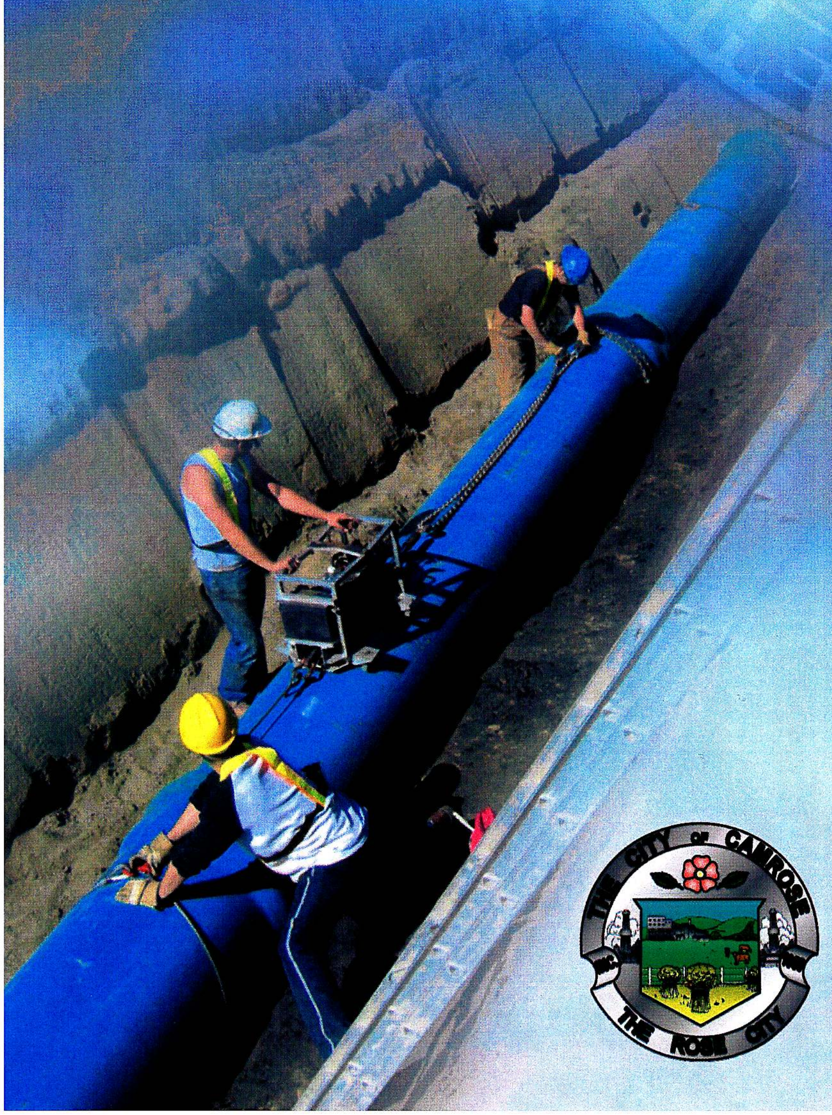
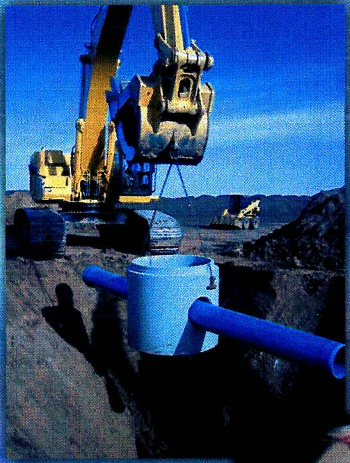
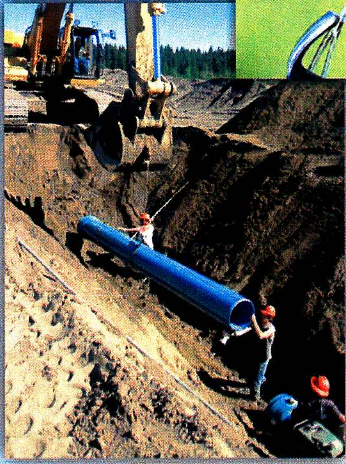
REPORT

The City of Camrose

Water Distribution System 2006 Master Plan Update







Associated Engineering

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1 Introduction

1.1 BACKGROUND

Due to the rapid development in the City of Camrose, the City needs to update its existing water distribution master plan.

The purpose of this Master Plan is to review and assess the performance of the existing water distribution system and potential expansion areas for the 5, 10 and 20 year growth scenarios. During the course of the project, the scope of the study was expanded to include the 50 year (ultimate) growth scenario. The growth scenarios were then changed to focus on the following: short-term (5 years), mid-term (20 years) and long-term (50 years) growth periods. Through computer simulation, the City of Camrose water distribution system was assessed for the required growth periods and improvements identified.

The 2006 Master Plan Update included the evaluation of available water distribution modelling software. The evaluation yielded the best suited software for the City of Camrose to adopt.

Figure 1.1 shows the existing City corporate boundary and the project Study area.

1.2 OBJECTIVES

The objectives of this Master Plan update are:

1.2.1 Modelling Software Evaluation

A number of hydraulic modelling software in the market today will be evaluated. The evaluation will be based on criteria to suit the City's best needs. The City's water system will be then be constructed using the selected software.

1.2.2 Water Network Analysis

With the assistance of the selected software, the City's network will be analyzed for:

- existing conditions
- short term growth (5 years)
- mid-term growth (20 years)
- ultimate growth (50 years)

Upon completion of the analysis, the report will include upgrade plans, phasing plans and cost estimates.

1.3 AUTHORIZATION

In May 2006, the City of Camrose authorized Associated Engineering to proceed with the Water Distribution System Master Plan Update. A start-up meeting was held on July 4, 2006 in the Camrose City Hall.

1.4 ACKNOWLEDGMENTS

Associated Engineering Alberta Ltd. gratefully acknowledges the advice, assistance and guidance provided by Ted Gillespie, City Engineer; Jeremy Enarson, Assistant Municipal Engineer; Jim Kupka, Director of Public Works and Sean Mascaluk, Superintendent of Utilities, during the preparation of this report.

1.5 REFERENCES

The following references were used in the execution of this project and preparation of this report:

1. City of Camrose – Growth Study Update 2006-2056; prepared by Brown and Associates Planning Group, November 2006.
2. City of Camrose – Water Distribution System Master Plan; prepared by Infrastructure Systems Ltd., April 2000.
3. City of Camrose – Sanitary Sewer Collection System Master Plan 2006; prepared by Associated Engineering, June 2006.
4. City of Camrose – Water Treatment Capacity Evaluation & Planning Study; prepared by Epcor, July 2003
5. Water consumption records provided by the City.
6. Existing Water Distribution System – Watercad Model provided by the City.

1.6 LIST OF ABBREVIATIONS

1.6.1 Metric Units

ha	hectare
sq m	square metres
cu m	cubic metres
L	litres
L/s	litres per second
L/d	litres per day
L/c/d	litres per capita day
L/d/ha	litres per day per hectare
ML	megalitres (1,000,000 litres)
MLD	megalitres per day
m	metres
m^3	cubic metres
m/s	metres per second

mm	millimetres
km	kilometres
sq km	square kilometres
kPa	kilopascal

1.6.2 Imperial Units

ac	acres
ac ft	acre feet
MIG	million imperial gallons
MIGD	million imperial gallons per day
ig	imperial gallons
igpm	imperial gallons per minute
igpd	imperial gallons per day
igpcd	imperial gallons per capita day
igpad	imperial gallons per acre per day

1.6.3 U.S. Units

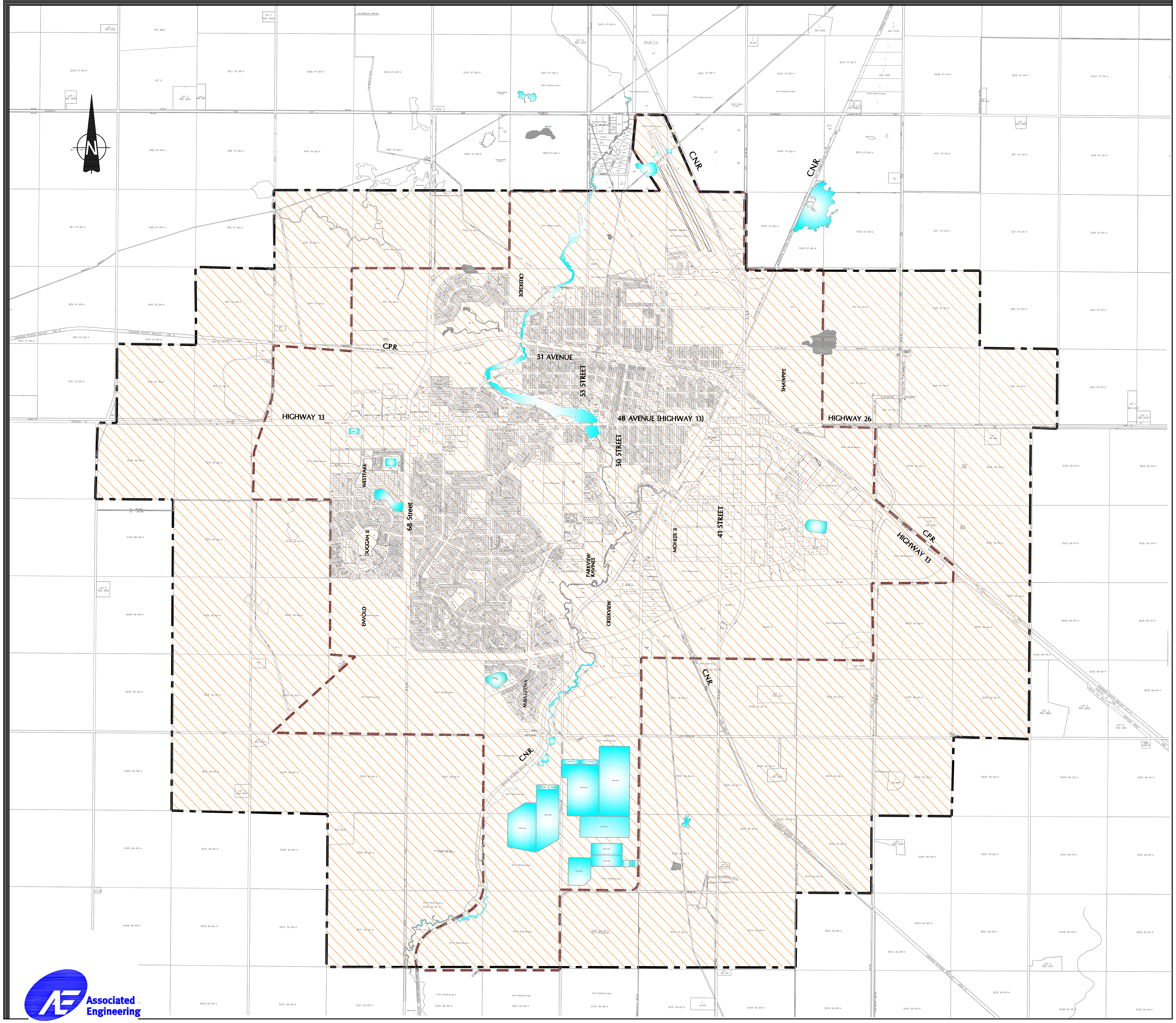
Usgpm	United States gallons per minute
ft	feet
fps	feet per second
psi	pounds per square inch

1.6.4 Miscellaneous

TDH	Total Dynamic Head
HGL	Hydraulic Grade Line
HWL	High Water Level
RES	Reservoir
PH	Pumphouse
WTP	Water Treatment Plant
HP	Horsepower
RPM	Revolutions per minute
ISO	Insurance Services Office
ISU	Iowa State University
IITRI	Illinois Institute of Technology Research Institute
NFPA	National Fire Protection Association
AEP	Alberta Environmental Protection
VFD	Variable Frequency Drive

1.6.5 Metric Conversion Factors

TO CONVERT FROM	TO	MULTIPLY 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	3.666
cubic metres/hour (m^3/hr)	USgpm	4.403
hectares (ha)	acres	2.471
kilopascals (KPa)	psi	0.1450
kilowatts (kw)	horsepower (HP)	1.341
litres/sec (L/s)	igpm	13.20
litres/sec (L/s)	USgpm	15.85
megalitres (ML)	imp gal (ig)	219,974
metres (m)	ft	3.281
millimetres (mm)	inches	0.0394
US gallons	imperial gallons	0.833



Associated Engineering

THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

STUDY AREA

LEGEND:

EXISTING CITY BOUNDARY

STUDY BOUNDARY

STUDY AREA

SCALE: 1 : 40,000

December, 2007

FIGURE 1.1

Time: 8:45am
Date: Dec 19, 2007
File: P:\20063076\00_CamroseWDSystem\Working_Dwgs\100_Civil\REPORT -FINAL\FR_3076-FG-1.1-study area.dwg by BW
Xrefs: 3076-RP01_BASE_2005_nad27
3076_RT-01_AE_BDR

2 Existing Facilities

2.1 INVENTORY OF EXISTING FACILITIES

2.1.1 Existing Raw Water Supply

The raw water supply system draws raw water from Dried Meat Lake to a lake station pump house. It is then pumped to a collector well and re-pumped to the City's water treatment plant.

The components of the water supply system, their brief description and features are as follows:

2.1.1.1 Raw Water Source

- All water used in Camrose is drawn from the midpoint of Dried Meat Lake, located 13 km southeast of Camrose.

2.1.1.2 Lake Intake

- The intake screens are located in the lake approximately 100 m off shore in deeper water.
- The 600 mm diameter HDPE conductor pipe is rested on the bottom of the lake between the intake and the lake station.

2.1.1.3 Lake Station Pump House

- The lake station pump house consists of the following main components:
  - Two 25 hp pumps in the raw water well.
  - Two 75 hp pumps in the clear water well.
- Maximum flow measured during the draw down test on July 31, 2001 was 13.21 MLD.
- The pumps transfer water from the lake station pump house to the collector well via a 300 mm pipeline.

2.1.1.4 Collector Well

- A 7.0 m diameter and 16.7 m deep "Cylindrical" shaped collector well, is located on top of the valley slope of the Battle River, with a design capacity of 0.6 ML of raw water.

- The pumps transfer water from the collector well to the City's water treatment plant via the raw water supply pipeline.
- Three 100 hp pumps located in the collector well.

2.1.1.5 Raw Water Supply Pipeline

- The 600 mm diameter raw water supply pipeline extends approximately 13 km between the raw water supply facilities on the north bank of the Battle River to the water treatment facilities located on the south side of the City of Camrose.

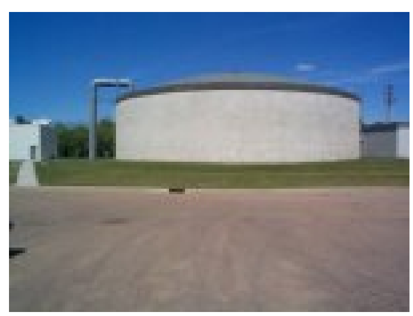
2.1.2 Existing Water Treatment Facilities

2.1.2.1 Existing Water Treatment Plant (WTP)

- The existing WTP was built in 1986.
- The rated capacity of the plant is 13.5 MLD with clarifiers running in parallel without water softening or 6.75 MLD with clarifiers running in series with water softening. (Information from "Water Treatment Capacity Evaluation & Planning Study" for the City of Camrose prepared by Epcor in July 2003.)
- The WTP currently treats an average of 5.6 MLD throughout the year.
- The plant is operated 24 hours per day. All filters are running each day (under normal conditions); each filter is backwashed once every 72 hours; other filters still operate during backwash.

2.1.3 Existing Water Storage and Pumping Facilities

2.1.3.1 High Lift Pump Station No. 2 (HLPS #2) and Reservoir



- HLPS #2 was built in 1966 and upgraded in 1983.
- HLPS #2 is located immediately north of the existing WTP.
- Potable water is supplied from WTP to storage via a 600 mm diameter pipeline.
- Potable water storage at HLPS #2 is approximately 3,600 cu.m.
- HLPS #2 has two distribution pumps (P-201 & P-202) and one standby pump (P-200).

- P-201 and P-202, pump potable water from the water reservoir, into the distribution system.
- The electric motor driven service pump P-201 is rated at 136.4 L/s @ 48.8 m TDH.
- The electric motor driven service pump P-202 is rated at 132.6 L/s @ 48.8 m TDH.
- The natural gas driven standby pump P-200 (fire pump) is rated at 136.4 L/s @ 48.8 m TDH.

HLPS #2			
Pump #	P-201	P-202	P-200 (Standby)
Pumping Head	@ 48.8 m TDH	@ 48.8 m TDH	@ 48.8 m TDH
Capacity	136.4 L/s	132.6 L/s	136.4 L/s
Storage Volume	3,600 m^3		

Note: Only one service pump is pumping at any time

2.1.3.2 High Lift Pump Station No. 3 (HLPS #3) and Reservoirs

- HLPS #3 was built in 1983 and is located at the southwest corner of the 44 Avenue and 55 Street intersection.
- The north reservoir was constructed in 1983 and has a storage capacity of 9,000 cu.m. The south reservoir was built in 1992 and has a storage capacity of 12,000 cu.m. (total storage available at HLPS #3 is 21,000 cu.m)
- Potable water is supplied from the WTP to storage reservoirs via a 600 mm diameter pipeline.
- HLPS #3 has four distribution pumps (P-301, P-302, P-303, P-304) with each rated at 94.7 L/s @ 57.9m TDH, electric driven.
- HLPS #3 has a standby pump (P-300) rated at 157.8 L/s @ 70.1 m TDH, diesel engine driven.
- HLPS #3 has two spare pump bays for future pump installation.

HLPS #3				
Pump #	1 pump @ 57.9 m TDH	2 pumps @ 57.9 m TDH	3 pumps @ 57.9 m TDH	P-300 (Standby) @ 70.1m TDH
Capacity	94.7 L/s	189.4 L/s	284.1 L/s	157.8 L/s
Storage Volume	21,000 m^3			

Note: Only three out of four service pumps are operating parallel at any time, the pumps can deliver 284 L/s at 57.9 m TDH (567 kPa).

2.1.3.3 Duggan Booster Station (B. Stn.)

- The B. Stn. was constructed in 1987.
- The B. Stn. is located at the northwest corner of 68 Street and Marler Drive intersection.
- The B. Stn is required to boost and maintain the desirable operating pressure on the southwest side of the City (development west of 68 Street).
- The B. Stn. also requires boosting pressure to transmit water to Village of Bittern Lake which is located approximately 13 km west of Camrose, and to the Ervick Subdivision which is a small industrial subdivision located halfway along the Bittern Lake water line.
- The B. Stn. has three service pumps.
- Discharge pressure set point is 45.9 m (450 KPa).

2.1.3.4 Summary Table

Facilities	Pumps	Capacity	Storage
HLPS #2	P-201 @ 48.8 m	136.4 L/s	3,600 m^3
	P-202 @ 48.8 m	132.6 L/s	
	P3 (Standby) @ 48.8 m	136.4 L/s	
HLPS #3	Any one pump @ 57.9 m	94.7 L/s	21,000 m^3
	Any two pumps in parallel @ 57.9 m	189.4 L/s	

Facilities	Pumps	Capacity	Storage
	Any three pumps in parallel @ 57.9 m	284.1 L/s	
	P-300 (Standby) @ 70.1m	157.8 L/s	
Duggan Booster Station	P-401	n/a	Nil
	P-402	n/a	
	P-400 (Standby)	n/a	

2.1.4 Water Distribution Mains

- The City has a network of distribution mains of various diameters and pipe materials:
  - Pipe distribution network of over 150 km in total length.
  - Pipe size ranges from 100 mm to 450 mm diameter.
  - Pipe material includes Asbestos Cement (AC); Cast Iron (CI); PVC and Steel.

- The City’s current standard for minimum size of water distribution main is 150 mm diameter for single family residential, 200 mm diameter for multi-family residential and 250 mm diameter for industrial / commercial; 100 mm diameter watermains are currently permitted in cul-de-sacs, upon approval by the City Engineer. While these are the current minimum sizes of watermains, the City occasionally requires developers to oversize certain watermains within a development. Which watermains are oversized, and the size of the approved watermain, is dictated by the City through a combination of existing planning documents and/or the results of water distribution computer modelling.

- The City has been implementing a replacement program of the cast iron (CI) mains since 1982. Currently the City has approximately 700 m of CI mains left to be replaced. The CI mains will be replaced in coordination with future road surfacing programs.

3 Design Criteria

3.1 LAND USE

Municipal servicing requirements for the City of Camrose are based on the existing and projected land uses, as shown in Figure 3.1.

Figure 3.1 presents the projected land uses and the assumed growth study area sequence for the next 50 years (Year 2056).

3.2 TOPOGRAPHY

The deep Camrose Creek valley, which runs north-south, divides the City of Camrose into two distinct sections. The terrain within the current study limits generally slopes from the west and the east towards Camrose Creek valley. The elevations on both sides of the Creek bank at City centre ranges from 730 m to 740 m. The elevations from the east end City to the west end of the current City limits range from 746 m to 750 m. The maximum difference in elevation within the study area is approximately 20.0 m.

3.3 POPULATION

One of the key variables in assessing the water system of a community is the population to be served. The population will:

- Provide a measure of the quantity of water required.
- Have an impact on the peaking factor.
- Have an impact on the distribution system based on population concentration (density).
- Determine the requirement for fire flows.

The 2005 population for the City of Camrose was 15,850 (based on the census conducted in 2005). The present population is estimated to be in the order of 16,000 (based on the latest 2007 City of Camrose - Growth Study Update).

From 1992 to the last City's census in 2005, the City has grown at a steady pace of 1.2% per annum. Based on the historical data, from 1951 to 2005, the City has grown at a rate of 2.3% per annum.

Under the direction of the City, for the purpose of this report, the population growth rate will be assumed 3.5% for the next five years and 2.5% thereafter, which is consistent with the 2007 Growth Study Update.

Table 3-1 gives the 50 year projected population of Camrose based on the above-mentioned growth rates.

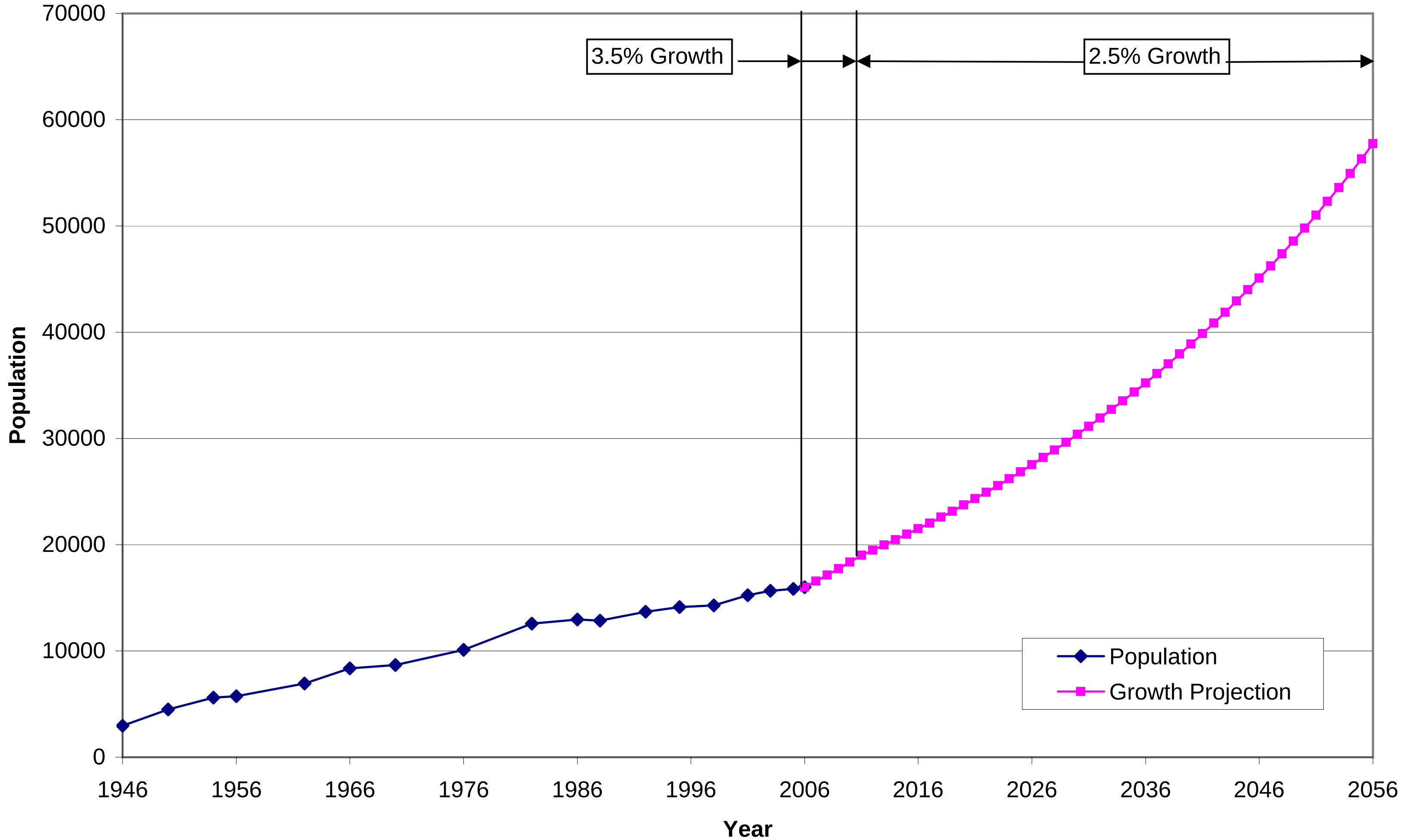
Table 3-1
City of Camrose Population Growth Projection

Year	Population	Growth Rate (%)
1946	2967	
1950	4500	11.0
1954	5609	5.7
1956	5745	1.2
1962	6939	3.2
1966	8362	4.8
1970	8673	0.9
1976	10104	2.6
1982	12570	3.7
1986	12968	0.8
1988	12850	-0.5
1992	13700	1.6
1995	14121	1.0
1998	14290	0.4
2001	15253	2.2
2003	15669	1.4
2005	15850	0.6
	Projected Population	**Projected Growth Rate (%)**
2006	16,000*	
2011	19,003	3.5*
2016	21,500	2.5*
2026	27,522	2.5*
2056	57,729	2.5*

* Based on the “City of Camrose – Growth Study Update 2006-2056”.

Refer to Figure 3.2 which presents the historical records and 50 year projection of Camrose’s population.

Figure 3.2
City of Camrose
Population History & 50-year Projection
3.5% (2006-2011) and 2.5% (2011-2056)
Projected Growth is based on the "City of Camrose-Growth Study Update 2006-2056"



3.4 WATER DEMAND

Water demand is critical in determining the distribution network, pumping capacity and storage required for a water system. Three (3) critical rates of demand: Average Day, Peak Day and Peak Hour flow rates are normally used. Fire flows, in conjunction with the Peak Day flows, are used to test the system's capability to deliver water and meet peak system demands.

3.4.1 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 composite "per capita per day demand" is derived. This rate is used primarily as a basis for the projection of the total water demand.

In the last three years, daily flow records as shown in Table 3-2, indicated a very steady trend of per capita average daily composite water consumption from 344 to 347 L/c/d.

Table 3-2
3-Year Record of Per Capita Water Consumption

Year	Pop.	Average Day		Peak Day			Peak 5-Day			Peak Hour		
		m^3	L/c/d	m^3	Factor	L/c/d	m^3	Factor	L/c/d	m^3	Factor	L/c/d
2003	15,669	5,414	345	8,895	1.64	568	N/A	N/A	N/A	N/A	N/A	N/A
2004	15,760	5,464	347	10,224	1.87	649	8,788	1.61	558	18,256	3.34	1,158
2005	15,850	5,444	344	8,432	1.55	532	7,803	1.43	492	13,913	2.56	879

Note: Water consumption records from 2003 to 2005 are included in Appendix B.

The City's existing Development Standards require systems to be designed based on the daily per capita composite water consumption of 454 L/C/d. This value is relatively high compared with the common industry standards (350 L/c/d) used for similarly sized municipalities. Currently, the City is undertaking a review of its Development Standards. Further discussions with the City, yielded the adoption of a daily per capita composite water consumption of 350 L/c/d. On the basis of this rate, future water demand projections were determined and are summarized in Table 3-3. This revised composite daily per capita water demand is more in line with the historical demands shown in Table 3-2.

Table 3-3
Projected Average Daily Per Capita Water Consumption

Year	(L/c/d)
2006	350
2011	350
2026	350
2056	350

The above noted per capita water consumption is a composite water demand, which is comprised of residential, commercial, industrial and institutional water demands.

The average daily per capita water consumption, 350 L/c/d, may be reduced in the future with water conservation techniques, such as water-saving devices, (e.g. low flush toilets; front loading washers; top aerator attachments; low flow shower heads), Quick leak repair, wise water use (e.g. never let water run continuously while washing dishes and brushing teeth, wash only full loads of laundry and dishes, lawn only during the early morning or late evening hours, collection of rain water to use for watering plants and gardens, etc.).

3.4.2 Peak Day Factor

The peak day demand is determined by the single day of maximum consumption observed in the distribution system. 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. To project the future peaking factor on a system, a ratio of the peak day to average day demand is used. The peak day demand is used in determining the delivery capacity required to supply mains, treatment facilities, storage facilities and pumping facilities. The peak day demands, in conjunction with appropriate fire flow demand, is used to test the water distribution system.

The peak day to average day demand factors (peaking factor) for 2003 to 2005 range from 1.55 to 1.87, with an average of 1.69. As directed by the City, it was determined that a peak day factor of 2.0, versus 1.8, as per the City's Development Standards currently under review, was adopted for this study.

3.4.3 Peak Hour Factor

The peak hour demand is the maximum demand observed during a short period of the day. The peak hour to average day demand factors (peak hour factor) of 2004 and 2005 were 3.34 and 2.56 respectively, with an average of 2.95. A peak hour factor of 3.0, as per the City's Development

Standards, was adopted for this study. This factor is consistent with communities of similar size to Camrose. The peak hour rate is used in determining watermain sizing and pumping requirements.

3.5 PROJECTED WATER DEMANDS

Based on the determined population projections, the design per capita demands, peak day factor and peak hour factor, the composite projected water demands for the next 50 years are as indicated in Table 3-4..

Table 3-4
Projected Water Demands

Year	Population	Per Capita Demands (L/c/d)	Average Day Demands (L/s)	Peak Day Demands (L/s)	Peak Hour Demands (L/s)
2006	16,000	350	65	130	195
2011	19,003	350	77	154	231
2026	27,522	350	112	224	336
2056	57,729	350	234	468	702

Note: Peak Day Demand = 2.0 x Average Day Demand
Peak Hour Demand = 3.0 x Average Day Demand

3.6 EQUIVALENT POPULATION/WATER DEMAND

One of the criteria used in establishing a water demand is land use.

According to the City's latest study, the recommended average density is 4 units per gross developable acre and average size of household is 2.4 persons. This assumption corresponds to 9.6 persons per acre or 23.7 persons per hectare. As directed by the City, residential densities of 25 persons per hectare will be used for this master plan update.

The following Table 3-5, summarizes the population densities for residential areas and equivalent population densities for other land uses within the City:

Table 3-5
Equivalent Population Density

Land Use	Equivalent Population (Per Hectare)
Residential	25 ppha
Commercial Business District (CBD)	114 eppha
Commercial	*62 eppha
Industrial	*50 eppha
Institutional	*62 eppha

*The population figures were derived from the sanitary requirements based on the City's current Development Standards.
ppha = People per hectare
eppha = Equivalent people per hectare

3.7 FIRE FLOWS

Fire flows, in conjunction with peak daily demands, are used in a hydraulic model to test the distribution system's capability to deliver water. Table 3-6 lists the fire flows required in accordance with the recommended Fire Underwriter Survey (FUS) Guidelines.

Table 3-6
Fire Flows

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

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

F = 220 $C\sqrt{A}$ 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 the fire flow requirements are:

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

Based on the fire flow criteria, the resultant storage volume required for fire protection is 3,355 m^3. This volume is based on a fire flow of 233 L/s for duration of 4.0 hours. This volume of storage is to be in addition to the other operational storage needs.

The minimum system pressures during a fire event are:

- Residual pressure at demand hydrant 140 kPa (20 psi)
- Zone (system) pressure 273 kPa (40 psi)

3.8 OPERATING PRESSURES

To achieve maximum user satisfaction, the recommended operating pressure in the system should be between 345 kPa (50 psi) and 552 kPa (80 psi). (Alberta Environment 2006 Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems). The base output pressure set points of the HLPS# 2 and #3 are set at 420 kPa (60 psi) and 480 kPa (70 psi) respectively. The Duggan Booster Station is to maintain the desirable operating pressure for the areas west of 68 Street and Bittern Lake during high demand periods. The discharge pressure set point of the booster station is set at 450 kPa (65 psi).

3.9 SUPPLY AND TREATMENT CAPACITY

The capacity (total output within the normal daily operation hours) of the water treatment facilities should be equal to the peak day water demands. The amount of required raw water supply should take into account system losses such as backwash etc.

3.10 WATER STORAGE

It is good practice to provide adequate storage in a water system for operational needs (peak hours), supply interruption and fire flow demand. Design guidelines vary depending on the size of the community and the capital costs involved. The appropriate level of storage must consider how quickly the system can be restored to be fully operational when impacted by an interruption (e.g. power failure, plant failure, scheduled plant shutdown, watermain break, etc.).

The storage provision of three (3) average days plus fire flow demand, was preferred by the City.

Table 3-7 shows the projected treated water storage requirements.

Table 3-7
Treated Water Storage Requirements

Year	Population	Per Capita Consumption	Average Day Demand	3 x Average Day Demand	Required Fire Storage	Required Storage
		(L/c/d)	m^3	m^3	m^3	m^3
2006	16,000	350	5,600	16,800	3,355*	20,155
2011	19,003	350	6,651	19,953	3,355*	23,308
2026	27,522	350	9,633	28,899	3,355*	32,253
2056	57,729	350	20,205	60,615	3,355*	63,971

*Fire flows evaluated at 13,980 L/min (233 L/s) for 4 hrs (3,355 m^3)

For comparison, Table 3-8 presents the recommended minimum treated water storage provisions, from several other municipalities.

Table 3-8
Treated Water Storage Requirements
Provincial Guideline and Municipal Standards Summary

Jurisdiction	**Minimum Storage Capacity for System Requiring Fire Protection**	**Reference**
Alberta Environment	25% of Peak day + 15% of Average Day + Fire Flow	2006 Standards & Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems
City of Lloydminster	Two Average Day	Waterworks Master Plan
Town of Stony Plain	Two Average Day + Fire Flow	Waterworks Master Plan
City of Spruce Grove	Two Average Day + Fire Flow	Waterworks Master Plan
Regional System	Two Average Day + Fire Flow	Regional Water Commission Group

* Fire flows evaluated at 13,980 L/min (233 L/s) for 4 hrs (3,355 m^3)

In terms of water storage, the 3 average day demand plus fire flow (adopted by the City of Camrose) is higher than the average industry standards.

3.11 DISTRIBUTION SYSTEM SUPPLY

Distribution system pumping facilities should be sized to meet the following water demand conditions:

- Maximum water demands during peak hour consumption periods
- Peak day plus fire flow demands
- Recommended minimum main sizes:
  - CBD Areas – 300 mm
  - Commercial & Industrial - 250 mm
  - Residential – 200 mm
  - Smaller pipe size can be used if it is confirmed by the computer model to be appropriate and approved by the City Engineer.

The minimum pipe size of 200 mm for residential and 250 mm for commercial and industrial, are the mostly adopted industry standards (e.g. City of Spruce Grove, City of Fort Saskatchewan, City of Leduc, City of Beaumont, Strathcona County and City of Edmonton). In some aforementioned municipalities, a 150 mm diameter main can only be used as minimum distribution mains on limited areas such as cul-de-sacs or areas with limited numbers of lots. Currently, the City is undertaking a review of its Development Standards.

3.12 PIPE ROUGHNESS (C-FACTOR)

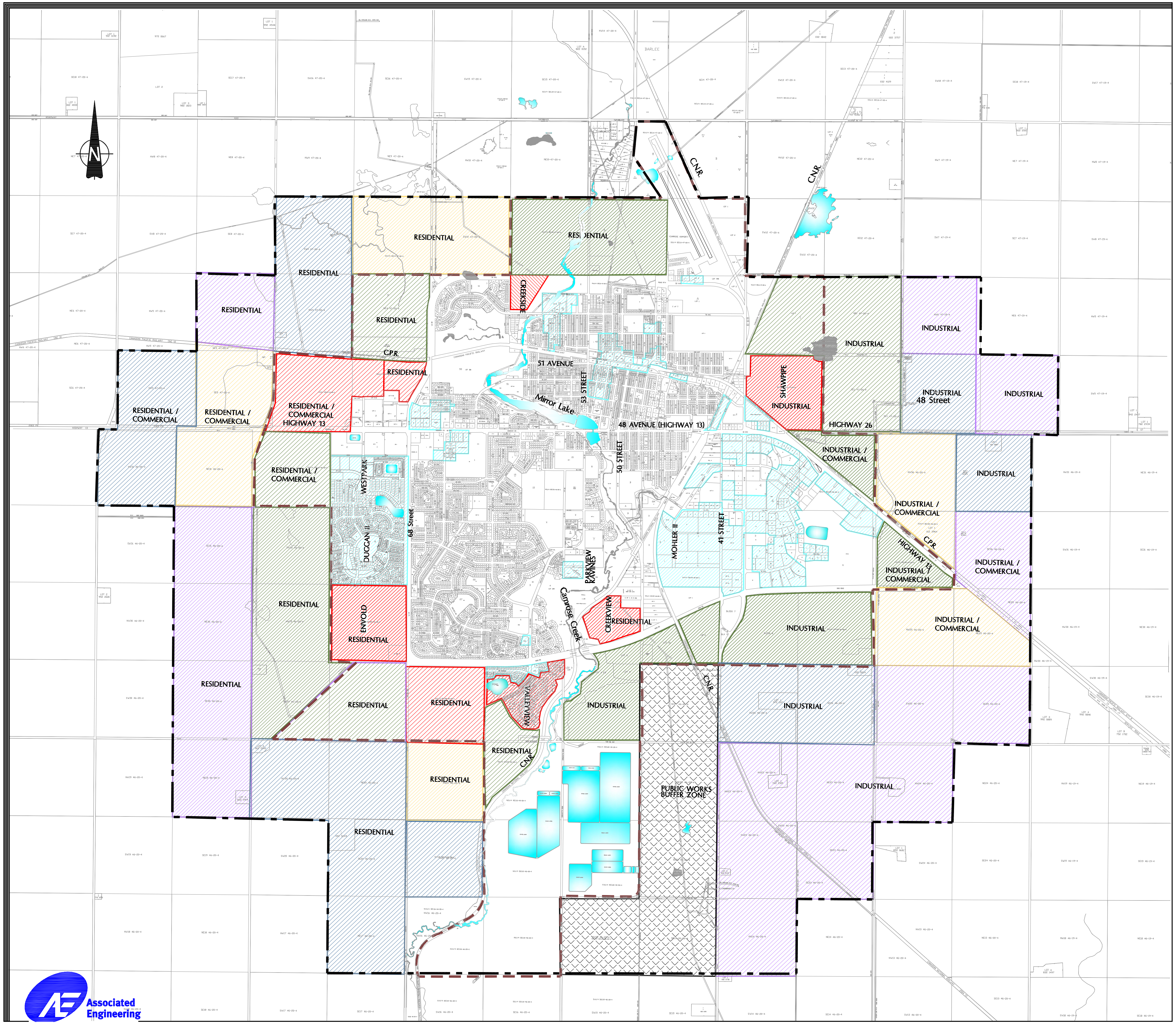
Roughness co-efficient is one of the many variables in the Hazen-Williams equation when determining liquid flow through pipe. The roughness co-efficient represents the material and the condition of the pipe.

Table 3-8 presents the C-Factor values used for this study.

Table 3-9
C-Factor Values

Material Type	C-Factor*
Cast Iron (C.I.)	110
Asbestos Cement (A.C.)	130
Polyvinyl Chloride (PVC)	135
Steel	100

Note: the above C-Factors were based on the value established in the report, "City of Camrose-Water Distribution System Master Plan", prepared by ISL in April 2000. As per the City's instruction, no field calibration for this study was undertaken.



THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

PROJECTED LAND USE PLAN AND ASSUMED GROWTH SEQUENCE FOR THE STUDY AREA

LEGEND:

- CITY BOUNDARY
- STUDY BOUNDARY
- PARTIALLY DEVELOPED (< 5 Years) UNDER EXISTING CONDITIONS
- < 5 Years
- 5 TO 20 YEAR GROWTH
- 30 YEAR GROWTH
- 40 YEAR GROWTH
- 50 YEAR GROWTH
- PUBLIC WORKS BUFFER (FUTURE DEVELOPMENT SUBJECT TO MINIMUM SET BACK REQUIREMENTS)

SCALE: 1 : 40,000

December, 2007

FIGURE 3.1

Time: 8:45am
Date: Dec 19, 2007
File: P:\20063076\00_CamroseWDSystem\Working_Dwgs\100_Civil\REPORT -FINAL\FR_3076-fg-3.1(Future Landuse and Growth Seq).dwg by BW
Xrefs: 3076-RP01_BASE_2005_nad27
3076_RT-01_AE_BDR

4 System Assessment & Proposed Upgrades

4.1 GENERAL

The function of the water distribution system is to transport water to consumers and fire hydrants located throughout the community. Pipe size should be adequate to carry the volumes of water required for the area it services and still retain adequate residual pressure at the terminal point for satisfactory consumer use and fire fighting needs. In addition, the distribution system should be flexible enough so that extensions into future development areas can be achieved economically and with minimum effect on the existing waterworks system.

A few distribution modelling systems common in the market today were evaluated. They were EPAnet, WaterCad, H2Onet, WaterGEMs, Infowater and Syneper. Current the City owns a 1000 pipes version of WaterCad (Version 7).

Based on the evaluation, it is prudent for the City to retain the WaterCad software and upgrade to a 2000 pipe version.

Modelling software evaluation technical memorandum is attached in the Appendix.

4.2 SYSTEM ASSESSMENT

The City's water distribution system was assessed for the following:

- Storage capacity
- Distribution pumping capacity
- Distribution main capacity (main size)

The system was assessed on the following scenarios:

- Existing (2006)
- Short-term growth in 5 years (2011)
- Mid-term growth in 20 years (2026)
- Long-term (ultimate) growth in 50 years (2056)

The assessment of the City's system was carried out using WaterCad modelling software. All the physical characteristic data of the systems required to run the model are as follows:

- Node numbers.
- Length of pipes
- Diameter in mm
- Roughness coefficient - C-Factor
- Ground elevation at nodes and reservoirs in metres

- Water demands at nodes in L/s
- Pump characteristics

4.3 PROPOSED POTABLE WATER STORAGE

4.3.1 System Assessment

- Existing total potable water storage between the HLPS #2 (3,600 cu.m.) and the HLPS #3 (21,000 cu.m.) is 24,600 cu.m. which is higher than the recommended level of 20,155 cu.m. Recommended storage volume of 20,155 cu.m. is based on year 2006 demands.

Table 4-1

Storage Requirement

Year	2006 Storage Volume Available (m^3)	Volume Required (m^3)	Surplus (+) / Deficit (-) (m^3)
2006	24,600	20,155	+4,445
2011	24,600	23,308	+1,292
2013	24,600	24,319	+281
2026	24,600	32,253	-7,653
2056	24,600	63,971	-39,731

4.3.2 Proposed Upgrades

- The storage capacity is adequate up to year 2013.
- No immediate upgrade is required.
- An immediate long-term plan for additional storage is recommended.
- An increase of 8,000 m^3 of storage capacity will be adequate beyond year 2026.

4.4 PROPOSED PUMPING FACILITIES

4.4.1 System Assessment

The City's distribution system is being operated in two separate pressure zones. The first pressure zone (Zone 1) is operated within the entire City limits. The second pressure zone (Zone 2) which is located south of Highway 13 and west of 68 Street. (See Figure 4.1a for pressure zones within City's boundary and Figure 4.4a for pressure zones within the study areas at ultimate stage of development). The City's operating philosophy regarding pumping, is to mainly rely on HLPS #3 as the main pumping station. HLPS #2 is a supplement to HLPS #3 and is operated on a minimal time in order to turn over the treated water and prevent the water from being stagnant.

The pumping stations are pumping water at a set pressure of 480 kPa (70 psi). When the demand is high and the pressure drops at the outskirt areas, the variable speed drive motor will increase the speed of the pump to increase the pumping pressure at the pump stations up to 550 kPa (80 psi). The Duggan booster station, which operates at a discharge pressure of 450 kPa (65 psi), is used to maintain a desirable pressure in the second pressure zone (Zone 2).

- High Lift Pump Station No.2 (HLPS #2)
  - Assume that HLPS #2 is still an integral part of the water system.
  - HLPS #2 houses three pumps. One pump (P-201) is a variable frequency drive (VFD) pump rated at 136.4 L/s @ 48.8 m head and the other pump (P-202) is a VFD pump rated at 132.6 L/s @ 48.8 m head. The third pump (P-200) is a natural gas driven standby (fire) pump rated 136.4 L/s @ 48.8 m head.
  - This pumping station operates twice per day on Monday through Friday, and once per day on Saturday and Sunday.
  - The operation provides water circulation in the reservoir and reduces water stagnation.
  - The operating pressure is set at a little higher than HLPS #3 system pressure. Therefore, when HLPS #2 pump is on, the higher pressure will make the pump(s) in HLPS #3 back off, and eventually shut off.
  - Under normal circumstances, only one service pump is pumping.
  - HLPS #2 will start on any low pressure demand; thus, if there is any watermain break, fire, or mechanical failure at HLPS #3, HLPS #2 will come on if the pressure warrants it.
- High Lift Pump Station No.3 (HLPS #3)
  - HLPS #3 has five pumps which include four service pumps and one standby pump. All four service pumps are VFD and are rated at 94.7 L/s @ 57.9 m head.

The diesel engine driven standby (fire) pump is rated at 157.8 L/s @ 70.1 m head.

- HLPS #3 pumps start on a preset low pressure. When one pump is unable to maintain system pressure, the 2^{nd} & 3^{rd} pumps will turn on to supplement the pressure (Assume only 3 out of 4 pumps are running at any time).
- The operating pressure of the standby (fire) pump is higher than the service pumps. If the standby pump is on, the service pumps will shut off. The standby pump cannot run at the same time as the service pumps.
- The standby pump can only be turned on manually.

- Booster Station (B. Stn.)
  - B. Stn. has three pumps which include two service pumps and one standby pump.
  - The B. Stn is to boost up and maintain a desirable operating pressure on the west side of the City (Development west of 68 Street) and to ensure an adequate flow to the Bittern Lake reservoir.
- The analysis shows that the existing pumping capacity at HLPS #2 & #3 will be adequate up to a population of 33,000 in year 2034 (see Table 4-2).

Table No. 4-2

Pumping Capacity (HLPS #2 + HLPS #3) vs. Projected Demand

Description	Existing (L/s)	2011 (L/s)	2026 (L/s)	2034 (L/s)	2056 (L/s)
HLPS #3 Distribution Pumping Capacity	284	284	284	284	284
HLPS #2 Distribution Pumping Capacity	133	133	133	133	133
HLPS #3 + HLPS #2 Total Distribution Pumping Capacity	**417**	**417**	**417**	**417**	**417**
Peak Hour Demand	194	231	336	401	702
(+) Surplus or (-) Deficit	**+223**	**+186**	**+83**	**+17**	**-285**
HLPS #2 Standby (Fire) Pumping Capacity	136	136	136	136	136
Total Pumping Capacity (Distribution + Standby)	**553**	**553**	**553**	**553**	**553**
Peak Day Demand	130	154	223	267	468
Fire Flow	233	233	233	233	233
Peak Day + Fire Flow Demand	**363**	**387**	**456**	**500**	**701**
(+) Surplus or (-) Deficit	**+190**	**+166**	**+97**	**+53**	**-148**

Note: The service pumps in HLPS #2 and HLPS #3 were set up to supplement each other when required.

4.4.2 Proposed Upgrades

- Pumping requirements at various development stages are as follows:
  - Year 2006 to Year 2011
    - No major upgrade is required.
  - Year 2010 to 2026
    - No major pumping capacity upgrade is required.
    - Pumps replacement may be required when the pumps reach expected design life.
  - Year 2026 to 2056 (Ultimate)
    - The pumping capacity of the pumps at HLPS #2 & #3 will be inadequate when the population reaches 33,000 in year 2034 and pump replacements will be required.

- Although it is common practice to oversize a replacement pump to meet future demand, the practice has now taken a new direction due to higher energy cost. A replacement pump sized too far into the future might have a lower capital cost, but could be operating off the best efficient point of the pump during the initial period of the pump's life. A life cycle cost analysis for the pump should be implemented when sizing the replacement pumps.
- Two additional booster stations are proposed to be installed to maintain a desirable pressure for Zone 2. The proposed booster stations are located on SW ¼ Sec 4-47-20-4 (north of Highway 13) and SE ¼ Sec 29-46-20-4 (south of Camrose Drive) respectively. The timeline for the additional booster stations is dependent upon the growth of Zone 2.

Table 4-2 summarizes the required pumping capacities versus project water demands for the system.

In terms of fire pumping capacity, only standby pump in HLPS #2 will come on if the pressure drop. The standby pump in HLPS #3 will only start manually and cannot run with the service simultaneously.

Since the service pumps and standby pump cannot operate at the same time, the standby pump can only supply 158 L/s versus 284 L/s supplied by three service pumps; therefore, in Table 4-2, the fire pumping capacity of HLPS #3 is not shown.

If the City wants to utilize the standby pump in HPLS #3 to supplement the service pumps during high demand (e.g. fire), the operating pressure has to be lowered to match the service pumps. By doing that, the pump control valve set point has to be reduced to match the operating pressure. However, the pump will be running beyond the Best Efficiency Point (BEP).

City should investigate further if the above-mentioned modification is feasible; the total pumping capacity could be increased by 158 L/s during high demand.

4.5 DISTRIBUTION MAINS

4.5.1 System Assessment

- To assess the adequacy of the existing water distribution system. WaterCad, a computer hydraulic network analysis model was used for the following water demand conditions at 2006, 2011, 2026 and 2056 (ultimate) levels of development:
  - Average Day Demand (ADD)
  - Peak Day Demand (PDD)

  - Peak Hour Demand (PHD)
  - Peak Day Demand + Fire Flows
- The existing and all upgrade analyses were performed on the assumption that HLPS #2 is still an integral part of the distribution system.
- An extended period simulation (EPS) analysis was also performed on the chlorine tracing of the existing system. The model has been calibrated using measured data provided by the City. This information derived from the model will be useful for the City to predict chlorine residual in future development areas.
- The network analyses indicate that the existing system is adequate for average day, peak day and peak hour water demands. However, from the model, it is evident that lack of fire flow during peak days will be realized in the industrial areas on the southeast side of the City, the northeast side (the airport areas) and also in the west Highway commercial area on both sides of Highway 13. The required fire flow is in accordance with the recommended Fire Underwriter Survey (FUS) Guidelines (See Table 3.6 in Section 3). The lack of fire flow is mainly due to undersized pipes.
- Figure 4.0 shows the areas with insufficient fire flow.
- Figure 4.1a shows the existing distribution system and Figure 4.1b shows the pressure contours for the Peak Hour Demand condition.

4.5.2 Proposed Upgrades

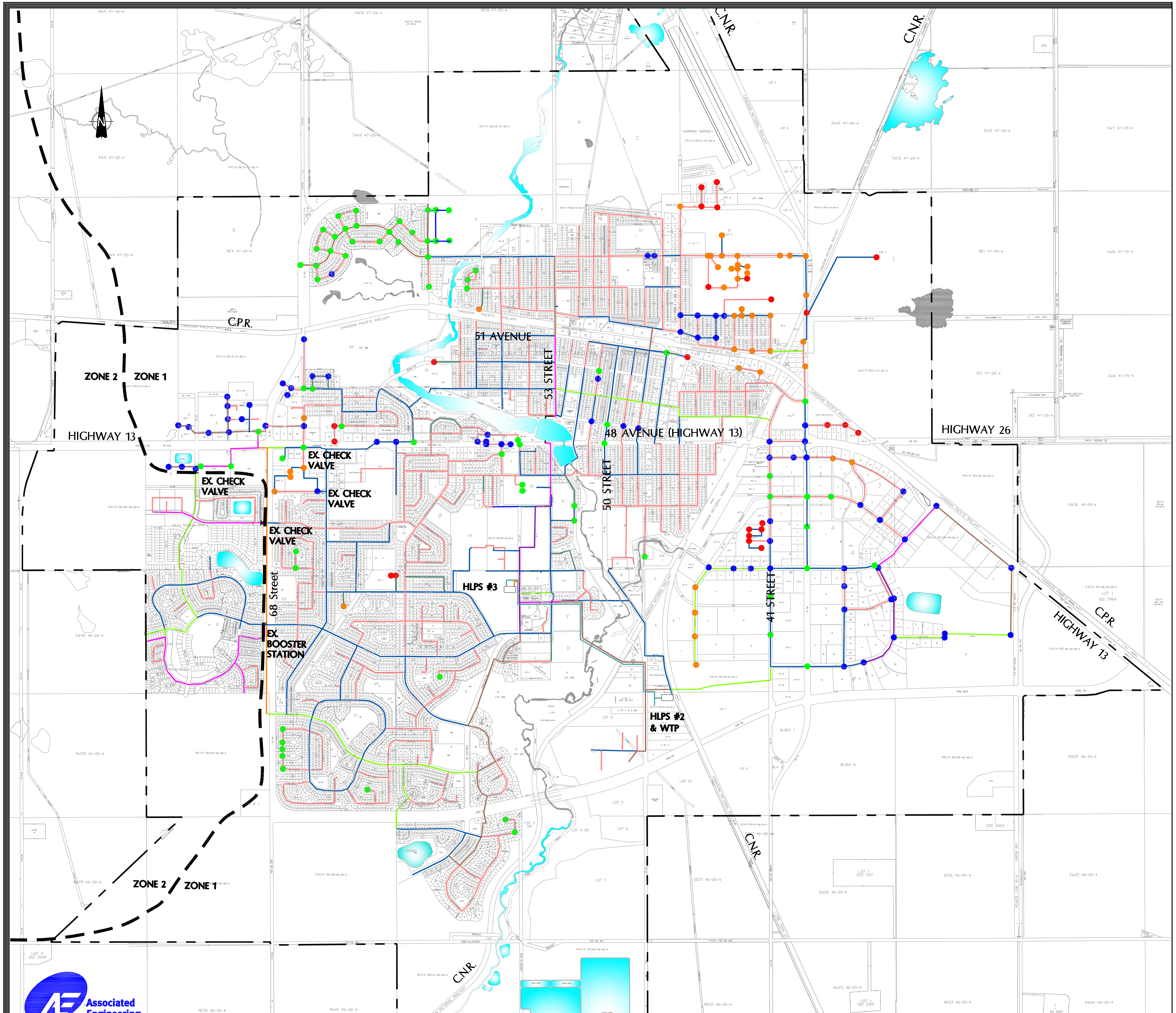
Figures 4.2a, 4.3a, and 4.4a show all watermain diameters, from 100 mm and larger, proposed for network upgrades and replacements, and show only the trunk mains for the proposed future distribution network .

- Existing Distribution Network
  - When replacement of existing watermains program is implemented, the following minimum main diameters are recommended:
    - CBD Areas – 300mm
    - Commercial & Industrial – 250mm
    - Residential – 200mm
  - Smaller pipe size can be used only if it is confirmed by the computer model and approved by the City Engineer.
- 2011 Distribution Network
  - Figure 4.2a presents the 2011 distribution network.
  - Figure 4.2b shows the pressure contours for the Peak Hour Demand of the 2010 distribution network.

- 2026 Distribution Network
  - Figure 4.3a shows the 2026 distribution network.
  - Figure 4.3b shows the pressure contours for the Peak Hour Demand of the 2026 distribution network.
- 2056 (Ultimate) Distribution Network
  - Figure 4.4a shows the ultimate distribution network.
  - Figure 4.4b shows the pressure contours for the Peak Hour Demand of the ultimate distribution network.

Figure 4.5 presents a complete staging plan for existing to ultimate development system upgrades.

With respect to the existing distribution network areas with insufficient fire flow, according to the computer model, if the City adopts all the proposed distribution network upgrades theoretically, there should be no fire flow deficiencies in the City.



THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

2006 EXISTING DISTRIBUTION NETWORK AREAS WITH INSUFFICIENT FIRE FLOW

LEGEND:

- EXIST. 100mmø
- EXIST. 150mmø
- EXIST. 200mmø
- EXIST. 250mmø
- EXIST. 300mmø
- EXIST. 350mmø
- EXIST. 400mmø
- EXIST. 450mmø
- EXIST. 600mmø
- EXIST. CITY BOUNDARY
- PRESSURE ZONE

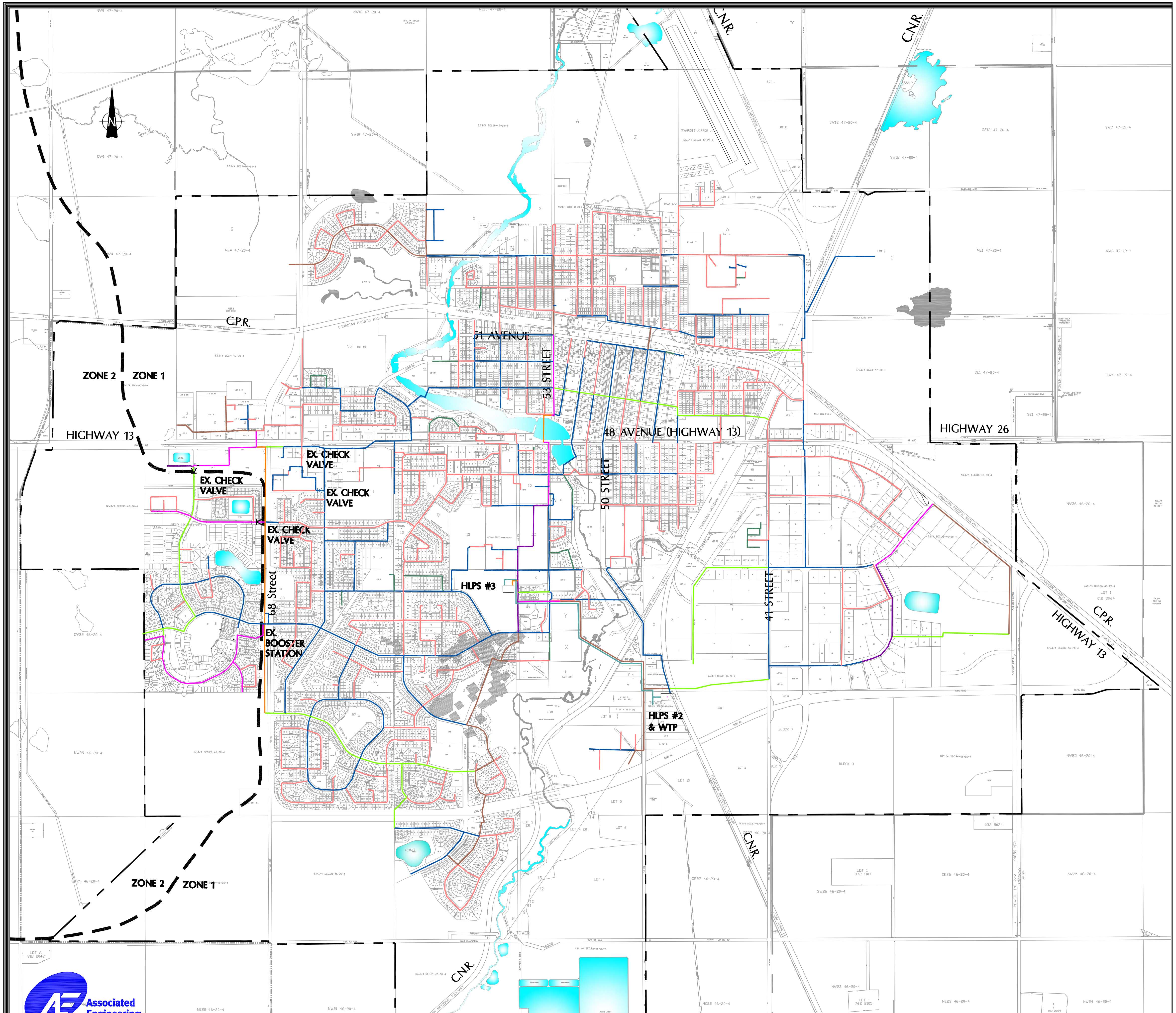
FIRE FLOW DEFICIENCY:

- < 20%
- 20 - 40 %
- 40 - 60 %
- > 60%

SCALE : 1 : 25,000

December, 2007

FIGURE 4.0



THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

2006 DISTRIBUTION NETWORK

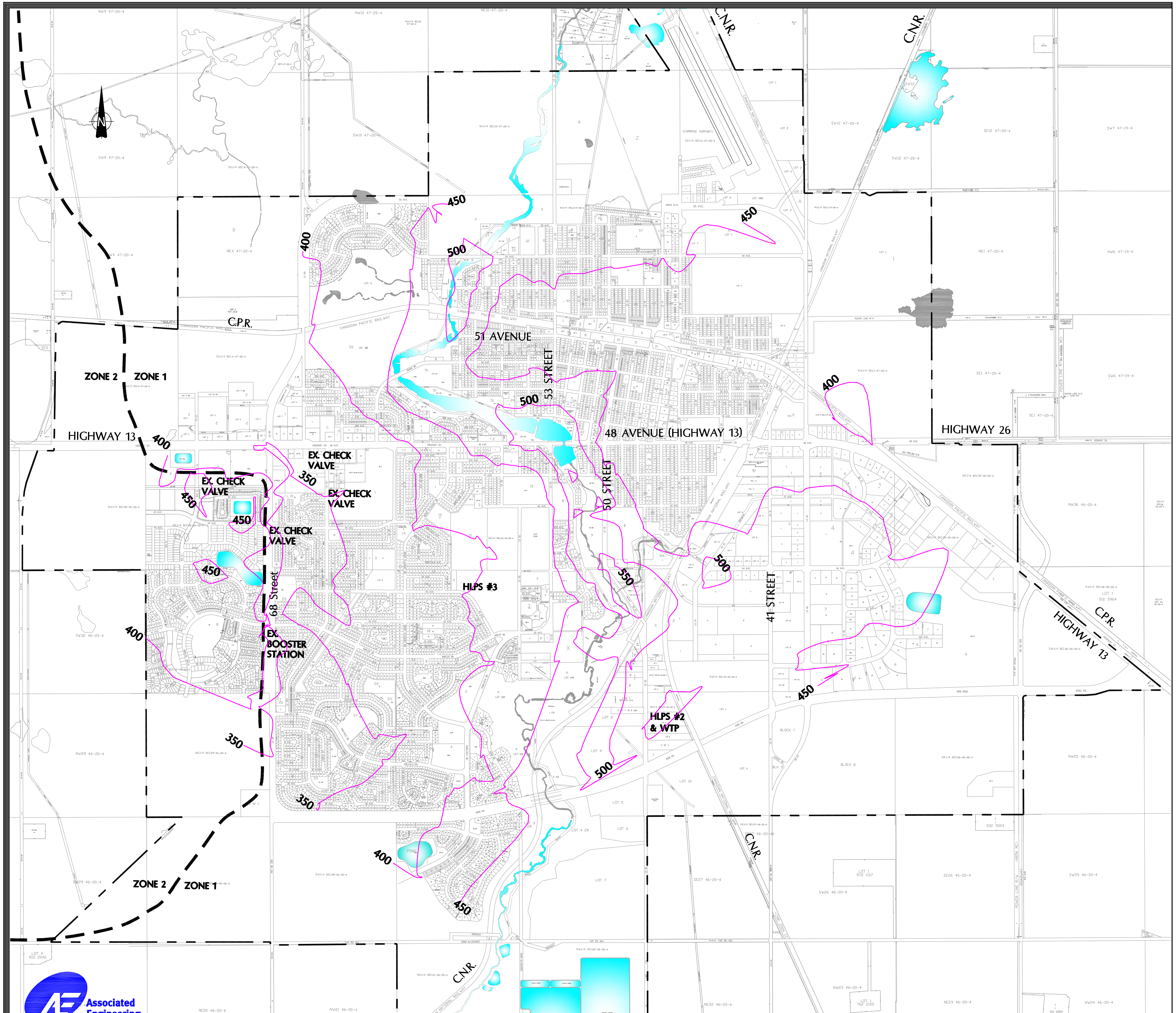
LEGEND:

- EXIST. 100mmø
- EXIST. 150mmø
- EXIST. 200mmø
- EXIST. 250mmø
- EXIST. 300mmø
- EXIST. 350mmø
- EXIST. 400mmø
- EXIST. 450mmø
- EXIST. 600mmø
- EXIST. CITY BOUNDARY
- PRESSURE ZONE

SCALE : 1 : 25,000

December, 2007

FIGURE 4.1a



THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

2006 PEAK HOUR PRESSURE CONTOURS

LEGEND:

450 (pink line)	PRESSURE CONTOUR (kPa)
(long-short dashed line)	EXIST. CITY BOUNDARY
(heavy dashed line)	PRESSURE ZONE

NOTE:

OPTIMUM OPERATING PRESSURE - FROM 345 kPa (50 psi) TO 552 kPa (80 psi)

SCALE : 1 : 25,000

December, 2007

FIGURE 4.1b

Time: 8:47am
Date: Dec 19, 2007
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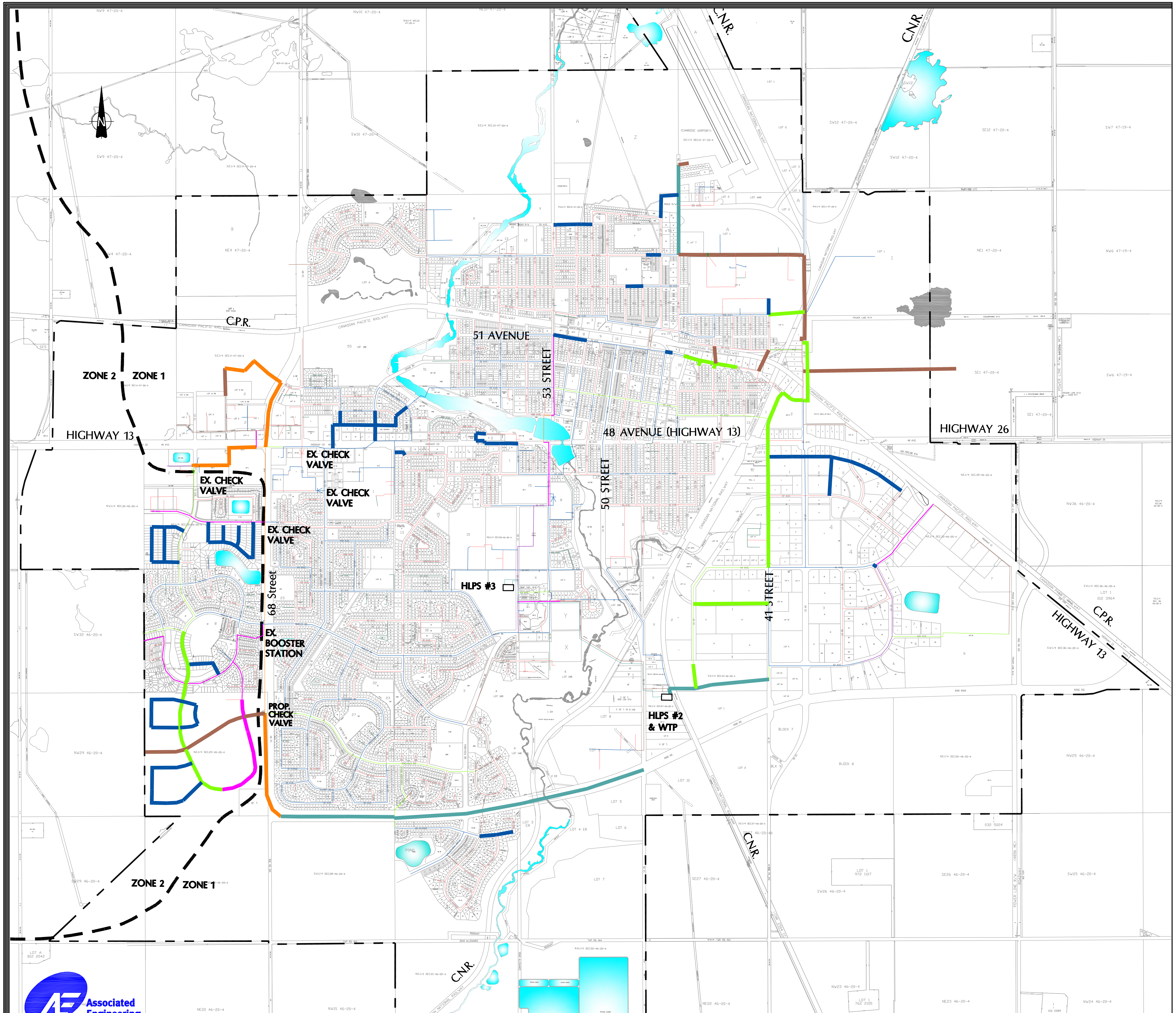

THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

2011 DISTRIBUTION NETWORK

LEGEND:

EXIST. 100mmø	PROP. 100mmø
EXIST. 150mmø	PROP. 150mmø
EXIST. 200mmø	PROP. 200mmø
EXIST. 250mmø	PROP. 250mmø
EXIST. 300mmø	PROP. 300mmø
EXIST. 350mmø	PROP. 350mmø
EXIST. 400mmø	PROP. 400mmø
EXIST. 450mmø	PROP. 450mmø
EXIST. 600mmø	PROP. 600mmø

EXIST. CITY BOUNDARY

PRESSURE ZONE

NOTE:

FUTURE DEVELOPMENT AREAS - TRUNK MAINS ONLY

SCALE : 1 : 25,000

December, 2007

FIGURE 4.2a

Time: 8:47am
Date: Dec 19, 2007
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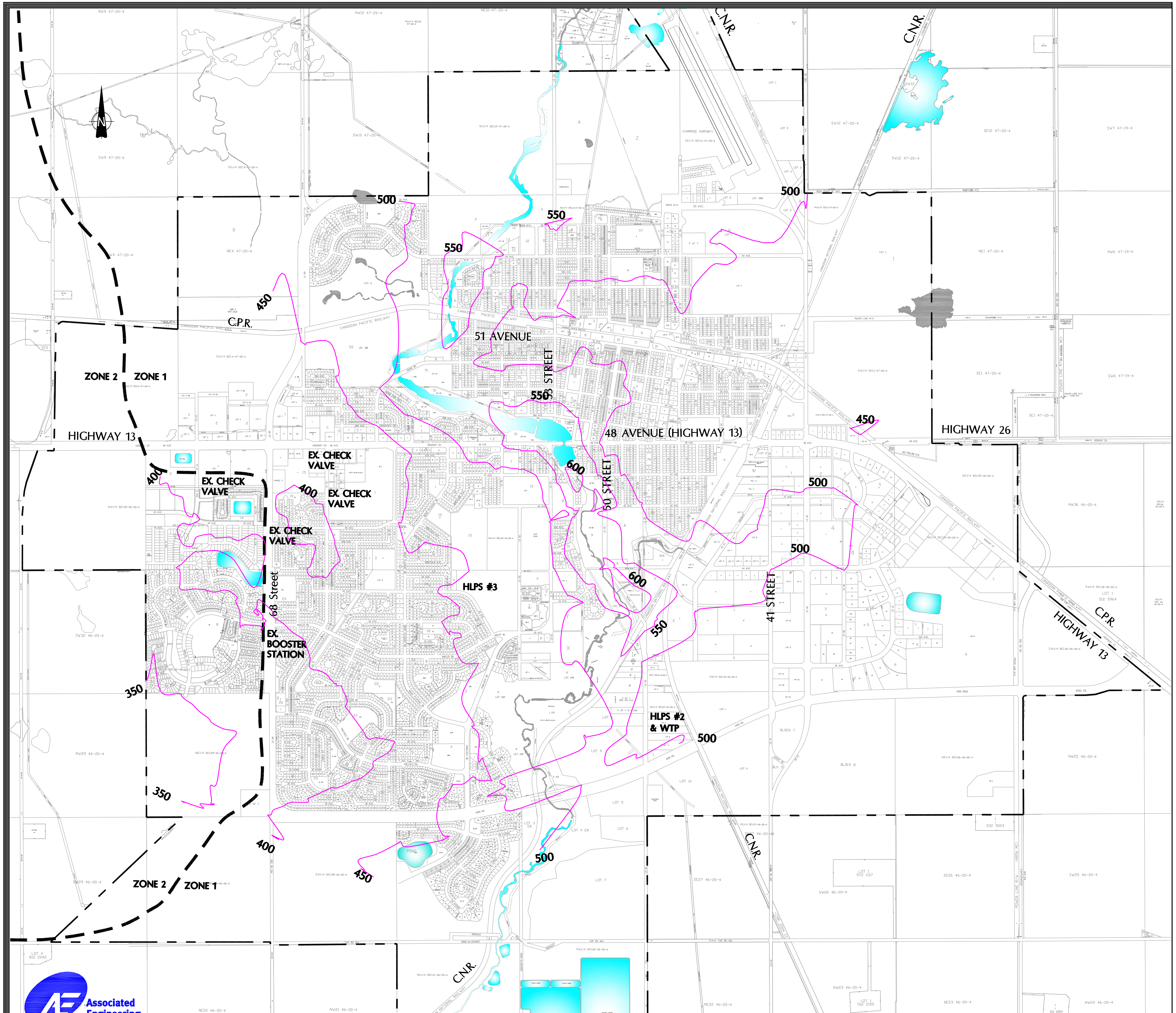

THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

2011 PEAK HOUR PRESSURE CONTOURS

LEGEND:

450 (line)	PRESSURE CONTOUR (kPa)
(line)	EXIST. CITY BOUNDARY
(line)	PRESSURE ZONE

NOTE:

OPTIMUM OPERATING PRESSURE - FROM 345 kPa (50 psi) TO 552 kPa (80 psi)

SCALE : 1 : 25,000

December, 2007

FIGURE 4.2b

Time: 8:48am
Date: Dec 19, 2007
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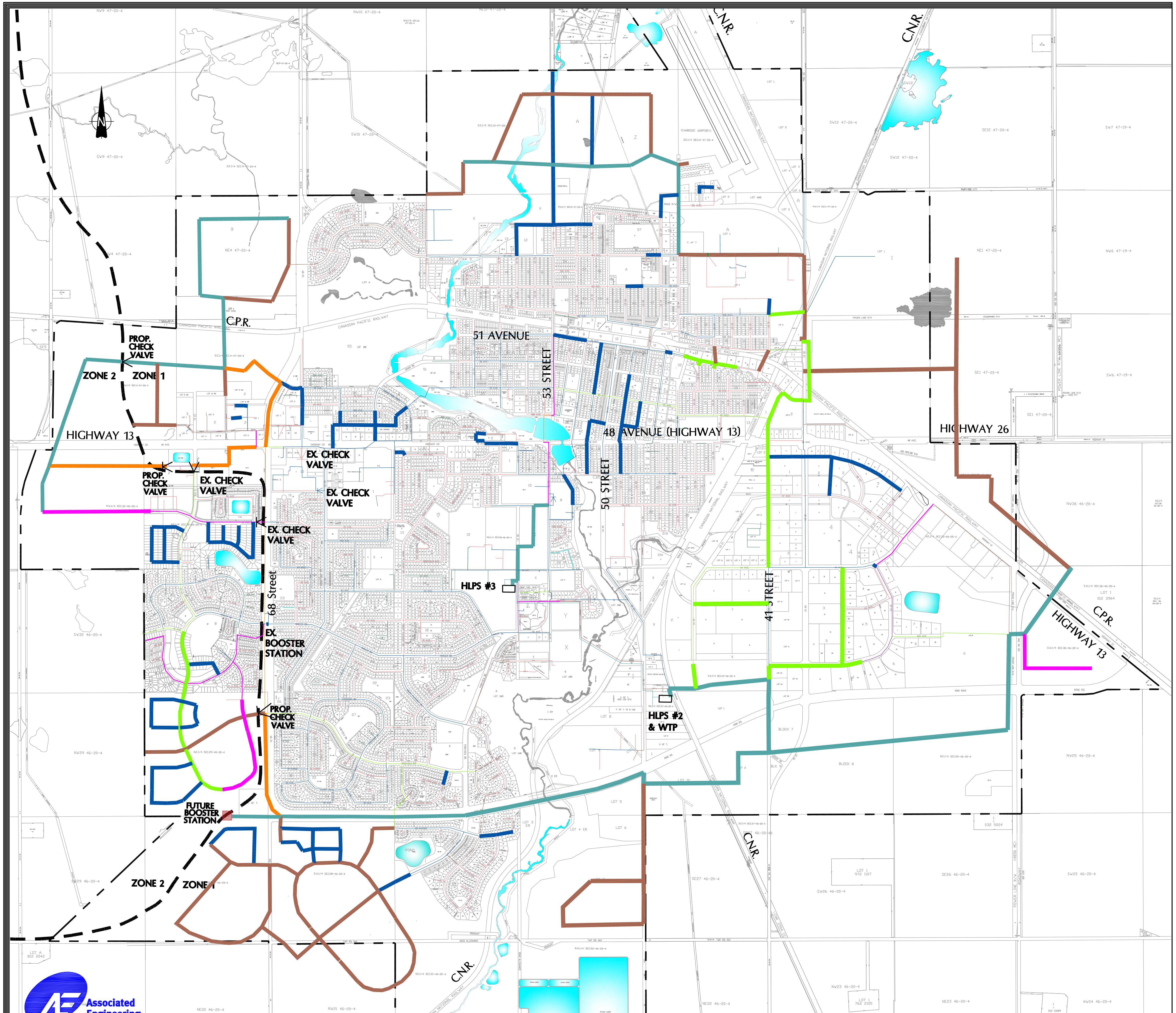


THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

2026 DISTRIBUTION NETWORK

LEGEND:

EXIST. 100mmø	PROP. 100mmø
EXIST. 150mmø	PROP. 150mmø
EXIST. 200mmø	PROP. 200mmø
EXIST. 250mmø	PROP. 250mmø
EXIST. 300mmø	PROP. 300mmø
EXIST. 350mmø	PROP. 350mmø
EXIST. 400mmø	PROP. 400mmø
EXIST. 450mmø	PROP. 450mmø
EXIST. 600mmø	PROP. 600mmø

EXIST. CITY BOUNDARY

PRESSURE ZONE

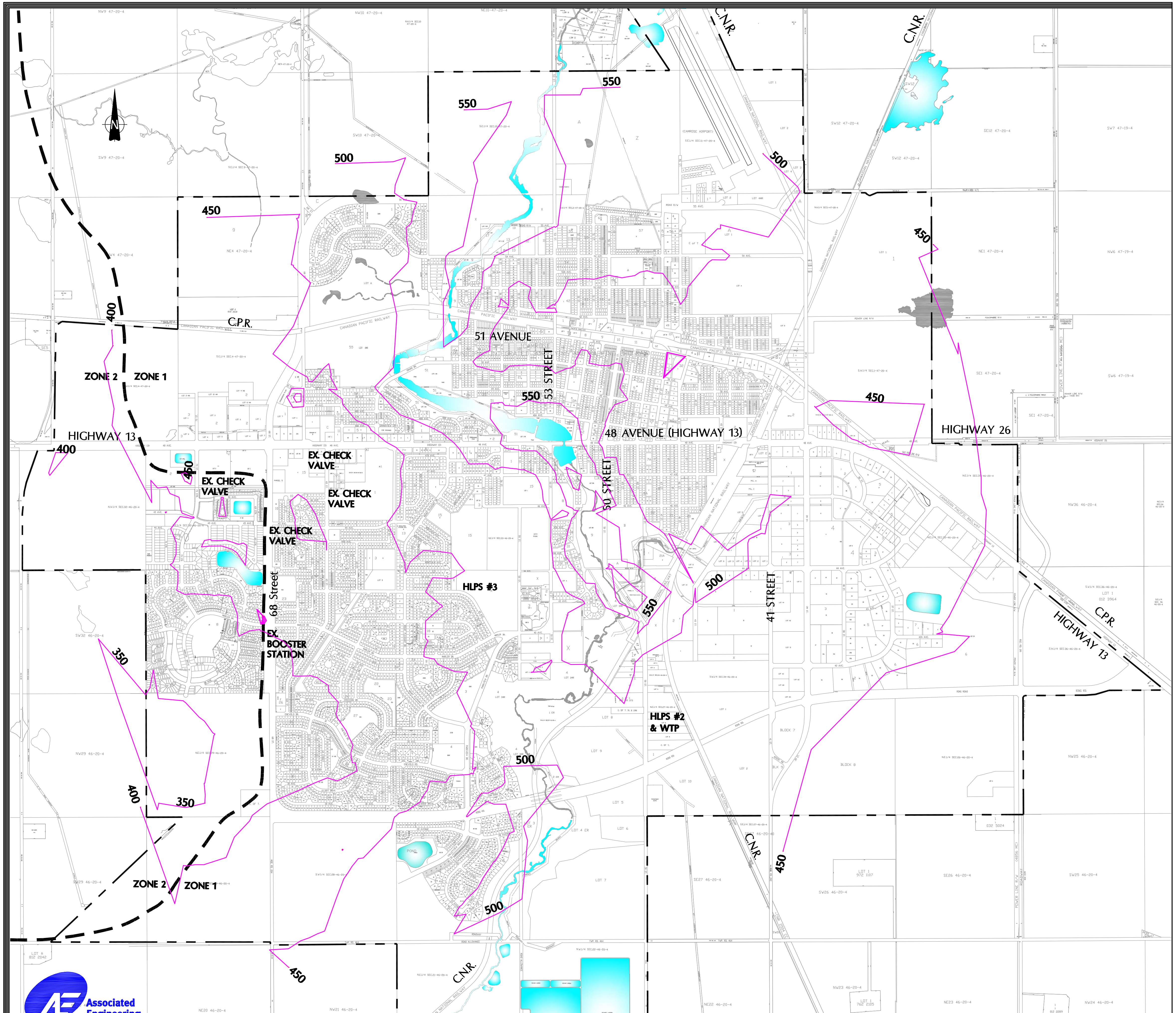
NOTE:

FUTURE DEVELOPMENT AREAS - TRUNK MAINS ONLY

SCALE : 1 : 25,000

December, 2007

FIGURE 4.3a



THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

2026 PEAK HOUR PRESSURE CONTOURS

LEGEND:

450	PRESSURE CONTOUR (kPa)
	EXIST. CITY BOUNDARY
	PRESSURE ZONE

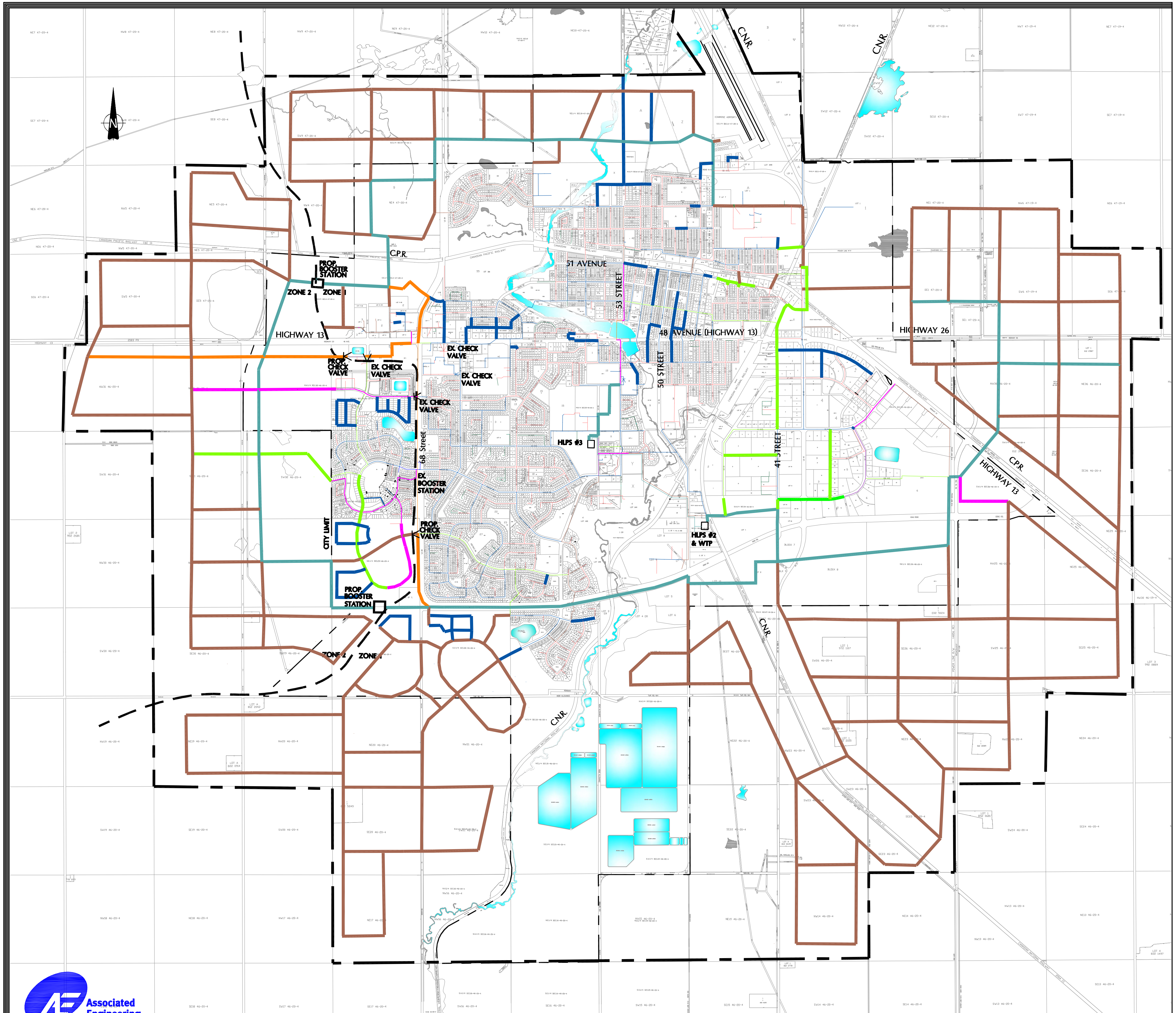
NOTE:

OPTIMUM OPERATING PRESSURE - FROM 345 kPa (50 psi) TO 552 kPa (80 psi)

SCALE : 1 : 25,000

December, 2007

FIGURE 4.3b



THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

2056 DISTRIBUTION NETWORK

LEGEND:

EXIST. 100mmø	PROP. 100mmø
EXIST. 150mmø	PROP. 150mmø
EXIST. 200mmø	PROP. 200mmø
EXIST. 250mmø	PROP. 250mmø
EXIST. 300mmø	PROP. 300mmø
EXIST. 350mmø	PROP. 350mmø
EXIST. 400mmø	PROP. 400mmø
EXIST. 450mmø	PROP. 450mmø
EXIST. 600mmø	PROP. 600mmø

EXIST. CITY BOUNDARY

STUDY LIMIT

PRESSURE ZONE

NOTE:

FUTURE DEVELOPMENT AREAS - TRUNK MAINS ONLY

SCALE : 1 : 35,000

December, 2007

FIGURE 4.4a

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Date: Dec 19, 2007
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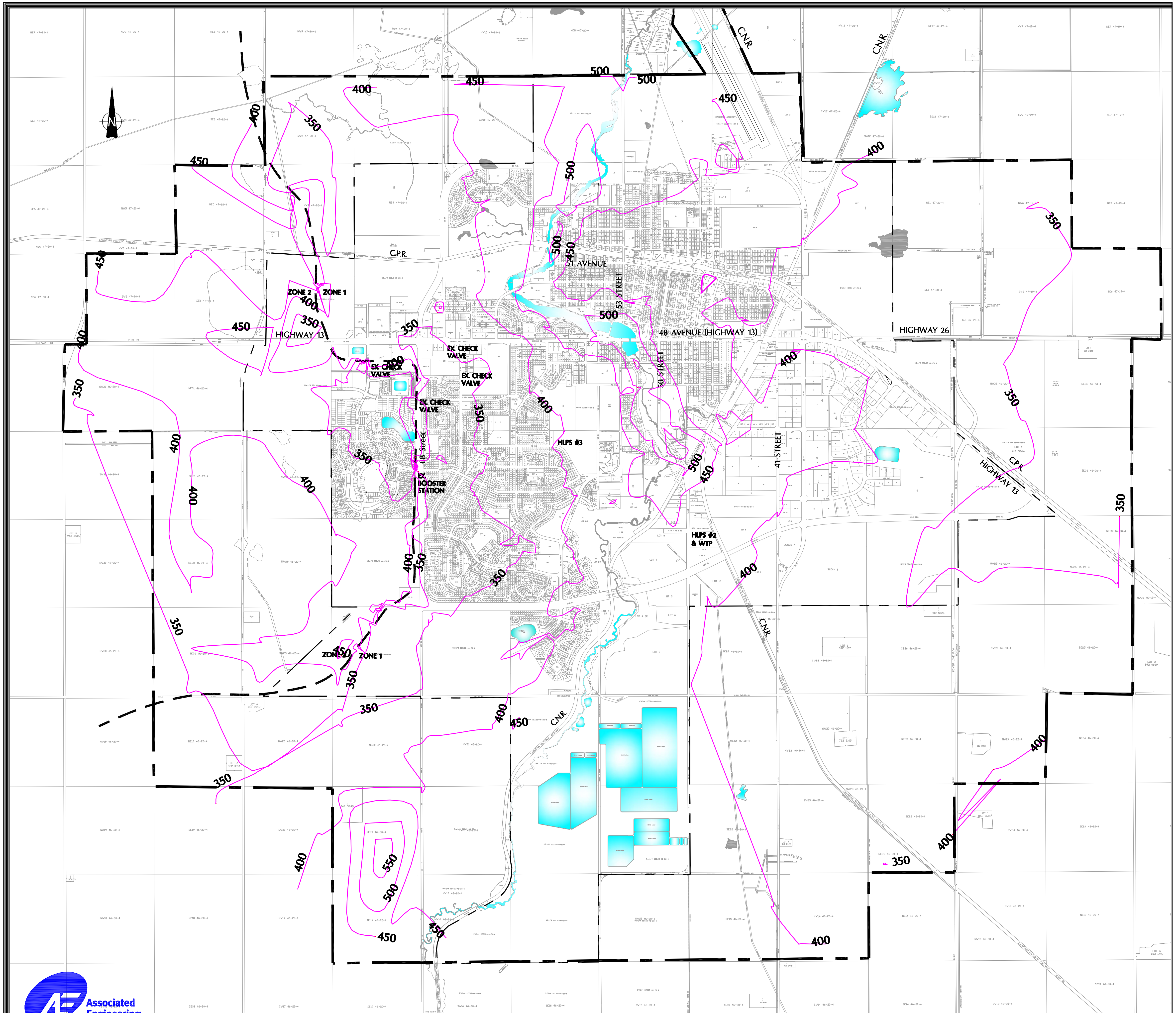

THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

2056 PEAK HOUR PRESSURE CONTOURS

LEGEND:

450	PRESSURE CONTOUR (kPa)
	EXIST. CITY BOUNDARY
	STUDY LIMIT
	PRESSURE ZONE

NOTE:

OPTIMUM OPERATING PRESSURE - FROM 345 kPa (50 psi) TO 552 kPa (80 psi)

SCALE : 1 : 35,000

December, 2007

FIGURE 4.4b

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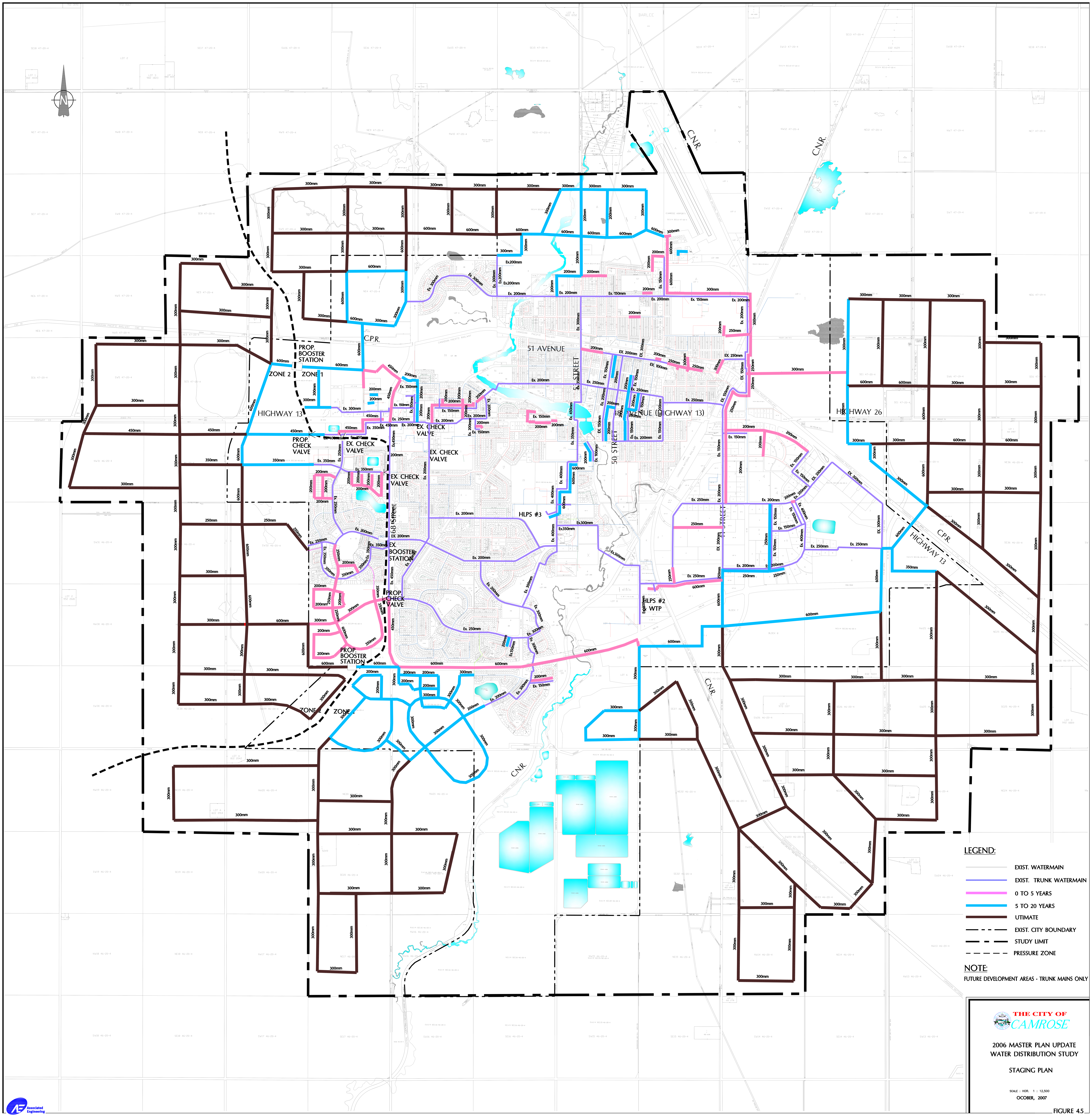


51 AVENUE
50 STREET
HIGHWAY 13
HIGHWAY 26
C.P.R.
C.N.R.
ZONE 2
ZONE 1
PROP. BOOSTER STATION
PROP. CHECK VALVE
EX. CHECK VALVE
EX. BOOSTER STATION
HLPS #3
HLPS #2 WTP
LEGEND:
EXIST. WATERMAIN
EXIST. TRUNK WATERMAIN
0 TO 5 YEARS
5 TO 20 YEARS
UTIMATE
EXIST. CITY BOUNDARY
STUDY LIMIT
PRESSURE ZONE
NOTE:
FUTURE DEVELOPMENT AREAS - TRUNK MAINS ONLY
THE CITY OF CAMROSE
2006 MASTER PLAN UPDATE
WATER DISTRIBUTION STUDY
STAGING PLAN
SCALE : HOR. 1 : 12,500
OCOBER, 2007
FIGURE 4.5

5 Cost Estimates

The cost estimates are based on current (2007) industry prices plus an allowance for contingency (20%) and engineering (15%).

5.1 STORAGE RESERVOIR

The existing storage reservoir will provide storage to meet the demand up to year 2013. The cost to add 8,000 m^3 of storage to the system based on 2007 dollars is approximately $12.0 million.

5.2 DISTRIBUTION PUMPS

In 2006, the total pumping capacity of the HLPS #2 and #3 will be adequate to meet the Peak Hour and the Peak Day plus fire demands up to 2034. (See Table 4-3)

The timeline for pumps to be reviewed and replaced is shown in Table 5-1:

Table 5-1 Pump Station Upgrading Cost (2007 dollars)

	HLPS #2	HLPS #3
2006 -2011		
Pump Upgrades	-	-
Pump Servicing	$30,000*	$60,000*
2011 - 2026		
Pump Upgrades / Replacement	$440,000**	$880,000**
Pump Servicing	$90,000*	$180,000*

*Annual cumulative cost

**One time cost

5.3 DISTRIBUTION MAINS

The cost estimates only include stripping and replacing topsoil, trenching, backfilling, compacting the native material and seeding. The extra cost for the new watermains in developed areas such as removals & restoration of sidewalks, curb & gutter, pavement & landscaping and reconnection to existing services are not included. As noted by the City, it is very expensive to upgrade underground utilities in developed areas. As such, any future watermain installation or replacement in developed areas will be coordinated with planned street paving programs, and will be completed in conjunction with a review of other underground utilities and services in the area.

The proposed system upgrades were grouped into for City quadrants for ease of reference. The north-south and the east-west City segments were divided by 48 Avenue and by 50 Street respectively. (See Figure 5.1 for reference.)

The capital cost breakdown for the proposed water trunk mains is shown in Table 5-2 & 5-3.

5.4 SUMMARY

Summary of capital costs for the distribution system improvements and for the upgrading of the potable water storage facilities are shown in Table 5-4.

Table 5-4
Summary of Estimated Costs (2007 dollars)

Year	Description	Amount ($ in Millions)
2006 to 2011	• Pump Servicing	0.1
	• South West (SW) Trunk Mains	7.2
	• North West (NW) Trunk Mains	1.8
	• North East (NE) Trunk Mains	3.4
	• South East (SE) Trunk Mains	2.1
	Total =	**14.7**
2011 to 2026	• Potable Water Storage Facilities Upgrading	12.0
	• Pump Upgrades and Servicing	1.6
	• South West (SW) Trunk Mains	8.9
	• North West (NW) Trunk Mains	7.7
	• North East (NE) Trunk Mains	1.9
	• South East (SE) Trunk Mains	6.0
	Total =	**38.1**
2026 to 2056	• Two Booster Stations	**2.5**

Note: Distribution System Improvements after Year 2011 will be required only as development in the respective areas occurs.

Table 5-2

Improvements Year 2006 -2011 (2007 dollars)

Quadrant	location (Roadway or Township Plan)	From		To		Length	Diameter	Unit Price	Amount
		Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)
SW	47 Ave	61 St	478	61 St West	476	70	200	500	35,000
SW	55 St	47 Ave	502	46 Ave	637	160	200	500	80,000
SW	48 Ave	68 St West	771	73 St	973	503	450	860	433,000
SW	73 St West Subdivision	44 Sve	915	44 Ave South	913	855	200	500	428,000
SW	45 Ave South Subdivision	69 St	923	71 St	921	935	200	500	468,000
SW	70 St / 38 Ave	38 Ave	947	Marler Dr	1158	250	200	500	125,000
SW	Marler Dr	41 Ave	436	41 Ave South	1656	466	250	550	257,000
SW	68 St	Enevold Dr	768	Camrose Dr	1823	710	450	860	611,000
SW	Camrose Dr	68 St	1823	50 St	1271	2400	600	1000	2,400,000
SW	28 Ave	57 St	JV3	56 St	JV2	120	200	500	60,000
SW	28 Ave	56 St	JV2	55 St	JV28	115	200	500	58,000
SW	NE-29-46-20-4		1656		1332	705	250	550	388,000
SW	NE-29-46-20-4		1332		963	780	350	670	523,000
SW	NE-29-46-20-4		768		1668	840	300	610	513,000
SW	NE-29-46-20-4		1656		1657	290	200	500	145,000
SW	NE-29-46-20-4		1657		1334	95	200	500	48,000
SW	NE-29-46-20-4		1334		1333	190	200	500	95,000
SW	NE-29-46-20-4		1333		1663	120	200	500	60,000
SW	NE-29-46-20-4		1663		1665	130	200	500	65,000
SW	NE-29-46-20-4		1665		1656	95	200	500	48,000
SW	NE-29-46-20-4		1658		1659	410	200	500	205,000
SW	NE-29-46-20-4		1659		1660	295	200	500	148,000
SW	NE-29-46-20-4		1660		1330	170	200	500	85,000
								Subtotal =	**7,278,000**
NW	55 Ave	53 St	1338	51 St	811	255	200	500	128,000
NW	51 Ave	53 St	270	51 St	912	220	200	500	110,000
NW	48 Ave	55 St	390	Lane	1606	290	200	500	145,000
NW	Lane	48 Ave	1605	48 A Ave	1606	50	200	500	25,000
NW	48 A Ave	Lane	1606	57 St	1607	55	200	500	28,000
NW	Utility R/W	Grand Park Cres	370	Grandview Cres	363	95	200	500	48,000
NW	Grandview Cres	Utility R/W	363	Grand Dr	362	200	200	500	100,000
NW	48 A Ave	Grand Dr	362	64 St	360	230	200	500	115,000
NW	48 A Ave	64 St	360	64 St West	751	40	200	500	20,000
NW		64 St West	751	48 Ave	677	160	200	500	80,000
NW	Grand Dr	48 B Ave	364	48 A Ave	362	95	200	500	48,000
NW	Grand Dr	48 A Ave	362	48 Ave	394	105	200	500	53,000
NW	64 St	48 B Ave	360	48 A Ave	355	95	200	500	48,000
NW	68 St	48 Ave	766	48 Ave North	1032	440	450	860	379,000
NW	North of 48 Ave / West of 68 St	68 St	1032	68 St West	1336	450	450	860	387,000
NW		68 St West	1336	Connect Existing	891	180	300	610	110,000
								Subtotal =	**1,824,000**

*Please refer to Fig. 4.6 (Ultimate Node and Pipe Numbers) for node numbers in Appendix C

Table 5-2 (Cont'd)

Improvements Year 2006 -2011 (2007 dollars)

Quadrant	location (Roadway or Township Plan)	From		To		Length	Diameter	Unit Price	Amount
		Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)
NE	SE-11-47-20-4	46 St	1183	46 St East	1705	70	300	610	43,000
NE	46 St	57 Ave	1183	54 Ave	1856	585	600	1000	585,000
NE	N of 55 Ave / W of 46 St	46 St	860	55 Ave	846	260	200	500	130,000
NE	54 Ave	46 St	856	39 St	633	820	300	610	501,000
NE	54 Ave	47 St	844	47 St West	1113	95	200	500	48,000
NE	53 Ave	49 St	830	48 St	834	115	200	500	58,000
NE	39 St	54 Ave	633	52 B Ave	629	380	300	610	232,000
NE	52 B Ave	41 St	896	39 St	629	240	250	550	132,000
NE	39 St	52 B Ave	629	52 A Ave	627	210	300	610	129,000
NE	39 St	52 A Ave	627	51 Ave	1010	435	250	550	240,000
NE	SW-1-47-20-4	39 St	1943	39 St East	1394	985	300	610	601,000
NE	51 Ave	39 St	1010	41 St	1004	155	250	550	86,000
NE	41 St	51 Ave	1004	48 Ave	1008	250	250	550	138,000
NE	44 St	52 Ave	1650	51 Ave	1676	113	300	610	69,000
NE	51 Ave	46 St	958	42 St	677	360	250	550	198,000
NE	51 Ave	47 St	956	47 St East	1894	61	200	500	31,000
NE	45 St	S of 51 Ave	1478	51 Ave	1675	35	250	550	20,000
NE	44 St	S of 51 Ave	1477	51 Ave	1676	35	250	550	20,000
NE	41 St	51 Ave	999	52 Ave	898	155	300	610	95,000
NE	41 St	52 B Ave	896	52 B Ave North	895	105	200	500	53,000
								Subtotal =	**3,409,000**
SE	41 St	48 Ave	1008	44 Ave	1280	805	250	550	443,000
SE	Lane S of 48 Ave	41 St	1240	37 St	1255	905	200	500	453,000
SE	Lane	Lane S of 48 Ave	1253	47 Ave	1251	255	200	500	128,000
SE	PUL	41 St	1290	43 St	1382	495	250	550	273,000
SE	43 St	S of 42 Ave	1272	42 Ave	1282	160	250	550	88,000
SE		HLPS #2	1114	41 St	1296	695	600	1000	695,000
								Subtotal =	**2,080,000**
								Total =	**14,591,000**

*Please refer to Fig. 4.6 (Ultimate Node and Pipe Numbers) for node numbers in Appendix C

Table 5-3

Improvements Year 2011 -2026 (2007 dollars)

Quadrant	location (Roadway or Township Plan)	From		To		Length	Diameter	Unit Price	Amount
		Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)
SW	NW-32-46-20-4		1168		941	770	450	860	663,000
SW	SW-4-47-20-4 / NW-32-46-20-4		1335		1703	595	600	1000	595,000
SW	NW-32-46-20-4		1335		1131	705	350	670	473,000
SW	SE-29-46-20-4		1921		1331	330	200	500	165,000
SW	SE-29-46-20-4		1331		1920	235	200	500	118,000
SW	SE-29-46-20-4		1325		1913	535	300	610	327,000
SW	SE-29-46-20-4		1913		1918	620	300	610	379,000
SW	SE-29-46-20-4		1918		1919	415	300	610	254,000
SW	SE-29-46-20-4		1919		1921	435	300	610	266,000
SW	SW-28-46-20-4		1823		1311	80	300	610	49,000
SW	SW-28-46-20-4		1311		1834	390	200	500	195,000
SW	SW-28-46-20-4		1834		1826	220	200	500	110,000
SW	SW-28-46-20-4		1311		1838	90	300	610	55,000
SW	SW-28-46-20-4		1838		1841	245	200	500	123,000
SW	SW-28-46-20-4		1841		1833	185	200	500	93,000
SW	SW-28-46-20-4		1837		1827	225	200	500	113,000
SW	SW-28-46-20-4		V17		1825	325	300	610	199,000
SW	SW-28-46-20-4		1825		1828	420	300	610	257,000
SW	SW-28-46-20-4		1828		1831	470	300	610	287,000
SW	SW-28-46-20-4		1825		1844	415	300	610	254,000
SW	SW-28-46-20-4		1828		1919	200	300	610	122,000
SW	SW-28-46-20-4		1918		1824	990	300	610	604,000
SW	SW-28-46-20-4		1824		1149	130	200	500	65,000
SW	SE-28-46-20-4		1149		1136	110	200	500	55,000
SW	SE-28-46-20-4		1844		1366	160	300	610	98,000
SW	NE-21-46-20-4		1365		1366	315	300	610	193,000
SW	NW21-46-20-4		1365		1831	695	300	610	424,000
SW	50 St	Camrose Dr	1271	Camrose Dr South	1360	75	600	1000	75,000
SW	50 St		1360		1361	915	300	610	559,000
SW	50 St West		1362		1363	345	300	610	211,000
SW	50 St West		1363		1361	890	300	610	543,000
SW	52 St	47 Ave	510	46 Ave	542	225	200	500	113,000
SW	51 St	48 Ave	298	47Ave	1202	205	200	500	103,000
SW	City Park	53 St / 46 Ave	540	55 St (HLPS #3)	588	685	600	1000	685,000
SW	Edgewood Dr.	Enevold Rd	1642	Edgewood Cl	583	95	200	500	48,000
								Subtotal =	**8,873,000**

*Please refer to Fig. 4.6 (Ultimate Node and Pipe Numbers) for node numbers in Appendix C

Table 5-3 (Cont'd)

Improvements Year 2011 -2026 (2007 dollars)

Quadrant	location (Roadway or Township Plan)	From		To		Length	Diameter	Unit Price	Amount
		Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)
NW	SW-4-47-20-4		1703		1337	450	600	1000	450,000
NW	SW-4-47-20-4		1337		1935	395	600	1000	395,000
NW	SW-4-47-20-4		1001		1936	215	300	610	132,000
NW	SW-4-47-20-4		1936		1885	245	300	610	150,000
NW	SW-4-47-20-4		1936		1935	400	300	610	244,000
NW	SW-4-47-20-4 / SE-4-47-20-4		1935		1336	515	600	1000	515,000
NW	SE-4-47-20-4 / NE-4-47-20-4		1336		1704	460	600	1000	460,000
NW	NE-4-47-20-4		1704		1368	150	600	1000	150,000
NW	NE-4-47-20-4		1368		1369	495	600	1000	495,000
NW	NE-4-47-20-4		1369		1211	585	600	1000	585,000
NW	NE-4-47-20-4		1211		3	305	300	610	187,000
NW	NE-4-47-20-4		3		1367	265	300	610	162,000
NW	NE-4-47-20-4		1367		1704	320	300	610	196,000
NW	SW-4-47-20-4		1001		1936	215	350	670	145,000
NW	SE-4-47-20-4		1949		989	85	200	500	43,000
NW	SE-4-47-20-4		987		1009	75	200	500	38,000
NW	50 Ave	68 St	1032	66 St	320	150	200	500	75,000
NW	66 St	50 Ave	320	48 Ave	310	385	200	500	193,000
NW	SE-10-47-20-4		1283		1342	240	300	610	147,000
NW	SE-10-47-20-4		1342		1799	205	300	610	126,000
NW	SE-10-47-20-4		1799		1818	195	600	1000	195,000
NW	SE-10-47-20-4		1818		1819	480	300	610	293,000
NW	SE-10-47-20-4		1819		1340	200	300	610	122,000
NW	SE-10-47-20-4		115		1338	450	200	500	225,000
NW	NW-4-47-20-4		1338		811	255	200	500	128,000
NW	SE-10-47-20-4 / SW-11-47-20-4		1818		1345	645	600	1000	645,000
NW	53 St	55 Ave	1338	55 Ave N	1339	1000	200	500	500,000
NW	SW-11-47-20-4		1340		1344	260	300	610	159,000
NW	SW-11-47-20-4		1344		1345	470	200	500	235,000
NW	51 St	51 Ave	924	49 Ave	920	337	200	500	169,000
NW	48 A Ave	51 St	296	50 St	1414	105	200	500	53,000
NW	51 St	48 A Ave	296	48 Ave	298	155	200	500	78,000
								Subtotal =	**7,690,000**

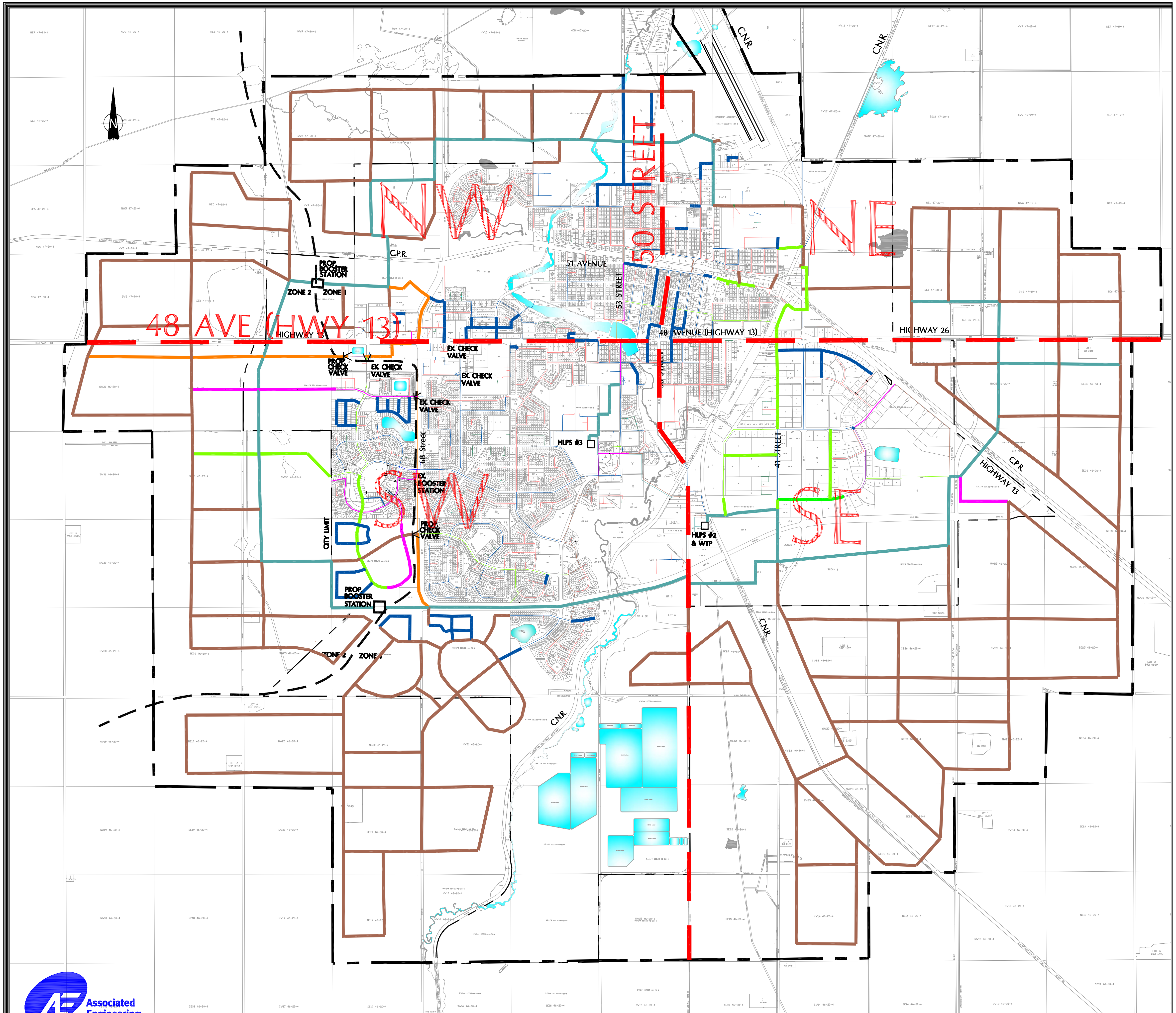
*Please refer to Fig. 4.6 (Ultimate Node and Pipe Numbers) for node numbers in Appendix C

Table 5-3 (Cont'd)

Improvements Year 2011 -2026 (2007 dollars)

Quadrant	location (Roadway or Township Plan)	From		To		Length	Diameter	Unit Price	Amount
		Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)
NE	SW-11-47-20-4		1344		1347	380	300	610	232,000
NE	SW-11-47-20-4		1347		1348	395	300	610	241,000
NE	SW-11-47-20-4		1345		1348	405	600	1000	405,000
NE	SW-11-47-20-4		1348		1183	190	600	1000	190,000
NE		NE-1-47-20-4	1706	SE-1-47-20-4	1349	725	300	610	443,000
NE		SE-1-47-20-4	1349	NE-35-46-20-4	1352	700	300	610	427,000
NE	49 St	50 Ave	936	48 A Ave	1083	345	200	500	173,000
NE	49 St	48 A Ave	1083	48 Ave	940	120	200	500	60,000
NE	48 A Ave	49 St	1083	48 St	1084	100	200	500	50,000
NE	48 St	48 A Ave	1084	48 Ave	942	180	200	500	90,000
								Subtotal =	**1,938,000**
SE	NE-35-46-20-4		1352		1353	385	300	610	235,000
SE		NE-35-46-20-4	1353	SW-36-46-20-4	1778	725	300	610	443,000
SE	SW-36-46-20-4		1778		1648	535	600	1000	535,000
SE	SW-36-46-20-4		1648		1647	660	350	670	443,000
SE		SW-36-46-20-4	1648	SE-35-46-20-4	1326	105	600	1000	105,000
SE		SE-35-46-20-4	1326	NE-26-46-20-4	1821	625	600	1000	625,000
SE		NE-26-46-20-4	1821	41 St	1357	1560	600	1000	1,560,000
SE		41 St	1357	50 St	1360	1010	600	1000	1,010,000
SE	41 St		1357		1296	180	600	1000	180,000
SE	41 St		1296	42 Ave	1294	70	250	550	39,000
SE	42 Ave	41 St	1294	38 St	1310	480	250	550	264,000
SE	38 St	42 Ave	1310	44 Ave	1304	645	250	550	355,000
SE	42 Ave	38 St	1310		1315	140	250	550	77,000
SE	49 St	48 Ave	940	47 Ave	1208	205	200	500	103,000
								Subtotal =	**5,974,000**
								Total =	**24,475,000**

*Please refer to Fig. 4.6 (Ultimate Node and Pipe Numbers) for node numbers in Appendix C



THE CITY OF CAMROSE

2006 MASTER PLAN UPDATE WATER DISTRIBUTION STUDY

WATERMAINS LOCATION PLAN

(red dashed line)	QUADRANT
(thin dash line)	EXIST. CITY BOUNDARY
(thick dash line)	STUDY LIMIT
(dashed line)	PRESSURE ZONE

SCALE : 1 : 35,000

December, 2007

FIGURE 5.1

Time: 8:55am
Date: Dec 19, 2007
File: P:\20063076\00_CamroseWDSystem\Working_Dwgs\100_Civil\REPORT -FINAL\FR_3076-fg5.1 Quadrants.dwg by BW
Xrefs: 3076_RT-01_AE_BDR
3076-RP01_BASE_2005_nad27

6 Conclusions and Recommendations

6.1 CONCLUSIONS

The following summarizes the results of the network analyses:

1. The existing distribution system is adequate for domestic water demands. The system, however, is inadequate to meet the peak day plus fire flow demands in the industrial area in the east, the airport area in the northeast and the west highway commercial in the west.

2. The total pumping capacity of HLPS #2 and #3 will provide adequate service for peak hour demand and peak day plus fire flow demand, up to a population of 33,000 in year 2034.

3. The existing storage capacity of 24,600 m^3 is adequate up to year 2013.

4. The WTP will reach its treatment capacity, with clarifiers running in parallel, when the population reaches 19,000 in 2011.

5. In regards to water modelling software evaluation, a technical memorandum which outlines the general functions and prices of the most market accepted modelling software is included in Appendix A.

6.2 RECOMMENDATIONS

On the basis of analysis performed during the course of this project, the following system improvements to the present and future development, are recommended:

1. As existing mains are replaced, an opportunistic upsizing to a min. of 200 mm dia. in residential; 250 mm dia. in industrial/commercial; and 300 mm diameter in central business district is recommended. Any potential upsizing should be verified with the hydraulic model.

2. To adopt the recommended study pipe sizes for future pipe installation and replacement.

3. To adopt the recommended pipe sizes shown for future developments.

4. To thoroughly review whether the HLPS #2 should be phased out or be replaced with a new pump station.

5. To outline a plan to increase storage capacity beyond year 2013.

6. To maintain the condition and monitor the performance of all pumps, in order to extend the design life of the pumps.

7. To undertake specific analysis of each proposed new development and water main replacement to confirm the required watermain sizes.

8. That City of Camrose retain and upgrade the current 1000 pipe WaterCad modelling software to the 2000 pipe model version (see Appendix A).

Closure

This report was prepared for the City of Camrose to update the City's Water Distribution System Master Plan.

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.

PROFESSIONAL ENGINEER ALBERTA
CHRIS SKOWRONSKI
Dec. 20, 2007

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ALAN Y. LUI
2007-12-20

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2007.12.20

Nella Gulley, E.I.T.
Project Engineer

PERMIT TO PRACTICE
ASSOCIATED ENGINEERING ALBERTA LTD.
Signature ______
Date December 20, 2007
PERMIT NUMBER: P 3979
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PERMIT STAMP

A Appendix A - Technical Memorandum - Water Modelling Software Evaluation

OBJECTIVE

The main objective of this Technical Memorandum (TM) is to:

- Provide a listing of well known hydraulic modeling software available in North America.
- Compile software evaluation criteria
- Evaluate candidate software
- Recommend the selected software for adoption by the City

BACKGROUND

The City currently owns a 1000 pipes version of WaterCad, a water distribution modeling software by Bentley Systems (formerly by Haestad Methods). Bentley currently supports the software through a package called SELECT. For an annual fee of US$1,300, this SELECT package provides the City with:

- Automatic access to software updates as soon as they're available (approx 1 major release per year)
- Upgrade protection (upgrade number of pipes, add users and only pay upgrade pricing)
- Local Area Network Deployment - Install software on any and all network personal computers,
- Full technical support, available toll-free 24/7
- Compatibility protection (with new versions of AutoCAD, Microsoft OS, etc)
- Access to online training and support resources

The City began preparation of the water distribution system in 80's with water model, "Waterworks" which was the predecessor of WaterCad. In 1999, hydrant flow tests were conducted and the results obtained were used to calibrate and refine the model. The model was then used to identify water system deficiencies, provide cost effective solutions and also assist in identifying appropriate pipe sizing for future development. A Water Distribution System Master Plan was then completed in 2000.

Since then the City has grown and an update to the model is required. However, due to the rapid development in the software market today, the City intends to invest in an evaluation of some of the well-known hydraulic modeling software in the market today.

The following sections provide a brief description on some software selected for evaluation; a set of criteria was also developed which also included capital and life cycle costs for comparison purposes.

SELECTION

Selection of the modeling software will be based on an established criterion (see Table 1). Most of the modeling software in the market today are very much similar or may have such minute differences that a modeller may not be even aware of. Some of the items included in the selection criterion are the capability to perform hydraulic analysis; performing water quality analysis; ease of construction and manipulating the model; the flexibility to read and export files; ability to do housekeeping within the model; ability to produce a quality presentation from the results; ability to work as standalone, with AutoCad or inside GIS. However, some of the essentials in the selection of modeling software are the initial capital cost to setup and yearly cost to maintain the license, and the availability of technical support from the vendor when required. The key to successful and effective use of modeling software is dependent on the training offered.

EVALUATION

Currently, the six eminent modeling softwares in Canada are the EPANet, WaterCad (WaterGEMS), H2Onet (InfoWater), SynerGEE, AquaCad and MikeNet. Although there are others in North America, their existence are not well publicized or lack of representation in Canada. For example, SynerGEE by Stoner Software Products is a water modeling software that is widely used in USA and Europe, however, it is not known in Canada. Others, like AquaCad, has now become H2Onet, and Waterworks, at one time a leading competition to Cybernet (WaterCad) is no longer available.

Following the web demo by Bentley on their WaterGEMS product on September 19, 2006, the City has narrowed down the list to WaterCad, WaterGEMS, H2Onet and InfoWater.

The following section provides a brief description on each of the software selected for the evaluation:

WaterCad

The City has owned a 1000 pipes license since 1998 and continues to use the software to investigate mainly water distribution system needs and issues. Currently, the license is on Version 6, however, with the SELECT support package, the city is able to upgrade the license to version 8 free of charge.

WaterCad has an easy to use interface and easy to model layout tools. It does support multiple backgrounds as a standalone, conversion utilities from CAD, GIS, and databases and able to integrate seamlessly with AutoCad.

It features advanced interoperability, model building, optimization, asset management tools, and helps engineers and operators of water utilities to analyze, design, and optimize their water distribution systems.

WaterGEMS

WaterGEMS is a “loaded” WaterCad product with capability to perform inside GIS environment. The incorporation of the geospatial model building tools help to reduce model building process; Loadbuilder helps to allocate water demands based on GIS water consumption data; Trex is able to extract elevations from DEMs; TINs; elevation shapefiles and 3D CAD drawings and surfaces.

It is more costly to purchase and has higher SELECT support annual fees than WaterCad. Although it has the capability to work inside a GIS environment, City of Camrose does not foresee any added advantage to have this feature. The GIS feature is without doubt a handy tool when constructing a model from scratch. However, having it linked to the GIS server all the time might pose a security issue, access authority and assigning user responsibility.

H2Onet

H2Onet is water distribution modeling software similar to WaterCad by MWH Soft headquartered in Broomfield, Colorado and its Operation Headquarters in Pasadena, California. In Canada, Chris Baxter of Hydrant, in Port Moody, BC, provides sales and technical support.

Basically, H2Onet uses the EPANet hydraulic engine with a third party (MWH Soft) developer providing a user friendly front end to sort, retrieve and display results generated by EPANet. Most of the features found in WaterCad are available in H2ONet, with one exception: H2ONet is a standalone and does not operate in AutoCad environment. Although, some features in H2ONet may take more steps to accomplish than in WaterCad, it would not be an issue once a modeller has gain familiarity with the software.

The software is cheaper to purchase and lower support cost than WaterCad. A 2000 pipes H2ONet is about half the cost of 2000 pipes WaterCad. Support cost for H2ONet is generally below US$1000 a year, while WaterCad is in the US$2,000 – US$3,000 range.

InfoWater

InfoWater is also from the same developer of H2Onet. The product is equivalent to WaterGEMS, that is: more features and operates inside GIS. InfoWater can operate as a standalone and also inside AutoCad environment.

The initial purchase and support cost are much lower than WaterCad and WaterGEMS.

CONCLUSION

The following are the conclusions derived from the preceding sections:

- City is familiar with WaterCad.
- Current model is in WaterCad format.
- WaterGEMS and InfoWater have GIS features but are not required.
- H2ONet and InfoWater have lower initial cost.
- H2ONet and InfoWater have lower support cost.
- H2ONet can only operate as standalone; WaterCad as Standalone and inside AutoCad.
- If Camrose decides to purchase H2ONet, existing files have to be converted to H2ONet. Only one scenario is brought over during the conversion process. Therefore, there will be a cost to reconstruct the scenarios in H2ONet.
- Additional training will be required on H2ONet, longer learning curve.
- There is always the “fear” factor of using a new (unfamiliar) software.

RECOMMENDATION

Based on the preceding sections and conclusion, it is recommended that the City of Camrose retain and upgrade the current 1000 pipe WaterCad software to a 2000 pipe version. This will offer a comfortable and smooth transition for the modeller. There is basically no “steep learning curve” to go through other than a moderate training from the WaterCad version no. 6 to the latest version, WaterCad version no. 8, and this can considerably outweigh the initial and support costs.

City of Camrose - Water Distribution Modeling Software Evaluation

Applications	EPANET	WaterCad	WaterGems	H2ONET	InfoWater	MikeNet	SynerGEE
1 Hydraulic Modeling Capabilities							
.1 limit on size of network	No	Yes	Yes	Yes	Yes	Yes	Yes
.2 computes using Hazen-Williams, Darcy-Weisbach or Chezy-Manning	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.3 models constant and variable speed pumps	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.4 computes pumping energy and cost		Yes	Yes	Yes	Yes	Yes	
.5 models various types of valves (FCV,PSV,PRV)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.6 multiple demand categories at each node	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.7 models emitters (sprinkler or hydrant)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.8 ability to run automatic fire flow	No	Yes	Yes	Yes	Yes	Yes	Yes
.9 ability to set different fire flows in Single Simulation	No	Yes	Yes	Yes	Yes	Yes	Yes
.10 variable speed model	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.11 multiple pump curves	Yes	Yes	Yes	Yes	Yes	Yes	
2 Water Quality Modeling Capabilities							
.1 models the movement of a tracer material through the network over time	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.2 models the movement of a material as it grows (disinfection by-product) or decays (chlorine) with time time	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.3 models the age of water throughout a network	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.4 models reactions both in bulk flow and at the pipe wall	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.5 allows wall reaction rate coefficients to be correlated to pipe roughness	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.6 allows for time-varying concentration or mass inputs at any location in the network	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.7 models storage tanks as being either complete mix, plug flow or two compartment reactors	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.8 extended period simulation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3 Interface And Graphical Editing							
.1 Standalone interface	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.2 AutoCad Interface	No	Yes	Yes	Yes	No	No	No
.3 element morphing, splitting and reconnection	No	Yes	Yes	Yes	Yes	Yes	No Info
.4 automatic element labeling	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.5 scaled, schematic and hybrid environment	With Difficulty	Yes	Yes	Yes	Yes	Yes	Yes
.6 element prototypes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.7 multiple background layer support	No	Yes	Yes	Yes	Yes	No	Yes
.8 locate parallel/duplicate/superimposed pipes	No	Yes	Yes	Yes	Yes	No	No Info
.9 locate and fix crossing/intersecting pipes	No	Yes	Yes	Yes	Yes	No	No Info
4 Import / Export							
.1 database	Text	Yes	Yes	Yes	Yes	Yes	Yes
.2 shapefiles	Text	Yes	Yes	Yes	Yes	Yes	Yes
.3 dxf	No	Yes	Yes	Yes	Yes	Yes	Yes
.4 real time SCADA connection	No	Yes	Yes	Yes	Yes	Yes	Yes
5 Model Building / Management							
.1 tree-based scenario management and alternative management	No	Yes	Yes	Yes	Yes	Yes	Yes
.2 import/export database,shapefiles,textfiles	Text	Yes	Yes	Yes	Yes	Yes	Yes
.3 scenario and alternative inheritance properties	No	Yes	Yes	Yes	Yes	Yes	Yes
.4 polyline to pipe conversion	No	Yes	Yes	Yes	Yes	Yes	Yes
.5 check hydraulic data prior to analysis run	No	Yes	Yes	Yes	Yes	Yes	No Info
.6 locate a fix pipe-split candidates	No	Yes	Yes	Yes	Yes	Yes	No Info
.7 join disconnected nodes	No	No	No	Yes	Yes	Yes	No Info
.8 skeletonization (add-on)	No	Yes	Yes	Yes	Yes	Yes	No Info
.9 calibration	Yes	Yes	Yes	Yes	Yes	Yes	No Info
.10 energy management	Yes	Yes	Yes	Yes	Yes	Yes	No Info
.11 cost management	No	Yes	Yes	Yes	Yes	Partly	No Info
6 Results Presentation							
.1 customizable reporting	No	Yes	Yes	Yes	Yes	Yes	Yes
.2 colour coding and symbology	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.3 animated display (Extended Period Simulation)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.4 contouring	Yes	Yes	Yes	Yes	Yes	Yes	No info
.5 profiling	Yes	Yes	Yes	Yes	Yes	Yes	No info
7 Energy And Capital Cost Management							
.1 Energy cost analysis	Yes	Yes	Yes	Yes	Yes	Yes	No info
.2 Capital (Upgrades) Cost analysis	No	Yes	Yes	Yes	Yes	Partly	No info
8 Platform							
.1 Standalone	Yes	Yes	Yes	Yes	Yes	Yes	Yes
.2 CAD base	No	Yes	Yes	Yes	Yes	No	No
.3 ArcGIS (ArcView)	No	No	Yes	No	Yes	No	MiddleLink
9 Cost in US Dollars (Based on 1000 pipes)							
.1 Software	Free	$4,995	$9,995	$4,000	$4,000	$3,640	Customize
.2 Support package	None	$1,300	$2,600	$800	$1,000	$1,560	Customize
.3 GIS Software	None		Not included		Not included		
10 Technical Support	None	Good	Good	Good	Good	Good	No info
11 Training / Seminar (Available)	None	Yes	Yes	Yes	Yes	Yes	Yes
12 Life Cycle Cost (10 years)	None	$12,191.64 Based on $0 purchase. Support at $1300 per year	$30,406.50 Based on $5000 upgrades. Support at $2600 per year	$12,321.13 Based on $4000 upgrades. Support at $800 per year	$14,196.77 Based on $4000 upgrades. Support at $1000 per year	$18,767.94 Based on $3640 upgrades. Support at $1560 per year	Customize

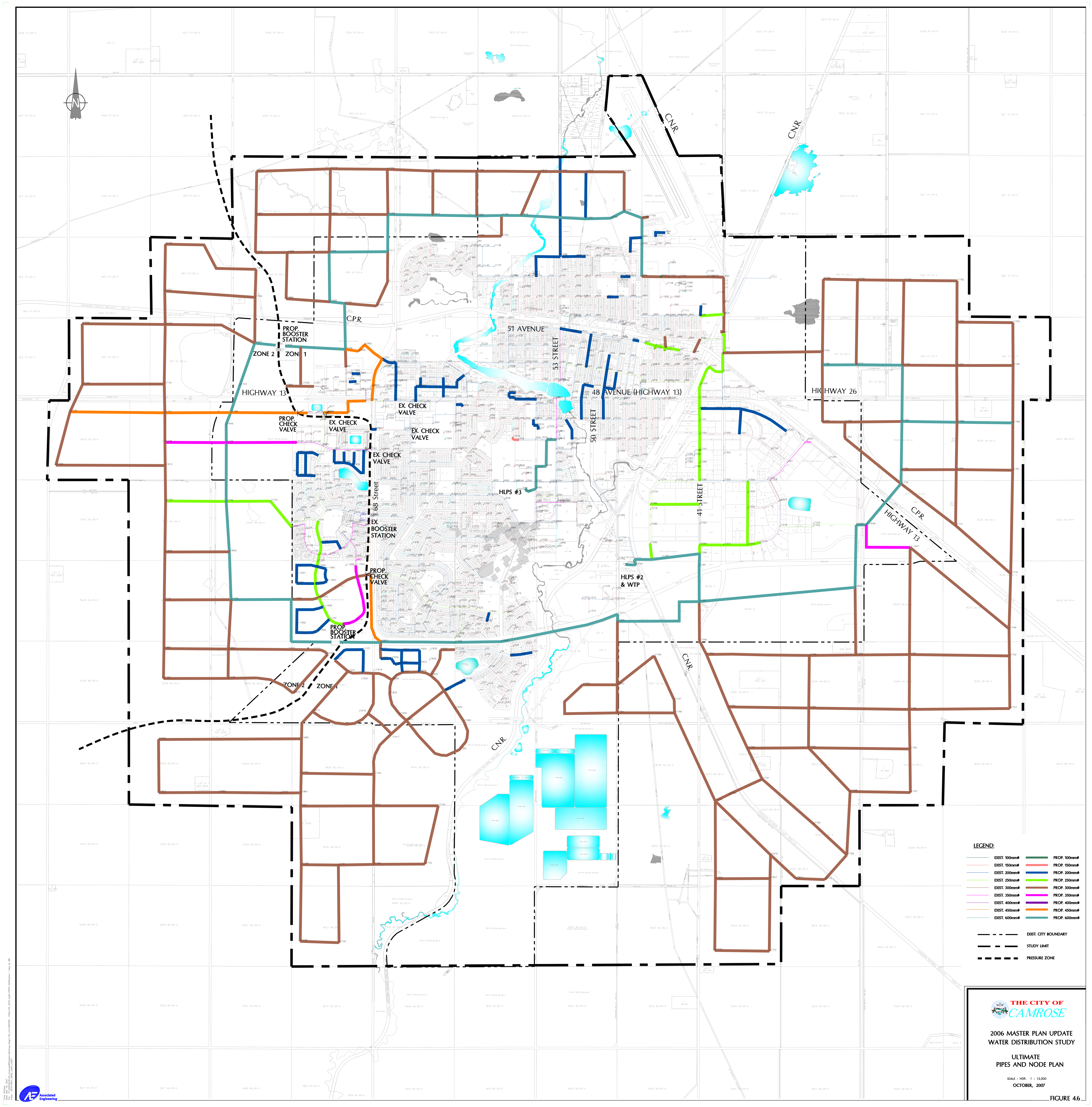
B Appendix B - Water Consumption Records

City of Camrose

Water Consumption Records 2003 - 2005

Month \ Year	2003 (m^3)	2004 (m^3)	2005 (m^3)
Jan	147,718	155,664	156,543
Feb	135,848	142,702	145,917
Mar	154,434	157,248	161,937
Apr	151,806	153,825	156,554
May	160,734	184,521	183,506
Jun	171,094	211,731	174,951
Jul	202,050	175,895	189,119
Aug	201,319	173,835	177,027
Sep	171,359	163,079	159,912
Oct	170,977	164,812	164,056
Nov	154,690	155,220	154,845
Dec	153,872	161,154	162,954
Total Annual	**1,975,901**	**1,999,686**	**1,987,321**
Avg. Daily Flow	**5,413**	**5,464**	**5,445**
Peak Day Flow	**8,895**	**10,223**	**8,432**
Peak Day Factor	**1.64**	**1.87**	**1.55**
Peak Hour Factor	**N/A**	**3.34**	**2.56**

C Appendix C - Pipe and Node Numbers


C.N.R.
C.P.R.
PROP. BOOSTER STATION
ZONE 2
ZONE 1
HIGHWAY 13
51 AVENUE
53 STREET
48 AVENUE (HIGHWAY 13)
50 STREET
HIGHWAY 26
EX. CHECK VALVE
PROP. CHECK VALVE
68 Street
EX. BOOSTER STATION
HLPS #3
HLPS #2 & WTP
41 STREET
HIGHWAY 13
LEGEND:
EXIST. 100mmø
EXIST. 150mmø
EXIST. 200mmø
EXIST. 250mmø
EXIST. 300mmø
EXIST. 350mmø
EXIST. 400mmø
EXIST. 450mmø
EXIST. 600mmø
PROP. 100mmø
PROP. 150mmø
PROP. 200mmø
PROP. 250mmø
PROP. 300mmø
PROP. 350mmø
PROP. 400mmø
PROP. 450mmø
PROP. 600mmø
EXIST. CITY BOUNDARY
STUDY LIMIT
PRESSURE ZONE
THE CITY OF CAMROSE
2006 MASTER PLAN UPDATE
WATER DISTRIBUTION STUDY
ULTIMATE
PIPES AND NODE PLAN
SCALE : HOR. 1 : 12,500
OCTOBER, 2007
FIGURE 4.6
Associated Engineering