	16W	11.54	11.54	1,239	2.9	3.7	10.7	6.29	6.29	0.5	3.0	1.6	17.84	5.0	17	**20**	449	250	0.55	44	0.90	45.7	684.76	681.56	680.56	678.08	0.200	4.20	3.48
16W	15W	16.67	56.63	6,077	14.1	3.2	44.5	2.09	40.77	3.5	3.0	10.5	97.40	27.3	82	**96**	656	450	0.12	99	0.62	96.9	681.56	679.36	674.25	673.46	0.075	7.31	5.89
15W	7W	0.00	56.63	6,077	14.1	3.2	44.5	12.53	53.30	4.6	3.0	13.7	109.93	30.8	89	**103**	497	525	0.10	136	0.63	76.1	679.36	681.93	673.39	672.89	0.050	5.97	9.05
7W	6W	2.56	61.90	6,642	15.4	3.1	48.1	8.89	184.68	15.8	3.0	47.5	246.58	69.0	165	**191**	414	525	0.60	333	1.54	57.5	681.93	675.73	672.84	670.36	0.012	9.10	5.37
6W	5W	0.00	61.90	6,642	15.4	3.1	48.1	31.37	216.06	18.5	3.0	55.5	277.95	77.8	181	**211**	377	525	0.85	396	1.83	53.2	675.73	670.98	670.34	667.14	0.075	5.38	3.83
5W	4W	0.00	61.90	6,642	15.4	3.1	48.1	26.22	242.27	20.7	3.0	62.2	304.17	85.2	196	**227**	431	600	0.40	388	1.37	58.5	670.98	669.12	667.07	665.34	0.012	3.91	3.78
4W	3W	0.00	61.90	6,642	15.4	3.1	48.1	30.69	272.96	23.4	3.0	70.1	334.86	93.8	212	**247**	200	600	0.40	388	1.37	63.5	669.12	667.30	665.33	664.53	0.075	3.79	2.76
3W	2E	0.00	61.90	6,642	15.4	3.1	48.1	22.48	295.44	25.3	3.0	75.9	357.33	100.1	224	**261**	597	675	0.10	266	0.74	98.0	667.30	667.59	664.46	662.36	0.225	2.84	5.22
2W	1W	0.00	0.00	0	0.0	4.5	0.0	27.24	27.24	2.3	3.0	7.0	27.24	7.6	15	**17**	828	250	0.40	38	0.77	45.2	665.67	663.07	661.47	658.15	0.050	4.20	4.92
1W	Lift Station	0.00	0.00	0	0.0	4.5	0.0	26.99	54.24	4.6	3.0	13.9	54.24	15.2	29	**34**	10	300	0.22	45	0.64	74.7	663.07	663.07	658.10	658.08	0.012	4.97	4.99
20E	19E	5.69	5.69	610	1.4	3.9	5.6	9.82	9.82	0.8	3.0	2.5	15.51	4.3	12	**14**	401	300	0.22	45	0.64	31.8	682.36	683.42	678.86	677.98	0.050	3.50	5.43
19E	18E	0.00	5.69	610	1.4	3.9	5.6	12.85	22.67	1.9	3.0	5.8	28.35	7.9	19	**22**	94	300	0.22	45	0.64	49.5	683.42	683.83	677.93	677.72	0.012	5.48	6.10
17E	18E	26.77	26.77	2,872	6.6	3.5	23.0	0.00	0.00	0.0	3.0	0.0	26.77	7.5	30	**35**	761	300	0.22	45	0.64	78.2	683.12	683.83	678.87	677.20	0.050	4.25	6.63
16E	15E	12.86	12.86	1,380	3.2	3.7	11.8	0.00	0.00	0.0	3.0	0.0	12.86	3.6	15	**18**	178	300	0.22	45	0.64	39.6	682.62	683.02	678.37	677.98	0.050	4.25	5.04
15E	13E	9.10	21.96	2,357	5.5	3.5	19.3	0.00	0.00	0.0	3.0	0.0	21.96	6.1	25	**30**	326	300	0.22	45	0.64	65.1	683.02	682.32	677.93	677.21	0.075	5.09	5.11
14E	13E	5.32	5.32	571	1.3	3.9	5.2	0.00	0.00	0.0	3.0	0.0	5.32	1.5	7	**8**	297	250	0.40	38	0.77	20.7	679.78	682.32	676.28	675.09	0.125	3.50	7.23
13E	12E	0.00	27.29	2,928	6.8	3.5	23.4	0.00	0.00	0.0	3.0	0.0	27.29	7.6	31	**36**	264	375	0.15	68	0.61	53.1	682.32	681.05	674.97	674.57	0.012	7.35	6.47
12E	8E	4.95	32.24	3,460	8.0	3.4	27.1	0.00	0.00	0.0	3.0	0.0	32.24	9.0	36	**42**	401	375	0.15	68	0.61	61.9	681.05	682.01	674.56	673.96	0.075	6.49	8.05
10E	9E	22.05	22.05	2,367	5.5	3.5	19.3	0.00	0.00	0.0	3.0	0.0	22.05	6.2	26	**30**	559	250	0.40	38	0.77	78.8	685.79	685.24	681.59	679.35	0.125	4.20	5.89
11E	9E	9.33	9.33	1,002	2.3	3.8	8.8	0.04	0.04	0.0	3.0	0.0	9.37	2.6	11	**13**	528	250	0.40	38	0.77	35.4	685.91	685.24	681.71	679.60	0.125	4.20	5.64
9E	8E	8.37	39.76	4,267	9.9	3.3	32.7	0.15	0.18	0.0	3.0	0.0	39.94	11.2	44	**51**	459	375	0.15	68	0.61	75.2	685.24	682.01	679.22	678.54	0.075	6.01	3.47
8E	7E	6.75	78.76	8,451	19.6	3.0	59.2	0.62	0.80	0.1	3.0	0.2	79.55	22.3	82	**95**	840	450	0.12	99	0.62	96.2	682.01	679.43	673.88	672.87	0.050	8.13	6.55
7E	6E	0.00	78.76	8,451	19.6	3.0	59.2	13.76	14.56	1.2	3.0	3.7	93.32	26.1	89	**104**	297	450	0.50	202	1.27	51.4	679.43	675.69	672.82	671.34	0.012	6.60	4.35
6E	4E	4.45	83.21	8,929	20.7	3.0	62.1	27.85	42.41	3.6	3.0	10.9	125.62	35.2	108	**126**	483	450	0.80	255	1.60	49.3	675.69	670.70	671.33	667.47	0.075	4.36	3.24
5E	4E	0.55	0.55	59	0.1	4.3	0.6	3.98	3.98	0.3	3.0	1.0	4.54	1.3	3	**3**	195	250	0.40	38	0.77	8.9	672.23	670.70	668.30	667.52	0.275	3.93	3.18
4E	3E	0.00	83.76	8,988	20.8	3.0	62.4	0.00	46.40	4.0	3.0	11.9	130.16	36.4	111	**129**	248	525	0.70	360	1.66	35.8	670.70	668.93	667.25	665.51	0.050	3.46	3.42
3E	2E	13.37	97.13	10,423	24.1	2.9	70.9	0.00	46.40	4.0	3.0	11.9	143.53	40.2	123	**143**	624	525	0.30	236	1.09	60.7	668.93	667.59	665.46	663.59	0.375	3.47	4.00
2E	1E	14.96	173.99	18,671	43.2	2.7	115.9	0.00	341.83	29.3	3.0	87.8	515.83	144.4	348	**405**	912	900	0.10	572	0.90	70.7	667.59	668.23	662.14	661.22	0.050	5.45	7.00
1E	N-INT 165	14.96	188.95	20,276	46.9	2.6	124.2	0.00	341.83	29.3	3.0	87.8	530.78	148.6	361	**419**	164	900	0.10	572	0.90	73.3	668.23	667.73	661.17	661.01	0.300	7.05	6.72

4.6.2 Option 2 – NW Annexation Area Serviced via Trunk West of Carrot Creek

Option 2 foregoes upsizing the Avenir sub trunk and instead services the annexation area east of Carrot Creek across the creek and through the west side system. The major limitation of this option is that any development east of the creek and north of the Avenir amendment area will require a significant amount of off-site infrastructure that crosses Carrot Creek and conveys wastewater through the west side of the creek. This may hinder development in the area east of the creek until the west side is developed first.

The creek crossing from 8E to 16W was originally evaluated as a syphon crossing with the following details:

- The syphon crossing itself would need to be approximately 100 m in length to account for the elevation changes within the creek valley;
- The invert at 16W is approximately 0.1 m higher than the invert at 8E;
- The length of west-to-east sewer is just under 400 m and is estimated to be 450 – 600 mm in size depending on whether the P.S. #4 area is diverted south into the annexation area wastewater network;
- To achieve PWWF capacity requirements and the minimum PDWF self-cleansing velocity requirements, the syphon head needs to be at least 1.5 m using a 350 mm syphon diameter;
- To account for minimum pipe slopes and matching obverts, a total drop from 8E to 16W is calculated to be approximately 0.6 – 0.7 m;
- The total change in depth from 8E to 16W is approximately 2.2 – 2.3 m; and
- From 16W to N-INT-165 (just downstream from 1E), the total length of trunk sewer is 4,250 m which ranges in depth from 2.8 – 9.1 m which would need to be lowered to at least 5.1 – 11.4 m in depth.

The cost of lowering over 4 km of trunk sewer by 2.3 m will be significant. Additionally, the 2.3 m drop will cause the downstream Avenir trunk invert to be lower than the existing N-INT-165 invert implying a lift station would be required to lift the wastewater into the NIT. Thus, a lift station (8E-LS) is proposed for crossing Carrot Creek from Manholes 8E to 16W.

Similar to Option 1, a lift station at 1W is required to pump wastewater into the NIT where the elevations are too low after crossing Carrot Creek (30 L/s and 150 mm forcemain). To minimize the pump station service area, the sanitary sewer trunk was diverted eastwards across the creek through a syphon from manhole 3W to manhole 2E.

Option 2A – Service Area #5 Gravity Servicing through On-Site Annexation System

Option 2A includes the gravity servicing of the P.S. #4 service area into the northwest annexation area sanitary sewer system. Option 2A is shown on **Maps 4.6** and **4.7** (north and south viewports). With the inclusion of P.S. #4, the sewer depths within the east trunk are deepened by the long trunk extension that diverts around large hills within the service area. **Table 4.9** at the end of this section shows the detailed sewer design table for Option 2A. The proposed 8E-LS has a design capacity of 125 L/s with a proposed 300 mm forcemain crossing Carrot Creek.

Option 2B – Service Area #5 Lift Station and Forcemain Servicing through to Erin Ridge North

Option 2B excludes the gravity servicing of the P.S. #4 service area into the northwest annexation area sanitary sewer system. Option 2B is shown on **Maps 4.8** and **4.9** (north and south viewports). **Table 4.10** shows the detailed sewer design table for Option 2A. The proposed 8E-LS has a design capacity of 85 L/s with a proposed 250 mm forcemain crossing Carrot Creek.

SEWERSHED AREAS SHOW NET DEVELOPABLE AREAS

OPTION 2A:
1. EAST SIDE SERVICED VIA WEST ANNEXATION AREA TRUNK

2. P.S. #4 SERVICE AREA INCLUDED IN ANNEXATION AREA SERVICING (DIVERTED SOUTH BY GRAVITY SEWERS)

Res. 0 ha ICI 12.6 ha
Res. 0 ha ICI 17.1 ha
Res. 2 ha ICI 17.1 ha
Res. 0 ha ICI 12.7 ha
Res. 0 ha ICI 12.1 ha
Res. 0.1 ha ICI 14.2 ha
Res. 8.1 ha ICI 1.1 ha
Res. 0 ha ICI 28.3 ha
Res. 11.5 ha ICI 6.3 ha
Res. 7.4 ha ICI 0 ha
Res. 16.7 ha ICI 2.1 ha
Res. 2.7 ha ICI 21.9 ha
Res. 2.6 ha ICI 8.9 ha
Res. 0 ha ICI 17.8 ha
Res. 0 ha ICI 12.5 ha
Res. 0 ha ICI 31.4 ha
Res. 0 ha ICI 26.2 ha
Res. 0.6 ha ICI 4 ha
Res. 0.5 ha ICI 9 ha
Res. 0 ha ICI 2.5 ha
Res. 0 ha ICI 9.5 ha
Res. 0 ha ICI 4.3 ha
Res. 6.8 ha ICI 0.6 ha
Res. 3.9 ha ICI 16.4 ha
Res. 5.7 ha ICI 0 ha
Res. 5.2 ha ICI 0 ha
Res. 5.3 ha ICI 0 ha
Res. 9.1 ha ICI 0 ha
Res. 0 ha ICI 0 ha
Res. 5.7 ha ICI 9.8 ha
Res. 11.6 ha ICI 0 ha
Res. 0 ha ICI 12.8 ha
Res. 15.2 ha ICI 0 ha
Res. 12.9 ha ICI 0 ha
Res. 22.1 ha ICI 0 ha
Res. 8.4 ha ICI 0.1 ha
Res. 9.3 ha ICI 0 ha

PROPOSED 8E LIFT STATION (125 L/s CAP.)

8E-LS
PS2
ERLS
NEIL ROSS ROAD
ST. ALBERT TRAIL
Carrot Creek

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City of St. Albert Cultivate Life

0 0.05 0.1 0.2 0.3 0.4 km

3TM114-83 1:15,000

- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Northeast Annexation Area
- Parcel
- Watercourse
- Water Body
- Proposed Road Concept
- Ray Gibbon Dr ROW
- Proposed Manholes

Proposed Sewers

- Gravity
- Forcemain
- Sewersheds
- Contours (2.5 m)
- Contours (0.5 m)
- Proposed Lift Station

Erin Ridge Development

- Proposed Node
- Proposed Lift Station
- Forcemain
- Gravity Sewer

Surrounding Areas

- Cherot / Avenir ASP Area
- Amendment Area
- East Amendment Area
- Badgerlands North
- NW Annexation (E of Carrot Creek)
- Erin Ridge Service Area
- P.S. #4 Service Area
- Sanitary Lift Station
- Sanitary Manhole
- Sewershed Connections

Existing Sewers

- <= 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- > 600 mm

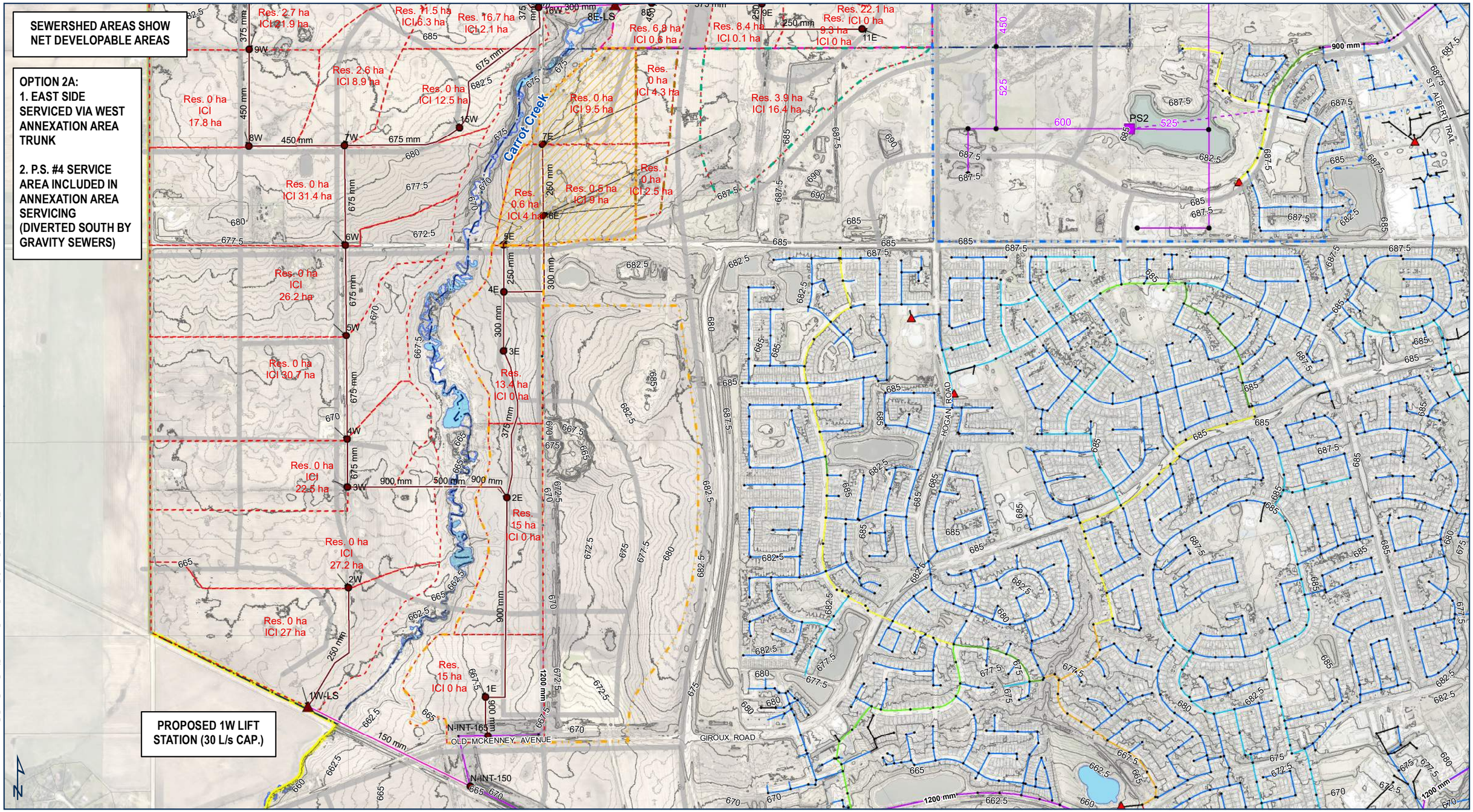
NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 4.6: SANITARY SEWER OPTION 2A NORTHSIDE VIEWPORT

SEWERSHED AREAS SHOW NET DEVELOPABLE AREAS

OPTION 2A:
1. EAST SIDE SERVICED VIA WEST ANNEXATION AREA TRUNK

2. P.S. #4 SERVICE AREA INCLUDED IN ANNEXATION AREA SERVICING (DIVERTED SOUTH BY GRAVITY SEWERS)



Municipal Boundary
City Boundary
Northwest Annexation Area
Northeast Annexation Area
Parcel
Watercourse
Water Body

Proposed Road Concept
Ray Gibbon Dr ROW
Proposed Manholes

Proposed Sewers
Gravity
Forcemain
Sewersheds

Contours (2.5 m)
Contours (0.5 m)
Proposed Lift Station

Erin Ridge Development
Proposed Node
Proposed Lift Station
Forcemain

Gravity Sewer

Surrounding Areas
Cherot / Avenir ASP Area
Amendment Area
East Amendment Area

Badgerlands North
NW Annexation (E of Carrot Creek)
Erin Ridge Service Area
P.S. #4 Service Area

Sanitary Lift Station
Sanitary Manhole
Sewershed Connections

Existing Sewers
<= 150 mm
200 mm
250 mm

300 mm
375 mm
450 mm
525 mm
600 mm
> 600 mm

0 0.05 0.1 0.2 0.3 0.4 km

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NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 4.7: SANITARY SEWER OPTION 2A SOUTHSIDE VIEWPORT

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SEWERSHED AREAS SHOW NET DEVELOPABLE AREAS

OPTION 2B:
1. EAST SIDE SERVICED VIA WEST ANNEXATION AREA TRUNK

2. P.S. #4 SERVICE AREA EXCLUDED FROM ANNEXATION AREA SERVICING (SERVICED EASTWARDS BY P.S. #4)

PROPOSED 8E LIFT STATION (85 L/s CAP.)

Res. 0 ha ICI 12.6 ha
Res. 0 ha ICI 17.1 ha
Res. 2 ha ICI 17.1 ha
Res. 0 ha ICI 12.7 ha
Res. 0 ha ICI 12.1 ha
Res. 0.1 ha ICI 14.2 ha
Res. 8.1 ha ICI 1.1 ha
Res. 5.7 ha ICI 0 ha
Res. 5.2 ha ICI 0 ha
Res. 5.3 ha ICI 0 ha
Res. 5.7 ha ICI 9.8 ha
Res. 11.6 ha ICI 0 ha
Res. 0 ha ICI 12.8 ha
Res. 15.2 ha ICI 0 ha
Res. 12.9 ha ICI 0 ha
Res. 9.1 ha ICI 0 ha
Res. 22.1 ha ICI 0 ha
Res. 7.4 ha ICI 0 ha
Res. 0 ha ICI 28.3 ha
Res. 11.5 ha ICI 6.3 ha
Res. 16.7 ha ICI 2.1 ha
Res. 5 ha ICI 0 ha
Res. 2.7 ha ICI 21.9 ha
Res. 2.6 ha ICI 8.9 ha
Res. 0 ha ICI 17.8 ha
Res. 0 ha ICI 12.5 ha
Res. 0 ha ICI 31.4 ha
Res. 0 ha ICI 26.2 ha
Res. 0.6 ha ICI 4 ha
Res. 0.5 ha ICI 9 ha
Res. 0 ha ICI 2.5 ha
Res. 6.8 ha ICI 0.6 ha
Res. 8.4 ha ICI 0.1 ha
Res. 9.3 ha ICI 0 ha
Res. 0 ha ICI 4.3 ha
Res. 3.9 ha ICI 16.4 ha

PS4 PS2 8E-LS ERLS

NEIL ROSS ROAD ST ALBERT TRAIL Carrot Creek

City of St Albert Cultivate Life

0 0.05 0.1 0.2 0.3 0.4 km

3TM114-83 1:15,000

- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Northeast Annexation Area
- Parcel
- Watercourse
- Water Body
- Proposed Road Concept
- Ray Gibbon Dr ROW
- P.S. #4 Manholes to Erin Ridge
- P.S. #4 Sewers to Erin Ridge

Proposed Sewers

- Gravity
- Forcemain
- Proposed Lift Station
- Sewersheds

Erin Ridge Development

- Proposed Node
- Proposed Lift Station
- Forcemain
- Gravity Sewer
- Contours (2.5 m)
- Contours (0.5 m)

Surrounding Areas

- Cherot / Avenir ASP Area
- Amendment Area
- East Amendment Area
- Badgerlands North
- NW Annexation (E of Carrot Creek)
- Erin Ridge Service Area
- P.S. #4 Service Area
- Sanitary Lift Station
- Sanitary Manhole
- Sewershed Connections

Existing Sewers

- <= 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- > 600 mm

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 4.8: SANITARY SEWER OPTION 2B NORTHSIDE VIEWPORT

Date: 2023-01-11 Document: J:\15\10\15167_St_Albert_Growth_Study_Annexation\02_CAD\25_GIS\251_Figures\12_SC3_Engineering_Design_Briefs\Map 4.8.mxd

SEWERSHED AREAS SHOW NET DEVELOPABLE AREAS

OPTION 2B:
1. EAST SIDE SERVICED VIA WEST ANNEXATION AREA TRUNK

2. P.S. #4 SERVICE AREA EXCLUDED FROM ANNEXATION AREA SERVICING (SERVICED EASTWARDS BY P.S. #4)

PROPOSED 1W LIFT STATION (30 L/s CAP.)

Carrot Creek

OLD MCKENNEY AVENUE

GIROUX ROAD

HOGAN ROAD

ST ALBERT TRAIL

PS2

Res. 2.7 ha ICI 21.9 ha
Res. 11.5 ha ICI 6.3 ha
Res. 16.7 ha ICI 2.1 ha
Res. 6.8 ha ICI 0.6 ha
Res. 8.4 ha ICI 0.1 ha
Res. 22.1 ha ICI 0 ha
Res. 9.3 ha ICI 0 ha
Res. 2.6 ha ICI 8.9 ha
Res. 0 ha ICI 12.5 ha
Res. 0 ha ICI 4.3 ha
Res. 0 ha ICI 9.5 ha
Res. 3.9 ha ICI 16.4 ha
Res. 0 ha ICI 17.8 ha
Res. 0 ha ICI 31.4 ha
Res. 0.6 ha ICI 4 ha
Res. 0.5 ha ICI 9 ha
Res. 0 ha ICI 2.5 ha
Res. 0 ha ICI 26.2 ha
Res. 0 ha ICI 30.7 ha
Res. 13.4 ha ICI 0 ha
Res. 0 ha ICI 22.5 ha
Res. 15 ha ICI 0 ha
Res. 0 ha ICI 27.2 ha
Res. 0 ha ICI 27 ha
Res. 15 ha ICI 0 ha

16W 8E-LS 8E 9E 11E 9W 15W 8W 7W 7E 6E 6W 5E 4E 5W 3E 4W 3W 2E 2W 1E 1W-LS N-INT-165 N-INT-150

375 mm 450 mm 600 mm 250 mm 300 mm 750 mm 500 mm 900 mm 1200 mm 150 mm 525 mm

Municipal Boundary
City Boundary
Northwest Annexation Area
Northeast Annexation Area
Parcel
Watercourse
Water Body

Proposed Road Concept
Ray Gibbon Dr ROW
P.S. #4 Manholes to Erin Ridge
P.S. #4 Sewers to Erin Ridge

Proposed Sewers
Gravity
Forcemain

Proposed Lift Station
Sewersheds

Erin Ridge Development
Proposed Node
Proposed Lift Station
Forcemain
Gravity Sewer

Contours (2.5 m)
Contours (0.5 m)

Surrounding Areas
Cherot / Avenir ASP Area
Amendment Area

East Amendment Area
Badgerlands North
NW Annexation (E of Carrot Creek)
Erin Ridge Service Area
P.S. #4 Service Area
Sanitary Lift Station
Sanitary Manhole

Sewershed Connections

Existing Sewers
<= 150 mm
200 mm
250 mm
300 mm
375 mm
450 mm
525 mm
600 mm
> 600 mm

0 0.05 0.1 0.2 0.3 0.4 km

3TM114-83 1:15,000

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 4.9:
SANITARY SEWER OPTION 2B SOUTHSIDE VIEWPORT

Date: 2023-01-11 Document: J:\15100\15167_St_Albert_Growth_Study_Annexation\02_CAD\05_GIS\35_Figures\12_SC3_Engineering_Design_Briefs\Map 4.9.mxd

Table 4.9 - Sanitary Sewer Flow Calculations and Sewer Design

Project: 15167 - St. Albert NW Annexation Area Engineering Design Brief
Client: City of St. Albert
Date: 2022-10-11
Scenario: Option 2A - Upstream Carrot Creek Crossing with P.S. #4 Service Area Included

ISL Engineering and Land Services

Nodes		Residential Peak DWF						Non-Residential Flows					I/I		Design Flows		Sewer Design						Sewer Layout						
								Non-Res Area		Non-Res Peak DWF													Ground Elevation		Invert Elevation			Depth of Cover to Invert	
U/S Node	D/S Node	Added Area (ha)	Cumulative Total Res Area (ha)	Cumulative Design Pop (persons)	Cumulative Average Flow (L/s)	Peaking Factor	Cumulative Peak Flow (L/s)	Added Area (ha)	Cumulative Total Non-Res Area (ha)	Total Average Non-Res Flow (L/s)	Peaking Factor	Cumulative Peak Flow (L/s)	Total Area (ha)	Cumulative Total I/I Allowance (L/s)	Cumulative Total Peak Flow (L/s)	**Qdesign (86% Full) (L/s)**	Length of Pipe (m)	Pipe Diameter (mm)	Slope (%)	Pipe Capacity (L/s)	Velocity (0.6 - 3.0 m/s) (m/s)	Design Capacity/Pipe Capacity (%)	U/S Node (m)	D/S Node (m)	U/S End (m)	D/S End (m)	Invert Drop Across D/S Node (m)	U/S Node (m)	D/S Node (m)
14W	13W	0.00	0.00	0	0.0	4.5	0.0	12.59	12.59	1.1	3.0	3.2	12.59	3.5	7	**8**	363	250	0.40	38	0.77	20.9	686.00	684.89	680.54	679.09	0.050	5.46	5.81
13W	11W	0.00	0.00	0	0.0	4.5	0.0	12.69	25.28	2.2	3.0	6.5	25.28	7.1	14	**16**	321	300	0.22	45	0.64	34.8	684.89	686.00	679.04	678.33	0.050	5.86	7.67
12W	11W	0.00	0.00	0	0.0	4.5	0.0	17.12	17.12	1.5	3.0	4.4	17.12	4.8	9	**11**	365	250	0.40	38	0.77	28.4	687.07	686.00	682.87	681.41	0.050	4.20	4.59
11W	10W	0.00	0.00	0	0.0	4.5	0.0	12.13	54.52	4.7	3.0	14.0	54.52	15.3	29	**34**	456	300	0.22	45	0.64	75.1	686.00	683.54	678.28	677.28	0.075	7.72	6.26
10W	9W	0.02	0.02	2	0.0	4.5	0.0	28.28	82.80	7.1	3.0	21.3	82.82	23.2	44	**52**	394	375	0.15	68	0.61	76.2	683.54	682.99	677.20	676.61	0.075	6.33	6.38
9W	8W	2.68	2.70	290	0.7	4.1	2.7	21.85	104.66	9.0	3.0	26.9	107.36	30.1	60	**69**	403	450	0.35	169	1.06	41.2	682.99	681.00	676.54	675.13	0.108	6.45	5.87
8W	7W	0.00	2.70	290	0.7	4.1	2.7	17.84	122.49	10.5	3.0	31.5	125.20	35.1	69	**81**	397	450	0.12	99	0.62	81.6	681.00	681.93	675.02	674.54	0.075	5.98	7.39
24W	23W	5.71	5.71	612	1.4	3.9	5.6	0.00	0.00	0.0	3.0	0.0	5.71	1.6	7	**8**	302	300	0.22	45	0.64	18.4	681.77	681.92	677.52	676.86	0.012	4.25	5.06
23W	19W	5.16	10.87	1,166	2.7	3.8	10.1	0.00	0.00	0.0	3.0	0.0	10.87	3.0	13	**15**	295	300	0.22	45	0.64	33.8	681.92	682.65	676.85	676.20	0.012	5.07	6.45
19W	18W	0.00	10.87	1,166	2.7	3.8	10.1	0.00	0.00	0.0	3.0	0.0	10.87	3.0	13	**15**	729	300	0.22	45	0.64	33.8	682.65	683.45	676.19	674.58	0.075	6.47	8.87
22W	20W	1.99	1.99	213	0.5	4.1	2.0	17.09	17.09	1.5	3.0	4.4	19.08	5.3	12	**14**	371	250	0.40	38	0.77	36.4	686.00	685.83	681.80	680.32	0.012	4.20	5.51
21W	20W	0.07	0.07	8	0.0	4.4	0.1	14.15	14.15	1.2	3.0	3.6	14.23	4.0	8	**9**	393	250	0.40	38	0.77	23.8	685.24	685.83	681.04	679.46	0.050	4.20	6.37
20W	18W	8.10	10.16	1,090	2.5	3.8	9.5	1.15	32.39	2.8	3.0	8.3	42.55	11.9	30	**35**	554	250	0.40	38	0.77	92.0	685.83	683.45	679.41	677.20	0.125	6.42	6.25
18W	16W	7.39	28.42	3,050	7.1	3.4	24.3	0.00	32.39	2.8	3.0	8.3	60.81	17.0	50	**58**	123	375	0.15	68	0.61	84.9	683.45	681.56	674.51	674.32	0.300	8.94	7.24
17W	16W	11.54	11.54	1,239	2.9	3.7	10.7	6.29	6.29	0.5	3.0	1.6	17.84	5.0	17	**20**	449	250	0.55	44	0.90	45.7	684.76	681.56	680.56	678.08	0.425	4.20	3.48
16W	15W	16.67	167.84	18,011	41.7	2.7	112.5	2.09	64.23	5.5	3.0	16.5	232.08	65.0	194	**226**	656	675	0.10	266	0.74	84.9	681.56	679.36	674.02	673.37	0.012	7.54	5.99
15W	7W	0.00	167.84	18,011	41.7	2.7	112.5	12.53	76.76	6.6	3.0	19.7	244.61	68.5	201	**233**	497	675	0.10	266	0.74	87.8	679.36	681.93	673.36	672.86	0.050	6.00	9.08
7W	6W	2.56	173.11	18,576	43.0	2.7	115.4	8.89	208.15	17.8	3.0	53.5	381.25	106.8	276	**321**	414	675	0.60	651	1.82	49.2	681.93	675.73	672.81	670.33	0.012	9.13	5.40
6W	5W	0.00	173.11	18,576	43.0	2.7	115.4	31.37	239.52	20.5	3.0	61.5	412.63	115.5	293	**340**	377	675	0.85	775	2.17	43.9	675.73	670.98	670.31	667.11	0.012	5.41	3.86
5W	4W	0.00	173.11	18,576	43.0	2.7	115.4	26.22	265.73	22.8	3.0	68.3	438.84	122.9	307	**357**	431	675	0.40	532	1.49	67.1	670.98	669.12	667.10	665.37	0.012	3.88	3.75
4W	3W	0.00	173.11	18,576	43.0	2.7	115.4	30.69	296.42	25.4	3.0	76.2	469.53	131.5	323	**376**	200	675	0.40	532	1.49	70.7	669.12	667.30	665.36	664.56	0.225	3.76	2.73
3W	2E	0.00	173.11	18,576	43.0	2.7	115.4	22.48	318.90	27.3	3.0	81.9	492.01	137.8	335	**390**	597	900	0.10	572	0.90	68.1	667.30	667.59	664.34	662.24	0.050	2.96	5.34
2W	1W	0.00	0.00	0	0.0	4.5	0.0	27.24	27.24	2.3	3.0	7.0	27.24	7.6	15	**17**	828	250	0.40	38	0.77	45.2	665.67	663.07	661.47	658.15	0.050	4.20	4.92
1W	Lift Station	0.00	0.00	0	0.0	4.5	0.0	26.99	54.24	4.6	3.0	13.9	54.24	15.2	29	**34**	10	300	0.22	45	0.64	74.7	663.07	663.07	658.10	658.08	0.012	4.97	4.99
20E	19E	5.69	5.69	610	1.4	3.9	5.6	9.82	9.82	0.8	3.0	2.5	15.51	4.3	12	**14**	401	300	0.22	45	0.64	31.8	682.36	683.42	678.86	677.98	0.050	3.50	5.43
19E	18E	0.00	5.69	610	1.4	3.9	5.6	12.85	22.67	1.9	3.0	5.8	28.35	7.9	19	**22**	94	300	0.22	45	0.64	49.5	683.42	683.83	677.93	677.72	0.012	5.48	6.10
18E	17E	11.55	17.24	1,850	4.3	3.6	15.5	0.00	22.67	1.9	3.0	5.8	39.90	11.2	32	**38**	761	300	0.22	45	0.64	83.2	683.83	683.12	677.71	676.04	0.075	6.12	7.09
17E	16E	15.22	32.45	3,483	8.1	3.4	27.3	0.00	22.67	1.9	3.0	5.8	55.12	15.4	49	**56**	256	375	0.15	68	0.61	83.2	683.12	682.62	675.96	675.58	0.075	7.16	7.04
16E	15E	12.86	45.32	4,863	11.3	3.3	36.7	0.00	22.67	1.9	3.0	5.8	67.98	19.0	62	**72**	178	450	0.12	99	0.62	72.4	682.62	683.02	675.50	675.29	0.050	7.12	7.73
15E	13E	9.10	54.42	5,840	13.5	3.2	43.0	0.00	22.67	1.9	3.0	5.8	77.08	21.6	70	**82**	326	450	0.12	99	0.62	82.9	683.02	682.32	675.24	674.85	0.050	7.78	7.47
14E	13E	5.32	5.32	571	1.3	3.9	5.2	0.00	0.00	0.0	3.0	0.0	5.32	1.5	7	**8**	297	250	0.40	38	0.77	20.7	679.78	682.32	676.28	675.09	0.200	3.50	7.23
13E	12E	0.00	59.74	6,411	14.8	3.1	46.6	0.00	22.67	1.9	3.0	5.8	82.41	23.1	76	**88**	264	450	0.12	99	0.62	88.9	682.32	681.05	674.80	674.48	0.012	7.52	6.56
12E	8E	4.95	64.70	6,942	16.1	3.1	50.0	0.00	22.67	1.9	3.0	5.8	87.36	24.5	80	**93**	401	450	0.12	99	0.62	94.5	681.05	682.01	674.47	673.99	0.150	6.57	8.02
10E	9E	22.05	22.05	2,367	5.5	3.5	19.3	0.00	0.00	0.0	3.0	0.0	22.05	6.2	26	**30**	559	250	0.40	38	0.77	78.8	685.79	685.24	681.59	679.35	0.125	4.20	5.89
11E	9E	9.33	9.33	1,002	2.3	3.8	8.8	0.04	0.04	0.0	3.0	0.0	9.37	2.6	11	**13**	528	250	0.40	38	0.77	35.4	685.91	685.24	681.71	679.60	0.125	4.20	5.64
9E	8E	8.37	39.76	4,267	9.9	3.3	32.7	0.15	0.18	0.0	3.0	0.0	39.94	11.2	44	**51**	459	375	0.15	68	0.61	75.2	685.24	682.01	679.22	678.54	0.225	6.01	3.47
8E	8E-LS	6.75	111.21	11,934	27.6	2.9	79.5	0.62	23.46	2.0	3.0	6.0	134.67	37.7	123	**143**	153	600	0.10	194	0.69	73.8	682.01	677.90	673.84	673.69	0.012	8.17	4.22
7E	6E	0.00	0.00	0	0.0	4.5	0.0	13.76	13.76	1.2	3.0	3.5	13.76	3.9	7	**9**	297	250	0.50	42	0.86	20.4	679.43	675.69	673.68	672.19	0.050	5.75	3.50
6E	4E	4.45	4.45	478	1.1	4.0	4.4	27.85	41.62	3.6	3.0	10.7	46.07	12.9	28	**33**	483	300	1.00	97	1.37	33.7	675.69	670.70	672.14	667.32	0.050	3.55	3.39
5E	4E	0.55	0.55	59	0.1	4.3	0.6	3.98	3.98	0.3	3.0	1.0	4.54	1.3	3	**3**	195	250	0.40	38	0.77	8.9	672.23	670.70	668.30	667.52	0.050	3.93	3.18
4E	3E	0.00	5.00	537	1.2	4.0	4.9	0.00	45.60	3.9	3.0	11.7	50.60	14.2	31	**36**	248	300	0.70	81	1.14	44.3	670.70	668.93	667.27	665.53	0.075	3.44	3.40
3E	2E	13.37	18.38	1,972	4.6	3.6	16.4	0.00	45.60	3.9	3.0	11.7	63.98	17.9	46	**54**	624	375	0.30	96	0.87	55.7	668.93	667.59	665.45	663.58	0.525	3.48	4.00
2E	1E	14.96	206.45	22,154	51.3	2.6	133.7	0.00	364.50	31.2	3.0	93.7	570.95	159.9	387	**450**	912	900	0.10	572	0.90	78.7	667.59	668.23	662.19	661.28	0.050	5.39	6.94
1E	N-INT 165	14.96	221.40	23,759	55.0	2.6	141.8	0.00	364.50	31.2	3.0	93.7	585.90	164.1	399	**464**	164	900	0.10	572	0.90	81.1	668.23	667.73	661.23	661.07	0.300	6.99	6.66

Table 4.10 - Sanitary Sewer Flow Calculations and Sewer Design

Project: 15167 - St. Albert NW Annexation Area Engineering Design Brief
Client: City of St. Albert
Date: 2022-10-11
Scenario: Option 2B - Upstream Carrot Creek Crossing with P.S. #4 Service Area Excluded

ISL Engineering and Land Services

Nodes		Residential Peak DWF						Non-Residential Flows					I/I		Design Flows		Sewer Design						Sewer Layout						
								Non-Res Area		Non-Res Peak DWF													Ground Elevation		Invert Elevation			Depth of Cover to Invert	
U/S Node	D/S Node	Added Area (ha)	Cumulative Total Res Area (ha)	Cumulative Design Pop (persons)	Cumulative Average Flow (L/s)	Peaking Factor	Cumulative Peak Flow (L/s)	Added Area (ha)	Cumulative Total Non-Res Area (ha)	Total Average Non-Res Flow (L/s)	Peaking Factor	Cumulative Peak Flow (L/s)	Total Area (ha)	Cumulative Total I/I Allowance (L/s)	Cumulative Total Peak Flow (L/s)	**Qdesign (86% Full) (L/s)**	Length of Pipe (m)	Pipe Diameter (mm)	Slope (%)	Pipe Capacity (L/s)	Velocity (0.6 - 3.0 m/s) (m/s)	Design Capacity/Pipe Capacity (%)	U/S Node (m)	D/S Node (m)	U/S End (m)	D/S End (m)	Invert Drop Across D/S Node (m)	U/S Node (m)	D/S Node (m)
14W	13W	0.00	0.00	0	0.0	4.5	0.0	12.59	12.59	1.1	3.0	3.2	12.59	3.5	7	**8**	363	250	0.40	38	0.77	20.9	686.00	684.89	680.54	679.09	0.050	5.46	5.81
13W	11W	0.00	0.00	0	0.0	4.5	0.0	12.69	25.28	2.2	3.0	6.5	25.28	7.1	14	**16**	321	300	0.22	45	0.64	34.8	684.89	686.00	679.04	678.33	0.050	5.86	7.67
12W	11W	0.00	0.00	0	0.0	4.5	0.0	17.12	17.12	1.5	3.0	4.4	17.12	4.8	9	**11**	365	250	0.40	38	0.77	28.4	687.07	686.00	682.87	681.41	0.050	4.20	4.59
11W	10W	0.00	0.00	0	0.0	4.5	0.0	12.13	54.52	4.7	3.0	14.0	54.52	15.3	29	**34**	456	300	0.22	45	0.64	75.1	686.00	683.54	678.28	677.28	0.075	7.72	6.26
10W	9W	0.02	0.02	2	0.0	4.5	0.0	28.28	82.80	7.1	3.0	21.3	82.82	23.2	44	**52**	394	375	0.15	68	0.61	76.2	683.54	682.99	677.20	676.61	0.075	6.33	6.38
9W	8W	2.68	2.70	290	0.7	4.1	2.7	21.85	104.66	9.0	3.0	26.9	107.36	30.1	60	**69**	403	450	0.35	169	1.06	41.2	682.99	681.00	676.54	675.13	0.108	6.45	5.87
8W	7W	0.00	2.70	290	0.7	4.1	2.7	17.84	122.49	10.5	3.0	31.5	125.20	35.1	69	**81**	397	450	0.12	99	0.62	81.6	681.00	681.93	675.02	674.54	0.075	5.98	7.39
24W	23W	5.71	5.71	612	1.4	3.9	5.6	0.00	0.00	0.0	3.0	0.0	5.71	1.6	7	**8**	302	300	0.22	45	0.64	18.4	681.77	681.92	677.52	676.86	0.012	4.25	5.06
23W	19W	5.16	10.87	1,166	2.7	3.8	10.1	0.00	0.00	0.0	3.0	0.0	10.87	3.0	13	**15**	295	300	0.22	45	0.64	33.8	681.92	682.65	676.85	676.20	0.012	5.07	6.45
19W	18W	0.00	10.87	1,166	2.7	3.8	10.1	0.00	0.00	0.0	3.0	0.0	10.87	3.0	13	**15**	729	300	0.22	45	0.64	33.8	682.65	683.45	676.19	674.58	0.075	6.47	8.87
22W	20W	1.99	1.99	213	0.5	4.1	2.0	17.09	17.09	1.5	3.0	4.4	19.08	5.3	12	**14**	371	250	0.40	38	0.77	36.4	686.00	685.83	681.80	680.32	0.012	4.20	5.51
21W	20W	0.07	0.07	8	0.0	4.4	0.1	14.15	14.15	1.2	3.0	3.6	14.23	4.0	8	**9**	393	250	0.40	38	0.77	23.8	685.24	685.83	681.04	679.46	0.050	4.20	6.37
20W	18W	8.10	10.16	1,090	2.5	3.8	9.5	1.15	32.39	2.8	3.0	8.3	42.55	11.9	30	**35**	554	250	0.40	38	0.77	92.0	685.83	683.45	679.41	677.20	0.125	6.42	6.25
18W	16W	7.39	28.42	3,050	7.1	3.4	24.3	0.00	32.39	2.8	3.0	8.3	60.81	17.0	50	**58**	123	375	0.15	68	0.61	84.9	683.45	681.56	674.51	674.32	0.225	8.94	7.24
17W	16W	11.54	11.54	1,239	2.9	3.7	10.7	6.29	6.29	0.5	3.0	1.6	17.84	5.0	17	**20**	449	250	0.55	44	0.90	45.7	684.76	681.56	680.56	678.08	0.350	4.20	3.48
16W	15W	16.67	135.39	14,529	33.6	2.8	93.9	2.09	41.57	3.6	3.0	10.7	176.96	49.5	154	**179**	656	600	0.10	194	0.69	92.3	681.56	679.36	674.10	673.44	0.012	7.46	5.91
15W	7W	0.00	135.39	14,529	33.6	2.8	93.9	12.53	54.10	4.6	3.0	13.9	189.49	53.1	161	**187**	497	600	0.10	194	0.69	96.3	679.36	681.93	673.43	672.93	0.050	5.92	9.00
7W	6W	2.56	140.65	15,094	34.9	2.8	97.0	8.89	185.48	15.9	3.0	47.7	326.13	91.3	236	**274**	414	600	0.60	476	1.68	57.7	681.93	675.73	672.88	670.40	0.012	9.05	5.33
6W	5W	0.00	140.65	15,094	34.9	2.8	97.0	31.37	216.85	18.6	3.0	55.7	357.51	100.1	253	**294**	377	600	0.85	566	2.00	51.9	675.73	670.98	670.39	667.19	0.012	5.34	3.79
5W	4W	0.00	140.65	15,094	34.9	2.8	97.0	26.22	243.07	20.8	3.0	62.5	383.72	107.4	267	**310**	431	600	0.40	388	1.37	79.9	670.98	669.12	667.17	665.45	0.012	3.80	3.67
4W	3W	0.00	140.65	15,094	34.9	2.8	97.0	30.69	273.76	23.4	3.0	70.3	414.41	116.0	283	**329**	200	600	0.40	388	1.37	84.8	669.12	667.30	665.44	664.64	0.150	3.69	2.66
3W	2E	0.00	140.65	15,094	34.9	2.8	97.0	22.48	296.23	25.4	3.0	76.1	436.89	122.3	295	**344**	597	750	0.10	352	0.80	97.6	667.30	667.59	664.49	662.39	0.150	2.81	5.19
2W	1W	0.00	0.00	0	0.0	4.5	0.0	27.24	27.24	2.3	3.0	7.0	27.24	7.6	15	**17**	828	250	0.40	38	0.77	45.2	665.67	663.07	661.47	658.15	0.050	4.20	4.92
1W	Lift Station	0.00	0.00	0	0.0	4.5	0.0	26.99	54.24	4.6	3.0	13.9	54.24	15.2	29	**34**	10	300	0.22	45	0.64	74.7	663.07	663.07	658.10	658.08	0.012	4.97	4.99
20E	19E	5.69	5.69	610	1.4	3.9	5.6	9.82	9.82	0.8	3.0	2.5	15.51	4.3	12	**14**	401	300	0.22	45	0.64	31.8	682.36	683.42	678.86	677.98	0.050	3.50	5.43
19E	18E	0.00	5.69	610	1.4	3.9	5.6	12.85	22.67	1.9	3.0	5.8	28.35	7.9	19	**22**	94	300	0.22	45	0.64	49.5	683.42	683.83	677.93	677.72	0.012	5.48	6.10
17E	18E	26.77	26.77	2,873	6.6	3.5	23.0	0.00	0.00	0.0	3.0	0.0	26.77	7.5	30	**35**	761	300	0.22	45	0.64	78.2	683.12	683.83	678.87	677.20	0.050	4.25	6.63
16E	15E	12.86	12.86	1,380	3.2	3.7	11.8	0.00	0.00	0.0	3.0	0.0	12.86	3.6	15	**18**	178	300	0.22	45	0.64	39.6	682.62	683.02	678.37	677.98	0.050	4.25	5.04
15E	13E	9.10	21.96	2,357	5.5	3.5	19.3	0.00	0.00	0.0	3.0	0.0	21.96	6.1	25	**30**	326	300	0.22	45	0.64	65.1	683.02	682.32	677.93	677.21	0.075	5.09	5.11
14E	13E	5.32	5.32	571	1.3	3.9	5.2	0.00	0.00	0.0	3.0	0.0	5.32	1.5	7	**8**	297	250	0.40	38	0.77	20.7	679.78	682.32	676.28	675.09	0.125	3.50	7.23
13E	12E	0.00	27.29	2,928	6.8	3.5	23.4	0.00	0.00	0.0	3.0	0.0	27.29	7.6	31	**36**	264	375	0.15	68	0.61	53.1	682.32	681.05	674.97	674.57	0.012	7.35	6.47
12E	8E	4.95	32.24	3,460	8.0	3.4	27.1	0.00	0.00	0.0	3.0	0.0	32.24	9.0	36	**42**	401	375	0.15	68	0.61	61.9	681.05	682.01	674.56	673.96	0.075	6.49	8.05
10E	9E	22.05	22.05	2,367	5.5	3.5	19.3	0.00	0.00	0.0	3.0	0.0	22.05	6.2	26	**30**	559	250	0.40	38	0.77	78.8	685.79	685.24	681.59	679.35	0.125	4.20	5.89
11E	9E	9.33	9.33	1,002	2.3	3.8	8.8	0.04	0.04	0.0	3.0	0.0	9.37	2.6	11	**13**	528	250	0.40	38	0.77	35.4	685.91	685.24	681.71	679.60	0.125	4.20	5.64
9E	8E	8.37	39.76	4,267	9.9	3.3	32.7	0.15	0.18	0.0	3.0	0.0	39.94	11.2	44	**51**	459	375	0.15	68	0.61	75.2	685.24	682.01	679.22	678.54	0.075	6.01	3.47
8E	8E-LS	6.75	78.76	8,451	19.6	3.0	59.2	0.62	0.80	0.1	3.0	0.2	79.55	22.3	82	**95**	153	450	0.12	99	0.62	96.2	682.01	677.90	673.88	673.70	0.012	8.13	4.20
7E	6E	0.00	0.00	0	0.0	4.5	0.0	13.76	13.76	1.2	3.0	3.5	13.76	3.9	7	**9**	297	250	0.50	42	0.86	20.4	679.43	675.69	673.69	672.20	0.050	5.74	3.48
6E	4E	4.45	4.45	478	1.1	4.0	4.4	27.85	41.62	3.6	3.0	10.7	46.07	12.9	28	**33**	483	300	1.00	97	1.37	33.7	675.69	670.70	672.15	667.33	0.050	3.53	3.38
5E	4E	0.55	0.55	59	0.1	4.3	0.6	3.98	3.98	0.3	3.0	1.0	4.54	1.3	3	**3**	195	250	0.40	38	0.77	8.9	672.23	670.70	668.30	667.52	0.050	3.93	3.18
4E	3E	0.00	5.00	537	1.2	4.0	4.9	0.00	45.60	3.9	3.0	11.7	50.60	14.2	31	**36**	248	300	0.70	81	1.14	44.3	670.70	668.93	667.28	665.54	0.075	3.43	3.39
3E	2E	13.37	18.38	1,972	4.6	3.6	16.4	0.00	45.60	3.9	3.0	11.7	63.98	17.9	46	**54**	624	375	0.30	96	0.87	55.7	668.93	667.59	665.47	663.59	0.525	3.46	3.99
2E	1E	14.96	173.99	18,671	43.2	2.7	115.9	0.00	341.83	29.3	3.0	87.8	515.83	144.4	348	**405**	912	900	0.10	572	0.90	70.7	667.59	668.23	662.24	661.33	0.050	5.34	6.89
1E	N-INT 165	14.96	188.95	20,276	46.9	2.6	124.2	0.00	341.83	29.3	3.0	87.8	530.78	148.6	361	**419**	164	900	0.10	572	0.90	73.3	668.23	667.73	661.28	661.12	0.300	6.94	6.61

4.6.3 Cost Comparison of Options

The cost estimate summary for Options 1A, 1B, 2A and 2B are shown in **Table 4.11**. As shown, Option 1A is the most cost-effective option and can effectively service the P.S. #4 area by gravity without the need for the lift station. It should be noted that Option 2A is the most expensive due to extensive deep trunk oversizing required on the west side of Carrot Creek to convey the P.S. #4 service area (across two syphons) which significantly impacts the cost.

Table 4.11: Sanitary Servicing Options Cost Estimate Summary

Item	Cost Estimates			
	Option 1 (Avenir Sub Trunk)		Option 2 (Carrot Creek Crossing)	
	A (P.S. #4 Area Included)	B (P.S. #4 Area Excluded)	A (P.S. #4 Area Included)	B (P.S. #4 Area Excluded)
250 mm Sewer	4,210,000	5,064,000	4,400,000	4,400,000
300 mm Sewer	4,148,000	4,447,000	4,609,000	4,908,000
375 mm Sewer	2,184,000	2,842,000	2,770,000	3,428,000
450 mm Sewer	4,770,000	5,033,000	3,695,000	1,704,000
525 mm Sewer	2,309,000	3,272,000	-	-
600 mm Sewer	4,345,000	651,000	268,000	4,180,000
675 mm Sewer	795,000	795,000	4,940,000	-
750 mm Sewer	-	-	-	922,000
900 mm Sewer	3,680,000	3,680,000	5,268,000	3,680,000
3W-2E Syphon	660,000	660,000	726,000	693,000
1W Lift Station & Forcemain	1,670,000	1,670,000	1,670,000	1,670,000
8E Lift Station & Forcemain	-	-	4,616,000	3,618,000
Manholes	4,239,000	4,083,000	3,922,000	3,823,000
NW Annexation Area to NIT Subtotal	**33,010,000**	**32,197,000**	**36,884,000**	**33,026,000**
P.S. #4 (ERN) & Forcemain	-	2,739,000	-	2,739,000
Grand Total	**33,010,000**	**34,936,000**	**36,884,000**	**35,765,000**

Note:

1. Cost estimates for manholes assume an average spacing of 120 m to account for bends in the sewers and a representative manhole average depth of approximately 5.5 m.

4.7 Recommended On-Site Sanitary Sewer Servicing Option

Based on the discussion and cost comparison in **Section 4.5** and the capacity in the NIT following the recommended orifice adjustments (as shown in **Table 4.6**), it is recommended that the majority of the Northwest Annexation Area (excludes Erin Ridge North service area) be serviced by Option 1A to the NIT.

Details from the NIT modelling analysis show that the orifices can be configured in the future to ensure that the northwest annexation area can be serviced by the NIT. This analysis was inclusive of the previously proposed Pump Station #4 Service Area implying that there is capacity for this area to be diverted through the northwest annexation area into NIT. This will reduce the overall pumping service area for St. Albert, effectively reducing the City's operations and maintenance costs and will also reduce the oversizing requirements for the Erin Ridge North Area which is to go through the proposed Erin Ridge North Sanitary Pump Station.

The on-site sanitary option analysis shows that Option 1A is the preferred option for the following reasons:

1. Option 1A is the most cost-effective option since it reduces the amount of lift stations and creek crossing required;
2. The cost of oversizing sewer trunks to service the P.S. #4 area is lower than the cost estimate for the lift station required to service this area to the Erin Ridge North service area; and
3. Option 1A has the overall best development flexibility since the areas west and east of the creek can generally develop independent of each other (excluding the need for the 900 mm trunk within Avenir that is a common requirement amongst all options).

The recommended wastewater boundary between the Erin Ridge North Lift Station and the North Interceptor Trunk will therefore be the same as the stormwater boundary between the Erin Ridge North stormwater system and servicing to Carrot Creek.

There are three key projects whose cost estimates have been included in **Table 4.12** for reference. As development begins within the northwest annexation area, these projects, which are located near the downstream end of the system will become part of the initial off-site levies for the annexation area.

Table 4.12: Key Off-Site Levy Projects for Option 1A

Project	Description	Cost ($)	Engineering (10%)	Contingency (40%)	Total ($)
1	900mm runs from N-INT-165 to 2E	2,681,000	268,000	1,072,000	4,021,000
2	600mm Sanitary Sewer (4E to 2E)	783,000	78,000	313,000	1,174,000
3	675mm Sanitary Sewer Carrot Creek Crossing (3W to 2E)	1,117,000	112,000	447,000	1,676,000

5.0 Stormwater

5.1 Carrot Creek Watershed

The northwest annexation area is mostly contained within the Carrot Creek watershed although part of the west side of the annexation area is within the Sturgeon River watershed upstream of Big Lake. The Sturgeon River upstream of Big Lake runs parallel to Carrot Creek prior to draining into Big Lake and the two watersheds are split by a ridge line that bisects the northwest annexation area west of Carrot Creek from north to south. Thus, the west edge of the annexation area is to be diverted into Carrot Creek which will increase the effective catchment area and anticipated runoff.

The entire Carrot Creek watershed has been analyzed in detail as part of the Carrot Creek Regional Master Drainage Plan. The watershed extends north encompassing all of Cardiff and a portion of south Morinville and extends east by up to two sections of land (2 miles). The east part of the watershed follows Highway 2 south from Morinville and confluences with the primary Carrot Creek branch near the north side of the annexation area.

5.2 Design Standards

The City of St. Albert Municipal Engineering Standards and Implementation Strategy (May 2021) provides details on required stormwater servicing standards for new development. **Table 5.1** summarizes some of the relevant design standards used to develop stormwater servicing concepts for the northwest annexation area.

Table 5.1: Select City of St. Albert Stormwater Management Design Standards

Standard		Value
Approved Discharge Rates (L/s/ha)	Carrot Creek	1.8
	Sturgeon River	2.5
Minimum Depth of Cover (m) from top of pipe		1.8
Minimum Wet Pond Surface Area (ha)		2.0
Minimum Depth at NWL (m)		2.5
Maximum Live Storage (m) from NWL to HWL		1.5
Side Slope Maximum	Above NWL	7:1
	Below NWL	5:1

Notes:

1. 100-year design intensity based on St. Albert IDF curve data from 1984 – 2015 from 11 City of Edmonton rain gauges.
2. NWL refers to the normal water level, which is the depth of water during dry weather periods. HWL refers to the high-water level and is the maximum pond depth designed for a 100-year event.

While the current City design standards use a discharge rate of 1.8 L/s/ha for Carrot Creek, the City of St. Albert has indicated that they are moving towards a discharge rate of 2.5 L/s/ha based on the current Carrot Creek Regional Master Drainage Plan study. The 2.5 L/s/ha value was therefore used for this study.

5.3 Stormwater Management Facility Concept Design

Stormwater servicing will consist of stormwater management facilities (SWMF) that store and release runoff to Carrot Creek at 2.5 L/s/ha as per updated St. Albert release rate requirements for Carrot Creek to prevent creek erosion. The SWMFs are proposed to be designed in-series such that upstream ponds will route through outlet control structures and sewers to a downstream SWMF. This approach reduces the overall length of stormwater outfall and provides the flexibility for developers to potentially oversize the stormwater pipes for local minor system drainage. This means that while the pond volume is sized the 100-year volume of rainfall over its catchment area, the outlet trunks and control structures need to account for upstream areas based on the 2.5 L/s/ha release rate. Minimum outfall sewer sizes were assumed to be at least 300 mm in size, although outfalls could be oversized to larger diameters to prevent blockages since the flows are controlled to 2.5 L/s/ha regardless.

The stormwater management concept for the northwest annexation area is shown on **Maps 5.1** and **5.2**. See **Table 5.2** for the stormwater management design table which summarizes the catchment areas, runoff coefficients, pond sizing including depth and area requirements, and outlet trunk sizing. **Sections 5.3.1** through **5.3.3** describe the design methodology/summary for the catchments, ponds and outlet trunk design.

SWMF east of Carrot Creek typically discharge directly to the creek. The only exceptions are SWMF #3 and #4 which discharge to SWMF #2. On the west side of Carrot Creek, the SWMF west of the ridge generally discharge to other SWMF to the south before connecting to downstream SWMF to the east and Carrot Creek. Most of the SWMF west of the creek and east of the ridge connect directly to Carrot Creek (SWMF #19 to SWMF #18 being the exception). The connectivity of the outfall trunks should be reviewed at the ASP stage of development. Modifications may be required in the future based on development staging, modifications to SWMF locations, land ownership constraints, and changes to roadway alignments.

5.3.1 Catchment Delineation

As shown on Maps 5.1 and 5.2, the annexation area extends to Highway 2; however, the Erin Ridge North stormwater servicing concept shows conceptual pond locations as per the Erin Ridge North Stormwater Lift Station Design Memorandum. Thus, the catchment areas have been adjusted to match the proposed Erin Ridge North service area boundary. Catchment areas for the northwest annexation area are shown in red dashed lines with red text showing the catchment area. The final revised boundary for the northwest annexation service area is shown on **Map 5.1** and extends 1,600 m north along Hogan Road, 400 m east and then 800 m extension along the ridge line that crosses the existing Carrot Creek east drainage channel. It should be noted that the servicing area boundary established by the Erin Ridge North servicing studies is consistent with the available ground contours and this boundary has been proposed for the proposed stormwater and wastewater servicing boundaries (Option 1A).

The runoff coefficients for each catchment have been calculated based on the anticipated land use and standard runoff coefficients. From these calculations, the total anticipated runoff volume can be calculated to determine the SWMF sizing as discussed below.

SERVICING AREA BOUNDARY ESTABLISHED BETWEEN NW ANNEXATION AREA AND ERIN RIDGE NORTH SERVICING AREA

SWMF #7
SWMF #6
SWMF #5
SWMF #4
SWMF #3
SWMF #2
SWMF #1
SWMF #20
SWMF #19
SWMF #18
SWMF #17
SWMF #16
SWMF #15
SWMF #14
SWMF #13

34.4 ha
41.9 ha
22.6 ha
38.4 ha
62 ha
71.2 ha
41.5 ha
34.9 ha
20.3 ha
69.8 ha
73.8 ha
65.7 ha
21.2 ha
50.1 ha
66.9 ha

Carrot Creek
NEIL ROSS ROAD
ST. ALBERT TRAIL

City of St. Albert — Cultivate Life

0 0.05 0.1 0.2 0.3 0.4 km

3TM114-83 1:15,000

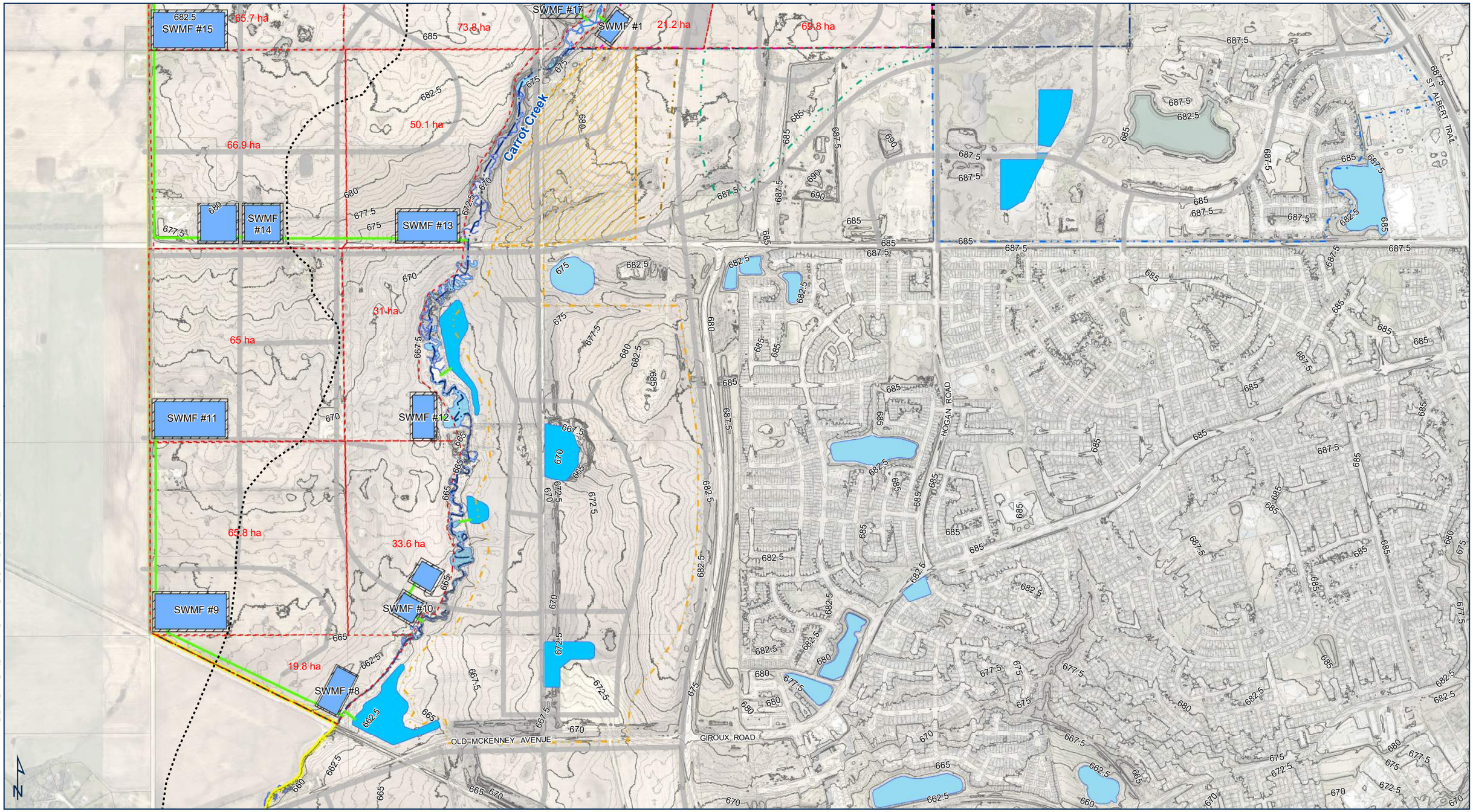
- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Northeast Annexation Area
- Parcel
- Watercourse
- Water Body
- Proposed SWMF (NWL)
- Proposed SWMF (HWL)
- Proposed Storm Trunks
- Catchments
- Proposed Road Concept
- Ray Gibbon Dr ROW
- Adjacent Proposed SWMF
- Proposed Erin Ridge Storm Trunks
- Sturgeon River Drainage Divide
- Contours (2.5 m)
- Contours (0.5 m)

Surrounding Areas

- Cherot / Avenir ASP Area
- Amendment Area
- East Amendment Area
- Badgerlands North
- NW Annexation (E of Carrot Creek)
- Erin Ridge Service Area
- P.S. #4 Service Area
- Servicing Area Boundary

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 5.1: STORMWATER SERVICING NORTHSIDE VIEWPORT



City of St. Albert — Cultivate Life

0 0.05 0.1 0.2 0.3 0.4 km

3TM114-83 1:15,000

- Municipal Boundary
- City Boundary
- Northwest Annexation Area
- Northeast Annexation Area
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Surrounding Areas

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- Amendment Area
- East Amendment Area
- Badgerlands North
- NW Annexation (E of Carrot Creek)
- Erin Ridge Service Area
- P.S. #4 Service Area
- Servicing Area Boundary

NORTHWEST ANNEXATION AREA ENGINEERING DESIGN BRIEF

MAP 5.2: STORMWATER SERVICING SOUTHSIDE VIEWPORT

Date: 2023-01-11 Document: J:\15100\15167_St_Albert_Growth_Study_Annexation\02_CAD\25_GIS\251_Figures\12_SC3_Engineering_Design_Briefs\Map 5.2.mxd

Table 5.2 - Stormwater Management Facility and Outlet Trunk Design

Project: 15167 - St. Albert NW Annexation Area Engineering Design Brief
Client: City of St. Albert
Date: 2022-10-11
Scenario: Stormwater management at 2.5 L/s/ha release rate to Carrot Creek

ISL Engineering and Land Services

SWMF	Catchment Area (ha)	% Imperviousness	Runoff Coefficient	Storage (m³)	Area at NWL (ha)	Area at HWL (ha)	NWL (m)	HWL (m)	Freeboard Elev. (m)	Outlet	Release Rate (L/s)	Diameter (mm)	Length (m)	Slope	Capacity (L/s)	U/S Inv. (m)	D/S Inv. (m)	Down-stream SWMF NWL (m)	Estimated Carrot Creek Bed Elevation (m)	Design Flow / Capacity
1	21.2	49	52%	15,304	0.8	1.2	678.0	679.5	680.0	Carrot Creek	53	300	41	5.6%	229	678.0	675.7	-	674.2	23%
2	34.9	50	53%	25,582	1.4	2.0	678.0	679.5	680.0	Carrot Creek	365	750	65	0.2%	480	678.0	677.9	-	677.4	76%
3	69.7	65	65%	63,092	3.8	4.7	681.5	683.0	683.5	SWMF #2	174	375	290	1.0%	179	681.5	678.5	678.0	-	98%
4	41.4	65	65%	37,477	2.2	2.9	680.0	681.5	682.0	SWMF #2	104	450	528	0.3%	152	680.0	678.5	678.0	-	68%
5	22.6	59	60%	18,876	1.7	2.1	680.5	681.5	682.0	Carrot Creek	56	300	29	1.3%	112	680.5	680.1	-	679.9	50%
6	41.9	69	69%	40,164	3.7	4.3	681.5	682.5	682.5	Carrot Creek	105	450	35	0.2%	128	681.5	681.4	-	681.2	82%
7	34.4	60	61%	29,340	2.7	3.2	681.5	682.5	682.5	Carrot Creek	86	450	33	0.2%	120	681.5	681.4	-	681.3	72%
8	19.8	67	67%	18,355	1.6	2.0	660.5	661.5	662.0	Carrot Creek	376	675	23	0.3%	460	660.5	660.4	-	660.2	82%
9	65.7	82	80%	73,152	4.4	5.4	662.0	663.5	664.0	SWMF #8	327	750	709	0.1%	419	662.0	661.0	660.5	-	78%
10	33.6	66	66%	31,044	1.8	2.4	662.0	663.5	664.0	Carrot Creek	84	375	37	0.6%	139	662.0	661.8	-	661.6	61%
11	64.9	82	80%	72,284	4.3	5.3	666.0	667.5	668.0	SWMF #9	162	450	651	0.5%	209	666.0	662.5	662.0	-	78%
12	31.0	68	68%	29,388	1.7	2.3	666.0	667.5	668.0	Carrot Creek	78	375	41	0.4%	116	666.0	665.8	-	665.6	67%
13	50.0	75	74%	51,473	3.0	3.8	670.5	672.0	672.5	Carrot Creek	634	525	41	2.5%	676	670.5	669.5	-	669.0	94%
14	66.8	81	79%	73,421	4.4	5.4	676.0	677.5	678.0	SWMF #13	509	600	488	1.0%	622	676.0	671.0	670.5	-	82%
15	65.6	82	80%	73,074	4.4	5.4	680.0	681.5	682.0	SWMF #14	342	600	982	0.4%	367	680.0	676.5	676.0	-	93%
16	71.2	82	80%	79,266	4.8	5.8	683.0	684.5	685.0	SWMF #15	178	525	721	0.3%	254	683.0	680.5	680.0	-	70%
17	73.8	69	68%	70,210	4.2	5.2	675.5	677.0	677.5	Carrot Creek	184	450	42	1.0%	287	675.5	675.1	-	674.6	64%
18	20.3	55	56%	15,943	0.8	1.3	678.0	679.5	680.0	Carrot Creek	206	450	45	0.9%	278	678.0	677.6	-	677.1	74%
19	61.9	81	79%	67,930	4.1	5.0	683.0	684.5	685.0	SWMF #18	155	375	409	1.1%	184	683.0	678.5	678.0	-	84%
20	38.3	59	60%	31,994	1.8	2.5	680.5	682.0	682.5	Carrot Creek	96	300	25	3.2%	174	680.5	679.7	-	679.2	55%

Notes:
1. Precipitation assumes a 100-year, 24-hour design storm.
2. Carrot Creek allowable release rate is set to 2.5 L/s/ha.
3. HWL is set to the minimum of 0.5 m below ground elevation.
4. NWL is set to the maximum of 1.5 m below HWL elevation (live depth of 1.5 m).
5. Pond depth at NWL is set to minimum 2.5 m depth.
6. Pond bottom to NWL requires 5:1 H:V side slopes with a 3.0 m safety ledge (submerged 0.6 m).
7. Above NWL the maximum side slopes are set to the maximum allowable at 7:1 H:V.
8. The public utility lot is 10.0 m from the inside edge of the safety ledge.
9. The easement beyond the PUL is a maximum of 6.5 m beyond that.
10. SWMFs #5-8 require 1.0 m live depths due to vertical constraints.
11. SWMFs #6-7 require berms to protect development near the ponds since the freeboard was removed due to vertical constraints.
12. SWMFs #6-7 will require spillways to be designed to spill directly to the creek and to avoid and potential inundation of private property.
13. SWMFs #5, #10 and #14 are designed on either side of a proposed roadway with an interconnecting trunk to keep them hydraulically connected.
14. It is assumed that the minimum pipe size is 300 mm.
15. SWMF outlets are to be integrated with the local minor system to save servicing costs.
16. D/S invert elevations are assumed to be 0.5 m above NWL where possible, and have been reduced in some areas to maintain positive grade.

5.3.2 Stormwater Management Facility Sizing

The calculated pond volume is based on the storage of the 100-year rainfall event over each SWMF catchment, based on the runoff coefficients. From these volumes and knowing standard side slope and pond depth requirements, the SWMF areas have been calculated. The live storage for each pond ranges from 1.0 – 1.5 m in depth based on vertical constraints and freeboards are designed to be 0.5 m above the HWL.

5.3.3 Outlet Pipe Alignments

Storm pond outlet trunks have been designed assuming the ponds were connected in-series. Each outlet trunk conveys the runoff from upstream catchments and ponds at 2.5 L/s/ha as well, thus, the pipes are sized based on the cumulative catchment area whereas the pond volume is designed for its specific catchment volume (inflow and outflow from upstream catchments is assumed to be identical in this scenario at 2.5 L/s/ha).

5.4 Adjacent Development Area Considerations

The location of the proposed SWMF in the southwest corner of Avenir will need to be shifted north by approximately 10 m to provide a suitable utility right-of-way for the wastewater forcemain from the proposed lift station west of Carrot Creek. The SWMF design needs to accommodate both the right-of-way, but also adequate workspace between the SWMF and the railway right-of-way to facilitate future construction. It is expected that the SWMF will be constructed several years before development commences on the west side of Carrot Creek.

The proposed stormwater servicing boundary is consistent with the proposed servicing boundary from the Erin Ridge North stormwater servicing concept. It is also the same as the proposed wastewater servicing boundary for the preferred wastewater servicing option (Option 1A). This servicing area boundary is shown on **Map 5.1**.

6.0 Conclusions and Recommendations

6.1 Conclusions

6.1.1 Land Use Planning

- The Northwest Annexation Area is the largest sub-area within the Annexation Area and has the highest availability of developable lands, including 444.60 ha of net developable employment lands and 246.97 ha of net developable residential land.
- At full buildout, the Annexation Area will be home to 12,276 dwellings and 32,933 residents. The Northwest Annexation Area will host 9,879 of the total dwellings and 26,503 of the total population, which means that around 80.5% of the expected growth in the Annexation Area will be located in the Northwest Annexation Area.
- The employment lands within the Annexation Area will be primarily developed with light industrial uses (65%) and major commercial uses (20%), followed by offices (10%) and ancillary retail uses (5%). A significant portion of the major commercial uses are expected to be accommodated around the St. Albert Trail corridor; however, the aggregate percentage shares are expected to be consistent throughout the Annexation Area.
- The Annexation Area is expected to create 15,336 new jobs most of which will be concentrated on major commercial areas (33%) and offices (32%), followed by light industrial developments (26%) and ancillary retail uses (9%).
- The Annexation Area will also have approximately 12,189,938 ft^2 of employment development, most of which will be dedicated to light industrial uses (59%) and major commercial uses (23%), followed by offices (13%) and ancillary retail uses (5%).

6.1.2 Transportation

- The recommended Annexation Area Roadway Network is expected to sufficiently accommodate future vehicle demand created by developing the Northwest Annexation Area.
- St Albert Trail, Ray Gibbon Drive, and 127 Street expected to be over capacity once the City is fully developed. These are key north-south roadways.

6.1.3 Wastewater

- The North Interceptor Trunk can accommodate the proposed Northwest Annexation Area if the orifice openings are adjusted as development in the annexation area proceeds.
- The most cost-effective way to service the Northwest Annexation Area east of Carrot Creek (excluding Erin Ridge North service area) is through the Avenir Neighbourhood.
- The Pump Station #4 sub-area within the Erin Ridge North service area can be serviced to the North Interceptor Trunk at a lower incremental cost than the cost to construct Pump Station #4.
- Carrot Creek represents a significant constraint to conveying wastewater flows from the west side of the creek to the North Interceptor Trunk. A syphon crossing will be required, and it will need to be located a minimum of about 1 km north of the North Interceptor Trunk due to elevation constraints at the upstream end of the trunk.
- The lands in the southwest corner of the Northwest Annexation Area will need to be serviced to the North Interceptor Trunk with a pump station and forcemain.

6.1.4 Stormwater

- A portion of the Northwest Annexation Area west of the ridge west of Carrot Creek naturally drains to the upper Sturgeon River and is proposed to be serviced to Carrot Creek.
- Stormwater servicing for the Northwest Annexation Area is feasible using conventional stormwater servicing techniques.
- The lands along the west edge of the Northwest Annexation Area will be more challenging to service due to the ridge west of Carrot Creek. This may impact development staging.
- Some stormwater management facilities adjacent to Carrot Creek will require a reduced depth of active storage due to elevation constraints. This will result in a greater footprint for these facilities.
- The west boundary of Erin Ridge North stormwater servicing concept can be used for the Northwest Annexation area, with lands west of the boundary being serviced to Carrot Creek. It is also the same servicing area boundary for the preferred wastewater concept.

6.2 Recommendations

6.2.1 Transportation

- The recommended Annexation Area Roadway Network be adopted and applied for future planning applications and long-term municipal plans.
- The City consider further study into alleviating congestion on the key north-south corridors. This may include exploring ways to increase commuter transit ridership or revisiting the Ray Gibbon Drive Functional Plan.

6.2.2 Wastewater

- The recommended wastewater servicing option for the Northwest Annexation Area (excluding Erin Ridge North Pump Station service area) is Option 1A as described below:
  - All lands east of Carrot Creek (including Erin Ridge North Pump Station #4 service area) should be serviced through the Avenir Neighbourhood to the North Interceptor Trunk. This results in the wastewater servicing boundary between the Erin Ridge North Lift Station and the North Interceptor Trunk being consistent with the stormwater basin boundary between Erin Ridge North and Carrot Creek.
  - The majority of the Northwest Annexation Area west of Carrot Creek should connect to the downstream end of the Avenir Trunk approximately 1 km north of the North Interceptor Trunk utilizing a syphon crossing of Carrot Creek.
  - The remaining service area west of Carrot Creek should be serviced by a pump station and forcemain to the North Interceptor Trunk.

6.2.3 Stormwater

- As part of the concurrent Carrot Creek Regional Master Drainage Plan, the City should advise Alberta Environment and Parks of the proposed diversion of a small portion of the upper Sturgeon River watershed to Carrot Creek.
- The stormwater servicing concept presented in Maps 5.1 and 5.2 should form the basis for future servicing for the Northwest Annexation Area. This confirms the stormwater basin boundary between the Erin Ridge North stormwater basin and the Carrot Creek basin.
- The City should establish a utility right-of-way in the Avenir Neighbourhood immediately north of the railway right-of-way for the future construction of a wastewater forcemain servicing lands west of Carrot Creek. This will require the location of the proposed SWMF immediately east of Carrot Creek to be adjusted.

APPENDIX A

North Interceptor Trunk Modelling Analysis Details

Appendix A North Interceptor Trunk Modelling Analysis Details

A.1 Modelling Methodology

The northwest annexation area is anticipated to begin development in the long term with areas on the east side of Carrot Creek and City infill expected to happen first. As such, the potential for the NIT to service the northwest annexation area was assessed based on the available capacity in the trunk under ultimate development within the pre-annexation area boundary. For this modelling assessment, the model from the St. Albert Sanitary I/I Study, 2019, was used.

For the modelling analysis of the North Interceptor Trunk, the ADWF projections have been added to the model and peak dry weather flow has been assessed using the following diurnal curves for residential and ICI development based on the City of St. Albert I/I Study (2019) and are shown on **Figures A.1** and **A.2**, respectively.

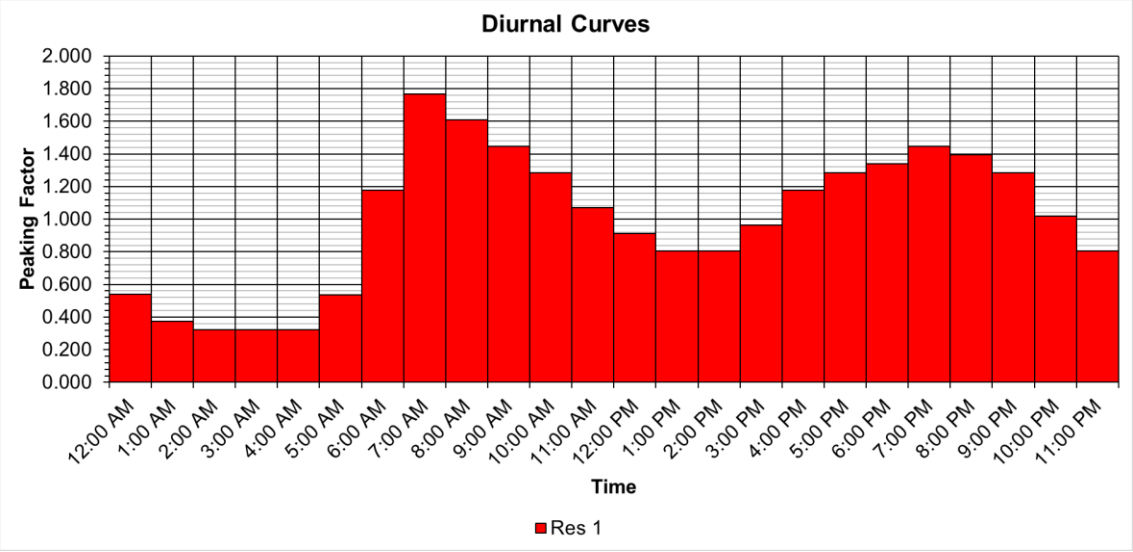

Figure A.1: Residential Diurnal Curve for NIT Modelling Assessment

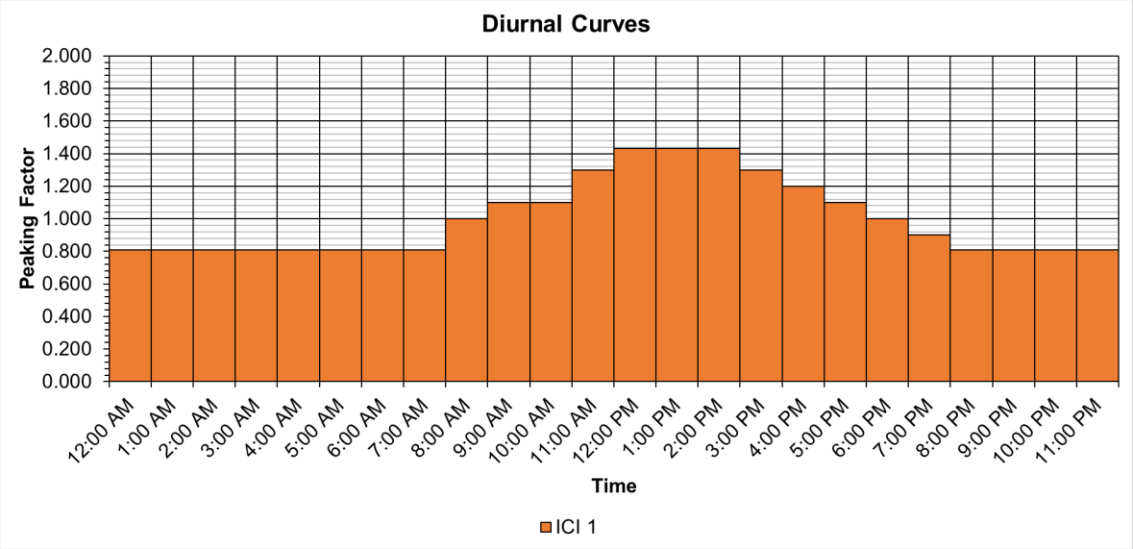

Figure A.2: ICI Diurnal Curve for NIT Modelling Assessment

Peak wet weather flow (PWWF) was assessed using calibrated rainfall-dependent inflow and infiltration (RDII) modelling parameters as shown in **Table A.1**. RDII parameters are defined based on a sanitary sewer system's short-term, medium-term and long-term response to rainfall, where:

- R refers to the percentage of rainfall volume that enters the sanitary sewer system;
- T refers to the "time to peak" and describes the time since the onset of the storm until a peak flow rate is experienced in the sewer; and
- K is a ratio of time to recession of the flow hydrograph to the time to peak.

These calibrated values are based on a calibrated I/I rate of 0.2 L/s/ha in the sanitary model as per the 2019 I/I report.

Table A.1: Calibrated RDII parameters

Response	R	T	K
Short-Term	0.00175	2.5	0.25
Medium-Term	0.00175	2.5	0.25
Long-Term	0.00175	2.5	0.25

The annexation area wastewater generation have been lumped together and placed at the upstream end of the NIT which is a conservative estimate since the model does not account for on-site sewer trunk storage volume and routing effects.

A.2 Future Development Impact on Existing North Interceptor Trunk and Orifices

This section has analyzed the existing NIT and orifice configuration with the future ultimate development wastewater flows with and without the northwest annexation area. It should be noted that the north and northeast annexation areas (east of Highway 2) have not been modelled in these scenarios.

To evaluate the impact of the northwest annexation area on the NIT and the current orifice sizes, two model scenarios were run in tandem:

1. **Scenario 1:** Ultimate development within the pre-annexation boundary using the current NIT and orifice configuration; and
2. **Scenario 2:** Adding the northwest annexation area ADWF projections with the modelling parameters from **Section A.1** into a second scenario to evaluate the net change / impact on the NIT.

Figure A.3 summarizes the hydraulic grade line (HGL) profiles from the upstream NIT (near CN Railway and Old McKenney Avenue) to the SAPS. The profiles show that ultimate development within the pre-annexation boundary uses approximately 50% of the upstream NIT capacity, implying some capacity for initial annexation area development; however, as the full area is developed, there is significant surcharging and flooding to the ground surface due to the orifices limiting the capacity.

The PWWF to the SAPS during both scenarios is summarized below:

1. **Scenario 1:** 1,556 L/s; and
2. **Scenario 2:** 1,583 L/s.

Due to the surcharging, flooding and orifice limitations during Scenario 2, the increase in flows to SAPS is small and is not representative of the total flow anticipated at SAPS when the orifice sizes are optimized.

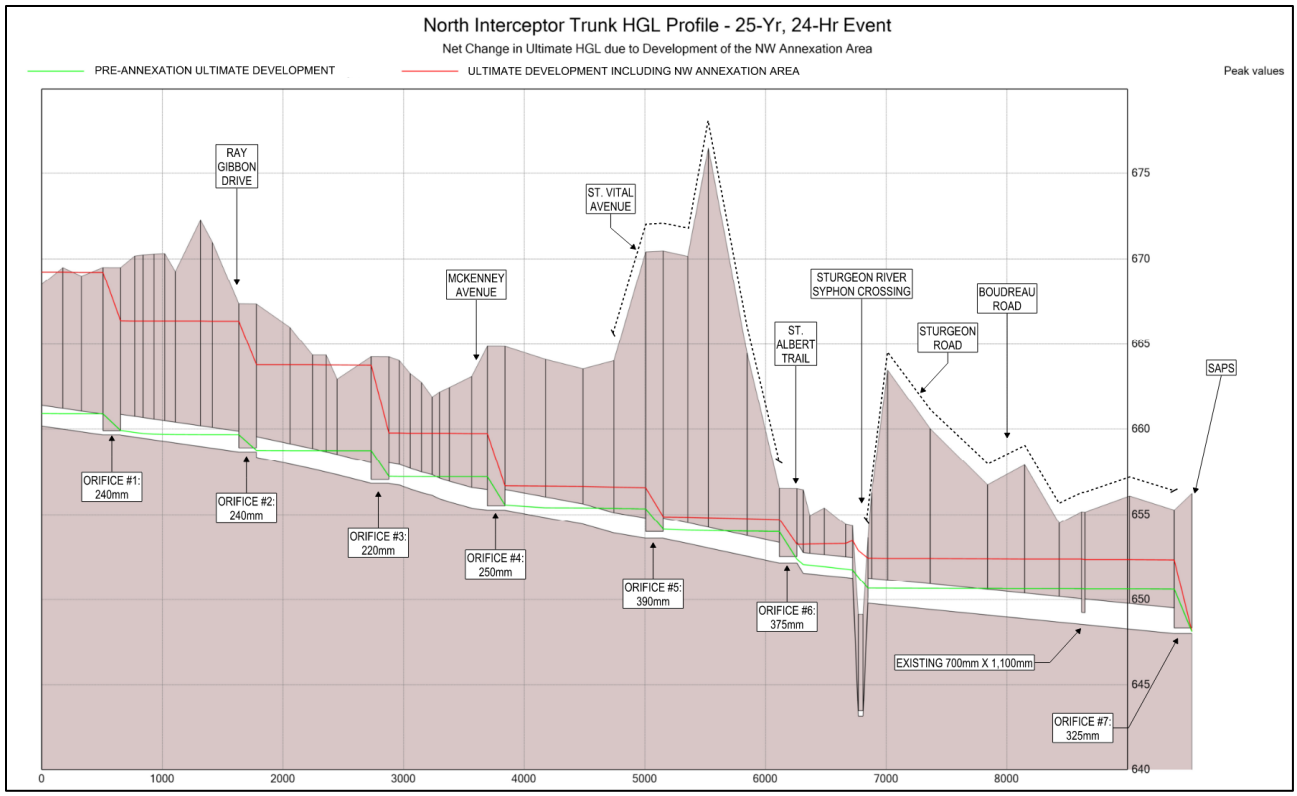

Figure A.3: Net Change in NIT HGL due to development of the northwest annexation area

A.3 North Interceptor Trunk Orifice Settings Refinement

Several model runs were evaluated to optimize the capacity and storage volume within the NIT and are summarized in **Table A.2**.

Table A.2: NIT Orifice Optimization Scenarios

Scenario	Orifice #1	Orifice #2	Orifice #3	Orifice #4	Orifice #5	Orifice #6	Orifice #7
Location	W of Rge Rd 255A along Railroad	E of Ray Gibbon Dr along Railroad	S of Legacy Terrace SWMF along Railroad	E of McKenney Avenue along Railroad	Intersection of Malmo Ave and St Vital Ave	Intersection of St Vital Ave and St. Albert Trail	At St. Albert Pump Station (SAPS)
Orifice Diameters (mm)							
Run 1 (Existing Size)	240	240	220	250	390	375	325
Run 2 (No Orifices)	-	-	-	-	-	-	-
Run 3	375	375	450	450	450	525	525
Run 4	375	300	375	450	450	450	450
Run 5	375	325	325	400	425	450	400

As shown in **Figure A.4**, the optimized orifice sizes for the development of the northwest annexation area are shown (Run 5) and have been selected to maximize the use of storage within the NIT, maintaining a peak HGL at or below the obvert at the upstream end of the NIT and maintaining a depth to peak HGL of at least 2.5 m along the entire trunk length.

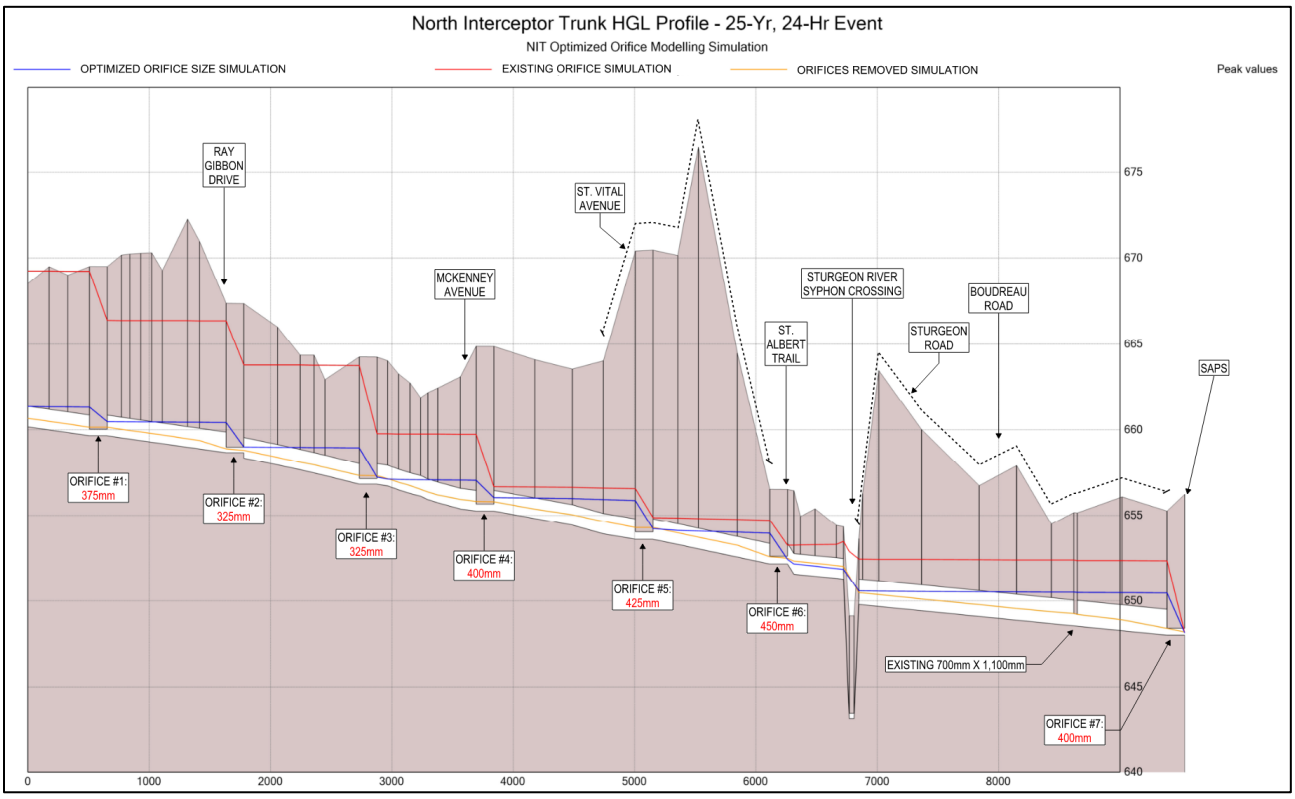

Figure A.4: Optimized orifices modelling simulation – 25-year, 24-hour design event

A summary of total flow to the SAPS (excluding north and northeast annexation areas) is summarized below for each of the scenarios:

1. Run 1 (Existing Orifices): 1,583 L/s
2. Run 2 (No Orifices): 2,228 L/s
3. Run 3: 1,900 L/s
4. Run 4: 1,781 L/s
5. Run 5: 1,707 L/s

In each scenario, the total flow to SAPS is less than the capacity of the ultimate SAPS configuration (2,400 L/s). As shown, Run 1 shows that ultimate development flows surcharge and flood when using the existing orifice configuration which reduces the total amount of flow anticipated at SAPS to 1,583 L/s. To reduce surcharging and flooding impacts, the orifices were removed to evaluate the potential of the NIT to convey flows without storage, and the result is an increase in total peak flow to SAPS of 2,228 L/s. Additional model runs were conducted to minimize the surcharging / flooding risk while also maintaining a reasonable peak flow to SAPS. As a result, Run 5 shows that the total peak flow to SAPS can be lowered to 1,707 L/s during ultimate development while the NIT conveys northwest annexation area flows without any significant surcharging / flooding risks. Additionally, the upstream peak HGL of the NIT is near the obvert implying low risk to the Cherot / Avenir ASP area that connects at this point.