CITY OF EDMONTON ANNEXATION APPLICATION

APPENDIX 6.0

INFRASTRUCTURE SERVICEABILITY REPORT

MARCH 2018

Edmonton

REPORT

City of Edmonton

Leduc Annexation

Infrastructure Serviceability Report

April 20, 2018

Associated Engineering

GLOBAL PERSPECTIVE. LOCAL FOCUS.

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Executive Summary

The City of Edmonton (City) and municipalities in the Capital Region have experienced rapid growth over the last decade. Due to this growth, on March 5, 2013, Edmonton City Council issued a motion to initiate a process of land annexation from Leduc County. The proposed City annexation areas consist of southwest and southeast lands, located within Leduc County. The total gross area for the proposed annexation is estimated to be 8,267 hectares (ha).

The southwest annexation area is located west of the Queen Elizabeth II (QE II) Highway (Hwy), and covers approximately 6,233 ha (excluding the Edmonton International Airport and the QE II Hwy corridor). The southeast area is located east of Range Road 243 (Rge Rd) and covers approximately 2,034 ha. These annexation land areas are inclusive of environmental reserves. On November 30, 2016, the City and Leduc County signed a framework agreement to annex the subject lands.

This report summarizes the infrastructure serviceability of the proposed annexation areas, focusing on water, wastewater, stormwater, and transportation networks. It presents high-level, potential servicing concepts for the four infrastructure components. The report presents estimates of capacities and capital costs for the infrastructure identified, considering the proposed annexation lands and future regional growth areas[1], within other municipal jurisdictions, as presented in **Figure 2-1**. This is in keeping with the City's preferred regional approach to planning**.** The infrastructure capacities presented in this report are high-level approximations, which will be superseded by subsequent detailed studies, including Area Structure Plans (ASP) and Neighbourhood Structure Plans (NSP).

The following outlines the general conclusions and recommendations of this report:

1 WASTEWATER COLLECTION

Upon full development, the proposed annexation areas and adjacent municipalities' areas are anticipated to generate peak wet weather sanitary flows (PWWF), in the order of 6.9 m^3/s, increasing to approximately 10.0 m^3/s for the future regional growth area[1]. The proposed annexation areas will be serviceable predominantly through a gravity system comprised of trunk sewers ranging from 900 mm to 2,920 mm in diameter. The ultimate servicing concept for the annexation areas will require improvements to the existing City's South Edmonton Sanitary Sewer (SESS), which is proposed to be upgraded to 3,300 mm.

It is recommended that further detailed investigations be undertaken to assess the effects of the annexation areas on the SESS mains. This will be necessary to establish both interim SESS servicing capabilities and to confirm long-term sizing and timing of future expansion.

[1] Future regional growth areas refer to lands outside of the City's proposed annexation that have been identified for development as metro areas by Capital Region Board. These are defined in Figure 2-1 of this report.

2 WATER

It is envisioned that the existing E.L. Smith Water Treatment Plant (WTP) will be a suitable source of water supply for the annexation areas. The proposed ultimate concept for servicing the annexation areas has been sized to include the potential future regional growth areas and communities currently serviced by the Capital Region Southwest Water Services Commission (CRSWSC). The distribution system will have capacity to supply 312 Million Litres per Day (312 MLD) of water to the proposed annexation and future regional growth areas, including the CRSWSC customers, through a pumped system of transmission mains, ranging from 400 mm to 1500 mm equivalent pipe diameters. The servicing concept will also include reservoirs and booster pump stations.

It is recommended that the proposed annexation and all regional growth areas be modelled under EPCOR Water Services Inc.'s direction, to determine the size and alignments of future watermains. The water infrastructure presented in this report will be superseded by subsequent detailed studies, including ASPs and NSPs.

3 STORMWATER MANAGEMENT

It is proposed that stormwater trunk mains from the annexation areas will outfall to watercourses within their catchments. It is also proposed, as is standard practice, that stormwater management facilities will be constructed in the annexation areas to control flows to pre-development levels.

It is anticipated that Irvine Creek will require significant improvements to service the proposed southeast annexation area and accommodate upstream flows. A review of the available studies and existing topographic information indicates poor hydraulic capacity and flooding in some sections of the creek. Improvements to Irvine Creek will be required to facilitate proper conveyance of flows. A detailed analysis is recommended to confirm improvements required for Irvine Creek.

Cawes Lake, located in the southeast annexation area, has been identified to provide stormwater attenuation for 980 ha of residential development. However, the feasibility of providing stormwater attenuation in Cawes Lake will need to be analyzed further to establish the most cost effective and sustainable solution.

At the time of writing this report, a Surface Water Management Study for the Blackmud/Whitemud basin was being conducted. It is recommended that the stormwater infrastructure concept presented in this report be reviewed once the findings of this study are published.

4 TRANSPORTATION NETWORK

The City of Edmonton can address the transportation infrastructure needed for the proposed annexation lands to be integrated into the transportation network for the Capital Region, including roads, transit service, and active transportation networks.

It is recommended that the City continue to work with the Capital Region Board to identify regional network upgrades. The City should update the transportation Demand Model with the land use and employment information for the annexation areas to confirm capacity upgrades necessary, within the current and future City boundaries. It is also recommended that the City work with EIA to co-ordinate supporting road and transit infrastructure for the airport and determine the impacts of the revisions to the Airport Vicinity Protection Area Plan (AVPA) and Federal Zoning Regulations.

5 SUMMARY OF COSTS

Table ES-1 summarizes the conceptual costs for the proposed infrastructure to service the annexation lands.

Table ES-1
Summary Costs (2018 Dollars)

Item	Phase 1	Phase 2	Phase 3	Total
Wastewater	$654,960,000	$134,530,000	$16,870,000	$806,360,000
Water	$47,170,000	$66,620,000	$4,340,000	$118,130,000
Stormwater**	$12,000,000			$12,000,000
Transportation	$815,000,000	$1,105,000,000	$358,000,000	$2,278,000,000
Total	**$1,529,130,000**	**$1,306,150,000**	**$379,210,000**	**$3,214,490,000**

* Cost estimates were prepared using average unit rates derived from infrastructure construction projects in green fields that have been completed by Associated Engineering.

** Cost covers hard armouring the channel with rip-rap for erosion protection.

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1 Introduction

The City of Edmonton (City) and municipalities in the Capital Region have experienced rapid growth over the last decade. Due to this growth, on March 5, 2013, City Council issued a motion to initiate a process of land annexation from Leduc County. The City's proposed annexation covers lands south of its current corporate boundary (41 Avenue SW), are shown in **Figure 1-1**.

Associated Engineering (AE) was retained by the City to assess the infrastructure serviceability of the proposed annexation areas. This report summarizes the infrastructure serviceability of the proposed annexation areas, focusing on water, wastewater, stormwater, and transportation networks. It presents high-level, potential servicing concepts for the four infrastructure components. In addition, it presents estimates of capacities and capital costs for the infrastructure identified, considering the proposed annexation lands and future regional growth areas[2], within other municipal jurisdictions. This is in keeping with the City's preferred regional approach to infrastructure planning.

The concepts presented in this report are based on a high-level desktop analysis that involved the review of available information and estimating infrastructure requirements. Detailed feasibility studies that involve modelling will be required to validate the servicing concepts and identify alternative options. The infrastructure capacities presented in this report are high-level approximations, which should be verified by subsequent studies.

[2] Future regional growth areas refer to lands outside of the City's proposed annexation that have been identified for development as metro areas by Capital Region Board. These are defined in Figure 2-1 of this report.

Associated Engineering

Legend:

- Proposed Annexation Area - SW
- Proposed Annexation Area - SE
- Edmonton International Airport
- Existing Urban Municipality

THE CITY OF Edmonton

FIGURE No. 1-1

CITY OF EDMONTON
ANNEXATION PROPOSAL

PROPOSED ANNEXATION

AE PROJECT No.	2015-3360
SCALE	1:90,000
APPROVED	
DATE	MARCH 2018
REV	
DESCRIPTION	FINAL REPORT

2 Study Area

2.1 ANNEXATION AREA AND ANTICIPATED 50 YEAR GROWTH AREA

The proposed City annexation areas consist of the southwest and southeast lands, located in Leduc County. The southwest annexation area is located west of the QE II Highway, and covers approximately 6,233 ha. The southeast area is located east of Rge Rd 243 and covers approximately 2,034 ha of. These figures are gross areas and includes environmental reserves.

The topography of the southeast annexation area generally falls from east to west, ranging in elevation from 735 m in the east to 690 m in the west adjacent to the Blackmud Creek. The southwest annexation area generally ranges from a maximum of 720 m in the northeast, to 695 m in locations close to the North Saskatchewan River.

It is assumed that the annexation areas will be absorbed by growth, south of 41 Avenue SW, in the next 50 years. Sound long range planning of infrastructure needs to consider lands that can be readily serviced. Using the City's land use vision and the Capital Region Board's (CRB) Draft Edmonton Metropolitan Regional Structure concept (May 26, 2016), some areas outside of the proposed annexation were identified for future/ultimate regional growth years, that may or may not be developed by the City. **Figure 2-1** presents the proposed City annexation lands and future regional growth areas. These areas have been included in this infrastructure serviceability assessment.

2.2 LAND USE

A breakdown of the land use was developed for the proposed annexation and future regional growth areas, based on the City's land use vision and the CRB's draft Edmonton Metropolitan Regional Structure concept (May 26, 2016). **Figure 2-2** presents a breakdown of the land use in the proposed southwest and southeast annexation areas, and the future regional growth areas. **Table 2-1** summarizes the total developable area and gross areas in the proposed southwest and southeast annexation lands. The total gross area for the proposed annexation lands is estimated to be 8,267 ha, excluding future regional growth areas.

The land use breakdown, shown in **Figure 2-2**, is a high-level concept, which was used to estimate the population and to assess infrastructure needs for the proposed annexation and the future regional growth areas.

Table 2-1
Summary of Estimates for Area Requirements in the Annexation, Adjacent Municipalities and Future Regional Growth Areas

Area	Southwest Area[3] (Hectares)	Southeast Area[3] (Hectares)	Future Regional Growth Area (Hectares)
Residential (including country residential)	2,008	1,709	1,983
Industrial and commercial	3,242	0	2,274
Total – Developable Area	**5,250**	**1,709**	**4,257**
Environmental reserves	983	325	436
Total – Gross Area	**6,233**	**2,034**	**4,693**

2.3 POPULATION

The Draft City of Edmonton Growth Study, March 2018, estimates the total residential population for the City's proposed southwest and southeast annexation areas to be **217,450**. Table 2-2 below summarizes the population figures that were used to calculate demands and estimate infrastructure requirements for the City's proposed annexation areas.

Table 2-2
City's Population Estimates for the Proposed Annexation Areas

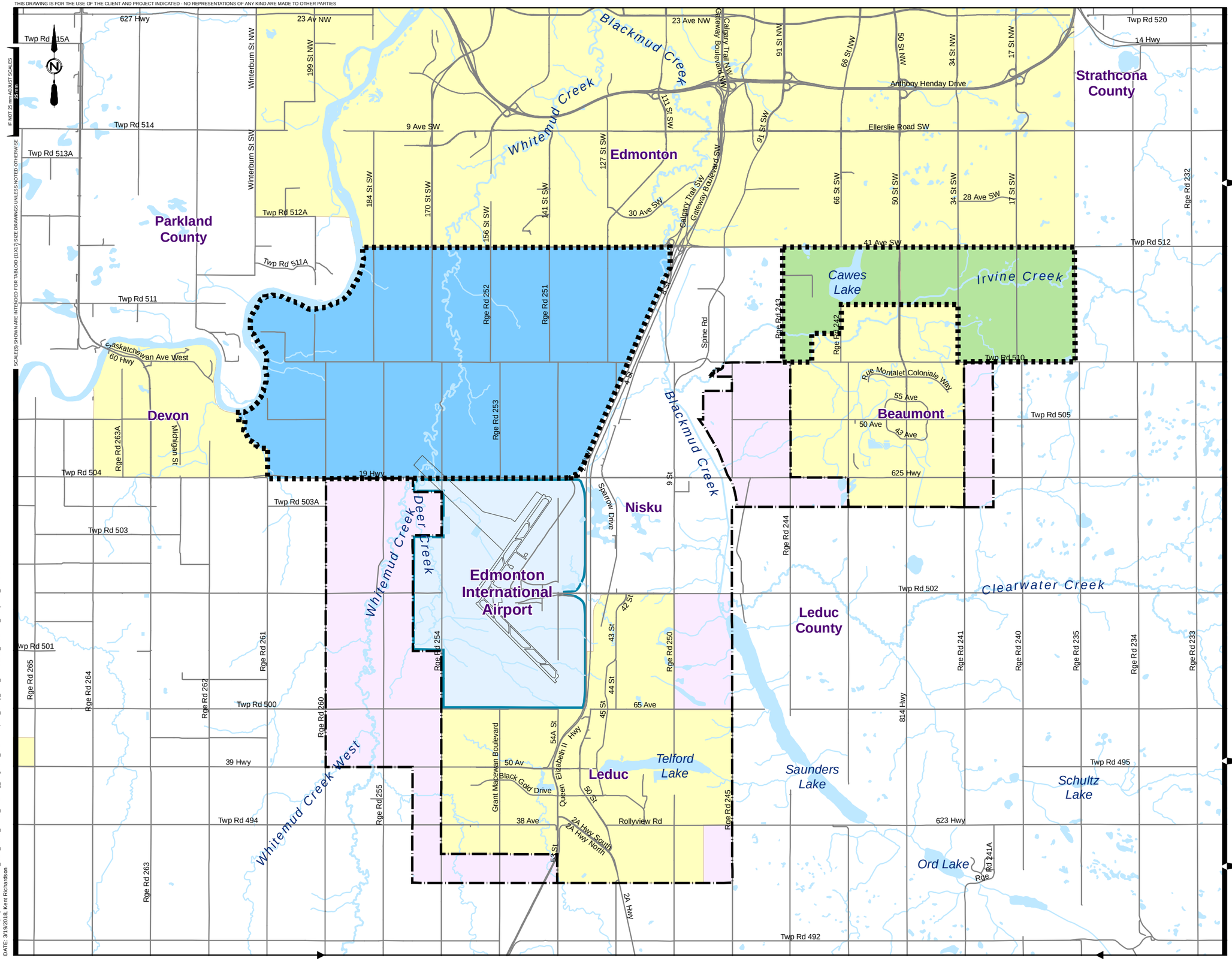
Annexation Area	Population
Southwest residential	
• East of Whitemud Creek	97,000
• West of Whitemud Creek	36,000
Southeast residential	84,450
Total	**217,450***

** Includes the current City's proposed annexation areas only. Population figures have been rounded up.*

The population figures presented in Table 2-2 were obtained from the DRAFT City of Edmonton Growth Study, March 2018. These were based on the following Capital Region Board target densities and dwelling units per net hectare (du/net ha):

- 45 du/net ha in the southwest annexation area, east of Whitemud Creek (between QE II Highway and Whitemud Creek).
- 35 du/net ha in the southwest annexation area, west of Whitemud Creek.
- 35 du/net ha in the southeast annexation area.

[3] At the time of completing this report, the annexation gross areas, densities, and population figures were under review as part of the Growth Study. These will be updated once the Growth Study is finalized.



Legend:

- Proposed Annexation Area - SW
- Proposed Annexation Area - SE
- Future Regional Growth Area
- Edmonton International Airport
- Existing Urban Municipality

Associated Engineering

THE CITY OF Edmonton

FIGURE No. 2-1

CITY OF EDMONTON
ANNEXATION PROPOSAL

PROPOSED ANNEXATION LANDS
& FUTURE REGIONAL GROWTH AREAS

AE PROJECT No.	2015-3360
SCALE	1:100,000
APPROVED	
DATE	MARCH 2018
REV	
DESCRIPTION	FINAL REPORT

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DATE: 3/19/2018, Kent Richardson

Associated Engineering

Parkland County
Devon
Edmonton
Nisku
Beaumont
Leduc
Leduc County
Edmonton International Airport

Twp Rd 512A
Twp Rd 511A
Twp Rd 510
Twp Rd 503A
Twp Rd 502
Twp Rd 500
Twp Rd 505
Twp Rd 495
Twp Rd 494
Twp Rd 512
30 Ave SW
28 Ave SW
41 Ave SW
55 Ave
50 Ave
43 Ave
65 Ave
38 Ave
39 Hwy
19 Hwy
625 Hwy
623 Hwy
814 Hwy
Airport Road
Rollyview Rd
Black Gold Drive
Coloniale Way
Rue Montalet
Sparrow Drive
Spine Rd
Grant Macewan Boulevard
Queen Elizabeth II Hwy
C. W. Gaetz Road
2A Hwy South
2A Hwy North
2 Hwy

184 St SW
170 St SW
156 St SW
141 St SW
66 St SW
50 St SW
34 St SW
17 St SW
Rge Rd 252
Rge Rd 251
Rge Rd 253
Rge Rd 243
Rge Rd 242
Rge Rd 234
Rge Rd 244
Rge Rd 262
Rge Rd 261
Rge Rd 260
Rge Rd 254
Rge Rd 250
Rge Rd 241
Rge Rd 240
Rge Rd 235
Rge Rd 241A
Rge Rd 225
8 St
4 St
6 St
69 St
42 St
43 St
44 St
45 St
46 St
50 St
54A St

Cawes Lake
Irvine Creek
Blackmud Creek
Whitemud Creek
Whitemud Creek West
Deer Creek
Telford Lake
Saunders Lake
Clearwater Creek
Ord Lake
Schultz Lake

Legend:
- Proposed Annexation Area
- Future Regional Growth Area
- Existing Urban Municipality
- Edmonton International Airport

Land Use
- Residential
- Industrial / Business
- Environmental Reserve

THE CITY OF Edmonton

FIGURE No. 2-2

CITY OF EDMONTON
ANNEXATION PROPOSAL

PROPOSED
LAND USE

AE PROJECT No.	2015-3360
SCALE	1:75,000
APPROVED	
DATE	MARCH 2018
REV	
DESCRIPTION	FINAL REPORT

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DATE: 3/16/2018, Kent Richardson

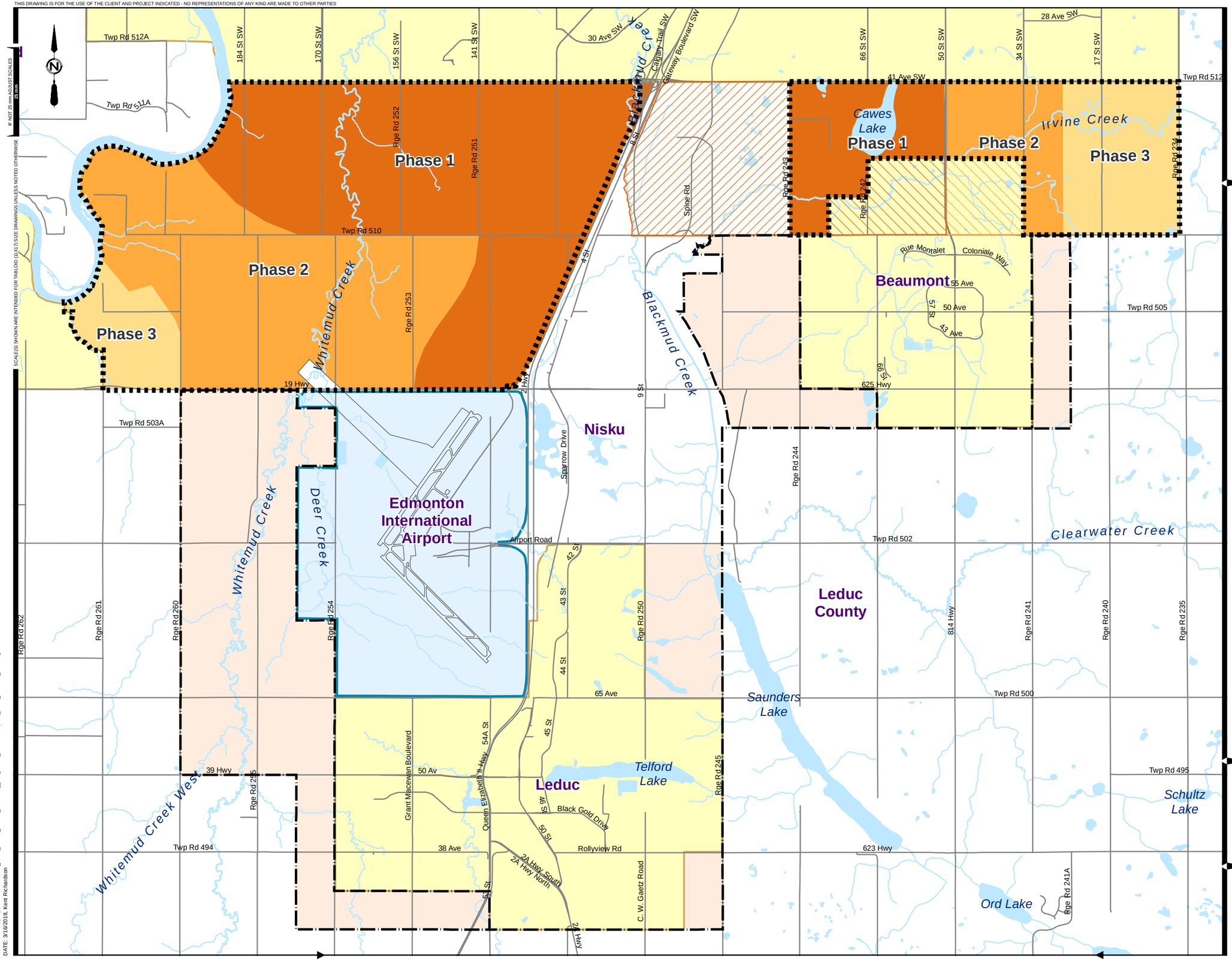
2.4 PHASING

A conceptual phasing plan was developed for the proposed annexation, Leduc County and Beaumont land, and the future regional growth areas to illustrate the potential consumption of land over time and the sequencing of infrastructure delivery. **Figure 2-3** presents the conceptual phasing plan showing the potential sequencing of infrastructure delivery. It is anticipated that each phase will take 10 – 20 years to develop.

The following assumptions were made in developing the conceptual phasing plan for the annexation areas:

- The City's proposed southwest and southeast annexation lands would be consumed within 50 years.
- For this study, the future regional growth areas identified will be utilized to accommodate future growth.
- Development on the southwest annexation area, would progress southwards from 41 Avenue towards the Edmonton International Airport and west towards the North Saskatchewan River.
- Development on the southeast annexation area would progress eastwards from Rge Rd 243 towards the annexation boundary on the east.
- It is assumed that development of Leduc County's land located between Rge Rd 243 (City's western annexation boundary on the SE) and QE II Highway will occur at the same time as the City's Phase 1.
- Development of Beaumont's annexation lands, north of Twp Rd 510, is assumed to occur at the same time as the City's Phase 1 and 2.
- Developments in Phase 1 will benefit from connecting into the City's existing major transportation, water, stormwater and sanitation infrastructure and any planned upgrades near to the development area.
- Development within each phase will be adjacent to previously developed land. This will ensure availability of infrastructure to support development of subsequent phases. It will also facilitate efficient operation of infrastructure.

The conceptual phasing plan presented in **Figure 2-3** was developed for the purposes of assessing infrastructure serviceability and is based on the assumptions stated above. Ultimately, the City working alongside the other stakeholders will decide the final phasing strategy.



Legend:

- Phase 1
- Phase 2
- Phase 3
- Future Regional Growth Area
- Leduc County Land Assumed to be Developed in Phase 1
- Beaumont Land Assumed to be Developed in Phase 1
- Beaumont Land Assumed to be Developed in Phase 2
- Proposed Annexation Area
- Future Regional Growth Area
- Edmonton International Airport
- Existing Urban Municipality

Figures are conceptual and not to be used for construction. These will be superseded by ASP/NSPs.

FIGURE No. 2-3

CITY OF EDMONTON
ANNEXATION PROPOSAL

PROPOSED PHASING/INFRASTRUCTURE DEVELOPMENT SEQUENCING

AE PROJECT No.	2015-3360
SCALE	1:75,000
APPROVED	
DATE	MARCH 2018
REV	
DESCRIPTION	FINAL REPORT

3 Wastewater

Using the population and land use breakdown discussed in Section 2, design flows were calculated for the proposed annexation, adjacent municipalities and future regional growth areas. A review of the existing wastewater infrastructure (South Edmonton Sanitary Sewer (SESS) SA, SW and SE systems) located near the study area, was conducted to establish available capacity. An assessment of the required infrastructure was undertaken, considering the available capacity in the infrastructure downstream of the study area, which would receive the flow from the annexation areas. A high-level servicing concept capable of supporting development within the annexation lands, adjacent municipalities, and future regional growth areas was then identified. Phasing of required infrastructure was also identified and cost estimates were developed for both onsite[3] and offsite[4] infrastructure.

The following provides the design assumptions, existing infrastructure capacity, proposed wastewater servicing concept and cost estimates for the proposed infrastructure.

3.1 DESIGN ASSUMPTIONS

The following design assumptions were utilized in the development of the wastewater servicing concept.

3.1.1 Land Use

Projected land use for the Southwest and Southeast annexation areas, as discussed in Section 2, were used to assess the wastewater infrastructure. Population estimates were applied in conjunction with the land use breakdown to determine wastewater infrastructure concepts for the study area.

[4] In this report, onsite refers to infrastructure located within the annexation area. Offsite refers to infrastructure located outside the annexation area, and as the downstream portion of the sanitary system.

Design flows for the wastewater infrastructure assessment were based on the City's Design and Construction Standards, March 2015 (Ref: 4). The relevant criteria used are summarized below:

3.1.2 Design Flow

- Residential Land Use:
  - The per capita daily sewage flow generation is 300 L/day/person;
  - Peaking factor was determined as the larger of 1.5; or
    PF = 2.6 $P_{pf}^{-0.1}$ where P is the population in 1000's.
- Non-Residential Land Use:
  - 0.2 L/s/ha for average dry weather flow (ADWF); or
  - Peaking factor was determined as the larger of 2.5 (to a maximum of 25) where PF = 10 $Q_{AVG}^{-0.45}$.
- General Inflow/Infiltration Allowance of 0.28 L/s/ha was applied to all land uses.
- No allowance for Sag Manholes or Foundation Drains was made.

At the time of writing this report, the daily sewage flow generation of 300 L/day/person was applied, as per the City's Design and Construction Standards, March 2015. It is our understanding that the City and EPCOR will continue to review the daily sewage flow generation as water demands change.

Table 3-1 presents the design flows calculated for the City's proposed annexation lands, adjacent municipalities and future regional growth areas, based on the phasing discussed in Section 2.4**.**

Table 3-1
Wastewater Design Flows*

Design Flows	ADWF (m^3/s)	PDWF (m^3/s)	WWF (m^3/s)	PWWF (m^3/s)
Phase 1				
Total Residential	0.5	0.9	0.8	1.7
Total Non-residential	0.5	1.3	0.7	2.0
Total Phase 1	1.0	2.1	1.5	3.6
Phase 2				
Total Residential	0.6	1.0	1.0	2.0
Total Non-residential	1.1	2.8	1.5	4.3
Total Phase 2	1.7	3.8	2.5	6.3
Phase 3				
Total Residential	0.7	1.2	1.2	2.4
Total Non-residential	1.2	2.9	1.6	4.5
Total Phase 3	1.9	4.1	2.8	6.9

Design Flows	ADWF (m^3/s)	PDWF (m^3/s)	WWF (m^3/s)	PWWF (m^3/s)
Future Regional Growth Areas				
Total Residential	1.2	1.9	2.1	3.9
Total Non-residential	1.4	3.6	2.0	5.6
TOTAL DESIGN FLOW	3.1*	5.9*	4.6*	10.0*

**Includes flows from Leduc County, Town of Beaumont, and future regional growth areas. Total Design Flows include 0.5 m^3/s contribution from the Town of Devon. Flows from each subsequent phase include those from the previous one. All flows are rounded up.*

3.1.3 Pipe Design

- Pipe design capacities were calculated using the peak wet weather flows summarized in **Table 3-1** above. The capacities were based on 86% of the full pipe flow capacity.
- Only trunk mains equal to or greater than 900 mm in diameter are presented in this report.
- Minimum pipe slope of 0.1% was generally applied to all future trunk mains, except those located in areas where the topography was found to rise steeply.
- Manning's "n" value of 0.013 was applied.

3.1.4 Storage

- South Edmonton Sanitary Sewer (SESS) was designed to store 100% of the wet weather flow.
- Storage rates were determined based on 1.6 m^3/residential lot and 25.1 m^3/ha for non-residential land use.
- An average value of 2.6 people/lot was applied for residential land use.
- The following criteria was used to calculate storage volumes:
  - A drawdown pumping rate equal to the average dry weather flow plus the stored volume over 48 hours was considered.

3.1.5 Pipe Capacity

- The downstream pipe capacity used was obtained from the SESS Planning Update Study, 2014 (Ref: 2).
- Existing sanitary mains were assumed not to exceed 50% maximum utilization during ADWF.
- Existing combined sewers were assumed not to exceed 25% maximum utilization.

3.2 EXISTING CAPACITY

Figures 3-1 and 3-2 present the wastewater infrastructure needed to service the annexation lands, adjacent municipalities and future regional growth areas. They also show the existing sections of the SESS, as well as proposed upgrades downstream of the annexation areas. Limited information on the capacity of SESS was available at the time of completing this assessment. For the purposes of conducting this assessment, future sections of SESS, downstream of SA4 were assumed to be 2,920 mm in diameter, with a capacity of 6.5 m^3/s, based on the current catchment area (refer to Figures 3-1 and 3-2). As discussed in later sections, it is proposed to increase the diameter to approximately 3,300 mm and accommodate the annexation lands, adjacent municipalities and future regional growth areas. Information provided in the SESS Planning Update (Ref: 2) suggested that there may be some available capacity within the existing southwest section of the SESS line. However, it appears that the existing downstream sections (SA1 to SA4) have been constructed without excess capacity.

3.2.1 SESS Design Flow

A design flow of approximately 6.5 m^3/s (6,500 L/s) was assumed for the ultimate SESS System. This was based on the assumption that the Southeast Regional Trunk Sewer (SERTS) main would ultimately be redirected to the SESS system. The design flow was based on the projected 2040 design population and development area identified in the Sanitary Servicing Joint Planning Study for South Edmonton and Region, 2011. (Ref: 1) and using the high-level design criteria outlined in Section 3.1 of this report. It was then adjusted to exclude some lands located in the southeast and southwest that were included in the Sanitary Servicing Joint Planning Study for South Edmonton and Region, 2011. (Ref: 1). Population growth projections beyond 2040 were not known at the time of writing this report, and as a result the SESS/SERTS flows beyond 2040 were not estimated.

The South Edmonton Sanitary Sewer (SESS) Planning Study, 2014 (Ref: 2), identified a total estimated peak wet weather flow (PWWF) of 4.7 m^3/s for 2040. However, it did not provide background information as to how this value was determined. For the purposes of developing high level servicing concepts, the design PWWF value of 6.5 m^3/s was maintained. It is recommended that this be reviewed in the future through detailed modelling to reflect the growing population projections for the SESS and SERTS services areas beyond 2040.

3.3 PROPOSED WASTEWATER SERVICING CONCEPT

3.3.1 Offsite Servicing Options

The proposed annexation encompasses a vast area of land, which will generate large volumes of wastewater. As shown in Table 3-1, the annexation lands and adjacent municipalities are anticipated to generate peak wet weather flows (PWWF) in the order of 6.9 m^3/s in Phase 3, increasing to approximately 10.0 m^3/s for the future regional growth areas (total design flow). The existing SESS mains were not designed to service ultimate build out for annexation area, adjacent municipalities and future regional growth areas, located south of 41 Avenue SW.

As such, the existing City sewers do not have sufficient capacity available to accommodate ultimate flows from the annexation areas, nor will the planned future expansion of the SESS mains, at the current proposed sizes. Significant investment in both on-site and off-site infrastructure will be required to service the annexation area, and beyond.

To service the annexation lands, adjacent municipalities and future regional growth areas, it is proposed that a new 2,920 mm diameter section of the SESS be constructed along 66 Street, connecting to the downstream end of SESS SA4 via a jog along 23 Avenue and 50 Street as shown in **Figure 3-1**. For the purposes of this report, the proposed section of main is referred to as SESS SB. An alignment along 50 Street was also considered, however, this would have resulted in a significantly deeper main. Ultimately, flows will be conveyed to the Gold Bar WWTP via the SESS SB and SA mains.

Construction of a new Wastewater Treatment Plant (WWTP) to service the proposed annexation lands, adjacent municipalities, and the future regional growth areas was also considered. This WWTP would discharge treated final effluent into the North Saskatchewan river. However, this was discounted as it was deemed undesirable to have a WWTP discharging treated effluent upstream of the existing E.L. Smith Water Treatment Plant.

3.3.2 Overall Servicing Concept

As described in Section 3.3.1 above, a new 2,920 mm diameter sewer, referred to as SESS SB in this report, is proposed to be installed along 66 Street to service the annexation area, adjacent municipalities, and future regional growth areas, as shown in **Figures 3-1** and **3-2**. The proposed SESS SB tunnel has been conceptually sized to provide conveyance of peak wet weather flow (PWWF) from the annexation area, adjacent municipalities, and future regional growth areas. This tunnel size would provide significant storage capacity, which will be required until the City's proposed SESS SA system is fully constructed. The SESS SA main will ultimately convey flows to Gold Bar wastewater treatment plant.

3.3.3 Southwest Annexation Area

At a location east of the QE II Highway, the proposed 2,920 mm tunnel will deepen by over 10 m. It will collect flows from a proposed 2,340 mm, and 2,920 mm diameter sewer that will run along 41 Avenue. A pumping station, SB1, will be required at the change in depth, to convey flow from the southwest annexation area toward the east tunnel. This concept is in keeping with the City's SESS SW concept, whereby the SW1 Pumping Station pumps flows from the lower elevation western system and discharges to the east.

The southwest annexation, adjacent municipalities, and future regional growth areas are proposed to be serviced by gravity sewers ranging from 900 mm on the south to 2,920 mm at the northern boundary. The sewers will generally drain from south to north. As shown in **Figure 3-1**, flows from the southwest annexation lands will be conveyed to a 2,340 mm and 2,920 mm trunk main running along 41 Avenue, which will discharge into the proposed pumping station located east of the highway.

3.3.4 City's Southeast Annexation Lands, Adjacent Municipalities, and Future Regional Growth Areas

Within the southeast annexation area, the 2,920 mm SESS SB tunnel is proposed to travel east, along 41 Avenue. It is anticipated to be of sufficient depth to service all developable lands within the southeast annexation lands, adjacent municipalities, and future regional growth areas. East of 66 Street, a 1,350 mm/1,050 mm main is proposed to convey wastewater from the eastern portion of the annexation area. Trunk mains within the southeast annexation area, will discharge flows from the south of the annexation into proposed sewers along 41 Avenue.

Further studies will be required to review and optimize the above conceptual sizes, including the possibility of deepening the proposed SESS SB trunk to eliminate the SB1 pump station. **Table 3-2** summarizes the proposed trunk mains in the annexation lands, future regional growth areas, and offsite locations.

Table 3-2
Proposed Sanitary Trunk Mains

Pipe Sizes (mm)	Southeast Length (m)	Southwest Length (m)	Future Regional Growth Areas & Adjacent Municipalities Length (m)	Offsite Length (m)
900	1,600	4,600	1,600	-
1,050	6,400	9,700	3,200	-
1,200	600	1,600	3,200	-
1,350	800	3,200	-	-
1,500	2,600	-	3,200	-
1,800	-	-	-	-
2,100	-	8,800	-	-
2,340	-	4,100	-	-
2,920	4,000	1,400	-	8,600
SESS Oversize	-	-	-	13,000
TOTALS	**16,000**	**33,400**	**11,200**	**21,600**

3.3.5 Edmonton International Airport

The Edmonton International Airport (EIA) is currently serviced by the Alberta Capital Region Wastewater Commission (ACRWC) SERTS Trunk Main. The Sanitary Servicing Joint Planning Study for South Edmonton and Region, 2011 (Ref: 1), which evaluated the performance of the SERTS system for a regional growth period up to 2040, found the SERTS to have adequate dry-weather capacity but sensitive to wet

weather flows. As well, the study only allowed for servicing of a fraction of the future development area within the EIA lands.

Although the EIA lands are not currently within the City's proposed Annexation boundary, servicing of this area has been included in the design concept, in keeping with a regional servicing approach. The servicing concept for the annexation areas and the airport does not propose to transfer EIA's existing flows to the new system but provide additional critical wastewater infrastructure necessary to facilitate future growth and expansion. It is assumed that the EIA's existing flows will continue to be serviced through the SERTS main, while the proposed trunk sewers within the southwest annexation area will provide capacity for future expansion of the airport and surrounding areas identified for future growth. Potential servicing of the EIA expansion areas will be accommodated by the proposed mains to the north and west.

3.4 PHASING

3.4.1 Phase 1

The first phase of development is anticipated to occur south of 41 Avenue SW, near serviced areas, as well as on either side of the QE II Highway (refer to Figure 3-1). Initial development in Phase 1 is anticipated to be accommodated utilizing available capacity within the existing SESS system.

Phase 1 development will require the construction of a new Pumping Station (SB1) to service the southwest annexation area. Pumping capacity could be staged as development occurs, as has been undertaken for the existing SESS SW1 pumping station. As shown in **Figure 3-1**, sections of the proposed 2,340 mm and 2,920 mm trunk main could be constructed systematically toward the west, to service the southwest annexation area. Some expansion could occur simultaneously toward the east within the Nisku Industrial Park. Further east, development of the Phase 1 annexation lands and adjacent municipalities areas will rely on the installation of the proposed 2,920 mm trunk along 66 Street. This will be necessary as these lands are not adjacent to the proposed Pumping Station SB1.

An interim forcemain is envisioned to be installed from the proposed SB1 Pumping Station to the existing SESS SE 1,200 mm main. For the purposes of this study, a 600 mm diameter forcemain has been assumed. This would accommodate the ADWF and drawdown of the stored volume (over 48 hours) for approximately 15% of the Phase 1 area. This is based on an assumption of remaining SESS SE capacity and the timing of future development. The available service capacity could be less, depending on the buildout rate of the SESS SE catchment, the Phase 1 Annexation area and the adjacent municipalities. Further information regarding the SESS SE and SA flows will be required to establish the available pipe capacity, which can be utilized in the interim scenario. Flows beyond this will require that the SESS SB line be fully constructed.

Additional pumping capacity is anticipated to be required at the existing SW1 Pumping Station to accommodate flow from the annexation, adjacent municipalities, and future regional growth areas. This may require that planned capacity upgrades occur earlier than previously anticipated.

A 2,340 mm and 2,920 mm diameter gravity trunk main are proposed to be installed along 41 Avenue SW and discharge into the SB1 Pumping Station. Trunk mains will extend south into lands west of Highway. East of the QE II Highway, and downstream of the proposed pumping station, a section of 2,920 mm diameter trunk main will be installed and will continue north to the existing SESS SA system. Trunk mains will extend both south and east to service the Phase 1 southeast annexation lands and the adjacent municipalities.

The SESS Planning Study (Ref: 2) suggests that there may be limited remaining capacity in the SESS SA system to accommodate growth in the interim. With limited SESS capacity projection information, development rates were assumed. Our assessment showed that the SESS SA system will have limited capacity to service Phase 1 development. SA5 and SA6 are anticipated to be required early in Phase 1 to provide interim servicing (refer to **Figure 3-2**).

In addition, SA7, SA8 and SA9 are anticipated to be constructed a short time later. These mains will be necessary to provide sufficient capacity such that up to 45% of the Phase 1 can be accommodated in 2030 (based on the ADWF and drawdown of the stored volume). However, the available service capacity could be significantly less based on the buildout rate of the SESS catchment and the Phase 1 lands. Further downstream sections will be required to service the entire Phase 1. The City's proposed SESS installation timelines may need to be accelerated to accommodate servicing of the annexation lands, adjacent municipalities, and future regional growth areas.

Information extracted from the SESS Planning Study indicates that there may be capacity for up to 45% of the Phase 1 flows in 2030; however, this is anticipated to reduce to zero remaining capacity by 2040 (due to continued growth within the existing SESS system). As such, mains downstream of SA10 are anticipated to be required at some point within this time (depending on the anticipated rate of growth).

The proposed 2,920 mm main from the annexation area to SESS SA 4 will be required when the remaining capacity has been exhausted in the SESS SE system (assumed at approximately 15% of Phase 1 development). It is anticipated that SA5 and SA6 will have already been constructed by this time (as well as the SA6 Pumping Station), to facilitate interim development. SA7, SA8 and SA9 will be required at around this point in time, as the capacity in the downstream trunks is anticipated to have been exceeded. It is anticipated that mains downstream of SA10 will need to be fully constructed well before 2040.

The necessary timing of SESS SA main expansion is not easily determined based on the recent studies undertaken. As well, the rationale behind the projected SESS SA construction timelines have not been provided beyond the year 2040. Based on the proposed annexation area and related design criteria, it is reasonable to assume that the entire SESS system will be required within Phase 1. The current SESS SA concept will require updating to reflect a new alignment to the Gold Bar WWTP.

It should be noted that the Phase 1 servicing requirements include the estimated design flows for the adjacent municipalities.

3.4.1.1 Storage

It will be necessary to provide peak wet weather storage until completion of the SESS SA mains (anticipated to be constructed during Phase 1). Storage requirements have been estimated as 152,000 m^3 for Phase 1, based on the criteria identified in Section 3.1.4. This assumes storage of 100% of Phase 1 flows.

In Phase 1, several large diameter mains will have been installed within the annexation lands, including all proposed 2,100 mm, 2,340 mm and 2,920 mm diameter mains along 41 Avenue and 66 Street. This will result in a storage capacity of approximately 128,000 m^3, which is less than the 152,000 m^3 as indicated above. Storage will not be required after full construction of the SESS SA mains, after which, the system will be designed based on conveyance alone.

As the SESS SA mains are assumed to be constructed partway through Phase 1, it is highly unlikely that the full Phase 1 storage volume will be required. As such, it is anticipated that there is likely to be sufficient storage within the Phase 1 system.

3.4.2 Phase 2

Prior to Phase 2 development, it is envisioned that all SESS gravity mains will be fully constructed and that adequate treatment capacity would be available at the Gold Bar WWTP.

Within the annexation lands, sanitary mains will be installed to support further development in the southwest and southeast annexation areas as shown in **Figure 3-1**. The proposed SB1 Pumping Station will require upgrading to provide additional pumping capacity to accommodate Phase 2 PWWF.

3.4.3 Phase 3

The sanitary trunk mains will continue outward within the southeast and southwest annexation areas as illustrated in **Figure 3-1**.

In the southwest annexation area, there is a relatively small increase in development area during Phase 3. As such, it is proposed that Pumping Station SB1 be sized to accommodate the Phase 3 PWWF, during proposed expansion undertaken in Phase 2.

3.4.4 Future Regional Growth Scenario

In addition to servicing the southwest and southeast annexation areas, the servicing concept was also sized to accommodate the adjacent municipalities and the future regional growth areas, as identified on **Figure 3-1**. It is important that the long-term servicing strategy looks beyond the current annexation boundaries and ensures that the infrastructure installed can accommodate additional growth. This approach should ensure that future regional growth is not constrained.

As shown on **Figure 3-1**, servicing the future regional growth area will require extending sanitary trunk mains further south of the Southeast and Southwest Annexation Areas.

Wastewater from Devon has been included in the sizing of the future regional growth scenario. It is understood that the Town of Devon is in the process of designing a new WWTP. However, the proposed concept provides an opportunity to eliminate the Devon WWTP, which discharges treated effluent upstream of the E.L. Smith WTP. It is envisioned that servicing the Town of Devon would include a sewage pumping station located at the site of the Devon Wastewater Treatment Plant. A forcemain would be constructed to convey flow from Devon to a new sanitary trunk main installed along Township Road 504.

The future regional growth development area has a considerable effect on the design flows for the overall area, increasing the PWWF from 6.9 m^3/s to 10.0 m^3/s. The trunk sewers proposed in the annexation areas have been sized to provide the necessary capacity.

Pumping Station SB1 would ultimately require further upgrades to accommodate the increase in PWWF resulting from development beyond Phase 3.

3.4.5 Offsite Improvements[3]

Based on the assessment, the ultimate flows to the existing SESS-SA and SERTS are assumed to be in the order of 6.5 m^3/s. With the addition of the annexation lands, adjacent municipalities, and the future regional growth areas (10.0 m^3/s), the total flow in the downstream SESS SA mains is anticipated to increase to approximately 16.5 m^3/s. This will require a pipe approximately 3,300 mm in diameter, based on a 0.1% slope. It is recommended that the future SESS mains downstream of SA4 have a minimum diameter of 3,300 mm. As SA10a is soon to be constructed, twinning will likely be required for this section at a future date.

Figure 3-2 presents the extent of SESS SA main oversizing.

3.4.6 Additional Considerations

The proposed concept is based on a revised SESS servicing plan, which routes the ultimate flows toward the Gold Bar WWTP for treatment. It is understood that recent study of the Gold Bar WWTP has indicated that it can be enhanced to accommodate the future SESS SA and SB design flows.

The routing of the proposed 2,920 mm main from the annexation area could provide an opportunity to service eastern portions of the SESS SE catchment via the new sanitary main. This could free up SESS SE and SA capacity, which can be used to accommodate significant future expansion of the SERTS development area or other growth areas. There are several servicing optimizations that could occur based on a “catchment swap”, such as the potential for the SESS SE main to be extended south to permanently service a portion of the Southeast Annexation Area or route flows from the SERTS Beaumont via the proposed southeast annexation mains.

It is assumed that all land within the annexation area will be serviced via the new trunk main system (other than existing flow from the Edmonton International Airport). However, for areas located immediately adjacent to the SERTS main, it may make economic sense to provide service via this main. For example, the SERTS mains may be able to service a portion of the future regional growth area in the Southeast, however, this will be dependent on the capacity of the SERTS main.

Servicing of the East Vistas development area has been included in the current concept. This will be subject to further review with the ACRWC.

The westerly portion of the future regional growth area in the Southeast Annexation Area is comparatively low and is unlikely to be serviced via Southeast Annexation Area mains (via gravity). If this existing Country Residential development requires piped servicing in the future, it may require a small local pump station or a low-pressure sewer system. Alternatively, it may require servicing from the SERTS main, if possible. A relatively small, undeveloped area located immediately to the east is also low lying and may require similar alternative servicing methods. Future investigation will be required.

Servicing potential low-lying areas adjacent to the North Saskatchewan River with a local pump station may allow for the trunk sewer to be raised in some locations. Future investigation will be required as the concept progresses and the service areas/elevations are confirmed.

Another servicing option to consider is to service the future regional growth area in the far southwest via the City of Leduc. Further investigation will be required to assess this option.

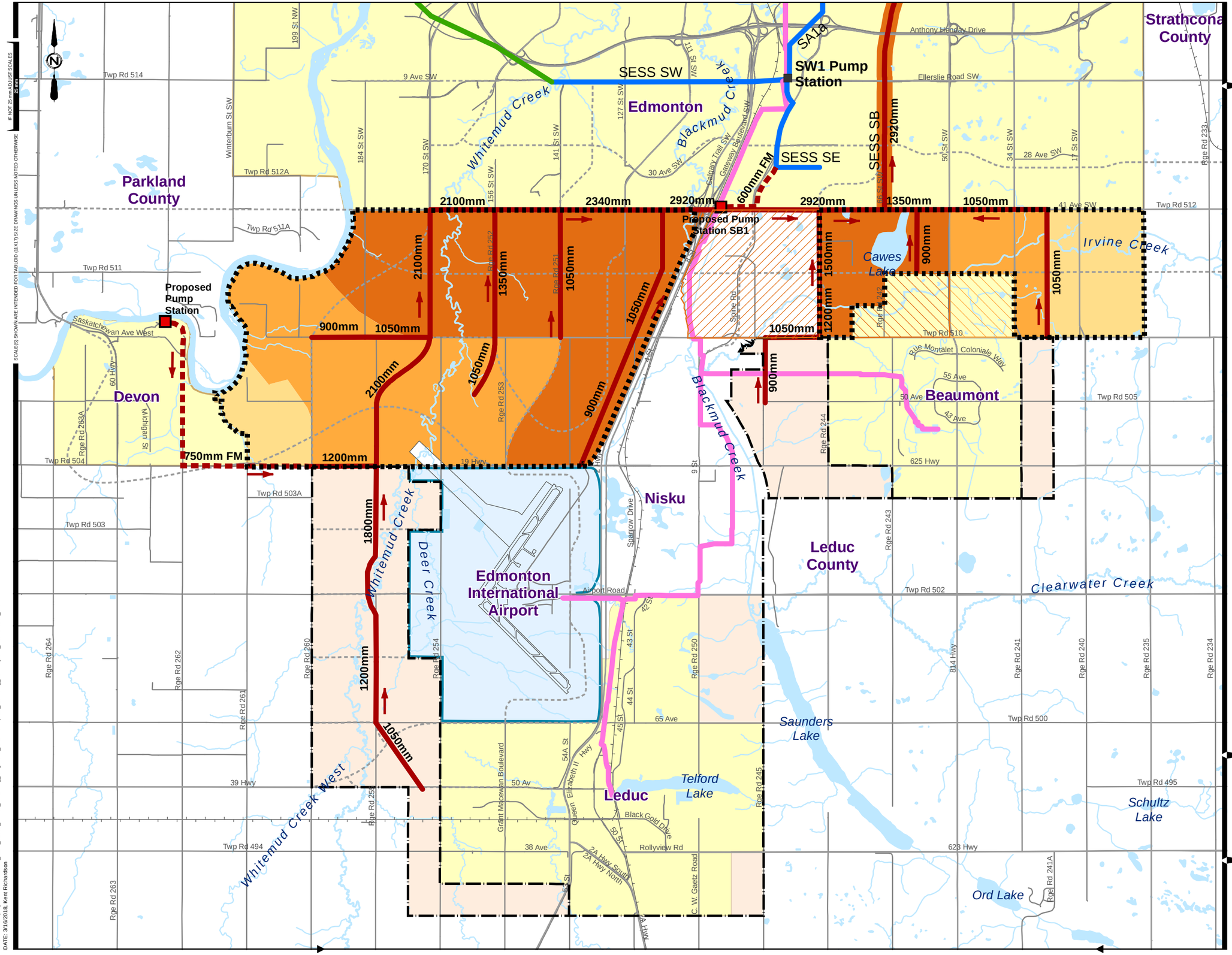
During future concept refinement/pre-design of the wastewater infrastructure, the City may wish to consider smart technologies, such as wastewater re-use for industrial developments.

3.5 COST ESTIMATE

A conceptual cost estimate, which was based on the proposed servicing concept, is presented in **Table 3-3**. Costs are included for mains 900 mm in diameter and greater, as well as other infrastructure specifically related to the southeast and southwest annexation areas. No costs are included for SESS components (mains, pumping stations) that are already planned to be constructed. Costs of oversizing the downstream SESS sections from 2920 to 3300 mm in diameter are incorporated. The unit costs used were for green field construction (except for the SESS oversizing). Costs presented are in 2018 dollars (excluding G.S.T.) and include allowance for engineering and some contingency.

Table 3-3
Conceptual Wastewater Cost Estimate (Phase 1-3)
Proposed Annexation Area Only

Conceptual Wastewater Cost Estimate (Phase 1-3)					
Phase 1					
Pipe Sizes (mm)	Unit Rate	Southeast Length (m)	Southeast Total (2018)	Southwest Length (m)	Southwest Total (2018)
900	$ 4,766	1600	$ 7,630,000	3300	$ 15,730,000
1050	$ 5,273		$ -	6500	$ 34,270,000
1200	$ 5,881	600	$ 3,530,000		$ -
1350	$ 6,895	800	$ 5,520,000	3200	$ 22,060,000
1500	$ 7,909	2600	$ 20,560,000		$ -
1800	$ 10,546		$ -		$ -
2100	$ 13,689		$ -	4800	$ 65,710,000
2340	$ 21,294		$ -	4100	$ 87,310,000
2920	$ 23,322	4000	$ 93,290,000	1400	$ 32,650,000
Sub-Total Gravity Mains		9600	$ 130,530,000	23300	$ 257,730,000
			Unit Rate	Length (m)	Total
SESS SB1 Pump house			LS		$ 30,420,000
600 mm interim forcemain			2200	$ 3,650	$ 8,030,000
SESS SA Oversize (2.9-3.3)			13000	$ 2,129	$ 27,680,000
2920 mm diameter main SESS SB			8600	$ 23,322	$ 200,570,000
Sub-Total Offsite Phase 1					$ 266,700,000
TOTAL PHASE 1					$ 654,960,000
Phase 2					
Pipe Sizes (mm)	Unit Rate	Southeast Length (m)	Southeast Total (2018)	Southwest Length (m)	Southwest Total (2018)
900	$ 4,766		$ -	1300	$ 6,200,000
1050	$ 5,273	3200	$ 16,870,000	3200	$ 16,870,000
1200	$ 5,881		$ -	1600	$ 9,410,000
1350	$ 6,895		$ -		$ -
1500	$ 7,909		$ -		$ -
1800	$ 10,546		$ -		$ -
2100	$ 13,689		$ -	4000	$ 54,760,000
2340	$ 21,294		$ -		$ -
2920	$ 23,322		$ -		$ -
Sub-Total		3200	$ 16,870,000	10100	$ 87,240,000
			Unit Rate	Length (m)	Total
SESS SB1 Pump house Expansion			LS		$ 30,420,000
Sub-Total Offsite Phase 2					$ 30,420,000
TOTAL PHASE 2					$ 134,530,000
Phase 3					
Pipe Sizes (mm)	Unit Rate	Southeast Length (m)	Southeast Total (2018)	Southwest Length (m)	Southwest Total (2018)
900	$ 4,766		$ -		$ -
1050	$ 5,273	3200	$ 16,870,000		$ -
1200	$ 5,881		$ -		$ -
1350	$ 6,895		$ -		$ -
1500	$ 7,909		$ -		$ -
1800	$ 10,546		$ -		$ -
2100	$ 13,689		$ -		$ -
2340	$ 21,294		$ -		$ -
2920	$ 23,322		$ -		$ -
Sub-Total		3200	$ 16,870,000	0	$ -
TOTAL PHASE 3					$ 16,870,000
TOTAL PHASES 1-3 (With Offsite) 2018 Dollars					$ 806,360,000



Legend:

- Wastewater Treatment Plant
- Proposed Pump Station
- Future Forecemain (Interim)
- Future Trunk Sewer
- SESS Facilities
- Existing ACRWC SERTS Trunk Sewer
- Existing SESS Trunk Sewer
- Proposed SESS Trunk Sewer
- Flow Direction

- Phase 1
- Phase 2
- Phase 3
- Future Regional Growth Area
- Leduc County Land Assumed to be Developed in Phase 1
- Beaumont Land Assumed to be Developed in Phase 1
- Beaumont Land Assumed to be Developed in Phase 2

- Proposed Annexation Area
- Future Regional Growth Area
- Edmonton International Airport
- Existing Urban Municipality

NOTES:
* ALL "SA" & "SB" LABELLED SEWERS DENOTE THE SESS SYSTEM
* SESS TRUNK MAINS CURRENTLY UNDER CONSTRUCTION ARE SHOWN AS EXISTING

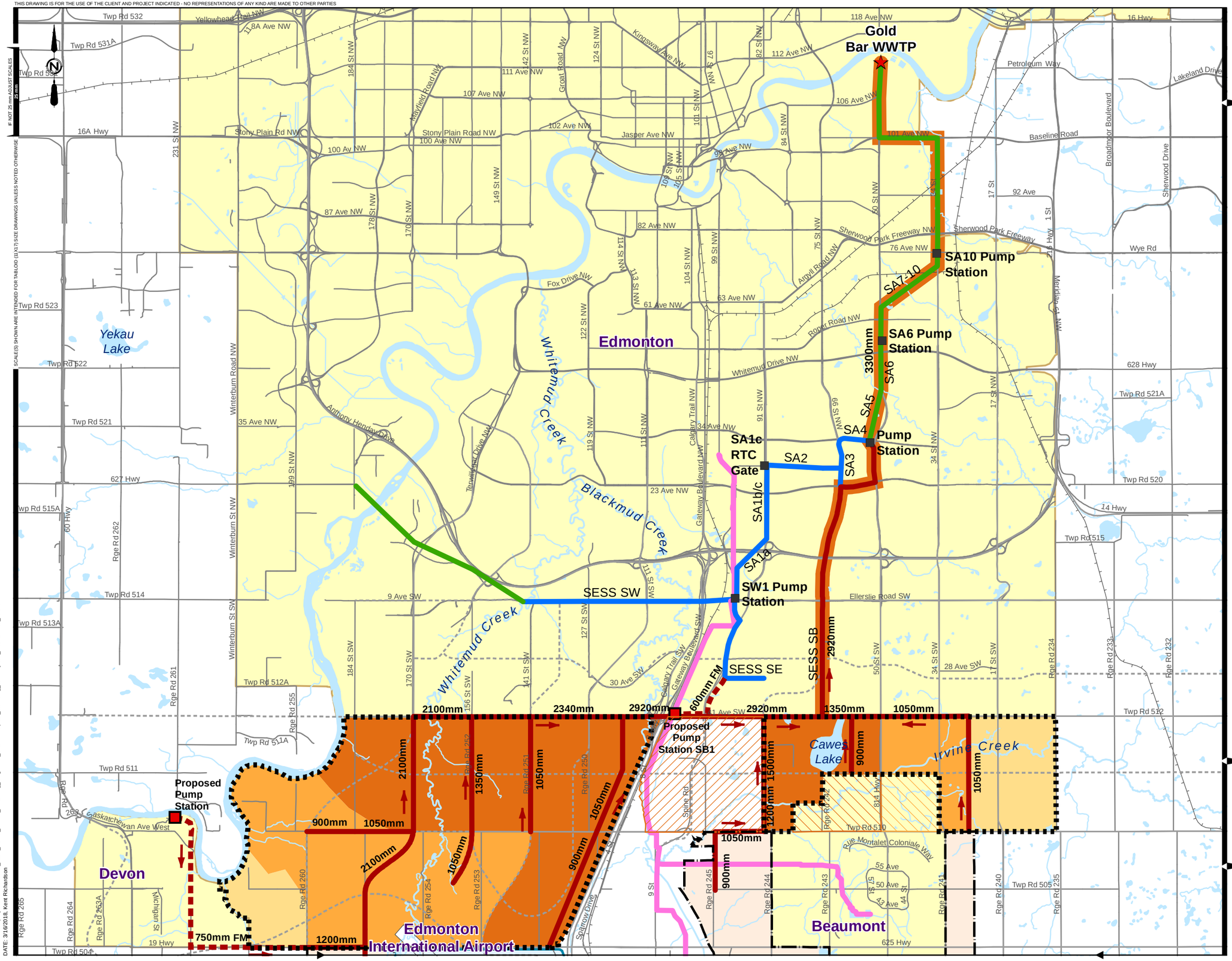
Figures are conceptual and not to be used for construction. These will be superseded by ASP/NSPs.

FIGURE No. 3-1

CITY OF EDMONTON
ANNEXATION PROPOSAL

PROPOSED WASTEWATER INFRASTRUCTURE

AE PROJECT No.	2015-3360
SCALE	1:90,000
APPROVED	
DATE	MARCH 2018
REV	
DESCRIPTION	FINAL REPORT



Legend:

- Existing Wastewater Treatment Plant
- Proposed Pump Station
- Future Forecemain
- Future Trunk Sewer
- SESS Facilities
- Existing ACRWC SERTS Trunk Sewer
- Existing SESS Trunk Sewer
- Proposed SESS Trunk Sewer
- Flow Direction

- Phase 1
- Phase 2
- Phase 3
- Future Regional Growth Area
- Leduc County Land Assumed to be Developed in Phase 1
- Beaumont Land Assumed to be Developed in Phase 1
- Beaumont Land Assumed to be Developed in Phase 2

- Proposed Annexation Area
- Future Regional Growth Area
- Edmonton International Airport
- Existing Urban Municipality

NOTES:
* ALL "SA" & "SB" LABELLED SEWERS DENOTE THE SESS SYSTEM
* SESS TRUNK MAINS CURRENTLY UNDER CONSTRUCTION ARE SHOWN AS EXISTING

Figures are conceptual and not to be used for construction. These will be superseded by ASP/NSPs.

FIGURE No. 3-2

CITY OF EDMONTON
ANNEXATION PROPOSAL

WASTEWATER
OFFSITE IMPROVEMENTS

AE PROJECT No.	2015-3360
SCALE	1:100,000
APPROVED	
DATE	MARCH 2018
REV	
DESCRIPTION	FINAL REPORT

4 Water

Based on the population discussed in Section 2 and discussions with EPCOR, the servicing concepts for the proposed annexation lands, adjacent municipalities and future regional growth areas were developed.

4.1 DESIGN ASSUMPTIONS

4.1.1 Water Demand

The following design assumptions were utilized in calculating the water demand for the proposed annexation areas, adjacent municipalities, and the future regional growth areas. A full list of assumptions and design notes is provided in **Appendix A**.

These assumptions were based on the information obtained through discussion with EPCOR. Residential population densities were derived from the "Draft" City of Edmonton Growth Study, March 2018.

Table 4-1
Water Demand Design Criteria

	Average Day Demand (ADD)	Max. Day Factor (PF)	Max. Day Demand	
			Southeast	Southwest
Design Criteria	185 Litres/cap/day	1.5	0.47 m^3/hr/ha (0.01 MLD)	West of Whitemud - 0.45 m^3 East of Whitemud - 0.67 m^3

For Non-Residential (commercial, institutional and industrial) density, where the land uses were unknown, EPCOR recommended using average day demand of 2.2 Million Litres per Day (MLD) per square mile (0.36 m^3/hr/ha). This is consistent with the City's recommendation for commercial/industrial demand.

A conservative peaking factor of 1.5 was applied to the Non-Residential Maximum Day Demand (MDD). Based on this, the non-residential MDD was calculated to be 0.54 m^3/hr/ha (0.013 MLD)

Other design assumptions are:

- From the preliminary concept provided by EPCOR, it was assumed that there were two reservoirs that could potentially be considered to service some of the annexation lands. These would be in Windermere and Decoteau. Each reservoir would service approximately 16 sections south of the existing Anthony Henday Drive.
- Nisku Industrial Park water demand was included in the total water demand. Nisku Industrial Park covers the land between QE II Highway and the southeast annexation land.
- Only pipes with diameters larger than 400 mm are presented in this assessment.
- Pipe diameters are "Equivalent" sizes for cost estimating purposes. A combination of smaller pipes may ultimately be installed to convey the design demands.
- Large diameter pipes were selected to provide Peak Day Demand at 1.5 m/s velocity.

Table 4-2 summarizes the water demand estimated for the study area.

Table 4-2
Estimated Water Demand

Area	City's Southwest Annexation Area Water Demands		City's Southeast Annexation Area Water Demands (MLD)	Future Regional Growth Areas and Adjacent Municipalities Water Demands (MLD)	CRSWSC Customers (MLD) (including Adjacent Municipalities)
	West of Whitemud Creek (MLD)	East of Whitemud Creek (MLD)			
Residential	5.36	24.33	18.61	36.87	-
Industrial and Commercial	20.8	20.69	0	30.04*	-
CRSWSC Customers - Southwest Area	-	-	-	-	94.35*
CRSWSC Customers - Southeast Area	-	-	-	-	60.19**
TOTAL	26.16	45.02	18.61	66.91	154.54

* Includes demand from the Edmonton International Airport, City of Leduc, Nisku and Calmar.

** Demand from Beaumont, including the land annexed from Leduc County and the Beaumont adjacent municipalities.

4.2 EXISTING CAPACITY

The City's potable water system is supplied by EPCOR, which also services the Capital Region Southwest Water Services Commissions (CRSWSC). The CRSWSC services most communities located south of the City's current boundary.

Figure 4-1 shows the existing water transmission lines, which supply the southern part of the City and surrounding areas. These transmission lines are supplied from the existing E.L. Smith and Rossdale Water Treatment Plants, which draw their water from the North Saskatchewan River. E.L. Smith is in the southwest of the City while Rossdale is centrally located.

An existing 600 mm main runs close to the City's corporate boundary (approximately 28th Avenue SW) and supplies neighbourhoods located north of the proposed southwest annexation area. A 600 mm main serviced by the Ellerslie booster station, runs along Ellerslie Road, and supplies neighbourhoods located north of the southeast annexation area. Another booster station (Walker booster station) is proposed on 50 Street and south of Ellerslie Road.

An existing 750 mm main runs along the west side of the QE II Highway and supplies water to the CRSWSC's Boundary booster station. The transmission main continues south to supply Nisku, EIA, the City of Leduc, Calmar and the Highway 21 Water Commission. A 400 mm transmission main, which takes off from the above 750 mm main, supplies Nisku's second storage reservoir and the Town of Beaumont, both located east of the QE II Highway and south of the proposed southeast annexation area.

EPCOR operates eight (8) storage reservoirs spread across the City. From our discussions with EPCOR, it is our understanding that two additional reservoirs are being considered. One to service the southwest of the City (Windermere Reservoir) and the second reservoir (Decoteau Reservoir) to be constructed on the north side of Ellerslie Road between 17 and 34 Street SW, as shown on **Figure 4-2**.

The City is divided into the following four main pressure zones, as shown on **Figure 4-2**.

- Primary: ground elevation between 660 m - 685 m.
- Secondary: ground elevation between 685 m - 705 m.
- Tertiary: ground elevation between 705 m -720 m.
- Quaternary: ground elevation between 720 m - 745 m.

For servicing across different pressure zones, either a pressure reducing valve (PRV) station or a booster station is required.

4.3 PROPOSED WATER SERVICING CONCEPT

4.3.1 Overall Servicing Concept

It is understood that EPCOR will supply water to the proposed annexed lands. It is envisioned that EPCOR will continue to assess its current infrastructure and construct new water mains as demand dictates. As shown in **Figures 4-2 and 4-3**, the proposed Windermere reservoir is assumed to supply the southwest and future regional growth areas through a system of pipes ranging from 400 mm – 1,500 mm equivalent diameters. The southeast annexation area water supply system will connect to the proposed Decoteau reservoir through a 600 mm line along Ellerslie Road.

The servicing concept has been sized to provide additional capacity to accommodate the adjacent municipalities and future regional growth areas (beyond the annexed land boundary).

4.3.2 Southwest Annexation Area

Figures 4-2 and 4-3 show that the southwest annexation area will be supplied from the proposed Windermere reservoir to be located north of the annexation boundary. A 1,500 mm equivalent diameter pipe is proposed to run south from the reservoir to supply the southwest annexation area. The main is proposed to extend further south as a 1,200 mm equivalent diameter and then to 900 mm to service the Industrial area northwest of the EIA as well as a proposed reservoir.

A 750 mm equivalent pipe is proposed in the southwest area. It will run west and connect to the proposed 1,500 mm equivalent diameter line from Windermere. It will continue eastwards and connect to a proposed 600 mm equivalent pipe. This 600 mm equivalent pipe will connect to a 750mm equivalent pipe that will link the southwest and southeast annexation areas. The proposed 600 mm equivalent pipe will also connect to EPCOR's existing 750 mm, which currently supplies the CRSWSC system.

A portion of the land on the southwest will be in a higher-pressure zone (Tertiary), compared to the surrounding areas. This area is proposed to be serviced by connecting an equivalent 600 mm pipe to the existing CRSWSC 750 mm pipe and providing a reservoir in the tertiary zone.

In the future, it will be necessary to support the CRSWSC to maintain supply to the downstream municipalities. This can be most effectively achieved by providing a direct feed to the existing Nisku reservoir from the EPCOR system and disconnecting it from the existing CRSWSC 750 mm. The 750 mm will be converted to be part of the EPCOR transmission system reinforcing the Municipalities downstream of the Nisku reservoir.

4.3.3 City's Southeast Annexation Lands, Adjacent Municipalities and Future Regional Growth Areas

Figures 4-2 and 4-3 present the proposed water supply system in the southeast annexation area. It is proposed that the existing 600 mm main that runs along 91 Street be extended south to 41 Avenue SW to connect to a proposed 600 mm equivalent diameter line that will supply water from the west side of QE II Highway. A booster station is proposed to supply the City's Southeast annexation lands, adjacent municipalities, and future regional growth areas. The requirement and location for this booster station will be confirmed through future detailed studies, including ASP/NSPS.

The eastern sections of the City's Southeast annexation lands, adjacent municipalities, and future regional growth areas will be supplied by a proposed 600 mm line, which will loop around to Decoteau reservoir. This 600 mm line will extend around Beaumont. A 600 mm line will extend south from the booster station to service Leduc County. A potential future connection to the existing CRSWSC waterline is proposed west of Beaumont to service the future regional growth area.

4.4 PHASING

4.4.1 Phase 1

Phase 1 development is anticipated to occur in areas close to 41 Avenue SW and progress to the south, west and east sides of QE II Highway. Approximately 2,900 m of 600 mm equivalent diameter water line is proposed to be constructed from an existing line along James Mowatt Trail SW. The existing water line is expected to supply approximately 14 MLD. EPCOR Water will review the capacity of this line to ensure there is sufficient capacity. On the southeast, a second 600 mm equivalent diameter line will connect to the CRSWSC's 750 mm pipe to service the lands located in the Tertiary Zone and further to the west. A third connection will be located at the proposed Windermere Reservoir.

To support development in the southeast, approximately 4,200 m of 600 mm equivalent pipe diameter is proposed to be extended from the existing 600 mm pipe at the intersection of Ellerslie Road SW and 66 Street SW. A 750 mm equivalent diameter pipe is also proposed to reinforce supply for future demand in the south.

It is assumed that development in the area north of Nisku in Leduc County, between QE II Highway and Rge Rd 243 will be completed in Phase 1. A proposed 600 mm equivalent water main will be extended from the existing 600 mm pipe at 91 Street SW to service the southeast annexation area. The water will be metered at the boundary (on 41 Avenue SW). **Figure 4-3** presents the proposed phasing for the annexation adjacent municipalities, and future regional growth areas. **Table 4-3** provides a summary of the proposed equivalent transmission mains in the annexation lands, adjacent municipalities, future regional growth areas, and the offsite locations.

4.4.2 Phase 2

Within the southwest annexation area, the proposed 1,200 mm, 900 mm and 750 mm equivalent diameter pipes will be extended south from the 1,500 mm main. This will supply water to developments north and west of the EIA. These mains will supply approximately 100 MLD.

In the southeast annexation area, a 600 mm equivalent pipe will be extended from the existing 750 mm on the west side of QE II Highway to augment supply from 91 Street. It will then continue eastward through a Booster Station to the 600 mm equivalent pipe installed in Phase 1. The 600 mm equivalent pipe in Phase 1 will be extended further to the east through a 600 mm water line, to supply approximately 12 MLD to service the residential area.

Refer to **Figure 4-3** and **Table 4-3** for the proposed phasing and summary of the infrastructure delivery, respectively.

4.4.3 Phase 3

In the southwest annexation area, development is anticipated to progress southwards. A reservoir and a 750 mm main are proposed. These will supply approximately 31 MLD to the future regional growth areas located to the west of the airport.

In the southeast annexation area, a 600 mm equivalent pipe will be extended towards the eastern boundary, where it will connect to a line supplying water from the proposed Decoteau reservoir, through a PRV station. The PRV station is necessary since the above connection point will be in a lower pressure zone, compared to Decoteau reservoir.

4.4.4 Future Regional Growth

To ensure that the proposed infrastructure was capable of accommodating growth, the servicing concept was sized to accommodate the future regional growth areas in the southeast. As shown in **Figure 4-3**, the future regional growth areas will require a new storage reservoir. The requirement and location of this reservoir will be confirmed by EPCOR through future detailed studies. The proposed infrastructure could support a future tie-in from the Town of Beaumont.

In the southwest, a 750 mm equivalent diameter pipe from the proposed reservoir will be extended to the south to service lands west of the airport. Two booster stations will be required since the ground elevations rise towards the south. This could potentially support a future connection to the City of Leduc.

4.4.5 Off-site Improvements[5]

It is anticipated that EPCOR will continue to assess the capacity of its infrastructure to service the future regional growth areas to the south. Further studies will be required to review and optimize the above conceptual sizes.

Table 4-3 summarizes the proposed water transmission mains in the annexation lands, adjacent municipalities, future regional growth areas, and the offsite locations.

Table 4-3
Proposed Equivalent Diameters of Water Transmission Mains

Pipe Sizes (mm)	Southwest Length (m)	Southeast Length (m)	Future Regional Growth Area Length (m)	Offsite Length (m)
400	5,700	-	-	-
600	5,300	9,390	8,350	13,940
750	8,200	4,920	-	-
900	2,000	-	-	-
1200	1,600	-	-	-
1500	2,400	-	-	800
TOTAL LENGTH	**25,200**	**14,310**	**8,350**	**14,740**
Other Structures				
Location	**Southwest Quantity**	**Southeast Quantity**	**Future Regional Growth Area Quantity**	**Offsite Quantity**
Meter Station	-	-	-	2
PRV Station	1	1	-	-
Booster Station	-	-	-	1
Reservoirs	2	-	1	-
TOTALS	**3**	**1**	**1**	-

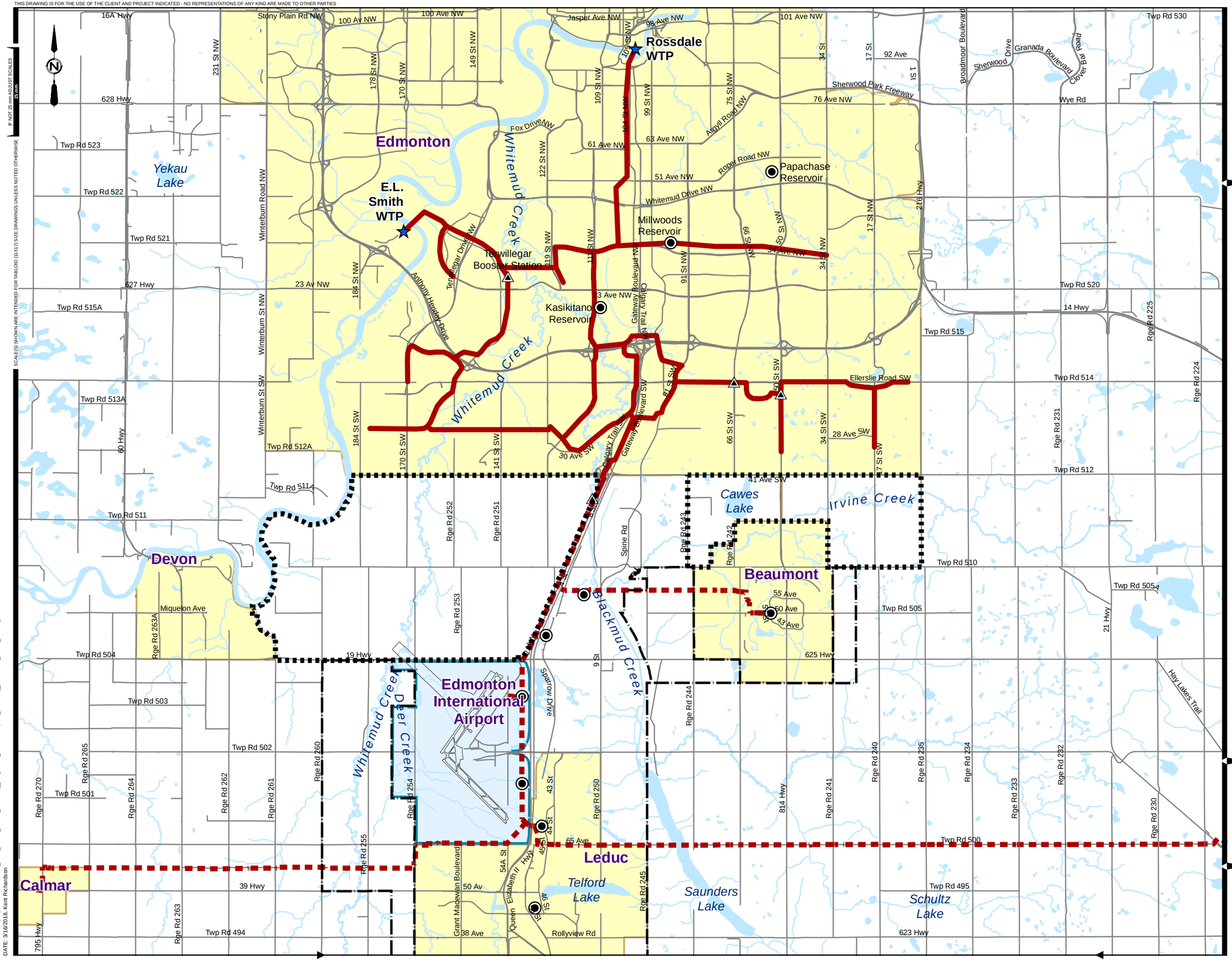
4.5 COST ESTIMATE

Table 4-4 presents the cost estimated for the water servicing concept. The cost estimate includes infrastructure to be constructed within the City's annexation areas during Phases 1 to 3 and offsite services. The costs do not include the infrastructure identified for the future regional growth areas and EPCOR's proposed Windermere reservoir, Decoteau reservoir and the Walker Booster Station.

[5] In this report, onsite refers to infrastructure located within the annexation area. Offsite refers to infrastructure located outside the annexation area.

Table 4-4
Conceptual Water Servicing Cost Estimate (Phase 1-3)
Proposed Annexation Area Only

SOUTHWEST				SOUTHEAST				Combined Total (2018)
Diameter (mm)	Length/Quantity	Unit Price	Total	Diameter (mm)	Length/Quantity	Unit Price	Total	
Phase 1								
600	6900 m	$740	$5,110,000	600	4390 m	$740	$3,250,000	
750	7200 m	$1,055	$7,600,000	750	2120 m	$1,055	$2,240,000	
1200	1600 m	$3,650	$5,840,000					
1500	2400 m	$4,565	$10,960,000					
Reservoir	1 each	$10,140,000	$10,140,000					
PRV	1 each	$2,028,000	$2,030,000					
Total - Phase 1			$41,680,000				$5,490,000	$47,170,000
Phase 2								
400	4800 m	$510	$2,450,000					
600	800 m	$740	$590,000	600	2500 m	$740	$1,850,000	
600 Crossing	m			600 Crossing	500	$3,045	$1,520,000	
750	1000 m	$1,055	$1,060,000					
900	2000 m	$1,690	$3,380,000					
Reservoir	1 each	$50,700,000	$50,700,000	Booster Station	1	$5,070,000	$5,070,000	
Total - Phase 2			$58,180,000				$8,440,000	$66,620,000
Phase 3								
400	900 m	$510	$460,000					
600	m	$740	$0	600	2500 m	$740	$1,850,000	
				PRV Station	1 each	$2,028,000	$2,030,000	
Total - Phase 3			$460,000				$3,880,000	$4,340,000
Grand Total (2018 Dollars)			$100,320,000				$17,810,000	$118,130,000



Legend:

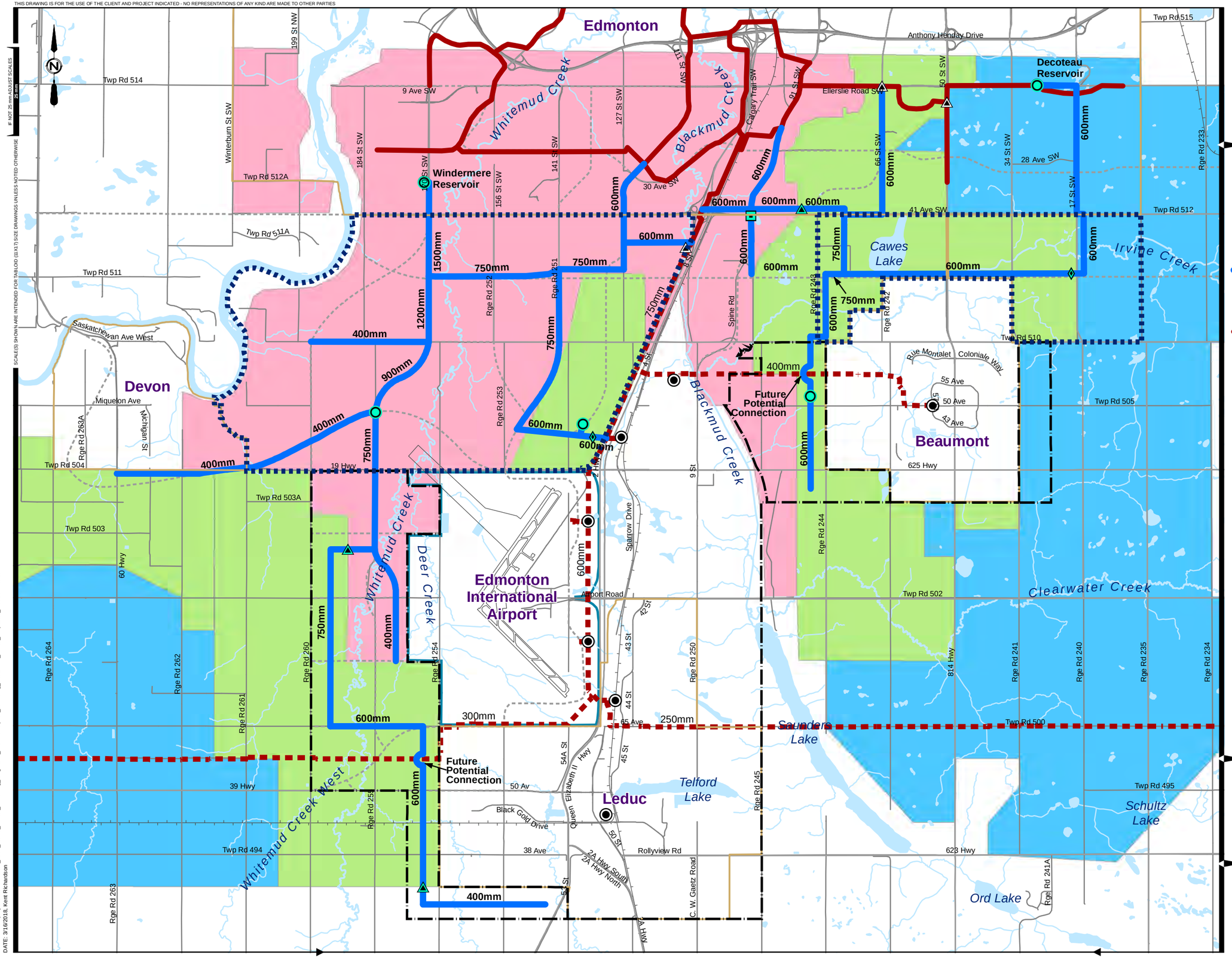
- Existing Water Treatment Plant
- Existing Booster Station
- Existing Storage Reservoir
- Existing & Future Water Transmission Line
- CRSWSC Transmission Line
- Proposed Annexation Area
- Future Regional Growth Area
- Edmonton International Airport
- Existing Urban Municipality

FIGURE No. 4-1

CITY OF EDMONTON
ANNEXATION PROPOSAL

EXISTING WATER MAINS

AE PROJECT No.	2015-3360
SCALE	1:125,000
APPROVED	
DATE	MARCH 2018
REV	
DESCRIPTION	FINAL REPORT



Associated Engineering

Legend:

- Proposed Pressure Reducing Valve
- Proposed Booster Station
- Proposed Reservoir
- Proposed Water Meter
- Proposed Waterline
- Existing Booster Station
- Existing Storage Reservoir
- Existing & Future Water Transmission Line
- CRSWSC Transmission Line

Pressure Zones

- >745m
- Quaternary Pressure Zone >720m-745m
- Tertiary Pressure Zone >705m-720m
- Secondary Pressure Zone >685m-705m
- <685m

- Proposed Annexation Area
- Future Regional Growth Area
- Edmonton International Airport

Figures are conceptual and not to be used for construction. These will be superseded by ASP/NSPs.

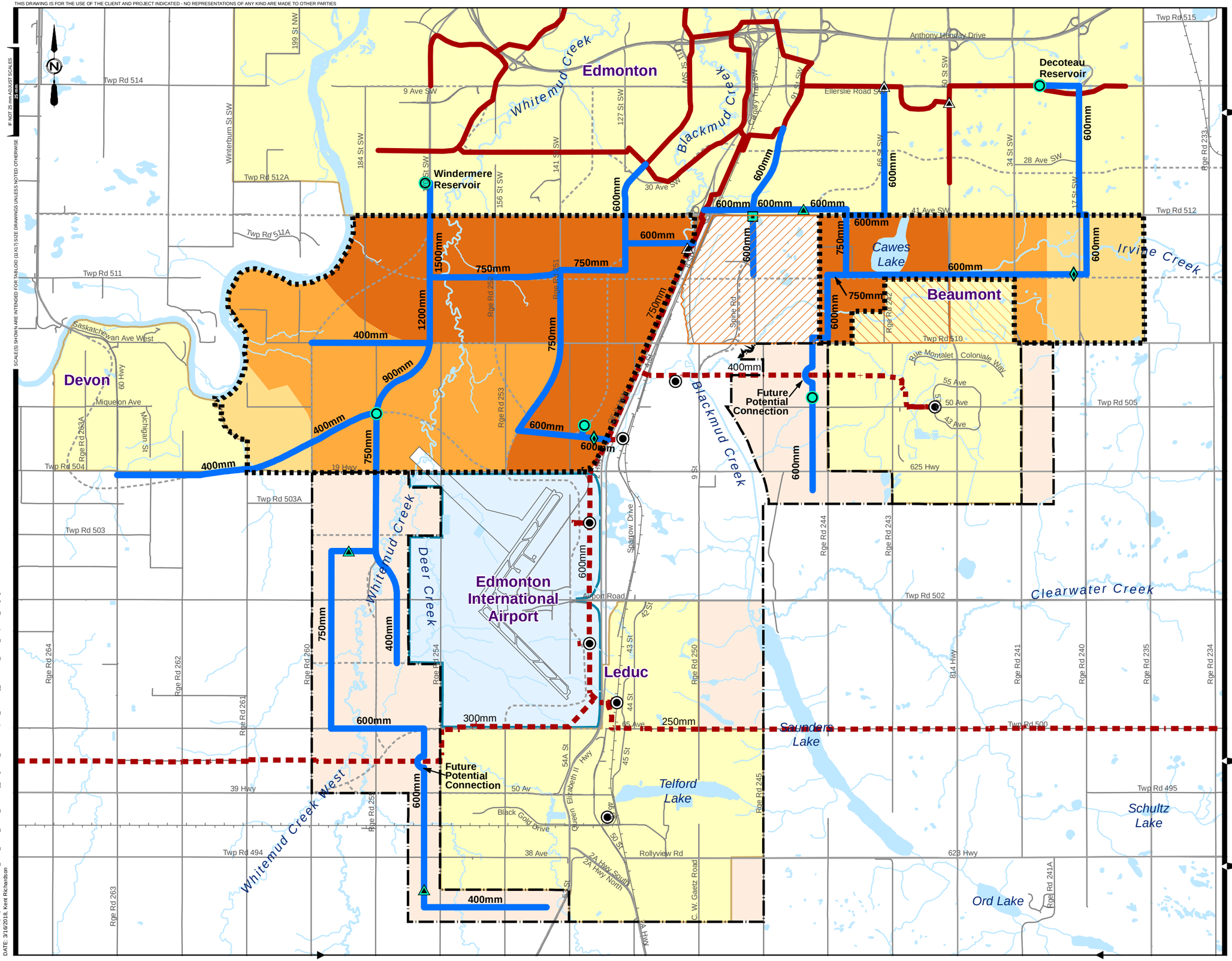
THE CITY OF Edmonton

FIGURE No. 4-2

CITY OF EDMONTON
ANNEXATION PROPOSAL

PROPOSED WATER MAINS - PRESSURE ZONES

AE PROJECT No.	2015-3360
SCALE	1:90,000
APPROVED	
DATE	MARCH 2018
REV	
DESCRIPTION	FINAL REPORT



Legend:

- Proposed Pressure Reducing Valve
- Proposed Booster Station
- Proposed Reservoir
- Proposed Water Meter
- Proposed Waterline
- Existing Booster Station
- Existing Storage Reservoir
- Existing & Future Water Transmission Line
- CRSWSC Transmission Line

- Phase 1
- Phase 2
- Phase 3
- Future Regional Growth Area
- Leduc County Land Assumed to be Developed in Phase 1
- Beaumont Land Assumed to be Developed in Phase 1
- Beaumont Land Assumed to be Developed in Phase 2

- Proposed Annexation Area
- Future Regional Growth Area
- Edmonton International Airport
- Existing Urban Municipality

Figures are conceptual and not to be used for construction. These will be superseded by ASP/NSPs.

FIGURE No. 4-3

CITY OF EDMONTON
ANNEXATION PROPOSAL

PROPOSED WATER MAINS
PHASING/SEQUENCING

AE PROJECT No.	2015-3360
SCALE	1:90,000
APPROVED	
DATE	MARCH 2018
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DESCRIPTION	FINAL REPORT

5 Stormwater

The City's proposed annexation areas were subdivided into the following five catchments:

- North Saskatchewan River (NSR) Catchment;
- Whitemud Creek Catchment;
- Blackmud Creek Catchment;
- Irvine Creek Catchment; and
- Clearwater River Catchment.

Allowable discharge rates were estimated for the above catchments based on the analysis of flood frequency from flow monitoring data obtained for each catchment. **Table 5-1** summarizes the estimated allowable discharge rates.

The allowable discharge rates in **Table 5-1** were used to calculate unit storage for stormwater attenuation per hectare of land development.

Table 5-1
Summary of Allowable Discharge Rates by Catchment

Catchment	Current Discharge Rate (L/s/ha)	Pre-Development Discharge Rate (L/s/ha)
North Saskatchewan River	1.9	2
Whitemud Creek Catchment	4.4	3
Blackmud Creek Catchment	0.7	1
Irvine Creek Catchment	0.7-2.7 *	1
Clearwater Creek	1	1

**Obtained from Irvine Creek Watershed Study (Reference 6).*

5.1 EXISTING CONDITIONS

The storm sewers within the existing City boundary outfall to one of the three prominent water bodies, namely the NSR, Whitemud and Blackmud Creek. Based on Topographic information, these water bodies appear to be well defined and have adequate capacity to convey flows from developments in the proposed annexation lands, adjacent municipalities, and future regional growth areas at allowable discharge rates. However, there have been instances of erosion in NSR, Blackmud and Whitemud Creeks.

In the absence of detailed topographic information, AE used AltaLIS 15 m DEM and streams from the National Hydro Network (NHN) to identify drainage patterns in the proposed annexation areas. The dataset used had a horizontal resolution of 15 m, and vertical accuracy of 0.3 m. **Figure 5-1** shows the existing drainage patterns within the proposed annexation lands, adjacent municipalities, and future regional growth areas, in the form of sub-catchments.

The southwest annexation lands and future development areas are drained by the NSR, Blackmud and Whitemud Creek. A review of the topographic information suggest that these watercourses have adequate hydraulic capacity to service the area at the allowable discharge rates identified in **Table 5-1**.

The southeast annexation lands, adjacent municipalities, and future regional growth areas are mostly drained by Irvine Creek and Clearwater Creek (significantly small area), which are both tributaries to Blackmud Creek, as shown in **Figure 5-2**. A review of the Irvine Creek and Cawes Lake Watershed Study (Ref: 6), Town of Beaumont Annexation Review (Ref: 7) and the existing topographic information, indicates that some sections of Irvine Creek have poor hydraulic capacity, and have previously experienced flooding. Cawes Lake is also located within the southeast annexation area, towards the north boundary.

5.2 PROPOSED STORMWATER SERVICING CONCEPT

At the time of writing this report, a surface water management study for the Blackmud and Whitemud basins was being conducted. The findings of the study were not available for review during the preparation of this report. The servicing concepts presented in this section were based on a review of the available information at the time. These concepts should be reviewed once the study is published.

5.2.1 Overall Servicing Concept

It is proposed that stormwater trunk mains from the annexation areas outfall to the watercourses in the catchment they are in, at the allowable discharge rates as identified in **Table 5-1**. It is proposed that stormwater management facilities be used for stormwater attenuation, which in turn would control flows to pre-development levels and prevent flooding and erosion in the watercourses. Unit volume storage requirements for different land uses, within the five sub-catchments of the study area, have been identified and are summarized in **Table 5-2**.

Table 5-2
Summary of Unit Storage Volume for Future SWMFs

Catchment/Land Use	Unit Storage Volume (m^3/ha)		
	Industrial	Commercial	Residential
North Saskatchewan River	720	810	530
Whitemud Creek	670	770	480
Blackmud Creek	760	850	570
Irvine Creek	760	850	570
Clearwater Creek	760	850	570

5.2.2 Southwest Annexation Area

The southwest annexation lands, adjacent municipalities, and future regional growth areas will be serviced by the NSR, Blackmud and Whitemud Creeks. A review of the topographic information indicates that these watercourses have adequate hydraulic capacity to service the area at the allowable discharge rates as identified in **Table 5-1**. Based on this, no improvements to the watercourses have been identified for this area. However, known instances of erosion are prevalent in the waterbodies stated above. Erosion protection and control for the entire length of the waterbodies, with rip-rap may not be feasible and repairs to the watercourse will have to be undertaken based on changes in stream flow due to development.

Since the post development discharge rates will be controlled to pre-existing levels, development of proposed annexation areas is not expected to worsen the existing erosion issues in the Whitemud and Blackmud Creeks.

5.2.3 Southeast Annexation Lands, Adjacent Municipalities, and Future Regional Growth Areas

The southeast annexation lands, adjacent municipalities, and future regional growth areas will be serviced by Irvine Creek and Clearwater Creek, which are both tributaries to Blackmud Creek. A review of the Irvine Creek Watershed Study (Ref: 6), Town of Beaumont Annexation Review (Ref: 7) and the existing topographic information, indicated poor hydraulic capacity and flooding in some sections of Irvine Creek. This will require improvements to Irvine Creek to facilitate conveyance of flows from developments in the area and offsite. **Figure 5-1** and **Figure 5-2** show the offsite areas that drain to the proposed southeast annexation area, as well as Irvine Creek.

The total catchment area of the Irvine Creek was estimated to be approximately 158 km^2. Based on the flood frequency analysis, the predevelopment flow of 21 m^3/s was estimated for the catchment. A trapezoidal channel of 5 m bottom width, 2.5 m depth, 1:5 side slopes and 0.1% longitudinal slope was assumed for Irvine Creek to convey the flows. This will provide a bankfull capacity of approximately 35 m^3/s for the creek.

Cawes Lake located north of Beaumont in the southeast annexation area could be used for as a regional drainage pond and stormwater management. Based on the information provided in the Irvine Creek and Cawes Lake Watershed Study (Ref: 6), the normal water level in this lake is approximately 703.85 m, and a volume of approximately 560,000 m^3 is available at an elevation of 704.5 m. This 0.5 m below the spill elevation of this basin, thus providing a 0.5 m freeboard.

The proposed annexation area upstream of Cawes Lake is proposed to be developed as a residential area, thus requiring 570 m^3/ha of storage for attenuation of runoff. Cawes Lake could be used to provide stormwater attenuation for 980 ha (approximately 15 quarter sections). This would reduce the number of SWMFs required in the catchment, however, the feasibility of providing stormwater attenuation in Cawes Lake will need to be analyzed further to establish the most cost effective and sustainable solution.

5.3 PHASING

5.3.1 Phase 1

It is anticipated that the proposed improvements along the entire length of Irvine Creek in the southeast annexation area will be completed in Phase 1 of development. This will ensure that the Creek has enough capacity available to convey flows from future development in subsequent phases.

The southwest annexation will be serviced by the NSR, Blackmud and Whitemud Creek, which have good hydraulic capacity. As such, no improvements have been identified for the watercourses at this stage.

5.3.2 Future Regional Growth Scenario

The future regional growth areas on the southwest will be serviced by the NSR and Whitemud Creek. These watercourses were assessed as having enough hydraulic capacity to accommodate future development in the area. However, future stormwater infrastructure and SWMFs will have to be sized adequately to avoid flooding and erosion issues upstream and downstream of the proposed annexation.

Figure 5-1 presents the areas identified for future growth. The areas identified on the southeast will be serviced by Irvine, Clearwater and Blackmud Creek. At this stage, only Irvine Creek was identified as requiring improvements.

5.3.3 Off-site Improvements[6]

Identifying the offsite areas is an important part of drainage planning, as this can avoid flooding and erosion issues following development. **Figure 5-1** shows the extent of the offsite areas draining to the project area. Future stormwater infrastructure and SWMFs will have to be sized adequately to accept the runoff from offsite areas and convey them to the receiving water bodies at pre-development rates as per **Table 5-1**.

The portion of the waterbodies, downstream of the proposed annexation areas will not be adversely impacted by the development of the offsite areas, as runoff from the offsite areas will be controlled to pre-development discharge rates. However, this will be reviewed once the Blackmud/Whitemud Surface Water Management Study has been published.

5.4 COST ESTIMATE

A cost estimate was completed for the proposed improvements to Irvine Creek. These are summarized in **Table 5-3**. The City, Beaumont and Leduc County's costs will be limited to improvements of the major drainage channels (Irvine Creek) within the respective current and future jurisdictions. Preliminary cost estimate for improvements to Irvine Creek are provided in **Table 5-3**.

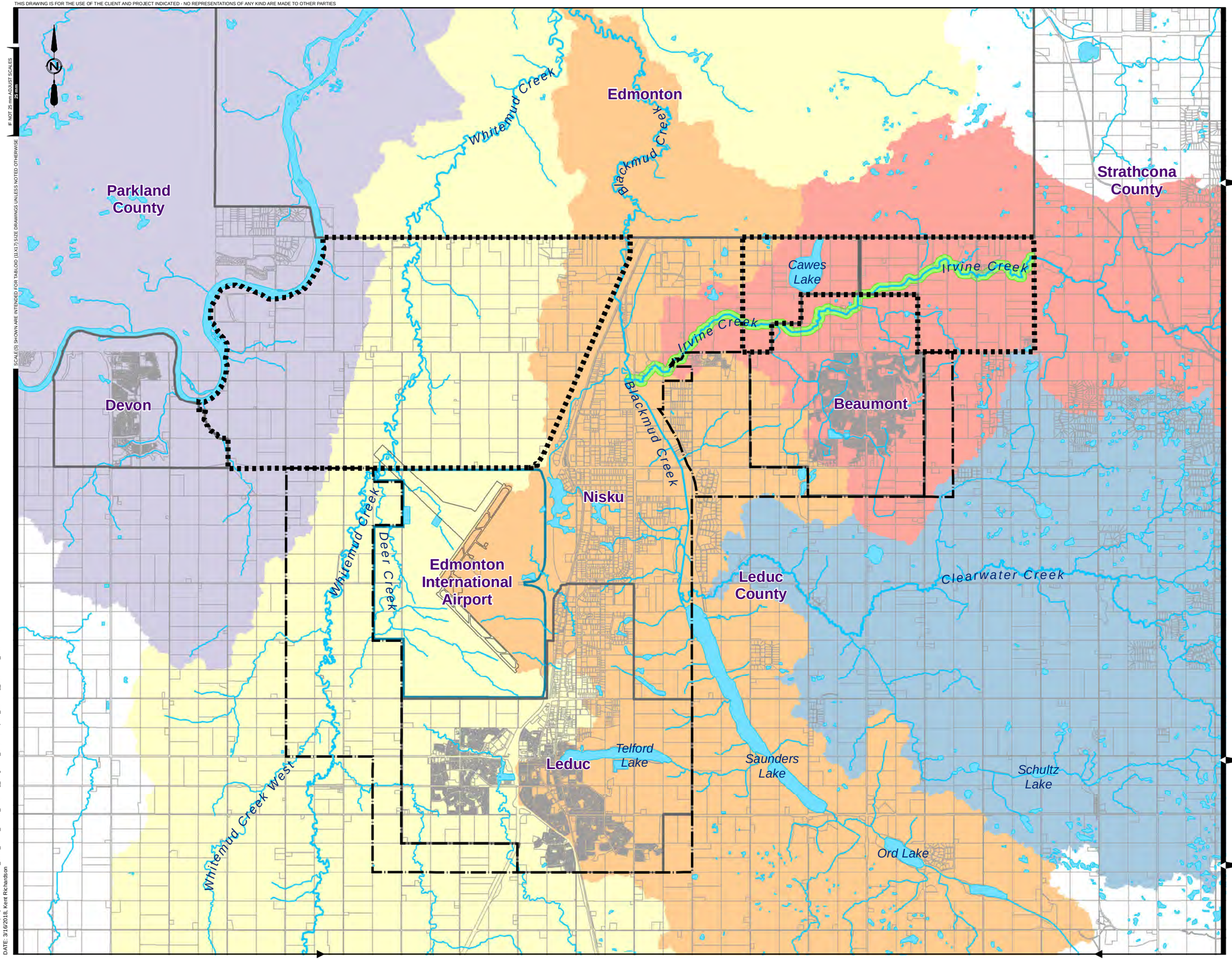
Table 5-3
Irvine Creek Improvements

Item	Portion within City's Annexation Area
Channel Length	8 km
Unit Cost	$1,500,000/km
Cost of Improvements	**$12,000,000**

*Based on a typical Channel cross section of 44 m^2.

[6] In this report, onsite refers to infrastructure located within the annexation area. Offsite refers to infrastructure located outside the annexation area, which acts as the downstream portion of the sanitary system.

Cost estimates were based on hard armouring improvements with rip-rap. The cost is anticipated to be significantly higher, if bio-engineering improvements are used. This cost estimate was based on a review of the available information at the time. This should be reviewed once the results of the Blackmud/Whitemud Surface Water Management Study are published.



Associated Engineering

Legend:

Catchment

- Blackmud Creek Catchment
- Clearwater Creek Catchment
- Irvine Creek Catchment
- North Saskatchewan River Catchment
- Whitemud Creek Catchment
- Irvine Creek Improvement Area

- Proposed Annexation Area
- Future Regional Growth Area
- Edmonton International Airport
- Existing Urban Municipality

Figures are conceptual and not to be used for construction. These will be superseded by ASP/NSPs.

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FIGURE No. 5-1

CITY OF EDMONTON
ANNEXATION PROPOSAL

SUB-CATCHMENTS

AE PROJECT No.	2015-3360
SCALE	1:100,000
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DATE	MARCH 2018
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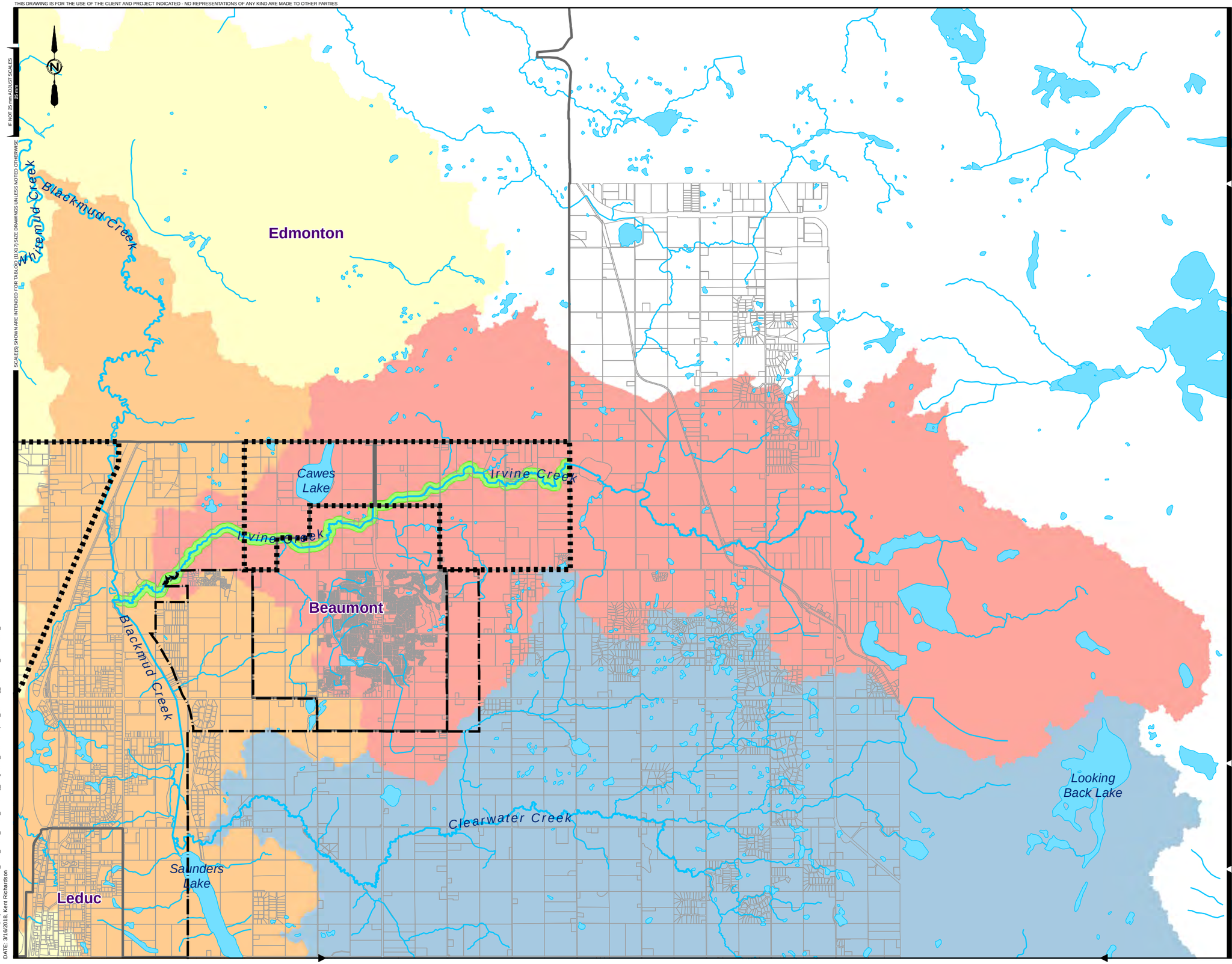
DESCRIPTION	FINAL REPORT



Associated Engineering

Legend:

Catchment

- Blackmud Creek Catchment
- Clearwater Creek Catchment
- Irvine Creek Catchment
- North Saskatchewan River Catchment
- Whitemud Creek Catchment
- Irvine Creek Improvement Area

- Proposed Annexation Area
- Future Regional Growth Area
- Existing Urban Municipality

Figures are conceptual and not to be used for construction. These will be superseded by ASP/NSPs.

THE CITY OF Edmonton

FIGURE No. 5-2

CITY OF EDMONTON
ANNEXATION PROPOSAL

IRVINE CREEK CATCHMENT

AE PROJECT No.	2015-3360
SCALE	1:90,000
APPROVED	
DATE	MARCH 2018
REV	
DESCRIPTION	FINAL REPORT

6 Transportation

This section provides a preliminary discussion on existing and future major transportation infrastructure required to support the proposed southeast and southwest annexation areas, within the proposed annexation areas.

The section also focuses primarily on identifying right of way corridors for roadways and major transit infrastructure. Future development should also consider active transportation, either through a connected multi-use trail system, on-street cycling infrastructure and pedestrian facilities. Active transportation networks will support the overall road network, with facilities provided on collector and arterial roadway systems to service residents to travel to work, school, for recreation and to connect with transit.

The transportation servicing concept was identified considering connections between future neighbourhoods, the existing City network and major regional infrastructure. The descriptions provided are divided into major north-south and east-west infrastructure. Most of the east-west roadways identified will cross through both the southeast and southwest annexation areas.

6.1 DESIGN ASSUMPTIONS

For long range planning, such as this, infrastructure serviceability report, priority should be given to identification of corridors that will be protected for future transportation infrastructure. The ultimate design of these corridors may shift with future design standards.

The time horizons of this report were assumed to be at least 50 years. Disruptive technologies such as connected and autonomous vehicles were noted as having considerable influence on land use and mobility within this timeframe. The capacity assumptions in this report represent a conservative estimate, given the likely impact of disruptive technology on land use planning and future travel demand.

6.1.1 Background Information

The transportation servicing contained in this section heavily borrowed the information that was produced by the Capital Region Board in the following reports:

- A Capital Region Inter-Municipal Transit Network Plan that illustrates the short, medium, and long-term public transit needs throughout the Capital Region - March 2009.
- Integrated Regional Transportation Master Plan Prioritization of Regional Transportation Projects - August 20, 2015.

A detailed list of design assumptions is included in **Appendix A**.

6.1.2 Roadways

For this study, the roadways identified fall under four major classifications: Freeways, Provincial Highways, Expressways and Arterials. The roadway classifications are summarized below:

- **Freeways:** Freeways, as defined by TAC, are designed for free flow and high volumes of traffic at optimum traffic flow. Intersections are grade separated and the design speeds are between 80 km/h to 120 km/h. Intersection spacing is recommended to be a minimum of 1600 m.

- **Provincial Highways:** Within the study area there are a number of existing and proposed Provincial Highways. Upgrade plans related to these highways, if know, were identified. The City road network will support these Provincial Highways as regional corridors. Provincial highways, particularly in the study area, generally have an ultimate freeway designation.

- **Expressways:** TAC identifies expressways as primarily for traffic movement, with volumes of traffic lower than freeways. Intersections will generally be signalized, and recommended as spaced at least 800 m. Expressways are generally designed with an ultimate cross section of between 4 and 8 lanes.

- **Arterials:** Arterials are also primarily for traffic movement, but will usually be supported by sidewalks or multi-use trails, preferably separated from the traffic. Parking is typically prohibited. Intersections are signalized and there may be additional pedestrian crossing accommodation. Intersection spacing is recommended to be 400 m. Arterials can range from 2 lanes to 6 lanes.

The above road classifications support heavy vehicle traffic and goods movement. They are typically supported by an internal network of collector roads, local roads, as well as bike paths and pedestrian routes. Bike paths and pedestrian routes were not identified in this report and will be identified as development plans are further refined.

6.1.3 Transit

This study identifies future major transit corridors, including LRT and major bus rapid transit corridors. Local bus routes have not been identified in this report and will be determined at the neighbourhood level as planning progresses.

6.1.4 Active Transportation

Active transportation (cycling and walking) routes are not identified in this report, though it is anticipated that arterial roadways will have accommodation for off-road cyclists and pedestrians within their corridor. On-street cycling through protected bike lanes may also be present on certain corridors, but will be identified in future studies.

It is also acknowledged that the City is working with the North Saskatchewan River Valley Alliance to establish an active transportation corridor from the Town of Devon and Leduc County to the City of Fort Saskatchewan, along the North Saskatchewan River. This corridor will likely provide additional active transportation trip opportunities from the southwest annexation area into the City of Edmonton.

6.2 EXISTING CAPACITY

This study focuses on additional infrastructure needs outside of the current boundaries of the City. Priorities within the current City boundaries will be identified through detailed analysis within future transportation master plans and the use of the City's travel demand model. The focus of this study was to identify necessary major roadways and transit connections from the annexation areas to connect to existing City and regional transportation infrastructure. Growth south of the current City boundaries will have impacts on roadways within the City. The City is best equipped to consider the road network as a whole to identify efficiencies in capacity upgrades to existing roadways as needed.

6.3 TRIP GENERATION

A detailed traffic analysis was not completed for this report at this stage as it was deemed to be beyond the scope of this assessment. However, a broad, high level assessment was undertaken to identify the overall transportation needs that would result from the anticipated population growth and trip generation in the annexation areas.

At this level of planning, trip generation is best estimated by reviewing the information available on existing conditions, and applying those assumptions to the new areas. Existing trip rates, household size, distribution patterns and mode splits have been used for the purposes of estimating roadway demand. We are cognisant that future technological changes, transit options, housing size, autonomous vehicle use, workplace patterns and alternative mode accessibility could create drastic changes in the baseline assumptions that have been made for this study. At this stage, it is critical that transportation planning preserve the land needed to accommodate potential traffic growth. If future conditions change, options for revising rights-of-way usage are always available. This approach will avoid the need to retroactively negotiate for rights-of-way after the annexation. This section identifies an overall estimate of potential trip generation created within the annexation areas. Additional details can be found in **Appendix A**.

6.3.1 Trip Generation and Distribution

The most comprehensive and detailed traffic data collected in the City of Edmonton was in the 2005 Household Travel Survey. At the time of writing this report, a survey was being undertaken to update the traffic data, but the results were not yet available. While the City has grown, and changed significantly in the last 12 years, the results from the 2005 survey provide a baseline that can be used as a high-level estimate of total trips generated by residents. Relevant results from the survey for our analysis include average trips/person, average car driver trips/person and average transit trips/person.

In 2005 the number of trips/person in the City was 3.64 trips/day. This represented an increase in 0.03 trips from 1994. The City provided a summary of these trips as total weekday daily trips, weekday daily car driver trips (representative of actual vehicles on the road), and weekday daily transit trips.

The trip generation rate assumptions were applied to the proposed annexation areas. The totals for car driver and transit trips for the annexation areas are summarized in **Table 6-1**. The rest of the trips are generally either as auto passengers (around 20%) or active modes (around 11%).

Table 6-1
New Trips from Annexation Areas

Area	Population	Total Trips/Day (3.64 trips/person)	Auto Driver Trips (based on 2005 HTS)	Transit Trips (based on 2005 HTS)
Southwest Annexation Area	133,000	484,000	280,700	31,500
Southeast Annexation Area	84,450	307,400	129,000	20,000
Total Residential Trips		**791,400**	**409,700**	**51,500**

* Figures have been rounded up.

Further discussion on trip distribution is included in the design assumptions in **Appendix A**. As final land use is decided, more detailed estimates of trip distribution will become available through future studies, including updates to the City travel model. This will provide more accurate data to assess new trips from the annexation areas.

6.4 PROPOSED TRANSPORTATION SERVICING CONCEPT

The proposed transportation infrastructure is described in the following section. The infrastructure is categorized into north-south and east-west connections. The phasing sequencing of infrastructure development has been assumed to travel outward from the QE II Highway. Phasing is discussed in each individual section.

6.4.1 North/South Transportation Corridors

6.4.1.1 Highway 21 – Highway

Though outside of the Southeast Annexation Area, Provincial Highway 21 is an important regional connection supporting the City's road network. Highway 21 runs north south, currently through Leduc County and the Strathcona County. It is a connection to industrial development in Fort Saskatchewan and is an oversized load corridor south of Highway 14, and north of Highway 16. Major east west roadways that will be developed in the annexation area will tie into Highway 21. The long-term plans identified by the Capital Region Board include potential interchanges at 41 Avenue SW and Highway 625. This annexation study identifies that there may be a future need for an additional east-west freeway within the southern annexation areas. As development progresses and future analysis is completed, an additional interchange with Highway 21 may be required at the intersection with the east-west freeway. As it is outside of the study, there is no phasing tied to Highway 21, and upgrades will be dependent on regional growth.

6.4.1.2 Meridian Street/ Range Road 234 – Expressway

Meridian Street/Range Road 234 forms the eastern boundary of the southeast annexation area. It does not currently connect to Anthony Henday Drive. As annexation proceeds, there will be a need for additional north-south capacity to support both the City and regional growth. Meridian Street is proposed to be a future expressway with high capacity and potential future circuitous connection to either Anthony Henday Drive or Highway 14.

6.4.1.3 17 Street/Range Rd 235 – Arterial

The arterial road of 17 Street travels north/south, within the City with a direct interchange connection to Anthony Henday Drive. It is a proposed arterial through the planned Decouteau Area Structure Plan, and should be extended as an arterial through the proposed southeast annexation area.

6.4.1.4 34 Street – Arterial

Another north/south corridor that is also expected to provide serviceability in support of the City's Southeast Annexation proposal adjacent to Beaumont is 34 Street. This street is not directly connected to the Anthony Henday Drive, but flies over the freeway and provides connection to the southeast of the City. As 34 Street is expected to also connect to the range road system and provide a connection to the southeast annexation area, the street is located near the east edge of the proposed Phase 2 of development including the east edge of Beaumont annexation lands.

6.4.1.5 50 Street/Hwy 814 – Arterial

A main north-south route is 50 Street with a direct connection to an interchange at Anthony Henday Drive. Within the current City boundaries, 50 Street is a major divided four lane arterial between Anthony Henday and Watt Common. Concept plans show a six-lane arterial roadway ultimate concept within the City’s boundaries. With the added capacity and growth from the annexation area, 50 Street is anticipated to be an important regional roadway to serve the City’s growth and continue to support commuters from Beaumont.

6.4.1.6 66 Street – Arterial

Another corridor that is expected to provide north/south access into the City is 66 Street. This roadway does not directly connect to Anthony Henday Drive, but has a flyover connection into the City. Plans to extend 66 Street south around Cawes Lake with a connection to the range road system, within Leduc County, will result in this corridor serving a significant role in support of the annexation of lands adjacent to the Town of Beaumont. This street is located in Phase 1 of the Southeast Annexation area.

6.4.1.7 91 Street and Ewing Trail – Arterial

There is a direct interchange to Anthony Henday Drive at 91 Street. This street is a divided four lane arterial between Anthony Henday Drive and Ellerslie Road. It connects into Ewing Trail, just north of 41 Avenue SW.

Ewing Trail was connected to the Nisku Spine Road, a divided four lane arterial, in 2016. Leduc County plans to extend Nisku Spine Road, in four phases, as a major Industrial Arterial along the east boundary of the City of Leduc. A connection is planned at Highway 2A south of the City of Leduc. The key routes of 91 Street, Ewing Trail, and Nisku Spine Road will be used for movement of goods between the City of Leduc, Nisku Industrial, and the City of Edmonton. Potential for upgrades to higher capacity six or eight lane arterials exists as the City and surrounding areas grow.

6.4.1.8 Queen Elizabeth II Highway (QE II) – Highway

The QE II Highway is a major north/south Provincial Highway that serves as the primary route between the City of Edmonton and the City of Calgary. It is the preferred route of the CANAMEX Trade corridor in Alberta. The QE II Highway is also a freeway between the City of Leduc and the City of Edmonton, with all accesses controlled by interchanges. Interchanges will be located approximately every three kilometres along the QE II Highway. All existing and proposed roadways within the proposed annexation lands will support the existing function of this important international corridor. It is a divided highway between Leduc and Edmonton and will be upgraded over time as traffic volumes increase.

QE II Highway through the annexation study area is managed and controlled by Alberta Transportation (AT). AT provided a set of drawings with the title “Queen Elizabeth II Highway - Functional Planning Study, Ellerslie Road to South Leduc Study Area,” dated May 2010. These single line drawings illustrate the proposed future alignment of the QE II, including interchange sketches. A high speed, high capacity interchange is proposed on QE II, between 41 Avenue and Highway 19, at the junction of the Future Edmonton Regional Ring Road. This future Edmonton Regional Ring Road will have a significant impact on mobility and access to the proposed annexation lands.

6.4.1.9 111 Street/James Mowatt Trail – Arterial

At 111 Street is an existing interchange with Anthony Henday, and it currently aligns to the west, connecting with the existing 127 Street alignment close to 41 Avenue SW. This road will continue south, cross Township Road 510 to the west of QE II Highway, and proceed south to tie into Crossroads Boulevard. James Mowatt Trail will provide connections into the City and to major east west corridors south to Township Road 510. The 111 Street/James Mowatt Trail is in Phase 1 of the southwest annexation area, and will develop southward during the build out of Phase 1.

6.4.1.10 141 Street/Heritage Valley Trail – Arterial

For 141 Street, it is planned to be realigned south of Anthony Henday Drive in the Heritage Valley Servicing Concept Design Brief (Office Consolidation February 2014), along the 132 Street corridor. This street ties into the 132 Street realignment (Heritage Valley Trail), at a proposed interchange on Anthony Henday Drive west of the 111 Street interchange. For 141 Street, it is proposed to continue through the proposed southwest annexation lands and become Crossroads Boulevard, connecting to Highway 19 just north the EIA at a proposed interchange. An important connection for the industrial traffic in the area north of the airport is 141 Street and it will also provide access to the City.

It is expected that 141 Street will be a major arterial and will be developed in Phase 1. The northern part of 141 Street should be developed in conjunction with residential areas moving south from 41 Avenue SW.

6.4.1.11 Rabbit Hill Road/RR 252 – Arterial

Rabbit Hill Road intersects with Anthony Henday Drive at an existing interchange. it is expected to serve more local residential traffic within the existing City lands, and tie into the rest of the network at Terwillegar Drive, where it terminates. 156 Street/RR 252 is recommended as an arterial, extending south into Phase 2, and connecting to Crossroads Boulevard.

6.4.1.12 Terwillegar Drive/170 Street – Freeway

Terwillegar Drive/170 Street is a major north south connection, that will eventually serve the City as a freeway with key connections to Anthony Henday Drive and Whitemud Drive. Currently, an expressway, Terwillegar Drive has an existing interchange at Anthony Henday Drive. It will have interchanges with other major east-west roads including 41 Avenue SW and Highway 19. Terwillegar Drive should retain a future freeway status between Anthony Henday Drive and Highway 19, with potential for future interchanges at major crossings. Ultimately, it is anticipated that Terwillegar Drive will be extended south of Highway 19 and Highway 39 with an indirect connection to QE II Highway through the SW leg of a potential outer ring road. Terwillegar Drive is proposed to be developed in Phase 1 and 2. This road will be high priority, especially as growth at the airport increases traffic volumes to and from the City and region.

6.4.1.13 Supporting Road Network West of the EIA – Arterial

The City is anticipating a combination of industrial and residential development in the future regional growth area lands immediately west of the airport. These lands will require a supportive grid of arterial roads. A grid system with major arterials located at 1600 m minimum intervals is proposed, as presented in **Figure 6-1**. This will provide continuation of the major road network north of the airport and service these lands with access to existing highways in the region.

6.4.1.14 Highway 60 – Provincial Highway

Highway 60 is located to the west of the City's proposed southwest annexation boundary. It is significant to the annexation lands as it serves as the location of the crossing of the North Saskatchewan River. Highway 60 provides access to Spruce Grove and Stony Plan, as well as Highway 16 west of the City. Industrial growth in the proposed southwest annexation area will be serviced by this Provincial Highway, which will provide alternative access to Highway 39.

6.4.2 East/West Transportation Corridors

6.4.2.1 Anthony Henday Drive – Provincial Highway

Anthony Henday Drive, also known as Provincial Highway 216 is a freeway ring road that provides a complete bypass around the central core of the City. Anthony Henday Drive is an important road that the supporting road network is built up around, providing access into the core as well as complete access for residents, commercial development and industrial pockets all around the City. In south Edmonton, Anthony Henday Drive is a divided four and six lane freeway with interchanges located at Terwillegar Drive, Rabbit Hill Road, 111 Street, QE II Highway, 91 Street, 50 Street and 17 Street. It has flyovers at 66 Street and 34 Street.

6.4.2.2 41 Avenue SW –Expressway

41 Avenue SW is the City's current south boundary with Leduc County. It has been identified by the City in the 41 Avenue Functional Planning Study as a multi-lane major arterial road. The City and Alberta Transportation recently completed construction of an interchange on the QE II Highway at the junction of 41 Avenue SW. 41 Avenue SW, with its high design standard and regularly spaced intersection connections, will provide east/west mobility in support of the City Annexation proposal. It is also identified as the location for a potential future new North Saskatchewan River crossing, connecting the southwest end of the City to growth areas west and north of the river as well as adding regional capacity to the entire network. Any necessary upgrades to 41 Avenue NW should occur in Phase 1, with the additional crossing across the North Saskatchewan River being planned for as needed for growth with Phase 2.

6.4.2.3 Future Arterial

The 3.2 km spacing between 41 Avenue SW and Township Road 510 allows for another east/west arterial road. This road will provide access from the Spine Road to 17 Street and beyond. The alignment of this proposed arterial is anticipated to avoid the environmentally sensitive Cawes Lake wetlands. This important east/west corridor will directly service lands that are within the City's southeast annexation proposal, including those lands adjacent to the north boundary of Beaumont. West of the QE II Highway, the proposed future arterial will continue to 184 Street. This road is proposed to be developed as part of Phase 1. The Future Arterial is proposed to cross QEII with a fly-over structure that can accommodate vehicle traffic in addition to the proposed transit corridor along the Future Arterial.

6.4.2.4 Township Road 510 – Expressway

Township Road 510 is an east/west corridor located adjacent to the northern boundary of Beaumont. In the County of Leduc Township Road 510 Functional Planning Study, this road is identified as a future divided arterial from 50 Street in Beaumont to QEII. There is a need for additional east-west capacity to accommodate the population growth and density caused by the Annexation lands. Ultimately, space should be preserved for a major expressway, forming a connection between the Nisku Industrial Park and the proposed Nisku Spine Road with regularly spaced intersection connections to collector and arterial roads. Township Road 510 is also identified as an arterial road by the Capital Region Board 2011 Integrated Regional Transportation Master Plan (IRTMP). It is believed that Township Road 510 could ultimately be directly connected to QEII by way of an interchange as the interchange spacing between 41 Avenue, Township Road 510, and Highway 19 on QEII complies with current Alberta Transportation interchange spacing policy. West of the QE II, Township Road 510 is anticipated to terminate at Terwillegar Drive, with connections to RR 252, 141 Street, 127 Street as well as tying into the proposed grid road network west EIA. The development of this road should occur as part of Phase 2 into Phase 3.

6.4.2.5 Highway 625 – Freeway/Provincial Highway

Highway 625 south of Beaumont proposed to be a divided major arterial from 50 Street in Beaumont to the QE II Highway. There will be a direct connection from Highway 625 to QE II via an existing interchange. A future interchange at 50 Street is proposed by Alberta Transportation. East of Beaumont, Highway 625 (from 50 Street to Highway 21) is identified as an expressway according to the 2015 Capital Region Board IRTMP. Highway 625 from east of QE II Highway to Highway 21 is also a provincial Over Dimensional Route, providing access between Nisku Industrial Park and Fort McMurray.

6.4.2.6 Highway 19 – Freeway/Provincial Highway

Highway 19 west of the QE II Highway is proposed to be realigned around the future third runway at the EIA, with interchanges at the Crossroads Boulevard, Terwillegar Drive and Highway 60. South of Devon, Highway 19 will have an interchange and realign through Devon as Highway 60 to travelling north. Highway 19 is proposed to be developed in Phase 2 and Phase 3.

6.4.2.7 Highway 39 – Provincial Highway

Highway 39 is located outside of the proposed annexation lands, but is a Provincial Highway that will provide support to development at the south end of the EIA. Highway 39 is proposed to connect to the existing 65 Avenue in Leduc with a new interchange at QE II Highway. It will provide connections to the QE II and Highway 60.

6.4.2.8 Future West Freeway

AT has identified the potential for a Future West Freeway south of the City of Leduc with an interchange at QE II Highway. This could ultimately connect Highway 43 and provide a continuous link to the northern trade corridor. Though no alignment for this road has been confirmed, future planning in the south of Edmonton will continue to take into consideration the need and demand for this Future West Freeway, which would help alleviate pressure on City roads.

6.4.3 Road Network Summary

The combination of these north/south and east/west interconnecting transportation corridors are expected to provide excellent integrated mobility for the movement of goods and people in support of the City's southeast and southwest annexation proposal. The comprehensive transportation systems planning which occurs in the City's Transportation Planning and Engineering Department will ensure that the residents and businesses located within the boundaries of the proposed annexation areas continue to enjoy the benefits of integrated, comprehensive, sustainable, and holistic planning and management of these important and vital transportation corridors.

6.4.4 Transit

There are two major transit corridors located south of Anthony Henday Drive that are proposed. These will service growth in the proposed Annexation areas. It is our understanding that the City has long-term plans to extend the LRT corridor to the southeast past Anthony Henday Drive terminating at Ellerslie Road and 50 Street. In this study a future major bus route extending to the northern boundary of Beaumont has been identified. The City has plans to extend the Southwest LRT corridor from Century Park to 127 Street and 41 Avenue SW. This could be extended to the EIA. Bus Rapid Transit (BRT) should be considered as an interim step to LRT. An east-west BRT corridor along the future arterial identified between Township Road 510 and 41 Avenue was identified.

This will be critical in providing quick access between the growing residential population south of the City and proposed business, industrial and employment areas north of the EIA. Some transit centres have also been identified. The possible approval of the future Edmonton Regional Ring Road may also impact the ultimate transit connectivity and alignment.

6.4.5 Comprehensive Transportation Network Modeling

Decisions on how and when to add capacity to a transportation network are impacted by growth, modal shift and upgrades elsewhere in the transportation network. The City currently has, and maintains, a comprehensive travel demand model, which connects to other regional models maintained through Alberta Transportation. This regional model is updated through City initiatives and contains data from all communities in the Capital Region. It reflects land use and road network planning coordinated through various City departments.

Working with the surrounding communities, the City is able to ensure that transportation planning through the region is handled in a consistent and comprehensive manner using volumes and patterns on Capital Region roadways identified through data developed with the travel demand model.

6.4.6 Edmonton International Airport

In this report, the EIA land was not considered as being included in the City's annexation proposal. However, the EIA represents a significant transportation element within the Greater Edmonton Region. It serves both as a primary and a secondary industry. As a primary industry, the airport attracts and grows its own customer base by providing products and services such as aircraft maintenance services, cargo transfer systems and the transfer of business and leisure passengers. Secondary industries satisfy the demand for air transportation, created by residents, and by travellers from other areas, who come to the general Edmonton area for business, tourism, and personal reasons.

Edmonton Regional Airports Authority has prepared an EIA Master Plan covering a planning horizon from 2010 to 2035. This Airport Master Plan covers forecast growth in the airside systems, passenger terminal, air cargo handling systems, business aviation, parking and ground transportation, airline support facilities, utilities, an environmental sustainability plan, and land use planning.

The EIA Master Plan includes the provision for expansion of the public transit service into the terminal with potential service to the groundside commercial properties within the airport boundaries. Currently the City operates a bus transit service to the airport terminal from Century Park LRT station. The EIA Master Plan provides a future alignment for the extension of the southwest LRT from Century Park into the terminal. This alignment is proposed to extend south through 127 Street, cross Hwy 19, and terminate at the EIA terminal. An inter-municipal bus service to the City of Leduc could link to the EIA LRT service at a station location along the route.

Discussions concerning a high-speed train service between Calgary and Edmonton have been taking place, primarily within the provincial government over the last several decades. The impetus for this service has primarily been to relieve the growing congestion that has been occurring on the QE II Highway and to potentially defer the need for adding lanes and capacity to the highway. Plans to connect this service into the EIA lands and integrate with the future LRT service to the airport are in their preliminary stages of investigation.

6.5 PHASING

Table 6-2 presents the road network needs, by phase. As development progresses south, not all roads will be built out to their full extents. Specific phasing will be developed through more detailed analysis in future studies. For the purposes of this study and basic cost estimate, phasing was identified as full development of the identified roads within the proposed annexation area to provide a high-level understanding of the sequencing.

Table 6-2
Proposed Development Phases Annexation Area

Road Description	Type	Number of Lanes	Length (km)	Inter-changes
Phase 1: Southwest Annexation Area				
41 Avenue SW from Hwy 2 to 184 Street	Expressway	6	8.5	1
Future Arterial from Hwy 2 to 184 St.	Arterial	4	8	2
Twp Rd 510 from QEII to 170 Street	Expressway	6	8.6	
Terwillegar Drive from 41 Avenue SW South	Freeway	6	3.5	
170 Street from Future Arterial to Twp Rd 510	Arterial	2	1.6	
Rge Rd 252 from 41 Ave SW to Twp 510	Arterial	2	3.2	
141 Street from 41 Ave SW to Hwy 19	Arterial	4	6.8	
James Mowatt Trail from 41 Ave SW to Crossroads Blvd.	Arterial	4	7.5	
Hwy 19 from Hwy 2 to Crossroads	Highway	4	2.5	2
Phase 1: Southeast Annexation Area				
41 Avenue SE from 50 Street to 66 Street	Expressway	6	1.6	
Future Arterial from 50 Street to 66 Street	Arterial	4	1.6	
Twp Rd 510 from ¼ mile east of 66 Street to 66 Street*	Expressway	6	0.4	
66 Street SE from 41 Avenue to Twp Rd 510	Arterial	2	1.6	
Rge Rd 242 from Future Arterial to Twp Rd 510*	Arterial	2	1.2	
50 Street from 41 Avenue to 1 Mile South	Expressway	4	1.6	
Phase 2: Southwest Annexation Area				
Terwillegar Drive from North of Twp Rd 510 to Twp Rd 504	Freeway	6	4.5	2
170 Street Realignment from Twp Rd 510 to Twp Rd 504	Arterial	2	3.7	
Rge Rd 252 from Twp 510 to Crossroads Blvd	Arterial	2	2.6	
Twp Rd 504 from YEG to Terwillegar	Arterial	2	2.5	
Twp Rd 510 from 170 Street to Terwillegar Drive	Expressway	6	3.0	
Hwy 19 from Crossroads Blvd to Terwillegar Drive	Provincial Highway	4	5.6	
41 Avenue SE from ¼ mile E. of 34 Street to 50 Street	Expressway	6	2.6	
Future Arterial from ¼ mile E. of 34 Street to 50 Street	Arterial	4	2.6	
Twp Rd 510 from ¼ mile E. of 34 Street to 34 Street*	Expressway	6	0.4	
34 Street from 41 Avenue to Twp Rd 510*	Arterial	2	3.2	
Phase 3: Southwest Annexation Area				
Hwy 19 from Terwillegar Drive to Rge Rd 261	Highway	4	2	
Twp Rd 504 from Terwillegar to Rge Rd 261	Arterial	2	1.6	
41 Avenue from ¼ mile E. of 34 Street to Meridian Street	Expressway	6	1.35	
Future Arterial from ¼ mile E. of 34 Street to Meridian Street	Arterial	4	1.35	
Twp Rd 510 from ¼ mile E. of 34 Street to Meridian Street	Expressway	6	1.35	
17 Street SE from 41 Avenue to Twp Rd 510	Expressway	4	3.2	
Rge Rd 234 from 41 Avenue to Twp Rd 510	Arterial	2	3.2	

Table 6-3
Transportation Cost Estimate Annexation Area

Road	Distance (km)	Type	Cost/km (2018)	Cost (2018)
PHASE 1: SOUTHWEST ANNEXATION AREA (SWAA)				
41 Avenue	8.5	6 Lane Expressway	$8,112,000	$69,000,000
Future Arterial	8	4 Lane Arterial	$5,070,000	$41,000,000
Twp Rd 510	8.6	6 Lane Expressway	$8,112,000	$70,000,000
141 Street	6.8	4 Lane Arterial	$5,070,000	$35,000,000
James Mowatt Trail	7.5	4 Lane Arterial	$5,070,000	$38,000,000
Rge Rd 252	3.2	2 Lane Arterial	$3,042,000	$10,000,000
Terwillegar Drive	3.5	6 Lane Freeway	$8,112,000	$28,000,000
170 Street	1.6	2 Lane Arterial	$3,042,000	$5,000,000
Highway 19	2.5	4 Lane Provincial Highway	$5,070,000	$13,000,000
Systems Interchanges	1	Interchange	$105,456,000	$106,000,000
Service Interchanges	3	Interchange	$79,092,000	$238,000,000
			Sub-total SWAA	**$653,000,000**
PHASE 1: SOUTHEAST ANNEXATION AREA (SEAA)				
41 Avenue	1.6	6 Lane Expressway	$8,112,000	$13,000,000
Future Arterial	1.6	4 Lane Arterial	$5,070,000	$8,000,000
Twp Rd. 510	0.4	4 Lane Expressway	$8,112,000	$3,000,000
66 Street SE	1.6	2 Lane Arterial	$3,042,000	$5,000,000
Rge Rd 242	1.6	2 Lane Arterial	$3,042,000	$5,000,000
50 Street	3.2	4 Lane Expressway	$8,112,000	$26,000,000
Transit – BRT (East of Highway 2)				$102,000,000
			Sub-total SEAA	$ 162,000,000
			TOTAL PHASE 1	**$ 815,000,000**
PHASE 2: SOUTHWEST ANNEXATION AREA				
Hwy 19	5.6	4 Lane Provincial Highway	$5,070,000	$29,000,000
Terwillegar Drive	4.5	6 Lane Freeway	$8,112,000	$37.000,000
170 Street	3.7	2 Lane Arterial	$3,042,000	$12,000,000
Rge Rd 252	2.6	2 Lane Arterial	$3,042,000	$8,000,000
Twp Rd 504	2.5	2 Lane Arterial	$3,042,000	$8,000,000
Twp Rd 510	3	6 Lane Expressway	$8,112,000	$25,000,000
Service Interchanges	2		$79,092,000	$158,000,000
Transit – BRT (West of Highway 2)				$71,000,000

Road	Distance (km)	Type	Cost/km (2018)	Cost (2018)
Transit – LRT (41 Ave to Hwy 19)				$710,000,000
			Sub-total SWAA	$ 1,058,000,000
PHASE 2: SOUTHEAST ANNEXATION AREA				
Twp Rd 510	0.4	4 Lane Expressway	$8,112,000	$3,000,000
34 Street	3.2	2 Lane Arterial	$3,042,000	$10,000,000
41 Avenue SE	2.6	6 Lane Expressway	$8,112,000	$21,000,000
Future Arterial	2.6	4 Lane Arterial	$5,070,000	$13,000,000
			Sub-total SEAA	$ 47,000,000
			TOTAL PHASE 2	$ 1,105,000,000
PHASE 3: SOUTHWEST ANNEXATION AREA				
Hwy 19	2	4 Lane Provincial Highway	$5,070,000	$10,000,000
Twp Rd 504	1.6	2 Lane Arterial	$3,042,000	$5,000,000
			Sub-total SWAA	$15,000,000
PHASE 3: SOUTHEAST ANNEXATION AREA				
41 Avenue	1.35	6 Lane Expressway	$8,112,000	$11,000,000
Future Arterial	1.35	4 Lane Arterial	$5,070,000	$7,000,000
Twp Rd 510	1.35	6 Lane Expressway	$8,112,000	$11,000,000
17 Street	3.2	4 Lane Expressway	$6,084,000	$20,000,000
Rge Rd 234	3.2	2 Lane Arterial	$3,042,000	$10,000,000
Transit – LRT (EIA) Lands				$284,000,000
			Sub-total SEAA	$343,000,000
			TOTAL PHASE 3	$358,000,000
			GRAND TOTAL PHASE 1, 2 AND 3	$2,278,000,000

6.6 CAPACITY

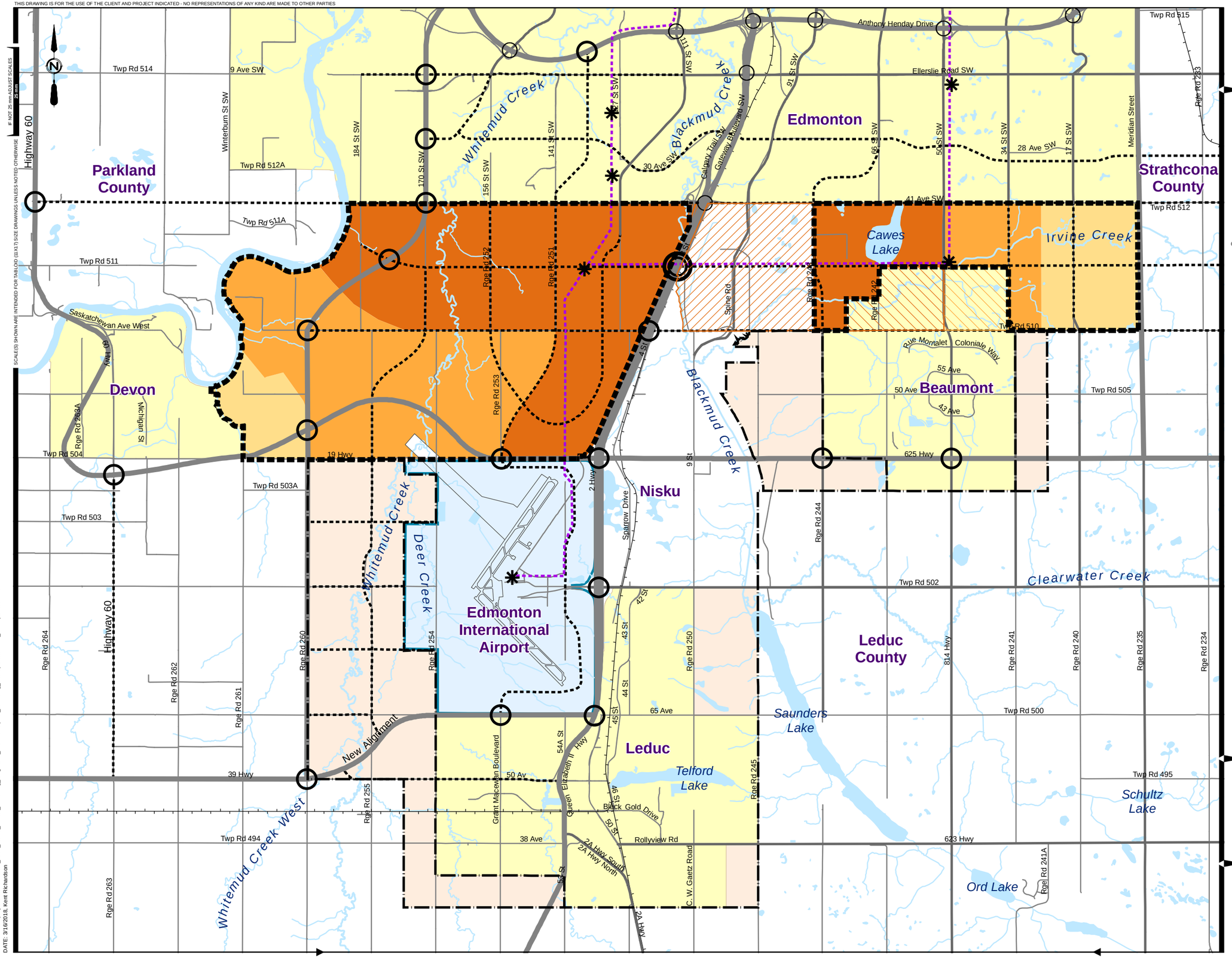
While future studies will be important to identify where capacity should be added to the network, a high-level overview assessment was undertaken to identify if the proposed major roadways (Highways, freeways, expressways, arterials) had enough capacity to accommodate the expected growth. Estimates presented in Section 6.3.1 and **Table 6-1** of this report show that approximately 41,000 vehicles per hour (VPH) of residential traffic and 5,200 transit trips per hour will result from the anticipated growth.

A review of the capacity of the major transportation infrastructure identified in this report is shown in **Table 6-4**.

Table 6-4
Capacity Overview

Road Description	Type	Number of Lanes	Lane Capacity (vehicles/lane/hour)	Road Capacity (PM Peak VPH)
East West Infrastructure				
41 Ave SW	Expressway	6	1100	6600
Future Arterial	Arterial	4	800	3200
Township Road 510	Expressway	6	1100	6600
Hwy 19/Hwy 625 from Terwillegar to Beaumont	Provincial Highway	4	1800	7200
			Total East West Roadway Capacity	23,600
North South Infrastructure				
17 Street	Expressway	4	800	3200
34 Street	Arterial	4	800	3200
Terwillegar Drive	Freeway	6	1100	6600
50 Street	Arterial	4	800	3200
66 Street	Arterial	4	800	3200
James Mowatt Trail	Arterial	4	800	3200
141 Street	Arterial	4	800	3200
Highway 2	Provincial Highway	2 (additional)	1800	3600
			Total North South High-Speed Roadway Capacity	29,400
			Total High-Speed Roadway Capacity	**53,000 VPH**

There is a total available capacity for approximately 53,000 VPH on the new and upgraded major roadways within this annexation area whereas the total population estimate suggests a travel demand of approximately 51,500 VPH generated from this annexation proposal (refer to Table 6.1). This represents surplus transportation capacity available for this annexation area based on the supporting transportation network.



Legend:

- Future or Upgrade Interchange
- Existing Interchange
- Flyover
- Existing & Future Highway & Freeway
- Existing Expressway & Arterial
- Future Expressway & Arterial
- Future Major Transit Centre
- Future Public Transit Line
- Phase 1
- Phase 2
- Phase 3
- Future Regional Growth Area
- Leduc County Land Assumed to be Developed in Phase 1
- Beaumont Land Assumed to be Developed in Phase 1
- Beaumont Land Assumed to be Developed in Phase 2
- Proposed Annexation Area
- Future Regional Growth Area
- Edmonton International Airport
- Existing Urban Municipality

Figures are conceptual and not to be used for construction. These will be superseded by ASP/NSPs.

FIGURE No. 6-1

CITY OF EDMONTON
ANNEXATION PROPOSAL

PROPOSED TRANSPORTATION INFRASTRUCTURE

AE PROJECT No.	2015-3360
SCALE	1:90,000
APPROVED	
DATE	MARCH 2018
REV	
DESCRIPTION	FINAL REPORT

7 Summary of Costs

Table 7-1 summarizes the estimates for capital costs for the infrastructure identified in the proposed concept to service the annexation areas. Some costs for offsite infrastructure and upgrades required to support serviceability of the annexation areas have also been included in the estimates.

The cost estimates were prepared using average unit costs derived from infrastructure construction projects in green fields that have been completed by Associated Engineering.

The capital costs presented were based on present day (2018) dollars. Future operation and maintenance costs have not been included in the estimates.

Table 7-1
Summary Costs

Item	Phase 1	Phase 2	Phase 3	Total
Wastewater	$654,960,000	$134,530,000	$16,870,000	$806,360,000
Water	$47,170,000	$66,620,000	$4,340,000	$118,130,000
Stormwater**	$12,000,000			$12,000,000
Transportation	$815,000,000	$1,105,000,000	$358,000,000	$2,278,000,000
Total	**$1,529,130,000**	**$1,306,150,000**	**$379,210,000**	**$3,214,490,000**

* Cost estimates were prepared using average unit rates derived from infrastructure construction projects in green fields and brown fields that have been completed by Associated Engineering consultation with the City of Edmonton.

8 Conclusions

8.1 WASTEWATER

- The existing SESS system is anticipated to have sufficient capacity to provide interim servicing of a portion of the Phase 1 development area.
- It is envisioned that the existing SESS concept does not have sufficient capacity to support the ultimate build out of the annexation, adjacent municipalities, and future regional growth areas.
- A pumping station will be required to service the southwest annexation area (lands west of QE II Highway), similar to SESS SW system.
- The southeast annexation area will be serviceable via gravity and will only require pumping on an interim basis.
- Flows from the Town of Devon can be accommodated following installation of the adjacent Phase 3 mains.
- It is envisioned that the proposed concept will provided additional wastewater infrastructure necessary to facilitate growth around the EIA.
- Total capital cost of wastewater infrastructure to support the annexation area is estimated to be $806,360,000. Oversizing for the adjacent municipalities lands and future regional growth areas is included.
- The wastewater infrastructure servicing concept proposed has been sized to provide capacity for the City's annexation lands, annexation, adjacent municipalities, and future regional growth areas.

8.2 WATER

- E.L. Smith WTP will be the main source to supply the annexation areas.
- A 1500 mm equivalent diameter water line is proposed to supply water to the annexation areas.
- The water infrastructure sizing and requirements will be assessed and evaluated by EPCOR Water through City of Edmonton land planning processes to validate sizing and timing of infrastructure requirements discussed in this report.
- Total cost of water infrastructure required to support the annexation is estimated to be $118,130,000. Oversizing for the adjacent municipalities and future regional growth areas is included.

8.3 STORMWATER

- The proposed annexation area drains to the North Saskatchewan River, Whitemud Creek, Blackmud Creek, Irvine Creek, and Clearwater Creek Catchments.
- The allowable discharge for SWMFs in each of these catchments have been estimated from flood frequency analysis or obtained from previous studies.
- Erosion is a continuing problem in each of the waterbodies identified above.
- The cost effectiveness of using lower allowable discharge rates for SWMFs, (thus resulting in larger SWMFs) will have to be evaluated against the cost of armoring the major creeks with riprap to prevent erosion.
- Major improvements will be required to Irvine Creek to convey flows from existing and proposed development, as well as offsite flows.
- The feasibility of using Cawes Lake for stormwater management will have to be evaluated for cost and environmental implications.
- Total cost of improvements for the portion of Irvine Creek within the City's annexation area is estimated to be $12,000,000.

8.4 TRANSPORTATION

- The City of Edmonton has existing policies and procedures in place to ensure that the proposed annexation lands will be comprehensively planned and managed.
- The City of Edmonton has the capability to ensure that the transportation infrastructure needed for the proposed annexation lands is integrated into the skeleton transportation network for the remainder of the Capital Region, including roads, transit service, and active transportation networks.
- Growth within the Capital Region will ultimately impact the transportation network within the current boundaries of the City; annexation allows comprehensive planning through existing planning tools to create efficiencies across the entire network.

- The City of Edmonton is able to provide sufficient transportation infrastructure capacity to adequately meet the demands of this annexation area.
- Total cost for providing transportation infrastructure to service the annexation areas is estimated to be $2,792,000,000. The transportation network includes capacity for the adjacent municipalities lands and the future regional growth areas.

9 Recommendations

9.1 WASTEWATER

- It is recommended that additional studies are undertaken to further assess the effect of the Southeast and Southwest Annexation Areas on the SESS mains. This will be necessary to establish both interim servicing capabilities as well as to confirm long-term sizing and timing of future infrastructure.
- It is recommended that the City proceed with the SESS SB servicing concept of the annexation lands, as presented in **Figures 3-1** and **3-2**.
- It is recommended that existing ACRWC sanitary infrastructure within the proposed annexation lands be transferred to the City at the time the annexation is approved.

9.2 WATER

- It is recommended that EPCOR Water include the additional annexation lands in their models to investigate whether their existing water infrastructure can support the proposed annexation and to confirm and verify the pipe sizes.
- It is recommended that existing CRSWSC water infrastructure within the proposed annexation lands be transferred to EPCOR at the time the annexation is approved.

9.3 STORMWATER

- A detailed analysis is recommended to improve Irvine Creek to convey flows from the existing, proposed developments and offsite areas.
- It is recommended that a cost benefit analysis be undertaken to compare armoring the major water bodies to prevent erosion, against using lower values of allowable discharge rates.
- A detailed study to evaluate the feasibility of providing regional stormwater management in Cawe's Lake is recommended.
- At the time of writing this report, the Blackmud/Whitemud Surface Water Management Study was being conducted. The concepts presented in this report should be reviewed once the findings of the study are published.

9.4 TRANSPORTATION

- The City should continue to work with the Capital Region Board to identify regional network upgrades.
- The City should update the transportation demand model with the land use and employment information for the annexation areas to confirm capacity upgrades necessary within the current and future City boundaries.
- The City should work with EIA to develop supporting road and transit infrastructure for the airport.
- Improving access to active transportation and transit will support the road network.

Closure

This report was prepared for the City of Edmonton to provide an Infrastructure serviceability review of the proposed annexation.

The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
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APEGA Permit to Practice P 3979

References

Below is a list of reference documents that were used in this assessment. Copies of the documents listed below can be obtained from the City, upon request.

1. City of Edmonton - Sanitary Servicing Joint Planning Study for South Edmonton and Region, Stantec, 2011 (Adjacent municipalities Study).
2. City of Edmonton - South Edmonton Sanitary Sewer (SESS) Planning Study Update, ISL, 2014 (SESS Planning Study).
3. City of Edmonton - Sanitary Sewer Database (DRAINS).
4. City of Edmonton Design and Construction Standards, March 2015.
5. City of Edmonton Design and Construction Standards, Volume 3 and Volume 4.
6. City of Edmonton – DRAFT Irvine Creek and Cawe's Lake Watershed Study, Stantec, 2014.
7. Town of Beaumont Annexation Review (on behalf of Leduc County), McElhanney, 2015.
8. Capital Region Board - Integrated Regional Transportation Master Plan, 2011.
9. Capital Region Board - Intermunicipal Transit Network Plan, 2009.
10. Capital Region Board – Integrated Regional Transportation System Study, 2011.
11. Capital Region Board - Growth Plan: Growing Forward, 2010.
12. City of Edmonton - Transportation Master Plan "The Way We Move," 2009.
13. City of Edmonton – Existing and Future Transit Centres/LRT Stations (Southside), 2014.
14. City of Edmonton - Decouteau Area Structure Plan, Stantec, 2014.
15. City of Edmonton - Southeast Area Structure Plan, Stantec, 2005.
16. City of Edmonton - Ellerslie Area Structure Plan, City of Edmonton Office Consolidation, 2013.
17. Leduc County - 9 Street (Nisku Spine Road) Functional Planning Study, Associated Engineering, 2006.
18. Leduc County - Township Road 510 Functional Planning Study, Associated Engineering, 2008
19. Edmonton International Airport – Master Plan 2010 – 2035, 2010.
20. City of Edmonton – 2005 Edmonton Household Travel Survey, 2005.

Appendix A – Design Notes

DESIGN ASSUMPTIONS AND DESIGN NOTES

1. WATER DESIGN ASSUMPTION

Storage Reservoir

Currently, Edmonton has 10 reservoirs and 2 Water Treatment Plants (with storage reservoir) servicing approximately 192 sections on land. Therefore, each reservoir is estimated to service approximately 16 sections (4,096 hectares).

From the preliminary concept provided by EPCOR, it was our understanding that two (2) reservoirs are being proposed – Windermere Reservoir (1.6 km south of Ellerslie Road and 170 Street SW) and Decoteau Reservoir (north side of Ellerslie Road, between 17 and 34 Street SW). Each reservoir will service approximately 16 sections south of Anthony Henday.

It was assumed these two reservoirs that could potentially be considered to service some of the proposed annexation lands. See **Figure 4-2 and 4-3**.

Pipe Design

- Only pipes with diameters of 400 mm and larger are presented in this assessment.
- Large diameter pipes to provide Peak Day Demand at 1.5 m/s.
- Fire Flows are not included.

2. TRANSPORTATION

Future roadways within the City of Edmonton will continue to comply to design standards as established through the Transportation Association of Canada (TAC) and implemented through the City of Edmonton Roadways Design Standards. As transportation values and priorities continue to shift and grow these designs standards may shift and grow as well. While the number of cars on the road will continue to increase for the foreseeable future, the City is also invested in providing more options for how we get around. The City is currently investing in improved transit through bus service and expanding the reach of the LRT. Cycling is growing in popularity and the City is also investing in increased cycling infrastructure through implementation of the first separated bike lane in the core. In May 2013, in support of the Transportation Master Plan, the City implemented the Complete Streets Guidelines, which recognize that a street is more than a place for cars, and that designs of the public realm of a road should consider users of all ages and modes.

Capital Region Board

The Capital Region Board is a corporation consisting of twenty-five participating municipalities established by the Government of Alberta in April 2008 to develop and implement a Growth Plan for the Edmonton Capital Region. The Growth Plan entitled “Growing Forward” consists of four components:

1. Land Use Plan
2. Intermunicipal Transit Network Plan
3. Housing Plan
4. Geographic Information System Plan

The Growth Plan was produced on March 31, 2009 and two Addenda documents for the Growth Plan were also produced on October 31, 2009 and December 31, 2009. These two Addenda included the development of maps that identified Priority Growth Areas as well as transportation and other infrastructure.

The transportation section of this annexation report heavily borrowed the information that was produced by the Capital Region Board. A Capital Region Inter-municipal Transit Network Plan was created in March 2009 to illustrate the short, medium, and long term public transit needs throughout the Capital Region.

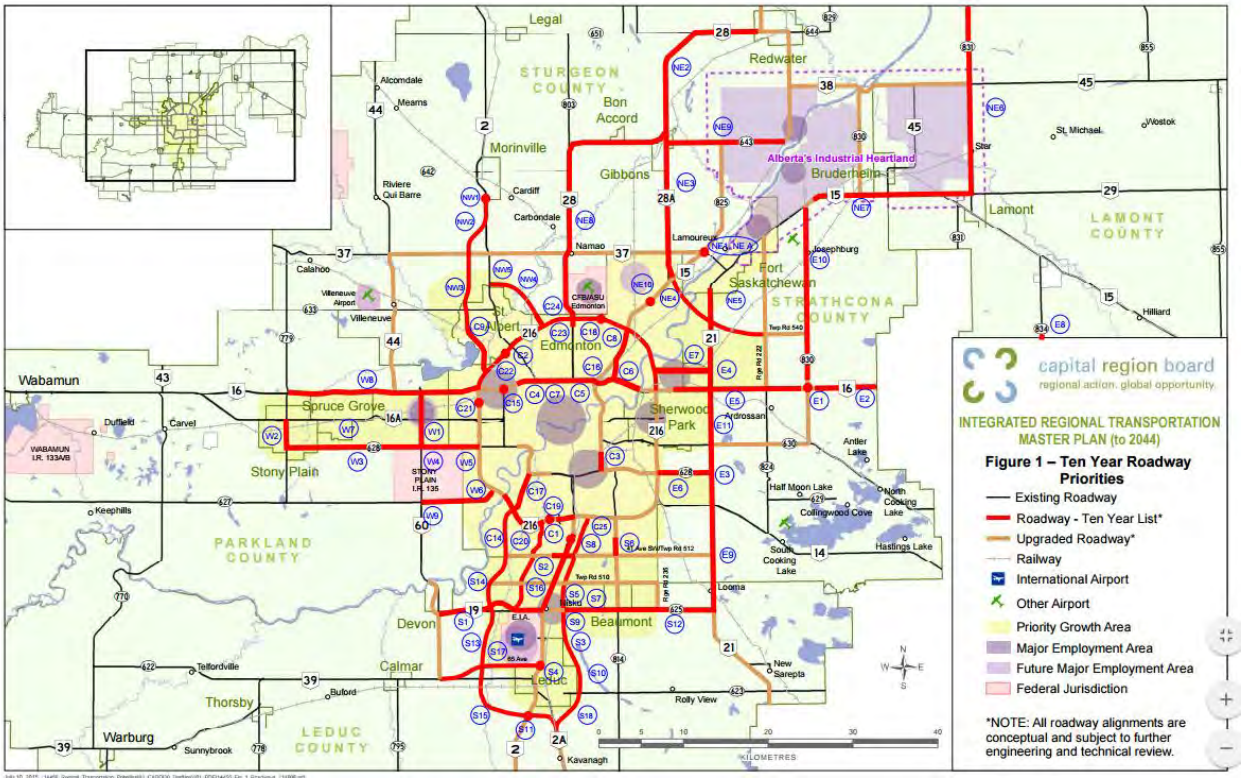
The Capital Region Board produced an Integrated Regional Transportation System Study in June 2011 based on a 35 year growth forecast adopted by the Capital Region Board in 2009. These forecasts were developed by the Capital Region Board in accordance with guidelines established by Alberta Finance and Enterprise and approved by the Minister of Municipal Affairs in 2010. The Capital Region Board forecasts anticipated population in the Capital Region to grow from 1.12 million in 2009 to 1.73 million in 2044. Employment was forecast to rise from 620,000 in 2009 to 862,000 in 2044. It is important to note that the June 2011 Integrated Regional Transportation Systems Study did not contemplate the current proposed City of Edmonton annexation plan although the notion of the Priority Growth Areas would have included this aspect of further densification and urban growth within the contemplated City of Edmonton proposed annexation area. The June 2011 Integrated Regional Transportation System Study produced a recommended transportation plan of existing and upgraded and new roads that did not include provision for an outer ring road.

The Integrated Regional Transportation Master Plan was created on September 2011 with the goal of being consistent with the Capital Region Growth Plan which has a planning horizon from 2009 to 2044. This Integrated Regional Transportation Master Plan considered the Priority Growth Areas which are areas that will be developed to higher urban densities than in the past. The Integrated Regional Transportation Master Plan is founded upon the requirement to fully integrate land use and transportation and to move the Region to a more compact form of urban development that minimizes the Region’s footprint. The Integrated Regional Transportation Master Plan attempts to establish a Regional Roadway Classification system including arterial roads, expressways, and freeways that link municipalities, future growth areas, major destination centres, employment centres, and other public spaces and amenities.

Other studies such as the Integrated Regional Transportation Master Plan Prioritization of Regional Transportation Projects, completed by another consultant in August 2015, provide further information on the proposed Capital Region transportation network in support of the Capital Region Board Growth Plan. This transportation assessment of the City of Edmonton Annexation Proposal is based on the past

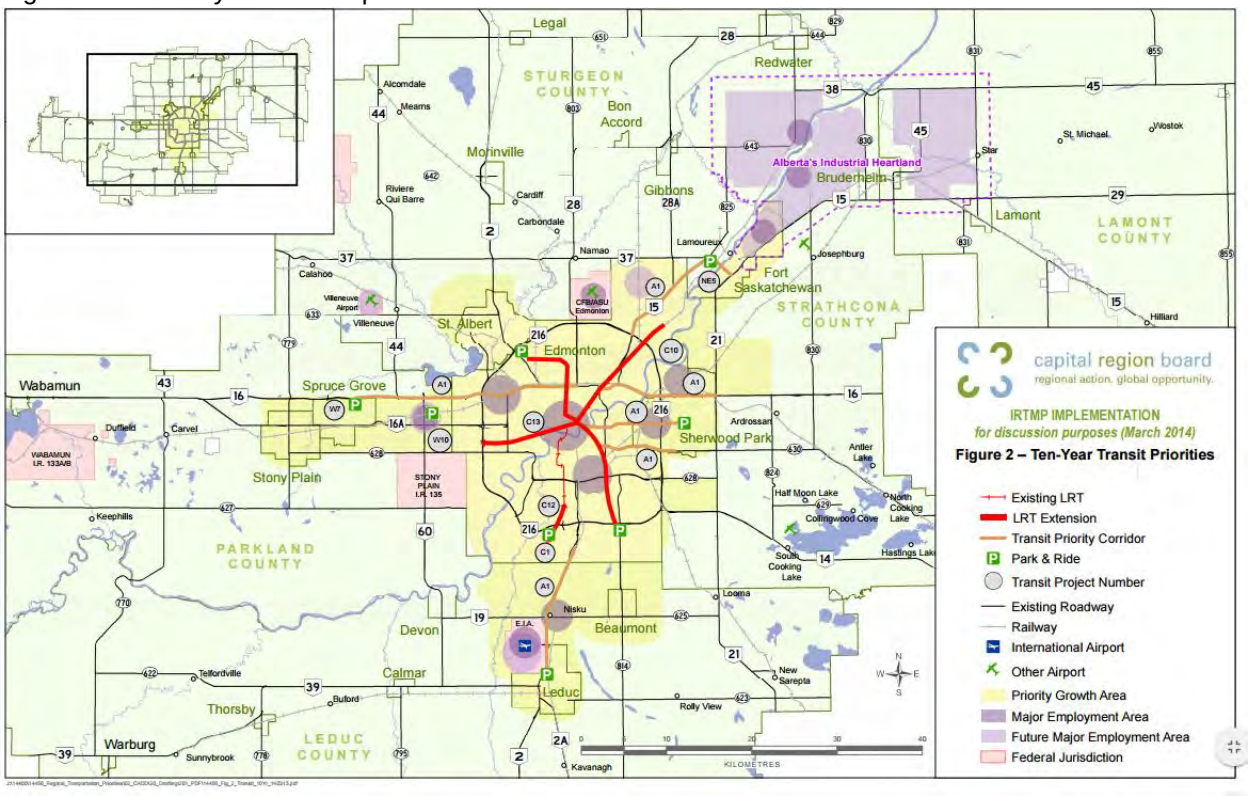
transportation studies completed for the Capital Region Board. The following figure identifies the 10 year priorities from the Integrated Regional Transportation Master Plan Prioritization of Regional Transportation Projects.

Figure A-3.1- CRB 10 year roadway projects



The 10 year transit projects are summarized in the following figure.

Figure A-3.2 – 10 year Transit priorities

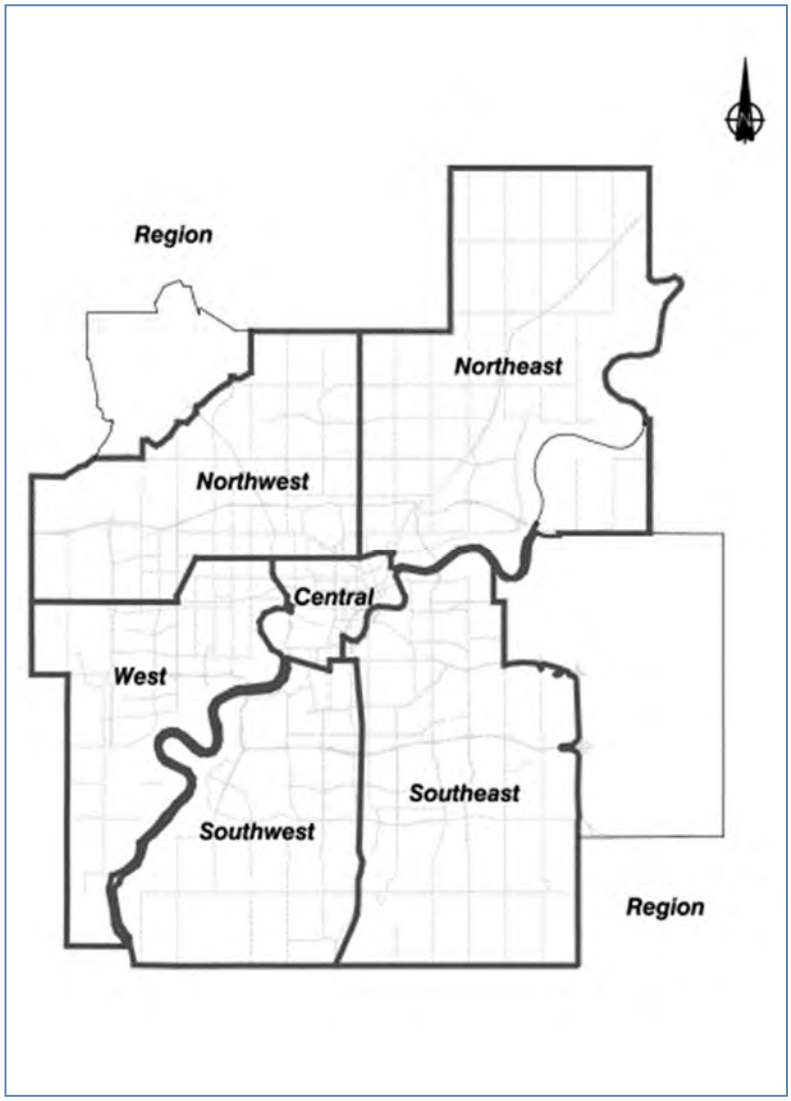


Trip Generation and Distribution

Using data from the 2005 Household Travel Survey, the following section identifies an estimate of typical trip distribution which may occur in the proposed annexation areas. This discussion assumes travel patterns within the annexation areas will remain similar to those seen in the existing City. It is likely that increased industrial and commercial development within the study area may alter these patterns (for example, more trips staying within one area instead of travelling throughout the City). Changes to transit infrastructure and availability of active modes may also influence the ultimate travel distribution. As plans progress to more detail, future study will be needed to review key travel patterns and identify priorities for transportation infrastructure development.

Trips within the 2005 Household Travel Survey were broken out with distribution via overall regions within the City. Those regions are identified in **Figure A-3.3**.

Figure A-3.3: City Quadrants from 2005 Household Travel Survey



To estimate the trips from the new annexation areas and their potential origins and destinations, Associated Engineering used the trip rate from the survey (3.64 trips/person), and then the proportion of trips that travel to and from the Southwest (to represent the southwest annexation area) and the Southeast (to represent the southeast annexation area). **Figures A-3.4** and **A-3.5** show the proportion of car driver trips from the southwest and southeast from the 2005 Household Travel Survey (existing conditions).

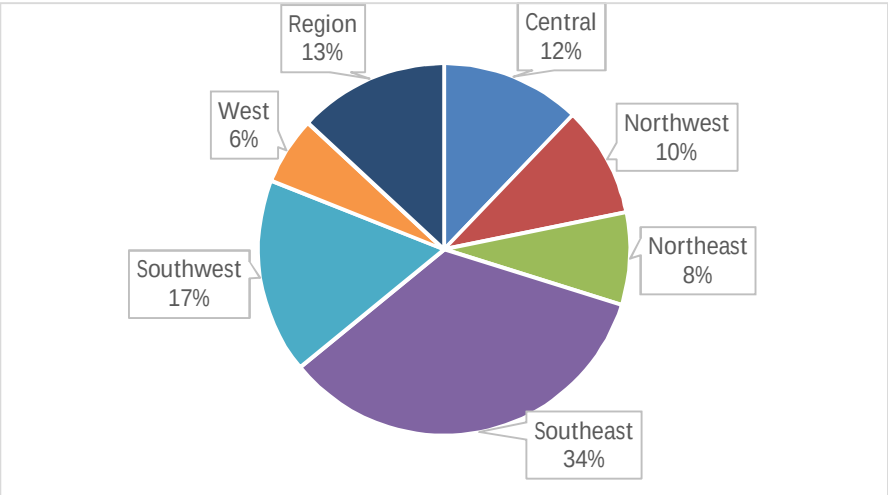


Figure A-3.4 – Total Trips Proportion Southeast Edmonton (2005 HTS)

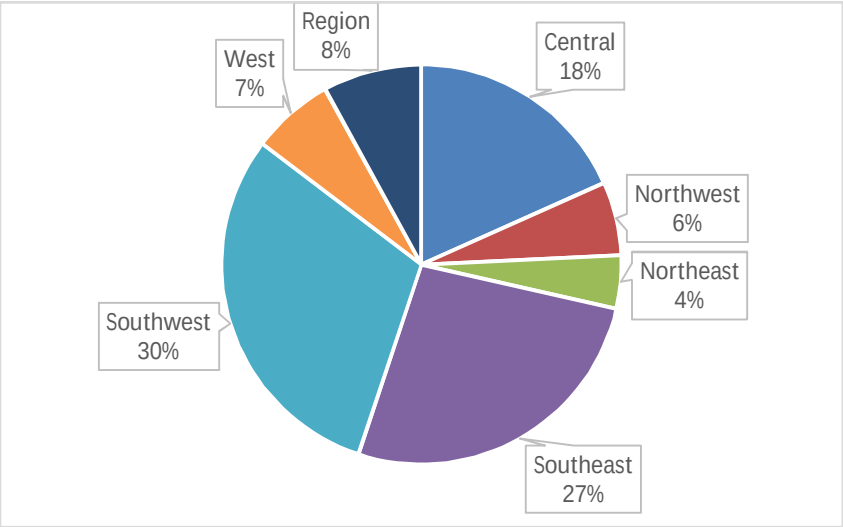


Figure A-3.5 – Total Trips Proportion Southwest Edmonton (2005 HTS)

Table A-3 uses the trip distribution found in the 2005 Household survey to identify the expected distribution of new trips generated within the Annexation Areas to the overall network. This table combines the new southwest annexation area with the existing southwest quadrant, and the new southeast annexation area with the existing southeast quadrant.

Table A-3: Trip Distribution New Annexation Areas

To and From Zone	Auto Trips	Transit Trips
Central	114,000	9,000
Northwest	52,000	4,000
Northeast	37,000	3,000
Southeast	208,000	17,000
Southwest	184,000	14,000
West	47,000	4,000
Region	68,000	6,000

The distribution for transit trips in particular can be expected to shift, with higher transit ridership rates associated with future mass transit, such as LRT expansion and bus rapid transit. If travel distribution patterns remain relatively consistent over the course of the annexation development, it is most likely that the majority of new trips will stay within, or nearby the new development areas, with some additional significant traffic growth to downtown (Central Zone).