Associated Engineering

GLOBAL PERSPECTIVE.
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REPORT

Town of Stony Plain

Water and Sanitary Master Plan Update







CANADA'S BEST MANAGED COMPANIES
Platinum member

March 2019

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1 Introduction

1.1 BACKGROUND

The Town of Stony Plain has engaged Associated Engineering to undertake an update of their Water and Sanitary Master Plans, which were last updated in 2008. Since then, the Town has experienced significant growth.

The updated Master Plan will assess the adequacy of the current water and sanitary sewer systems and identify necessary upgrades to the existing system. It will identify potential servicing concepts for future growth areas, provide estimated costs and prioritize proposed upgrades. It will help to guide future development and minimize the leap-frogging that has sometimes occurred in the past.

Associated Engineering will provide this report to the Alberta Capital Region Wastewater Commission (ACRWC) for review and comment. All components and content required by the ACRWC's Wet Weather Flow Management Strategy have been included in the sanitary system assessment. This is part of the first component of the ACRWC's phase 1 implementation framework. Subsequent assessments should provide a background to understand the sources of Wet Weather Flows (WWFs) and develop action plans and programs to manage those flows through reduction or storage.

1.2 STUDY AREA

The Town of Stony Plain is located approximately 20 km west of the City of Edmonton. The present corporate boundaries encompass approximately 36.8 square kilometres, which form the ultimate study area for the Water and Sanitary Master Plan Update.

The topography of the area generally falls toward the northeast, with the highest elevations occurring in the extreme west portion of the study area, and the lowest elevations located in the northeast.

1.3 REPORT OBJECTIVES AND SCOPE

- Update the water and sanitary sewer models to reflect the current level of development within the Town.
- Review the historical growth rate and establish projected future growth rates and associated population.
- Establish appropriate design criteria including design demands.
- Assess the adequacy of the existing water and sewer systems and identify shortfalls.
- Identify proposed upgrades to the existing water and sewer systems to meet the design objectives.
- Identify staged growth areas and servicing concepts in consultation with the Town.
- Develop a staged implementation plan to present the development concepts.
- Identify capital cost estimates for proposed upgrades and staged development.
- Prioritize proposed upgrades.
- Identify eligible system development charges and analyze/review funding structure/options.

1.4 REFERENCES

The following information has been reviewed in preparation of this report:

1. Town of Stony Plain Water Distribution System Master Plan Update, Associated Engineering, January 2008.
2. Town of Stony Plain Sanitary Collection System Master Plan Update, Associated Engineering, January 2008.
3. Town of Stony Plain Draft Wet Weather Flow Management Plan, Associated Engineering, May 2012.
4. Town of Stony Plain Municipal Development Standards, April 2006.
5. Town of Stony Plain Transportation Study, Associated Engineering, August 2011.
6. Northwest Wastewater Transmission System Hydraulic Model Development Final Report, ACRWC, July 2013.
7. ACRWC 2015 Northwest Model, MIKE URBAN.
8. Stony Plain flow data, ACRWC.
9. Stony Plain rainfall data, ACRWC.
10. Town of Stony Plain Municipal Development Plan 2013.
11. Town of Stony Plain Land Use Districts Map, November 2017.
12. Area Structure Plans.
13. Record drawings.
14. Town of Stony Plain GIS information.
15. Town of Stony Plain water records.

We wish to take the opportunity to acknowledge the Town of Stony Plain staff, who provided a great deal of assistance and collaboration on this project.

1.5 ABBREVIATIONS

AC	asbestos cement
fps	feet per second
ft^3/s	cubic feet per second
ft^3	cubic feet
ig	imperial gallons
igpcd	imperial gallons per capita day
igpm	imperial gallons per minute
km	kilometre
L/s	Litres per second
L	Litre
Lpcd	Litres per capita day
m	metre
m/s	metres per second
m3/s	cubic metres per second
m^3	cubic metres

mig	million imperial gallons
mm	millimetre
PRV	Pressure Reducing Valve
PVC	Polyvinyl Chloride
AEAL	Associated Engineering Alberta Ltd.
USGPM	United States Gallons per Minute

1.6 METRIC CONVERSIONS

To Convert From	To	Multiple By
cubic metres (m^3)	cubic feet (ft^3)	35.31
cubic metres (m^3)	imp gal (ig)	219.97
cubic metres/hour (m^3/hr)	igpm	3.667
kilopascals (kPa)	psi	0.145
kilowatts (kw)	horsepower (hp)	1.341
litres/sec (L/s)	igpm	13.2
megalitres (ML)	imp gal (ig)	219974
metres (m)	ft	3.281
millimetres (mm)	inches	0.0394

2 Design Criteria

2.1 GENERAL

2.1.1 Population

One of the main variables in assessing a community's municipal servicing components is the population. The population will:

- Provide a measure of the quantity of water required and sewage generated.
- Have an impact on the peaking factor.
- Have an impact on the distribution and collection systems based on population concentration (density).

Table 2-1 presents historical population for the Town of Stony Plain from 2006 onward. Based on the data, the average annual growth rate was 3.35% from 2006 through 2016. This is relatively close to the 4% growth rate assumed in the 2008 Water Master Plan.

Table 2-1
Historical Population

Year	Population	Source
2006	12,363	Federal
2008	11,322	Municipal
2010	14,177	Municipal
2011	15,052	Federal
2015	16,127	Municipal
2016	17,189	Federal

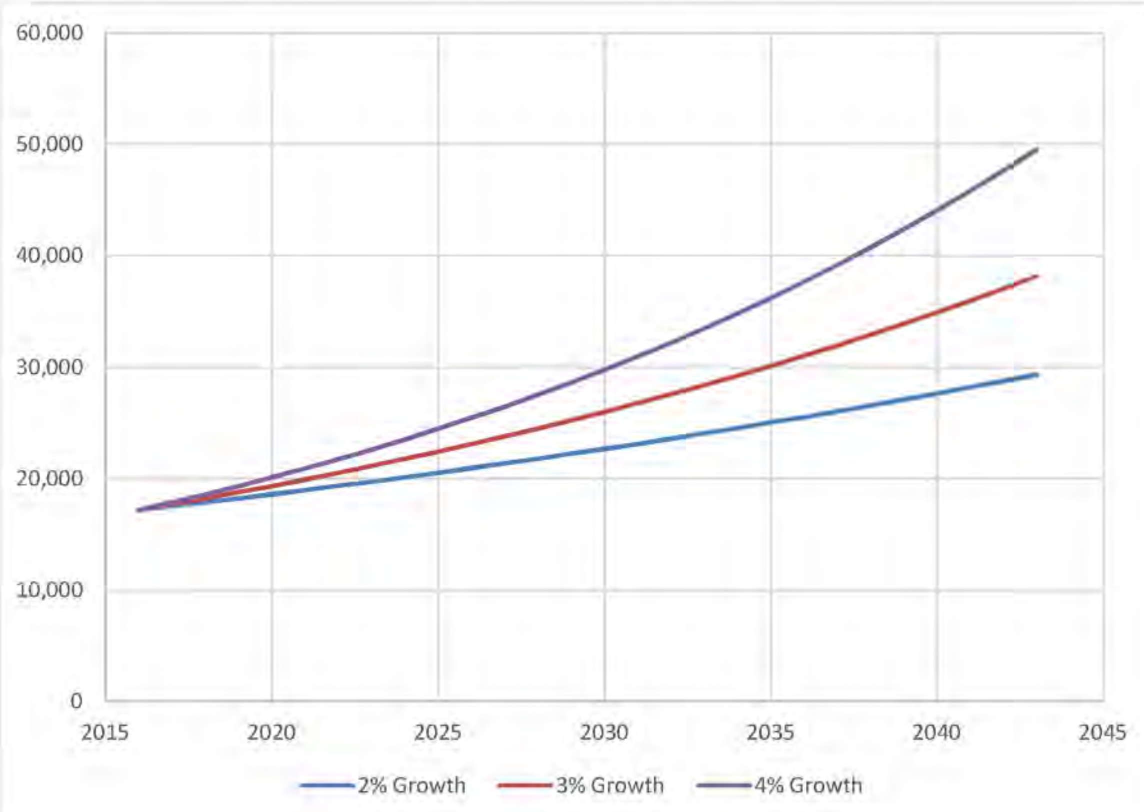
A workshop was held on February 5, 2018 with a focus on establishing growth projections and staged development areas. The historical growth rate as well as the Capital Region Board growth projections Edmonton Metropolitan Region Growth Plan 2.0 (EMRB 2.0) were reviewed. The population targets identified in the EMRB 2.0 for Stony Plain indicated a low growth rate in the order of 2.2% and a high growth rate of 2.95%. Based on the range of growth rate projections presented, the Town selected a growth rate of 3% to be adopted for the Master Plan Update.

Table 2-2 below presents projected future population for the 25 year study horizon based on a range of future growth rates. Populations have been projected 25 years into the future from 2018. Figure 2-1 presents the projected population growth as a figure. As identified above, the Town has selected to proceed with a proposed growth rate of 3.0% which will yield an estimated population of 38,200 in the year 2043.

Table 2-2
Projected Population (Varying Growth Rates)

Year	2% Growth	3% Growth	4% Growth
2016	17,189	17,189	17,189
2017	17,533	17,705	17,877
2018	17,883	18,236	18,592
2019	18,241	18,783	19,335
2020	18,606	19,346	20,109
2021	18,978	19,927	20,913
2022	19,358	20,525	21,750
2023	19,745	21,140	22,620
2024	20,140	21,775	23,524
2025	20,542	22,428	24,465
2026	20,953	23,101	25,444
2027	21,372	23,794	26,462
2028	21,800	24,507	27,520
2029	22,236	25,243	28,621
2030	22,681	26,000	29,766
2031	23,134	26,780	30,956
2032	23,597	27,583	32,195
2033	24,069	28,411	33,482
2034	24,550	29,263	34,822
2035	25,041	30,141	36,215
2036	25,542	31,045	37,663
2037	26,053	31,977	39,170
2038	26,574	32,936	40,737
2039	27,105	33,924	42,366
2040	27,647	34,942	44,061
2041	28,200	35,990	45,823
2042	28,764	37,070	47,656
2043	29,340	38,182	49,562

Figure 2-1
Projected Population Curves (Varying Growth Rates)



2.1.2 Population Density

Population densities are utilized to estimate the population or equivalent population for different land use areas. These values are used in conjunction with the per capita daily consumption/sewage generation rates to estimate the demands/flows on the water and sewer system.

The Town of Stony Plain Municipal Development Standards were reviewed in terms of population densities, and it was found that there were some inconsistencies between values used in the water and sewer systems. It is recommended that the values identified below be applied for the purpose of this assessment, to be reviewed and confirmed by the Town. All values represent the population per gross hectare.

Residential (existing development areas):

- Single Family Residential/Low Density Residential = 40 p/ha
- Multi Family Residential/Medium Density Residential = 80 p/ha (2 times density of Single Family Residential)
- High Density Residential (walk up apartments) = 200 p/ha (5 times density of Single Family Residential)

Residential (future development areas)

- Residential density (blended) of 47 p/ha (3000 people per Quarter Section – as per Workshop 1 discussion)

Commercial	37 ep/ha (equivalent population per hectare)
Industrial	30 ep/ha

Institutional locations have been assumed to have a commercial density of 37 ep/ha.

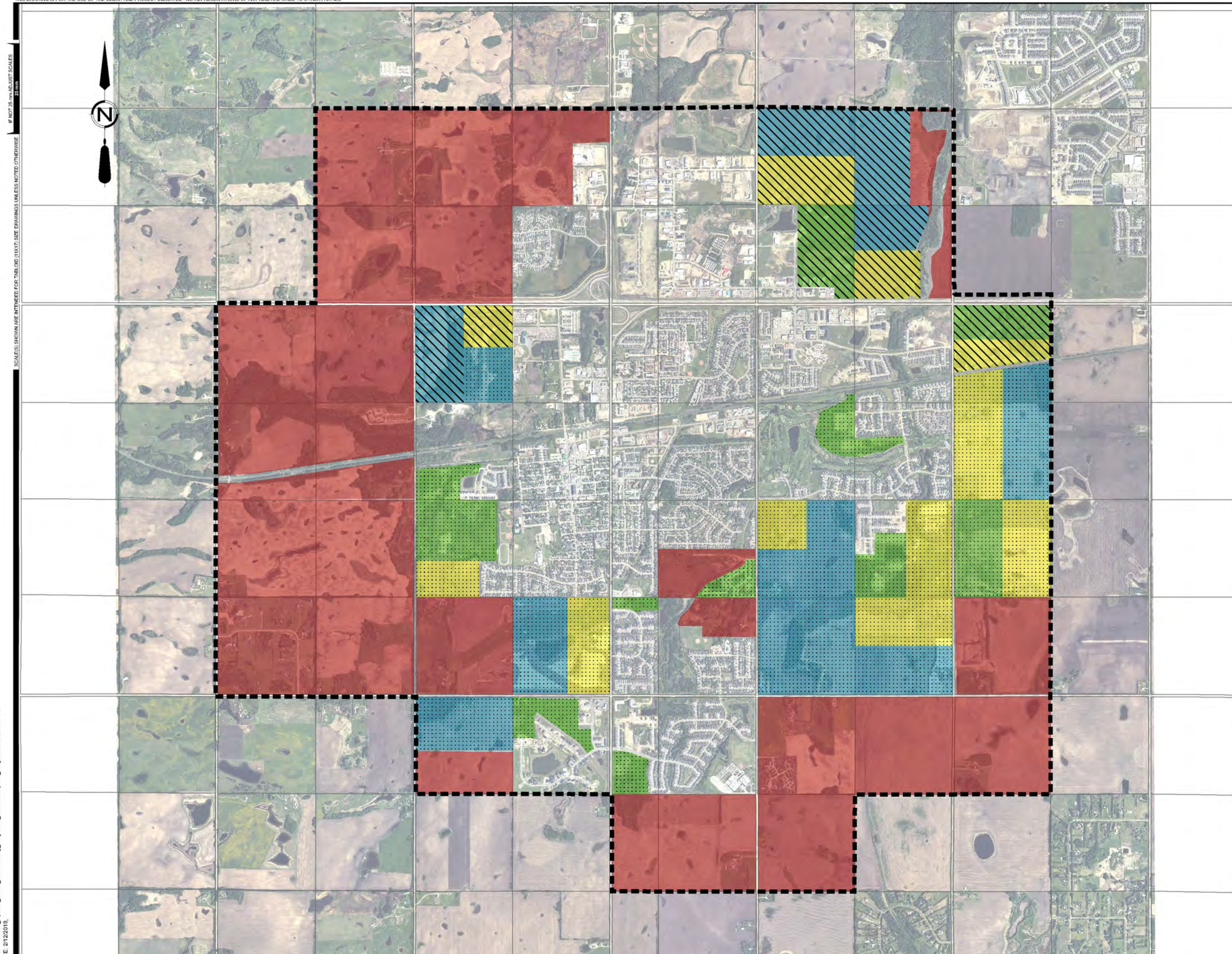
2.1.3 Land Use

An existing Land Use Map was provided by the Town of Stony Plain. The equivalent population densities established above were applied in conjunction with the Land Use Map to establish equivalent populations, and resulting system demands/flows.

2.1.4 Future Staged Growth Areas

Figure 2-2 presents the proposed future staged growth areas as determined during Workshop 1. An allowance for Municipal Reserve of 10% of the future development areas has been assumed for the purpose of this study. Based on a calculated population of 18,236 in 2018 and the future residential population areas, Table 2-3 presents the population associated with each future development stage based on a future residential density of 47 p/ha.

THIS DRAWING IS FOR THE USE OF THE CLIENT AND PROJECT INDICATED - NO REPRESENTATIONS OF ANY KIND ARE MADE TO OTHER PARTIES



Associated Engineering

TOWN OF STONY PLAIN

FIGURE No. 2-2

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

PROJECTED STAGED GROWTH AREAS

AE PROJECT No.	2018-3146
SCALE	1:30,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 FEBRUARY
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

IF NOT 25 mm ADJUST SCALES 25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

P:\20183146\00_Update_Water_and\Working_Dwgs\010_GIS\ArcMap\1.2_StagedGrowthAreas.mxd
DATE: 2/12/2019,

Table 2-3
Staged Population Growth

Stage	Population	Target Year	
		Based on 2%-4% growth	Based on 3% growth (Study Purposes)
1	24,721	2025-2034	2028
2	33,054	2033-2049	2038
3	44,902	2041-2065	2048

2.2 WATER SYSTEM

2.2.1 Water Demand

Water demand is critical in determining the distribution network, pumping capability and storage required for a water system. Three critical rates of demand are normally used: Average Day, Peak Day, and Peak Hour demand. Fire Flows, in conjunction with the Peak Day Flows are also used to test the water system's capability to deliver water and meet system demands.

The following briefly describes each of the critical flow conditions:

2.2.1.1 Average Day

The average day demand is determined by dividing the total annual consumption by 365 days. By dividing this rate by the population served, the per capita per day demand is derived. This rate is used primarily as a basis for the projection of the total water demand.

2.2.1.2 Peak Day

The peak day demand is determined by the single day of maximum consumption observed in the distribution system over one year. In using the single day maximum flow, one must ensure that the record is not distorted by fire fighting demand, equipment malfunction or watermain breaks. The peaking factor is determined by comparing the peak day demand to the average day demand. The peak day demand is used in determining the delivery capacity required of supply mains, treatment facilities, storage facilities and pumping facilities. In conjunction with the fire flow, it is used to test the water system's capacity to supply the fire and peak day demand.

2.2.1.3 Peak Hour

The peak hour demand is the expected maximum demand observed during a short period of the day. Usually, most facilities are not equipped to record peak hour demands in such detail. Therefore, the rate is established based on experience and judgment. The peak hour rate is used in determining pumping requirement.

The Town of Stony Plain has provided water consumption records for the past two years. A summary is provided in Table 2-4.

Table 2-4
Historical Water Usage

	2016	2017
Total Water Usage (m^3/year)	1,649,675	1,617,715
Total Truckfill Usage (m^3/year)	189,614	165,053
Total Non-Truckfill Usage (m^3/year)	1,460,061	1,452,662
Average Day (m^3/day)	4507	4432
Peak Day (m^3/day)	7578	7205
Peak Day Factor	1.7	1.6
Average Day Demand (less truckfill) (L/s)	46.3	46.1
Average Day Per Capita (L/c/d)	233	225
Population (based on 3% growth)	17,189	17,705

As shown in the above table, the truckfill used approximately 10% of the overall water provided to the Town. As such, per capita usage was calculated based on the total water consumed less the volume provided to the truckfill. This resulted in a per capita water consumption of 233 L/c/d for 2016 and 225 L/c/d for 2017; these are relatively low values compared to many other communities in Alberta.

The peak day factors identified in Table 2-4 were based on actual recorded values compared against the yearly average. The peak day factors were found to be 1.7 and 1.6 for 2016 and 2017 respectively.

2.2.1.4 Proposed Design Demands

We recommend that the average per capita water consumption be 280 L/c/d. This is approximately 20% greater than the current calculated rate and will allow for some conservatism going forward. A peak day factor of 2.0 is recommended to allow for higher peak years, potentially due to dryer conditions.

The existing facilities did not measure peak hour flows for the three years of data provided. From experience in similar communities, a peak hour factor of 3 times the average day demand has been observed and will be adopted for this report.

A private truckfill is located on the distribution system which affects the distribution system pumping rates. The truckfill flow rate was previously established at 45 L/s in the 2008 Water Master Plan and further information has not been provided by the Town. As such, a flow rate of 45 L/s has been assumed for the truckfill. Truckfill demand does not get peaked, as it is either in operation or not in operation.

The proposed water demand and demand criteria for the next 25 years are outlined in Table 2-5 below.

Table 2-5
Proposed Water Demands

	2018	2023	2028	2033	2038	2043
Population	18,236	21,140	24,507	28,411	32,936	38,182
Average Day Per Capita (L/c/d)	280	280	280	280	280	280
Peak Day Factor	2.0	2.0	2.0	2.0	2.0	2.0
Peak Hour Factor	3.0	3.0	3.0	3.0	3.0	3.0
Average Day Demand (L/s)	59.1	68.5	79.4	92.1	106.7	123.7
Average Day Demand (m^3/day)	5,106	5,919	6,862	7,955	9,222	10,691
Peak Day Demand (L/s)	118.2	137.0	158.8	184.1	213.5	247.5
Peak Day Demand (m^3/day)	10,212	11,838	13,724	15,910	18,444	21,382
Peak Hour Demand (L/s)	177.3	205.5	238.3	276.2	320.2	371.2
Assumed Truckfill Operating Rate (L/s)	45	45	45	45	45	45

2.2.1.5 Recommended Fire Flows

The following table presents the recommended Fire Flows derived from the Fire Underwriters Survey, and appears in the Stony Plain Municipal Development Standards.

Table 2-6
Fire Flows

Description		Recommended Fire Flow litres/minute
1. Single Family Residential		
Wood frame construction, two stories or less		
100 m^2 to 150 m^2		5,000 (83 L/s)
150 m^2 to 275 m^2		6,000 (100 L/s)
2. Multi Family Residential		
Wood frame construction c/w fire separator		
four units up to 100 m^2 each		8,000 (133 L/s)
3. Walk-up Apartments		
Ordinary construction up to 3,200 m^2	(10-20 m separation)	12,000 (200 L/s)
4. Schools		
Non-combustible construction		
up to 3,300 m^2		10,000 (167 L/s)
up to 4,000 m^2		11,000 (183 L/s)
up to 12,000 m^2		19,000 (317 L/s)
5. Institutional, Churches		
Ordinary construction (15% exposure)	up to 850 m^2	6,000 (100 L/s)
6. Commercial		
Non-combustible construction (50% exposure)		
up to 2,900 m^2		11,000 (183 L/s)
up to 4,200 m^2		14,000 (233 L/s)
7. Light Industry		
Non-combustible construction		
up to 2,900 m^2 (25% exposure)		9,000 (150 L/s)
up to 2,900 m^2 (50% exposure)		11,000 (183 L/s)
8. Low Density Rural Residential		
2 stories or less over 30 m separation		2,000 (33 L/s)
9. High Density Rural Residential		3,000 (50 L/s)
2 stories or less 10.1 to 30 m separation		

The preceding flows, based on Fire Underwriter's Guidelines, are determined as follows:

F	=	220 C√A where
F	=	required fire flow in litres per minute
C	=	1.5 for wood frame construction
	=	1.0 for ordinary construction
	=	0.8 for non-combustible construction
	=	0.6 for fire flow resistant construction (fully protected frame, floors, roof)
A	=	total floor area in square metres (including all storeys)

Other considerations when determining fire flow requirements are:

- occupancy hazard
- automatic sprinkler protection
- exposure within 45 metres

The following fire flows are recommended to be adopted by this study based on the table provided above:

Residential	Single Family	83 L/s
	Multi Family	133 L/s
	High Density (walk up apartments)	200 L/s
Commercial	(standard)	183 L/s
(up to 2,900 m^2- assumed at strip mall, health centre etc.)		233 L/s
Industrial		183 L/s
Schools	(elementary)	167 L/s
	(high school)	183 L/s
Institutional	(churches)	100 L/s

In general, the higher value of 200 L/s will be applied to all new residential locations (in ultimate scenario). This is intended to allow for the potential of high density neighbourhood development (walk up apartments) and will also provide for additional fire flow flexibility in these locations.

2.2.2 Operating Pressures

The recommended normal operating system pressures are:

- Absolute minimum pressure at peak demand 280 kPa (40 psi)

- Target minimum pressure 350 kPa (50 psi)
- Target maximum pressure 550 kPa (80 psi)
- Absolute maximum pressure 620 kPa (90 psi)

The minimum recommended system pressures during a fire event are:

- Residential pressure at demand hydrant 150 kPa (22 psi)
- Zone pressure 280 kPa (40 psi)

2.2.3 Pipe Roughness Coefficient ("C" Values)

The 2008 Master Plan Update adopted pipe roughness values from the prior master plan. For the purpose of the current report, it is recommended that the previously applied roughness values be rounded. This is in recognition of the time since the roughness assessment was undertaken, and is meant to reflect the high level nature of the current work.

The model created for this document has not been calibrated as hydrant flow data was not provided.

The following pipe roughness values are proposed to be utilized within the model:

PVC	130
Asbestos Cement	110
Cast Iron	100
Steel	120
Ductile Iron	120

Proposed watermains will be assumed to have a pipe roughness value of 130.

2.2.4 Minimum Pipe Sizes

The following are minimum recommended pipe sizes per land use as per the Stony Plain Municipal Development Standards. Additional information has been provided for High Density Residential Development.

- Single Family Residential (includes semi-detached/duplex) 200 mm
- Medium Density Residential (multi-family including fourplex and row housing) 250 mm
- High Density Residential (walk up apartment buildings) 300 mm
- Commercial/industrial 300 mm

2.2.5 Velocity

The Municipal Development Standards indicate that the velocity at maximum flow is not to exceed 1.5 m/s. We recommend that maximum velocity not exceed 1.5 m/s during normal system operation, increasing to a maximum of 3.0 m/s during fire flow scenarios.

2.2.6 Water Storage

It is good practice to provide adequate storage in a water system for operational needs (peak hour), supply interruption and fire flow demand. There are two methods which are generally used to calculate water storage requirements. Alberta Environment and Parks (AEP) guidelines require:

- Equalizations Storage (peak hour demand); 25% of Peak Day flow, and
- Fire Storage.

Plus, the greater of:

  - Emergency Storage (in event of supply interruption); 15% of Average Day flow, and
  - Disinfection contact time (T_{10}) storage.

Water storage requirements for systems with long supply lines, or where storage is located at long distances from the source of water, are at a higher risk of supply interruption (i.e. regional pipelines). In these cases, the recommended storage is given below, however, specific situations could warrant even higher storage recommendations.

- 1 Peak Day
- Fire Storage

As the Town of Stony Plain is serviced via the Capital Region Parkland Water Services Commission, it is recommended that the second method of calculating storage requirements be applied.

2.3 SANITARY SYSTEM

2.3.1 Dry Weather Flows (DWF)

Existing domestic sanitary flows were calibrated in the Town of Stony Plain's MOUSE model completed by Associated Engineering in 2012. The values differ somewhat from those proposed for the water system as they have been calibrated for specific land uses and include base flows. The calibrated values used in the model were as follows:

• Residential	300 L/c/day
• Multi Family Residential	200 L/c/day
• High Density Residential	200 L/c/day
• Downtown Commercial	0.02 L/s/ha
• General Commercial	0.02 L/s/ha
• Heritage Park Area	0.01 L/s/ha

- Industrial 0.01 L/s/ha
- Institutional 0.05 L/s/ha

The diurnal variation of DWF was modelled using diurnal curves developed based on flow monitoring data from 2006 and 2009. These diurnal curves represent the hourly variation of flow relative to the average flow as illustrated in **Figure 2-3**. The weekend curves were used for this project as they have a slightly higher peak hour factor than the weekday curves (1.2 for commercial and industrial land uses and 1.5 for residential).

It is suggested that the Stony Plain Municipal Development Standards continue to be used by developers for design purposes of all laterals. The intent of the revised values above is for conceptual sizing of trunk sewers and upgrades to the existing system.

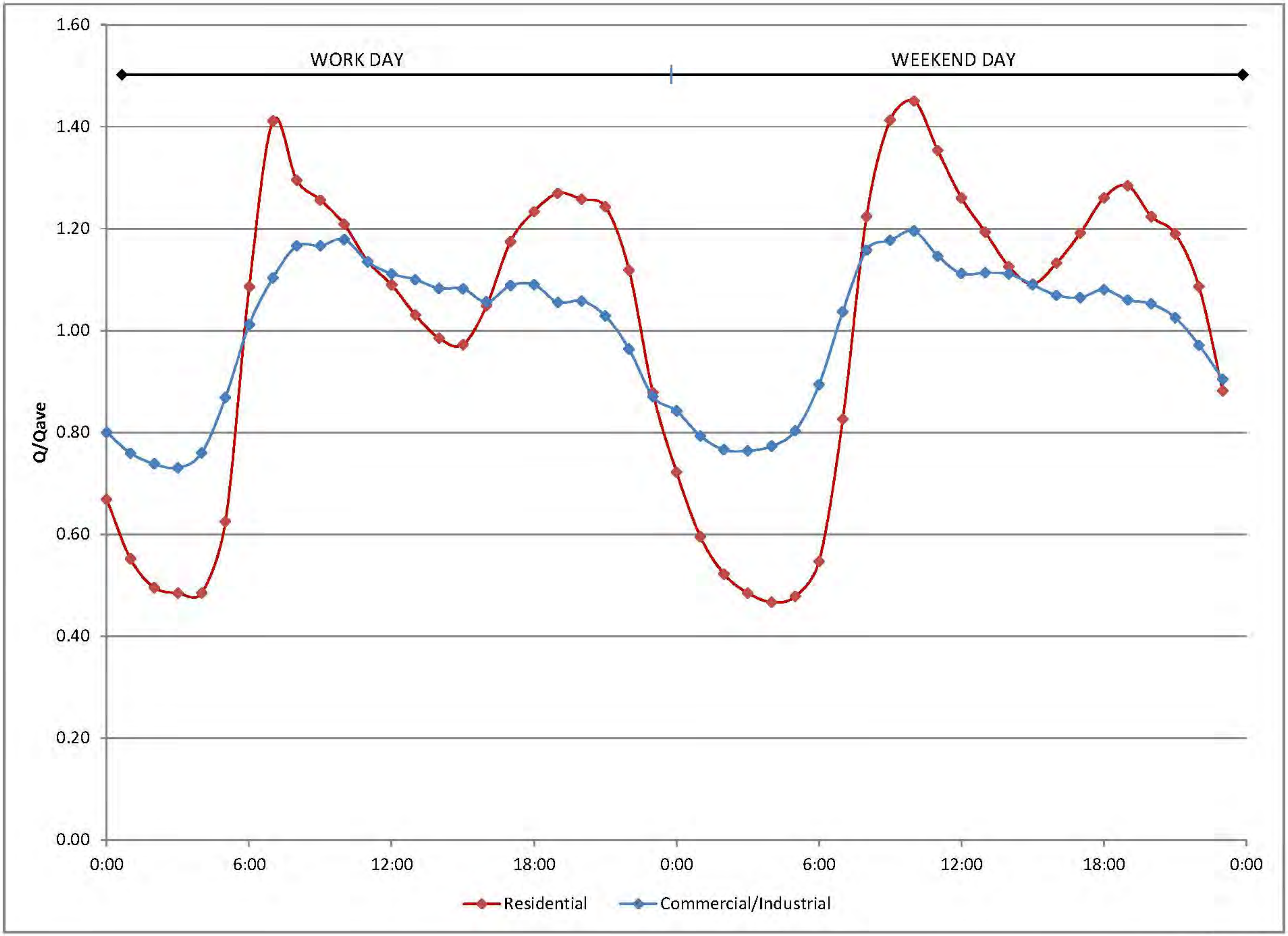


FIGURE 2-3
DIMENSIONLESS DIURNAL CURVES FOR DRY-WEATHER FLOW

2.3.2 Wet Weather Flows (WWFs)

The wet weather flow includes the sanitary or dry weather flow described above and the inflow/Infiltration (I/I) component generated by rainwater entering the sewer system through manhole vents and joints, pipe joints, and house weeping tiles (in older neighbourhoods). Prior to 2000 the house weeping tiles were typically connected to the sanitary sewer system and have been found to generate significant inflow rates during storm events.

WWF is simulated with the Inflow/Infiltration (I/I) component of the MOUSE computer model software. The software contains various algorithms and parameters that simulate the fast-responding components of rainfall induced runoff into sanitary sewers (manhole inflows), the medium-responding components (principally weeping tiles), and the slow-responding components (groundwater infiltration). These components were calibrated for weeping-tile areas and non-weeping tiles areas using rainfall and sewer flow data collected in Stony Plain since 2006 as will be discussed in Section 4 of this report.

The 1:25 year 4-hour duration "Chicago" design storm was used for simulating the existing sewer system, while the 1:100 year 4-hour design storm was used for conceptual design of proposed upgrades and sizing the facilities required for future system expansion. This design standard provides a level of service that is consistent with other municipalities in the Edmonton region and the Alberta Capital Region Wastewater Commission (ACRWC) Collection System. It is also generally consistent with the Town's servicing standards as adopted in the previous sanitary master plan.

Figure 2-4 shows the time pattern of the design storm event. It is based on the most recent update to the City of Edmonton's Intensity-Duration-Frequency (IDF) curves as provided by EPCOR in 2018. The curve has shifted in time to match peak rainfall intensity with peak dry-weather flow rate. **Table 2-7** provides a summary of the IDF curve parameters.

It is suggested that the Stony Plain Municipal Development Standards continue to be used by developers for design purposes of all new local and lateral sewers. The revised values above are intended for conceptual sizing of trunk sewers and upgrades to the existing system.

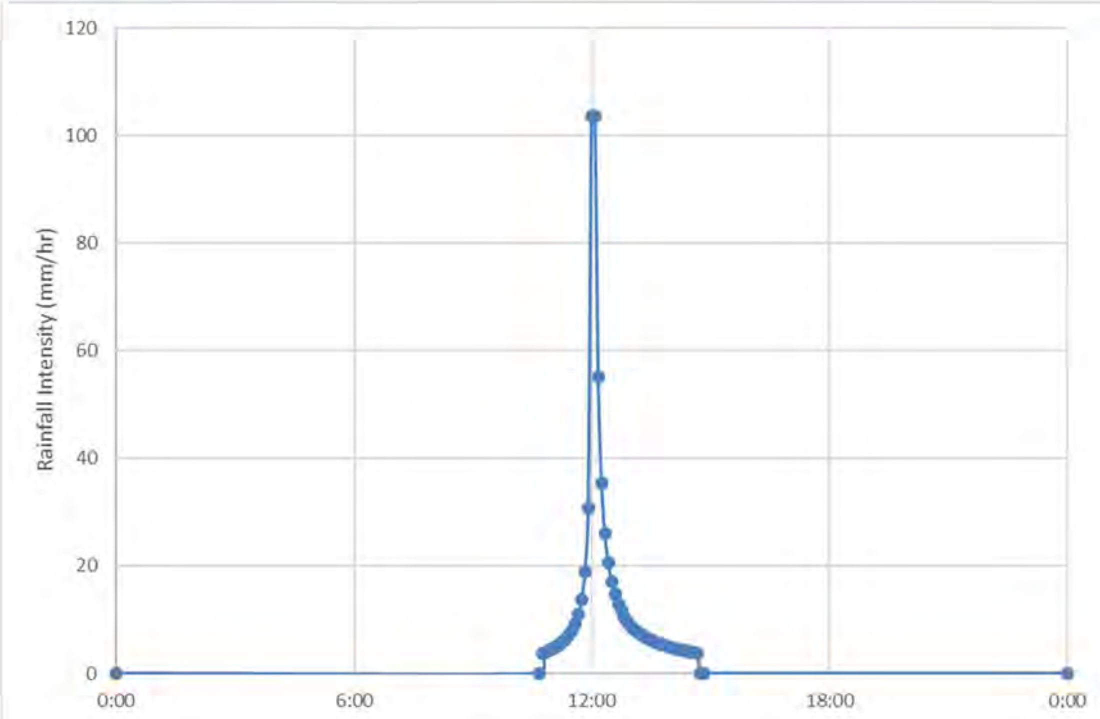


Figure 2-4
Design Storm Rainfall for Sanitary Sewer System

Table 2-7
2018 EPCOR IDF Values

Rate – a*(t+c)^b	Return Frequency						
Parameters	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**	**200-yr**
a (t in min)	337.0	498.1	665.2	909.9	1027.7	1200.5	1498.1
b	-0.732	-0.735	-0.748	-0.757	-0.742	-0.733	-0.735
c (min)	4.3	5.4	6.3	7.1	7.0	7.5	8.8

2.3.3 Pipe Roughness

The gravity sewers represented in the MOUSE model in new areas were given a roughness value of 0.013 (PVC or concrete).

2.3.4 Velocity

Suggested velocities for the sanitary system are as follows:

- Gravity mains: minimum of 0.6 m/s, maximum of 3.0 m/s
- Forcemains: minimum of 0.76 m/s, maximum of 1.5 m/s

2.3.5 Pipe Slope

Minimum slopes, as recommended by Alberta Environment are required to achieve a 0.6 m/s minimum scour velocity. The Stony Plain Municipal Development Standards specify that slopes are not to be less than 0.15%. However, existing slopes less than 0.15% are accepted.

3 Water System

3.1 EXISTING WATER DISTRIBUTION SYSTEM

3.1.1 Existing Facilities

The existing water system within the Town of Stony Plain consists of:

- Treated Water Supply Lines
- Meridian Heights Reservoir and Pumphouse
- High Park Reservoir and Pumphouse
- Water Distribution System
- Privately operated Truckfill station

3.1.1.1 Treated Water Supply Line

Treated water from the City of Edmonton is supplied from the Capital Region Parkland Water Services Commission (Parkland Water Commission) via a 200 mm diameter main and a 400 mm diameter main to the Meridian Heights Reservoir. The Parkland Water Commission is planning a number of upgrades in the future to meet the projected demands, including transmission main twinning as well as a direct connection to the High Park Reservoir and Pumphouse. It is anticipated that the lateral to the High Park Reservoir and Pumphouse will be constructed in approximately the year 2030.

3.1.1.2 Reservoirs and Pumphouses

The Meridian Heights Reservoir and Pumphouse serves as the primary water supply source for the entire water distribution system of the Town. During low water demand periods (generally at night), the distribution system also fills the High Park Reservoir through a common fill/discharge line. The High Park Reservoir and Pumphouse is primarily used to supplement the water distribution system during peak flow and fire flow demand. **Table 3-1** summarizes the existing reservoir storage and pumping capacities.

Table 3-1
Pumping and Reservoir Capacity

Reservoir	Pump Designation	Pumping Capacity
Meridian Heights		
Dist. Pump (Electric) VFD	P-102	140 L/s (2,219 USGPM) 53.0 m head
Dist. Pump (Electric) VFD	P-103	140 L/s (2,219 USGPM) 53.0 m head
Fire/Standby Pump (Engine)	FP-101	227 L/s (3,600 USGPM) 56.4 m head
High Park		
Dist. Pump (Electric) Constant Speed	P-203 (Jockey)	21 L/s (340 USGPM) 52.5 m head
Dist. Pump (Electric) Constant Speed	P-204	61 L/s (960 USGPM) 52.5 m head
Dist. Pump (Electric) Constant Speed	P-205	61 L/s (960 USGPM) 52.5 m head
Fire/Standby Pump (Engine)	FP-201	95 L/s (1,500 USGPM) 52.5 m head
Fire/Standby Pump (Engine)	FP-202	95 L/s (1,500 USGPM) 52.5 m head
Reservoir Capacity:		
Meridian Heights	14,630 m^3 (3.0 mig)	
High Park	4,545 m^3 (1.0 mig)	
Total Capacity	**19,185 m^3 (4.0 mig)**	

The two variable speed pumps (P-102 and P-103) in the Meridian Heights Pumphouse were replaced in, or around 2009. These pumps, in conjunction with the three constant speed pumps (P-203, P-204 and P-205) in the High Park Pumphouse, provide flexibility in meeting the water distribution system demands.

The variable speed pumps are programmed to operate at approximately 752.8 m HGL (65 psi) at the Meridian Heights Pumphouse. There is a pressure relief valve (PRV) located on the header which will operate to relieve high pressures including operation of the fire/standby pump. As the pressure setpoint of this PRV is unknown, it has been assumed to be set at the same pressure as the VFD's, and similar to the operating hydraulic gradeline (HGL) at the High Park Pumphouse.

There is also a pressure relief valve at the High Park Pumphouse, which controls the maximum outgoing pressure to 753.2 m HGL (60 psi).

It is understood that the operating philosophy has not changed since the 2008 Water Master Plan was undertaken. As such, the operating mode is understood to function as indicated below. It should be noted that the system demands identified below have been increased to reflect the pump replacements at Meridian Heights.

At the present time, the water distribution system operates under a day/night mode to meet peak system demands during the day, providing changeover of water in the High Park Reservoir and allow filling of the High Park Reservoir during the night. The two different pumping modes are:

1. **8:00 p.m. to 8:00 a.m. Operation**

Total System Demand	Pump(s) in Operation
0.0 – 140.0 L/s	P-102
140.0 – 280.0 L/s	P-102 + P-103
280.0 – 300.0 L/s	P-102+P-103+P-203

Total distribution pumping capacity is 300.0 L/s.

During this time period, the Meridian Heights variable speed pump(s) operate to meet the system demand, including the filling of the High Park Reservoir. If higher flows are required, High Park can pump into the system.

2. **8:00 a.m. to 8:00 p.m. Operation**

Total System Demand	Pump(s) in Operation
1.0 – 160.0 L/s	P-203 + P-102
160.0 – 300.0 L/s	P-203 + P-102 + P-103
280.0 – 340.0 L/s	P-102+P-103+P-204

Total distribution pumping capacity is 340.0 L/s.

In this operating mode, the small constant speed jockey pump (P-203) in the High Park Pumphouse starts at 8:00 a.m. and will run continuously throughout the day until 8:00 p.m. A variable speed pump in the Meridian Heights Pumphouse (P-102 or P-103) will also operate to satisfy the water distribution system demand.

Should the demand increase beyond the pumping capacity of P-203 and P-102, a second pump (P-103) in the Meridian Heights Pumphouse will start up and operate as a constant speed pump to meet the system demands.

In the event that the three pumps cannot keep up with the system demand, the jockey pump (P-203) in the High Park Pumphouse will shut off and a constant speed pump (P-204 or P-205) will start up and operate together with P-102 and P-103) as required to meet the system demands. In this scenario one of the variable speed pumps in Meridian Heights will operate at a pumping capacity to satisfy the system demands.

3.1.1.3 Distribution System

The existing distribution system is comprised of cast iron, asbestos cement, ductile iron, PVC, and steel pipes. The majority of the older parts of Town are asbestos cement, with some cast iron, ductile iron, and steel piping. The majority of the newer piping is PVC. Pipe sizes range in size from 100 mm in diameter to 600 mm in diameter at the High Park Reservoir and Pumphouse. Figure 3-1 indicates the pipe sizes of the existing water distribution system.

It should be noted that there is some uncertainty regarding the existing watermains in the vicinity of the Meridian Heights Reservoir and Pumphouse, as identified on Figure 3-1. It is recommended that the Town investigate the existence of these mains.

3.1.1.4 Truckfill Station

A privately owned and operated truckfill station is located at Wood Avenue and Boulder Blvd. This truckfill provides approximately 45 L/s directly from the distribution system (as discussed in the design criteria section of this report). The Town of Stony Plain does not currently have control of the flow rates delivered from this station. The truckfill stations' water demands are a significant portion of the existing system demands (45 L/s at the truckfill versus the Towns' Average Day demand of 59.1 L/s for a total demand of 104.1 L/s).

If the truckfill were no longer allowed to tap directly into the distribution system, then it is estimated that a 1600 m^3 reservoir could be required by the owner in order to store 1 peak day of flow (to ensure current level of service). This is calculated by assuming a 2.5 minute turnaround between trucks, and an average fill time of 6 minutes per truck. If this were to occur from 6:00 a.m. to 8:00 p.m. then it would operate for a total of 592.9 minutes at 45 L/s. In order for the Town to replenish this flow, a constant supply of 18.5 L/s would be required to the truckfill (a reduction from the current supply of 45 L/s). The fill and turnaround times were previously estimated from SCADA printouts in the 2008 Master Plan.

A constant flow supply would be easier on the existing pumps and distribution system in that the pumps would not be required to operate inconsistently at as high of a rate. This would reduce the potential stress on the distribution system which may experience some hammer when a large demand is started and stopped.

The supply rate could be negotiated with the owner. The value of 18.5 L/s presented in this report is an estimation. It is not necessary that the owner construct the storage reservoir. They can weigh the costs of constructing on-site storage against delivering at lesser flow rate to their clients.

3.1.2 Existing Model Update

The existing model was updated to reflect the current distribution system. The following tasks were undertaken:

- Input upgrades to piped distribution system.
- Input expansion to piped distribution system.
- Input lidar ground elevations.
- Update water demands to reflect current water use and land use.
- Update fire flow requirements to reflect current land use.
- Update the pumps and pumphouse setpoints.
- Review record drawings of existing system and update piping, material where necessary.

3.1.3 Existing System Assessment

Following model updating, the existing distribution system was analyzed to determine the peak hour pressures and peak day plus fire flow capabilities. Nearly all locations experience pressures within the recommended targets. The following describes each scenario in detail:

3.1.3.1 Average Day Scenario

The Average Day Demand scenario was run in order to assess the maximum system pressures with and without the truckfill in operation. During the average day with the truckfill operating and a total demand of 104.1 L/s, the highest system pressure was 561 kPa (81.4 psi) at Golf Course Road and Slate Avenue in the North Business Park, and the lowest was 349 kPa (50.7 psi) in the Genesis on the Lakes neighbourhood. This is based on pump P-102 operating at the Meridian Heights Pumphouse and pump P-203 (jockey) operating at the High Park Pumphouse (based on daytime operation).

If the Average Day Demand were to occur in the evening without the truckfill operating and a total demand of 59.1 L/s, the highest anticipated pressure would be 564 kPa (81.8 psi) and the lowest would be 347 kPa (50.3 psi). This is based solely on pump P-102 operating at the Meridian Heights Pumphouse.

As identified above, nearly all pressures fell within the recommended range of 345 to 550 kPa.

3.1.3.2 Peak Day Scenario

It is recommended that the Peak Day Demand scenario be assessed in systems where reservoirs are supplied off of the existing distribution system. The existing distribution system must have sufficient capacity to convey the peak day demand from the Meridian Heights Pumphouse to the High Park Pumphouse while maintaining minimum system pressure. Based on the current operating philosophy, it is assumed that the High Park Reservoir will be fully replenished during the overnight period.

Based on re-supplying an estimated 30% of the design peak day demand during the overnight period, it is anticipated that pressures would remain above the absolute minimum pressure of 280 kPa (40 psi).

3.1.3.3 Peak Hour Scenario

During the Peak Hour scenario with the truckfill demand of 45 L/s, pumps P-203, P-102 and P-103 operate to accommodate the total demand of 222.3 L/s. Pressures range from 333 kPa (48.3 psi) to 548 kPa (79.5 psi) in this scenario, with the lowest pressures located in the Genesis on the Lakes neighbourhood. Although slightly lower than the target pressure of 350 kPa (50 psi), pressures remains above 280 kPa (40 psi) which is the absolute minimum allowable pressure during peak demand. The minimum pressure will increase to 349 kPa (50.6 psi) when the truckfill is not in operation.

Below target distribution system pressures are anticipated during the peak hour plus truckfill scenario as the operating pumps cannot maintain the target outlet pressure at High Park. Operating distribution pump P-204 rather than jockey pump P-203 would increase the minimum system pressure to 345 kPa (50 psi).

Figure 3-1 identifies the Peak Hour pressures for the existing system (plus truckfill) and is based on operation of the Jockey pump at the High Park Pumphouse.

3.1.3.4 Peak Day plus Fire Scenario

The majority of locations satisfied the Peak Day plus Fire Flow criteria. Those areas which did not meet the criteria include the south portion of Meridian Meadows, recent extensions in the distribution system (North Business Park, Sommerville, Genesis on the Lake etc.), as well as miscellaneous locations throughout the Town.

In general, overall fire flow availability appears to have decreased from those presented in the 2008 Water Master Plan, due to the following factors:

- Peak demand flows have increased since 2008 due to significant population growth.
- The pumphouse operating pressures appear to have been reduced.
- The land use designation in the older, central area of the Town has been revised to include commercial development.
- New, un-looped watermain extensions have been constructed.
- Fire Flow requirements have been reviewed to identify existing/new commercial/multi-family and apartment locations (higher fire flow).

It should be noted that although there is sufficient fire pumping capacity (in theory), there are distribution system constraints to fully accessing the flow from the High Park Pumphouse. Although High Park can potentially supply 190 L/s during fire flow conditions, there can be significant losses through the distribution system due to the single 300 mm watermain connection to the central part of the Town.

Figure 3-2 identifies the locations which did not meet the recommended criteria. This scenario was run with fire/standby pumps on at both of the pumphouses.

Although there are fire flow deficiencies identified, the Town has been actively addressing the recommended upgrades from the 2008 Water Master Plan, and has constructed many of the upgrades proposed at the time.

3.1.3.5 Pump Capacity

Table 3-2 presents the pumping capacity analysis. The analysis is based on:

- Operating one distribution pump at Meridian Heights;
- Operating one distribution pump plus the jockey pump at High Park; and
- Reserving one distribution pump at each pumphouse as backup.

Ideally, there is full distribution pumping backup to allow for pump maintenance and repair so as not to cause system disruption.

As shown in the table, there is currently no surplus pumping capacity available after meeting the 2018 peak hour plus truckfill demands, if reserving two distribution pumps as backup. There is sufficient fire/standby pump capacity to meet the anticipated peak day plus fire flow (plus truckfill) demand until 2023. It should also be noted that the 2018 peak day plus truckfill demand is 163.2 L/s, which is larger than one pump operating at Meridian Heights (140 L/s). Although the High Park Pumphouse will contribute during peak demands during the day, all flow delivered through High Park will ultimately need to be re-supplied by Meridian Heights. It is therefore recommended that the Meridian Heights Pumphouse have the capacity to supply the Peak Day plus Truckfill demand.

Table 3-2
Pumping Capacity Analysis

Year	2018	2023	2028	2033	2038	2043
Population	18,236	21,140	24,507	28,411	32,936	38,182
Average Day including. Truckfill (L/s)	104.1	113.5	124.4	137.1	151.7	168.7
Peak Day including Truckfill (L/s)	163.2	182.0	203.8	229.1	258.5	292.5
Peak Hour Analysis						
Peak Hour including Truckfill (L/s)	222.3	250.5	283.3	321.2	365.2	416.2
Distribution Pumping Capacity (L/s)	222	222	222	222	222	222
Surplus Deficit (L/s)	-0.3	-28.5	-61.3	-99.2	-143.2	-194.2

Year	2018	2023	2028	2033	2038	2043
Peak Day + Fire Flow Analysis						
Peak Day plus Fire Flow including Truckfill (L/s)	396.2	415.0	436.8	462.1	491.5	525.5
Fire/Standby Pump Capacity (L/s)	417	417	417	417	417	417
Surplus Deficit (L/s)	20.8	2.0	-19.8	-45.1	-74.5	-108.5

3.1.3.6 Water Storage

There are two methods of calculating water storage requirements:

- Alberta Environment and Parks (AEP) Guidelines which require:
  - Equalizations Storage (peak hour demand); 25% of Peak Day flow.
  - Fire Storage.
  - Plus the greater of:
    - Emergency Storage (in event of supply interruption); 15% of Average Day flow.
    - Disinfection contact time (T_{10}) storage.

- Supply System based criteria (systems dependent on long supply lines):
  - 1 Peak Day.
  - Fire Storage.

For systems dependent on long supply lines, it is recommended that the second method of calculating storage requirements be applied. As such, Table 3-3 calculates the required storage based on 1 Peak Day plus Fire storage requirements. As indicated, the total storage requirement for the existing Town is 14,329 m^3 resulting in a storage surplus of 4,829 m^3 to meet the current needs.

The recommended fire flow is the largest demand allowed for in a water distribution system. Based on the Town of Stony Plain Municipal Development Standards, the largest recommended fire flow used in this study is 233 L/s for the large commercial areas. A fire flow of 233 L/s is required to be maintained for 3.0 hours, in accordance with Fire Underwriter's survey. This results in a fire flow storage requirement of 2,516 m^3.

The truckfill storage requirement has been estimated based on the maximum likely hours of filling during a single day. This is calculated by assuming a 2.5 minute turnaround between trucks, and an average fill time of 6 minutes per truck. If this were to occur from 6:00 a.m. to 8:00 p.m. then it would operate for a total of 592.9 minutes at 45 L/s (or 1,600 m^3/day).

If the storage for the truckfill is to be located offsite (at the truckfill station), then there could be an additional 1600 m^3 of storage surplus available (assuming typical truckfill demands are not considered in the overall storage calculation).

Table 3-3
Storage Capacity Analysis

	Existing Storage (m^3)	Estimated Population	Peak Day Flow (L/s)	Peak Day Flow (m^3/day)	Peak Day Truckfill (m^3/day)	Fire Flow (233 L/for 3 hours) (m^3)	Total Required Storage (m^3)	Remaining Storage (Surplus) (m^3)
Existing (2018)	19,158	18,236	118.2	10,212	1,600	2,516	14,329	4,829
2023	19,158	21,140	137.0	11,838	1,600	2,516	15,955	3,203
2028	19,158	24,507	158.8	13,724	1,600	2,516	17,840	1,318
2033	19,158	28,411	184.1	15,910	1,600	2,516	20,027	-869
2038	19,158	32,936	213.5	18,444	1,600	2,516	22,561	-3,403
2043	19,158	38,182	247.5	21,382	1,600	2,516	25,498	-6,340

3.1.3.7 Hydrant Coverage

Figure 3-3 indicates the current level of hydrant coverage within the Town. The coverage is based on a 75 m radius for hydrants within single family residential areas, and 50 m for commercial/industrial locations. These values are outlined in the Stony Plain Municipal Development Standards, and have been calculated using the Fire Underwriters guidelines. The hydrant locations were obtained through the Town of Stony Plain GIS information.

The figure also recommends locations for future hydrants in areas without sufficient coverage. Most of the areas which require additional hydrants can be easily serviced off of existing watermains. As actual building location are not shown on the drawings, additional hydrants could be required to protect the far side of large buildings such as schools and commercial/industrial buildings.

3.2 UPGRADES TO EXISTING SYSTEM

3.2.1 Distribution System

Upgrades to the distribution system are presented on Figure 3-4 and are recommended to satisfy fire flow criteria. As mentioned previously, overall fire flow availability appears to have declined due to several factors including increased demand due to population growth. As such, additional upgrades are proposed currently than were identified in the 2008 Water Master Plan. Upgrades have been based on meeting the peak day plus fire flow criteria, during operation of the truckfill station. The proposed upgrades are as follows:

- New 300 mm diameter watermains are recommended as shown:
  - To replace the existing 100 mm Ductile Iron pipe from Highway 16A to Meridian Meadows;
  - 47 Avenue from 48 Street to 50 Street;
  - 52 Avenue from 48 Street to 50 Street;
  - 50 Avenue from 49 Street to 50 Street;
  - 51 Avenue from 49 Street to 50 Street;
  - 53 Avenue from 49 Street to 50 Street;
  - 50 Street from 50 Avenue to 52 Avenue;
  - 50 Avenue from 48 Street to Brown Street; and
  - 47 Street from 52 Avenue to 54 Avenue.
- Various watermain looping and interconnections.
- Some dead ends will require future adjacent development and watermain looping to fully satisfy the fire flow criteria. Watermain extensions may or may not be identified for these locations at this time.

A new 300 mm watermain is proposed to extend north from the existing 300 mm watermain extending east of the High Park Reservoir and Pumphouse. This is required to satisfy fire flow deficiencies in the new Sommerville development, as well as to increase connectivity between the High Park Pumphouse and the central portion of the Town (including the nearby hospital). The proposed watermain allows for additional water to be provided from the High Park Pumphouse, and reduces overall risk to the system by improving connectivity. This will become increasingly useful in the future, as a new supply lateral is planned to connect directly to the High Park Reservoir from the Parkland Water Commission.

The upgrades indicated on **Figure 3-4** are those required to meet the recommended fire flow criteria. However, it is recommended that mains be upsized to the minimum recommended diameter when the opportunity arises. It is recommended that a minimum of 200 mm diameter pipes be installed in all residential areas, a minimum of 250 mm in all multi-family areas, and 300 mm in all commercial/industrial areas as per the Town of Stony Plain Municipal Development Standards.

Following the proposed upgrades, there are a few isolated locations which are not anticipated to meet the recommended fire flow criteria. A brief discussion on each location is provided below:

- North end of North Business Park
  - There are a few nodes which are slightly deficient in the far northerly section of the distribution system. This will be rectified in future development phases which include looping of watermains in adjacent developments.
- Northeast end of Sun Meadows Close
  - This location is minimally deficient to meet the projected high density residential fire flow. This will be rectified in future development phases which include looping of watermains in adjacent developments.
- North end of Sunrise Village Road
  - This location was found to be deficient in terms of commercial fire flow. However, the Town GIS does not identify a hydrant in this area so fire flow provision at this particular location may not have been intended. The Town GIS indicates that there are fire hydrants located

within the commercial development itself, however, drawings of this system were not located.

- 50 Street north of 50 Avenue
  - This location is anticipated to be approximately 1% deficient following system upgrading. As well, the Town GIS indicates that the hydrant is located on the 400 mm waterline rather that the 150 mm waterline. If found to be correct, there would be no deficiency in the area.
- East end of Egerland Place
  - This location is anticipated to be approximately 1% deficient following system upgrading. Upgrades are not recommended to overcome the minor shortfall.
- East end of 55A Avenue
  - This location is anticipated to be approximately 3% deficient following system upgrading. Upgrades are not recommended to overcome the minor shortfall.
- John Paul II School
  - This location is minimally deficient to meet the projected school fire flow, however, full fire flow is available along the municipal roadway. Should the Town wish to increase fire flow within the school site itself, a short 200 mm water connection could be made to the development to the south.
- Stony Plain Baptist Church and Stony Plain Outdoor Pool.
  - These facilities are serviced off of a watermain located along 55 Avenue. Sufficient fire flow can be achieved along the municipal roadway (55 Avenue) and as such, upgrades have not been identified.
- 52 Street and 54 Avenue
  - There is insufficient fire flow available within the existing 150 mm watermain at this location. Although there is an adjacent 300 mm watermain, the hydrant at this location appears to be serviced from the 150 mm main. It is recommended that the hydrant be reconnected to the existing 300 mm watermain, or a new hydrant installed.

In additional to the watermain upgrades identified above, approximately 38 new hydrants are recommended to improve hydrant coverage throughout the Town.

3.2.2 Pumping

Table 3-2 identifies that there is no surplus pumping capacity available beyond 2018 if one distribution pump is retained as backup at each pumphouse. As such, it is recommended that a third pump be installed at the Meridian Heights Pumphouse, at the same design setpoint (flow/head) as the existing two pumps. This would increase the outflow capacity from the pumphouse to 280 L/s and retain 50% backup pumping, accommodating the projected peak flows up to 2038. There is currently room to install a third pump within the pumphouse, with a blind flange located on the main header. This is based on a pump design setpoint of 140 L/s at 53 m of head and does not consider adjustments due to a lower actual operating head or additional losses when operating two pumps.

It is recommended that the Meridian Heights Pumphouse have capacity to accommodate the peak day demand (with backup, preferably). As such, increased distribution pumping capacity at the High Park

Pumphouse is recommended to be secondary to Meridian Heights until such time as the new supply lateral is connected to the High Park Reservoir in or around 2030.

Table 3-2 also identifies that there is sufficient fire/standby pump capacity to meet the projected peak day plus fire flow demand to 2023. It is recommended that fire/standby pumping capacity be increased by the year 2023 to meet projected future demands. As the largest fire/standby pump is currently located at the Meridian Heights Pumphouse, it may be prudent to replace one of the two smaller fire/standby pumps which are located at the High Park Pumphouse. However, **increased fire/standby pump capacity at the High Park Pumphouse will only be useful if connectivity from High Park to the central areas of Town are increased** (i.e. new watermain to Sommerville).

The Town may wish to consider revising the current operating philosophy such that the overnight period would occur from 8 pm to 6 am (rather than 8 am) and the daytime period would occur from 6 am (rather than 8 am) to 8 pm. The morning period may be a relatively high consumption period as people prepare for their day. Pressures could be improved if the jockey pump were to operate (depending on the actual demands during this period). The Town could choose to monitor the pressures during the early morning period in the Genesis on the Lake area to determine if a revision to the operating period is warranted.

Extending the operating period of the High Park pumps may also help to improve water turnover at the reservoir, as it is understood that it may have been difficult to achieve chlorine residual levels at times in the past. It is recommended that the Town monitor the water quality at the High Park Reservoir and assess if required.

3.3 STORAGE

From Table 3-3, it appears that there is sufficient storage to serve up to the 2031 population.
If truckfill requirements were to be removed (i.e. storage provided at the truckfill site itself), then the existing storage would be adequate up to the year 2034. This will not significantly delay construction of additional storage to service the Town, and has not be considered further.

The analysis is based on providing the recommended Fire Flow storage of 2,516 m^3 between the two existing reservoirs, not at each reservoir. If Fire Flow storage is preferred at each location, then the total existing storage would satisfy the projected population to year 2024.

As shown in the table, additional storage will be required by approximately 2031. From record drawings it appears that land has been retained to twin the existing storage capacity at the High Park Reservoir. This would increase the overall storage capacity by an additional 4,545 m^3, and delay construction of further storage reservoirs until approximately 2040 (basically, after Stage 2).

It does not appear that there is any significant space available within the current parcel to accommodate a storage expansion at the Meridian Heights Reservoir. However, there may be sufficient room to accommodate a future expansion if the municipal lot located immediately to the east was also available for use (currently a small playground and parking lot). It is estimated that up to 7,000 m^3 of additional storage could potentially be constructed at this site, however, investigation will be required to further assess the potential.

3.4 FUTURE WATER DISTRIBUTION SYSTEM

The future water system concept is presented in 4 phases; Stages 1 through 3 as well as Ultimate development as presented in **Figure 1-2.** In general, a fire flow of 200 L/s has been assumed in each future residential area to allow for high density development (walk up apartments). A fire flow of 183 L/s has been allowed for in all future non-residential developments. Where a future land use has not been identified, the greater of the two fire flows has been applied. An exception has been made for short term development where the ASP indicates that the maximum land use will be medium density residential, whereby a fire flow of 133 L/s has been applied.

For all future development stages, it has been assumed that a consistent HGL of 753 m will be maintained from all existing and future pumphouses servicing the primary pressure zone. This is an average of 752.8 m and 753.2 m currently experienced at the Meridian Heights and High Park Pumphouses respectively. As such, it is assumed that appropriate pumps will be operated in order to maintain the target outlet pressure.

All scenarios presented include an allowance of 45 L/s to supply the existing truckfill. It has been assumed that the truckfill flow rate will be maintained at the current rate.

Generally, only major watermains (250 mm and above) have been identified in the expansion areas. The future employment lands will result in far more 300 mm diameter mains than shown, as it is the minimum pipe size recommended in these areas.

ASP's were reviewed and are reflected in the future watermain concept where appropriate. There were instances where more recent development in adjacent neighbourhoods suggests that revisions may be likely within some ASP locations. The Stony Plain Transportation Study (Associated Engineering, 2010) and the Water Distribution System Master Plan Update (Associated Engineering, 2008) were also reviewed.

3.4.1 Stage 1

3.4.1.1 Distribution System

Figure 3-5 presents the proposed distribution system for Stage 1.

During the average day demand scenario, pressures range from 351 kPa (51 psi) to 563 kPa (81.7 psi). The pressure falls minimally during the peak hour scenario to range from 349 kPa (50.6 psi) to 548 kPa (79.5 psi). The vast majority of locations fall within the target pressure range.

Fire Flows are not fully met in all areas of the existing development, or within all Stage 1 lands. Proposed development in the South Creek and Edgeland Park areas will require future watermain looping to provide the target fire flow of 200 L/s. It should be noted that although the target fire flow of 200 L/s is not fully met in this area, further internal looping may improve the results presented in the figure. As well, smaller fire flows may be required throughout much of the development based on the final land use concept. The figure identifies the level of fire flow available.

It should be noted that the highest fire flow assessed in the future Fairways North development is 133 L/s for medium density development, as indicated on the ASP. The ASP identifies medium density development as semi-detached, duplex, row housing and fourplex developments.

As shown in the Figure, some existing dead ends will continue to fall somewhat short of the target fire flows.

3.4.1.2 Pumping and Storage

Additional distribution system pumping is recommended for the existing system to meet the current projected demands and ensure backup pumping. By 2023, it is anticipated that additional fire/standby pumping will also be required as discussed earlier. It is recommended that additional pumping be located at the Meridian Heights Pumphouse, until such time as the dedicated supply main is constructed to High Park (for distribution pumping) or, until additional watermains are installed between High Park and the central areas of Town (for fire/standby pumping). It is anticipated that the dedicated supply main will be in service at the end of Stage 1 or near the beginning of Stage 2.

Additional storage is not anticipated to be required during Stage 1.

3.4.2 Stage 2

3.4.2.1 Distribution System

Figure 3-6 presents the proposed distribution system for Stage 2. In addition to expansion areas, upgrades are identified for the outlet main from the Meridian Heights Reservoir as well as along the roadway to connect with the 400 mm main to the east. This is required to reduce the velocity to less than 1.5 m/s during the peak hour demand.

During the average day demand scenario, pressures range from 351 kPa (51 psi) to 562 kPa (81.6 psi). The pressure falls minimally during the peak hour scenario to range from 349 kPa (50.6 psi) to 544 kPa (78.9 psi). The vast majority of locations fall within the target pressure range. The few nodes which slightly exceed the maximum target are located in the North Business Park, in lower elevations.

Fire flows are not fully met in all areas of the existing development, or within all Stage 2 lands. Proposed development in the South Creek, Edgeland Park and Tussic areas will require future watermain looping to provide the target fire flow of 200 L/s. It should be noted that although the target fire flow is not fully met in this area, further internal looping may improve the results presented in the figure. As well, the full target fire flow may not be required throughout much of the development. The figure identifies the level of fire flow available.

In some locations, fire flows have been improved due to installation of loop mains through new development areas. An additional watermain crossing Highway 16A as well as new development and looping in the area, have improved fire flow deficiencies north of the Highway.

As shown in the Figure, some existing dead ends will continue to fall somewhat short of the target fire flows.

3.4.2.2 Pumping and Storage

Further pumping requirements are not identified for the projected development stages as it will depend on prior upgrades undertaken by the Town. It is recommended that pumps be regularly inspected and maintained to prolong their lifespan. It should be anticipated that pumps may need to be replaced every 10-15 years with new and higher capacity pumps.

It is anticipated that additional storage will be required during Stage 2. It is recommended that the Town twin the existing High Park Reservoir, as it appears that land has been retained for this purpose. It is anticipated that an addition 4,500 m^3 will be constructed.

3.4.3 Stage 3

3.4.3.1 Distribution System

Figure 3-7 presents the proposed distribution system for Stage 3.

During the average day demand scenario, pressures range from 351 kPa (51 psi) to 610 kPa (88.6 psi). The pressure falls minimally during the peak hour scenario to range from 347 kPa (50.3 psi) to 593 kPa (86.0 psi). The majority of locations fall within the target pressure range. The highest pressures are found within the far northeastern Quarter Section of the North Business Park. Although these pressures remain within the absolute maximum acceptable pressure limit, the Town could choose to install PRV stations to lower the pressure closer to 550 kPa (80 psi).

Fire Flows are fully met in all new development lands, including in Stages 1, 2 and 3. As shown in the Figure, some dead ends in existing development areas will continue to fall somewhat short of the target fire flows.

3.4.3.2 Pumping and Storage

Pumping upgrades have not been identified beyond Stage 1. It is recommended that pumps be regularly inspected and maintained to prolong their lifespan. It should be anticipated that pumps may need to be replaced every 10-15 years with new and higher capacity pumps.

After twinning the High Park storage in Stage 2, further storage is anticipated to be required in approximately 2040, at the start of Stage 3. Figure 3-7 identifies the location of the proposed West

Reservoir. This location has been selected primarily based on its proximity to higher ground to the west, as well as to Stage 2/3 lands.

It is apparent from the Lidar data that some lands located along the western Town boundary will be too high to service based on the current pumping HGL. The proposed West Reservoir and Pumphouse will facilitate servicing of the westerly lands, as well as provide additional storage for the current service area. It is anticipated that the reservoir will be supplied via the existing distribution system in the short term, with a dedicated supply to the Parkland Water Commission or the WILD Regional Water Services Commission (WILD System) further into the future. Additional discussion is provided in the Ultimate System discussion below.

3.4.4 Ultimate System

3.4.4.1 Distribution System

Figure 3-8 presents the proposed distribution system for the Ultimate System. This figure presents the overall peak hour pressure rather than insufficient fire flow (as in Stages 1 through 3), as all expansion areas will achieve full fire flow. It provides an overview of the lowest anticipated pressures at full development.

A new western pressure zone is proposed for the Ultimate Development Stage. The proposed West Reservoir and Pumphouse would provide distribution system pressure and fire flow to service the higher elevations located along the west Town boundary. Large diameter watermains would be required to meet the design fire flows.

It is anticipated that the proposed West Reservoir and Pumphouse will be supplied via the Parkland Water Commission or the WILD System. For the purpose of this report, a connection to the Wild System has been identified. It is proposed that a new supply main would be constructed along Highway 16A to the proposed reservoir site. It is assumed that the Town will have full jurisdiction over the Highway lands at that time.

A proposed East Reservoir and Pumphouse is also identified in the Ultimate Development Stage. This is proposed to be located along the future supply main to the High Park Reservoir. This will provide additional storage capacity to service the ultimate population, as well as support the slightly higher elevations which occur along the southeastern Town Boundary.

In the primary zone, pressures range from 351 kPa (50.9 psi) to 610 kPa (88.6 psi) during the average day demand scenario. The pressure falls minimally during the peak hour scenario to range from 341 kPa (49.5 psi) to 593 kPa (86.0 psi). In the proposed western zone, pressures are anticipated to range from 370 kPa (53.7 psi) to 547 kPa (79.4 psi) during the average day demand scenario. Pressures are anticipated to range from 361 kPa (52.4 psi) to 542 kPa (78.7 psi) during the peak hour scenario.

Based on a proposed HGL of 768 m at the future West Reservoir (west zone header), all pressures in the western zone will be within the target limits. The majority of locations within the primary zone fall within the target pressure range. Once again, the highest pressures are found within the far northeastern quarter section of the North Business Park.

Fire Flows are fully met in all new development lands. As shown in the Figure, some existing dead ends will continue to fall somewhat short of the target fire flows.

A hill is located east of Boundary Road and North of Secondary Highway 628. Approximately 30% of the quarter section is at an elevation greater than 717 m, which will place it above the general service pressure in the area. based on the grade of the hill, it is unlikely that it will be fully developed at the current elevation. It is therefore assumed that the steep/high sections will not be serviced, significant regrading will occur or a local solution will be undertaken.

A Node Numbering Plan of the proposed Ultimate Water System is enclosed in **Appendix A.**

3.4.4.2 Pumping and Storage

As mentioned above, pumping upgrades have not been identified beyond Stage 1. It is recommended that pumps be regularly inspected and maintained to prolong their lifespan. It should be anticipated that pumps may need to be replaced every 10-15 years with new and higher capacity pumps.

The proposed West Reservoir and Pumphouse would be comprised of two headers; one pumping to an HGL of 768 m to service the western zone, and the other pumping to 753 m HGL to service the primary zone. The proposed East Reservoir and Pumphouse would pump to an HGL of 753 m, in keeping with the primary zone pressure.

After twinning the High Park Storage capacity, it is estimated that approximately 30,000 m^3 of additional storage will be required to service the Ultimate Development Stage (Town Boundary). It is assumed that this would be split between the proposed West Reservoir and proposed East Reservoir. A minimum of 10,000 m^3 is anticipated to be required for the western zone alone, including fire flow.

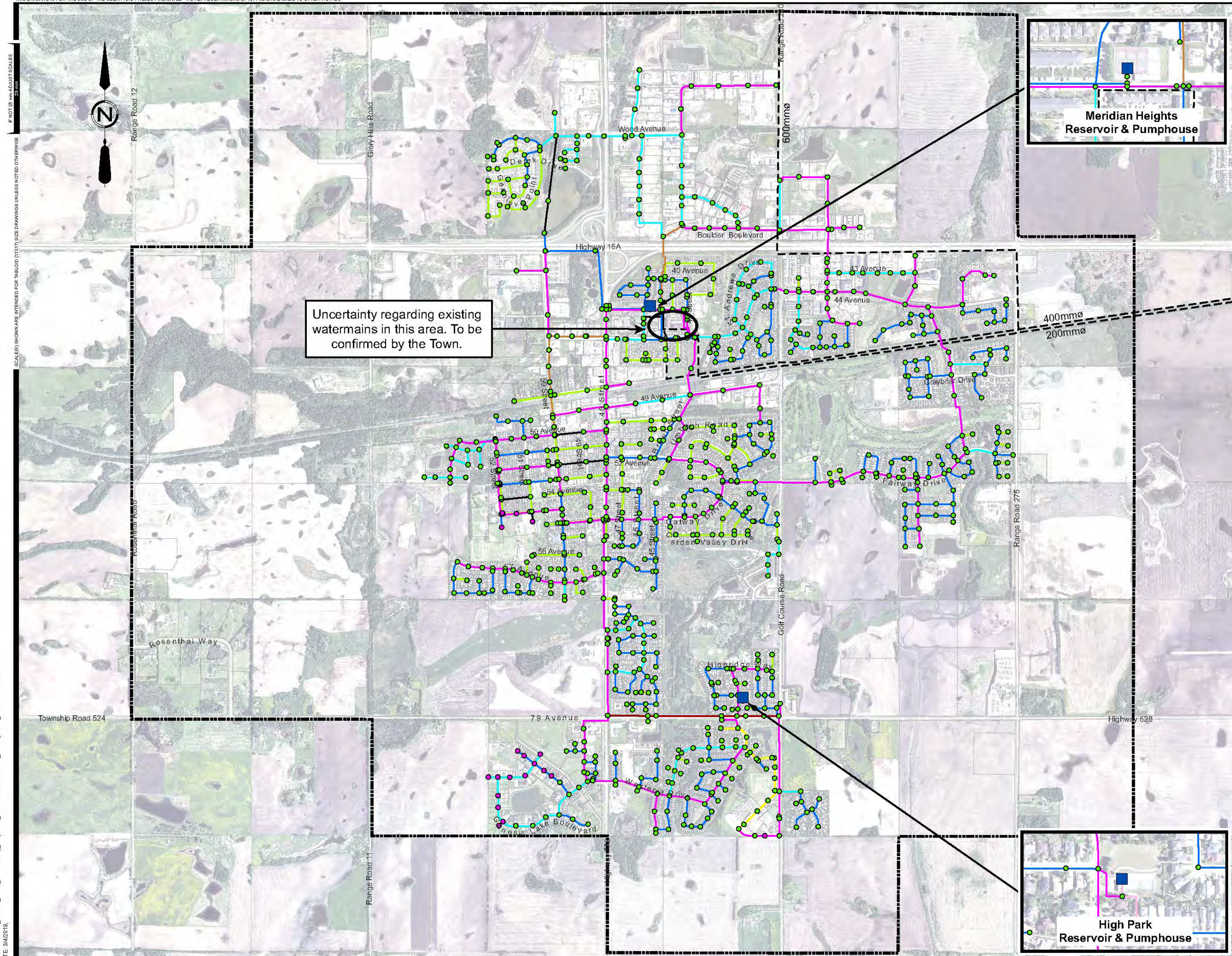
3.5 REGIONAL SUPPLY

It is understood that the Parkland Water Commission will construct a dedicated supply line to the High Park Reservoir in approximately 2030. This will allow for continuous operation of the High Park Pumphouse and will reduce the risk to the community based on reliance upon a single supply line.

It is proposed that future reservoirs also be directly connected to the supply system, rather than through the distribution system. Supply to the future West Reservoir has been identified along Highway 16A in **Figure 3-8**. It is anticipated that the Town will have jurisdiction over the highway at this point in time, which will allow for construction within the Highway right-of-way. Supply to the future East Reservoir is proposed to be taken directly from the dedicated supply to the High Park Reservoir.

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

Legend:

- Existing Reservoir & Pumphouse

Peak Hour Pressure

- 40 - 50 psi (280 kPa - 350 kPa)
- 50 - 80 psi (350 kPa - 550 kPa)
- 80 - 90 psi (550 kPa - 620 kPa)

Distribution System

- Existing 100 mmø
- Existing 150 mmø
- Existing 200 mmø
- Existing 250 mmø
- Existing 300 mmø
- Existing 350 mmø
- Existing 400 mmø
- Existing 450 mmø
- Existing 500 mmø
- Existing 600 mmø
- Supply Main
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. 3.1

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

EXISTING WATER SYSTEM
PEAK HOUR PRESSURE

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

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DATE: 3/4/2019,

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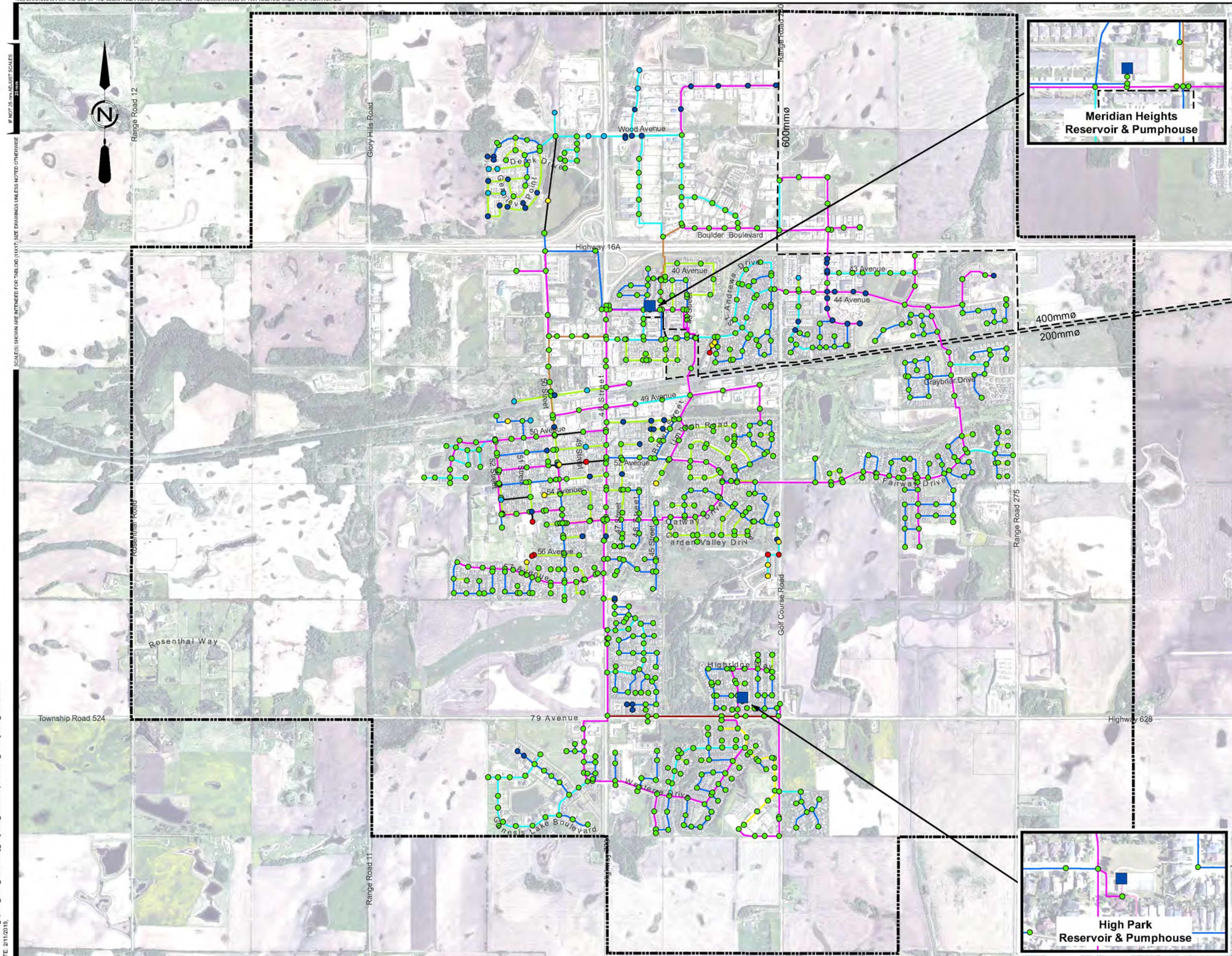

Legend:

- ■ Existing Reservoir & Pumphouse

Fire Flow Availability

- Exceeds Fire Flow Requirements
- 80% - 99%
- 60% - 80%
- 40% - 60%
- 0% - 40%

Distribution System

- Existing 100 mmø
- Existing 150 mmø
- Existing 200 mmø
- Existing 250 mmø
- Existing 300 mmø
- Existing 350 mmø
- Existing 400 mmø
- Existing 450 mmø
- Existing 500 mmø
- Existing 600 mmø
- Supply Main
- Stony Plain Boundary

Associated Engineering

TOWN OF STONY PLAIN

FIGURE No. 3.2

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

EXISTING WATER SYSTEM
PEAK DAY PLUS FIRE FLOW

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 FEBRUARY
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

IF NOT 25 mm ADJUST SCALES 25 mm

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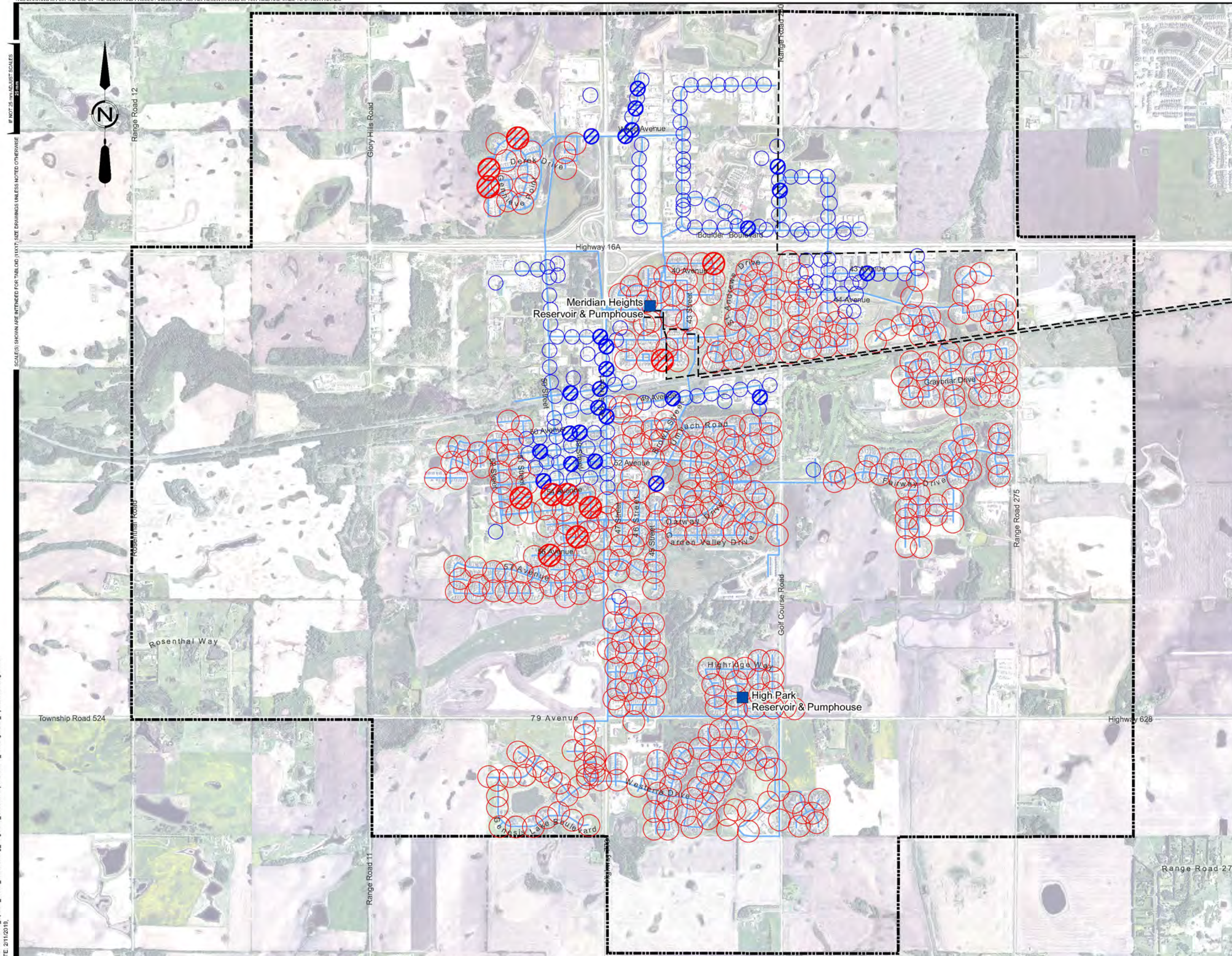
DATE: 2/11/2019,



Legend:

- Existing Reservoir & Pumphouse
- Existing Hydrant Coverage in Residential Areas (75m Radius)
- Existing Hydrant Coverage in Other Areas (50m Radius)
- Proposed Hydrant Coverage in Residential Areas (75m Radius)
- Proposed Hydrant Coverage in Other Areas (50m Radius)
- Existing Watermain
- Supply Main
- Stony Plain Boundary

Associated Engineering

TOWN OF STONY PLAIN

FIGURE No. 3.3

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

EXISTING WATER SYSTEM
HYDRANT COVERAGE

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 FEBRUARY
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

IF NOT 25 mm ADJUST SCALES 25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

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DATE: 2/11/2019,

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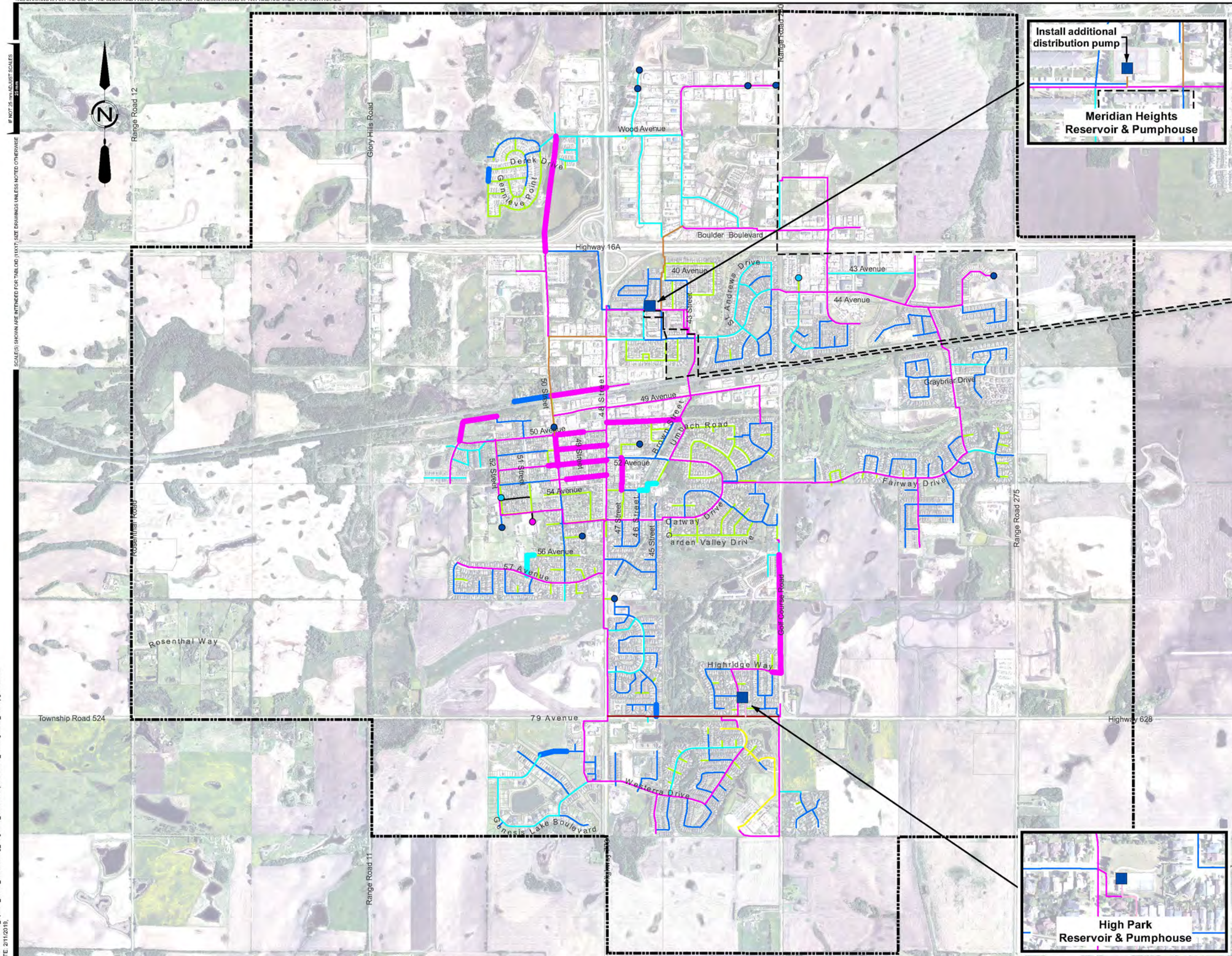

Associated Engineering

TOWN OF STONY PLAIN

FIGURE No. 3-4

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

EXISTING WATER SYSTEM
WITH UPGRADES

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 FEBRUARY
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE. IF NOT 25 mm ADJUST SCALES 25 mm

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DATE: 2/11/2019

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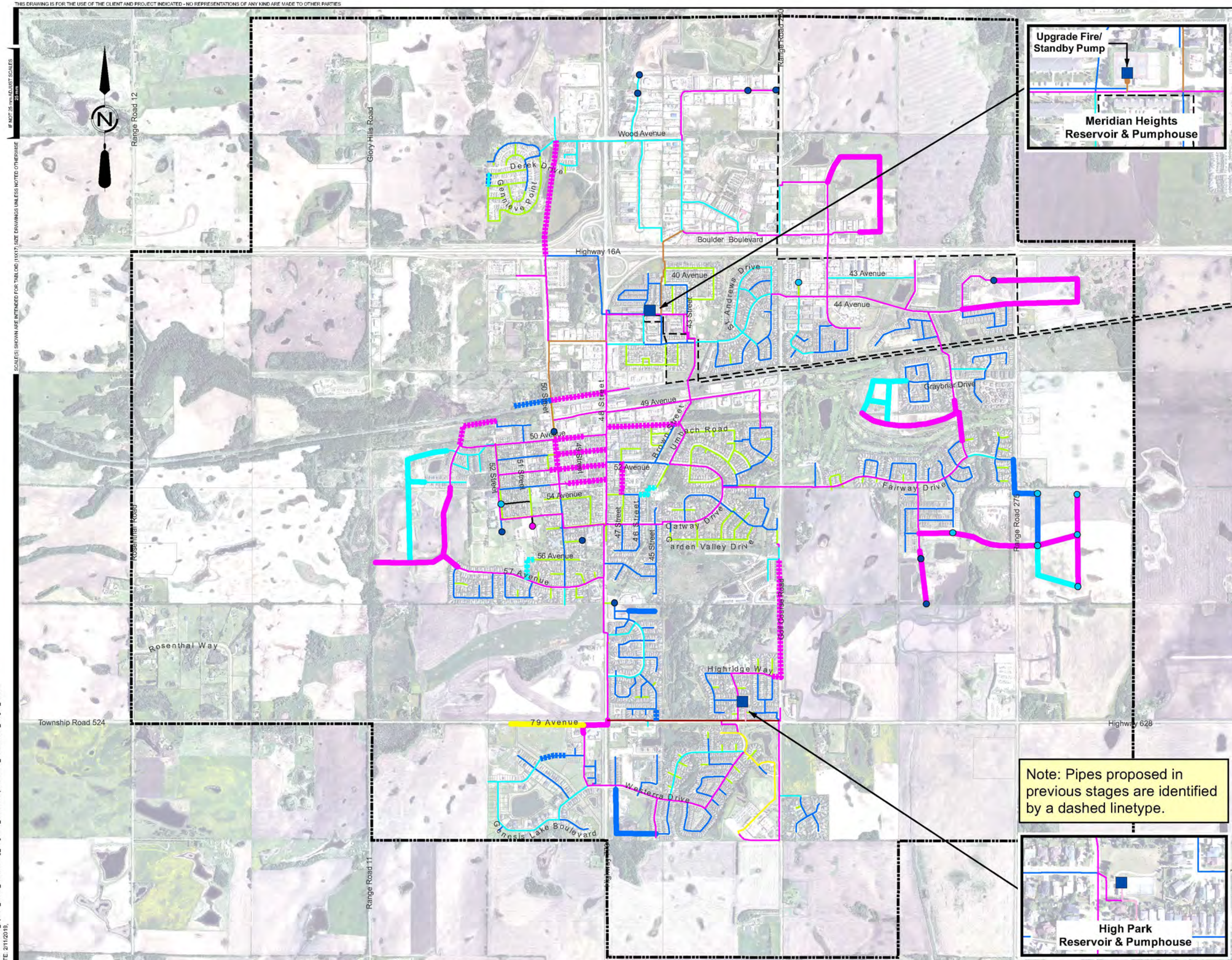


Legend:

- Existing Reservoir & Pumphouse

Fire Flow Availability

- 80% - 99%
- 60% - 80%
- 40% - 60%
- 0% - 40%

Distribution System

- Existing 100 mmø
- Existing 150 mmø
- Existing 200 mmø
- Existing 250 mmø
- Existing 300 mmø
- Existing 350 mmø
- Existing 400 mmø
- Existing 450 mmø
- Existing 600 mmø
- Proposed 200 mmø
- Proposed 250 mmø
- Proposed 300 mmø
- Proposed 350 mmø
- Proposed 400 mmø
- Proposed 500 mmø
- Supply Main
- Stony Plain Boundary

TOWN OF STONY PLAIN

Note: Pipes proposed in previous stages are identified by a dashed linetype.

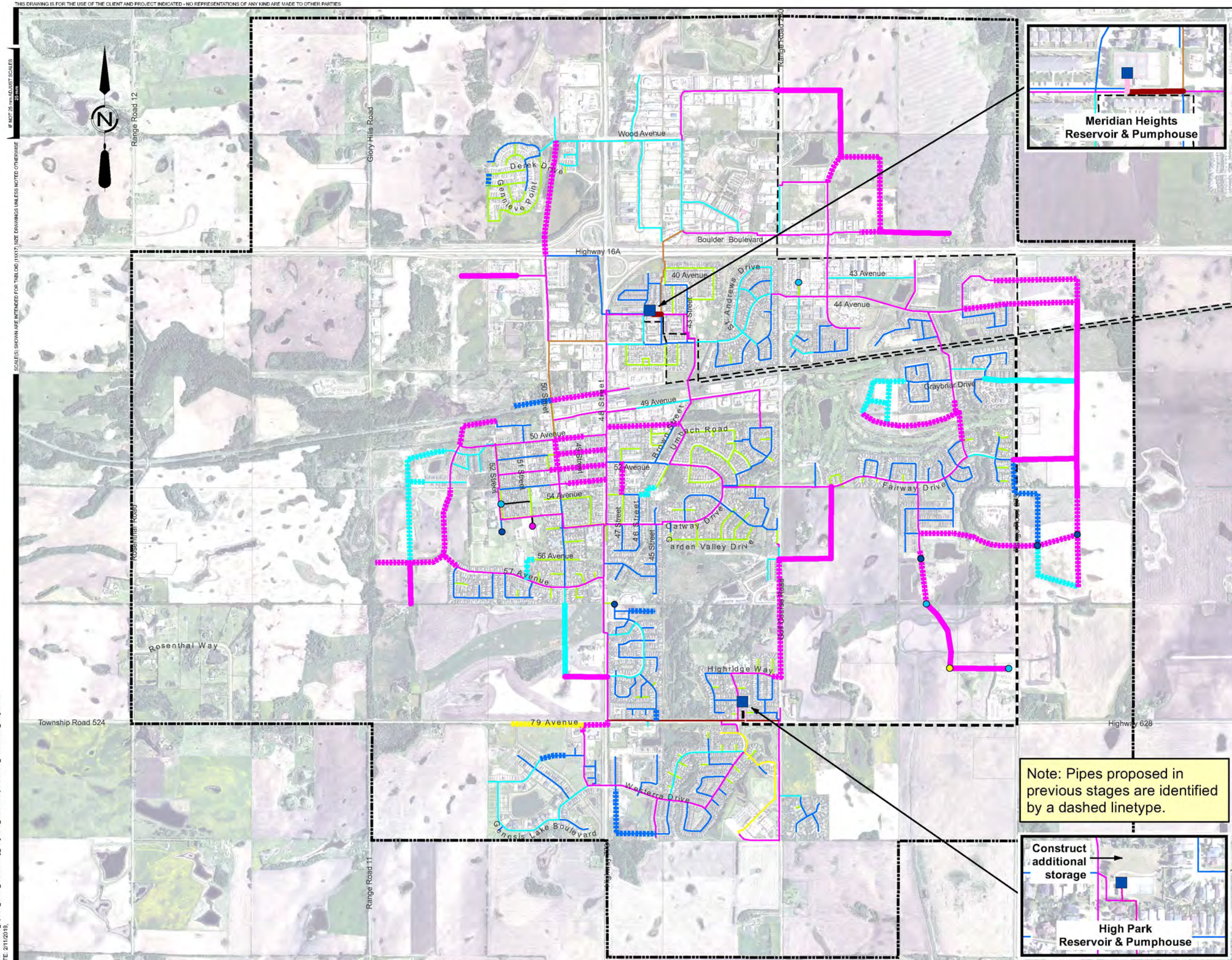
FIGURE No. 3.5

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

FUTURE WATER SYSTEM
STAGE 1

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 FEBRUARY
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

Associated Engineering



Associated Engineering

Legend:

- Existing Reservoir & Pumphouse

Fire Flow Availability

- 80% - 99%
- 60% - 80%
- 40% - 60%
- 0% - 40%

Distribution System

- Existing 100 mmø
- Existing 150 mmø
- Existing 200 mmø
- Existing 250 mmø
- Existing 300 mmø
- Existing 350 mmø
- Existing 400 mmø
- Existing 450 mmø
- Existing 500 mmø
- Existing 600 mmø
- Proposed 200 mmø
- Proposed 250 mmø
- Proposed 300 mmø
- Proposed 350 mmø
- Proposed 400 mmø
- Proposed 450 mmø
- Proposed 500 mmø
- Proposed 600 mmø
- Existing Supply Main
- Proposed Supply Main
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. 3.6

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

FUTURE WATER SYSTEM
STAGE 2

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 FEBRUARY
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

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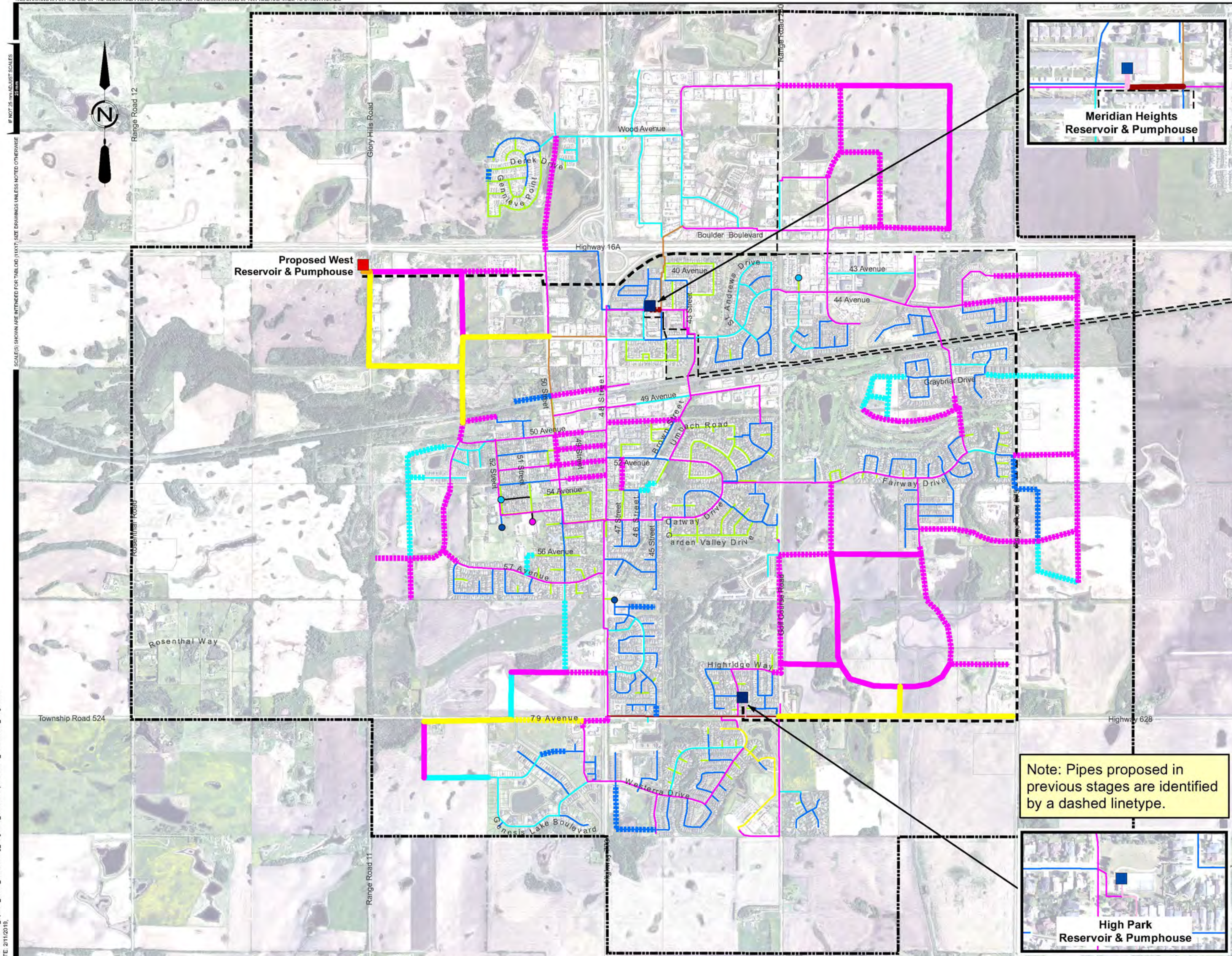


Note: Pipes proposed in previous stages are identified by a dashed linetype.

Associated Engineering

Legend:

- Existing Reservoir & Pumphouse
- Proposed Reservoir & Pumphouse

Fire Flow Availability

- 80% - 99%
- 60% - 80%
- 40% - 60%
- 0% - 40%

Distribution System

- Existing 100 mmø
- Existing 150 mmø
- Existing 200 mmø
- Existing 250 mmø
- Existing 300 mmø
- Existing 350 mmø
- Existing 400 mmø
- Existing 450 mmø
- Existing 500 mmø
- Existing 600 mmø
- Proposed 200 mmø
- Proposed 250 mmø
- Proposed 300 mmø
- Proposed 350 mmø
- Proposed 400 mmø
- Proposed 450 mmø
- Proposed 500 mmø
- Proposed 600 mmø
- Existing Supply Main
- Proposed Supply Main
- Stony Plain Boundary

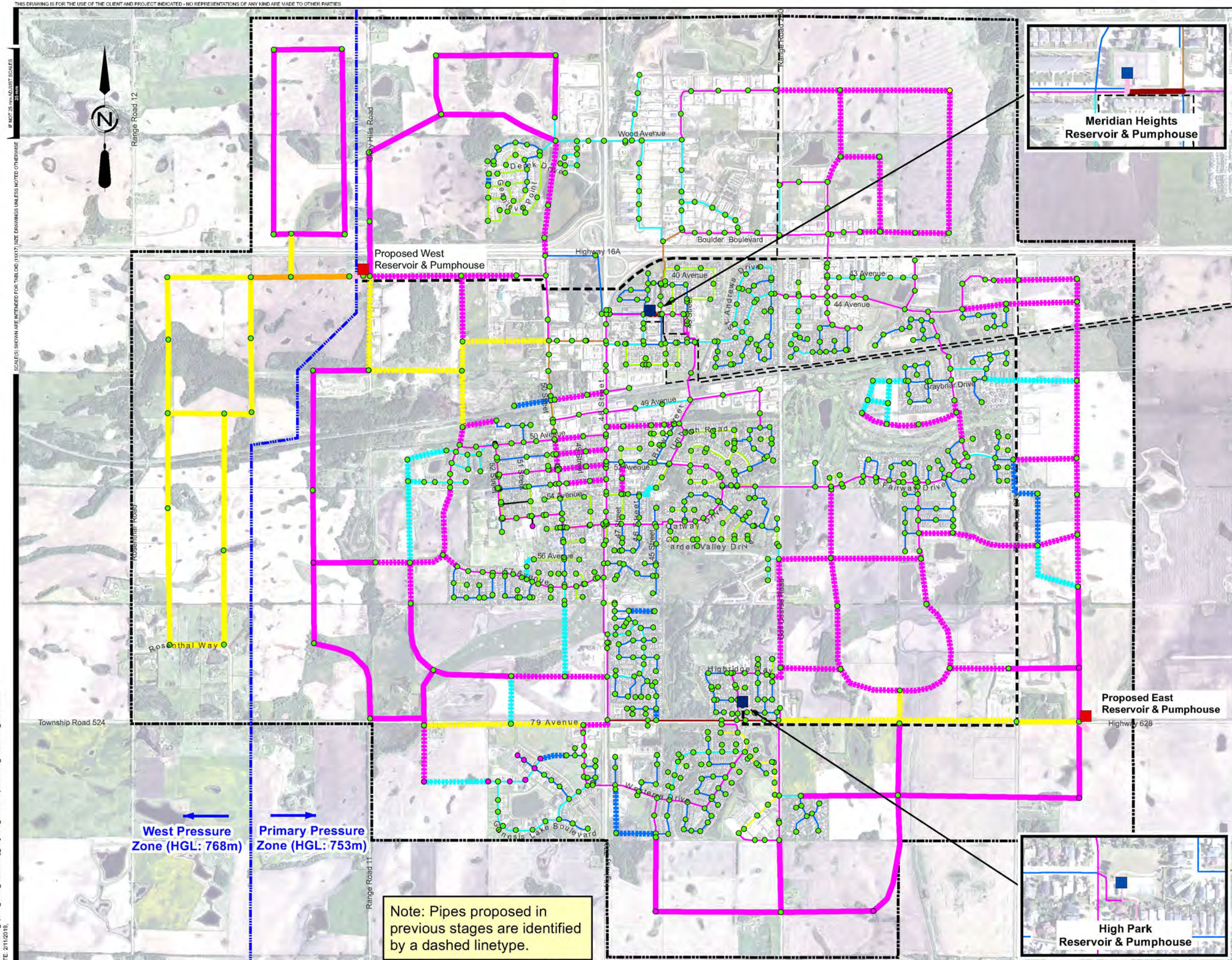
TOWN OF STONY PLAIN

FIGURE No. 3-7

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

FUTURE WATER SYSTEM
STAGE 3

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 FEBRUARY
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT



Legend:

- Existing Reservoir & Pumphouse
- Proposed Reservoir & Pumphouse

Peak Hour Pressure

- 40 - 50 psi (280 kPa - 350 kPa)
- 50 - 80 psi (350 kPa - 550 kPa)
- 80 - 90 psi (550 kPa - 620 kPa)

Distribution System

- Existing 100 mmø
- Existing 150 mmø
- Existing 200 mmø
- Existing 250 mmø
- Existing 300 mmø
- Existing 350 mmø
- Existing 400 mmø
- Existing 450 mmø
- Existing 500 mmø
- Existing 600 mmø
- Proposed 200 mmø
- Proposed 250 mmø
- Proposed 300 mmø
- Proposed 350 mmø
- Proposed 400 mmø
- Proposed 450 mmø
- Proposed 500 mmø
- Proposed 600 mmø
- Existing Supply Main
- Proposed Supply Main
- Pressure Zone Boundary
- Stony Plain Boundary

Associated Engineering

TOWN OF STONY PLAIN

FIGURE No. 3.8

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

FUTURE WATER SYSTEM
ULTIMATE

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 FEBRUARY
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

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DATE: 2/11/2019

4 Sanitary System

4.1 EXISTING SANITARY SYSTEM

4.1.1 Existing Facilities

The existing sanitary system within the Town of Stony Plain consists of the collection system, lift stations and forcemains, low pressure sewer systems, and the Alberta Capital Region Wastewater Commission (ACRWC) Regional Trunk sewer. Figure 4-1 shows the existing sanitary system and major catchment areas. The existing collection system is made up of four major catchment areas:

- The Central Trunk Catchment.
- The East Trunk catchment.
- The Meridian/North Catchment.
- The West Trunk Catchment.

The Central Trunk Sewer varies in size from 200 mm in diameter to 600 mm in diameter. The East Trunk Sewer ranges from 600 mm in diameter to 1050 mm in diameter across Highway 16A. The West Trunk Sewer, constructed in 2010, ranges from 375 mm to 900 mm in diameter.

The Central Trunk Sewer catchment is nearly fully developed, while the East Trunk Sewer has ample room for additional development and the West Trunk currently services only one new development.

There are currently four lift stations located within the Town:

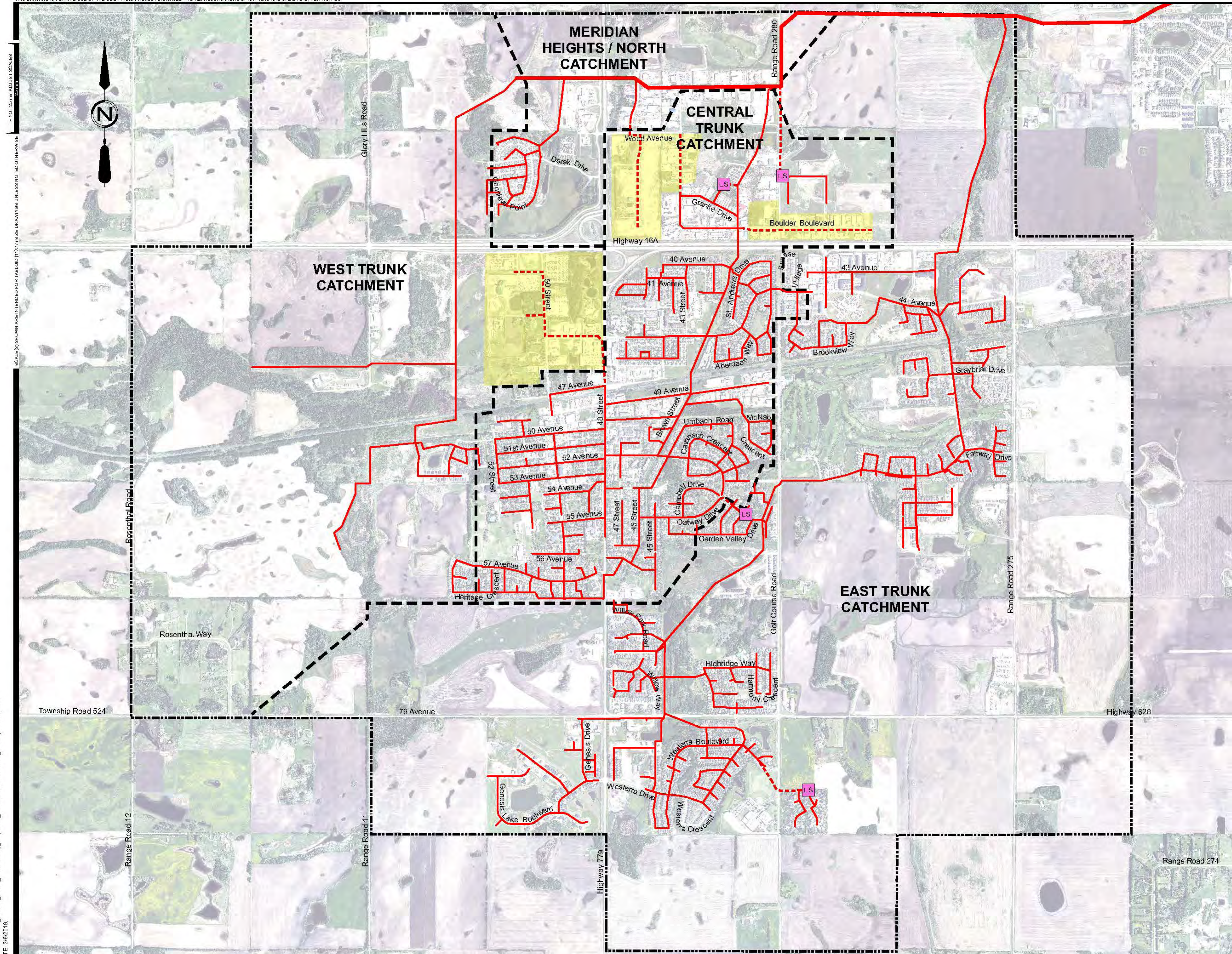
- North Business Park Lift Station;
- Southridge Lift Station;
- Country Plains Estates Lift Station; and
- Quance Lift Station.

There are four low pressure sewer systems within the Town. Low pressure sewers use a small pump station located at each property to move wastewater through the sewer system. A low pressure sewer system will not operate properly unless all pumps are the same size. The accepted design criteria for low pressure sewer systems with the Town of Stony Plain is as follows:

- Pipe Material:
  - HDPE DR 11 (Series 160).
  - Minimum pressure rating 1,100 kPa (160 psi).
- Maximum Design Pressure: 276 kPa (40 psi).
- Pumping Design Rate: 41.6 K/min (11 USGPM).
- Velocity: 0.75 m/s (2.5 fps) minimum.

One low pressure sewer system is located in the industrial area west of Meridian Heights, south of Highway 16A and west of 48 Street. It services the existing commercial/industrial area as well as the exhibition ground and discharges to the gravity system near the CN Railway and 48 Street. There are also two low pressure systems in the North Business Park and one low pressure system within the Goertz Business Park. The areas serviced by lift stations and low pressure sewers were modelled as lumped catchments contributing to the trunk sewer system.

The Town's existing sanitary trunk sewer discharges to the ACRWC trunk sewer (Regional Trunk). The Regional Trunk ranges from 600 mm to 750 mm in diameter between the west and east boundary of the Town of Stony Plain. Downstream, the Regional Trunk increases to 1050 mm in diameter near the west boundary of Spruce Grove. The Regional Trunk continues to the ACRWC Treatment Plant located northeast of Edmonton, and collects wastewater from Spruce Grove, Parkland County, Cardiff, Morinville, St. Albert, CFB Edmonton, and Sturgeon Valley. The Regional Trunk is shallow in some areas, which is a consideration for servicing in the northern portion of the Town.



Associated Engineering

Legend:

- ACRWC Trunk Sewer
- Existing Sanitary Sewer
- Existing Force Main
- Lift Station
- Low Pressure Sewer System
- Major Catchments
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. 4-1

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

EXISTING SANITARY SEWER
COLLECTION SYTEM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

IF NOT 25 mm ADJUST SCALES 25 mm

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DATE: 3/6/2019

4.1.2 Model Update

The existing model which was developed for the Wet Weather Flow Management Plan in January 2012 was updated as part of this project. This model update consisted of the following:

- Sanitary system upgrades completed since 2006.
- New sanitary systems constructed since 2006.
- New areas with flow contribution.
- Overall quality control review and correction of several pipe and manhole elevations.
- Model validation using flow and rainfall data provided by the ACRWC.

Land use and population densities for the development areas were added to the model based on the design criteria outlined in Section 2. Dry weather flow contributing areas were aggregated from the 2018 Altalis Base Plan drawing provided by the Town. Each contributing area was assigned to the closest manhole using Geographic Information System (GIS) tools.

The contributing area for inflow/infiltration (I/I) includes the dry-weather flow (DWF) catchments and road areas based on the Town roadway drawing. Road areas were assigned to manholes on each road.

4.1.2.1 Model Validation

The existing model was validated for five recorded storm events. Table 4-1 provides a summary of the rainfall characteristics for each of the five storms.

Table 4-1
Sanitary Sewer System Model Validation Events

Date	Rainfall Depth (mm)	Peak Intensity (mm/hr)	Duration (hours)	Return Period (years)
August 1, 2009	25.0	79.0	2	1:5
May 22, 2016	49.5	11.0	30	<1:2
June 25, 2016	34.5	49.0	9	1:2
July 9, 2016	37.2	110.0	23	1:2 to 1:50
May 23, 2017	25.0	8.4	10	<1:2

The ACRWC provided the flow and rainfall data for 2016 and 2017. Flow monitor and rainfall data from the 2009 flow monitoring program were used for the August 1, 2009 storm event.

The wet weather flow parameters were revised through an iterative process to achieve a better fit to recorded flow and level data. These parameters are generally consistent with those used in the ACRWC sanitary model except for catchment length where the Regional model uses greater values to represent routing and storage effects in lumped catchments. The revised parameters are summarized in Table 4-2.

Table 4-2
Sanitary Model Validation Parameters

Catchment Type	Catchment Length (m)	Catchment Slope (%)	Impervious Area Flat				RDI Model	
			Impervious (%)	Wetting Initial Losses (mm)	Storage Initial Losses (mm)	Manning's Roughness Coefficient	RDI (%)	Parameters
Residential with Weeping Tiles	$\sqrt{Area}$	10	1	0.05	0.6	0.014	5	ACRWC model values
Other			0.6				2.5	

Key model parameters are as follows:

- Catchment Length - affects the surface routing, storage effects, and the time delay between rainfall and runoff.
- Imperviousness % - the percent of the catchment area that is directly connected to the sewer system.
- RDI % - the percent of the catchment that contributes to the medium- and slower-acting components of the I/I process. Their relative contribution depends on a number of parameters outlined in **Table 4-3**. These values are generally consistent with the range of values seen in other areas in and around Edmonton.

Table 4-3
RDI Model Parameters

RDI Parameter	Value
Surface Storage (Umax)	10 mm
Root Zone Storage (Lmax)	20 mm
Overland Coefficient (CQof)	0.9
Groundwater Coefficient (Carea)	1.0
TC Overland Flow (CK)	20-hours
TC Interflow (CKif)	500 hours
TC Baseflow (BF)	2000 hours

Figures 4-2 and **4-3** provide a visual comparison of recorded and simulated wet weather flows in the Central and East Trunk for the most severe storm event that occurred during the monitoring period on July 9, 2016. **Figure 4-4** provides the same for the Capital Region Trunk in the one storm event for which there was flow data. **Appendix B** provides comparison plots for all storm events.

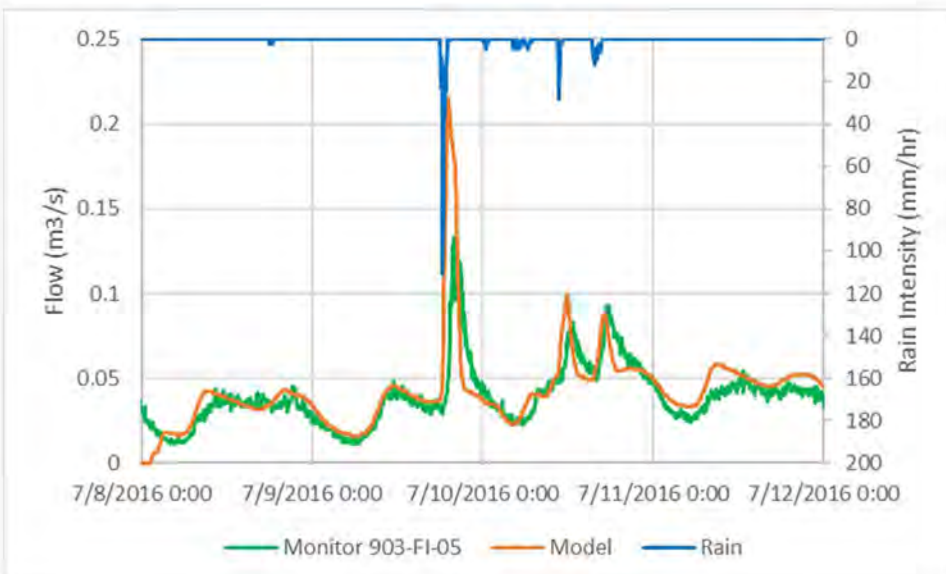

Figure 4-2
Wet Weather Flow Hydrographs for Central Trunk July 9, 2016

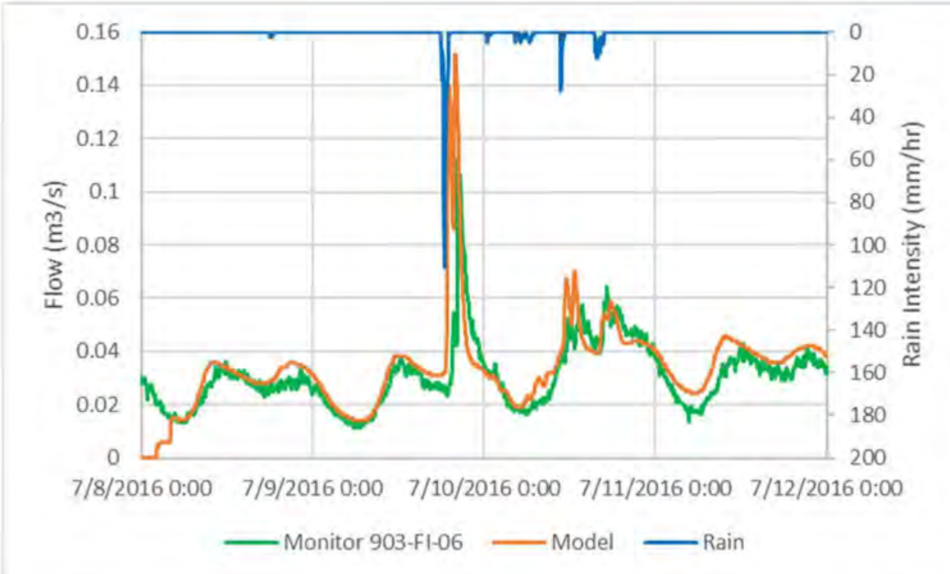

Figure 4-3
Wet Weather Flow Hydrographs for East Trunk July 9, 2016

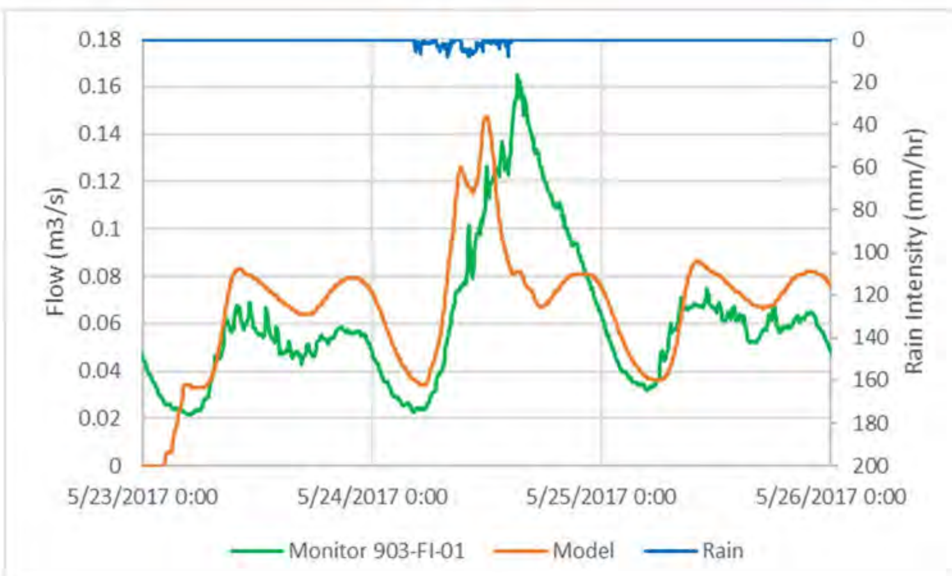

Figure 4-4
Wet Weather Flow Validation ACRWC Trunk May 23, 2017

Figures 4-5 and 4-6 compare the simulated peak flow with the monitored peak flow for all validation events for the Central and East Trunks respectively. These results confirm that the model represents the actual flows in the system reasonably well although the relatively low R^2 value of 0.58 indicates there is some room for improvement. R^2 is the Index of Determination which measures the strength of correlation between two variables, ranging from 0.0 for no relationship to 1.0 for perfect agreement.

Perfect agreement should not be expected at all locations and for all storm events due to the following factors:

- Spatial variability of rainfall.
- Potential inaccuracies in the flow data that vary with the level of quality control.
- Model approximations and limitations.

Associated Engineering recommends that monitoring be continued with a high level of quality control to provide refinement to the model calibration in future.

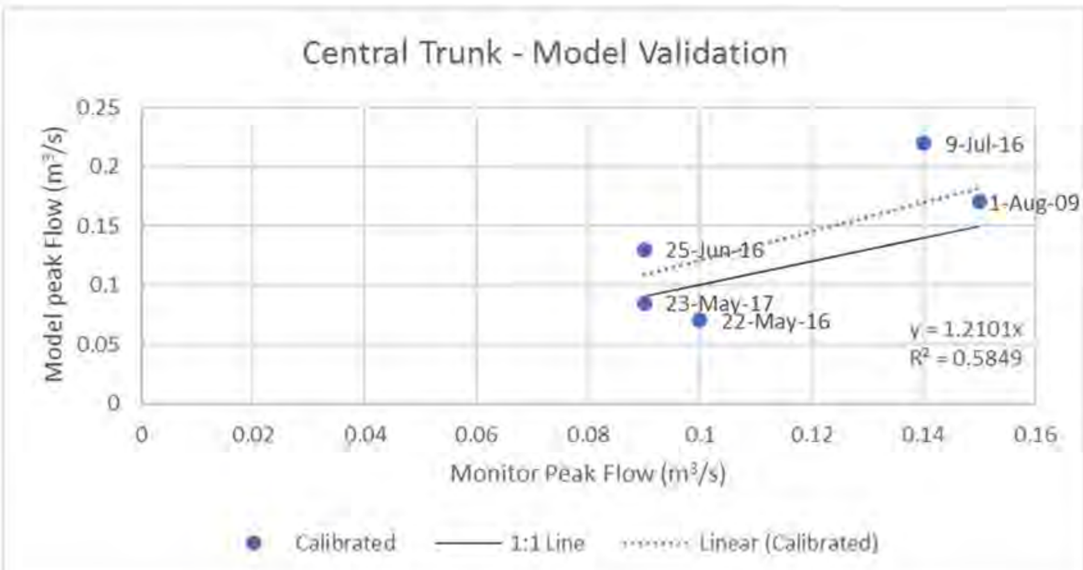

Figure 4-5
Validation Scatter Plot for Central Trunk

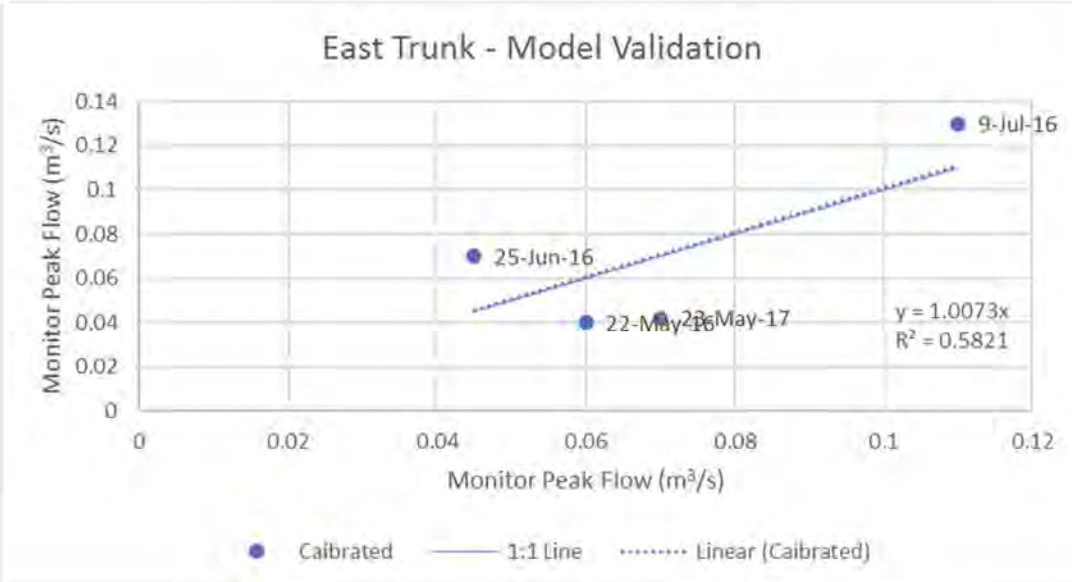

Figure 4-6
Validation Scatter Plot for East Trunk

4.1.3 Existing System Assessment

Following validation of the model, the following design storms were simulated using the 2018 EPCOR Intensity-Duration-Frequency (IDF) curves for the City of Edmonton:

- 1:5 year 4-hour;
- 1:10 year 4-hour;
- 1:25 year 4-hour (design storm);
- 1:25 year 24-hour;
- 1:100 year 4-hour; and
- 1:100 year 24-hour.

The system was modelled based on the population densities described in Section 2 and flow parameters derived during model validation.

The model results for each link were converted into theoretical loading factors (TLF) and the results for each node were converted into grade line factors (GLF) to illustrate surcharge levels. The TLF indicates the ratio of peak flow to pipefull capacity with values greater than 1.0 indicating the pipe is carrying more than its design flow. Note that pipes can be overloaded locally due to flat gradients without significantly affecting the overall performance of the system. The GLF indicates the water level in each manhole, expressed in metres below ground. Areas where the system is surcharged to within 2.0 m of ground are at risk of basement flooding.

The following is a summary of the existing system performance in the various storm events. Figures presenting the sanitary model result are included in Appendix C.

1:5 Year 4-Hour Storm Event (Figure C-1)

- The Central Trunk is at or over capacity in some locations during the 1:5 year 4-hour design storm event.
- There are a few locations where the trunk sewers are surcharged to basement level, primarily where the pipes are shallow.
- The existing Regional Trunk has spare capacity in the modelled reach to the Parkland lagoon. Note there are several shallow manholes where water levels are within 2 m of ground surface.

1:10 Year 4-Hour Storm Event (Figure C-2)

- There are increased flows within the Central Trunk during the 1:10 year 4-hour design storm event.
- The Regional Trunk has spare capacity in the modelled reach to the Parkland lagoon.

1:25 Year 4-Hour Design Storm Event (Figure C-3)

- Pipe flow is further increased within the Central Trunk during the 1:25 year 4-hour design storm event with some pipes flowing over two times capacity.
- Risk of basement flooding in the downtown area and along the Central Trunk south of Highway 16A.
- The Regional Trunk has capacity for the 1:25 year 4-hour design storm event with only a few nodes showing surcharge levels within 2 m of ground level.
- This storm is proposed for system assessment, upgrading, and expansion requirements.

1:25 Year 24-Hour Storm Event (Figure C-4)

- Peak flows and surcharge levels are lower than in the 1:25 year 4-hour duration event.
- This storm was used by the ACRWC for assessment of the Regional Trunk sewer system.
- There is capacity within both the Central and Regional Trunks during the 1:25 year 24-hour design storm event.

1:100 Year 4-Hour Storm Event (Figure C-5)

- Pipe loading is increased with the majority of the Central Trunk flowing above capacity (1.5 to 2 times) and surcharge to within basement level north of the CNR tracks.
- A portion of the Westerra neighbourhood along Westerra Boulevard shows surcharge to within basement level.
- The Regional Trunk has capacity for the 1:100 year 4-hour design storm event with some surcharging at the east Town limits.

1:100 Year 24-Hour Design Storm Event (Figure C-6)

- Similar to the 1:25 year 24-hour design storm event, the 1:100 year 24-hour design storm event has a lower intensity than a 4-hour event.
- The Central and Regional Trunks have capacity for the 1:100 year 24-hour design storm event.

The model results indicate that the Central Trunk is overloaded with surcharge to basement level in the 1:25 year 4-hour design storm downstream along Oatway Drive. A profile of the Central Trunk for the 1:25 year and 1:100 year 4-hour storm events is shown in **Figure C-7**. The East, West, and Regional Trunks have capacity for the 1:25 year and 1:100 year 4-hour storm events under existing levels of development.

4.2 UPGRADES TO EXISTING SYSTEM

4.2.1 Proposed Upgrade Plan

Several upgrades have been completed within the sanitary system according to those proposed in the 2008 Master Plan Update. These include upgrades along Highway 779, 50 Avenue, and south of The Glens neighbourhood. These upgrades have increased sewer capacity and have been included in the existing system model.

A three-staged approach was used to incorporate the remaining upgrades proposed within the 2008 Master Plan Update and 2012 Wet-Weather Flow Management Plan. The proposed upgrades were split into high, medium, and low priorities based on their relative effectiveness in reducing overall surcharge levels. Their locations are illustrated in **Figure 4-7**.

The proposed upgrades were modelled for both the 1:25 year and 1:100 year 4-hour design storm events and detailed results are presented in **Appendix C**. Results showed that all the high, medium, and low priority upgrades will be required to prevent basement flooding in the design 1:25 year storm event. **Figure C-8** shows the simulated peak flows and surcharge levels with the proposed upgrades during the 1:25 year 4-hour design storm event. **Figure C-9** shows the simulated peak flows and surcharge levels during the 1:100 year 4-hour storm event. **Figure C-10** shows the simulated hydraulic grade line profiles within the Central Trunk for the 1:25 year and 1:100 year 4-hour design storm events with the proposed upgrades completed indicating that the proposed upgrades will have capacity for the 1:100 year 4-hour storm.

It should be noted that the upgrades downstream of Highway 16A will have to be lowered from existing elevation due to the extremely shallow grades. The available ground elevation data indicates that the area immediately south of Highway 16A, near St. Andrews Street is a low area with minimal cover over the Central Trunk. It is recommended that this area be surveyed to confirm the elevations to determine if there is a basement flood risk.

There is residual risk of local basement flooding at one manhole along Highway 779 due to shallow sewer elevations after completed upgrades during the 1:25 and 1:100 year 4-hour storm events. To mitigate this risk, approximately 50 m of pipe would need to be replaced with 250 mm diameter.

There are no upgrades proposed in Lake Westerra Estates despite the risk of basement flooding during the 1:100 year 4-hour storm event. Country Plains Estates, which currently discharges northwest through an existing lift station, is proposed to discharge east by gravity with ultimate sanitary trunk development. This will reduce the flows and flood risk within Lake Westerra Estates. However, flood risk exists until this is completed. Country Plains Estates discharge is discussed further in the Future Sanitary System.

4.2.2 Storage Option

To eliminate the required replacement of the Central Trunk, a storage alternative was investigated. The location of storage was identified within the Brown Street Playground park (Brown Street and 50A Avenue). The location of the proposed storage tank is presented in Figure 4-8. Storage was modelled with a weir installed at the crown elevation of the Central Trunk directing flows into a 3 m deep tank with a footprint of 15 m x 15 m. Flows would be stored during rain events and pumped out after the storm's end.

This storage option was simulated for the 1:25 year and 1:100 year 4-hour design storm events with the proposed storage tank and upstream upgrades completed. The simulated storage volume required was approximately 90 m^3 in the 1:25 year 4-hour storm and 400 m^3 in the 1:100 year 4-hour storm. Results are included in Appendix C.

Figure C-11 shows the simulated hydraulic grade lines within the Central Trunk for both storm events. The HGL is lower than the existing profile in Figure C-7 but still above the crown of pipe. In addition, the HGL rises above rim elevation at two locations of low elevation during the 1:100 year 4-hour storm. Therefore, the storage option does not provide a 1:100 year level of service.

Figure C-12 shows the simulated surcharge and pipe loading conditions for the 1:25 year 4-hour storm event with the storage tank and upstream upgrades. Figure C-13 shows the surcharge and pipe loading conditions for the 1:100 year 4-hour storm. These maps show that the storage option would reduce the risk of basement flooding south of Highway 16A but would have limited effect north of Highway 16A.

Overall, the storage option is effective in reducing the HGL along the Town's Central Trunk within the residential area south of Highway 16A. The HGL north of Highway 16A and the Regional Trunk is not significantly changed from existing conditions. An additional tank could be required downstream in order to lower the HGL within the industrial area north of the highway. Local upgrades are still required upstream of the storage tank as proposed in the upgrade plan.

While this option could potentially eliminate the need for Central Trunk upgrading, the odour and operational maintenance of a storage tank for peak sanitary flows needs to be considered. Other disadvantages may include additional costs of construction and standby power, as well as public perception of the tank. In addition, this option does not provide total protection against sanitary surcharge and is more sensitive to model assumptions and uncertainties than is the pipe upgrade option.

There are no upgrades proposed in Lake Westerra Estates despite the risk of basement flooding during the 1:100 year 4-hour storm event. Country Plains Estates, which currently discharges northwest through an

existing lift station, is proposed to discharge east by gravity with ultimate sanitary trunk development. This will reduce the flows and flood risk within Lake Westerra Estates. However, flood risk exists until this is completed. Country Plains Estates discharge is discussed further in the Future Sanitary System.

4.2.3 Super Pipe Option

An additional option to eliminate the required replacement of the Central Trunk was investigated. This consisted of the installation of approximately 500 m of 1500 mm diameter concrete "Super" storage pipe between 52 Avenue/Oatway Drive and 49 Avenue presented in **Figure 4-9**. Flows would be allowed to back up during rain events and would be controlled with a 250 mm diameter orifice at the downstream end.

The "Super Pipe" option was simulated for the 1:25 year and 1:100 year 4-hour design storm events. The proposed concrete pipe creates approximately 900 m^3 of available storage capacity within the system. Upstream local upgrades would still be required at 52 Avenue/Oatway Drive and 55 Avenue. Results are included in **Appendix C**.

Figure B-14 shows the simulated hydraulic grade lines within the Central Trunk for both storm events. The HGL is below the crown of pipe during both storm events.

Figure C-15 shows the simulated surcharge and pipe loading conditions for the 1:100 year 4-hour storm event with the "Super Pipe" and upstream upgrades. These maps show that the "Super Pipe" option would reduce the risk of basement flooding south of Highway 16A.

Overall, the "Super Pipe" option provides more effective storage and reduction of flows within the Central Trunk when compared with the storage option. This option would also result in less odour issues and maintenance requirements due to constant dry weather flows through the system. This is a robust solution to the existing capacity issue within the Central Trunk.

There are no upgrades proposed in Lake Westerra Estates despite the risk of basement flooding during the 1:100 year 4-hour storm event. Country Plains Estates, which currently discharges northwest through an existing lift station, is proposed to discharge east by gravity with ultimate sanitary trunk development. This will reduce the flows and flood risk within Lake Westerra Estates. However, flood risk exists until this is completed. Country Plains Estates discharge is discussed further in the Future Sanitary System.

4.3 FUTURE SANITARY SYSTEM

The future sanitary system concept is presented in 4 phases; Stages 1 through 3 as well as Ultimate development. The proposed sanitary system concept options with Ultimate Development are presented in **Figures 4-10** to **4-12**. The proposed gravity sewers were designed to provide capacity for ultimate development in a 1:100 year 4-hour storm event. This is an increased level of service and subsequently has resulted in larger pipe diameters in the southeast area of the Town than previously proposed in the 2008 Master Plan Update and currently being designed for.

A residential population density of 47 people/ha has been used as discussed above for residential areas proposed in Stages 1 through 3 as well as Ultimate development lands to provide conservative flows.

Only major sanitary sewer mains (300 mm and above) have been identified in the expansion areas. The Stony Plain Transportation Study (Associated Engineering, 2010) and the Sanitary Collection System Master Plan Update (Associated Engineering, 2008) were reviewed. Area Structure Plans (ASPs) were also reviewed and are reflected in the future sanitary concept where appropriate. There were instances were more recent development in adjacent neighbourhoods suggests that revisions may be likely within some ASP locations.

The ultimate sanitary system was modelled for the 1:100 year 4-hour design storm event. The Central Trunk was modelled with the proposed upgrade plan completed. No future development was connected to the Central Trunk. As discussed above, flows from the Country Plains Estates subdivision were directed east based on information included in the ASP and record drawings. The existing lift station is proposed to be abandoned and subdivision flows directed by gravity to the east when ultimate development facilitates it. This will eliminate the risk of basement flooding within the Lake Westerra Estates subdivision shown in existing system results.

The ACRWC plans to upgrade the Regional Trunk from Atim Creek (east Town of Stony Plain boundary) to the future diversion chamber of the Spruce Grove Lagoon starting in 2021. The ACRWC provided the conceptual trunk sizing for the proposed upgrades and Associated Engineering modelled the proposed upgrades with the ultimate development of Stony Plain.

Figure C-16 included in **Appendix C**, shows the simulated surcharge and pipe loading conditions for the 1:100 year 4-hour design storm event with the Regional Trunk upgrades completed. Results show that with ultimate Town development, the West and East Trunks will be at capacity during the 1:100 year 4-hour design storm event. The existing Regional Trunk within Stony Plain will be overloaded and will back up into the downstream end of both the West and East Trunks. This is consistent with results provided by the ACRWC.

A model with proposed upgrade twinning of the Regional Trunk within Stony Plain was simulated for the 1:100 year 4-hour storm events. These upgrades would be required to provide capacity for ultimate development flows but would not be required until after Stage 3 development is complete. It is recommended that the Town of Stony Plain be involved with reviewing the ACRWC design.

A Manhole Numbering Plan of the proposed Ultimate Sanitary System is enclosed in **Appendix A**.

4.4 WET WEATHER FLOW MANAGEMENT

The Town sealed 125 low-lying manhole lids in 2008. This involved plugging three out of the four vent holes to reduce the I/I from ponding on the street surface during a major storm event. This program involved about 12% of the manholes in Stony Plain. It was recognized at the time that the I/I reductions that could be achieved would be relatively modest but relatively easy to achieve.

Comparing the 2006 storm events with those which occurred in 2009 suggested that I/I rates may have been reduced slightly by the manhole sealing program. However, the change was inconsistent compared with the natural variability of I/I rates between storm events. Further reductions may be possible, especially in larger storm events, by sealing more of the manhole lids.

A "fillsinks" analysis for the existing sanitary system is included in **Appendix D**. This shows the sanitary manholes located in street sags and susceptible to inflow if manhole vent holes are not plugged. The results of the analysis indicated that this may occur along the Central Trunk, as well as in the Brickyard neighbourhood on the west side of Town. In addition, there are some localized sags located within the St. Andrews, Forest Green, and Meridian Heights neighbourhoods.

Flow and rainfall data show that flow rates increase in the Town during rain storms at monitoring sites provided by the ACRWC. This confirms that stormwater I/I is still entering into the sanitary sewer system. Typically, I/I from residential areas is much higher than in commercial areas due to lot grading, weeping tile connections, and downspout drainage into house weeping tiles which were typical of servicing prior to the year 2000.

The potential limitations of permitted discharge flow to the ACRWC Trunk in the future should be considered during detailed design of any upgrades and future systems. The peak allowable outflow for the year 2010, as stated in the Alberta Capital Region Wastewater Commission Level of Service Study Phase 3 (UMA, 2006) was 0.34 m^3/s, (corresponding to an allowable I/I rate of 0.28 L/s/ha) and the recommended level of service applied to a 1:25 year storm event. However, based on conversations with the ACRWC, we understand that the threshold of 0.28 L/s/ha will no longer be considered an allowance. It is only part of the design criteria that the ACRWC will be using to develop a plan to manage or eliminate wet weather flows with their member municipalities. The Town should continue to manage I/I rates as development progresses and infrastructure ages.

This report used a 1:100 year 4-hour level of service for conceptual design of proposed upgrades and sizing the facilities required for future system expansion. However, the 1:25 year 24-hour design storm event was simulated for the existing system. In this simulation, an I/I contribution between 0.22 and 0.26 L/s/ha was estimated for the East Trunk and Central Trunk, respectively. Localized I/I may be greater than these values but, in general, this contribution is within the previously allowable I/I rate of 0.28 L/s/ha.

The Wet Weather Flow Management Plan (2012) recommended that the Town continue its program of manhole sealing to reduce the I/I, with a goal of sealing three-quarters of the sanitary manhole lids. Additionally, a wet weather flow management strategy should include the following:

- Disconnection of residential weeping tiles from the sanitary sewer
- Development of CCTV inspection program to assess the existing sewer conditions and repair where significant I/I may be entering through cracks/joints
- Gather rainfall and flow data to assess reduction of I/I, if any

- Install new sanitary sewers with watertight connections from acceptable materials according to the Town's Municipal Development Standards
- Install new sanitary manholes with F-90 frame and cover with gasket seal

Based on the ACRWC Wet Weather Flow Management Strategy Regulatory Framework – Phase 1, the Town is required to undertake an assessment of their sanitary systems at least once every ten years to identify and characterize I/I sources. The first assessment report must be submitted to the ACRWC by December 31, 2019. In order to complete this assessment, the Town should plan to install flow monitors at strategic locations to pinpoint sources of I/I. Recommended monitoring locations are illustrated in Figure 4-13 and follow the monitor programs completed in 2006 and 2009. The reasons for this are two-fold:

1. Monitoring in the same locations as previously provides data that is easily comparable between years. This will provide evidence for the effectiveness of I/I reduction.
2. The 2006 and 2009 programs focused on existing residential areas with weeping tile connections. Further monitoring at these locations can confirm the magnitude of weeping tile flows.

Additional monitor locations may be considered during monitoring program planning. Catchments should also be mapped based on I/I contributions so that detailed problematic areas may be identified and mitigated with future strategies.

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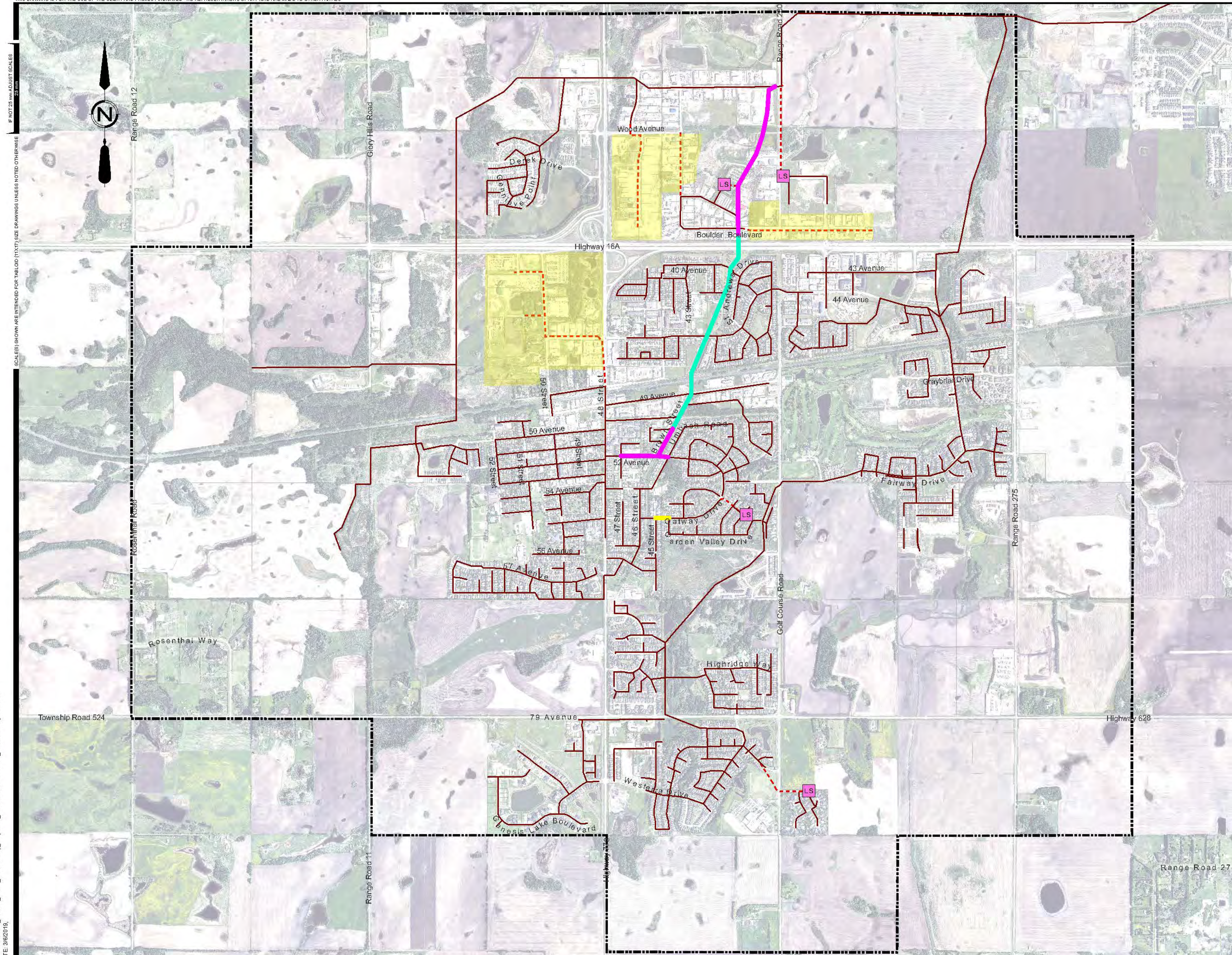

IF NOT 25 mm ADJUST SCALES 25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Associated Engineering

Legend:
- High Priority Upgrade
- Medium Priority Upgrade
- Low Priority Upgrade
- Existing Sanitary Sewer
- Forcemain
- LS Lift Station
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. 4.7

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

PROPOSED SANITARY UPGRADES

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

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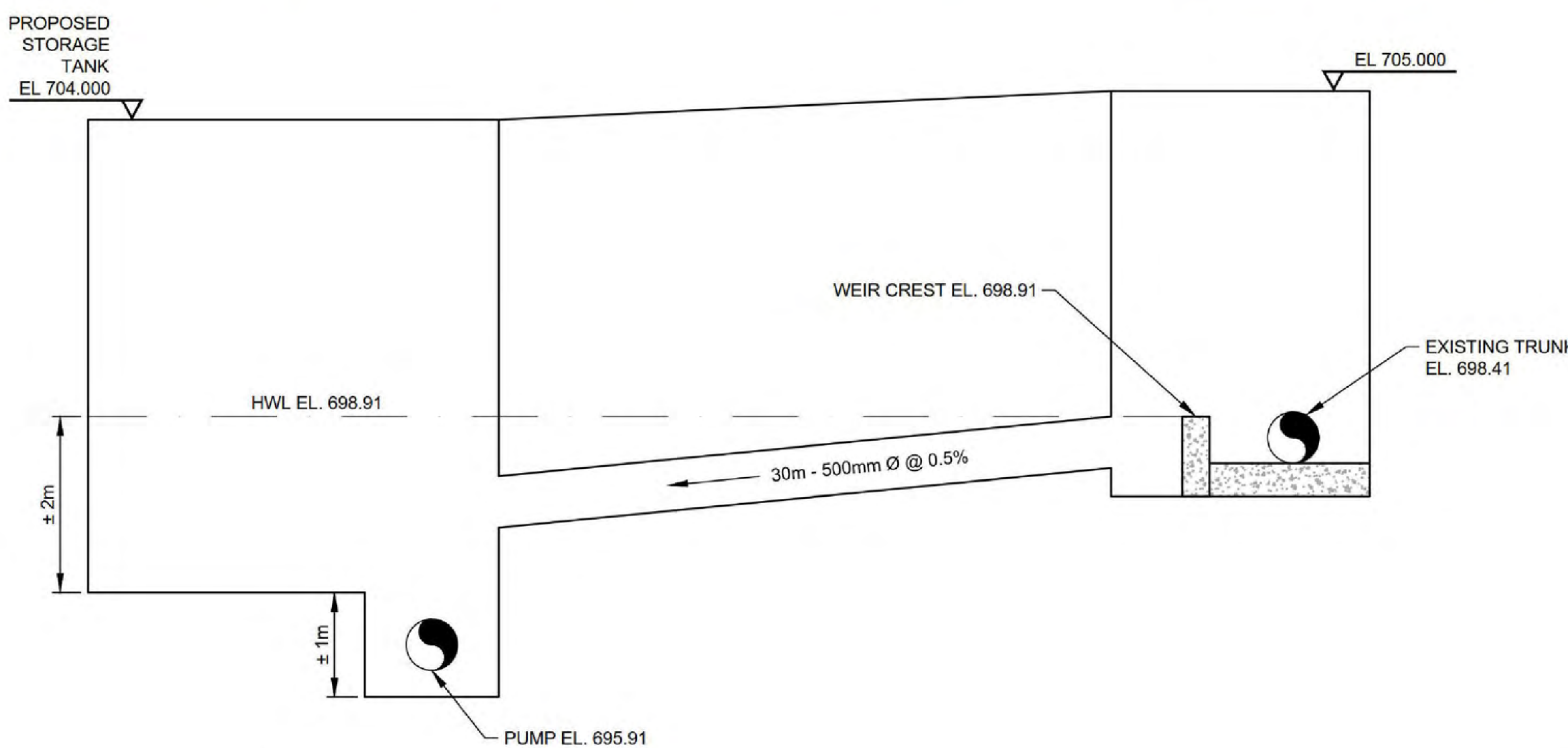
DATE: 3/6/2019.

Associated Engineering

Legend:

- Existing Sanitary Manhole
- Existing Sanitary Pipe
- Proposed Sanitary Pipe
- Proposed Storage Tank



TOWN OF STONY PLAIN

FIGURE No. 4-8

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

PROPOSED STORAGE TANK LOCATION

AE PROJECT No.	2018-3146
SCALE	NTS
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2018 AUGUST
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

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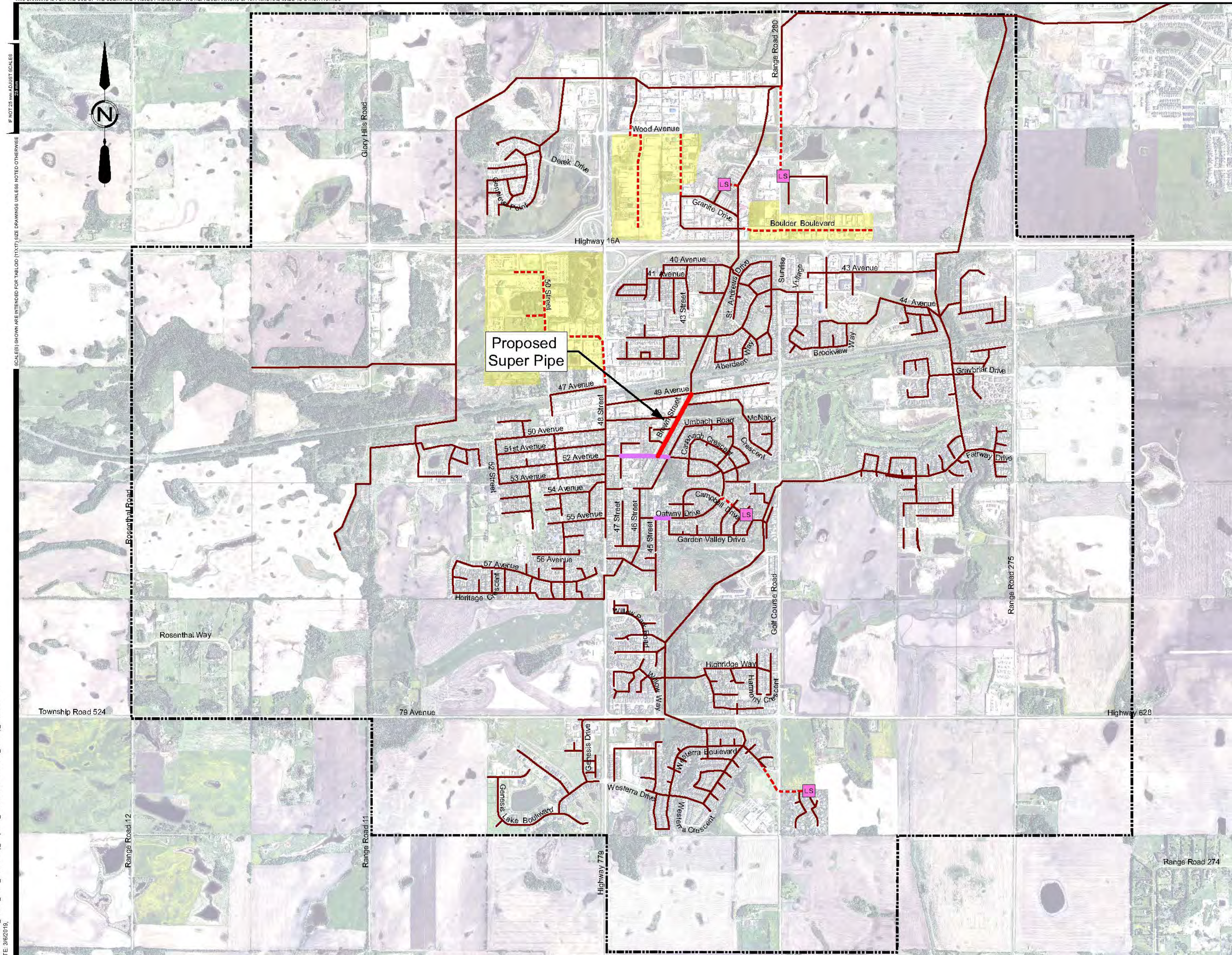

Associated Engineering

Legend:

- Proposed Upgrades
- Proposed Super Pipe
- Existing Sanitary Sewer
- Forcemain
- LS Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. 4-9

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

PROPOSED SUPER PIPE OPTION

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE
IF NOT 25 mm ADJUST SCALES 25 mm

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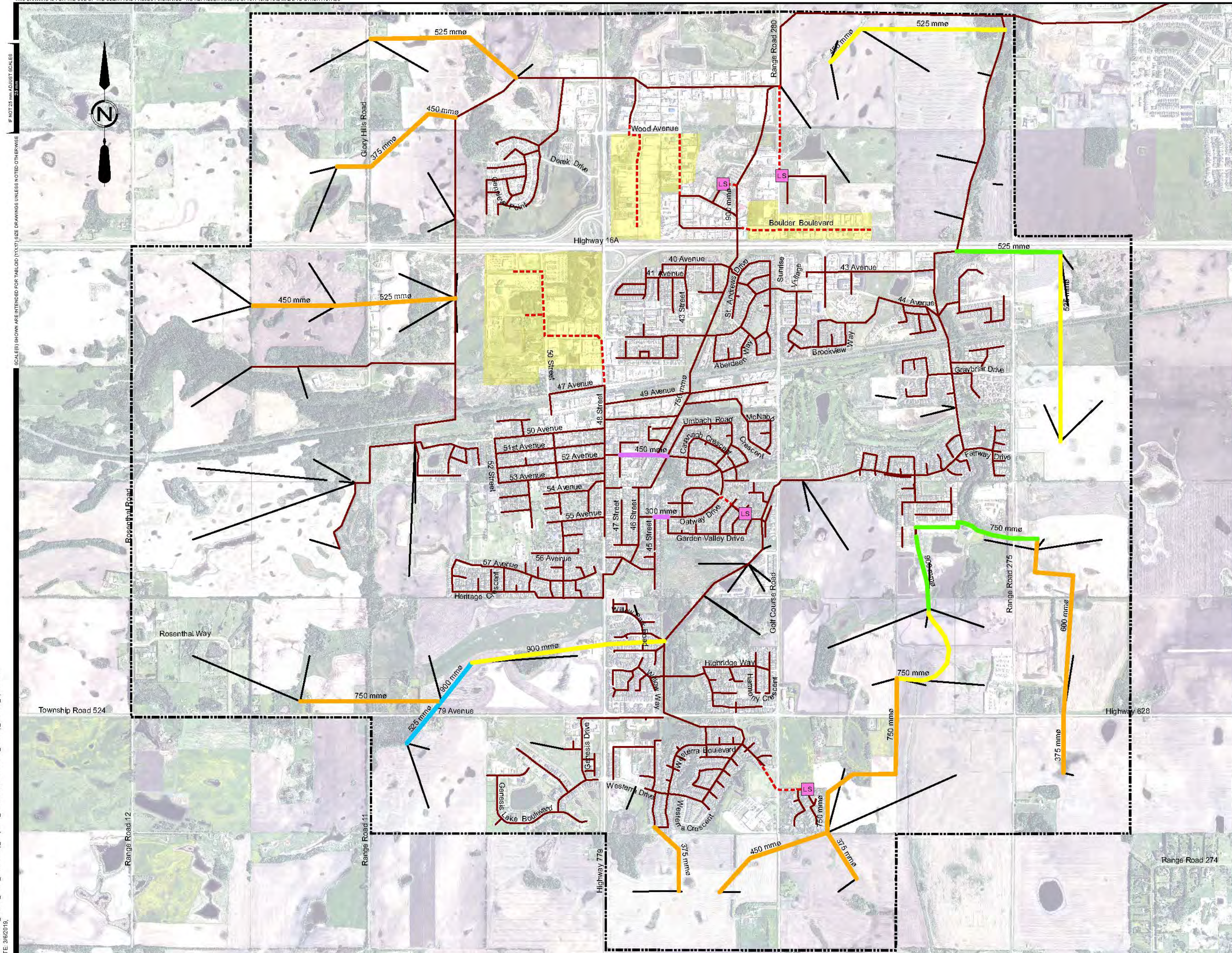
DATE: 3/6/2019.



Associated Engineering

Legend:

- Stage 1
- Stage 2
- Stage 3
- Ultimate
- Catchment Connection
- Existing Sanitary Sewer
- Forcemain
- LS Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. 4-10

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

ULTIMATE SANITARY NETWORK WITH CENTRAL TRUNK UPGRADES

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

IF NOT 25 mm ADJUST SCALES 25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

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DATE: 3/6/2019.

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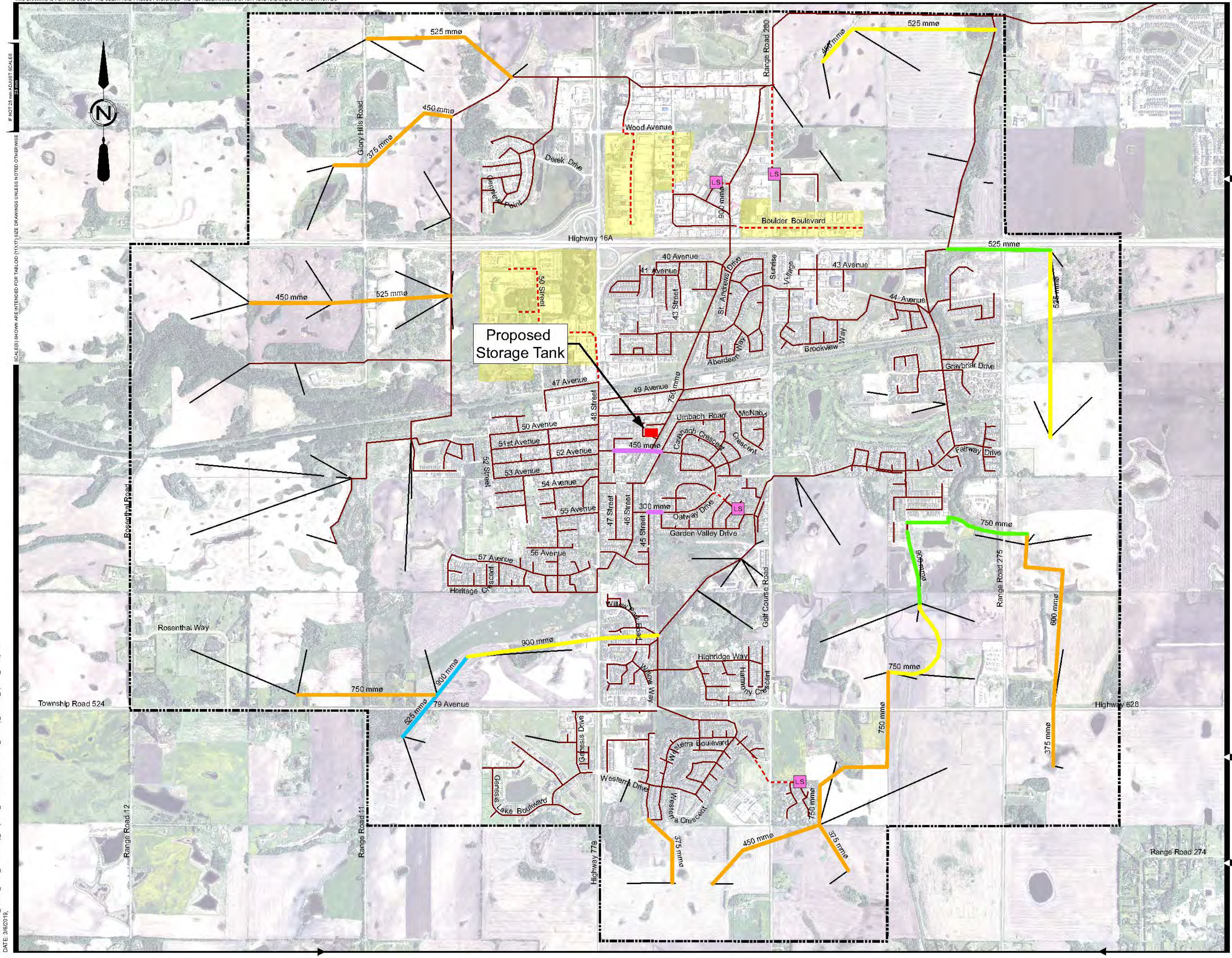

Legend:

- Stage 1
- Stage 2
- Stage 3
- Ultimate
- Proposed Upgrades
- Catchment Connection
- Existing Sanitary Sewer
- Forcemain
- Proposed Storage Tank
- LS Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

Associated Engineering

TOWN OF STONY PLAIN

FIGURE No. 4-11

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

ULTIMATE SANITARY NETWORK WITH STORAGE OPTION

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

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DATE: 3/6/2019

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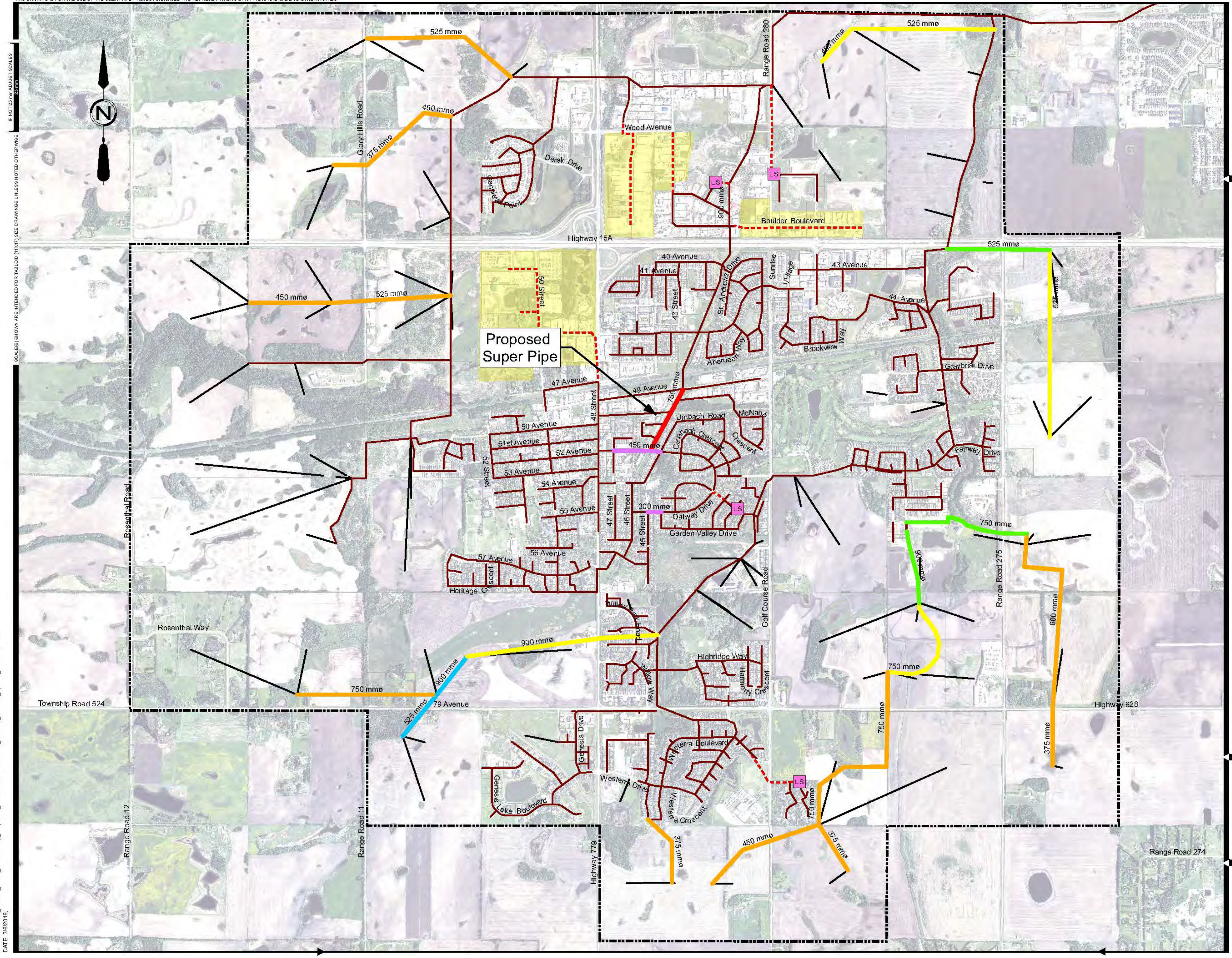

Legend:

- Stage 1
- Stage 2
- Stage 3
- Ultimate
- Proposed Upgrades
- Proposed Super Pipe
- Catchment Connection
- Existing Sanitary Sewer
- Forcemain
- LS Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

Associated Engineering

FIGURE No. 4-12

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

ULTIMATE SANITARY NETWORK WITH PROPOSED SUPER PIPE OPTION

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

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DATE: 3/6/2019,

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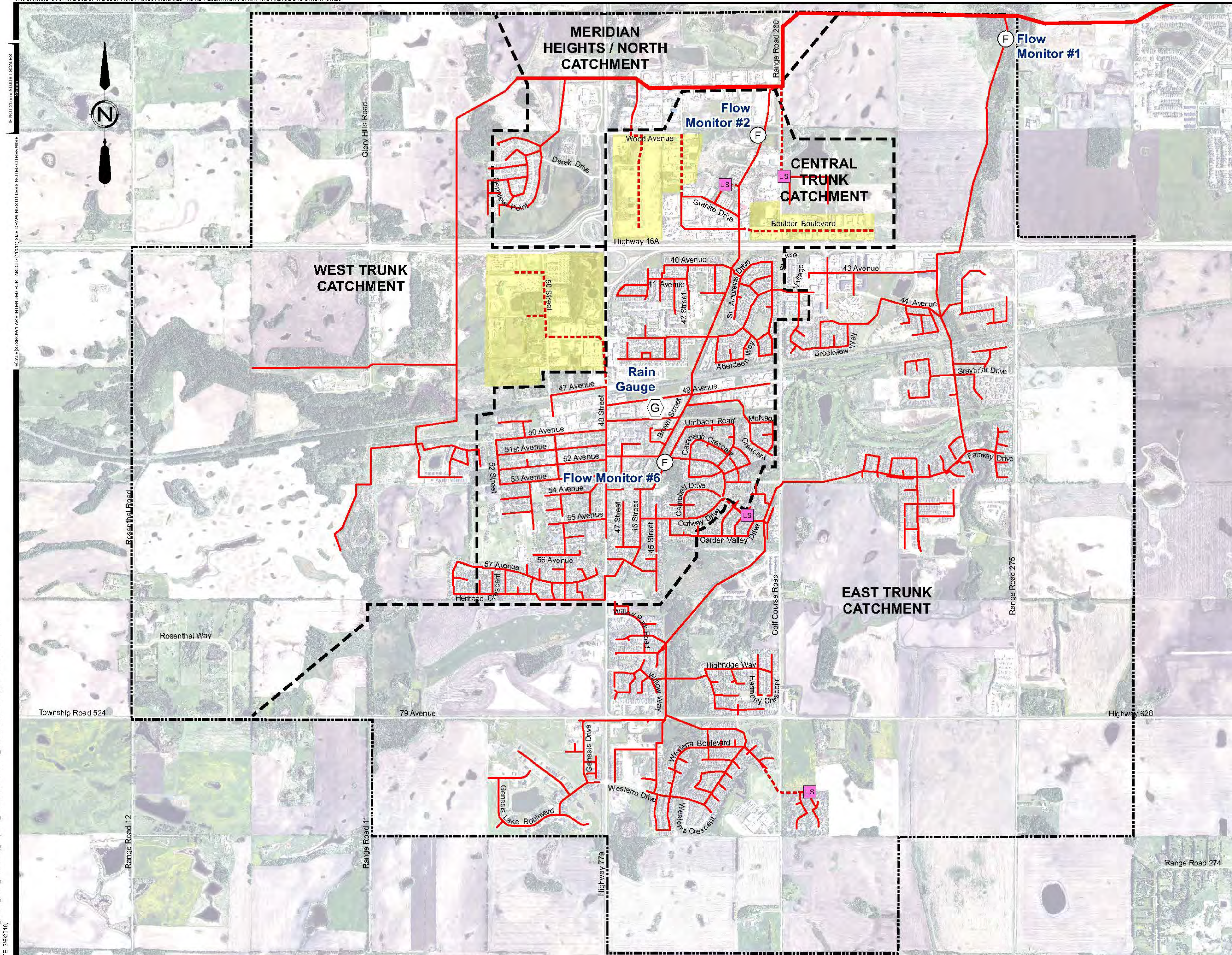

Associated Engineering

TOWN OF STONY PLAIN

FIGURE No. 4-13

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

RECOMMENDED SANITARY FLOW MONITOR LOCATIONS

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

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DATE: 3/6/2019;

5 Cost Estimates

5.1 CAPITAL COST ESTIMATES

5.1.1 Water System

A summary of capital cost estimates is provided in **Table 5-1** below for upgrades which are recommended for the existing water system, as well as for Stage 1, Stage 2, Stage 3 and the Ultimate development scenario. The estimates presented include an allowance for engineering (15%) and contingency (15%), but do not include GST. The costs are based on 2018 construction dollars. Unit costs and detailed estimates are provided in **Appendix E**.

For future development scenarios, costs are presented for watermains which are not anticipated to be covered by developers. These include offsite watermains and those over 300 mm in diameter. Costs for watermains over 300 mm in diameter are anticipated to be recovered through development charges.

Table 5-1
Summary of Capital Cost Estimates – Water System

Upgrades to Existing System	
Watermains	$10,315,000
Hydrants	$444,000
New Distribution Pump at Meridian Heights Pumphouse	$150,000
TOTAL UPGRADES TO EXISTING SYSTEM	**$10,909,000**
Stage 1	
Watermains	$630,000
New Fire/Standby Pump at Meridian Heights Pumphouse	$250,000
TOTAL STAGE 1	**$880,000**
Stage 2	
Watermains	$320,000
Storage Expansion at High Park Reservoir	$4,500,000
TOTAL STAGE 2	**$4,820,000**
Stage 3	
Watermains	$6,316,000
West Reservoir and Pumphouse	$15,000,000
TOTAL STAGE 3	**$21,316,000**

Ultimate Development Scenario	
Watermains	$10,880,000
East Reservoir and Pumphouse	$15,000,000
TOTAL ULTIMATE DEVELOPMENT SCENARIO	**$25,880,000**

5.1.2 Sanitary System

A summary of capital cost estimates is provided in Table 5-2 below for upgrades which are recommended for the existing sanitary system, as well as for Stage 1, Stage 2, Stage 3 and the Ultimate development scenario. The estimates presented include an allowance for engineering (15%) and contingency (15%), but do not include GST. The costs are based on 2018 construction dollars. Unit costs and detailed estimates are provided in Appendix E.

For future development scenarios, costs are presented for sanitary sewers which are not anticipated to be covered by developers. These include offsite sewers and those 375 mm and greater in diameter.

Table 5-2
Summary of Capital Cost Estimates – Sanitary System

Upgrades to Existing System including Central Trunk (CT)	
Sanitary Sewer and Manholes	$7,952,000
TOTAL UPGRADES TO EXISTING SYSTEM	**$7,952,000**
Upgrades to Existing System with CT Storage Option	
Sanitary Sewer and Manholes	$848,200
Storage Tank and Pump	$1,162,700
TOTAL STORAGE OPTION	**$2,011,000**
Upgrades to Existing System with CT Super Pipe Option	
Sanitary Sewer and Manholes	$848,200
Super Pipe and Orifice	$2,364,300
TOTAL SUPER PIPE OPTION	**$3,213,000**
Stage 1	
Sanitary Sewer and Manholes	$2,607,000
TOTAL STAGE 1	**$2,607,000**
Stage 2	
Sanitary Sewer and Manholes	$6,194,000
TOTAL STAGE 2	**$6,194,000**
Stage 3	

Sanitary Sewer and Manholes	$974,000
TOTAL STAGE 3	**$974,000**
Ultimate Development Scenario	
Sanitary Sewer and Manholes	$11,055,000
TOTAL ULTIMATE DEVELOPMENT SCENARIO	**$11,055,000**

A life-cycle cost assessment was completed for the Upgrades to Existing System with CT Storage Option to determine whether the lower capital cost would be indicative of future maintenance costs. Annual costs would include $2,000 for operation and maintenance (i.e. cleaning out storage tank and flushing return pipes). In addition, it is anticipated pumps would be replaced every 15 years incurring a cost of approximately $20,000. An annual rate of inflation of 3% was assumed. Based on this, the storage option is estimated to cost an additional $480,000 over the next 50 years. This would not include any rehabilitation required on the storage tank itself.

5.2 FUNDING OPTIONS

The capital cost components for recommended upgrades may be eligible for Federal and Provincial grant funding programs resulting in lower residual cost to the Town and their residents. The most relevant programs are highlighted below:

5.2.1 Federal Funding

Gas Tax Fund: The Gas Tax Fund allocates funds to each community within Alberta on a per capita basis. The Gas Tax Funds are designed to support environmentally sustainable municipal infrastructure including water and wastewater infrastructure projects, therefore, upgrades to the water and wastewater systems will be eligible for allocated funds under this program.

New Building Canada Fund – Provincial-Territorial Infrastructure Component – Small Communities Fund (PTIC-SCF): The New Building Canada Fund – Provincial-Territorial Infrastructure Component provides funding support for projects with significance on the local, regional or national level. The Small Communities Fund provides funding for projects benefiting municipalities with populations < 100,000. Most projects will be cost shared on a ⅓ basis, in the provinces. This excludes provincial highways, major roads and public transportation, which will receive up to 50% funding, and for profit private sector projects, which will receive up to 25% funding. There are several eligible project categories under PTIC-SCF.

Clean Water and Wastewater Fund (CWWF): The Clean Water and Wastewater Fund provides joint funding from the Federal and Provincial Governments to fund projects involving the rehabilitation of water treatment/distribution systems, wastewater and storm systems, initiatives to improve asset management, system optimization as well as projects involving planning for future upgrades to water and wastewater systems. The deadline for submission has recently passed, however, it is understood that the Provincial and Federal Governments are negotiating an extension. This program provides up to 50% funding.

5.2.2 Provincial Funding

Alberta Municipal Water/Wastewater Program (AMWP): The program funds water supply and treatment and wastewater treatment projects within the Province of Alberta. The program provides up to 75% funding for populations less than 45,000, for the eligible components.

Municipal Sustainability Initiative: The Municipal Sustainability Initiative funds infrastructure projects that enhance the long-term sustainability of a municipality. The funding is based upon the following formula:

- 48% based on per capita;
- 48% based on education property tax requisition; and
- 4% based on kilometres of road.

Of the above federal and provincial funding options, we anticipate that the following could be applied:

- PTIC-SCF funding of 33%;
- AMWP funding of 75%; and/or
- CWWF funding of 50% (it is not clear, at this time, if the program will be extended).

The Municipality Sustainability Initiative and the Gas Tax Fund may not be as likely to be applied as the County may have already allocated those funds to other projects.

5.2.3 Municipal Funding

There are several options that the Town can use to either fund a project or recover costs from residents to fund a project. These options are presented below. The Town may wish to proceed with a Funding Analysis, to further define the actual anticipated costs.

5.2.3.1 Capital Reserve

A capital reserve account is generated through government subsidies, donated funds, or can be set aside from the municipalities regular revenue-generating operations. The account is reserved for long-term capital investment projects or any other large and anticipated expense(s) that will be incurred in the future. The capital reserve will be used to fund the municipalities portion of the projects(s).

Cost Recovery Options

The municipal cost recovery alternatives vary dependent on whether the infrastructure benefits the entire community such as water treatment and supply, or if the infrastructure is a local improvement. The alternatives are presented below.

5.2.3.2 Off-site Infrastructure

Off-site infrastructure is infrastructure, which benefits either a large percentage of the community or the whole community. For this project, off-site infrastructure may include Reservoirs and Pumphouses. The following options are available to fund Off-site Infrastructure:

Offsite Levies: Under authority of the Municipal Government Act, the municipality is permitted to impose offsite levies against new developments to cover the costs of new or expanded facilities. The offsite levies can be recovered by a developer at the time of development.

The Water and Sanitary Master Plan's focus is to provide an improved level of service to the existing residents, with an allowance for moderate growth. Cost recovery through offsite levies may not be an effective method of cost recovery in this case, if most of the capacity is required to service the existing population.

Property Tax: The cost or percentage of the cost, to construct the offsite infrastructure can be recovered through property taxes. The offsite infrastructure benefits the community as a whole; therefore, the costs would be shared equally though the community through annual property tax payments.

Utility Rates: The cost or percentage of the cost, to construct the offsite infrastructure can be recovered through utility rates. The offsite infrastructure benefits the community as a whole; therefore, the costs to construct, maintain and operate the infrastructure could be recovered through utility rates, which would be borne by the end user.

5.2.3.3 Local Infrastructure

Local infrastructure includes infrastructure, which benefits an area of the municipality rather than the municipality, as a whole. Upgrades to the local water distribution system and sewage collection system, up to private property, would be considered local infrastructure. The local infrastructure will be recovered under a Local Improvement Tax.

Local Improvement Tax: A local improvement tax (LIT) is collected from area of the community benefiting from the improved infrastructure. The LIT can be based on; each parcel of land, each unit of frontage, or each unit of area and will be paid back over a predetermined period. The LIT will appear on the landowners' property tax assessment, but can be paid at any time.

6 Conclusions

6.1 WATER SYSTEM

- Nearly all pressures fall within the recommended range of 350 to 550 kPa (50 to 80 psi).
- The majority of locations satisfy the Peak Day plus Fire Flow criteria.
- Although there is sufficient fire pumping capacity (in theory), there are distribution system constraints to fully access the fire flow capacity from the High Park Pumphouse.
- There is no surplus pumping capacity in 2018 after meeting the peak hour plus truckfill demands and retaining approximately 50% backup pumping.
- The recommended storage for 2018 is 14,329 m^3 (including truckfill) resulting in a storage surplus of 4,829 m^3.
- The truckfill station's water demands are a significant portion of the existing system demands (45 L/s – assumed out of a total average day demand of 104.1 L/s).
- The majority of the Town has adequate fire hydrant coverage.

6.2 SANITARY SYSTEM

- The model has been validated and I/I parameters have been revised to be consistent with those used in the ACRWC sanitary model as well as to provide a better fit to the flow monitor data provided by the ACRWC.
- The calibrated model simulates the recorded flows reasonably well but is limited by the amount of data presently available.
- The Central Trunk currently provides less than a 1:25 year 4-hour design event level of service.
- Upgrading the Central Trunk will reduce the risk of basement flooding and loading of the sanitary network. It would provide a 1:100 year 4-hour design storm service level.
- Flow control with an underground tank within the Brown Street Playground park (Brown Street and 50A Avenue) could also be used to control surcharge levels in the Central Trunk. Preliminary storage volume estimates are 90 m^3 in the 1:25 year 4-hour storm and 400 m^3 in the 1:100 year 4-hour storm. This option would forego the planned upgrading of the Central Trunk but could meet with concerns regarding odours, operational issues, and limited performance in more severe storm events. It would have minimal benefit to the Capital Region Trunk and to the Central Trunk north of Highway 16A.
- An alternative to an underground storage tank or Central Trunk upgrades would be the construction of a 1500 mm diameter concrete "Super Pipe" between 52 Avenue/Oatway Drive and 49 Avenue. Results showed reduced risk of basement flooding along the Central Trunk. This option provides more effective storage and reduction of flows when compared to the storage option and would also result in less odour issues and maintenance requirements.
- The West and East Trunks are at capacity with ultimate peak wet weather flows for the 1:25 year 4-hour design storm.
- The Regional Trunk is undersized for ultimate flows and will need to be upgraded as proposed by the ACRWC.

6.2.1 Wet Weather Flow Management

- The Town sealed 125 low-lying manhole lids in 2008 which slightly reduced I/I rates between 2006 and 2009.
- A "fillsinks" analysis for the existing sanitary system showed ponding locations along the Central Trunk and within the Brickyard, St. Andrews, Forest Green, and Meridian Heights neighbourhoods which would be susceptible to inflow if manhole vent holes are not plugged.
- I/I contribution during the 1:25 year 24-4hour design storm event was estimated between 0.22 and 0.26 L/s/ha for the East Trunk and Central Trunk, respectively.
- The Town is required to undertake an assessment of their sanitary systems at least once every ten years to identify and characterize I/I sources. The first assessment report must be submitted to the ACRWC by December 31, 2019.

7 Recommendations

7.1 WATER SYSTEM

- Install additional hydrants as per Figure 3-3.
- Proceed with the watermain upgrading recommendations shown on Figure 3-4.
- Install a third distribution pump at Meridian the Meridian Heights pumphouse.
- Monitor pressures to determine if it would be beneficial to revise the operating philosophy to an overnight period of 8 pm to 6 am and a daytime period of 6 am to 8 pm.
- Plan for proposed staged expansion of the water system as presented in Figures 3-5 through 3-8.
- Investigate and confirm the watermain sizes in the vicinity of the Meridian Heights Reservoir and Pumphouse as identified on Figure 3-1.

7.2 SANITARY SYSTEM

- Further monitoring is required to meet the requirements of the ACRWC's Wet Weather Flow Management Strategy.
- It is recommended that the master plan be reviewed in 5 to 10 years or when sufficient monitoring data is available.
- Prior to completing upgrades, the Town should CCTV the Central Trunk to assess its condition. If the Central Trunk is found to be in poor condition, it is recommended that upgrades are completed along the entire trunk following the proposed upgrade plan. If the Central Trunk is found to be in good condition, it is recommended that the "Super Pipe" option be implemented.
- The Town should work with the ACRWC during design of the Regional Trunk upgrades.

7.2.1 Wet Weather Flow Management

The Town's Wet Weather Management Strategy should include the following:

- Continuation of manhole sealing program according to street sag locations to reduce the I/I, with a goal of sealing three-quarters of the sanitary manhole lids.
- Disconnection of residential weeping tiles from the sanitary sewer.
- Development of CCTV inspection program to assess the existing sewer conditions and repair where significant I/I may be entering through cracks/joints.
- Gather rainfall and flow data to assess reduction of I/I, if any after each step towards reduction.
- Install new sanitary sewers with watertight connections from acceptable materials according to the Town's Municipal Development Standards.
- Install new sanitary manholes with F-90 frame and cover with gasket seal.
- The Town should plan to install flow monitors at recommended monitoring locations to pinpoint sources of I/I and prepare an I/I assessment report to be submitted to the ACRWC by December 31, 2019.

Closure

This report was prepared for the Town of Stony Plain to update the Water and Sanitary Master Plans.

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,
Associated Engineering Alberta Ltd.

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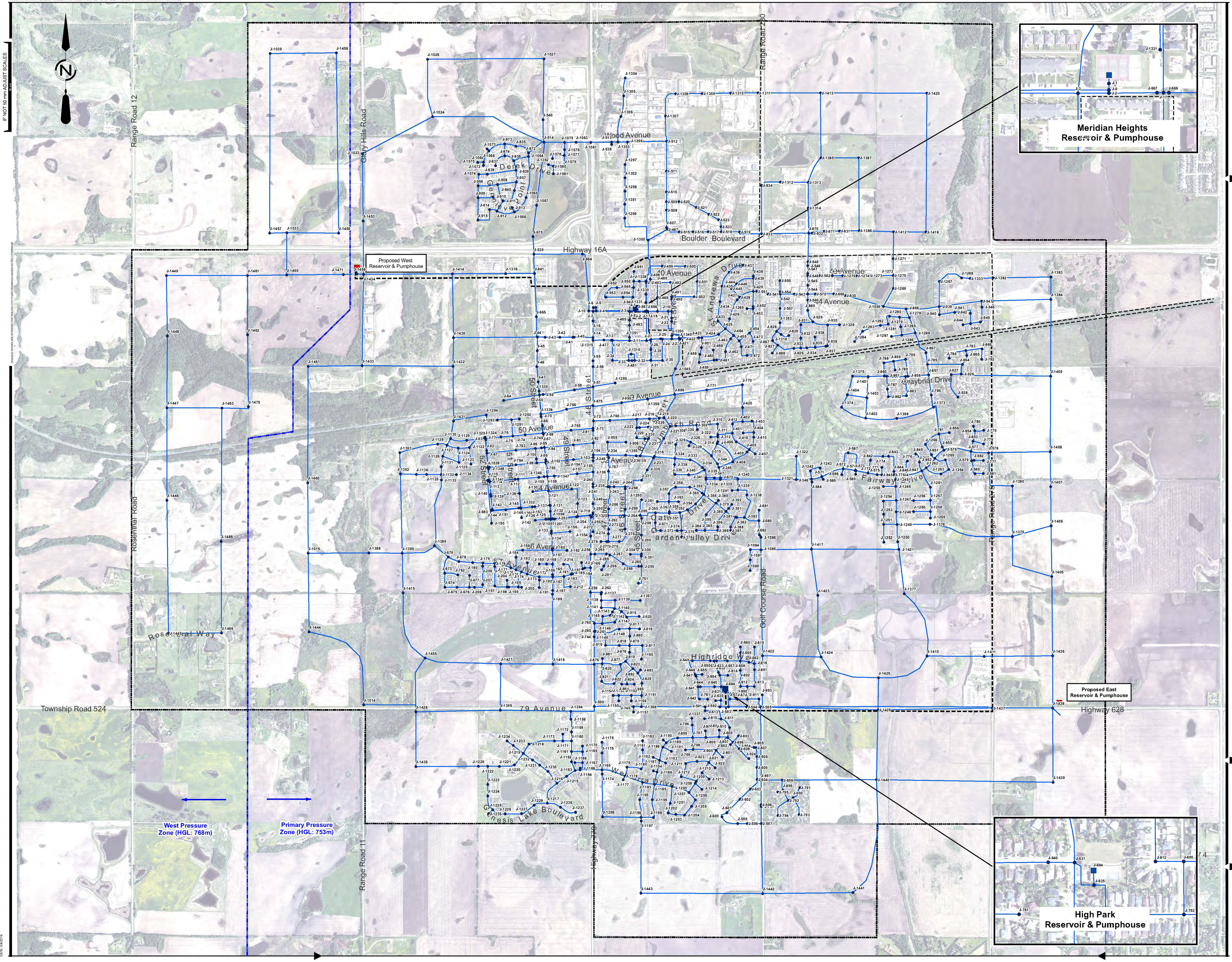
Project Engineer

ASSOCIATED ENGINEERING QUALITY MANAGEMENT SIGN-OFF	
Signature:	
Date:	2019-03-08

APEGA Permit to Practice P 3979

Appendix A - Node and Manhole Numbering Plans



Associated Engineering

Legend:

- Water Node
- Existing Reservoir & Pumphouse
- Proposed Reservoir & Pumphouse
- Waterline
- Existing Supply Main
- Proposed Supply Main
- Pressure Zone Boundary
- Stony Plain Boundary

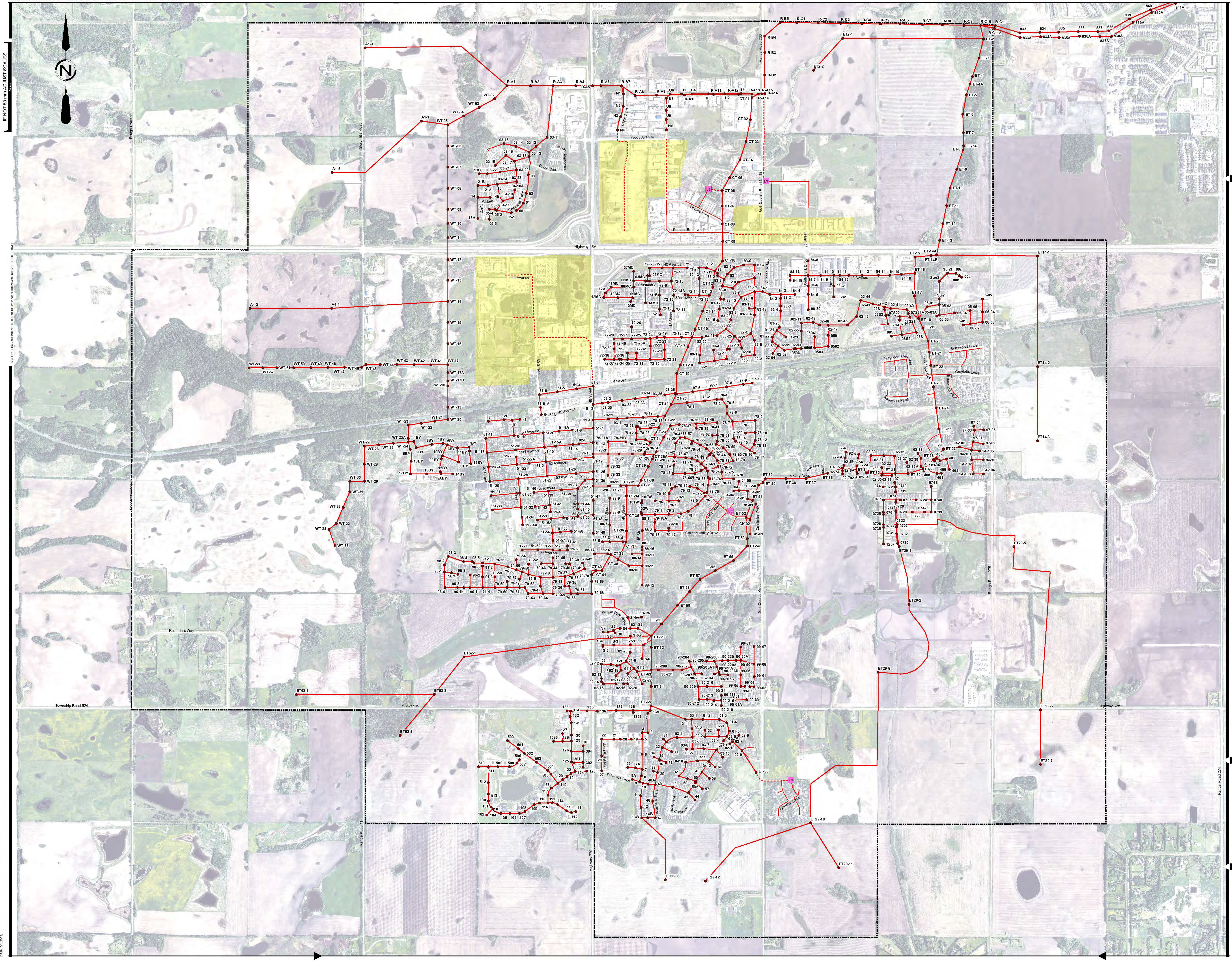
TOWN OF STONY PLAIN

FIGURE No. A-1

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

ULTIMATE WATER SYSTEM
NODE NUMBERING PLAN

AE PROJECT No.	2018-3146
SCALE	1:12,500
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	
DESCRIPTION	ISSUED FOR REPORT



Associated Engineering

Legend:

- Sanitary Line
- Forcemain
- Manhole
- Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

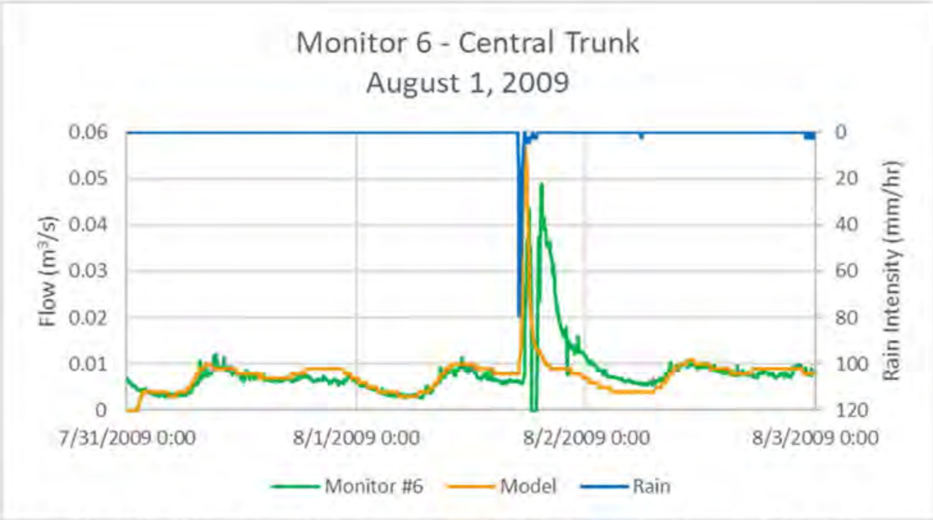
FIGURE No. A-2

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

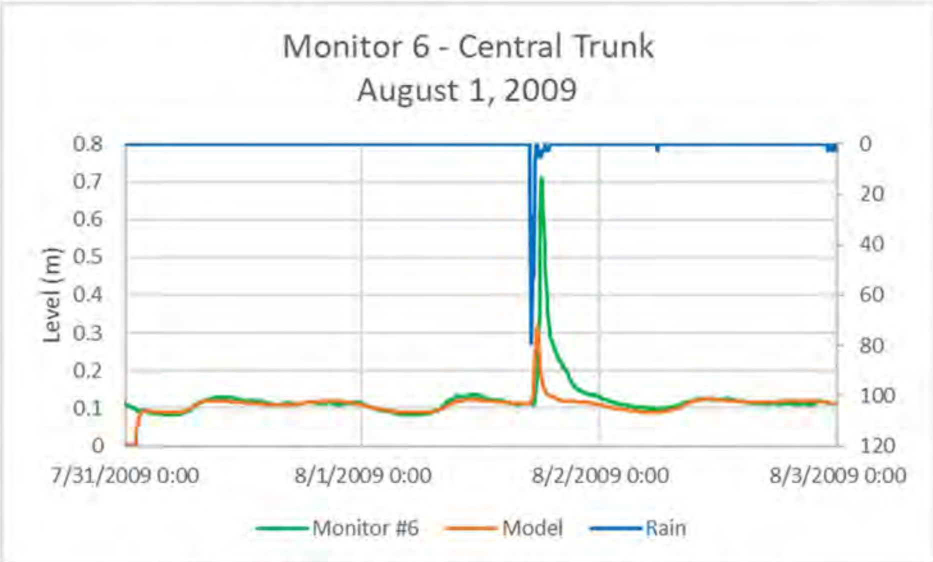
ULTIMATE SANITARY SYSTEM
MANHOLE NUMBERING PLAN

AE PROJECT No.	2018-3146
SCALE	1:12,500
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	
DESCRIPTION	ISSUED FOR REPORT

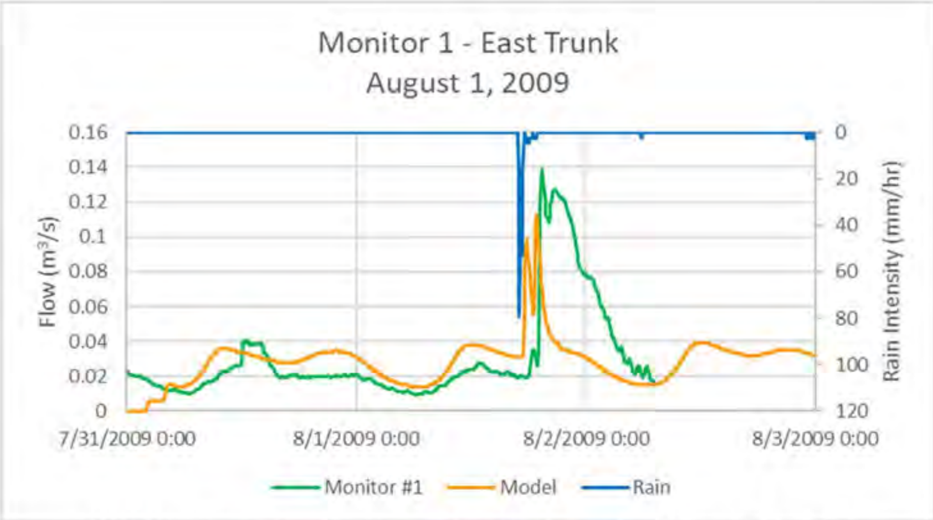
Appendix B - Sanitary Model Validation Plots



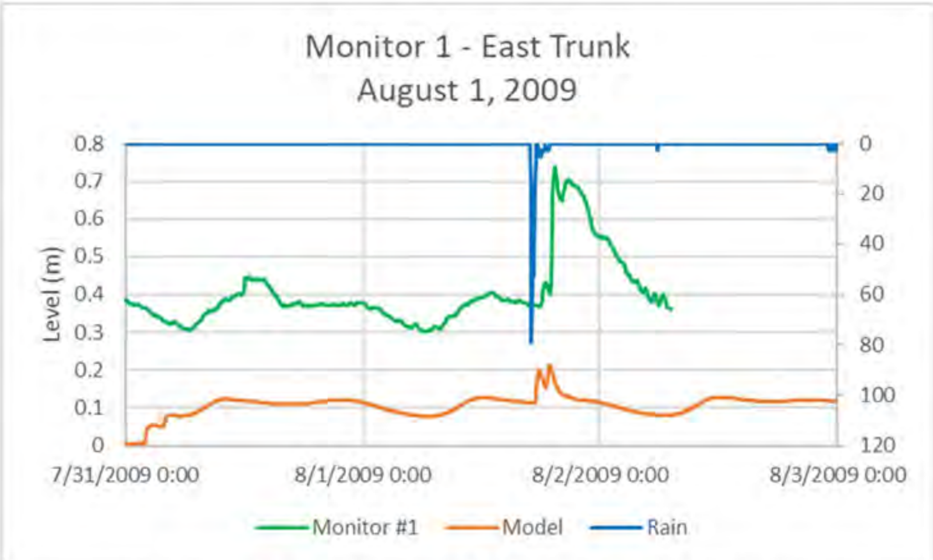
Wet Weather Flow Hydrograph – Central Trunk – August 1, 2009



Wet Weather Levels – Central Trunk – August 1, 2009



Wet Weather Flow Hydrograph – East Trunk – August 1, 2009



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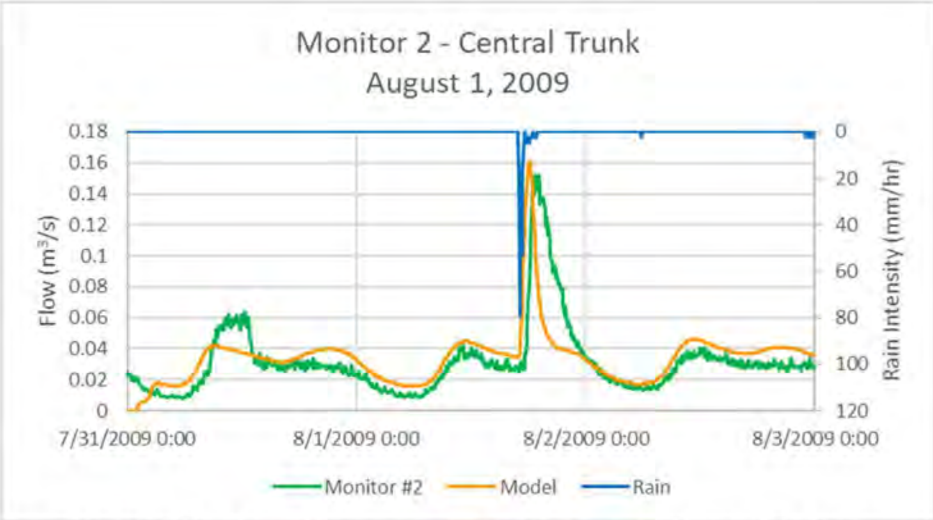
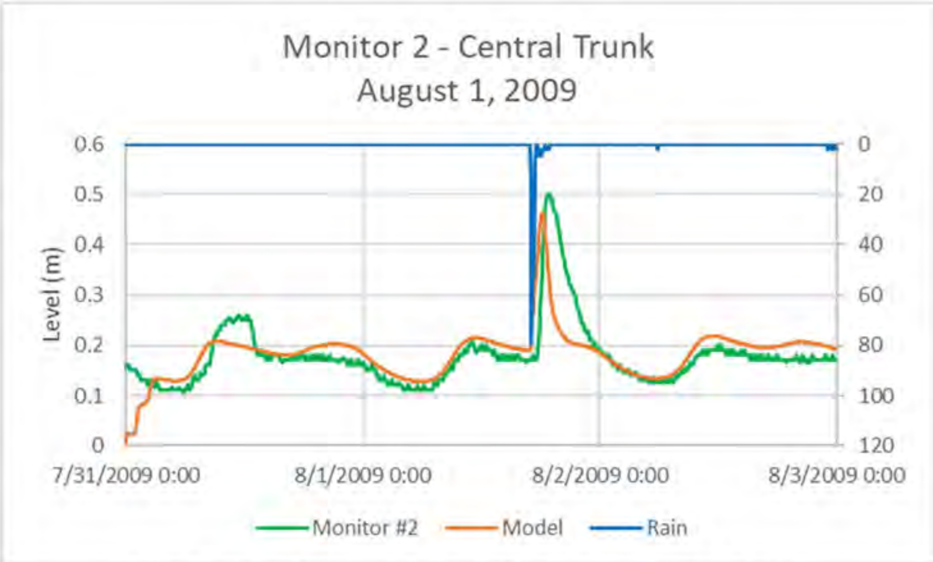
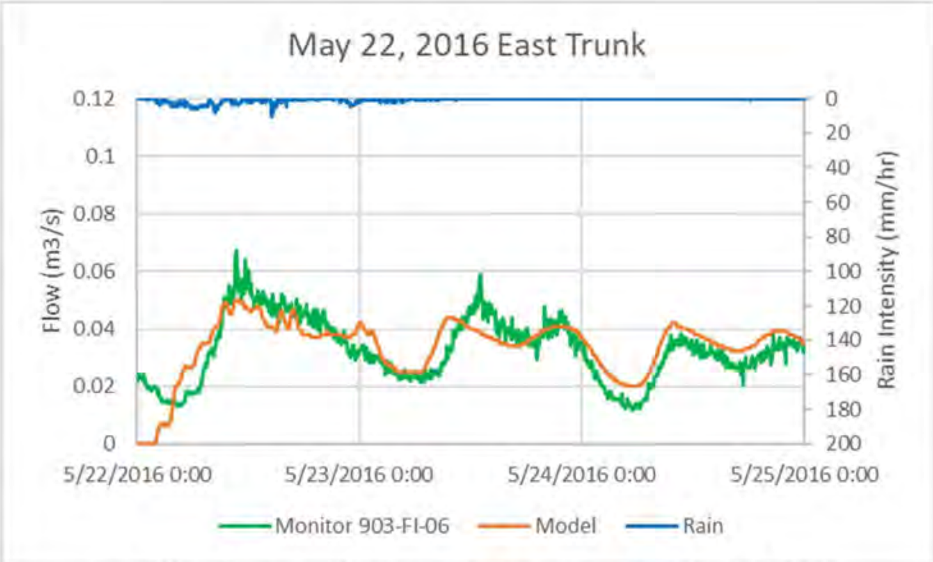


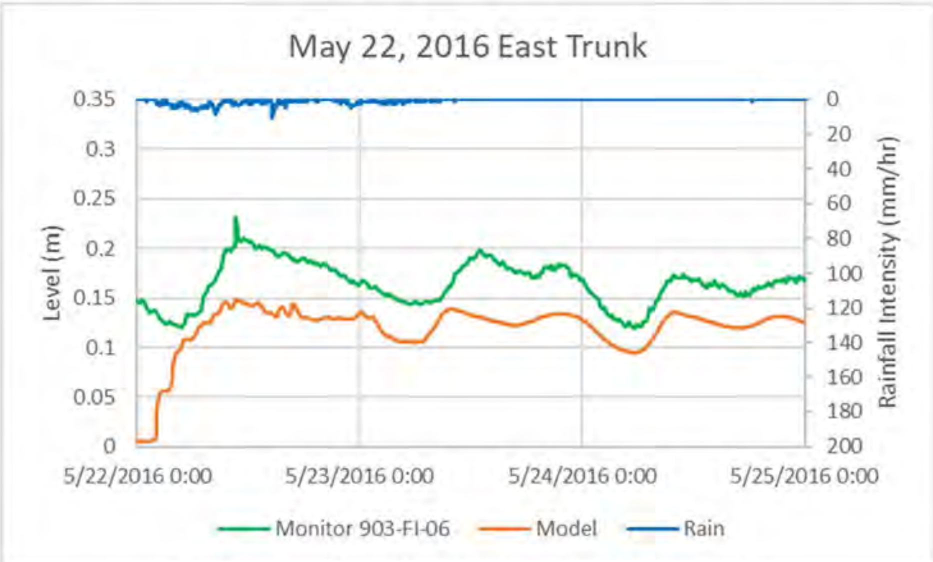
Wet Weather Flow Hydrograph – Central Trunk – August 1, 2009



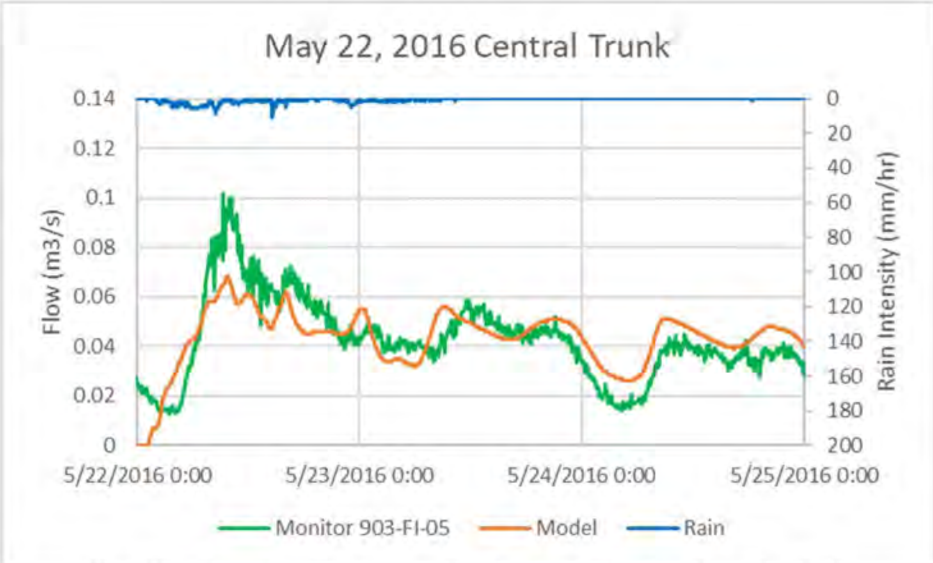
Wet Weather Levels – Central Trunk – August 1, 2009



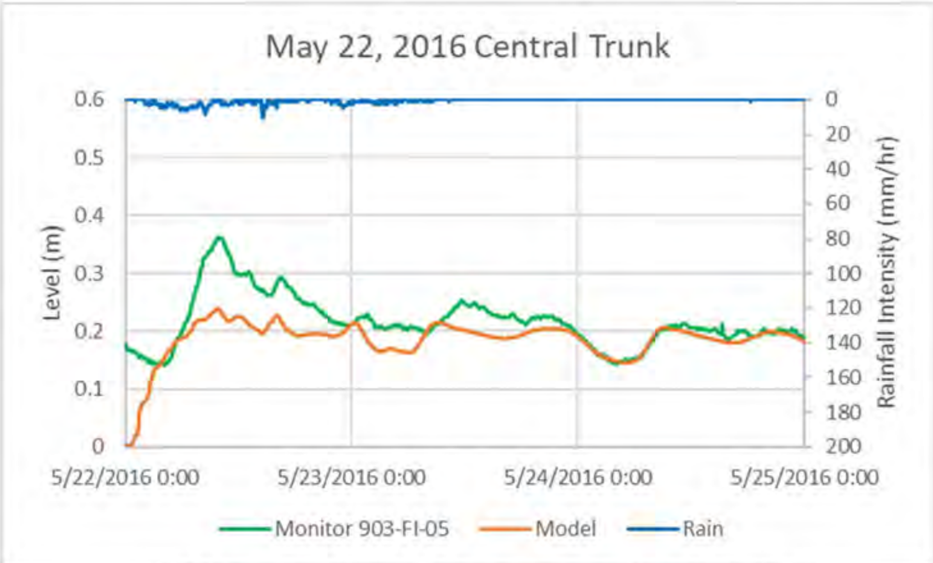
Wet Weather Flow Hydrograph – East Trunk – May 22, 2016



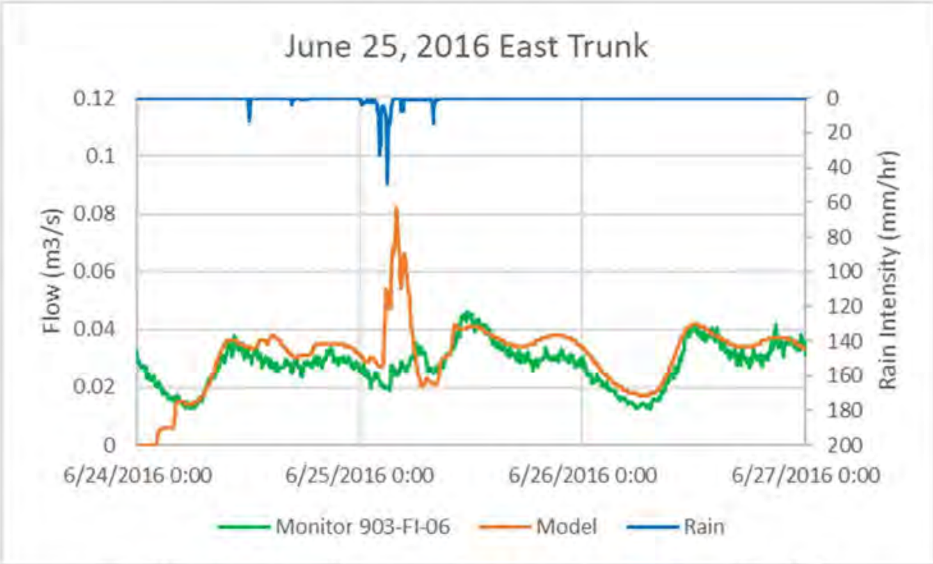
Wet Weather Levels – East Trunk – May 2, 2016



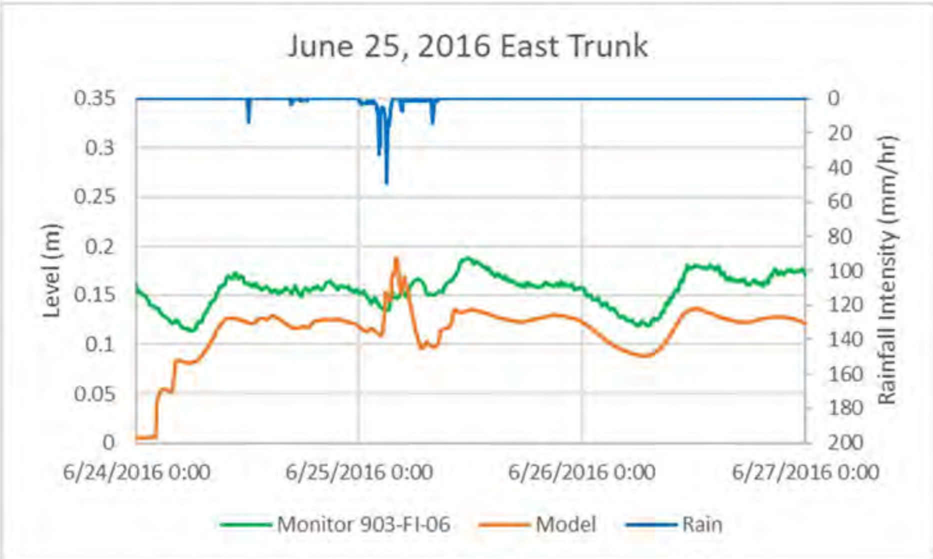
Wet Weather Flow Hydrograph – Central Trunk – May 22, 2016



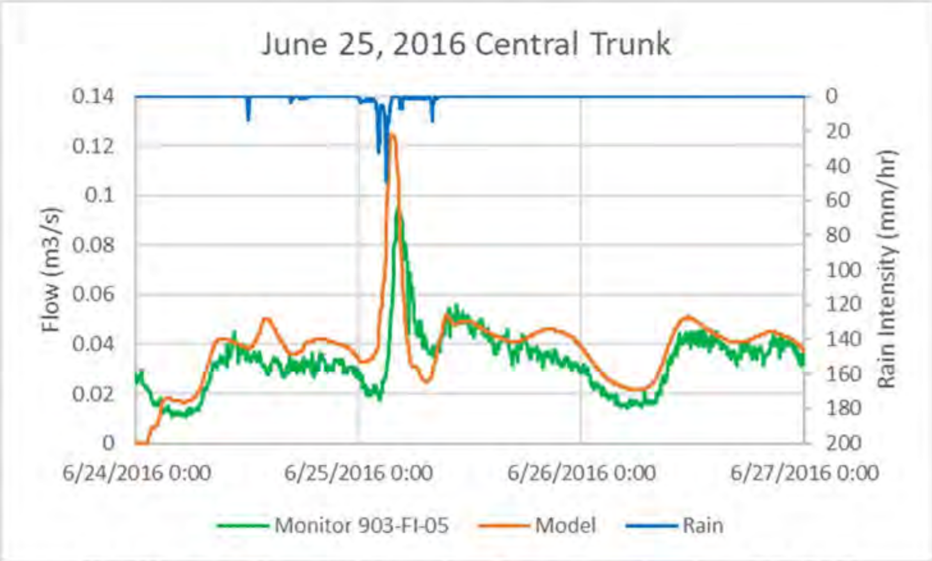
Wet Weather Levels – Central Trunk – May 22, 2016



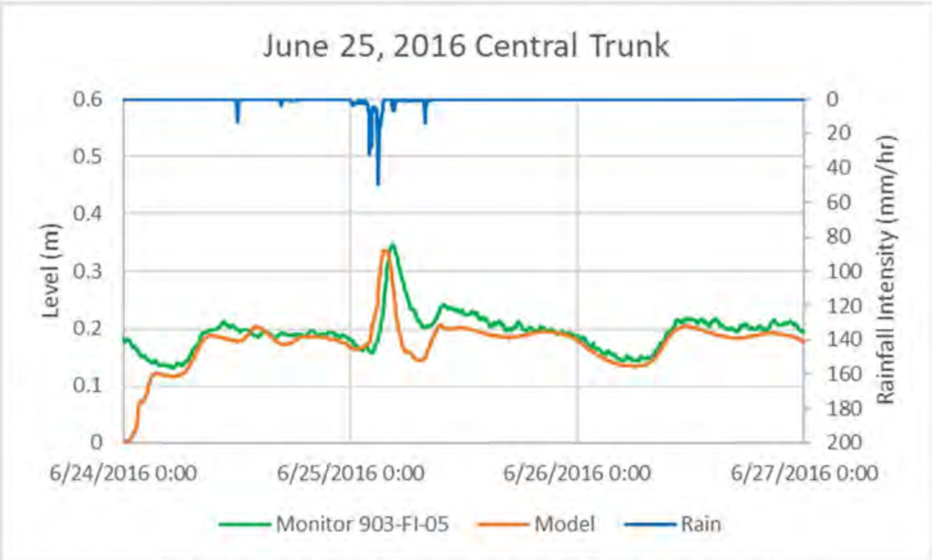
Wet Weather Flow Hydrograph – East Trunk – June 25, 2016



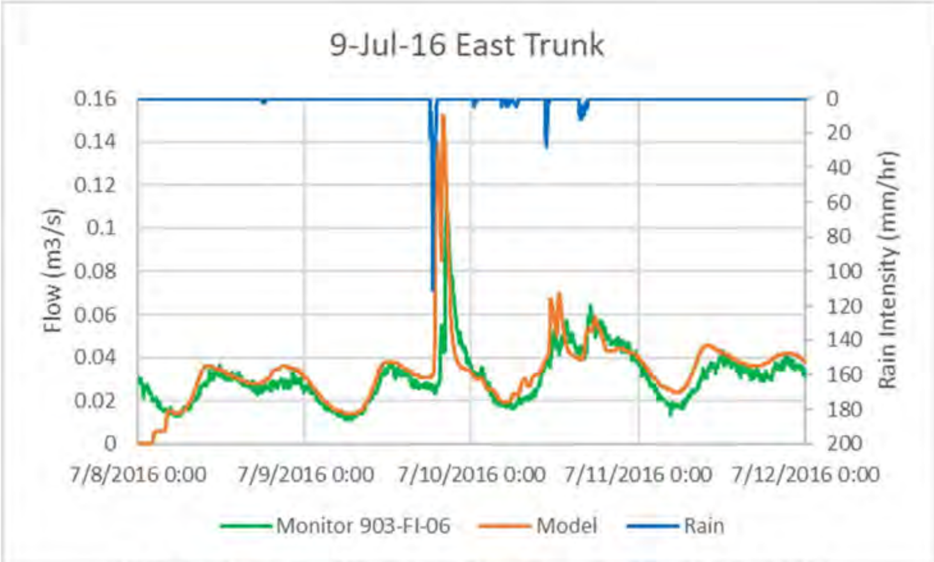
Wet Weather Levels – East Trunk – June 25, 2016



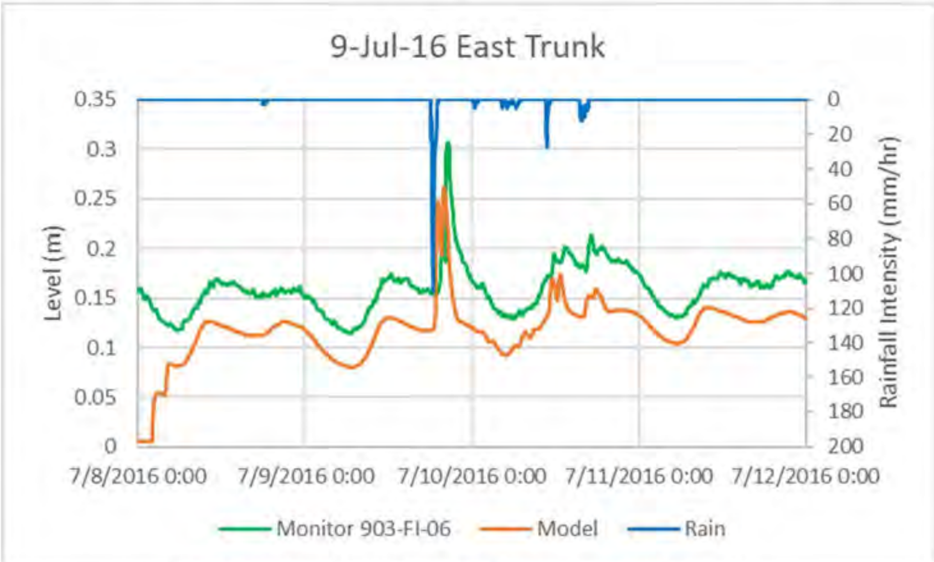
Wet Weather Flow Hydrograph – Central Trunk – June 25, 2016



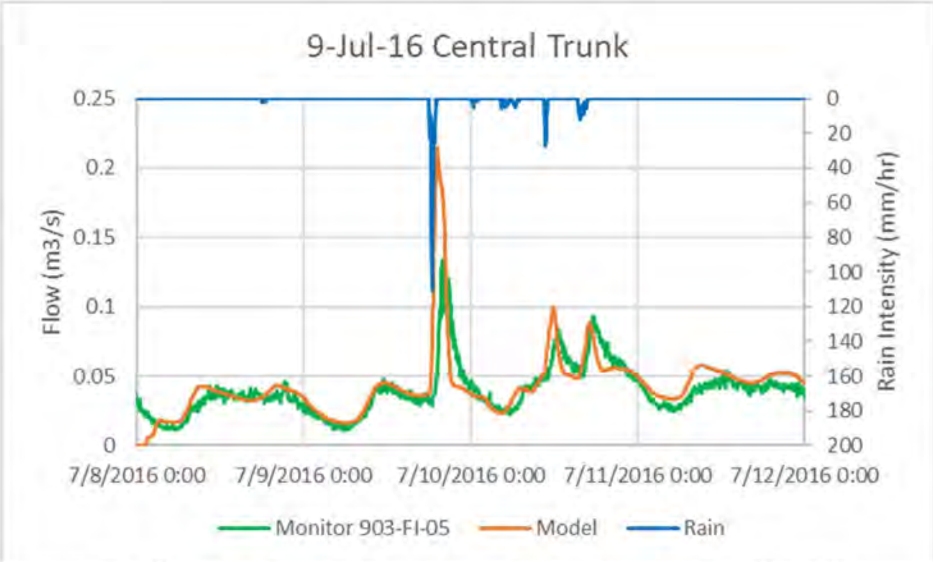
Wet Weather Levels – Central Trunk – June 25, 2016



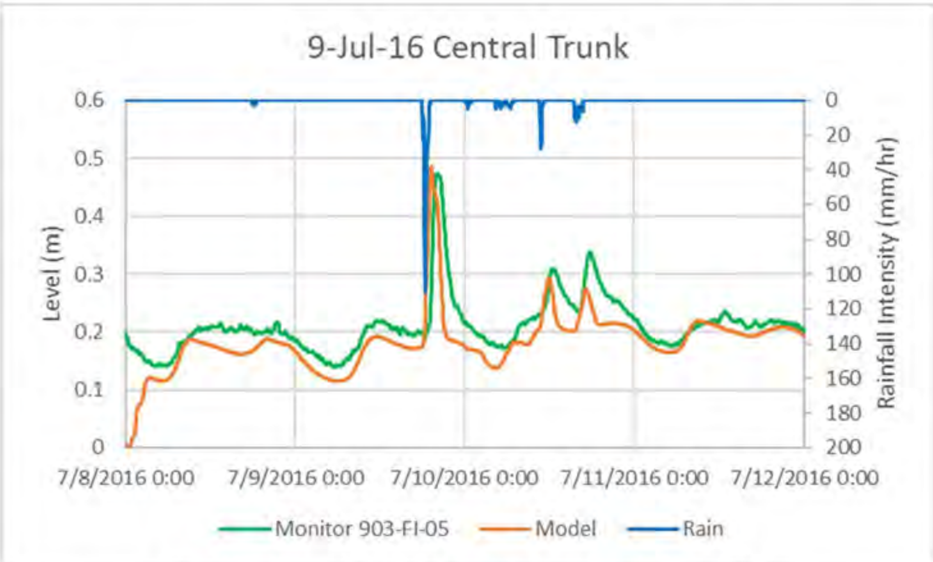
Wet Weather Flow Hydrograph – East Trunk – July 9, 2016



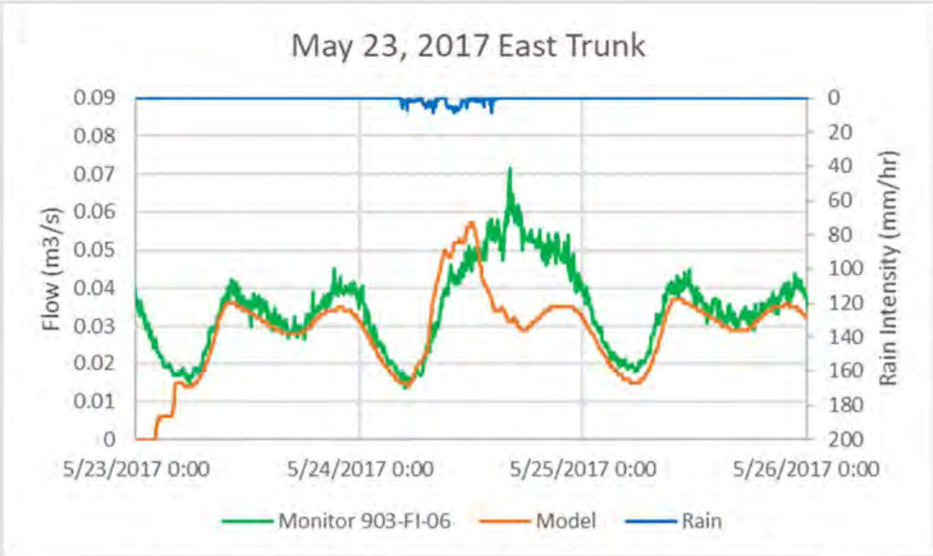
Wet Weather Levels – East Trunk – July 9, 2016



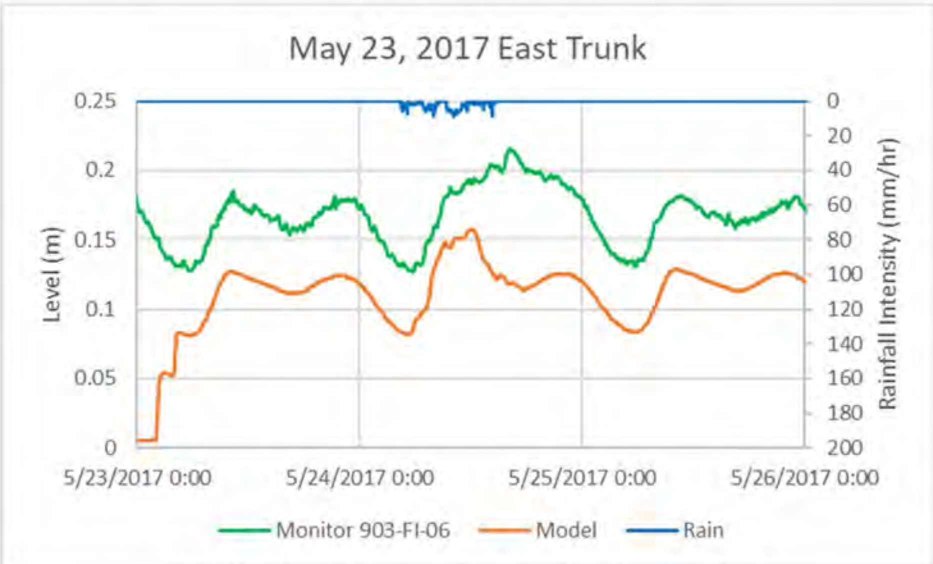
Wet Weather Flow Hydrograph – Central Trunk – July 9, 2016



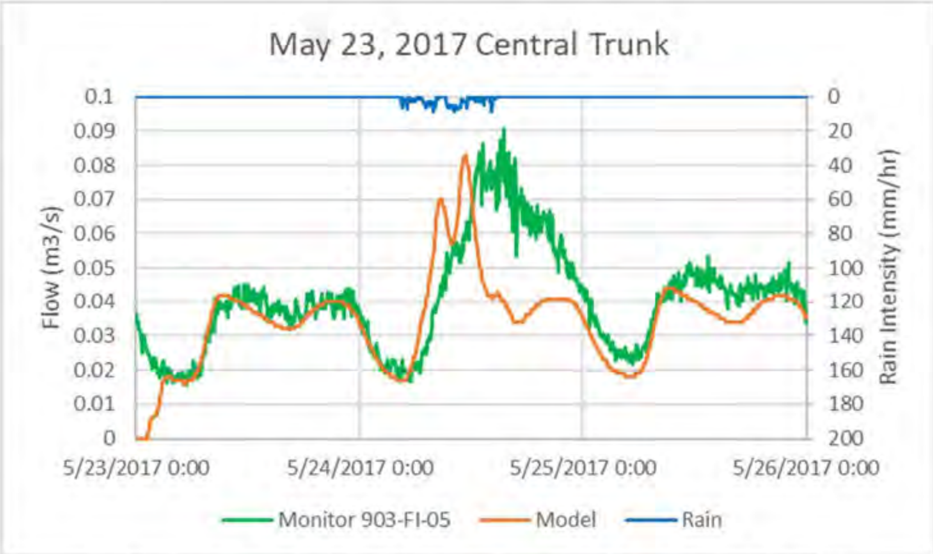
Wet Weather Levels – Central Trunk – July 9, 2016



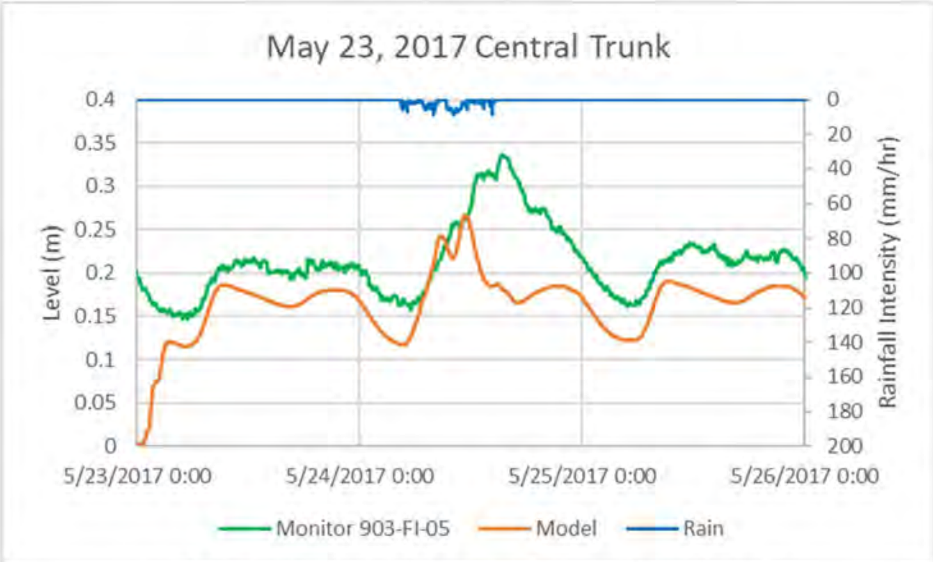
Wet Weather Flow Hydrograph – East Trunk – May 23, 2017



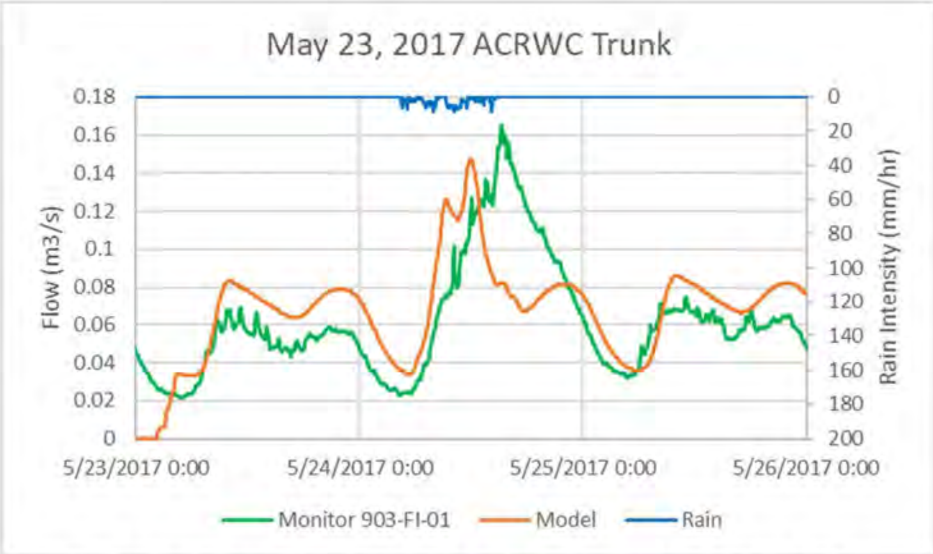
Wet Weather Levels – East Trunk – May 23, 2017



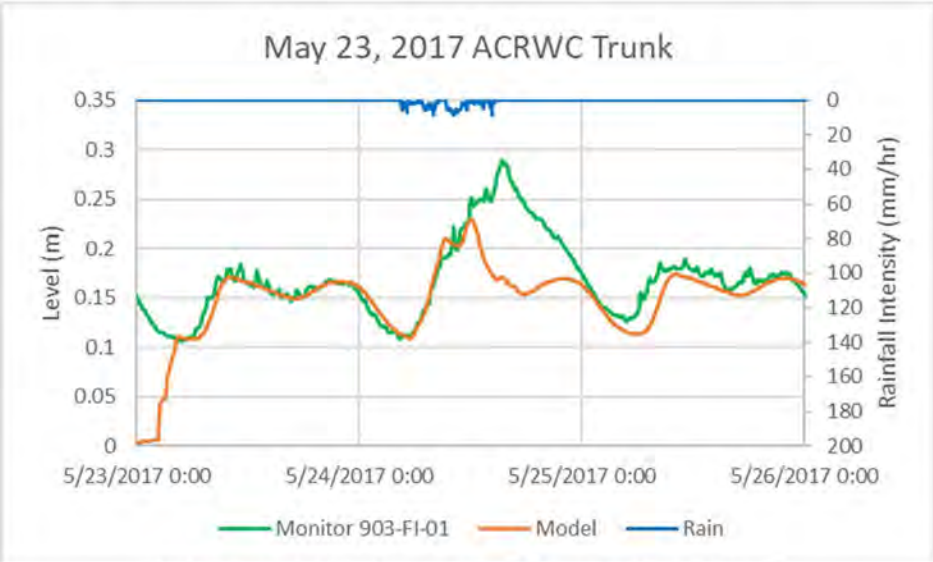
Wet Weather Flow Hydrograph – Central Trunk – May 23, 2017



Wet Weather Levels – Central Trunk – May 23, 2017



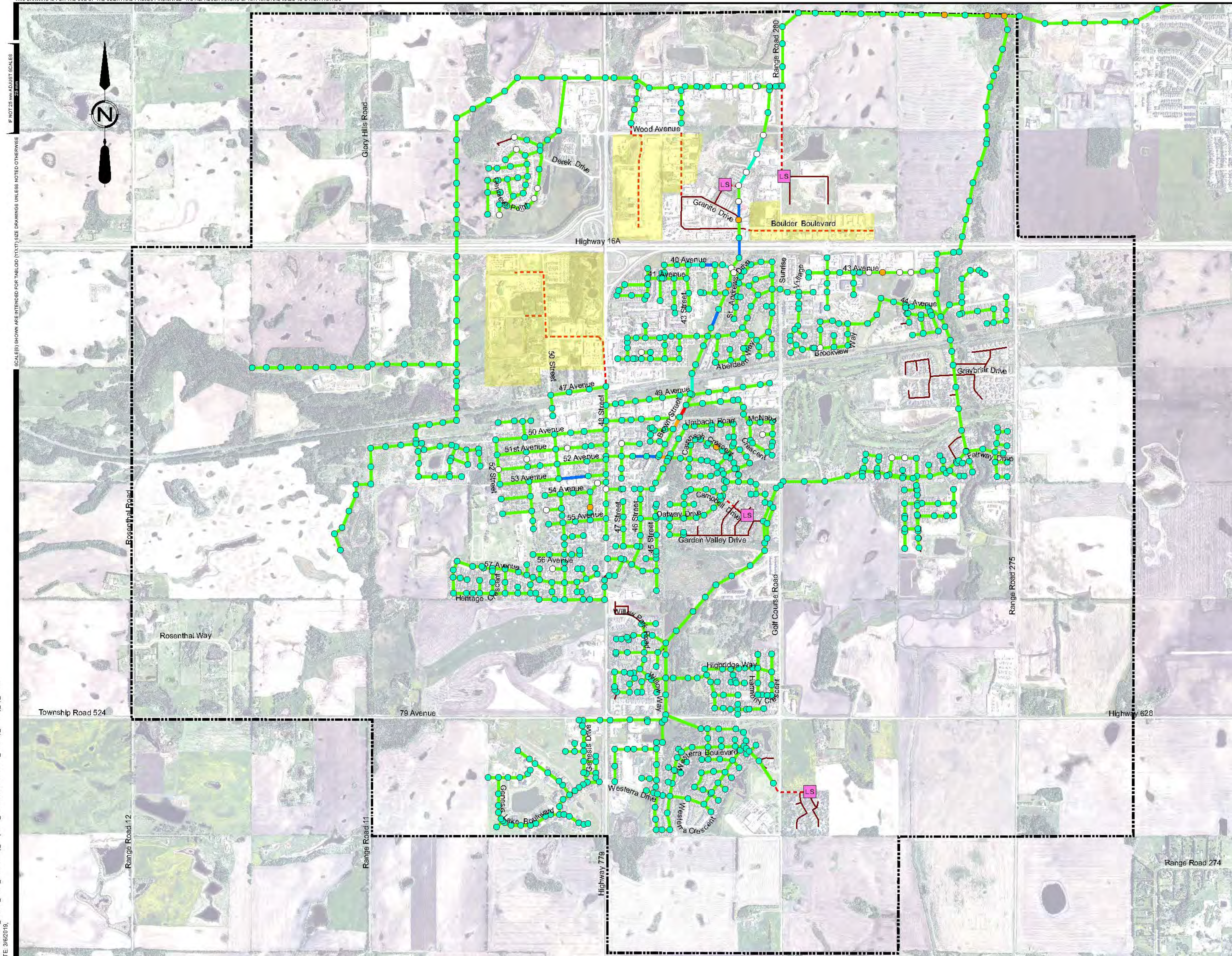
Wet Weather Flow Hydrograph – ACRWC Trunk – May 23, 2017



Wet Weather Levels – ACRWC Trunk – May 23, 2017

Appendix C - Sanitary Model Results

THIS DRAWING IS FOR THE USE OF THE CLIENT AND PROJECT INDICATED - NO REPRESENTATIONS OF ANY KIND ARE MADE TO OTHER PARTIES



IF NOT 25 mm ADJUST SCALES 25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

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DATE: 3/6/2019;

Associated Engineering

Legend:

Surcharge Level (m below ground)
- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)
- < 1
- 1 - 1.2
- > 1.2 - 1.5
- > 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. C-1

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

EXISTING SANITARY SEWER SIMULATED SURCHARGE LEVELS AND FLOW LOADING 1:5 YEAR 4 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

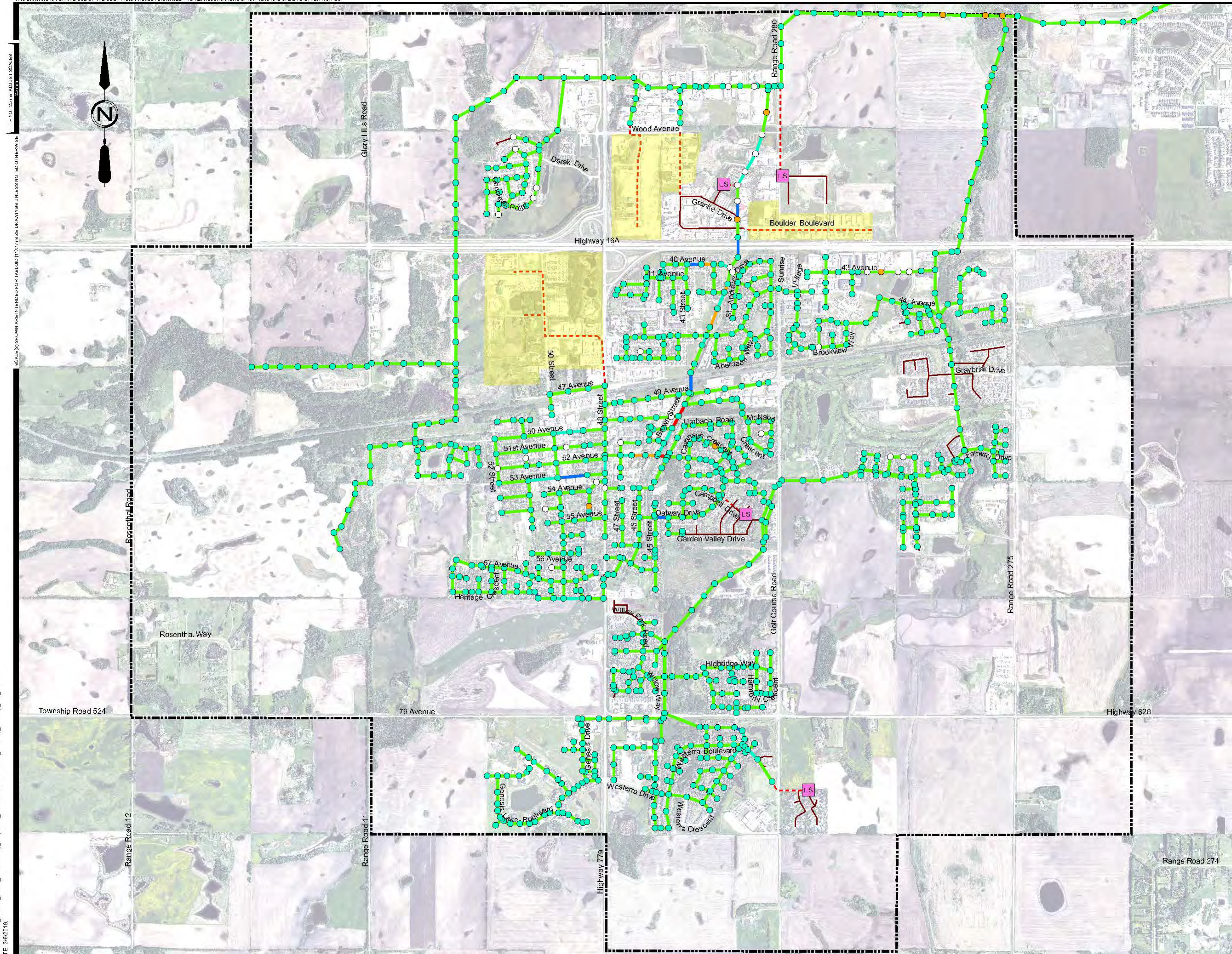

FIGURE No. C-2

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

EXISTING SANITARY SEWER SIMULATED SURCHARGE LEVELS AND FLOW LOADING 1:10 YEAR 4 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

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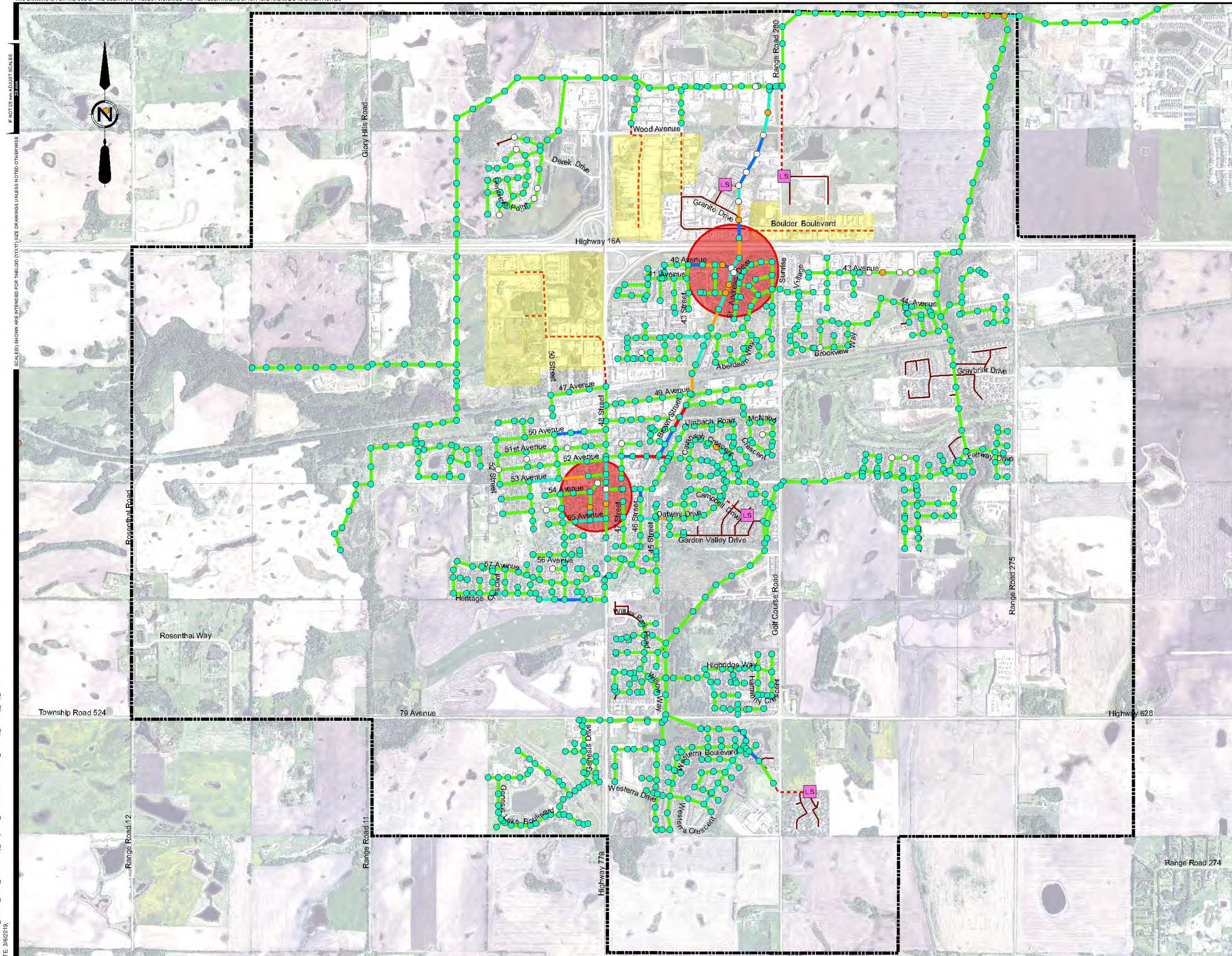
DATE: 3/6/2019



Associated Engineering

Legend:

Surcharge Level (m below ground)

- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)

- < 1
- 1 - 1.2
- > 1.2 - 1.5
- > 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- Flood Risk Areas
- Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

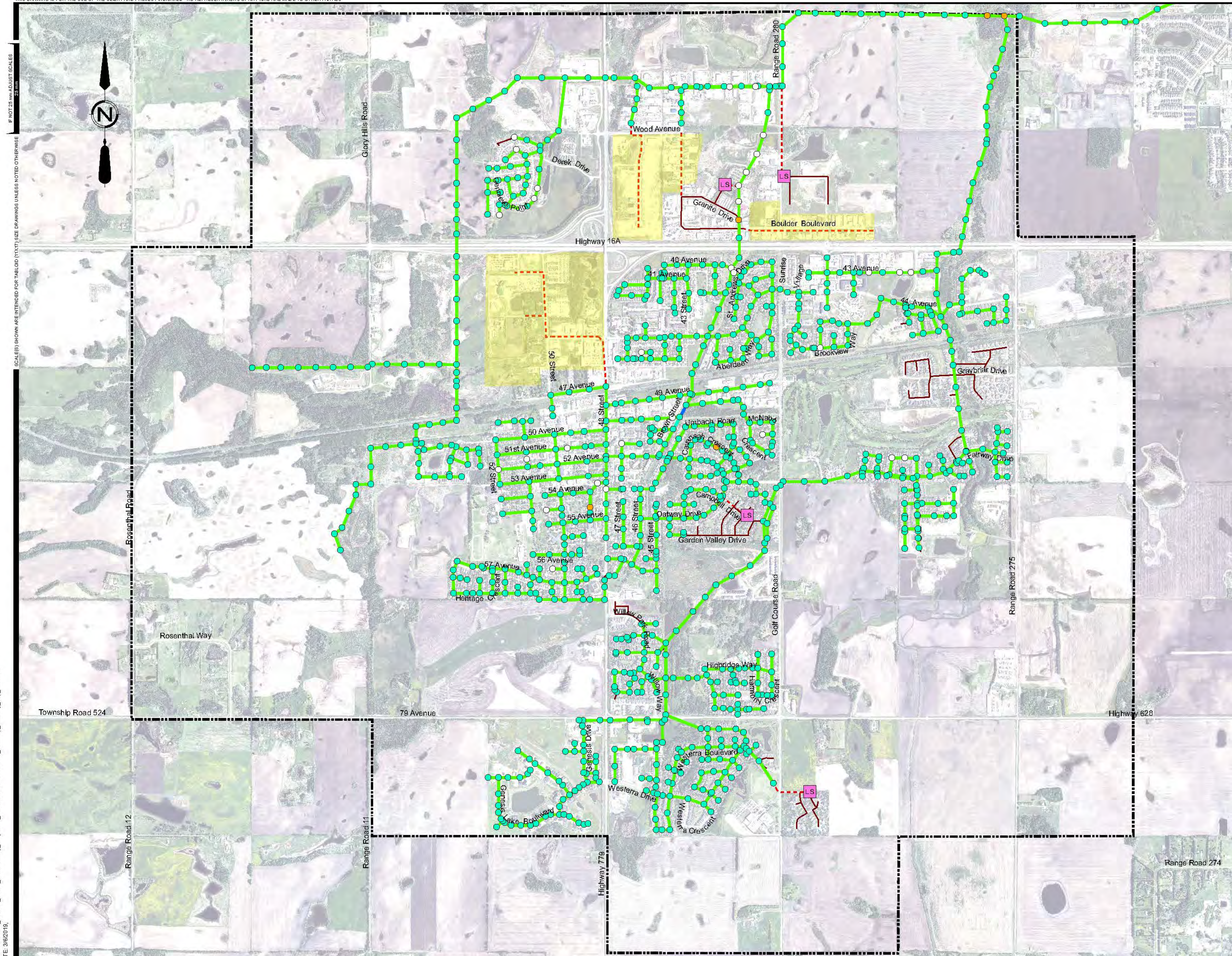
FIGURE No. C-3

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

EXISTING SANITARY SEWER SIMULATED
SURCHARGE LEVELS AND FLOW LOADING
1:25 YEAR 4 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

THIS DRAWING IS FOR THE USE OF THE CLIENT AND PROJECT INDICATED - NO REPRESENTATIONS OF ANY KIND ARE MADE TO OTHER PARTIES



Legend:

Surcharge Level (m below ground)
- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)
- < 1
- 1 - 1.2
- > 1.2 - 1.5
- > 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

Associated Engineering

TOWN OF STONY PLAIN

FIGURE No. C-4

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

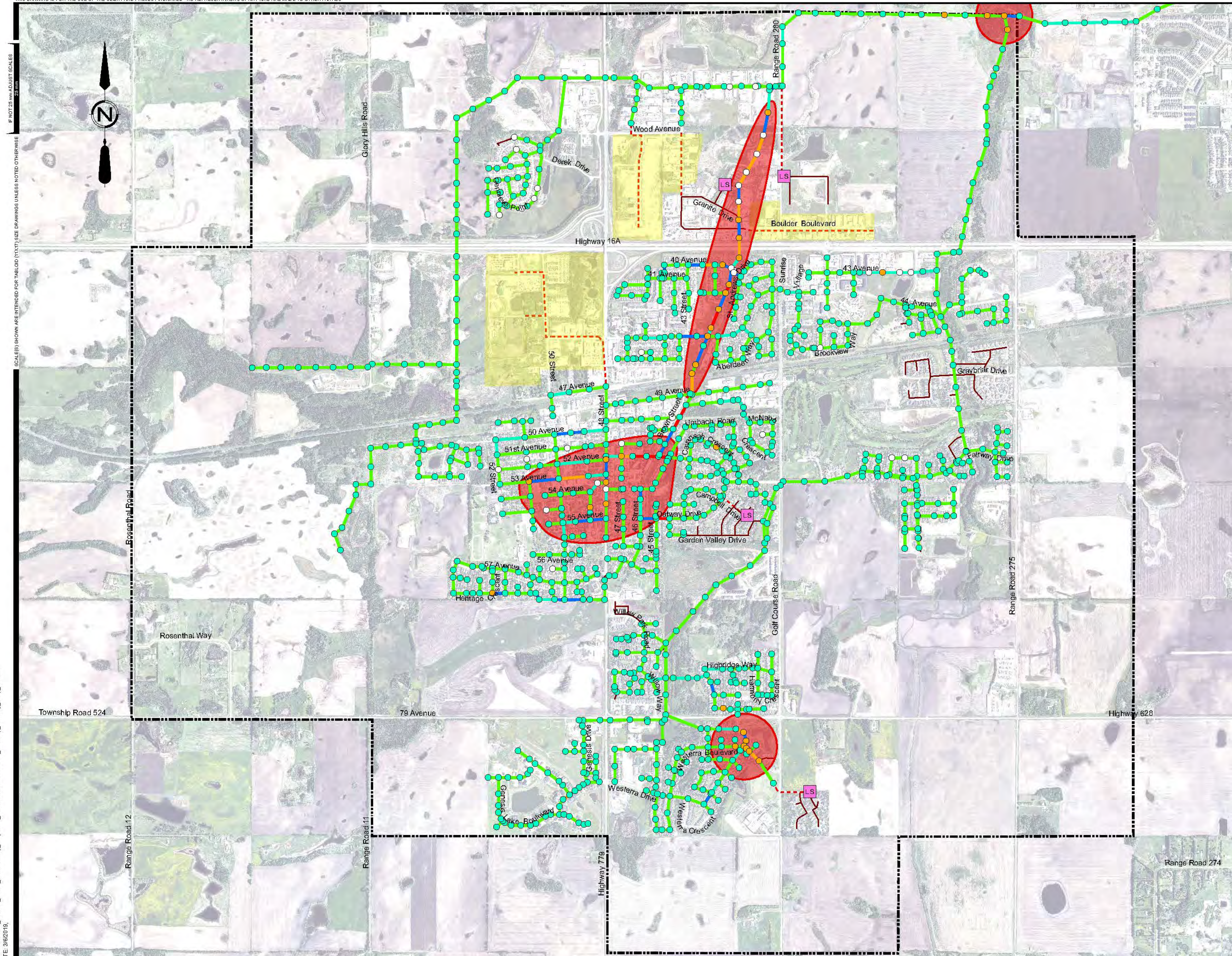
EXISTING SANITARY SEWER SIMULATED
SURCHARGE LEVELS AND FLOW LOADING
1:25 YEAR 24 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

THIS DRAWING IS FOR THE USE OF THE CLIENT AND PROJECT INDICATED - NO REPRESENTATIONS OF ANY KIND ARE MADE TO OTHER PARTIES

IF NOT 25 mm ADJUST SCALES

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

Legend:

Surcharge Level (m below ground)

- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)

- < 1
- 1 - 1.2
- > 1.2 - 1.5
- > 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- Flood Risk Areas
- LS Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

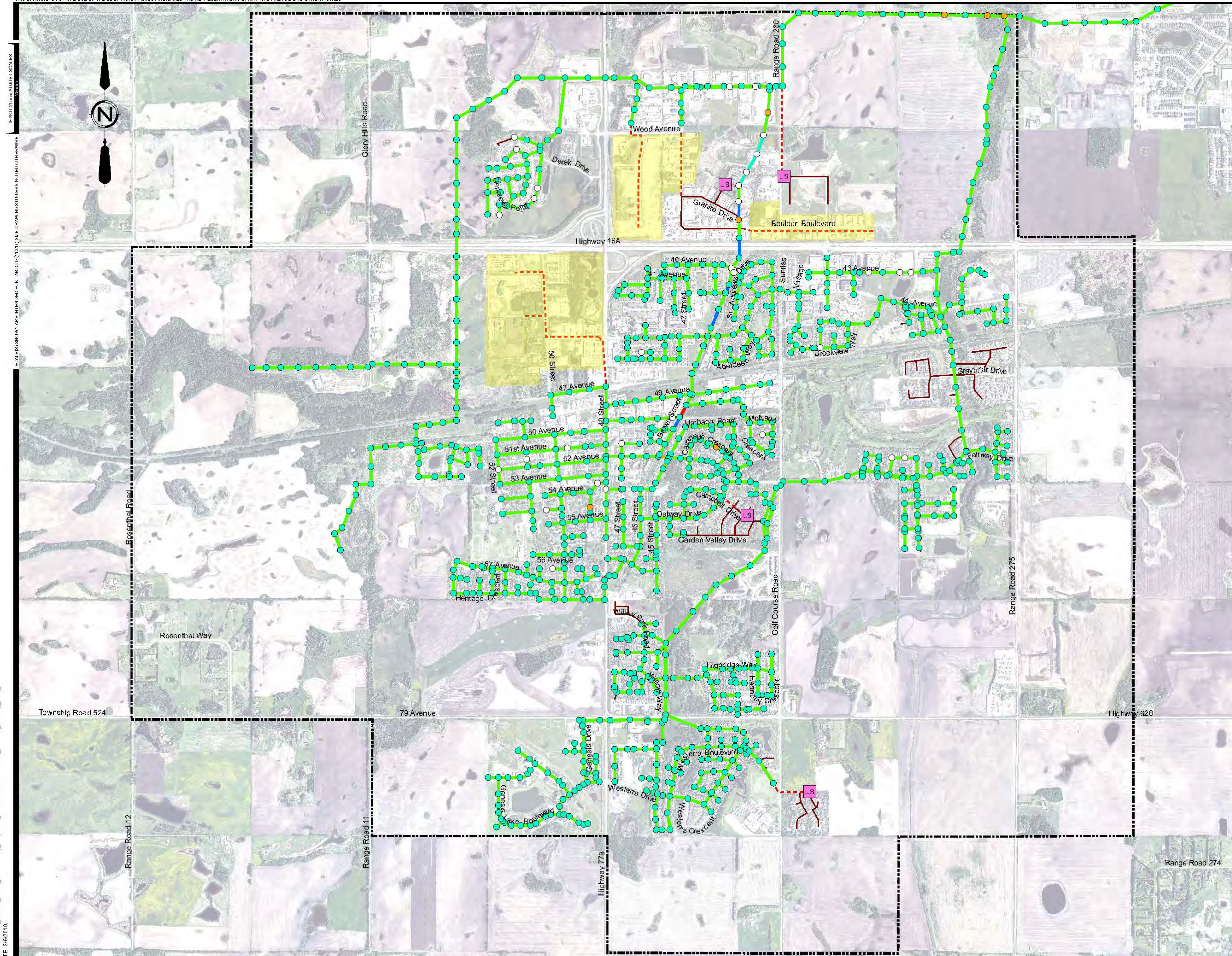
FIGURE No. C-5

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

EXISTING SANITARY SEWER SIMULATED
SURCHARGE LEVELS AND FLOW LOADING
1:100 YEAR 4 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

P:\20183146\00_Update_Water_and\Working_Dwgs\010_GIS\ArcMap\Sewer\4-11_Sanitary_Existing_100y_4h.mxd
DATE: 3/6/2019



Legend:

Surcharge Level (m below ground)
- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)
- < 1
- 1 - 1.2
- > 1.2 - 1.5
- > 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. C-6

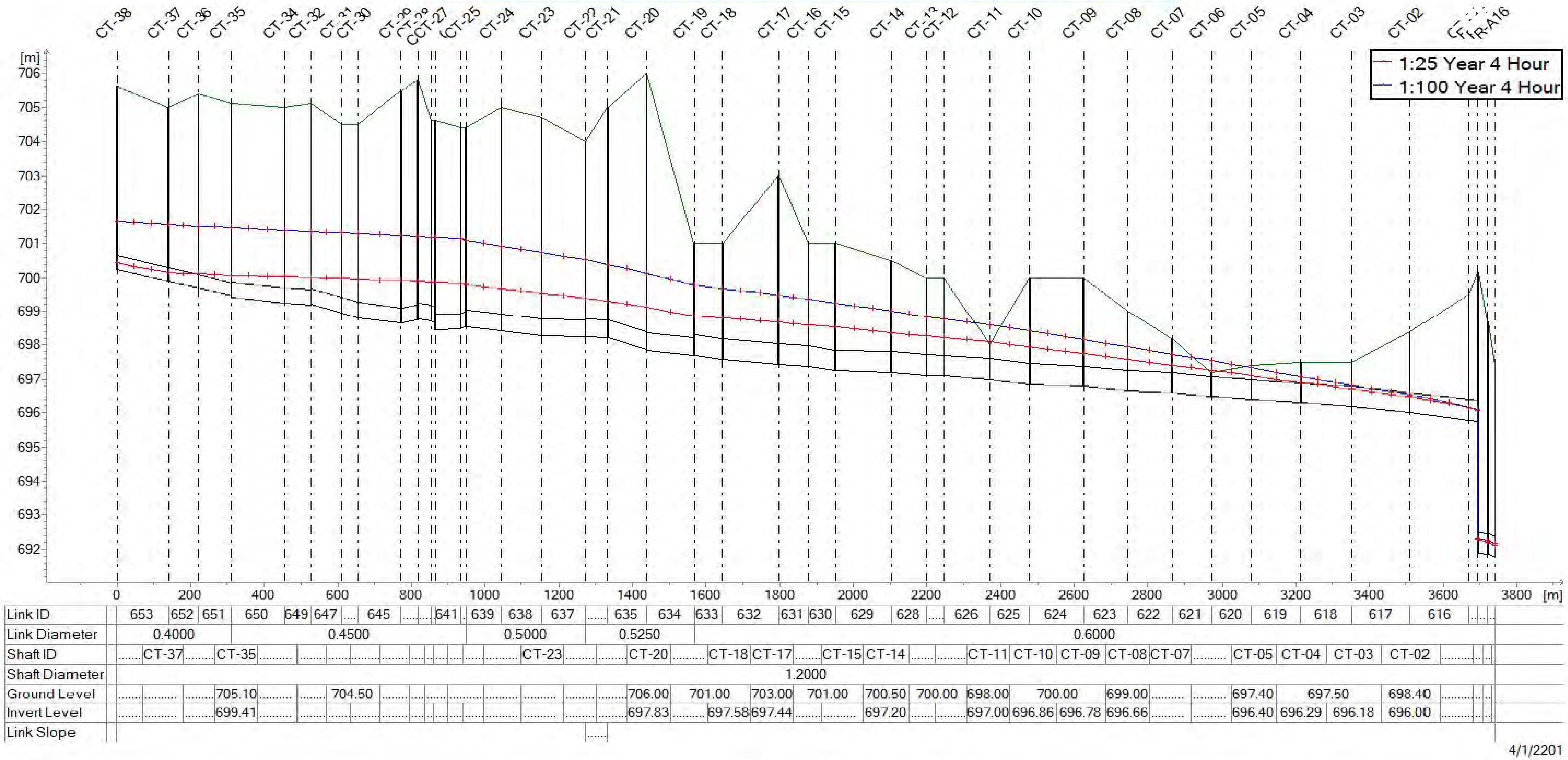
TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

EXISTING SANITARY SEWER SIMULATED SURCHARGE LEVELS AND FLOW LOADING 1:100 YEAR 24 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

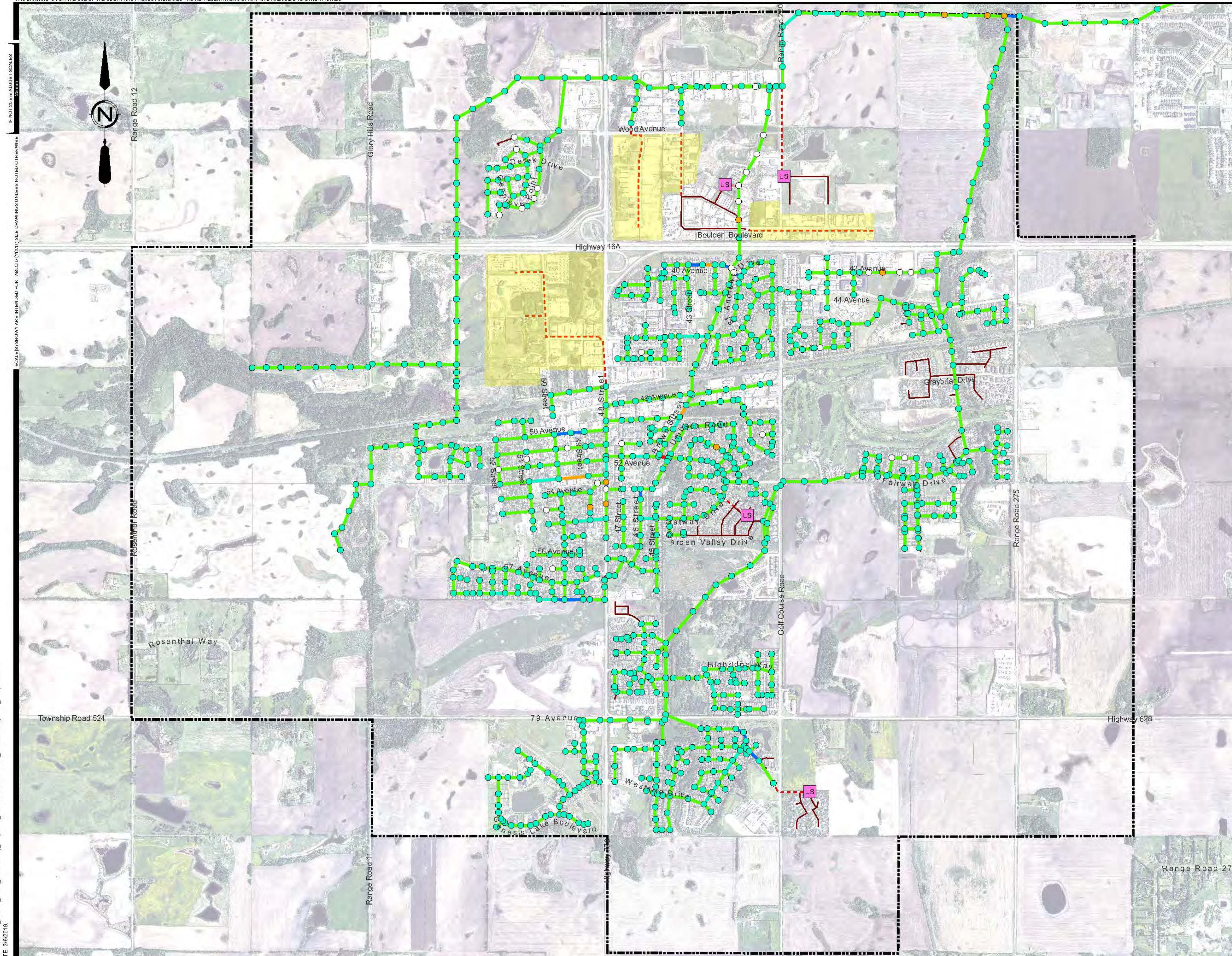
IF NOT 25 mm ADJUST SCALES 25 mm
SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE
P:\20183146\00_Update_Water_and\Working_Dwgs\010_GIS\ArcMap\Sewer\4-12_Sanitary_Existing_100y_24h.mxd
DATE: 3/6/2019.

Figure C-7
Existing System
Central Trunk Profile 1:25 year and 1:100 year 4 hour Design Storm Events



IF NOT 25 mm ADJUST SCALES

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Legend:

Surcharge Level (m below ground)

- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)

- < 1
- 1 - 1.2
- 1.2 - 1.5
- 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- LS Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

Associated Engineering

TOWN OF STONY PLAIN

FIGURE No. C-8

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

PROPOSED UPGRADES TO EXISTING SYSTEM
SIMULATED SURCHARGE LEVELS AND FLOW LOADING. 1:25 YEAR 4 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

P:\20183146\00_Update_Water_and\Working_Dwgs\010_GIS\ArcMap\Sewer\4-4_ProposedUpgrades_1-25yr.mxd
DATE: 3/6/2019

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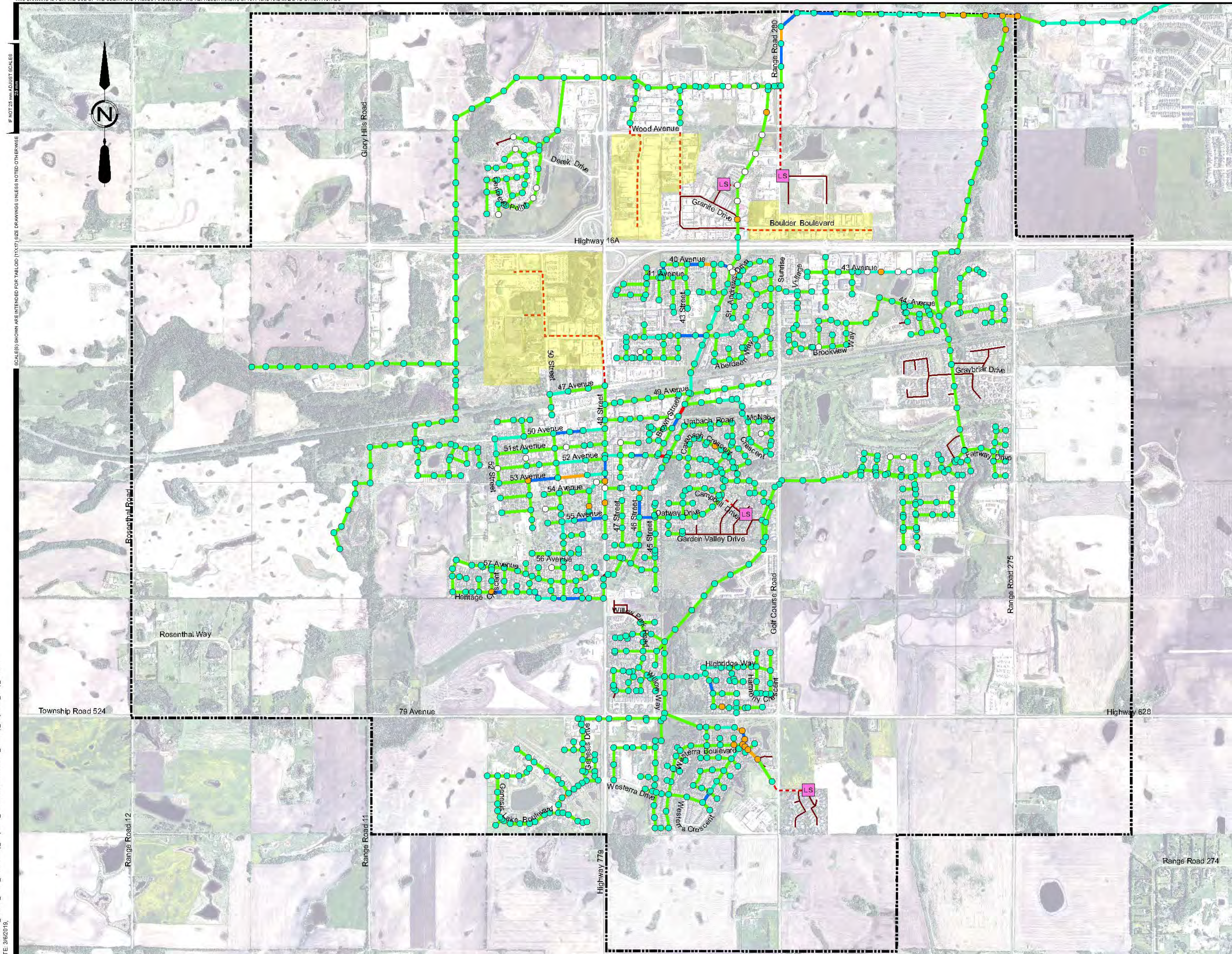
SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE. IF NOT 25 mm ADJUST SCALES 25 mm



Associated Engineering

Legend:

Surcharge Level (m below ground)
- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)
- < 1
- 1 - 1.2
- > 1.2 - 1.5
- > 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. C-9

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

PROPOSED UPGRADES TO EXISTING SYSTEM
SIMULATED SURCHARGE LEVELS AND FLOW
LOADING. 1:100 YEAR 24 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

P:\20183146\00_Update_Water_and\Working_Dwgs\010_GIS\ArcMap\Sewer\4-16_Sanitary_Upgrades_100y_4h.mxd
DATE: 3/6/2019.

Figure C-10
Proposed Upgrades
Central Trunk Profile 1:25 year and 1:100 year 4 hour Design Storm Events

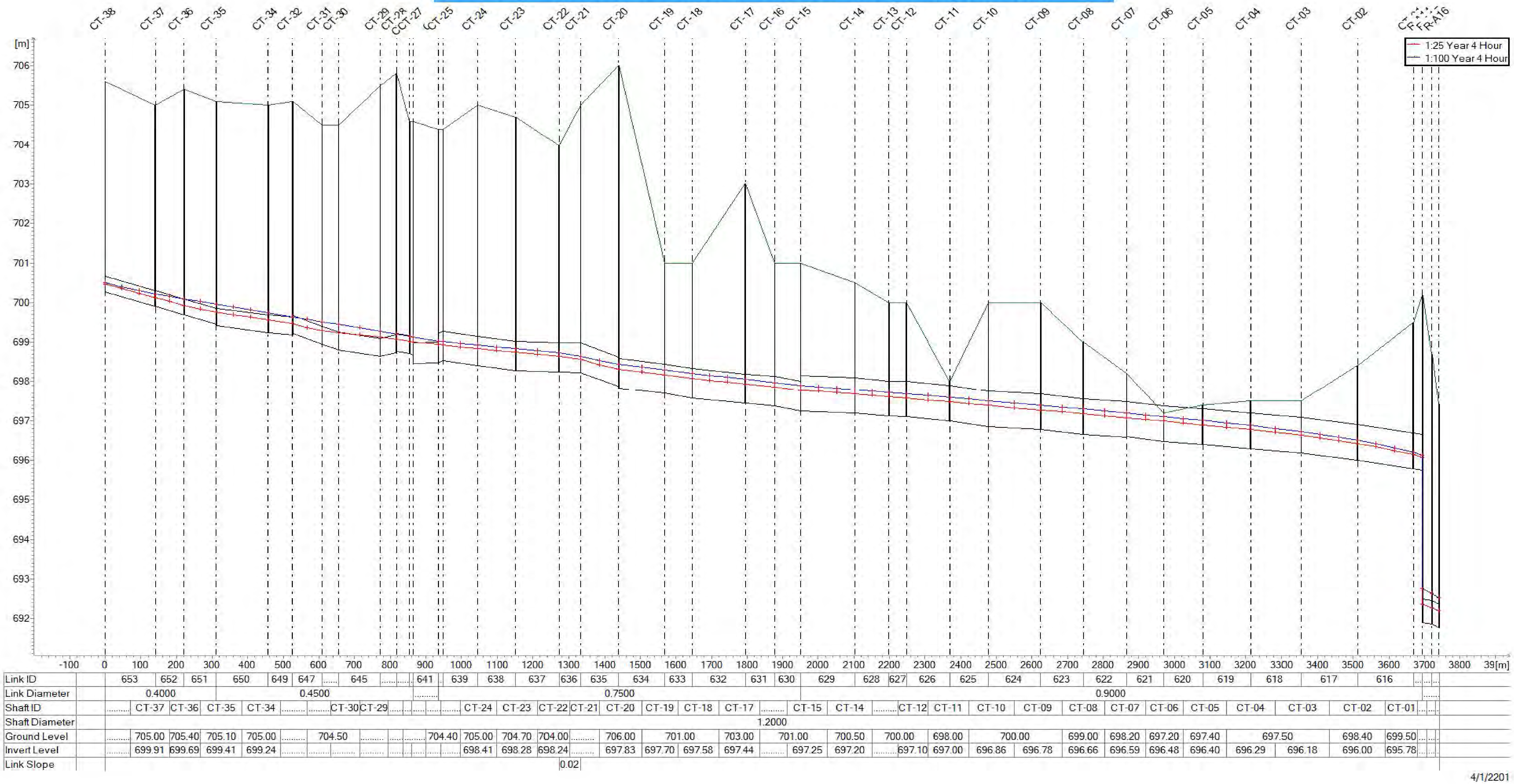
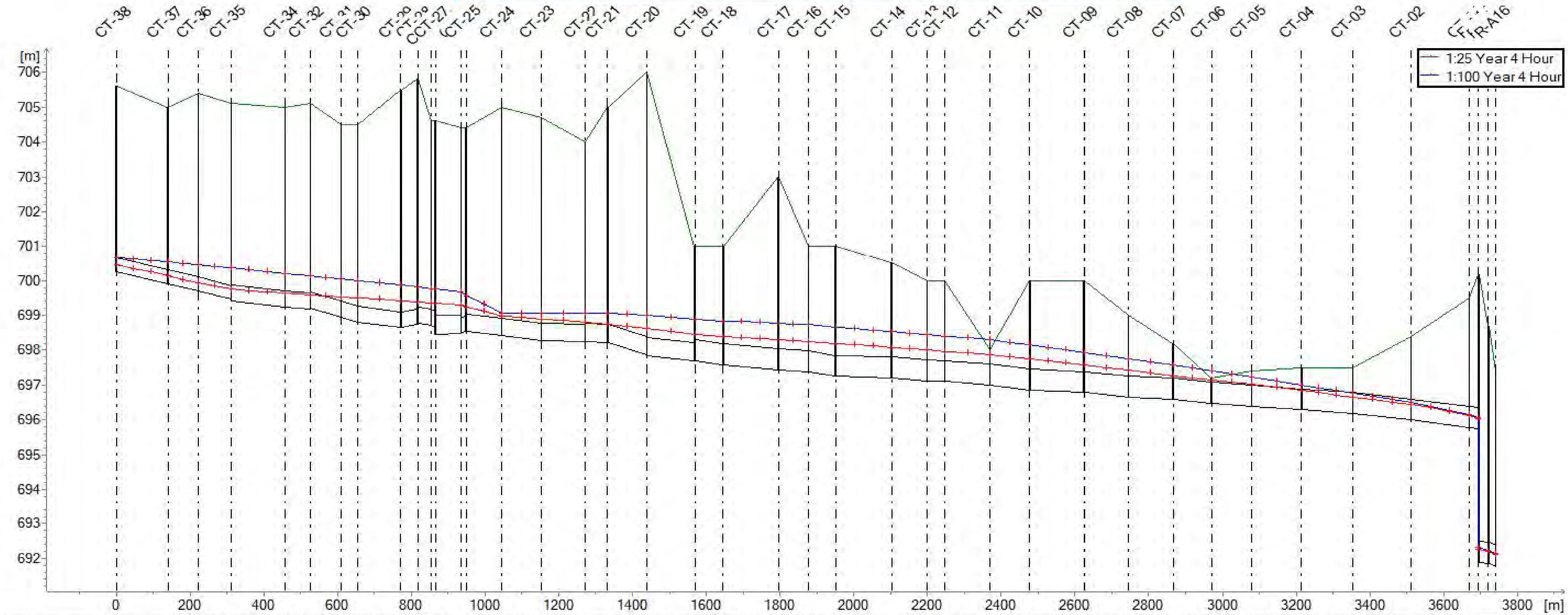


Figure C-11

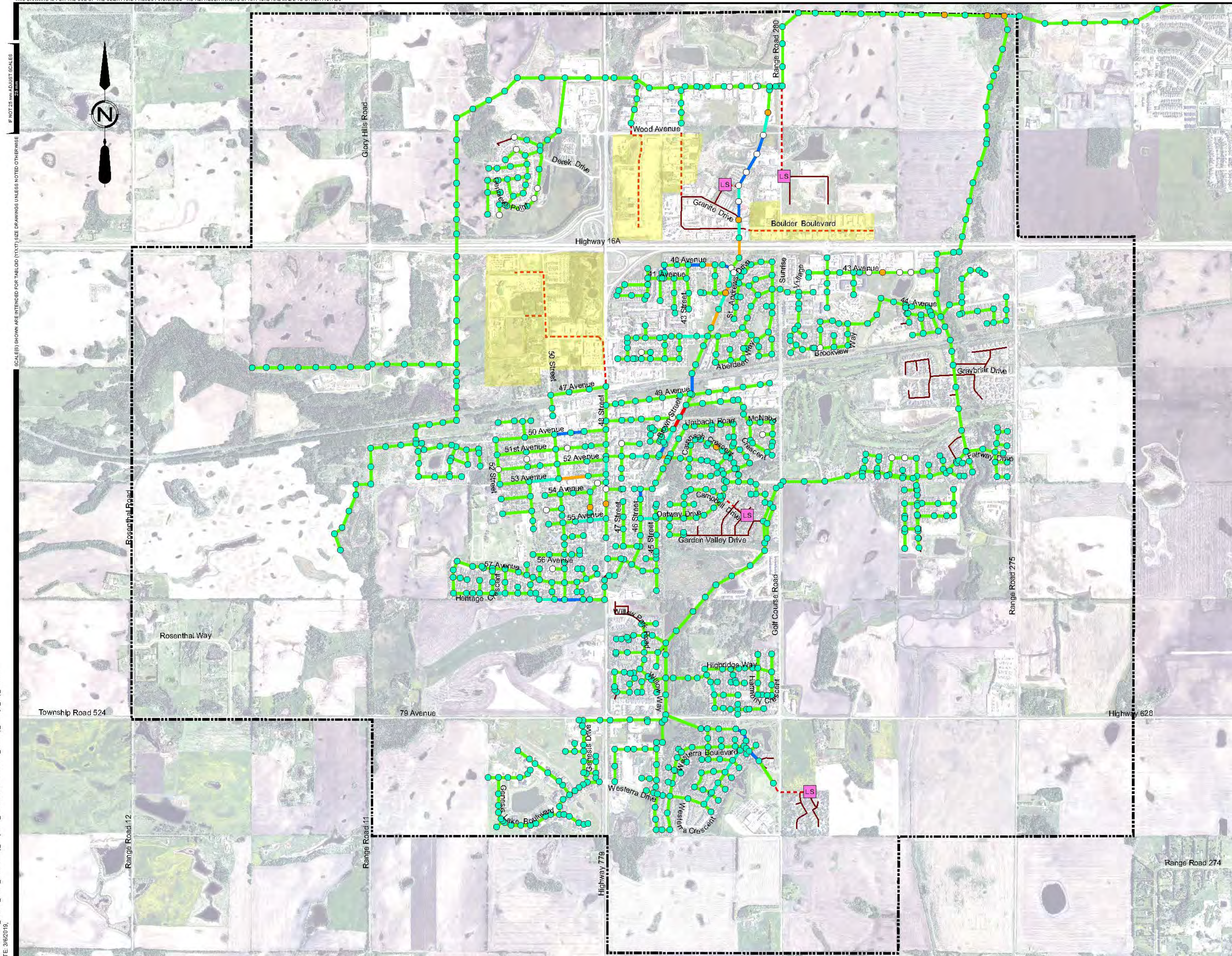
Proposed Storage Option

Central Trunk Profile 1:25 year and 1:100 year 4 hour Design Storm Events



Link ID	653, 652, 651, 650, 649, 647, 645, 641, 639, 638, 637, 635, 634, 633, 632, 631, 630, 629, 628, 626, 625, 624, 623, 622, 621, 620, 619, 618, 617, 616
Link Diameter	0.4000, 0.4500, 0.5000, 0.5250, 0.6000
Shaft ID	CT-37, CT-35, CT-23, CT-20, CT-18, CT-17, CT-15, CT-14, CT-11, CT-10, CT-09, CT-08, CT-07, CT-05, CT-04, CT-03, CT-02
Shaft Diameter	1.2000
Ground Level	705.10, 704.50, 706.00, 701.00, 703.00, 701.00, 700.50, 700.00, 698.00, 700.00, 699.00, 697.40, 697.50, 698.40
Invert Level	699.41, 697.83, 697.58, 697.44, 697.20, 697.00, 696.86, 696.78, 696.66, 696.40, 696.29, 696.18, 696.00
Link Slope	0.12

4/1/2201



Associated Engineering

Legend:

Surcharge Level (m below ground)
- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)
- < 1
- 1 - 1.2
- > 1.2 - 1.5
- > 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

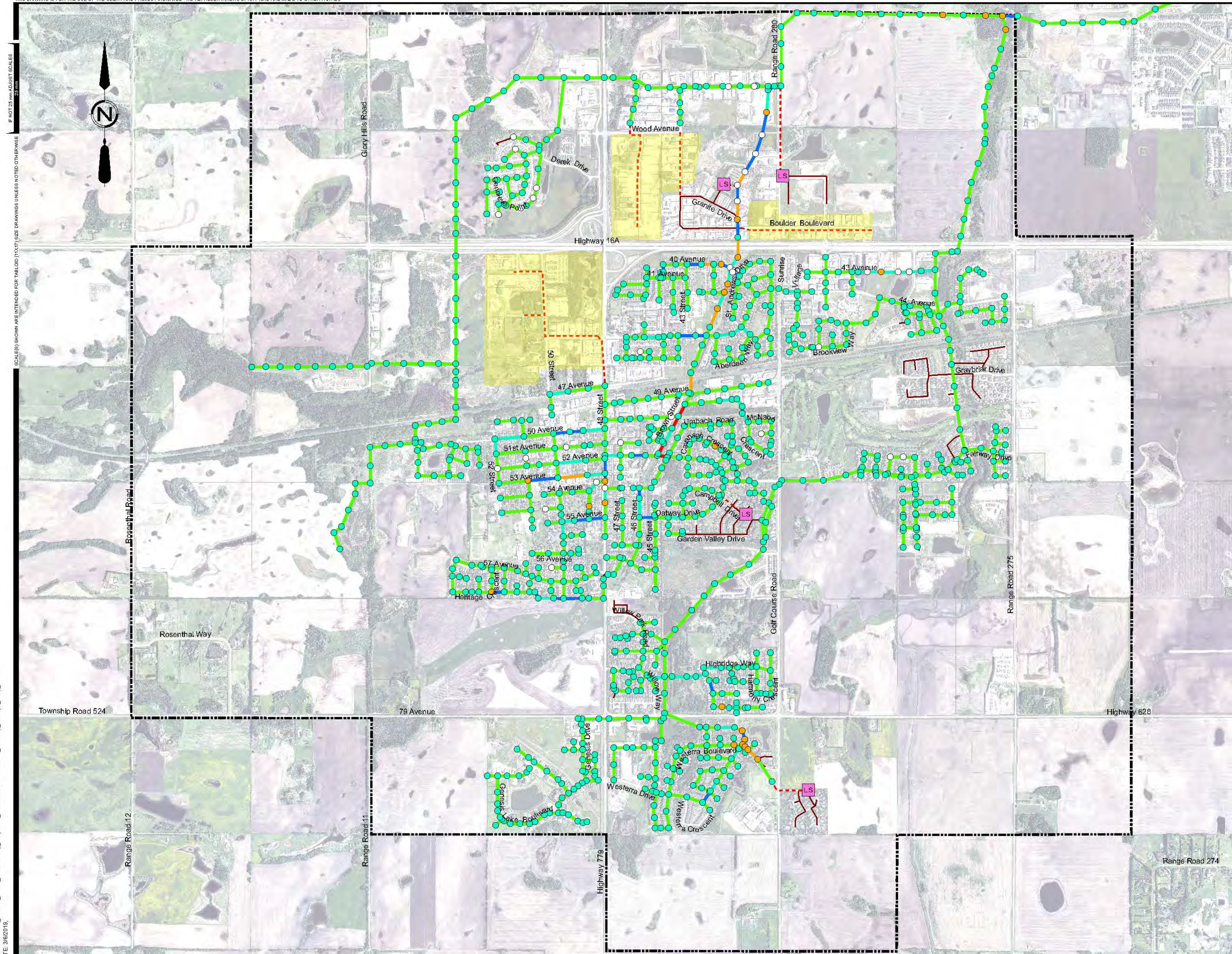
FIGURE No. C-12

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

PROPOSED STORAGE OPTION
SIMULATED SURCHARGE LEVELS AND FLOW LOADING. 1:25 YEAR 4 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

THIS DRAWING IS FOR THE USE OF THE CLIENT AND PROJECT INDICATED - NO REPRESENTATIONS OF ANY KIND ARE MADE TO OTHER PARTIES



Associated Engineering

Legend:

Surcharge Level (m below ground)
- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)
- < 1
- 1 - 1.2
- > 1.2 - 1.5
- > 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. C-13

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

PROPOSED STORAGE OPTION
SIMULATED SURCHARGE LEVELS AND FLOW LOADING. 1:100 YEAR 24 HOUR STORM

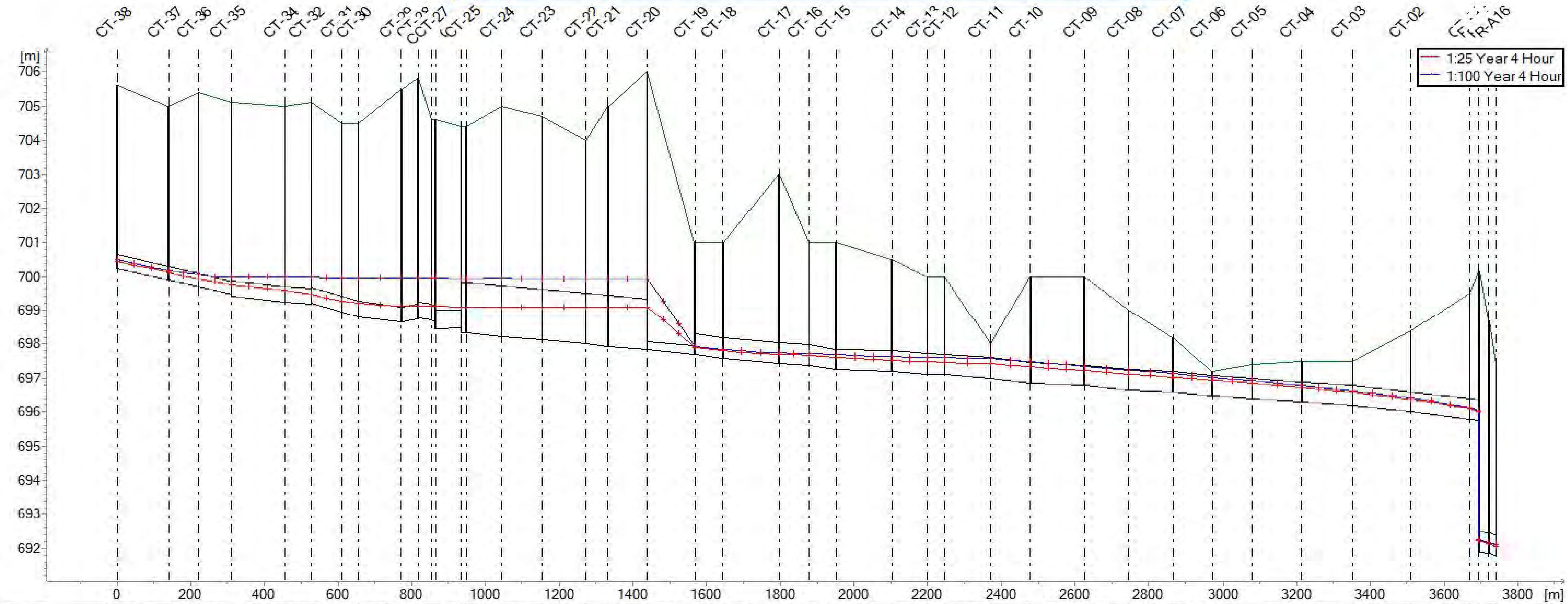
AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

IF NOT 25 mm ADJUST SCALES 25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

P:\20183146\00_Update_Water_and\Working_Dwgs\010_GIS\ArcMap\Sewer\4-21_Sanitary_Storage_100y_4h.mxd
DATE: 3/6/2019,

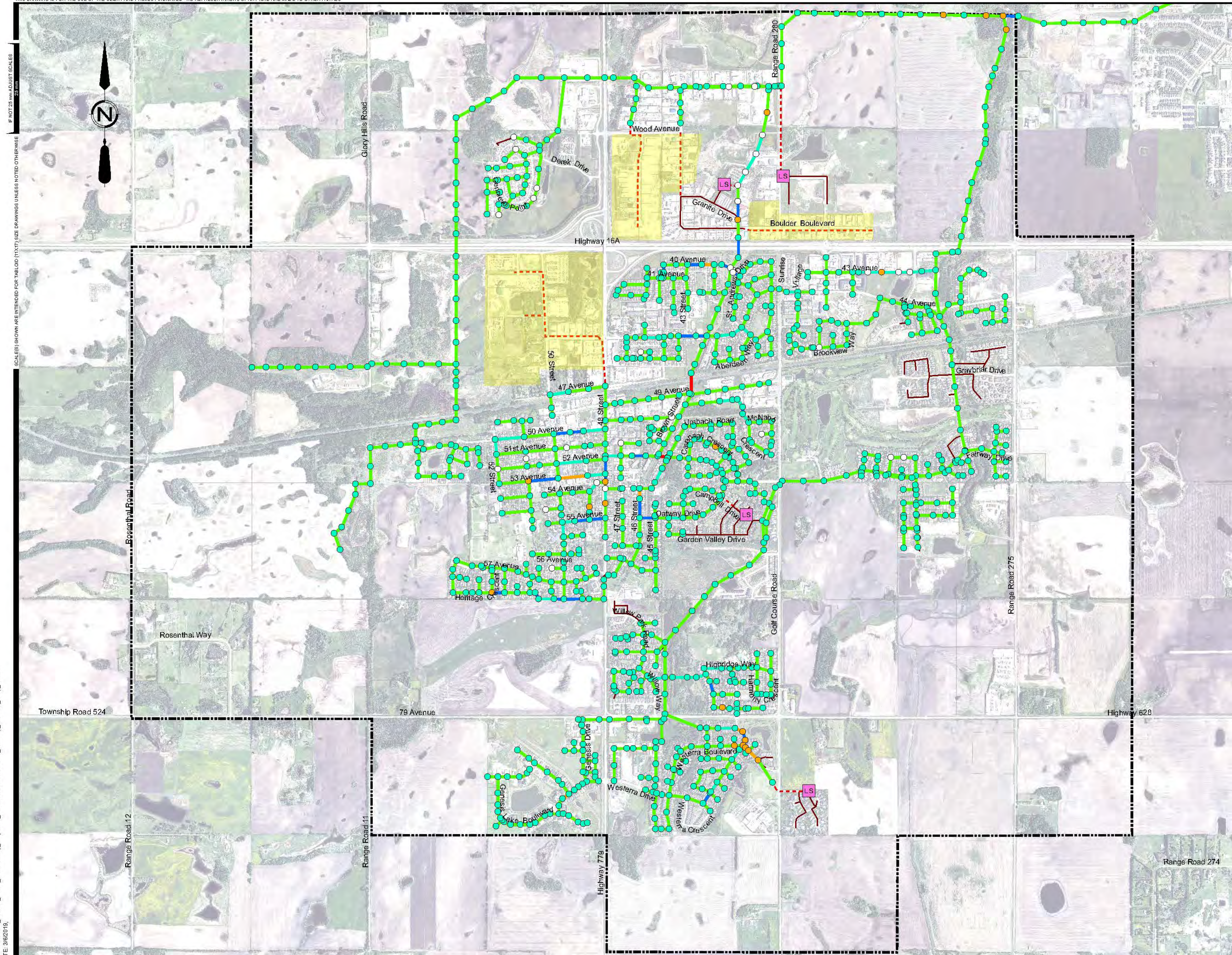
Figure C-14
Proposed Super Pipe Option
Central Trunk Profile 1:25 year and 1:100 year 4 hour Design Storm Events



Link ID	653 | 652 | 651 | 650 | 649 | 647 | .... | 645 | ...... | .... | 641 | . | 639 | 638 | 637 | ..... | 635 | 634 | 633 | 632 | 631 | 630 | 629 | 628 | .... | 626 | 625 | 624 | 623 | 622 | 621 | 620 | 619 | 618 | 617 | 616 | .. | .. | ..
Link Diameter	0.4000 | 0.4500 | ...... | 1.5000 | 0.2500 | 0.6000
Shaft ID	...... | CT-37 | .... | CT-35 | .... | ...... | ...... | ...... | ...... | ... | .. | ... | ... | ..... | .... | CT-23 | .... | .... | CT-20 | .... | CT-18 | CT-17 | .... | CT-15 | CT-14 | ...... | .... | CT-11 | CT-10 | CT-09 | CT-08 | CT-07 | .... | CT-05 | CT-04 | CT-03 | CT-02 | .... | .. | ..
Shaft Diameter	1.2000
Ground Level	...... | .... | .... | 705.10 | .... | ...... | 704.50 | ...... | ... | ...... | .... | .... | .... | .... | .... | 706.00 | 701.00 | 703.00 | 701.00 | 700.50 | 700.00 | 698.00 | 700.00 | 699.00 | .... | .... | 697.40 | 697.50 | 698.40 | .... | .. | ..
Invert Level	...... | .... | .... | 699.41 | .... | ...... | ...... | ...... | ... | .. | ... | ... | ..... | .... | .... | .... | .... | 697.83 | .... | 697.58 | 697.44 | ...... | .... | 697.20 | ...... | .... | 697.00 | 696.86 | 696.78 | 696.66 | .... | .... | 696.40 | 696.29 | 696.18 | 696.00 | .... | .. | ..
Link Slope	.....

6/1/2201

THIS DRAWING IS FOR THE USE OF THE CLIENT AND PROJECT INDICATED - NO REPRESENTATIONS OF ANY KIND ARE MADE TO OTHER PARTIES



Associated Engineering

Legend:

Surcharge Level (m below ground)
- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)
- < 1
- 1 - 1.2
- > 1.2 - 1.5
- > 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. C-15

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

PROPOSED SUPER PIPE OPTION SIMULATED SURCHARGE LEVELS AND FLOW LOADING 1:100 YEAR 4 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

IF NOT 25 mm ADJUST SCALES 25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

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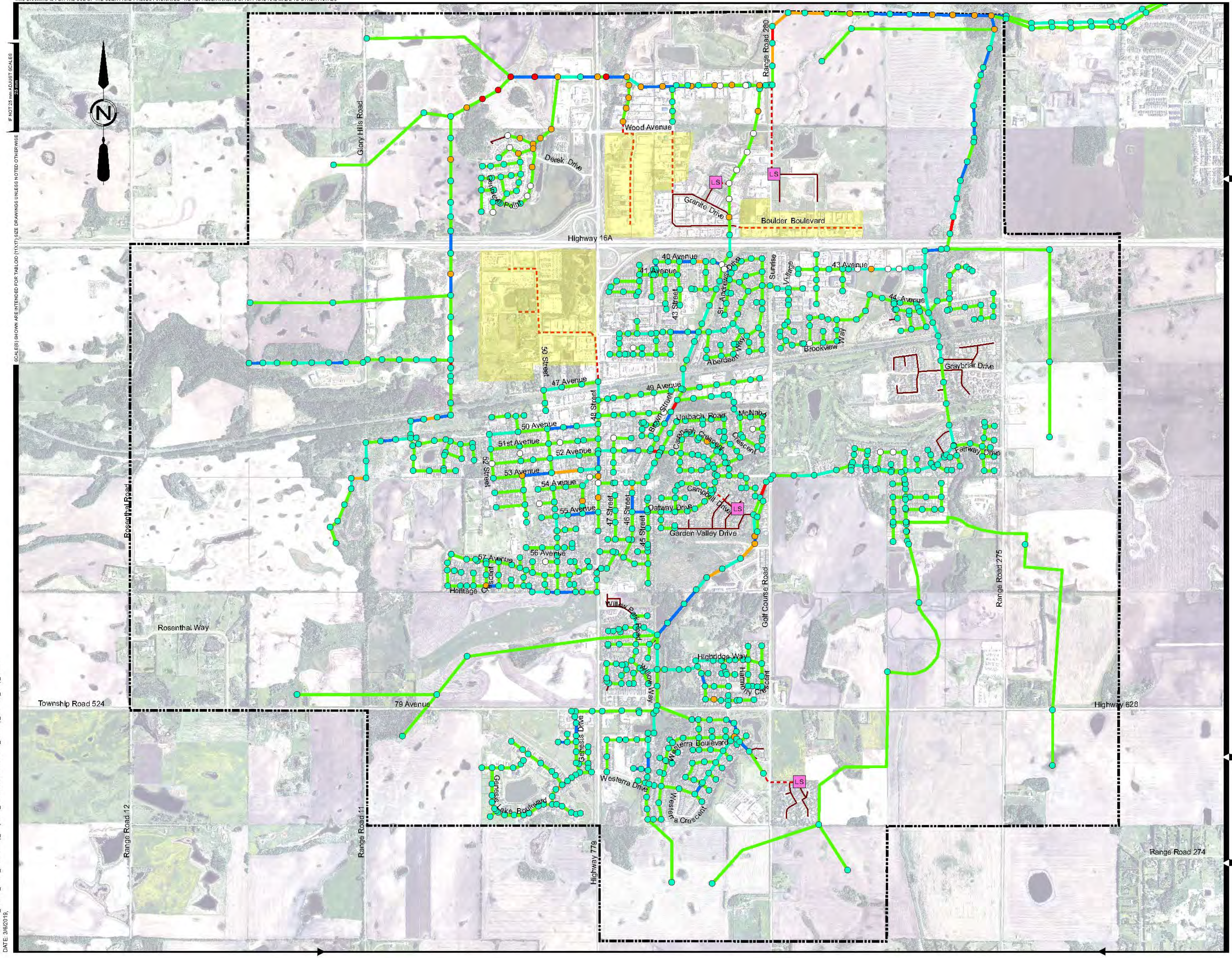
DATE: 3/6/2019;



Associated Engineering

Legend:

Surcharge Level (m below ground)
- < 0
- 0 - 2
- > 2
- Shallow Manhole < 2m Depth

Flow Loading (Qmax/Qf)
- < 1
- 1 - 1.2
- > 1.2 - 1.5
- > 1.5 - 2
- > 2
- Existing Sanitary Sewer
- Forcemain
- Lift Station
- Low Pressure Sewer System
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. C-16

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

ULTIMATE SYSTEM WITH REGIONAL TRUNK UPGRADES SIMULATED SURCHARGE LEVELS AND FLOW LOADING 1:100 YEAR 4 HOUR STORM

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 MARCH
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

Appendix D - Sanitary Fillsinks Analysis

Associated Engineering GLOBAL PERSPECTIVE. LOCAL FOCUS.

Issue Date:	September 12, 2018	**File:**	2018-3146.00.E.03.00
Previous Issue Date			
To:	Patrick Mastromatteo, P.Eng.		
From:	Laurel Richards, E.I.T.		
Client:	Town of Stony Plain		
Project Name	Water and Sanitary Master Plan Update		
Project No.	2018-3146		
Subject:	Fillsinks Task		

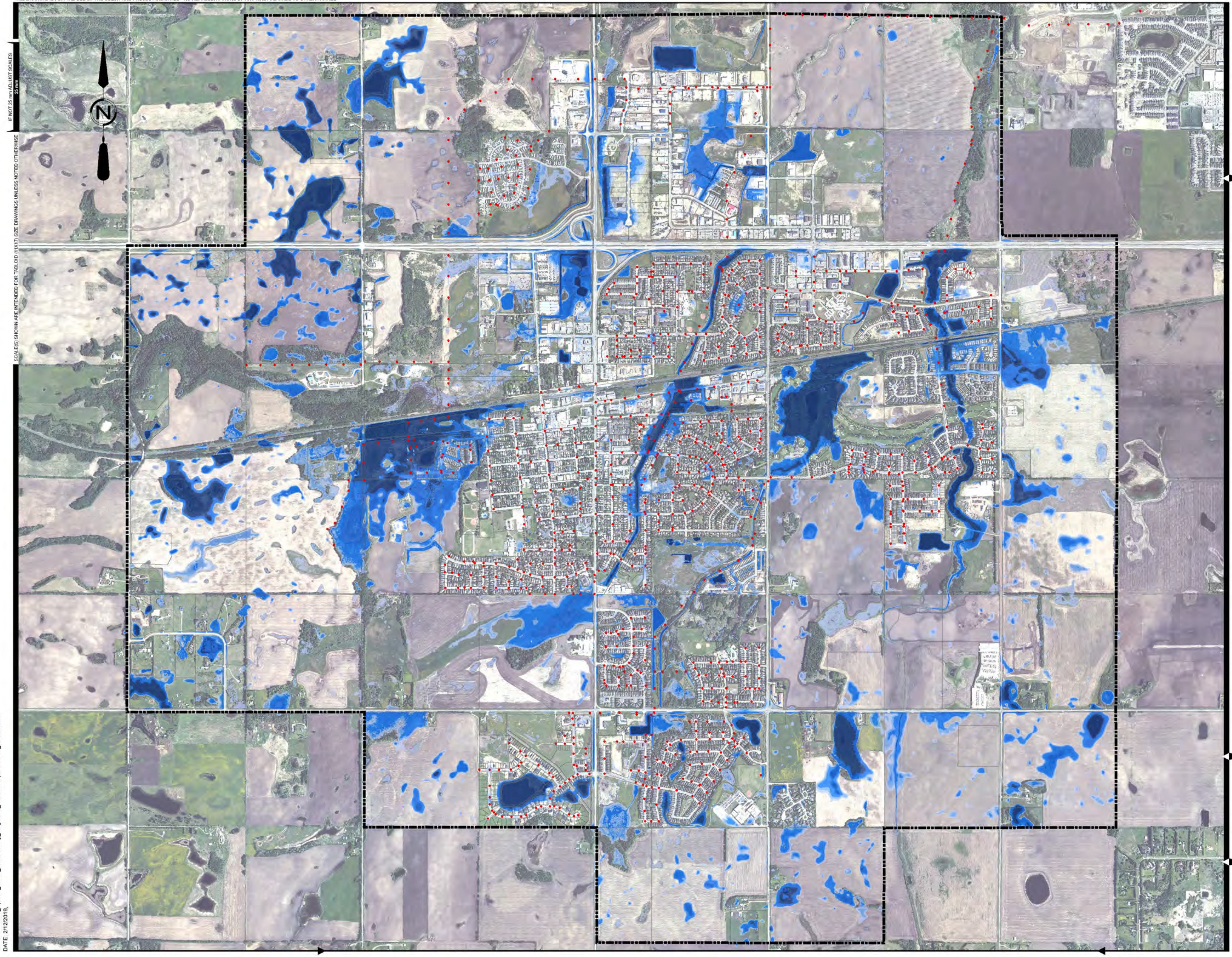
TECHNICAL MEMORANDUM

Associated Engineering completed a "fillsinks" analysis for the Town of Stony Plain as a value-added task under the Water and Sanitary Master Plan Update. Using 1 m LiDAR data, we prepared a map of major street sags in Stony Plain. This is helpful in determining the sanitary manholes located in street sags that are at risk of flooding.

"Fillsinks" creates banded contours of ponding depth based on the topography of an area. In **Figure 1** attached, incremental depths are shown along with existing sanitary manhole locations. Sanitary manholes located where ponding depths are shown are susceptible to inflow and infiltration if manhole vent holes are not plugged. The results of the analysis indicate that this may occur along the Central Trunk, as well as in the Brickyard neighbourhood on the west side of Town. In addition, there are some localized sags located within the St. Andrews, Forest Green, and Meridian Heights neighbourhoods.

Figure 1 may be used as an operational planning tool for manhole plugging as well as to illustrate development areas requiring regrading to facilitate overland drainage.

THIS DRAWING IS FOR THE USE OF THE CLIENT AND PROJECT INDICATED - NO REPRESENTATIONS OF ANY KIND ARE MADE TO OTHER PARTIES



Associated Engineering

Legend:

- Sanitary Manhole

Sinks (height)

- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50
- Stony Plain Boundary

TOWN OF STONY PLAIN

FIGURE No. 1

TOWN OF STONY PLAIN
WATER AND SANITARY MASTER PLAN UPDATE

FILL SINKS

AE PROJECT No.	2018-3146
SCALE	1:25,000
COORD. SYSTEM	NAD 1983 3TM 114
DATE	2019 FEBRUARY
REV	VERSION 1
DESCRIPTION	ISSUED FOR REPORT

Appendix E - Detailed Cost Estimates

Table E-1
Town of Stony Plain
Cost Breakdown - Water System

Upgrades to Existing System

Watermains

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
East of Meridian Meadows	North of Hwy 16A	J-670	Wood Avenue	J-514	675	300	$1,130	$762,750	Undeveloped
East of Meridian Meadows	South of Hwy 16A	J-539	North of Hwy 16A	J-670	125	300	$2,700	$337,500	Developed
Meridian Meadows		J-1074		J-956	85	200	$950	$80,750	Undeveloped
47 Avenue	48 Street	J-57	50 Street	J-60	375	300	$2,410	$903,750	Developed
47 Avenue	50 Street	J-60		J-64	260	200	$2,220	$577,200	Developed
50 Avenue	48 Street	J-72	Brown Street	J-219	470	300	$2,410	$1,132,700	Developed
50 Avenue	50 Street	J-68	49 Street	J-765	200	300	$2,410	$482,000	Developed
50 Street	50 Avenue	J-68	52 Avenue	J-97	200	300	$2,410	$482,000	Developed
51 Avenue	50 Street	J-84	48 Street	J-82	350	300	$2,410	$843,500	Developed
52 Avenue	West of 50 Street	J-98	48 Street	J-103	400	300	$2,410	$964,000	Developed
53 Avenue	East of 50 Street	J-1347	48 Street	J-106	280	300	$2,410	$674,800	Developed
47 Street	54 Avenue	J-239	52 Avenue	J-234	230	300	$2,410	$554,300	Developed
54 Avenue	46 Street	J-244	45 Street	J-331	160	250	$2,300	$368,000	Developed
Folkstone Place	50 Avenue	J-1294	Brickyard Drive	J-1130	365	300	$1,020	$372,300	Undeveloped
51 Street	57 Avenue	J-175	56 Avenue	J-158	190	250	$2,300	$437,000	Developed
Willow Way	Willow Wood Lane	J-1151	79 Avenue	J-1368	80	200	$2,220	$177,600	Developed
Genesis Wynd		J-1173		J-1218	185	200	$950	$175,750	Undeveloped
Golf Course Road	Highridge Way	J-816	Sommerville	J-1085	875	300	$1,130	$988,750	Undeveloped
Total Watermains								$10,315,000	

Hydrants

Hydrants	Quantity	Unit Cost ($/each)	Total Cost
New Hydrant Installation	37	$12,000	$444,000

Meridian Heights Reservoir and Pumphouse

Pumping Upgrades	Quantity	Unit Cost ($/each)	Total Cost
(1 x 140 L/s)	1	$150,000	$150,000

Stage 1

Watermains

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
79 Avenue	Genesis Drive	J-1394		J-1395	500	350	$1,260	$630,000	Undeveloped
Total Watermains								$630,000	

Meridian Heights Reservoir and Pumphouse

Pumping Upgrades	Quantity	Unit Cost ($/each)	Total Cost
New Fire/Standby Pump	1	$250,000	$250,000

Table E-1 continued
Town of Stony Plain
Cost Breakdown - Water System

Stage 2

Watermains

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
Meridian Heights outlet				J-2	30	600	$3,280	$98,400	Developed
43 Avenue	Meridian Hieghts PH	J-2	Meridian Close	J-17	80	450	$2,770	$221,600	Developed
Total Watermains								$320,000	

High Park Reservoir and Pumphouse

Storage Expansion	Volume (m^3)	Unit Cost ($/m)	Total Cost
	4,500	$1,000	$4,500,000

Stage 3

Watermains

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
West Reservoir outlet			J-1434		30	500	$1,790	$53,700	Undeveloped
44 Avenue	50 Street	J-44	Brickyard Drive	J-1430	600	350	$1,260	$756,000	Undeveloped
Brickyard Drive	44 Avenue	J-1430	Folkstone Place	J-1431	600	350	$1,260	$756,000	Undeveloped
Nearby West Reservoir	West Reservoir	J-1434	Brickyard Drive	J-1432	1300	350	$1,260	$1,638,000	Undeveloped
79 Avenue West		J-1395		J-1428	600	350	$1,260	$756,000	Undeveloped
79 Avenue East	Golf Course Road	J-595	Boundary Road	J-1437	1640	350	$1,260	$2,066,400	Undeveloped
North of 79 Avenue East	79 Avenue	J-1426		J-1425	230	350	$1,260	$289,800	Undeveloped
Total Watermains								$6,316,000	

West Reservoir and Pumphouse

New Reservoir and Pumphouse	Volume (m^3)	Unit Cost ($/m)	Total Cost
	15,000	$1,000	$15,000,000

Ultimate Development

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
East Reervoir Outlet				J-1438	30	600	$2,110	$63,300	Undeveloped
79 Avenue East	Boundary Road	J-1437	Reservoir	J-1438	430	350	$1,260	$541,800	Undeveloped
West of West Reservoir					820	500	$1,790	$1,467,800	Undeveloped
West Zone north extension		J-1450		J-1033	235	350	$1,260	$296,100	Undeveloped
Hwy 16A Crossing					65	350	$3,000	$195,000	Developed
West Zone (far west) mains					6600	350	$1,260	$8,316,000	Undeveloped
Total Watermains								$10,880,000	

East Reservoir and Pumphouse

New Reservoir and Pumphouse	Volume (m^3)	Unit Cost ($/m)	Total Cost
	15,000	$1,000	$15,000,000

Table E-2
Town of Stony Plain
Water Distribution System Unit Costs ($/m)

Watermains

Undeveloped Lands

Item	200mm	250mm	300mm	350mm	400 mm	450 mm	500 mm	600 mm
Topsoil Stripping and Stockpile (assume depth of 0.4m)	$21	$21	$21	$21	$23	$23	$23	$23
Trenching and backfilling	$305	$305	$305	$305	$357	$357	$357	$357
Pipe Zone Material	$32	$32	$32	$32	$58	$58	$58	$58
Supply and Install DR18 Pipe	$95	$125	$180	$240	$315	$405	$500	$695
Place Topsoil, compact and seed	$42	$42	$42	$42	$47	$47	$47	$47
Fire Hydrant (1 every 90 m)	$116	$116	$116	$116	$116	$116	$116	$116
Gate valve (1 per 100m 300mm down, 1 per 200m 400mm and up)	$37	$58	$79	$105	$68	$89	$116	$147
Fittings (Tees, Bends, Reducers, Plugs)	$13	$15	$17	$18	$23	$27	$32	$36
Miscellaneous (Mob/De-Mob, Survey, Signage) (10%)	$66	$71	$79	$88	$101	$112	$125	$148
Total Construction	$727	$785	$871	$967	$1,108	$1,234	$1,374	$1,627
Contingency (15%)	$109	$118	$131	$145	$166	$185	$206	$244
Engineering (15%)	$109	$118	$131	$145	$166	$185	$206	$244
Project Total (rounded)	**$950**	**$1,020**	**$1,130**	**$1,260**	**$1,440**	**$1,600**	**$1,790**	**$2,110**

Developed Lands

Item	200mm	250mm	300mm	350mm	400mm	450 mm	500 mm	600 mm
Asphalt Pavement Removal	$52	$52	$52	$52	$79	$79	$79	$79
Granular Base Removal and Disposal	$37	$37	$37	$37	$53	$53	$53	$53
Curb, Gutter and Sidewalk Removal	$58	$58	$58	$58	$58	$58	$58	$58
Trenching and Backfilling	$420	$420	$420	$420	$473	$473	$473	$473
Pipe Zone Material	$32	$32	$32	$32	$58	$58	$58	$58
Supply and Install DR 18 Pipe	$95	$125	$180	$240	$315	$405	$500	$695
Existing Pavement Repair	$231	$231	$231	$231	$347	$347	$347	$347
New Monolithic Curb, Gutter and Sidewalk	$221	$221	$221	$221	$221	$221	$221	$221
Fire Hydrant (1 every 90 m)	$116	$116	$116	$116	$116	$116	$116	$116
Gate valve (1 per 100m 300mm down, 1 per 200m 400mm and up)	$37	$58	$79	$105	$68	$89	$116	$147
Fittings (Tees, Bends, Reducers, Plugs)	$13	$15	$17	$18	$23	$27	$32	$36
Reconnect Services	$231	$231	$231	$231	$0	$0	$0	$0
Manhole/Valve/Catch Basin Adjustments	$11	$11	$11	$11	$11	$11	$11	$11
Miscellaneous (Mob/De-Mob, Survey, Signage) (10%)	$155	$161	$169	$177	$182	$194	$206	$229
Total Construction	$1,709	$1,768	$1,854	$1,949	$2,004	$2,131	$2,270	$2,523
Contingency (15%)	$256	$265	$278	$292	$301	$320	$341	$379
Engineering (15%)	$256	$265	$278	$292	$301	$320	$341	$379
Project Total (rounded)	**$2,220**	**$2,300**	**$2,410**	**$2,530**	**$2,610**	**$2,770**	**$2,950**	**$3,280**

Table E-3
Town of Stony Plain
Cost Breakdown - Sanitary System

Upgrades to Existing System

Sanitary

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
Downtown	Garden Valley Drive	79-1	45 Street	88-1	65	300	$2,120	$137,800	Developed
Downtown	52 Ave/Egerland Place	78-31	Oatway Drive/Umbach Road	78-29	175	375	$2,300	$402,500	Developed
Downtown	52 Ave/Egerland Place	78-29	Oatway Drive/Umbach Road	CT-26	80	450	$2,020	$161,600	Developed
Downtown	52 Ave/Egerland Place	CT-27	Oatway Drive/Umbach Road	CT-26	70	525	$2,090	$146,300	Developed
Downtown	52 Ave/Oatway Drive	CT-26	North of 44 Ave/Meridian Heights School Baseball Diamonds	CT-15	1050	750	$2,430	$2,551,500	Developed
Meridian Heights/North Business Park	North of 44 Ave/Meridian Heights School Baseball Diamonds	CT-15	Boulder Boulevard	R-A14	1750	900	$2,680	$4,690,000	Developed
Total Upgrades to Existing System								$7,952,000	

Storage Option

Sanitary

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Volume (m^3)	Unit Cost ($/m)	Pipe Cost ($)	Type
Downtown	Garden Valley Drive	79-1	45 Street	88-1	65	300		$2,120	$137,800	Developed
Downtown	52 Ave/Egerland Place	78-31	Oatway Drive/Umbach Road	78-29	175	375		$2,300	$402,500	Developed
Downtown	52 Ave/Egerland Place	78-29	Oatway Drive/Umbach Road	CT-26	80	450		$2,020	$161,600	Developed
Downtown	52 Ave/Egerland Place	CT-27	Oatway Drive/Umbach Road	CT-26	70	525		$2,090	$146,300	Developed
Downtown	Brown Street	CT-24	Storage Tank		30	525		$2,090	$62,700	Developed
Downtown	Storage Tank						400	$2,500	$1,000,000	Developed
Downtown	Pump							$100,000	$100,000	Developed
Total Storage Option									$2,011,000	

Super Pipe Option

Sanitary

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
Downtown	Garden Valley Drive	79-1	45 Street	88-1	65	300	$2,120	$137,800	Developed
Downtown	52 Ave/Egerland Place	78-31	Oatway Drive/Umbach Road	78-29	175	375	$2,300	$402,500	Developed
Downtown	52 Ave/Egerland Place	78-29	Oatway Drive/Umbach Road	CT-26	80	450	$2,020	$161,600	Developed
Downtown	52 Ave/Egerland Place	CT-27	Oatway Drive/Umbach Road	CT-26	70	525	$2,090	$146,300	Developed
Downtown	52 Ave/Oatway Drive	CT-26	49 Ave	CT-20	500	1500	$4,180	$2,090,000	Developed
Downtown	49 Ave	CT-20	under CNR	CT-19	130	250	$2,110	$274,300	Developed
Total Storage Option								$3,213,000	

Table E-3 continued
Town of Stony Plain
Cost Breakdown - Sanitary System

Stage 1 Development

Sanitary

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
East side south of Highway 16A		ET14-1		ET-14A	720	525	$1,100	$792,000	Undeveloped
South Creek		ET29-5		ET29-1	700	750	$1,390	$973,000	Undeveloped
South Creek		ET29-2		0732	510	900	$1,650	$841,500	Undeveloped
Total Stage 1								$2,607,000	

Stage 2 Development

Sanitary

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
Northeast		ET2-2		ET2-1	305	450	$1,030	$314,150	Undeveloped
Northeast		ET2-1		ET-2	1000	525	$1,100	$1,100,000	Undeveloped
East of Boundary Road, south of Highway 16A		ET14-3		ET14-1	1305	525	$1,100	$1,435,500	Undeveloped
Tussic		ET29-8		ET29-2	815	750	$1,390	$1,132,850	Undeveloped
Southwest		ET62-1		ET-61	1340	900	$1,650	$2,211,000	Undeveloped
Total Stage 2								$6,194,000	

Stage 3 Development

Sanitary

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
Southwest		ET62-4		ET62-2	375	525	$1,100	$412,500	Undeveloped
Southwest		ET62-2		ET62-1	340	900	$1,650	$561,000	Undeveloped
Total Stage 3								$974,000	

Ultimate Development

Sanitary

Location	From	Start Node	To	Stop Node	Length (m)	Diameter (mm)	Unit Cost ($/m)	Pipe Cost ($)	Type
Northwest		A1-3		R-A1	1110	525	$1,100	$1,221,000	Undeveloped
Northwest		A1-5		A1-1	775	375	$990	$767,250	Undeveloped
Northwest		A1-1		WT-05	190	450	$1,030	$195,700	Undeveloped
West side south of Highway 16A		A4-2		A4-1	580	450	$1,030	$597,400	Undeveloped
West side south of Highway 16A		A4-1		WT-14	820	525	$1,100	$902,000	Undeveloped
Southwest		ET62-3		ET62-2	980	750	$1,390	$1,362,200	Undeveloped
South of Lake Westerra Estates		ET66-3		13W	515	375	$990	$509,850	Undeveloped
South of Country Plains Estates		ET29-11		ET29-10	375	375	$990	$371,250	Undeveloped
South of Country Plains Estates		ET29-12		ET29-10	880	450	$1,030	$906,400	Undeveloped
East of Country Plains Estates		ET29-10		ET29-8	1450	750	$1,390	$2,015,500	Undeveloped
East of Boundary Road		ET29-7		ET29-6	390	375	$990	$386,100	Undeveloped
East of Boundary Road		ET29-6		ET29-5	1400	600	$1,300	$1,820,000	Undeveloped
Total Ultimate								$11,055,000	

Table E-4
Town of Stony Plain
Sanitary Collection System Unit Costs ($/m)

Sanitary Sewer

Undeveloped Lands

Item	200mm	250mm	300mm	375mm	450mm	525mm	600mm	750mm	900mm	1500mm Conc
Topsoil Stripping and Stockpile (assume depth of 0.4m)	21	21	21	23	23	23	26	26	26	26
Trenching and backfilling	305	305	305	357	357	357	410	410	410	410
Pipe Zone Material	32	32	32	58	58	58	84	84	84	84
Supply and Install DR 35 Pipe	58	63	69	76	110	158	210	273	452	1,500
Place Topsoil, compact and seed	42	42	42	47	47	47	53	53	53	53
Manholes (1 every 100 m)	131	131	131	131	131	131	131	131	131	131
Miscellaneous (Mob/De-Mob, Survey, Signage) (10%)	49	57	57	66	69	74	87	93	110	110
Total Construction	638	651	657	758	795	848	1,001	1,070	1,266	2,314
Contingency (15%)	96	98	99	114	119	127	150	161	190	347
Engineering (15%)	96	98	99	114	119	127	150	161	190	347
Total (rounded)	**830**	**850**	**850**	**990**	**1,030**	**1,100**	**1,300**	**1,390**	**1,650**	**3,010**

Developed Lands

Item	200mm	250mm	300mm	375mm	450mm	525mm	600mm	750mm	900mm	1500mm Conc
Asphalt Pavement Removal	$53	$53	$53	$79	$79	$79	$105	$105	$105	$105
Granular Base Removal and Disposal	$37	$37	$37	$53	$53	$53	$68	$68	$68	$68
Curb,Gutter, Sidewalk Removal	$58	$58	$58	$58	$58	$58	$58	$58	$58	$58
Trenching and Backfilling	$420	$420	$420	$473	$473	$473	$525	$525	$525	$525
Pipe Zone Material	$32	$32	$32	$58	$58	$58	$84	$84	$84	$84
Supply and Install DR 35 Pipe	58	63	69	76	110	158	210	273	452	1,500
Monolithic Sidewalk Curb and Gutter	$221	$221	$221	$221	$221	$221	$221	$221	$221	$221
Existing Pavement Repair	$231	$231	$231	$231	$231	$231	$231	$231	$231	$231
Reconnect Services	$231	$231	$231	$231	$0	$0	$0	$0	$0	$0
Manholes (1 every 100 m)	$131	$131	$131	$131	$131	$131	$131	$131	$131	$131
Miscellaneous (Mob/De-Mob, Survey, Signage) (10%)	$147	$148	$148	$161	$141	$146	$163	$170	$188	$292
Total Construction	1,619	1,625	1,631	1,772	1,555	1,608	1,796	1,866	2,063	3,215
Contingency (15%)	243	244	245	266	233	241	269	280	309	482
Engineering (15%)	243	244	245	266	233	241	269	280	309	482
Total (rounded)	**$2,100**	**$2,110**	**$2,120**	**$2,300**	**$2,020**	**$2,090**	**$2,340**	**$2,430**	**$2,680**	**$4,180**