Town of Blackfalds 2016 Water Model Update

FINAL REPORT

Prepared for:
Town of Blackfalds

Prepared by:
Stantec Consulting Ltd.

113929339-07

February 14, 2017

TOWN OF BLACKFALDS 2016 WATER MODEL UPDATE

14 February 2017

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1.0 Introduction

1.1 GENERAL

Stantec Consulting Ltd. (Stantec) was retained by the Town of Blackfalds to provide engineering services to complete an update to the existing water model based on the current infrastructure and the future development plans for the Town.

The updated hydraulic model will provide insight into existing capacities of the storage facility volumes, pumping capacity and the distribution pipes to determine the adequacy of each infrastructure in terms of meeting existing levels of service. It will also identify deficiencies that may have an impact on both the existing system as well as future development.

1.2 SCOPE OF WORK

The primary objectives of the Town of Blackfalds 2015 Water Model Update include:

- Update the existing Town of Blackfalds Water Model based on as-built drawings and current water demands;
- With the coordinated efforts of the Town's Public Works Department, complete a field flow testing program that provides the necessary data required to calibrate and verify the accuracy of the model in predicting actual system performance and response.
- Complete a modeling analysis using the updated and calibrated water model representing existing infrastructure for average day demand, maximum day demand, peak hour demand, and maximum day demand with fire flows;
- Provide recommendations regarding the operation of the existing Water Distribution System based on modeling results;
- Using future land use plans, the Town of Blackfalds MDP and the Lacombe County Joint Economic planning documents, complete a modeling analysis based on future demand projections to the year 2038 (25 years) for average day demand, maximum day demand, peak hour demand, and maximum day demand with fire flows;
- Provide recommendations regarding the future operation of the Water Distribution System based on modeling results;

- Outline the findings from the study including an operational component that will describe how the system could be operated for optimize the performance of the water distribution system.
- Submit a working WaterCAD V.8i Model to the Town of Blackfalds including all scenarios that were developed and analyzed for the Study.

1.3 STUDY AREA

The study area in this study is the area within the current municipality boundary of the Town. However, since the Town is extending its water distribution network to directly service a portion of the Lacombe County Joint Economic Area (JEA) west to the Town across the Queen Elizabeth Highway II, the portion of the JEA is also included in the study.

Figure 1.1 presents the study areas with the designated land use types that are directly serviced by the Town's water distribution system. The Area Identification numbers (Area ID) are also indicated in each of the areas for future reference.

1.4 PREVIOUS STUDIES

Several studies have been completed for the purposes of identifying a long-term water supply for the Town. Previous studies and guideline referenced in the completion of this water model update report include the following:

- Town of Blackfalds Master Plan – Stantec Consulting Ltd., November 2000.
- 2004 Water Distribution Analysis – Stantec Consulting Ltd., December 2004.
- Town of Blackfalds Water Reservoir and Pump Station Preliminary Design Report – Stantec Consulting Ltd, December 2006.
- Town of Blackfalds Master Plan Update for Annexation Application – Stantec Consulting Ltd., May 2008.
- Town of Blackfalds Municipal Development Plan – August 2009.
- Town of Blackfalds Design Guidelines Manual – 2011.
- Town of Blackfalds 2013 Offsite Levies Report – Stantec Consulting Ltd., 2013.
- Lacombe County – Water & Wastewater Servicing Study Joint Economic Area West of Blackfalds – Stantec Consulting Ltd., 2013

1.5 ABBREVIATIONS

The following abbreviations are used in this report:

AESRD	Alberta Environment and Sustainable Resource Development

ADD	Average Day Demand
HMI	Human Machine Interface
HP	Horsepower
HVAC	Heating, Ventilation and Air-Conditioning
JEA	Joint Economic Area (Lacombe County)
kPa	Kilopascals
km	Kilometre
kwh	Kilowatt hour
Lpcd	Litres per capita per day
L/s	Litres per second
L/s/ha	Litres per second per hectare
mm	Millimetre
m^3	Cubic Metres
MDD	Maximum Day Demand
NRDWSC	North Red Deer Water Service Commission
O&M	Operation and Maintenance
PHD	Peak Hour Demand
psi	Pounds per square inch
PRV	Pressure Relief Valve
PVC	Polyvinyl Chloride
PE	Polyethylene
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
TDH	Total Dynamic Head
TOB	Town of Blackfalds
VFD	Variable Frequency Drive
WTP	Water Treatment Plant

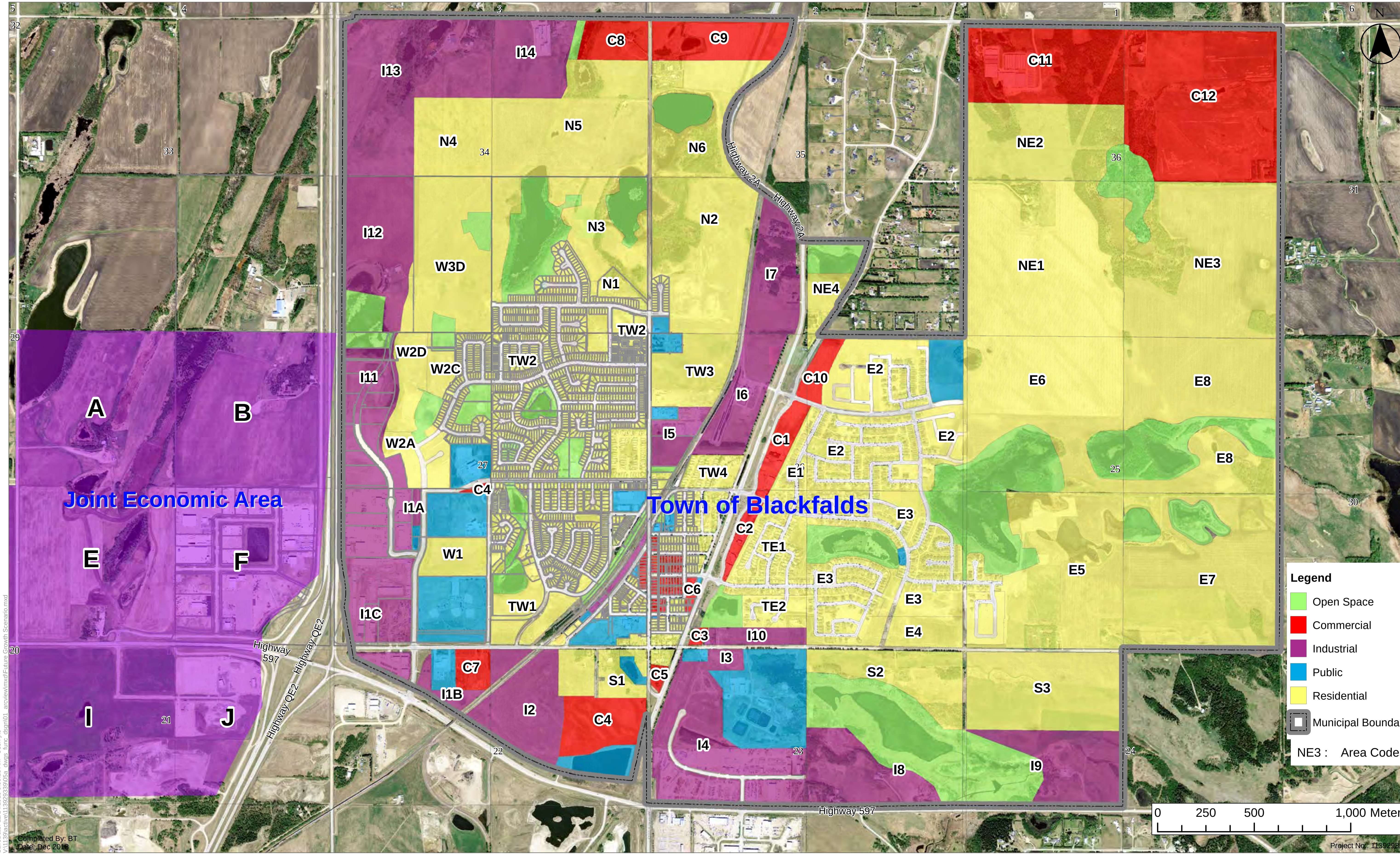


Figure 1.1: Study Area
Town of Blackfalds and Joint Economic Area

Stantec

Town of Blackfalds Water Model

2.0 Existing Water Model Update

2.1 EXISTING WATER DISTRIBUTION SYSTEM

The Town of Blackfalds water distribution system provided potable water and fire protection services to a population of approximately 8,793 people within the town boundary in 2015. The Town of Blackfalds potable water source is supplied entirely from the North Red Deer Regional Water System Commission (NRDRWSC). The distribution system has been expanded to the Joint Economic Area (JEA) west of Blackfalds, which is outside of the current town boundary.

The existing Town water system consists of one pressure zone, two reservoirs and their associated pump houses and a distribution network. **Figure 2-1**presents the existing water distribution system the Town is operating. The two reservoirs are the Railway reservoir and the Broadway reservoir.

2.1.1 Water Supply

The Town's water supply comes from City of Red Deer via the NRDWSC regional supply line, which currently extends from City of Red Deer to the Town of Ponoka. One 250 milimetre (mm) diameter line supplies water to the Railway reservoir and pump station. Another 300 mm regional supply line connects to the regional line at the northeast corner of quarter section NE 26-39-27-4. It extends to the west across Highway 2A and the existing railway then to the Broadway reservoir and pump station. These two supply lines currently provide adequate water to meet the existing water demands in the distribution system.

2.1.2 Distribution Pipes

The existing distribution network comprises of approximately 54 kilometres (km) of water distribution mains ranging in size from 50 mm to 400 mm diameter, including the 3 km in the JEA area. **Table 2-1** and **Figure 2-2** present the breakdowns of distribution mains by diameter and pipe material.

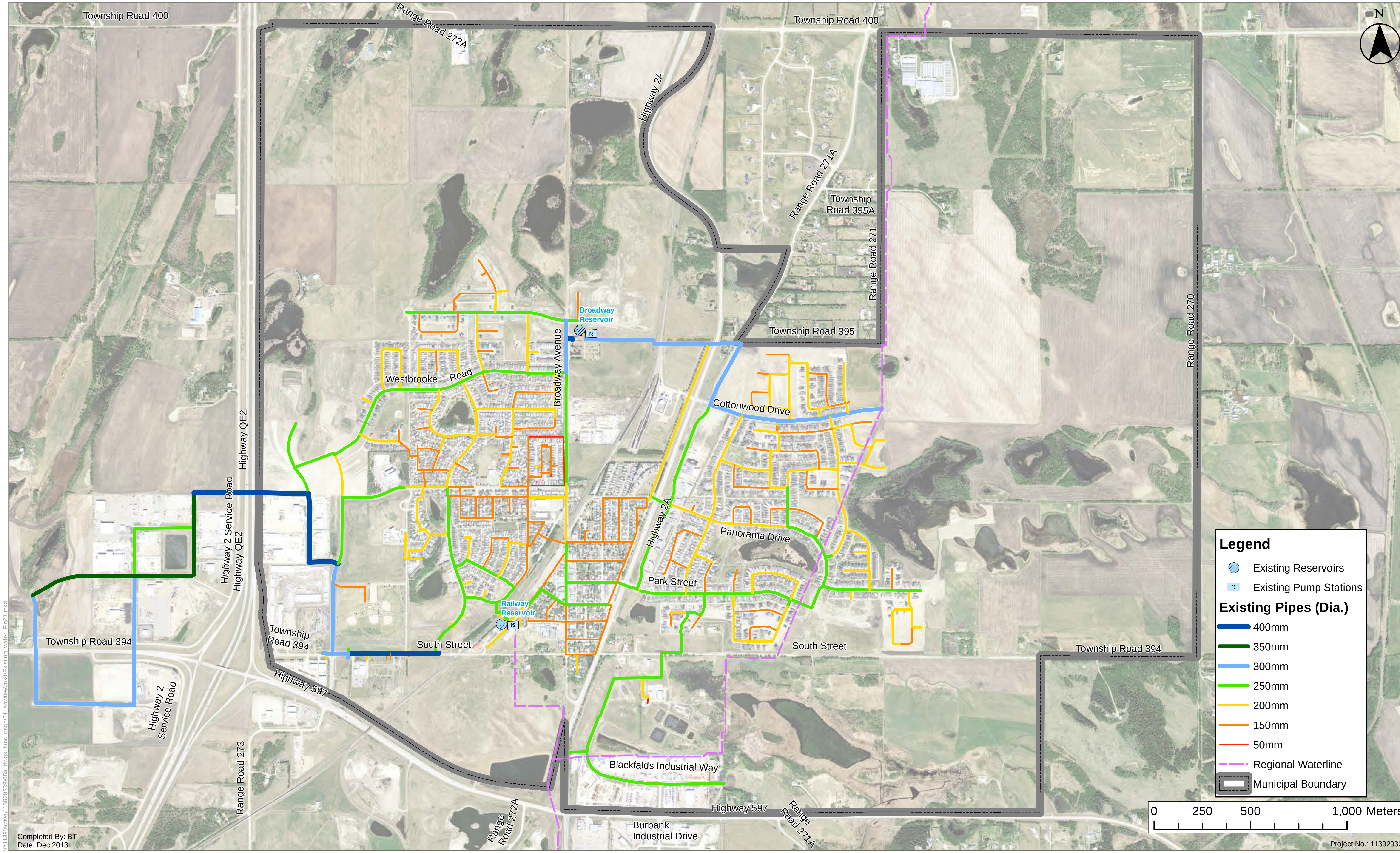


Figure 2.1: Existing Distribution System Within Blackfalds Boundary

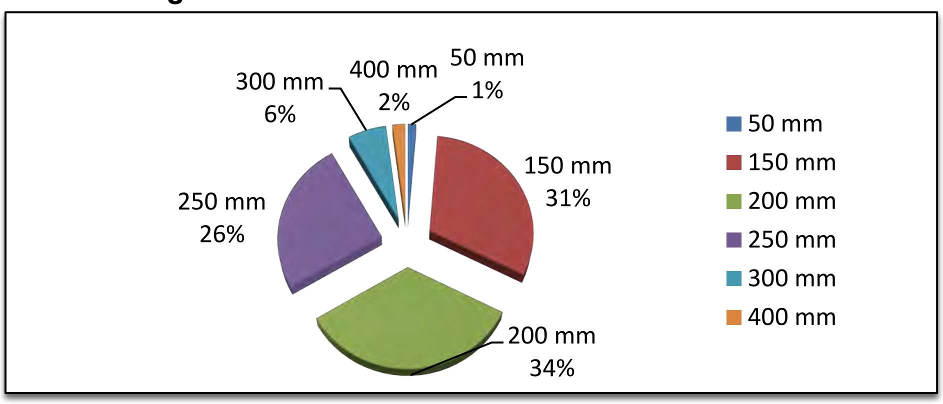
Water Model **Update**

Town of Blackfalds

Table 2-1 Water Mains in The Existing Distribution System

Pipe Material	Hazen-Williams C	Pipe Length (m)						Total (m)
		50 mm	150 mm	200 mm	250 mm	300 mm	400 mm	
Asbestos cement	110	-	4,297	131	-	-	-	**4,428**
Ductile Iron	110	-	245	-	-	-	-	**245**
PolyVinyl Chloride	130 -140	657	11,015	16,743	12,671	3,083	1,014	**45,183**
Steel	120	-	-	166	-	-	-	**166**
Total	**-**	**657**	**15,557**	**17,040**	**12,671**	**3,083**	**1,014**	**50,022**

Figure 2-2 Water Distribution Mains Breakdown



2.1.3 Reservoirs and Pumping Systems

2.1.3.1 Railway Reservoir and Pump Station

The East Railway Reservoir is located on East Railway Street north of South Street, adjacent to the CP Rail tracks. The reservoir has a total underground storage volume of 2,450 m^3. The associated pump station in the Railway Reservoir contains four pumps: one constant speed distribution pump (a jockey pump), two variable speed distribution pumps and one fire pump with a diesel engine. As seen in **Table 2-2**, the Railway pump station currently has a firm capacity (with largest pumping unit out of service) of 43.4 litres per second (L/s) plus fire pump of 106.1 L/s, and a total capacity of 74.9 L/s plus fire pump of 106.1 L/s.

Table 2-2 Railway Reservoir Pump Station Pumps Parameters

No.	Pump	VFD Driven?	TDH (m)	Flow (L/s)
1	7.5 HP Jockey Pump	NO	34.0	11.9
2	25 HP Variable Speed Pump	YES	41.6	31.5
3	25 HP Variable Speed Pump	YES	41.6	31.5
4	75 HP Diesel Power Fire Pump	NO	63.4	106.1

2.1.3.2 Broadway Reservoir and Pump Station

The Broadway reservoir and pump station was built in 2008 and is located immediately north of the cemetery on Broadway Avenue, which is readily accessible from the NRDWSC supply line and also enables the pump station to effectively provide pressure and water flow into the distribution system. The Broadway reservoir currently has a storage capacity of 6,800 cubic meters (m^3).

The pumping station currently houses four variable speed pumps with a firm capacity of 160 L/s (with the largest pumping unit out of service) and a total capacity of 240 L/s. It was determined that the existing Railway fire pump in conjunction with the operation of Broadway distribution pumps will be sufficient to the meet the fire flow demands, therefore, there is no dedicated fire pumps installed in Broadway pumping station (Master plan 2008). **Table 2-3** shows the pump parameters of the Broadway pump station.

Table 2-3 Broadway Pump Station Pump Parameters

No.	Pump	VFD Driven?	TDH (m)	Flow (L/s)
1	40 HP Variable Speed Pump	YES	50	40
2	40 HP Variable Speed Pump	YES	50	40
3	75 HP Variable Speed Pump	YES	50	80
4	75 HP Variable Speed Pump	YES	50	80

2.2 EXISTING WATERCAD MODEL

The Town of Blackfalds provided a WaterCAD model that was based on the original model developed by Stantec in 2006. The physical model components such as pipes, junctions, pumps etc. were updated to reflect the current state of infrastructure in the Town of Blackfalds.

The original model's coordinate system was re-projected to a coordinate projection system "NAD_1983_3TM_114", so that the various background layers (CAD and GIS) can be used directly within the WaterCAD software. The verification of the model turned up some minor inconsistencies in the connectivity of the system model. Each minor item was corrected to ensure that the model fully represented the physical conditions of infrastructure in the Town.

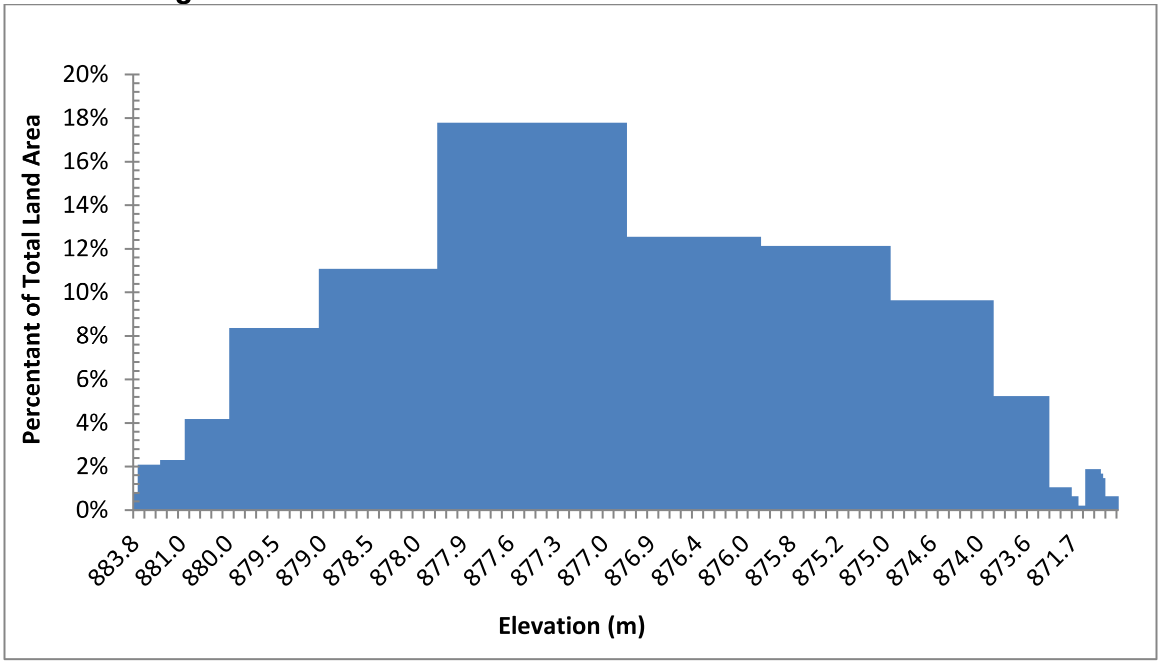
2.2.1 PIPE INVERT ELEVATION

The pipe invert elevations, which are defined as "junction elevations" in the WaterCAD model, were updated in the WaterCAD model. Note that the invert elevations in the model are the surface elevations corresponding to the location of the junction. The elevations are not based on the actual pipe invert elevations. This is a common practice in a WaterCAD model, which is also in accordance with the Town of Blackfalds Minimum Design Standards. The junction elevations were extracted from the Towns Digital Terrain Map (DTM).

The junction elevations within the existing water distribution system of the Town of Blackflads range from 861 m to 884 m. The topography of the existing area is considered to be relatively flat from a water service point of view. All of the Town's water users in the study area are readily serviceable through the existing water system within a single pressure zone. The target Hydraulic Grade Line (HGL) elevation for the Town's existing water distribution system is 918 m.

Figure 2-3 provides a summary of the junction elevations within the existing distribution network of the Town of Blackfalds.

Figure 2-3 Junction Elevations of the Water Distribution Model



With the target HGL of 918 m, the static head (pressure) at the junctions ranges from 34 meters to 57 meters (49 to 82 pounds per square inch (psi)).

2.3 WATER DEMAND UPDATES

A WaterCAD modeling exercise typically evaluates the hydraulic performance in three water demand scenarios – average day demand (ADD), maximum day demand (MDD), and peak hour demand (PHD). Automatic available flows calculation is also conducted in the MDD scenario.

The ADD is defined as the annual water consumption divided by 365 days. The MDD is defined as the highest consumption day in a year. The PHD is defined as the maximum 1-hour water demand during a particular year.

In order to update the water demands in the model, a water use analysis was completed using the following flow data provided by Town as part of our water demand evaluation and update.

- NRDRWSC – Water Sales Volume (2006 to June 2012)
- Consumption Billing Records from 2009 to 2012
- Daily Water Volume In and Out of Railway and Broadway Reservoir (2010-2012)
- Customer Water Meter billing Records (2010 – August 2013)

The daily reservoir meter records were provided for each of the reservoirs in Town from 2010 to August 2013 (no records available through July to December 2012). As presented in the following **Table 2-4**, the sales record from NRDRWSC and the combined outflow of the two reservoirs were both less than the combined reservoir Inflow between 2010 and 2012. Therefore, the combined reservoir inflow was used as the total annual average flows for existing water system analysis.

Table 2-4 Comparison of the Reservoir Reading and Water Sales Records of NRDWSC

Year	Population	Combined Reservoir Inflow (m^3/year)	Combined Reservoir Outflow (m^3)	NRDWSC Water Sales Volume (m^3/year)	Variance from Res. Inflow to Outflow (%)	Variance from Water Sales to Res. Inflow (%)	Variance from Water Sales to Res. Outflow (%)
2010	5,991	526,448	500,565	524,584	-5%	-0.20%	5%
2011	6,399	528,545	472,824	526,983	-6%	5.20%	11%
2012	6,767	562,868	n/a	564,434	n/a	0.20%	n/a

The Town's water meter billing data was provided in excel format from 2010 to August 2013. The monthly billed water volumes for each meter was summarized for 2010, 2011, and 2012 to calculate the average annual daily demand (ADD) at each meter. It was found that some of the annual consumption totals among the three years varied significantly (i.e. 2011 total consumption was 10 times the consumption of 2010 or 2012, etc.). In cases where annual consumption of one of the years was inconsistent with the other two years, the consumption volume in the year was omitted from the average consumption calculation.

The summation of the all annual metered consumption for the last three years were found to be about 0.2-4.3% higher than the total Water Sales Volumes, as presented in **Table 2-5**. This discrepancy was unexpected, as typically the total consumption from water meter records is generally less than the total flow supplied from reservoirs since the service metered flow does not account for water losses (unmetered connections, pipe leaks, watermain breaks, etc.). However, the discrepancy is not significant. In the future, the Town can conduct an audit on the water meter records or/and have the main metered recalibrated if the discrepancy is higher than 5%.

Table 2-5 Annual Water Meter Consumption vs. Reservoir Flows

Year	Population	Water Sales Volume (m^3/year)	Water Billing from Parcel Water Meters (m^3/year)	Variance from Water Billing Records to Water Sales Volume (%)
2010	5,991	524,584	525,853	0.2%
2011	6,399	526,983	535,230	1.6%
2012	6,767	564,434	588,670	4.3%

2.3.1 Major Users

The current land uses within the Town of Blackfalds consists of residential, industrial, commercial and institutional lots. Major water users are represented as large demand junctions in the model, which might have a substantial impact on hydraulic performance in the water distribution system. Based on the data analysis on the meter records provided by the Town, there are 5 major users in the Town of Blackfalds as shown in **Table 2-6**. Each of the major users consumed approximately more than 5,000 m^3 per year and contributed more than 1% of Town's total annual water consumptions through 2010 to 2012.

Table 2-6 Town of Blackfalds Major Users

Location	Use Type or MF	2010		2011		2012	
		Usage (m^3)	% of Total Consumption	Usage (m^3)	% of Total Consumption	Usage (m^3)	% of Total Consumption
5308 - Womacks Road (Mobile Home Park)	Commercial	12,406	2.36%	23,764	4.44%	20,331	3.45%
5201 - Highway Avenue	Commercial	11,536	2.19%	13,286	2.48%	13,494	2.29%
5018 - Waghorn Street (Spray Park)	Commercial	5,664	1.08%	8,155	1.52%	11,442	1.94%
6001 - Parkwood Road	Commercial	3,100	0.59%	3,142	0.59%	6,062	1.03%

2.3.2 Average Day Demand (ADD)

Table 2-7 provides a summary of the annual average flows and gross per capita water consumption for the Town of Blackfalds. The average flow for 2010 through 2012 increased proportionately with the increasing population, while the gross per capita demand varied from 228.5 litres per capita per day (Lpcd) to 239.9 Lpcd. The average value was used to reflect the water consumption fluctuations during the last three years resulting in a gross per capita demand of 231.3 Lpcd.

Table 2-7 Annual Average Consumption and Per Capita Flows

Town of Blackfalds				
Year	**Population**	**Water Sales (m^3/year)**	**Lpcd**	**Annual Average Flow(L/s)**
2010	5,991	524,584	239.9	16.6
2011	6,399	526,983	225.6	16.7
2012	6,767	564,434	228.5	17.9
AVG		538,667	**231.3**	

The normalized average annual water meter consumption for 2012 from each water meter was then allocated to the nearest model nodes and imported into the WaterCAD model as the basis for the ADD scenario. The total modeled ADD is 18.2 L/s**.**

The calculated average consumption from billing records for each service meter was referenced to its legal parcel in Geographic Information System (GIS). The modeler utilized the spatial analysis capabilities of GIS to assign the calculated flows for the service meters to the nearest junction in the water model. The average daily demands assigned to the water model junctions are shown in **Figure 2-4**.

2.3.3 MDD and PHD

The MDD was derived by identifying the single highest day of combined reservoir outflow between 2010 and 2011. The maximum day multiplier for the system is calculated by dividing the maximum day demand by the average day demand.

PHD is defined as the highest rate of water consumption occurred in a single hour per day. Peak Hour Factor can be defined as ratio of peak hour demand on the peak day over the average annual daily demand. The peak hour factor tends to be high for small municipalities and it is usually lower for larger communities.

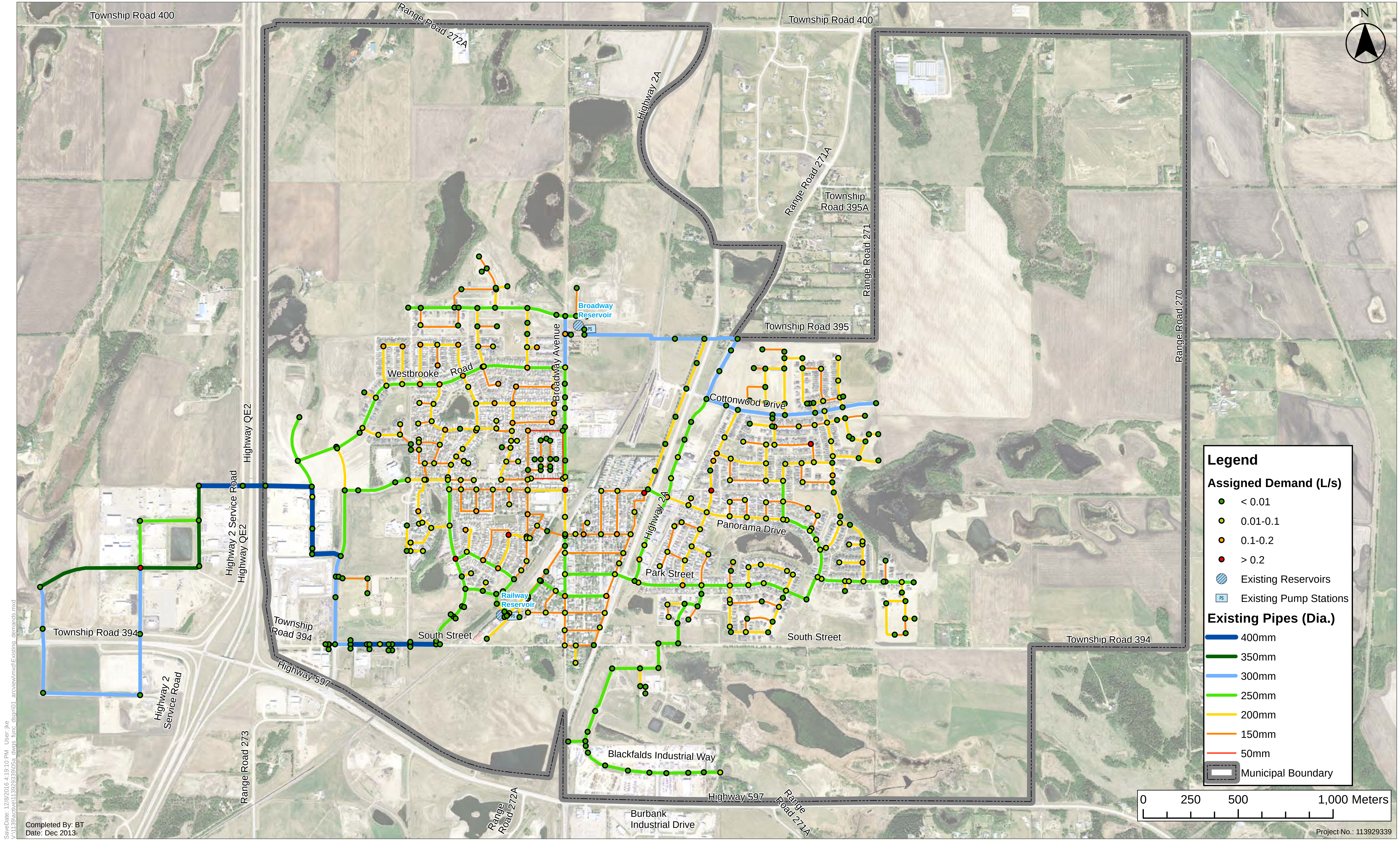


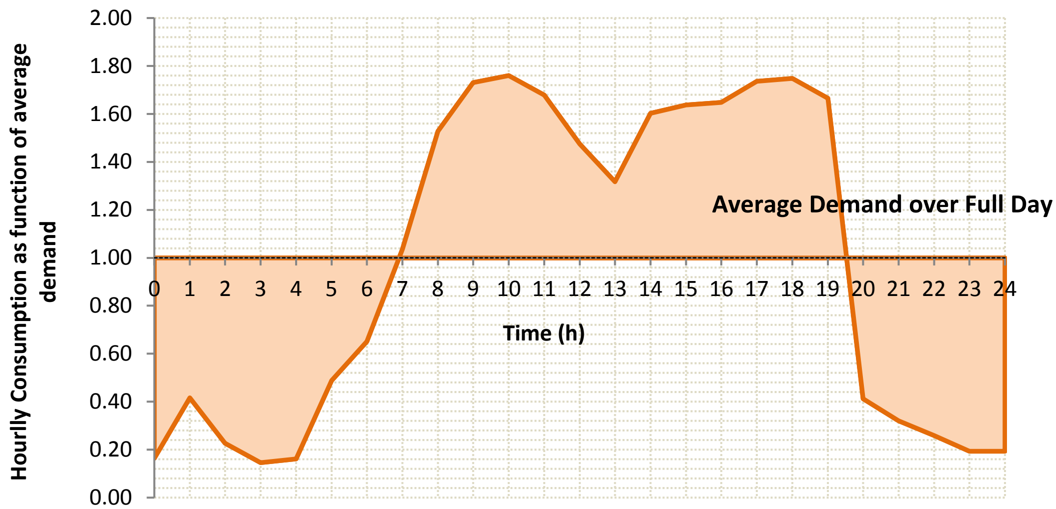
Figure 2.4: Assigned Demands in Existing Distribution System

Town of Blackfalds Water Model

The Supervisory Control and Data Acquisition (SCADA) data provided by the Town comprises water usage within Town of Blackfalds at 10-second interval in 2011-2012. The peak hour demand occurred on Oct 26th 2011.

The hourly variation in water demand during the day is significant. Generally, two peak periods can be observed: one on the morning and one in the afternoon as shown in **Figure 2-5**.

Figure 2-5 Variation of Water Demand During the Day



The peak hour demand can be expressed as average hourly demand multiplied by the peak hour factor. The data analysis of the three years data released that:

$$PHD = 2.02 \text{ x}MDD = 2.02 \text{ x } 1.8 \text{ } ADD = 3.64 \text{ X } ADD$$

The calculated MDD and PHD factors, 2.02 and 3.64, respectively, are close to the typical values of 2 and 4, which are observed in municipalities of similar size. Hence, the MDD factor of 2 and PHD factor of 4 were adapted in the WaterCAD model.

Table 2-8 below summarizes the Town of Blackfalds existing system water demand and demand scenarios in the hydraulic model.

Table 2-8 Existing Water System Demand Summary

Demand Scenario	Water Demand (L/s)	Water Demand (m³/day)
Average Day Demand (ADD)	18.2	1,572
Maximum Day Demand (MDD)	36.4	3,144
Peak Hour Demand (PHD)	72.8	6,289

2.4 MODEL VERIFICATION

Prior to beginning the hydraulic analysis it was necessary to confirm that the model is an accurate representation of the actual distribution system. A verification analysis was conducted by comparing the results of actual hydrant flow tests with results generated by the model. Successful calibration of the static pressure indicates that the network components are operating correctly, demand is appropriately allocated, and the reservoir levels are correct. Successful calibration of the residual pressure indicates that the pipe Roughness coefficients are set at the appropriate levels, similar to actual conditions.

2.4.1 Flow Testing Program

Stantec developed a comprehensive field testing program which could provide the necessary data to verify the accuracy of the hydraulic model. The hydrant testing program involves three fire hydrants. The first hydrant is the “test (residual) hydrant”, the second and the third hydrants are called the “flow hydrants”. The residual hydrants are located directly upstream from the flow hydrants (as shown in the field pictures). The hydrant flow tests were conducted according to National Fire Protection Association (NFPA) 291 standards.

With the coordinated efforts of the Town’s Public Works Department, the hydrant flow tests were performed at 10 locations throughout the distribution system to measure the flows and residual pressure at the locations. The fire flow testing locations are presented in the Fire Flow Test **Index Map** in the **Appendix A**. The fire flow testing locations are also presented the following **Table 2-9**.

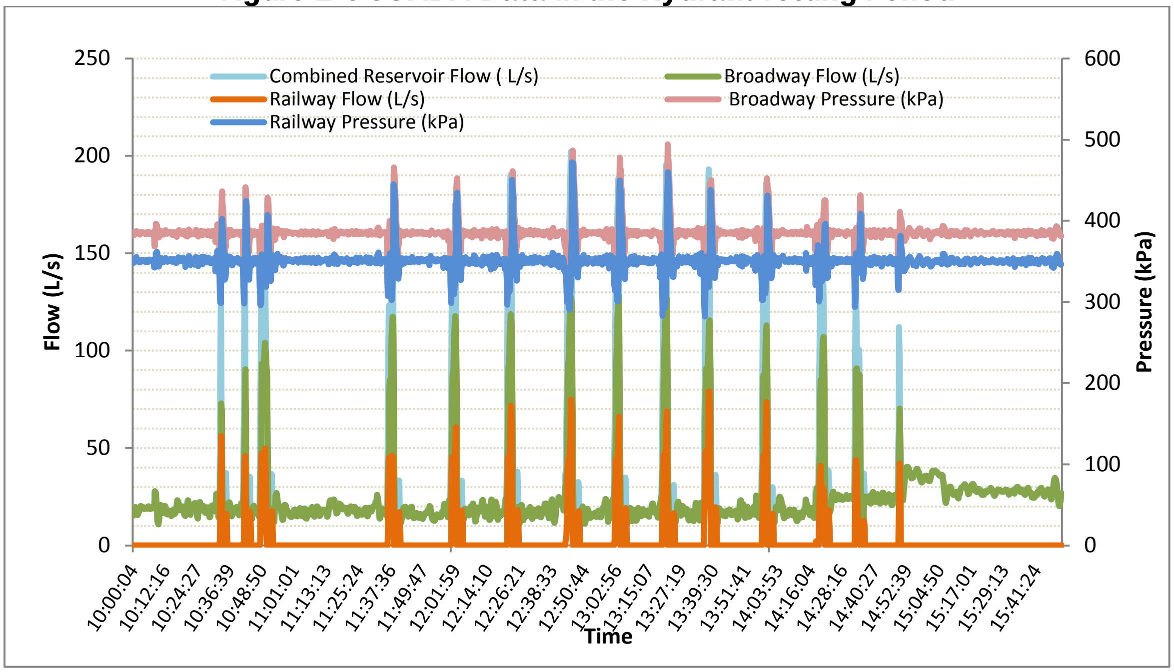
Table 2-9 Test Hydrant Locations in Town of Blackfalds

No.	Test Hydrant Locations	Supply Main
1	Blackfalds Industrial Way	250 mm on Blackfalds Industrial Way (Dead End)
2	Eastpointe Drive	250 mm on Eastpointe Drive
3	Cedar Square	200 mm on Cedar Square
4	Prairie Ridge Avenue	200 mm on Prairie Ridge Avenue
5	Parkwood Road	250 mm on Parkwood Road
6	Broadway Avenue	250 mm on Broadway Avenue
7	Aspen Drive and Poplar Avenue	150 mm on Aspen and Poplar Avenue
8	South Street	400 mm on South Street
9	Vista Trial	400 mm on Vista Trial
10	Ash Close	150 on Ash Close

2.4.2 Model Calibration

Actual field conditions based on hydrant flow tests were simulated in the WaterCAD model to determine the level of accuracy of the model. The operational data, such as reservoir levels, pump on/off status, resulting pump station flow and pressures were collected at the time of each flow test. **Figure 2.6** presents the various reading from the relevant instruments during the fire flow test period.

Figure 2-6 SCADA Data in the Hydrant Testing Period



Based upon this SCADA data and the system water flows during the hydrant tests, water use factors in the model were adjusted so that the sum of the modeled water flow rate equals to the actual water flow rate at the time of the fire flow test.

Model calibration was accomplished using an iterative process where the simulation results were compared to field measured values. Where there was a discrepancy, the model parameters were adjusted, the model was rerun and the results were rechecked. The calibration process continued until model results reasonably agreed with the field measurements. In some cases, it was not possible to match the field measured values. The possible reason is that the actual physical water system configurations are not what they are shown in the as-built drawings. For instance, the system contains an inadvertently closed valve that no one is aware of, or incorrect elevation or pipe diameter etc.

The following **Table 2-10** summarizes the Hazen-Williams ‘C’ values in the WaterCAD model.

Table 2-10 Hazen-Williams ‘C’ Value Factor in Model

Pipe Material	Hazen-Williams ‘C’ Value
Asbestos Cement	110
Steel	120
PVC	130-140
Ductile Iron	110

The calculated residual pressure values from the model are close to the field measurements. The absolute pressure difference between the field measurements and the model is within 5%, which indicates that the modeled network configurations are set properly and the pipe parameters are accurately reflecting actual conditions. The calibration results were summarized in **Table 2-11**.

Table 2-11 Model Calibration Results Summary for 10 Locations within Town of Blackfalds

Test Hydrant Locations

Test Condition	Test Location #1					Test Location #2					Test Location #3					Test Location #4					Test Location #5				
	Field Measurement			Model Results	Variance from Model Result to Field Measurement (%)	Field Measurement			Model Results	Variance from Model Result to Field Measurement (%)	Field Measurement			Model Results	Variance from Model Result to Field Measurement (%)	Field Measurement			Model Results	Variance from Model Result to Field Measurement (%)	Field Measurement			Model Results	Variance from Model Result to Field Measurement (%)
	Flow (L/s)		Residual Pressure (kPa)	Residual Pressure (kPa)		Flow (L/s)		Residual Pressure (kPa)	Residual Pressure (kPa)		Flow (L/s)		Residual Pressure (kPa)	Residual Pressure (kPa)		Flow (L/s)		Residual Pressure (kPa)	Residual Pressure (kPa)		Flow (L/s)		Residual Pressure (kPa)	Residual Pressure (kPa)	
	Q1	Q2				Q1	Q2				Q1	Q2				Q1	Q2				Q1	Q2			
Starting Static case			545	546	0.2%			400	401	0.3%			414	413	-0.2%			379	380	0.1%			407	412	1.3%
Hydrant #1 flowed	60		345	361	4.6%	50		331	333	0.6%	53		345	337	-2.2%	59		310	307	-1.2%	59		372	356	-4.5%
Hydrant #1 and #2 flowed	60	54	193	184	-4.7%	50	45	241	248	2.8%	53	76	310	315	1.6%	59	76	276	282	2.3%	59	76	303	305	0.5%

Test Hydrant Locations

Test Condition	Test Location #6					Test Location #7					Test Location #8					Test Location #9					Test Location #10				
	Field Measurement			Model Results	Variance from Model Result to Field Measurement (%)	Field Measurement			Model Results	Variance from Model Result to Field Measurement (%)	Field Measurement			Model Results	Variance from Model Result to Field Measurement (%)	Field Measurement			Model Results	Variance from Model Result to Field Measurement (%)	Field Measurement			Model Results	Variance from Model Result to Field Measurement (%)
	Flow (L/s)		Residual Pressure (kPa)	Residual Pressure (kPa)		Flow (L/s)		Residual Pressure (kPa)	Residual Pressure (kPa)		Flow (L/s)		Residual Pressure (kPa)	Residual Pressure (kPa)		Flow (L/s)		Residual Pressure (kPa)	Residual Pressure (kPa)		Flow (L/s)		Residual Pressure (kPa)	Residual Pressure (kPa)	
	Q1	Q2				Q1	Q2				Q1	Q2				Q1	Q2				Q1	Q2			
Starting Static case			372	375	0.7%			393	398	1.3%			407	410	0.8%			379	391	3.1%			421	420	-0.1%
Hydrant #1 flowed	62		310	310	-0.2%	59		310	309	-0.5%	66		345	333	-3.4%	69		331	327	-1.2%	40		379	371	-2.3%
Hydrant #1 and #2 flowed	62	76	296	299	0.7%	59	76	262	271	3.2%	66	76	290	302	4.3%	69	76	276	280	1.5%	40	76	345	329	-4.6%

3.0 Existing Water Distribution System Analysis

The calibrated WaterCAD model was utilized as the basis to evaluate the hydraulic performance of the system. The WaterCAD model is simulated for the ADD, MDD and PHD to determine if the levels of service are met. Automatic available fire flow calculations were also conducted to see if the firefighting flow is sufficient at the junctions.

3.1 SERVICE CRITERIA

The *Water Design Standards of Town of Blackfalds (2011)* specifies design criteria or the service criteria that the water distribution system should provide. The service criteria are described in the following sections.

3.1.1 System Pressure Requirements

The residual pressure under all daily demand conditions shall range 300 (kilopascals) kPa (43.5 psi) to 620 kPa (90 psi) at ground level. The minimum residual line pressure under maximum day plus fire flow conditions shall be 150 kPa (21.8 psi) at ground level of any point in the system.

3.1.2 Flow Velocity

The main line flow velocities should not exceed 1.5 metres per second (m/s) during all daily demand flow conditions. The allowable maximum velocity in the water system is 2.5 m/s during maximum day plus fire flow conditions.

3.1.3 Fire Flow Requirements

The requirements of firefighting flows are based on land use types and are adapted from the design standards and Town's master plan, which are in accordance with the Water Supply for Public Fire Protection published by Fire Underwriters Survey.

Table 3-1 Fire Fighting Flow Requirements

Land Use Type	Required Fire Fighting Flow (L/s)	Required Duration (hours)
Single Family Residential	75	1.5
Multiple Family Residential	135	2
Mixed/Commercial/Industrial	233	3

3.2 EXISTING DISTRIBUTION SYSTEM ANALYSIS

3.2.1 Existing Storage Capacity Evaluation

The Town of Blackfalds currently has a total water storage capacity of 9,250 m^3:

- Railway Reservoir: 2,450 m^3
- Broadway Reservoir: 6,800 m^3

The calculation of the required water storage for a given water supply system is based on the Alberta Environment Standards and Guideline as follows:

$$S = A + B + C$$

Where:

S = Total Storage Requirements

A = Fire Storage, m^3, the required Fire Storage Capacity in Town should equal 233 L/s for 3 hours, per the Fire Underwriters Survey, equivalent to 2,516 m^3.

B = Equalization Storage, m^3, the typical volume of water required for peaking or equalization storage is to be 25% of the MDD condition. With a total MDD of 3,144 m^3/day, the required equalization storage is 786 m^3.

C= Emergency Storage, m^3, the emergency storage is usually needed to provide potable water to the distribution system in case of a supply line failure or maintenance shut down. An emergency storage of 15% of the ADD is required, which is 236 m^3 with a total ADD of 1,572 m^3/day.

The NRDWSC is a long regional water supply line that extends from the City of Red Deer to the Town of Ponoka. As a contingency for the long distance water supply, additional storage volume defined as (D) for the town and should be added to account for supply interruption. NRDWSC determined to use an additional required storage volume of 1.25 times ADD in the reservoirs connecting to the regional line, which is calculated as 1,966 m^3 in this case.

Given this criterion, the total storage calculation is as follows:

$$S = A + B + C + D = 2{,}516\ m^3 + 786\ m^3 + 236\ m^3 + 1{,}966\ m^3 = 5{,}504\ m^3$$

The total water storage requirement for the Town of Blackfalds by combining the storage requirements as noted above is 5,504 m^3.

The current storage available within the Town of Blackfalds is 9,250 m^3 (> 5,504 m^3), which meets the requirements for fire flow, emergency and equalization storage as required by Alberta Environment and Parks (AEP).

3.2.2 System Pressures and Velocity

The hydraulic performance of the existing distribution system was assessed reviewing the water model results under the ADD, MDD and PHD flow scenarios. The demands in the water model were adjusted by using the ADD demand as the base scenario and multiplying the demands with the peaking factors as in Section 2.2.3.

The WaterCAD modeling results were illustrated in **Figure 3-1, Figure 3-2 and Figure 3-3** . The three figures indicate that the existing distribution system has adequately capacity, i.e. pumps have sufficient pump heads and flow capacities and pipe size are big enough to handle all daily demands in the Town to meet the service criteria. The residual pressures are within 300 to 600 kPa (43 - 90 PSI) at the nodes in the three demand scenarios. The flow velocities in the existing water distribution system under ADD, MDD and PHD conditions are all within the allowable maximum velocity of 1.5 m/s.

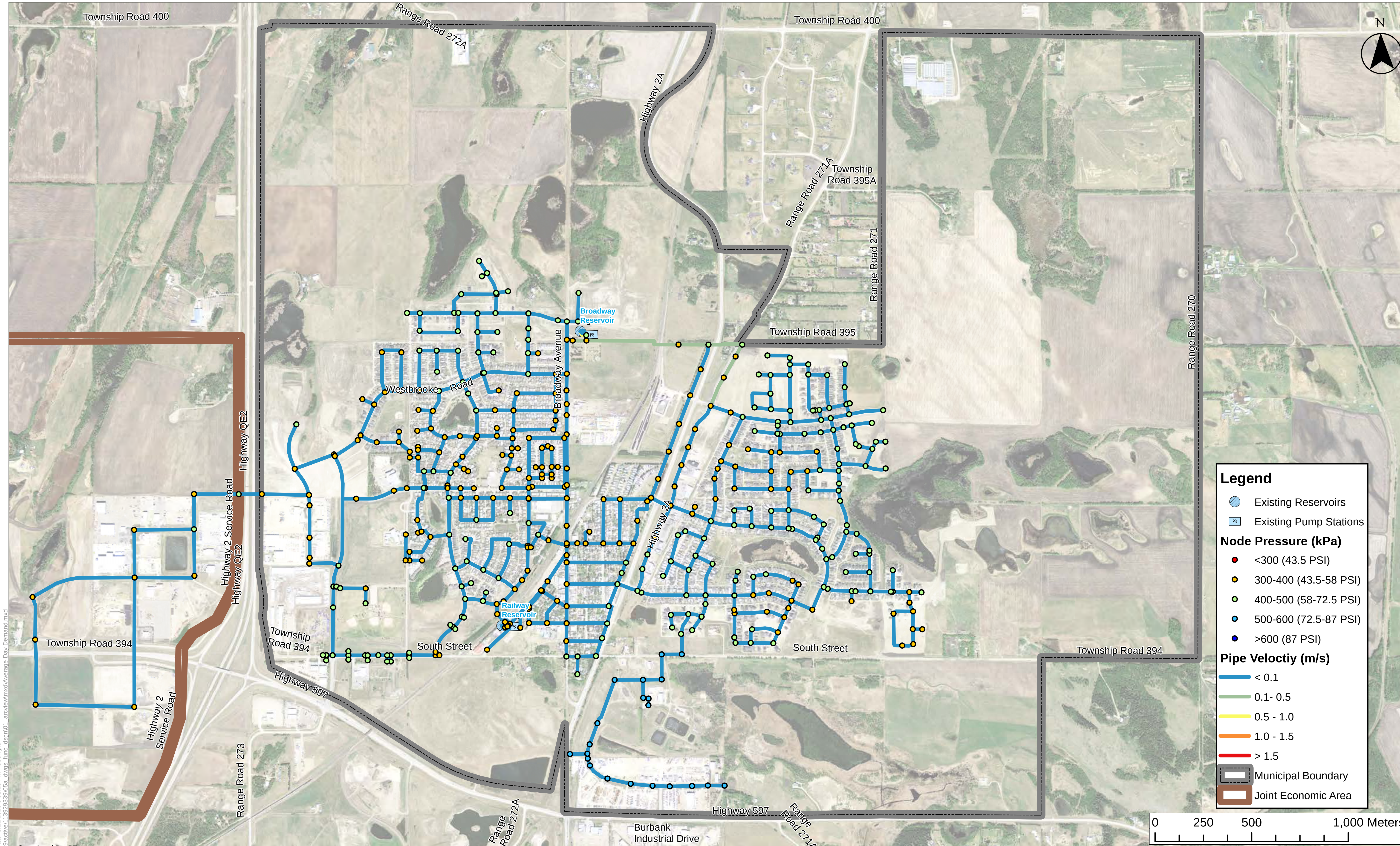


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Figure 3.1: Existing System Average Day Demand Scenario

Water Model Update
Town of Blackfalds

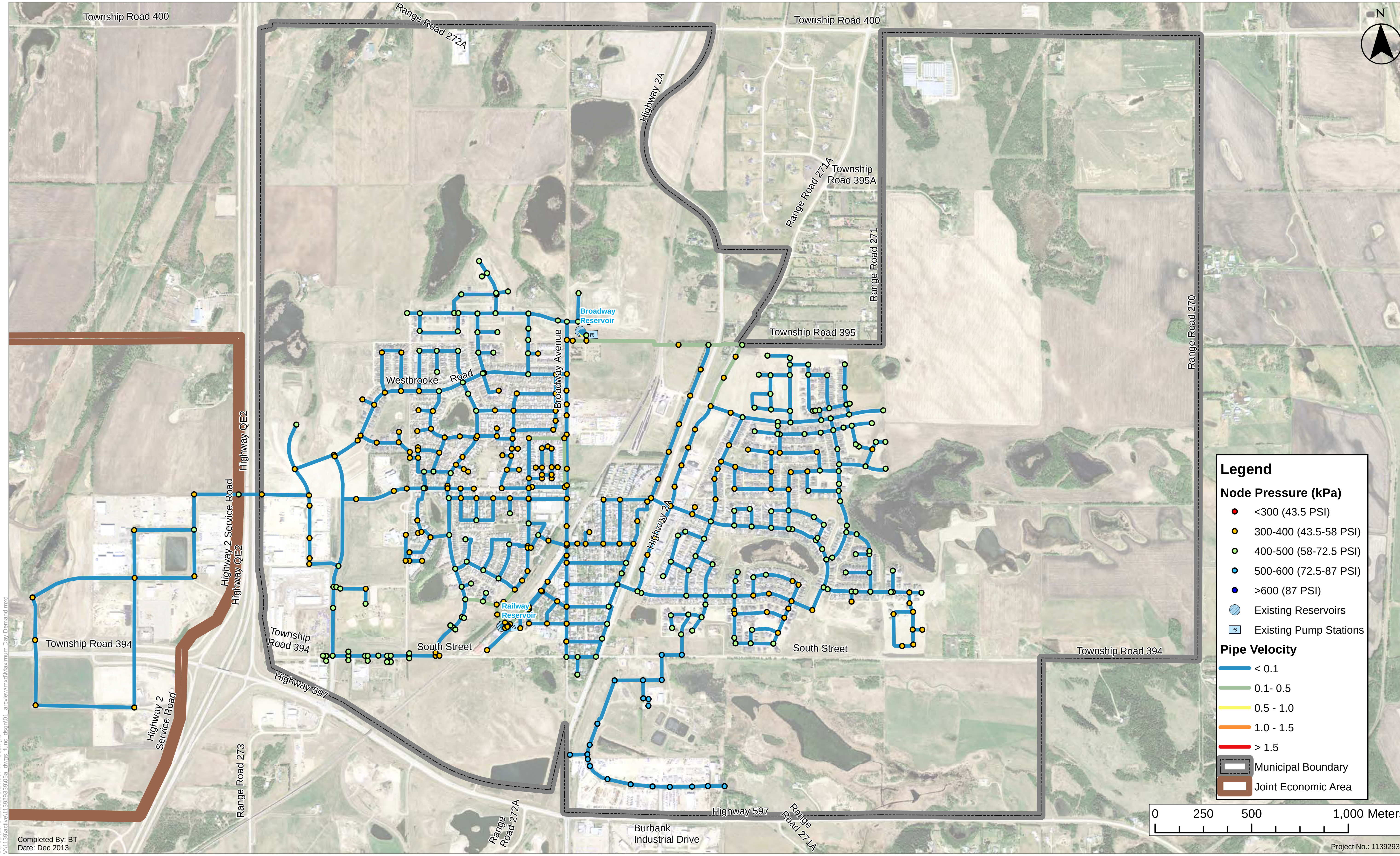

Figure 3.2: Existing System
Maximum Day Demand Scenario
Water Model Update
Town of Blackfalds

Stantec

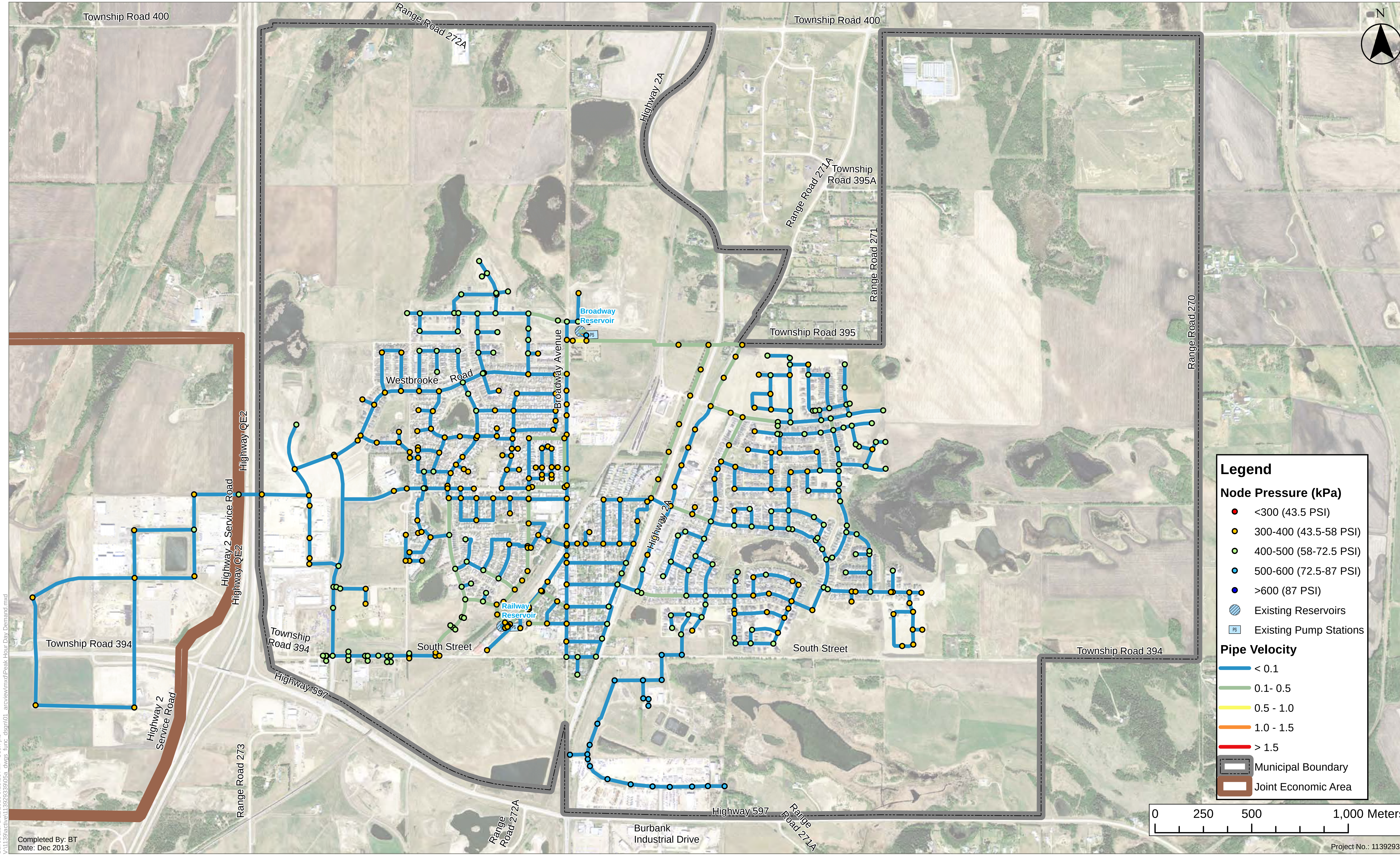

Figure 3.3: Existing System Peak Hour Demand Scenario

Water Model Update
Town of Blackfalds

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3.2.3 Watermain Headloss

Although it is not specified in the service criteria section, watermain headloss value per km of pipe is used to indicate areas with relatively high headloss within the distribution system. With the per km headloss values in the water pipes, one can identify undersized mains or capacity bottlenecks in the water distribution system. Those modeling results of the watermain headloss could provide valuable insight into the distribution system, that which watermains should be targeted when developing improvements for levels of service deficiencies for system pressures or fire flow availability.

Figure 3-5 shows the headloss of watermains during ADD condition. There is no pipe that has headloss gradient larger than 1 m/km.

3.2.4 Available Fire Flow

The fire flow analysis was undertaken to determine the available flows at the nodes in the distribution system in a MDD scenario.

Figure 3-6 presents the calculated available firefighting flows in the MDD scenario with the velocity constraint of 2.5 m/s as per the Town's Design Guidelines.

For the Town of Blackfalds, the water distribution system serves three designated land types: residential, commercial and industrial. As summarized in **Table 3-3**, there are 72 junctions with available fire flow that do not meet the required rate using 2.5 m/s velocity constraint.

Table 3-2 Numbers of Failed Fire Flow Junctions with 2.5 m/s Velocity Constraints

Land Use Type	Required Fire Flow (L/s)	Numbers of Failed Fire Flow Nodes
Single Family Residential	75	14
Multi-Family Residential	135	14
Commercial / Industrial	233	44
Total		72

These locations with deficient fire flows are generally due to the minimum velocity constraint. The available fire flow from an un-looped pipe with 200 mm diameters or smaller can reach 78 L/s at the most at the 2.5 m/s flow velocity.

Note that in a distribution system that supplies firefighting flow, the velocity 2.5 m/s constraint for available fire flow calculation is mainly for new pipe sizing, in additional to the residual pressure constraint. The velocity constraint is set to lower the pipe break risk level in a firefighting event. However, it does not mean that the available fire flows in the field are the same as what have been calculated.

In a typical firefighting event, the firefighters use the residual pressure in the fire pump suction as the only hydraulic constraint to control the flow rate draw from the distribution. There is not a normal practice to monitor the flow velocity in the system in a firefighting event. For an existing system, the available fire flow calculated with residual pressure as the only constraint is close to what can be obtained in the field. Therefore, in the existing available fire calculation, the velocity constraint was removed from the hydraulic model. A fire flow calculation was run without a velocity constraint. The number of junctions with less than desired fire flow is presented in Table 3-4.

Table 3-3 Number of Failed Fire Flow Junctions without Velocity Constraint

Required Fire Flow	Numbers of Failed Fire Flow Junctions
Residential (75 L/s)	0
Multi-Family (135 L/s)	1
Commercial/Industrial (233 L/s)	18
Total	19

The numbers of junctions in Table 3-3 that cannot meet the fire flow requirements are less than the ones in Table 3-2 which the fire flow calculation was conducted with a velocity constraint of 2.5 m/s.

3.3 EXISTING SYSTEM IMPROVEMENTS

The fire flow deficiency in Tables 3-3 and 3-4 can be eliminated by increasing the distribution pipe sizes or connecting the pipes to form a looped network, or increasing the pumping capacity in the pump stations.

The proposed upgrades in the distribution system as illustrated in **Figure 3-7** are:

1. Add a 250 mm interconnection pipe for the watermains in the Parkwood Rd and Highway Street to increase fire flow protection for those commercial/industrial areas.
2. The 150 mm watermain to the triangle area between the Moore Street and Broadway Ave. could be upgraded to a 200 mm main to increase the available fire flow;
3. Update the existing water main from the existing Railway reservoir to a 300 mm main and extend this west along South Street;
4. Construct a 250 mm loop from South Street through areas I4, C4 and I2 to connect the proposed 300 mm main along South Street south of the existing Railway reservoir;
5. Extend the 250 mm water main from Park Street to South Street along Parkwood Road south extension.

6. Install a new 250 mm water main to JEA area across the QE Highway II to increase the fire flow in the JEA direct service areas.

The proposed upgrades and the available fire flow after the upgrades are highlighted in **Figure 3-7**. Note that in the southern industrial area along the Blackfalds Industrial Way, the available fire flow is still not meeting the 233 L/s desired level. The long 250 mm pipe without any looping in the Blackfalds Industrial Way is the main reason that leads to the low available fire flow. In the future, the 250 mm pipe will extend to the east and north to connect to the proposed mains in the South Street. The loop will increase the available flow to the desired level.

However, the capital costs to replace an existing pipe with a larger diameter pipe or to install looping pipe are very high in a developed area. The upgrades proposed here to increase the available fire flow will have the least priority among the infrastructure projects. The upgrades should be implemented when the physical condition of the pipe requires a replacement or with other deep utility replacements. In some cases, the proposed new pipes for looping could be installed when the pipe section is needed for a new development.

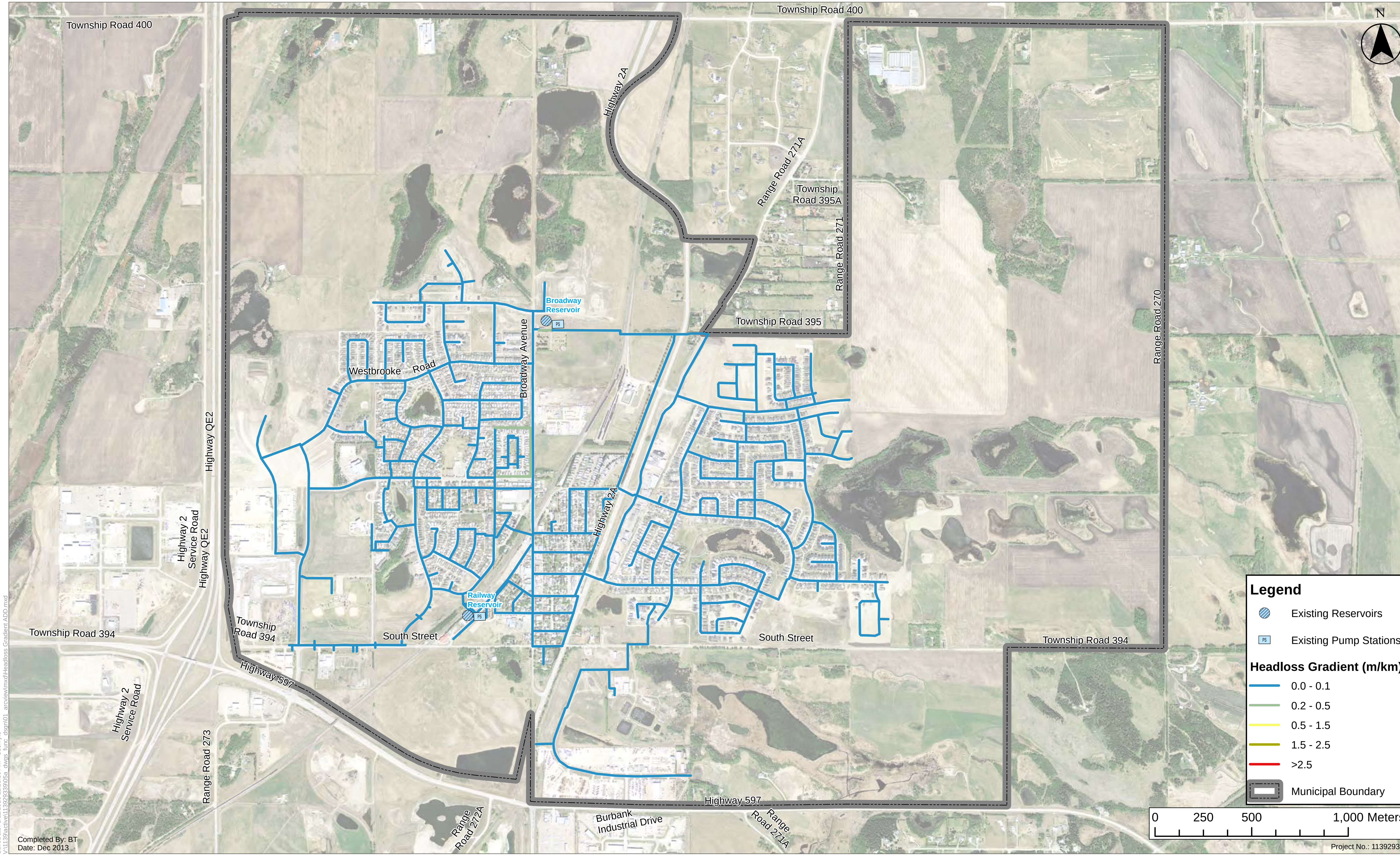

Figure 3.4: Headloss Gradient
Existing Average Day Demand Scenario

Water Model Update
Town of Blackfalds

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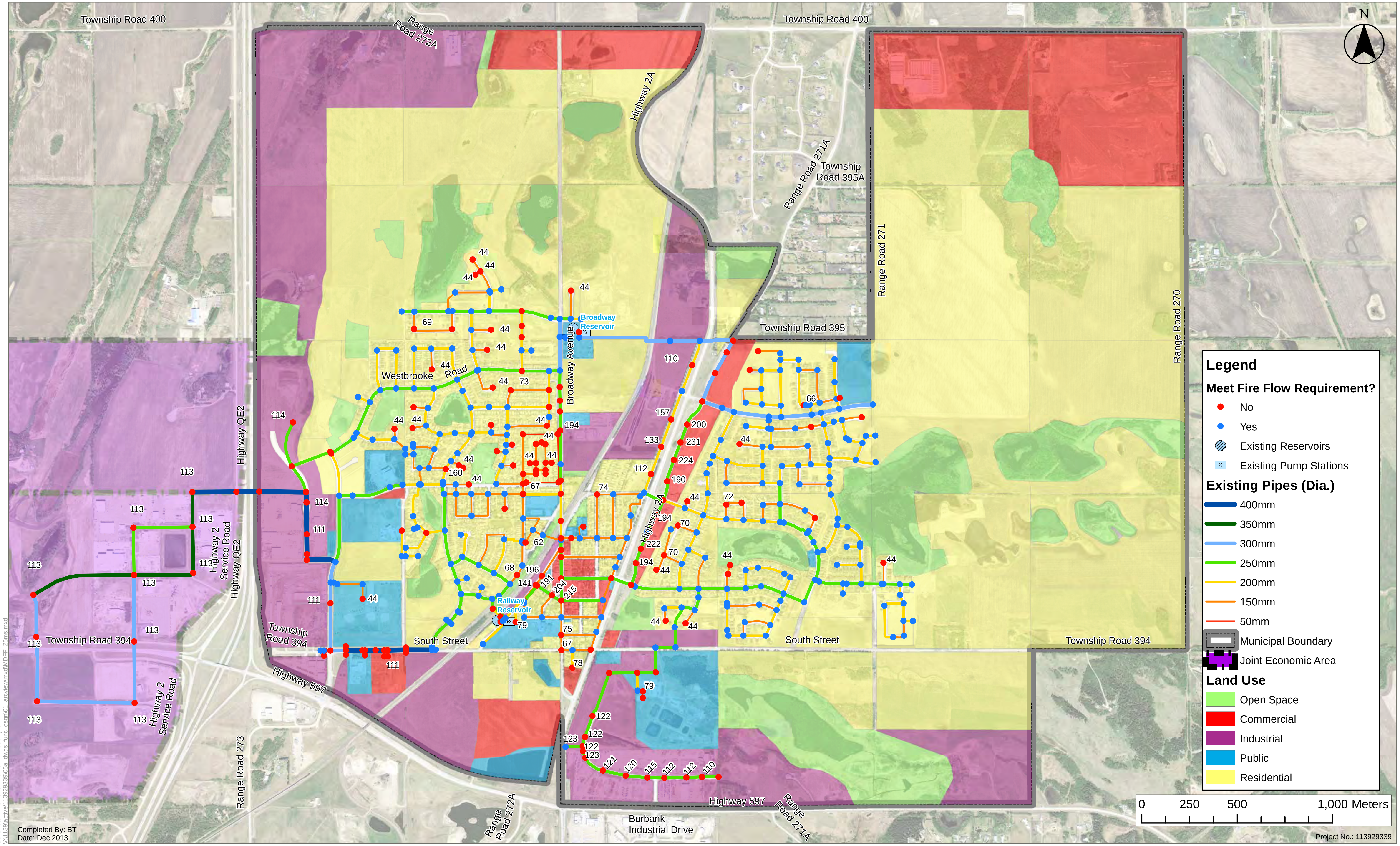

Figure 3.5:Available Fire Flow with 2.5 m/s Velocity Constraint In Exisiting System MDD Scenario

Water Model Update

Town of Blackfalds

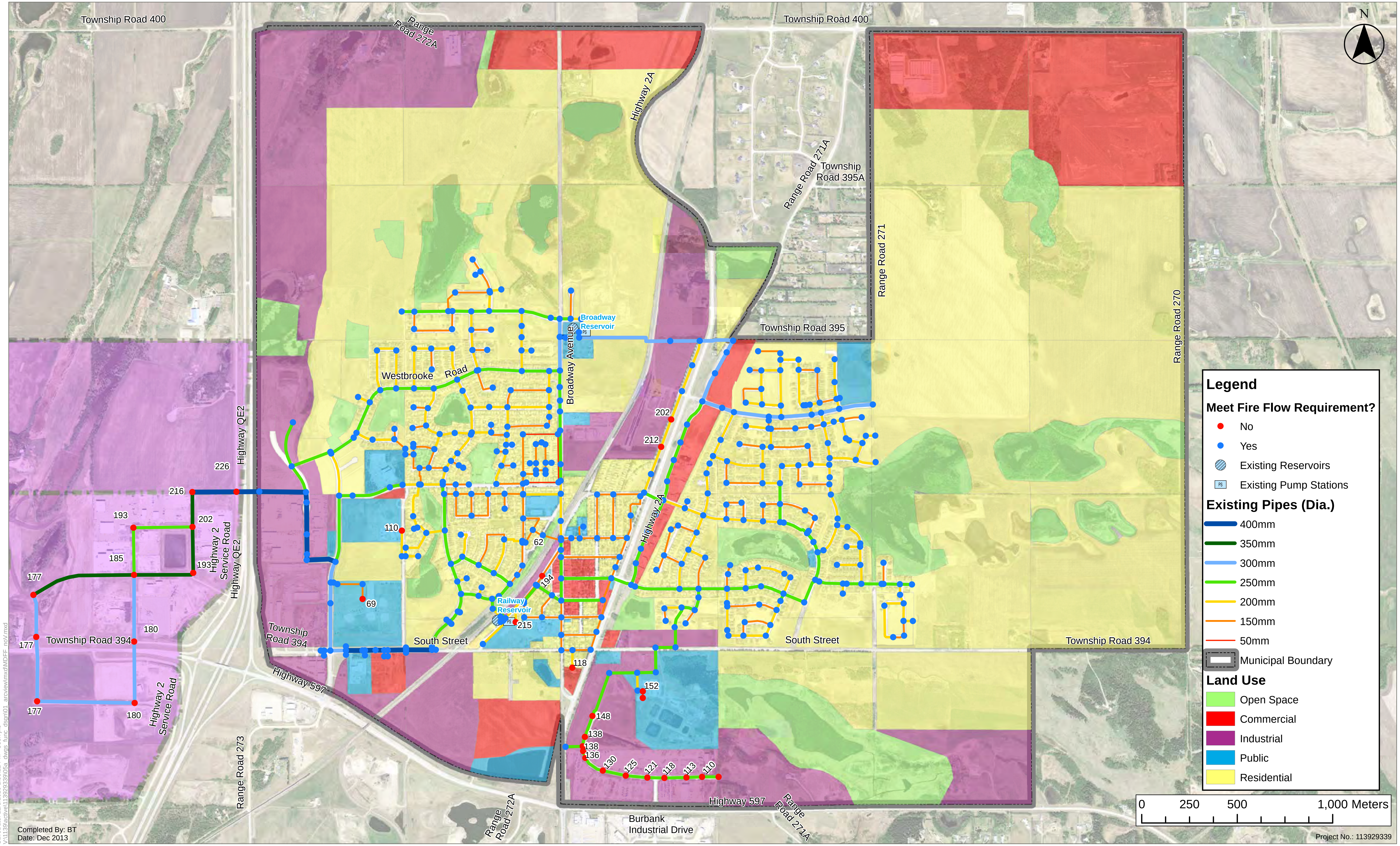

Figure 3.6: Available Fire Flow without Velocity Constraint In Exisiting System MDD Scenario

Water Model Update

Town of Blackfalds

Stantec

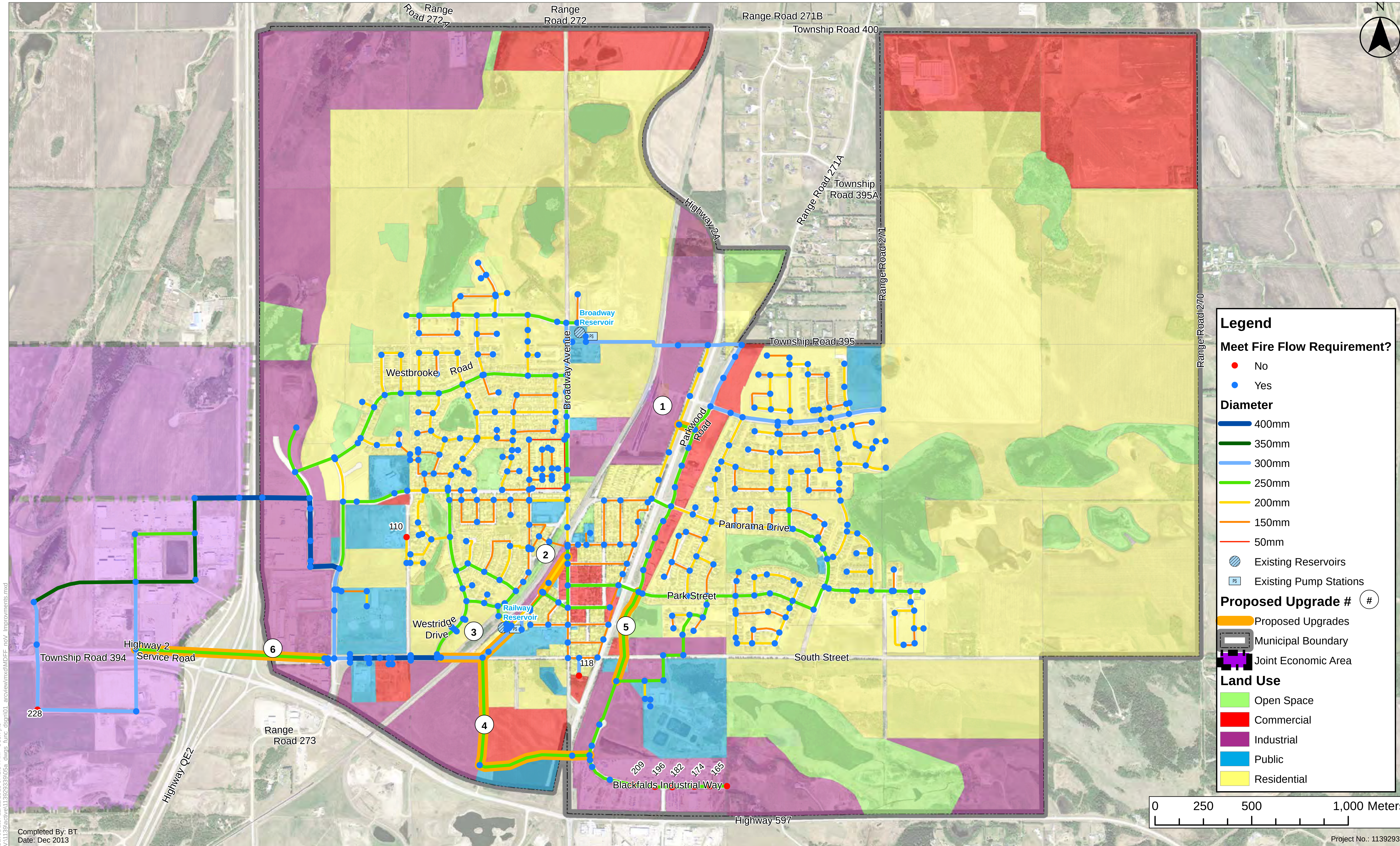

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Figure 3.7: Available Fire Flows without Velocity Constraint In Improved Exisiting System MDD Scenario

Water Model Update
Town of Blackfalds

4.0 Future Water Distribution System

4.1 FUTURE POPULATION PROJECTION

The 2001 to 2016 federal government census data and municipal census data were provided from the Town of Blackfalds for use in this study. The growth rate of Town's population has been significant since 2001. The Town of Blackfalds has experienced growth averaging 7.21% per year over the last decade (2006-2016), and 5% per year over the past 40 years. As the Town's population continues to grow, the most recent 10 year growth rate was projected only for the next 5 year. The 40 year growth rate of 5% was employed for the remainder of the 25 year horizon, as it was considered to be a more sustainable long term growth rate. **Table 4-1** gives the details of the population projection for Town of Blackfalds.

Table 4-1 Population Projection for Town of Blackfalds over 25 years

Year	Population	Average Annual Growth
2012	6,767	5.75%
2013	7,220	7.51%
2014	7,858	8.01%
2015	8,793	11.90%
2016	9,510	8.15%
2017	10,196	7.21%
2018	10,932	7.21%
2019	11,721	7.21%
2020	12,567	7.21%
2021	13,474	7.21%
2022	14,148	5.00%
2023	14,856	5.00%
2024	15,599	5.00%
2025	16,379	5.00%
2026	17,198	5.00%
2027	18,058	5.00%
2028	18,961	5.00%
2029	19,910	5.00%
2030	20,906	5.00%
2031	21,952	5.00%

Year	Population	Average Annual Growth
2032	23,050	5.00%
2033	24,203	5.00%
2034	25,414	5.00%
2035	26,685	5.00%
2036	28,020	5.00%
2037	29,421	5.00%
2038	30,893	5.00%
2039	32,438	5.00%
2040	34,060	5.00%
2041	35,763	5.00%

4.2 FUTURE WATER DEMAND PROJECTION

The future growth areas and population developed in this study was mainly based on the existing conditions and Town of Blackfalds planning documents listed as below.

- Municipal Developments Plan, August, 2009
- Blackfalds Master Plan Update for Annexation Application, May, 2008
- Town of Blackfalds Design Guideline, May, 2011
- Joint Economic Agreement, 2007
- Lacombe County – Water & Wastewater Servicing Study Joint Economic Area West of Blackfalds, 2013

To plan for the future distribution system to service the future growths, some assumptions were made in this study as in following sections.

4.2.1 Future Demands in Town

As part of the growth scenarios for future developments, it is suggested by Town's 2008 Master Plan of Annexation that the projected need for housing units based on the moderate population growth scenario retaining the average household size of 2.89 people as a constant throughout the 30 year planning horizon. The desired community density should be within the range of 10.0 to 12.5 dwelling units per gross developable hectare, which is equivalent to 28 - 36 people/gross hectare. A community density of 12.5 dwelling units per gross hectare was applied in this study as a conservative consideration.

The average residential daily demand of 300 L/capita/day was assumed for the future development based on the historical water consumption evaluation in Section 2.2.

- Average Day Demand - 300 L/person/day
- Maximum Day Demand – 2.0 X Average Day Demand
- Peak Hour Demand – 4.0 X Average Day Demand

For non-residential developments, i.e. Industrial, Commercial and Institutional (ICI) developments the average day demand was set at 0.15 litres per second per hectare (l/s/ha).

4.2.2 Joint Economic Area

The Town and Lacombe County have adopted the *Inter-municipal Development Plan (IDP)* in the Joint Economic Agreement (2007). The IDP provides the coordination of land use planning within the Joint Economic Area (JEA), which is located west of the Town of Blackfalds across Hwy 2. All of the land considered in the JEA was designated for light industrial/commercial developments for the next 30-40 years at a rate of approximately one quarter section per five years.

As presented in the *Lacombe County – Water & Wastewater Servicing Study Joint Economic Area West of Blackfalds (2013)*, the areas A,B,E,F,I,J within the Joint Economic Area were determined to be directly serviced by the Town of Blackfalds water distribution system on the same Hydraulic Grade Line (HGL) without constructing a new water reservoir and pumping station. The projected water demands for those direct severable areas within the JEA presented in **Table 4-2**, were 26.6 L/s of ADD, 46.4 L/s of MDD and 66.3 L/s of PHD, respectively (the table was abstracted from Lacombe County – Water & Wastewater Servicing Study report).

Table 4-2 Water Demand Projections for JEA Direct Service Areas

Quarter Section	Total Area (Ha)	Estimated Developable Area (Ha)	ADD (L/s)	MDD (L/s)	PHD (L/s)
A	59	19.2	2.9	5	7.2
B	64	32	4.8	8.4	12
E	64	32	4.8	8.4	12
F	54	38.4	5.8	10.1	14.4
I	64	38.4	5.8	10.1	14.4
J	40	16.8	2.5	4.4	6.3
Totals:	345	176.8	26.6	46.4	66.3

As recommended in the *Lacombe County JEA – Water & Wastewater Servicing Study* Report (JEA Water & Wastewater Servicing Report), the rest of the JEA areas (C,D,G,H) will be serviced by a future JEA reservoir due to the high ground elevations. The filling of the reservoir is from the distribution system in the direct service JEA areas. The proposed JEA reservoir can also distribute water into the Town's distribution system.

The following basic design criteria were applied in the water distribution analysis for the JEA:

- For new pipes, Hazen-Williams C Value = 140;
- Minimum pressure at ground level during peak hour flow is 280 kPa (40 psi);
- Maximum pressure at ground level for all scenarios is 650 kPa (94 psi);
- Fire flow requirement is 230 L/s for the industrial and commercial developments in JEA.

4.2.3 Future Demand Projections

The following **Table 4-3** summarized the ultimate water demand projections based on the land use plan (**Figure 1-1**).

Table 4-3 Ultimate Water Demand Projection

Area ID	Area (ha)	Development Type	Residential Population	ADD (l/s)	MDD (l/s)	PHD (l/s)
E4	12.700	Residential	459	1.59	3.19	6.38
E5	50.000	Residential	1,807	6.27	12.55	25.10
E6	53.200	Residential	1,922	6.67	13.35	26.69
E7	57.500	Residential	2,078	7.22	14.43	28.86
E8	49.500	Residential	1,789	6.21	12.42	24.85
N2	36.300	Residential	1,312	4.56	9.11	18.22
N3	17.500	Residential	633	2.20	4.40	8.79
N4	16.400	Residential	593	2.06	4.12	8.24
N5	41.200	Residential	1,489	5.17	10.34	20.68
N6	22.600	Residential	817	2.84	5.67	11.35
NE4	6.000	Residential	217	0.75	1.51	3.01
S1	4.000	Residential	145	0.50	1.01	2.01
S2	27.500	Residential	994	3.45	6.90	13.81
S3	32.800	Residential	1,185	4.11	8.23	16.46
W3	34.300	Residential	1,240	4.31	8.61	17.22
I1B	8.500	Industrial		1.28	2.55	5.10
I1C	9.800	Industrial		1.47	2.94	5.88
I2	16.500	Industrial		2.48	4.95	9.90
I8	27.800	Industrial		4.17	8.34	16.68
I9	25.200	Industrial		3.78	7.56	15.12
I12	24.000	Industrial		3.60	7.20	14.40

Area ID	Area (ha)	Development Type	Residential Population	ADD (l/s)	MDD (l/s)	PHD (l/s)
I13	46.400	Industrial		6.96	13.92	27.84
I14	16.200	Industrial		2.43	4.86	9.72
C4	11.800	Commercial		1.77	3.54	7.08
C8	7.100	Commercial		1.07	2.13	4.26
C9	14.200	Commercial		2.13	4.26	8.52
E3	29.400	Residential	1,063	2.13	7.38	14.76
N1	13.300	Residential	481	1.67	3.34	6.68
TW3	13.900	Residential	503	1.75	3.49	6.99
W2A	4.500	Residential	163	0.57	1.13	2.26
W2D	8.200	Residential	296	1.03	2.06	4.11
E2	42.000	Residential	1,518	5.27	10.54	21.08
I7	14.900	Industrial		2.24	4.47	8.94
C11	8.000	Commercial		1.20	2.40	4.80
C12	16.000	Commercial		2.40	4.80	9.60
NE1	16.000	Residential	578	2.01	4.01	8.03
NE2	12.000	Residential	434	1.51	3.01	6.03
NE3	8.000	Residential	289	1.00	2.01	4.01
C10	5.100	Commercial		0.77	1.53	3.06
Total of Growth Area :			**22,005**	**112.57**	**228.26**	**456.53**
Total of Existing Area (2012):			**6,767**	**18.12**	**36.24**	**72.48**
Total of Town of Blackfalds:			**28,772**	**130.69**	**264.50**	**529.01**
Joint Economic Area (Direct Service Area)				**26.60**	**46.40**	**66.30**
Total of Ultimate Future System:			**28,772**	**157.29**	**310.90**	**595.31**

As indicated in Table 4-3, the planned population within the existing town boundary will reach 28,772, which is less than the 35,763 people in 2041 projected in the Table 4.1. That means the town will need more land outside of the current boundary to support the population growth beyond 2036 if the assumed annual growth rates are close to reality. In this water study, the demands and hydraulic simulations are on the growth areas which are within the existing boundary only.

4.3 FUTURE WATER DISTRIBUTION SYSTEM

The Town's water distribution system will be expanded and upgraded to accommodate the increasing water demands to service the future growths within the Town boundary and the JEA area. The WaterCAD model developed in the existing system analysis was expanded to include areas accordingly.

The proposed future water system consists of a network of pipe sizes ranging from 200 mm diameter to 400 mm diameter trunk main as illustrated in **Figure 4-1.** The future network construction and piping sizing were based on *Town of Blackfalds Design Guidelines* and the *Town of Blackfalds Master Plan (2008)*. The proposed water mains for the JEA were incorporated as they were in the original model developed by Stantec in 2013 with minor revisions. The following sections describe the future water service expansions based upon the growth scenarios proposed in Town's Mater Plan (2008) and land use plans.

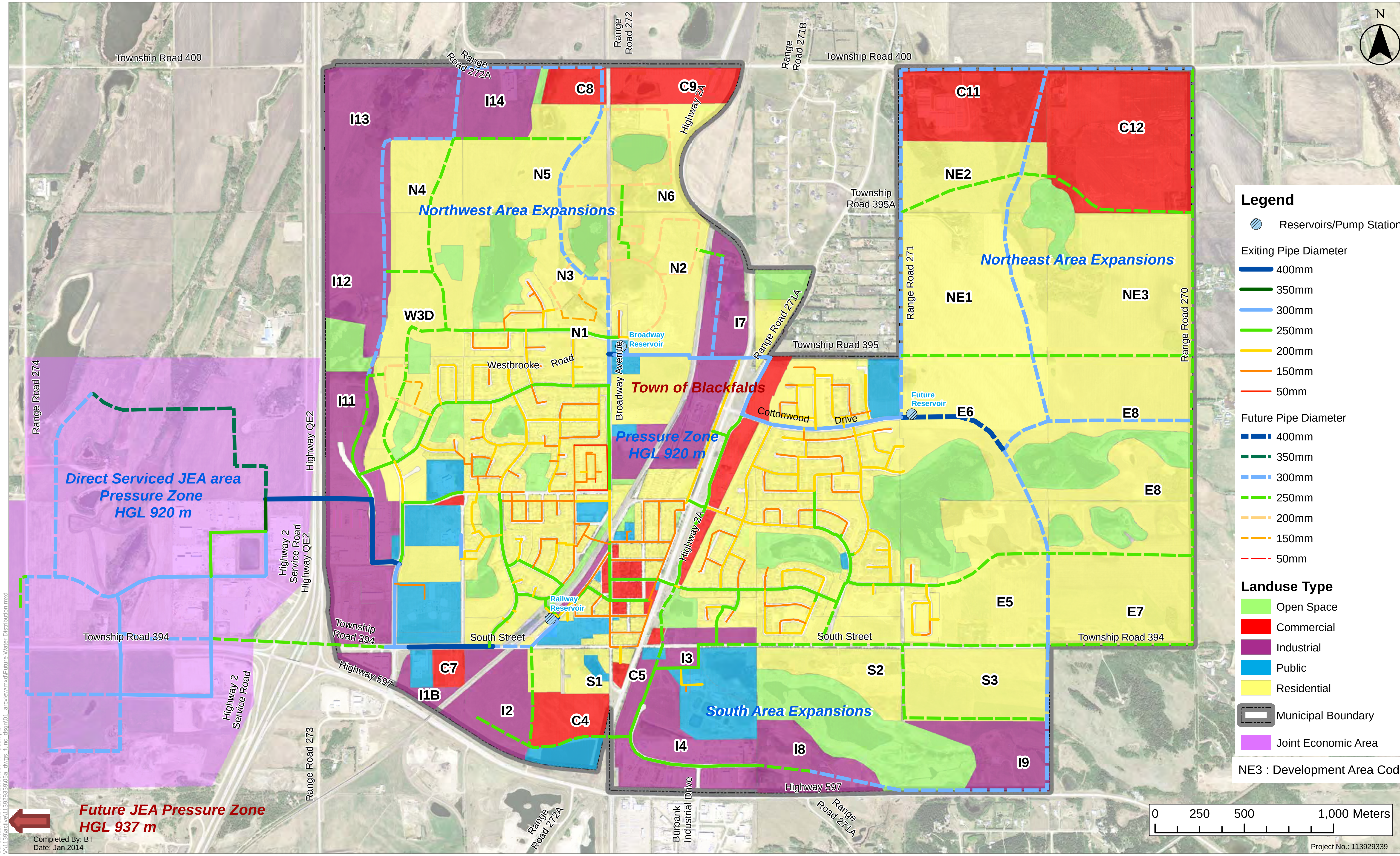


Figure 4.1: Future Water Distribution System

Stantec

Town of Blackfalds Water Model

4.3.1 Northwest Area Expansions

The proposed watermain in the Northwest Area are:

- Extend the 250 mm watermain along west industrial roadway north through areas I13 and I14 and then east to connect to Vista Trail and continue east where it will connect to the proposed 300 mm watermain along Broadway Avenue.
- Extend the 300 mm watermain along Vista Trail north through area N4, I14 and I15 to Lakeside Sargent Road. Extend the 300 watermain along Broadway Avenue north to Lakeside Sargent Road.
- Install a 250 mm watermain along Lakeside Sargent Road to complete the loop from Vista Trail to Broadway Avenue.

4.3.2 South Area Expansions

The following watermains are proposed in the South:

- Extend a 250 mm watermain along South Street between areas E5 and S2. Extend a 250 mm watermain east from area E3 through area E5.
- Extend the 300 mm watermain from area E2 east through area E6 then south along the east boundary of E5 to complete the loop to South Street.

4.3.3 Northeast Area Expansions

The main water distribution infrastructures in the Northeast Area are:

- Construct a new pump station and water reservoir at the high point on the east end of Cottonwood Drive.
- Install a 300 mm main from the future reservoir to the north and extend with a 250 mm watermain through areas NE1, NE2 and C11 to Lakeside Sargent Road as per **Figure 4-1**;
- Extend a 300 mm watermain from area E6 east through area E8 to the east annexation boundary and extend the watermain along South Street as a 300 mm watermain to the east annexation boundary.
- Install a 300 mm watermain north from areas E6 and E8 to the Lake side Sargend Road to service areas NE1, NE3 , NE2, C11 and C12.
- Install a 300 mm watermain along the north boundary of area C12 to complete the water loop for this area and install a 250 mm watermain along the east

annexation boundary to complete the water loops for all areas on the east side of Town.

- In addition to the above pipeline development, the 200 mm existing supply main from the Railway reservoir to the distribution system could be upsized to 400 mm, such that can decrease the high headloss.

4.4 FUTURE STORAGE CAPACITY REQUIREMENT

The Town has been receiving water from the NRDWSC regional water pipeline since 2006. It is assumed that NRDWSC can supply sufficient water to the town for their long-term needs.

4.4.1 Existing Storage Capacity

As discussed in Section 3.2.1, the Town's existing distribution system has an estimated storage capacity of 9,250 m^3.

- Railway Reservoir: 2,450 m^3
- Broadway Reservoir: 6,800 m^3

4.4.2 Future Storage Requirement With Town Boundary

The future storage requirement for the Town of Blackfalds was calculated based on the formula in Section 3.2.1. The required storage volume for the projected demands is 24,038 m^3. With the existing storage of 9,250 m3, the deficiency in storage volume is 14,788 m^3 without considering the demands in JEA, as presented in the following **Table 4-4**.

Table 4-4 Future System Storage Requirement

Total Storage Requirement S = A + B + C + D	**Volume (m^3)**
A = 233 L/s for 3 hours (Fire Storage Requirements)	2,516
B = 25% MDD (Equalization Storage)	5,713
C = 15% ADD (Emergency Storage)	1,694
D = 1.25xADD (Supply Interruption)	14,115
Total Storage Required (m^3)	**24,038**
Existing Storage	9,250
Future Deficient Storage	**14,788**

4.4.3 Storage Requirements for Joint Economic Area

To provide water servicing to the JEA from the Town of Blackfalds water system, the Town's reservoir storage capacity must have enough capacity to accommodate the development direct service area in the JEA. As shown in the following table, the required storage for the JEA is 4,219 m^3, assuming the fire flow storage is shared throughout the system.

Table 4-5 Water Storage Capacity Requirements for Direct Serviced JEA

Average Day Demand		Maximum Day Demand		25% MDD	15% ADD	1.25 ADD	Required Storage
m^3	L/s	m^3	L/s	m^3	m^3	m^3	m^3
2,291	26.6	4,010	46.4	1,002	344	2872.8	4,219

4.4.4 Total Combined Storage Requirement

The total ultimate storage requirement to service all the planned developments in the study area for the Town and the JEA area is presented in **Table 4-6**.

Table 4-6 Total Required Storage Volume

Area	Required Storage Volume (m3)	Percentage of the Total Volume
Direct Serviced JEA Area	**4,219**	**15%**
Town of Blackfalds	**24,038**	**85%**
Total	**28,257**	**100%**

4.5 FUTURE STORAGE UPGRADES

In order to provide sufficient water supply to the future water distribution system, the following improvements are recommended to upgrade the Town's water storage capacity. The Railway reservoir will remain as it is since there is not more land in its vicinity for storage expansion.

4.5.1 Broadway Reservoir Upgrades

It was determined in the Broadway Reservoir Pre-design Report that a two-celled storage reservoir was needed. The Town initially constructed a 6,800 m^3 storage cell in 2008. It was planned that the second cell with a 6,800 m^3 storage volume should be constructed after approximately 10-12 years after the initial construction.

4.5.2 Proposed Future Reservoir

To accommodate the ultimate design population of 28,772 in the full built out, it was recommended by the *Blackfalds Master Plan Update* (2008) that a new Pump Station and Water Reservoir (the East Reservoir) shall be constructed at the northeast area of the Town. The preferred location has been identified at the east end of Cottonwood Drive. This location takes advantage of the high elevation and proximity to future developments in and around this area (*Blackfalds Master Plan Update for Annexation Application, 2008*).

Per the above analysis, the required storage volume of the proposed future Reservoir is determined as follows:

$$S_{\text{New Reservoir}} = 28{,}257\ m^3 - 9{,}250\ m^3 - 6{,}800\ m^3 = 12{,}207\ m^3$$

Although the calculated volume is 12,207 m^3 for the future reservoir, it is recommended to plan to build the reservoir with 13,600 m^3 storage volume to match the total volume of the Broadway Reservoir. **Table 4-7** summarized the proposed future ultimate storage volume of the three reservoirs within the Town of Blackfalds.

Table 4-7 Summary of Future Ultimate Storage Volumes

Reservoir Location	Existing Volume (m3)	Proposed Additional Volume (m3)	Total Storage Volume (m^3)
Railway Reservoir	2,450	0	2,450
Broadway Reservoir	6,800	6,800	13,600
Future East Reservoir	0	13,600	13,600
Total	**9,250**	**20,400**	**29,650**

The required volume (4,219 m^3) for the direct serviced JEA accounts for 20% of the proposed additional volume to be built.

4.5.3 Storage Upgrades Staging

The total water flows from the reservoirs grew from 1,572 m^3 in 2010 to 2,063 m^3 in 2015. The calculated per annual growth rate is 7.1%, which is approximately equal to the recorded population growth in the last decade. As more ICI users will move in into the service area in the Town and direct service area in JEA, higher water demand growth rates are expected. If the population growth and the planned ICI developments complete in 2036 as projected in **Table 4-1**, the water demand will grow at an annual growth rate of 8.6%. To support the planned residential and ICI development and meet the increasing demands at the planned growth rates, the storage upgrades should be planned accordingly.

Table 4-8 presents the detailed calculations of estimated storage requirements for each year. As can be seen in the table, the storage deficiency will occur in the year of 2021, with the population approximately reaching 13,500 horizon. The storage deficiency will be approximately 7,000 m^3 in 2029 and will be reaching 17,000 m^3 for the full built out within the City boundary.

It is recommended to construct the new Broadway reservoir storage cell of 6,800 m^3 in 2020 and construct the future 13,600 m^3 East Reservoir in 2029. The construction of the East Reservoir can be phased into two stages, e.g. construct one storage cell of 6800 m^3 in 2029 and the other cell of 6,800 m3 in 2034. The staging plan for the East Reservoir depends on the future growth rates and development plans beyond the current Town boundary.

Table 4-8 Summary of Projected Water Storage Requirements

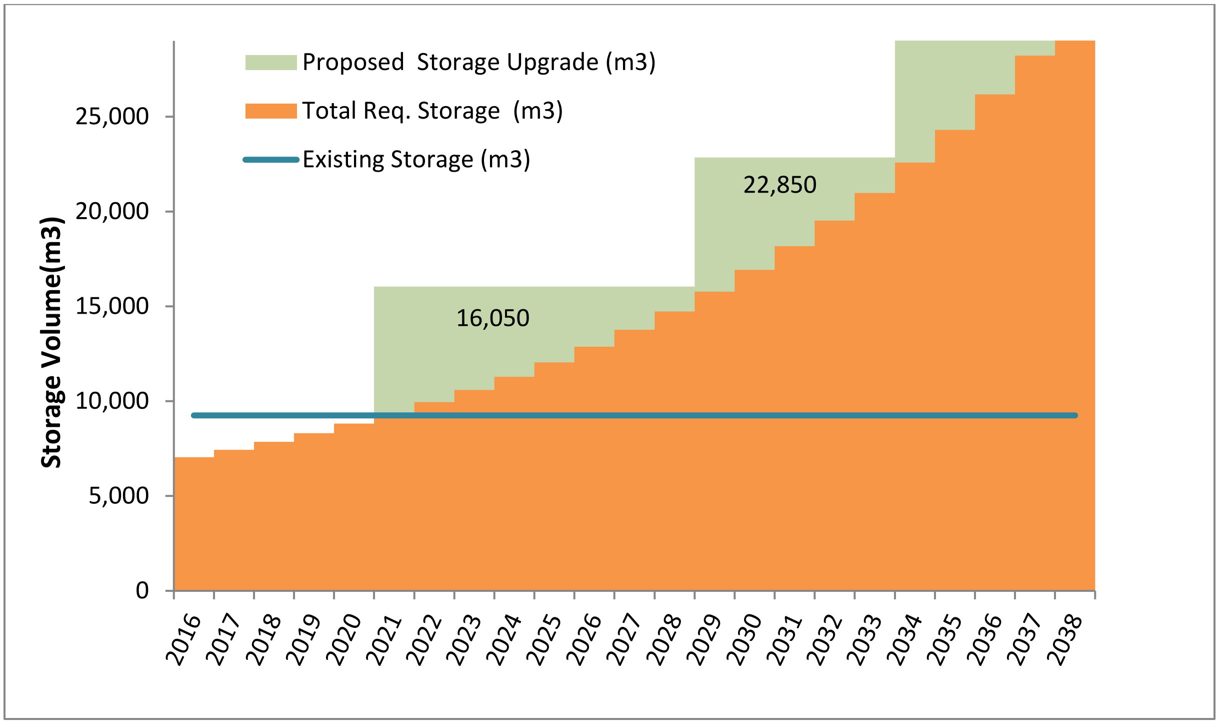
Year	Population	ADD (Town+JEA)	MDD (Town+JEA)	(A) Fire Protection	(B) 25% MDD	(C) 15% ADD	(D) Supply Interruption	(S) Total Req. Storgae	Existing Storage	Storage Deficiency
		(m3)	(m3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)
2016	9,510	2,677	5,355	2,516	1,339	402	2,789	7,046	9,250	2,204
2017	10,196	2,908	5,816	2,516	1,454	436	3,029	7,436	9,250	1,814
2018	10,932	3,159	6,317	2,516	1,579	474	3,290	7,860	9,250	1,390
2019	11,721	3,431	6,862	2,516	1,715	515	3,574	8,320	9,250	930
2020	12,567	3,727	7,453	2,516	1,863	559	3,882	8,821	9,250	429
2021	13,474	4,048	8,096	2,516	2,024	607	4,216	9,364	9,250	-114
2022	14,148	4,397	8,793	2,516	2,198	659	4,580	9,954	9,250	-704
2023	14,856	4,776	9,551	2,516	2,388	716	4,975	10,595	9,250	-1,345
2024	15,599	5,187	10,374	2,516	2,594	778	5,403	11,291	9,250	-2,041
2025	16,379	5,634	11,268	2,516	2,817	845	5,869	12,048	9,250	-2,798
2026	17,198	6,120	12,239	2,516	3,060	918	6,375	12,869	9,250	-3,619
2027	18,058	6,647	13,294	2,516	3,324	997	6,924	13,761	9,250	-4,511
2028	18,961	7,220	14,440	2,516	3,610	1,083	7,521	14,730	9,250	-5,480
2029	19,910	7,842	15,685	2,516	3,921	1,176	8,169	15,783	9,250	-6,533
2030	20,906	8,518	17,036	2,516	4,259	1,278	8,873	16,926	9,250	-7,676
2031	21,952	9,252	18,504	2,516	4,626	1,388	9,638	18,168	9,250	-8,918
2032	23,050	10,050	20,099	2,516	5,025	1,507	10,468	19,517	9,250	-10,267
2033	24,203	10,916	21,831	2,516	5,458	1,637	11,371	20,982	9,250	-11,732
2034	25,414	11,856	23,713	2,516	5,928	1,778	12,350	22,574	9,250	-13,324
2035	26,685	12,878	25,757	2,516	6,439	1,932	13,415	24,302	9,250	-15,052
2036	28,020	13,988	27,976	2,516	6,994	2,098	14,571	26,180	9,250	-16,930
2037	29,421	15,194	30,387	2,516	7,597	2,279	15,827	28,219	9,250	-18,969
2038	30,893	16,503	33,006	2,516	8,252	2,475	17,191	30,434	9,250	-21,184
2039	32,438	17,925	35,851	2,516	8,963	2,689	18,672	32,840	9,250	-23,590
2040	34,060	19,470	38,940	2,516	9,735	2,921	20,281	35,453	9,250	-26,203
2041	35,763	21,148	42,296	2,516	10,574	3,172	22,029	38,292	9,250	-29,042

Notes:

1. The projected demand growth rate is 8.6% per year.
2. The demands in the direct service area in JEA account for approximate 15% of the total demands.
3. The projected demands after 2036 are based on the demand growth rate of 8.6% only. The future development plans beyond the current Town boundary will determine the real demands.

The staged storage upgrades can be presented in Figure 4-2.

Figure 4-2 Proposed Storage Upgrade for the Planned Growth



4.6 FUTURE PUMPING CAPACITY REQUIREMENT

Along with meeting the Town's water storage requirements, this study also addressed the pumping capacity to supply water to the Town's distribution system.

The Town of Blackfalds currently operates its water distribution system with target a hydraulic grade line (HGL) of 918 m. When considering the future water supply to the west and east development areas of the Town and the JEA, the pumps will be required to provide a hydraulic grade line of 920 m at all of the pump stations for the ultimate scenario.

4.6.1 Broadway Pump Station

As mentioned in Section 2.1.4, the distribution pumps in the Broadway Pump station and the Railway Pump Station currently supply water to the Town's distribution system. It was also suggested both in the *Broadway Avenue Reservoir Pre-design Report* and the *Blackfalds Master Plan (2008)* that the Broadway Avenue Pump Station should be upgraded to have an ultimate total capacity of 400 L/s, with a firm capacity of 320 L/s. The pumping capacity can be upgraded along with the construction of the new 6,800 m^3 storage cell. **Table 4-8** outlines the proposed ultimate pumping capacity of the Broadway station.

Table 4-9 Future Ultimate Pumping Capacity of Broadway Station

No.	Pump	Design Flow (L/s)	TDH (m)
1	75 HP Variable Speed Pump	80	50
2	75 HP Variable Speed Pump	80	50
3	75 HP Variable Speed Pump	80	50
4	75 HP Variable Speed Pump	80	50
5	75 HP Variable Speed Pump	80	50

4.6.2 Proposed Future Pump Station Capacity

With the updated model, the analysis results confirmed that in the ultimate PHD scenario, the Railway pump station with one distribution pump (one standby) and one Jockey pump on operation can supply flow approximately 48 L/s. The Broadway pump station with four duty pumps (one standby) operation can supply about 265 L/s. Therefore, the ultimate total capacity requirements of the future distribution pumps in the proposed new pump station are calculated to be 282 L/s. **Table 4-9** illustrates the approximate pump capacity requirements and calculations for the ultimate PHD scenario in the design year of 2036.

Table 4-10 Future Ultimate Pumping Capacity Analysis

Year	Ultimate Design Capacity Requirement (PHD) (L/s)	Flow Supplied by Existing Pump Stations (L/s)		Proposed Future New Pump Station Capacity (L/s)
		Railway Station	Broadway Station	
2036	595	48	265	282
Total	595	313		

Based on the above calculations, it is recommended that the firm capacity of the proposed future pump station is 320 L/s and a total capacity is of 400 L/s(four on duty and one standby), which are outlined in the following **Table 4-10**.

Table 4-11 Proposed Future Pump Station Capacity

No.	Pump	Flow (L/s)	TDH (m)	Speed (r/min)
1	75HP Variable Speed Pump	80	50	1800
2	75 HP Variable Speed Pump	80	50	1800
3	75 HP Variable Speed Pump	80	50	1800

No.	Pump	Flow (L/s)	TDH (m)	Speed (r/min)
4	75 HP Variable Speed Pump	80	50	1800
5	75 HP Variable Speed Pump	80	50	1800

The projected direct serviced JEA area PHD is 67 l/s while the PHD in the Town is 529 l/s, which means the direct serviced JEA area PHD will account for approximate 11% of the total future pumping capacity. The rest 89% pumping capacity will service the Town.

4.6.3 Filling of the JEA Reservoir

As recommended in the JEA Water and Wastewater Service report, the JEA area will require a future reservoir to service the developments (areas C,D,G,H) with higher than 887 m ground elevation in the long term. The JEA reservoir will have a total storage of 4,025 m^3 and operate at a target HGL elevation of 937 m. The projected MDD supplied by the JEA reservoir is 52 l/s (4,492 m^3/day). The total MDD in the JEA areas, serviced by the pump stations in the Town or by the JEA reservoir is projected to be 98.5 L/s.

The extended distribution system will fill the JEA future reservoir to keep up with the MDD consumption in the JEA areas serviced by the reservoir, i.e. 4,492 m^3/day or 52 L/s. In the WaterCAD model, the required filling rate to the JEA reservoir was modeled as a single point demand at one of the junctions in the JEA area to simulate the filling.

5.0 Future Distribution System Hydraulic Performance

The future distribution system should be constructed with the capacity to meet the daily demands and firefighting flow demands for the existing and the future scenarios. The components of the distribution system proposed in the Section 4 were sized to meet the design criteria in accordance with the *Town of Blackfalds Design Guideline (2011) Water Design Standards* as in Section 3.1. The hydraulic modeling results of the proposed distribution system, i.e. the node pressure, flow velocity, watermain head loss and available fire flow are presented in the following sections.

5.1 SYSTEM PRESSURES

The system pressures were evaluated under ADD, MDD and PHD scenarios for Town's future distribution system.

The modeling results regarding to the residual pressures and pipe velocities are presented in **Figure 5-1**, **Figure 5-2** and **Figure 5-3** for the scenario ADD, MDD and PHD, respectively.

The proposed future distribution system provides adequate water to the Town for all levels of service conditions except for two service nodes located on the west boundary of JEA with the residual pressures of 38 psi which is slightly less than the minimum pressure requirement of 280 kPa (40 psi) in the MDD and PHD scenarios. The low pressure in the PHD scenario in these two nodes is due to their high ground elevations. However, when the JEA reservoir and pumping station is constructed, pressure reducing valves will be installed in the interconnection pipes between the high pressure zone and the low pressure zone. The PRV will actuate to allow the low pressures in the low pressure zone rise to 280 kPa.

Note that there is one service node located in the northeast corner of the Town with the lowest elevation of approximately 851m, experiences a high residual pressure approximately of 94 - 97 psi, which exceed the allowable maximum pressure of 620 kPa (90 psi). Pressure reducing servicing valves might be needed in service lines entering the future buildings within the area.

5.2 WATERMAIN FLOW VELOCITY

The pipes velocities under ADD, MDD and PHD scenarios were also presented in **Figures 5-1, 5-2 and 5-3**. The results indicated that most of the pipe velocities in the future water distribution system are within 1.5 m/s, except couple sections of the existing discharge mains from the Broadway reservoir to west part of distribution system where velocities exceed 1.5 m/s, which is due to the high water demand under PHD scenario. The high velocity concerns can be addressed by upsizing the Broadway Reservoir discharge pipe to 400 mm diameter in the future.

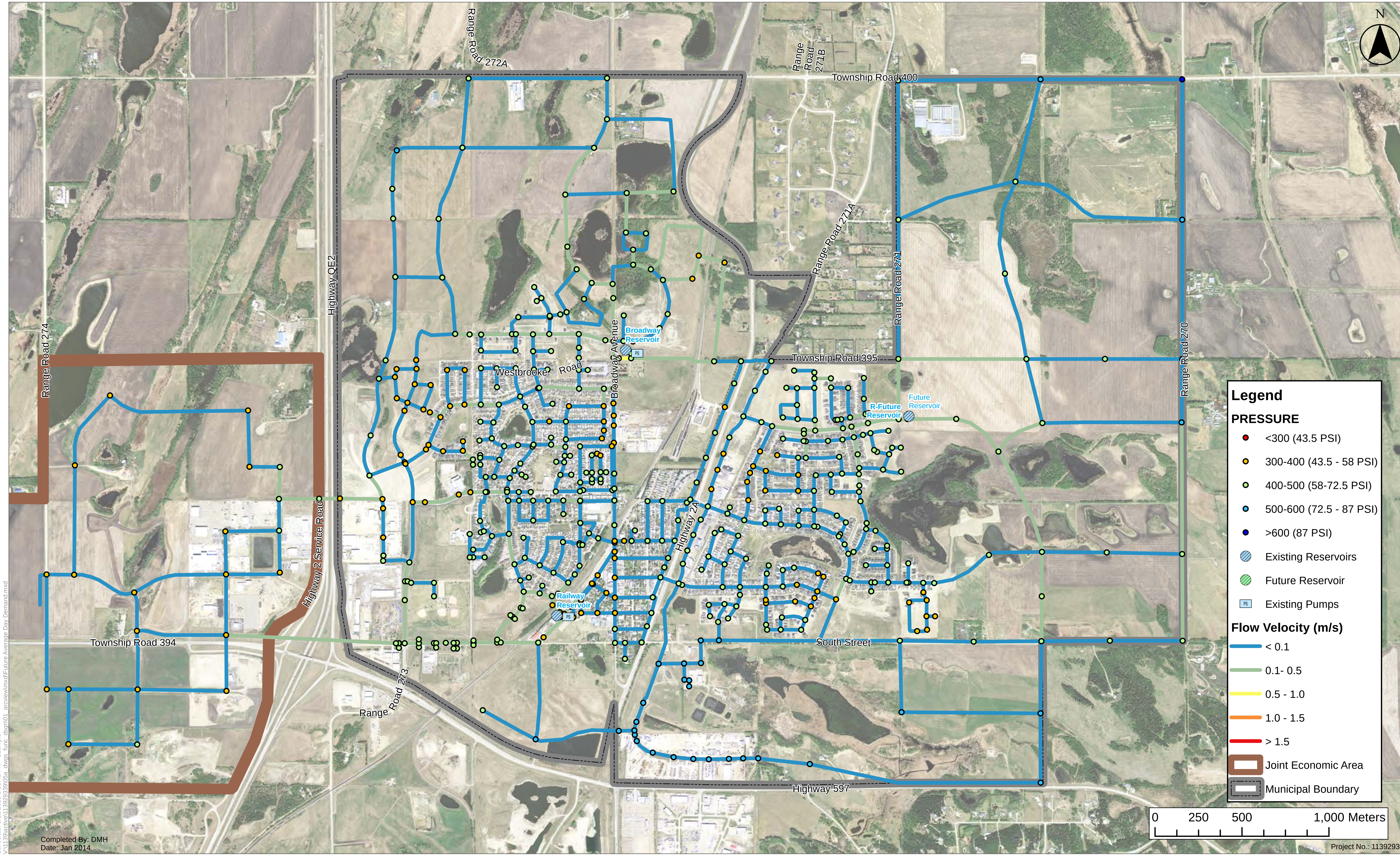


Figure 5.1: Future System Average Daily Demand Scenario

Water Model Update

Town of Blackfalds

Stantec

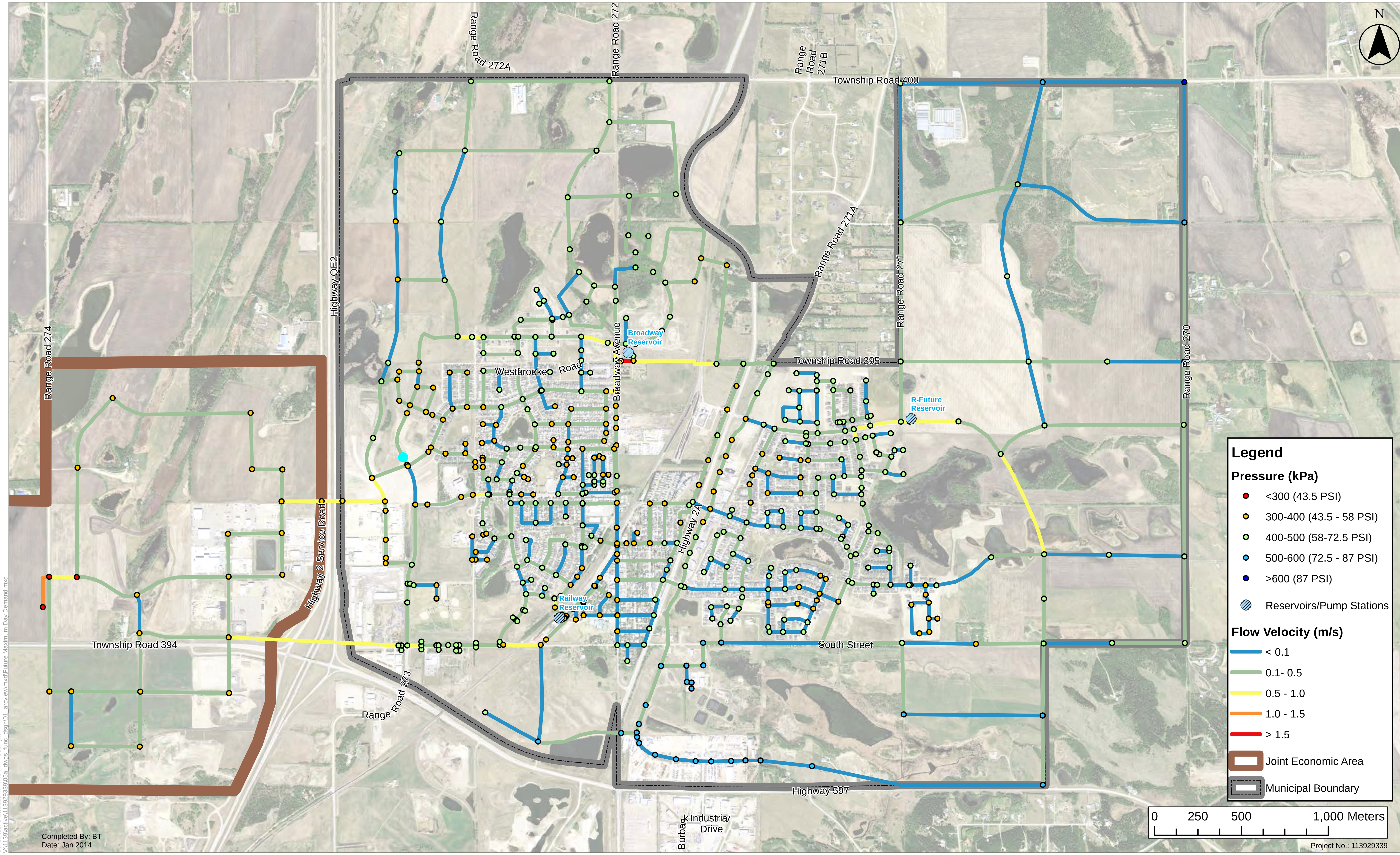


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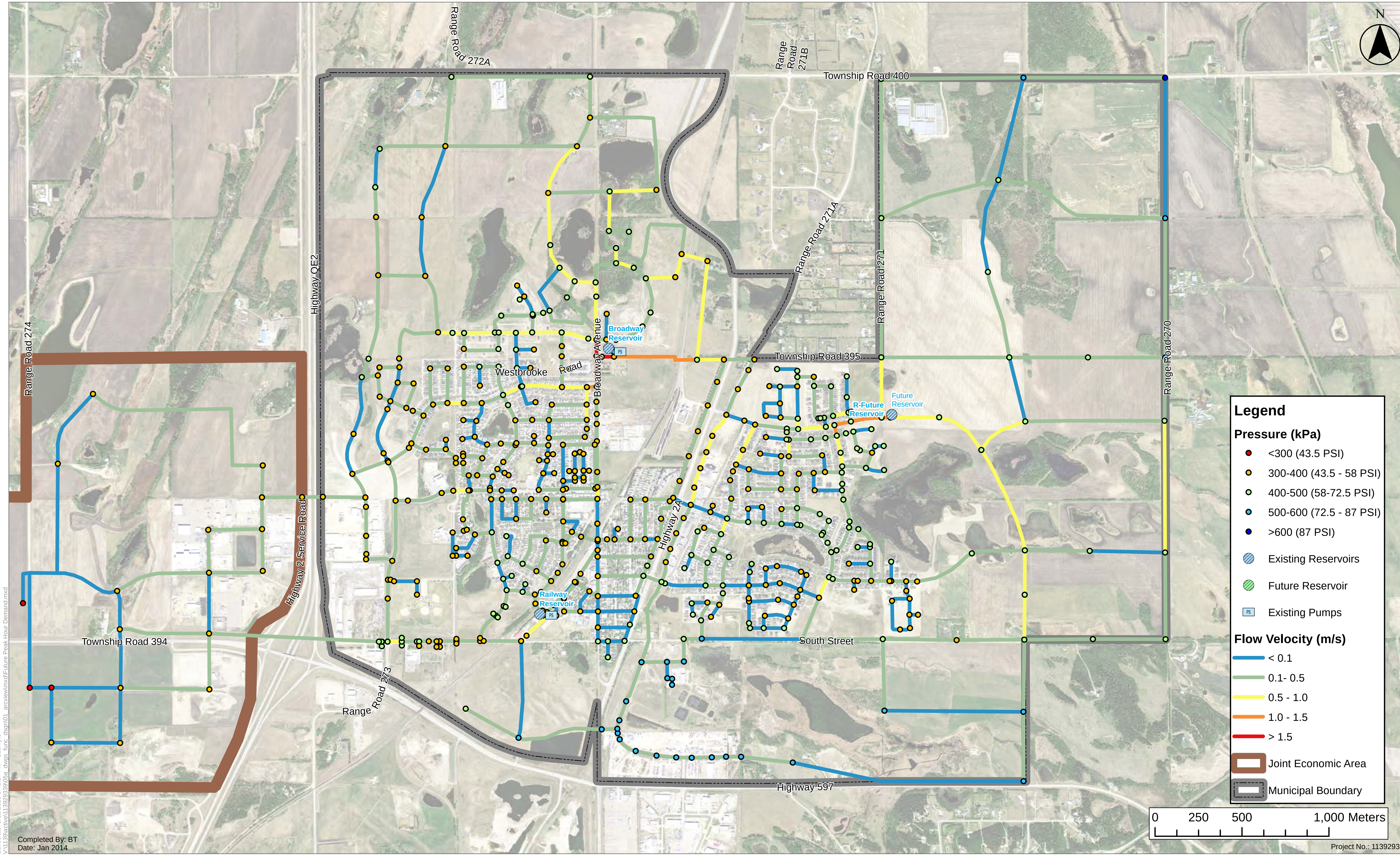
Figure 5.2: Future System Maximum Day Demand Scenario

Water Model Update

Town of Blackfalds



Stantec

Figure 5.3: Future System Peak Hour Demand Scenario

Water Model Update
Town of Blackfalds

5.3 WATERMAIN HEADLOSS

Based on the analysis results, the watermain headloss under ADD scenario were illustrated in **Figures 5-4**. It can be seen that the majority of pipe headloss are within 2.5 m/km.

5.4 AVAILABLE FIRE FLOW

Velocity constraint of 2.5 m/s was applied to the future new pipes in the fire flow analysis in the future water system. The model results are presented in **Figure 5-5**.

As shown in the figure, the water system can supply adequate fire flow protection in the majority of the nodes in the proposed distribution system. There is one node with the available fire flow of 220 L/s. The available fire flows cannot meet the minimum requirement of 233 l/s for industrial/commercial developments within JEA areas which are directly serviced by the pumps in the Blackfalds pump stations. The pump capacity in the Railway pump station is the limiting factor. However, as recommended in the *JEA Water and Wastewater Servicing Report*, the future pumps in the JEA reservoir pump station will supply sufficient fire flow to the area, through the pressure reducing valves installed to connect the two pressure zones.

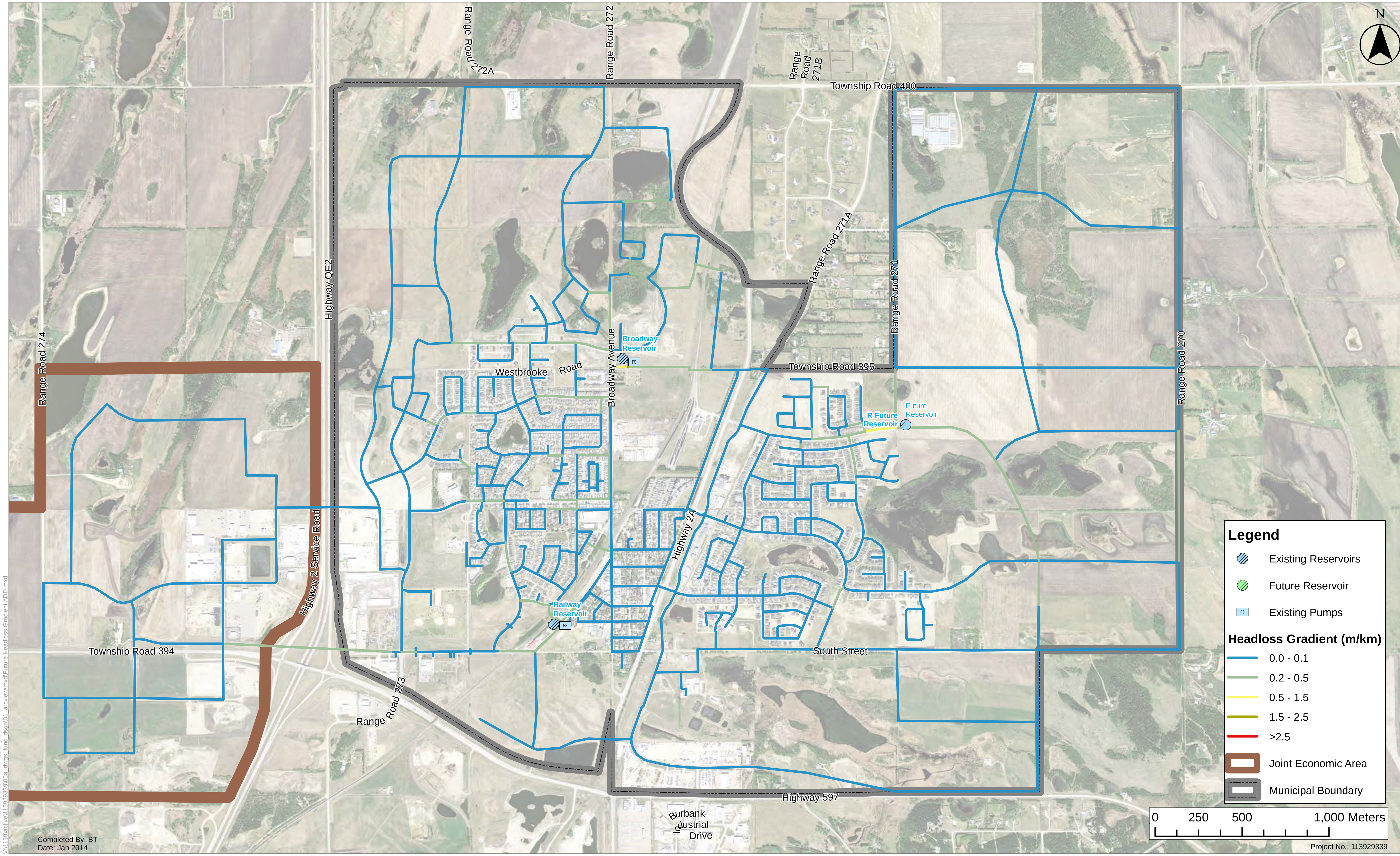


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Figure 5.4: Headloss Gradient under Future Average Day Demand Scenario

Water Model Update

Town of Blackfalds

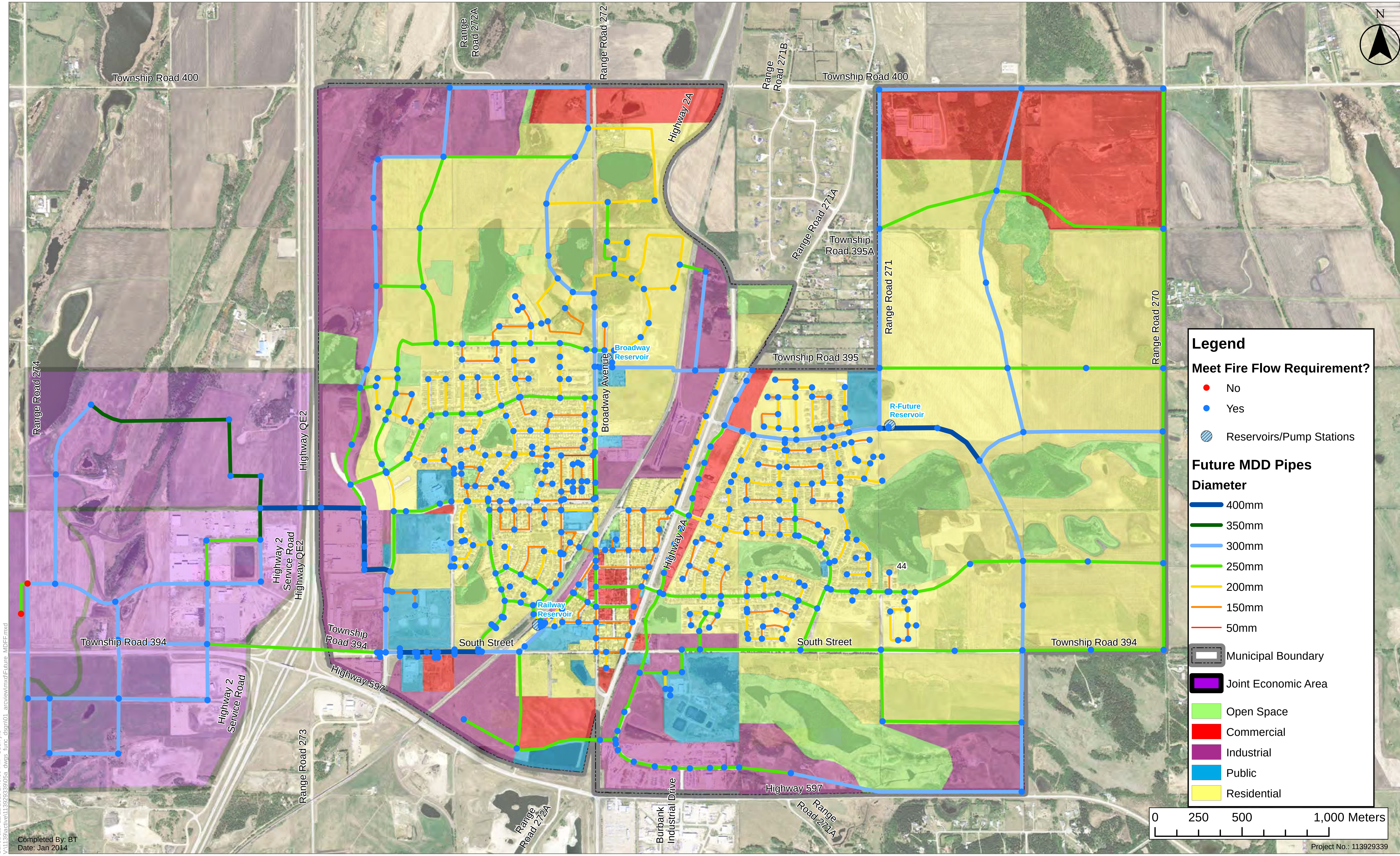


Figure 5.5: Available Fire Flows with 2.5 m/s Velocity Constraint In Future Pipes In MDD Scenario

Water Model Update

Town of Blackfalds

Stantec

6.0 Conclusions and Recommendations

The following are the conclusions and recommendations of the water model update 2015 study for Town of Blackfalds.

6.1 EXISTING WATER SYSTEM

- The water model has been calibrated and updated to accurately represent the actual existing distribution system.
- The evaluation of Town's existing infrastructure shows that the hydraulic capacity of the existing distribution system is adequate to meet the level of service under ADD, MDD and PHD scenarios.
- The system deficiency was detected under MDD + FF scenario for the existing water system. The available fire flows are not satisfied with the requirements for the residential area equipped with the 150 mm single lines and the industrial/commercial development in some locations with the 2.5 m/s flow velocity constraint applied, as per **Figure 3-5**. However, when the velocity constraint is removed, most of the available fire flow can meet the fire flow requirement except some nodes in the industrial areas, as shown in **Figure 3-6**.
- The available fire flow deficiency in **Figure 3-6** can be alleviated by the improvement of upsizing or looping the watermains as highlighted in **Figure 3-7**. The proposed upgrades can lower the flow velocity in the pipes in a firefighting event and increase the available fire flow. However, these upgrades highlighted in **Figure 3-7** should NOT be in the infrastructure improvement "high priority" list.

6.2 FUTURE WATER SYSTEM

- The conceptual plan for future growth scenarios of the Town of Blackfalds and the JEA (Lacombe Country) over next 25 years (2038) was developed based upon the Town's updated existing system and development plans of Town's Master Plan and 2013 Offsite Levies Report.
- In order to accommodate the future growth demands, a HGL of approximately 920 m is recommended to provide sufficient pressure and flow to the proposed future system.
- The modeling results indicate that with the population growth as estimated in Table 4.1, the deficiency of future distribution system will occur around the year of 2018 as per Table 4-7 in terms of the storage and pumping capacity. For the long term servicing of the Town of Blackfalds and the JEA, the system deficiency will

approximately reach 19,000 m3 in the design year of 2038 reaching the storage capacity.

- Given the storage deficiency, it is recommended to construct a 6,800 m^3 reservoir cell around 2020 to the Broadway Reservoirs to increase the total storage volume to 13,600 m^3. In addition to the storage cell construction, it is also suggested that the pumping station to be upgraded to have a firm capacity of 320 L/s and a total capacity of 400 L/s (four on duty and one standby) as per **Table 4-8**.

- A new reservoir and its associated pumping station are proposed at the east end of Cottonwood Drive to increase the storage capacity and to meet the future demand for both the Town and the direct service JEA areas.

- The proposed pumping station is recommended to be equipped with a firm capacity of 320 L/s and a total capacity of 400 L/s (four on duty and one standby) as shown in **Table 4-10**.

- The proposed new reservoir may be constructed in 2 phases with a two-cell configuration.

6.3 OPINION OF PROBABLE COSTS

Table 6-1 provides a summary of the Opinion of Probable Cost (OPCs) for the above recommended upgrades in Section 6.1 and 6.2. All the costs are in 2015 Canadian dollar. A preliminary implementation schedule based on the population projection in this report is also included in the table.

The OPCs for the future distribution mains proposed in the future development areas are not included in this OPC table because the construction costs should be carried by the developers.

Table 6-1 OPC Estimated Capital Improvements

Year	Infrastructure Upgrade	OPC
2020	Upgrade the Broadway Reservoir with a 6,800 m^3 second storage cell and install new distribution pumps	$5,600,000
2029	Construct a 6,800 m^3 new Reservoir/ Pumping Station at the east end of Cottonwood Drive.	$ 7,200,000
2034	Upgrade the Cottonwood Reservoir with a 6,800 m^3 second adjoining reservoir	$5,440,000
Note 1	Add a 250 mm interconnection pipe between Highway Street and Parkwood Rd. (87 m long)	$223,590

Year	Infrastructure Upgrade	OPC
Note 2	Upsize the 150 mm pipe to 200 mm in the E.Railway Street, between Moore St. and Broadway Ave. (220 m)	$581,680
Note 3	Upsize existing 200 mm diameter water main from Railway reservoir and extend west along South Street as a 300 mm diameter main (435 m)	$1,150,140
Note 4	Construct a 250 mm loop from South Street through areas S1, C4 and I2 to connect the proposed 300 mm main along South Street south of the existing Railway reservoir (1200 m)	$565,200
Note 5	Extend the 250 mm water main from Park Street to South Street along Parkwood Road (490 m)	$230,790
Note 6	Install the 250 mm pipe to JEA area (total 980 m, 280 m HDD)	$1,049,300

Notes:

1. 1 and 2. The upgrades can be implemented when the developers require the Town to supply 233 l/s in these two areas before the construction of the East reservoir.
3. The upgrade is proposed to increase the fire flow to the west and lower the velocity in the reservoir discharge main. The work can be implemented when more industrial buildings are planned along the west portion of the South Street.
4. The work can be done when the internal network in the S1,I2 and C4 areas is installed.
5. The extension is proposed to increase the fire flow in the short term and to form a loop for the future system. The upgrade can be implemented along with the 250 mm main in the South Street.
6. The 250 mm main is proposed to supply a second line to the JEA and increase the fire flow in the direct serviced areas in JEA when the JEA Reservoir is not in placed. This second line can increase the reliability of the water supply to the JEA area to provide emergency for water supply.

Appendix A SFE Globe Flow Test Report

Final Report for
Stantec

Attn: Mr. Andrew Robertshaw, P.Eng.

Blackfalds, Alberta
2013 Fire Hydrant Flow Testing

Prepared and submitted by:

SFE Global
10707 - 181th Street
Edmonton, Alberta T5S 1N3
Phone (780) 461-0171 Fax (780) 443-4613
Toll Free: 1-877-293-0173

November 7, 2013

Mr. Andrew Robertshaw, P.Eng.

Stantec
Executive Place
#1100, 4900 – 50th Street
Red Deer, Alberta
T4N 1X7

FINAL REPORT: 2013 Fire Hydrant Flow Testing
Blackfalds, Alberta

Dear Mr. Robertshaw;

Please find enclosed SFE's Final Report for the above mentioned project. If you have any questions, comments or concerns, please do not hesitate to contact us at your earliest convenience.

Thank you for having SFE conduct this work on your behalf. We are appreciative of the opportunity to work with you and your team on this project. We look forward to working together again in the near future.

Sincerely,
SFE Global

Kevin McMillan
Vice-President
(780) 461-0171 x 202
kevin.mcmillan@sfeglobal.com
www.sfeonline.com

1. Executive Summary

This report provides details of the hydrant fire flow testing conducted in Blackfalds, Alberta. SFE Global was retained by Stantec under the direction of Mr. Andrew Robertshaw, P.Eng. Mr. Kevin McMillan represented SFE Global as Project Manager during this project.

As requested, SFE conducted ten (10) hydrant fire flow tests on October 31st, 2013. All flow hydrants and test hydrants were indicated to SFE by maps supplied by the client. The fire flow tests were conducted according to National Fire Protection Association (NFPA) 291 standards.

2. Summary of Testing

SFE Technicians met representatives of the Town of Blackfalds and Stantec on site to perform testing on October 31st, 2013. The testing plan was discussed and location maps reviewed by all participants.

Testing Equipment

Testing was performed on each specified flow hydrant utilizing a Pollard Water Hose Monster system with integral dechlorinator. This is a fixed pitot device to measure flow, dechlorinate and diffuse in one process. The benefit of this system is the ability to provide repeatable results and manage discharge water conditions. Residual pressure was measured with a liquid filled Bourdon tube type pressure gauge. Pitot pressure readings were also obtained from liquid filled, Bourdon tube pressure gauges.

The configuration for this testing consisted of two (2) 2.5 inch Hose monsters on Flow 1 hydrant and one (1) 4 inch hose monster on Flow 2 hydrant. Pressure recording gauges and a digital pressure logger were installed on the designated residual pressure hydrant.

To digitally log pressure at the residual hydrant and at two nodes within the distribution system SFE Technicians installed three Telog HPR hydrant pressure loggers. These devices were set to one minute logging intervals and one second sampling intervals. Each one minute interval logs the minimum, maximum and average pressure for that interval.

Testing Procedure

The client selected two flow hydrants and one residual hydrant for each test. SFE Technicians installed flow testing equipment on each flow hydrant and residual pressure measurement equipment on the residual hydrant.

The tests were performed by recording system static pressure, flowing two (2) 2.5 inch ports on Flow 1 hydrant and recording corresponding pitot and residual pressures. Then one (1) 4 inch port on Flow 2 hydrant was also flowed and all pressures recorded. Total flow and extrapolated flow to 20 psi residual pressure are calculated from this test on the flow testing summary sheets.

Flow testing summary sheets are included in Appendix I.

Data loggers were installed to measure min, max and average pressure. One logger was utilized and travelled with the residual pressure measurement device. The other two were installed at Hydrant H241 and Hydrant H190 to measure system pressure at the South and North ends of Town respectively. A graph of the data from these locations is included in Appendix I.

3. Data

The testing reports included in Appendix I contain all test results and photos. All pressure readings are in psi and all flow values are reported in IGPM. All hydrants were returned to as found condition upon completion of testing.

Please find the testing results Appendix I and a drawing of the test sites as provided by the client in Appendix II.

4. Safety

A pre-job safety inspection and meeting was conducted by SFE personnel, and the following potential hazards were identified:

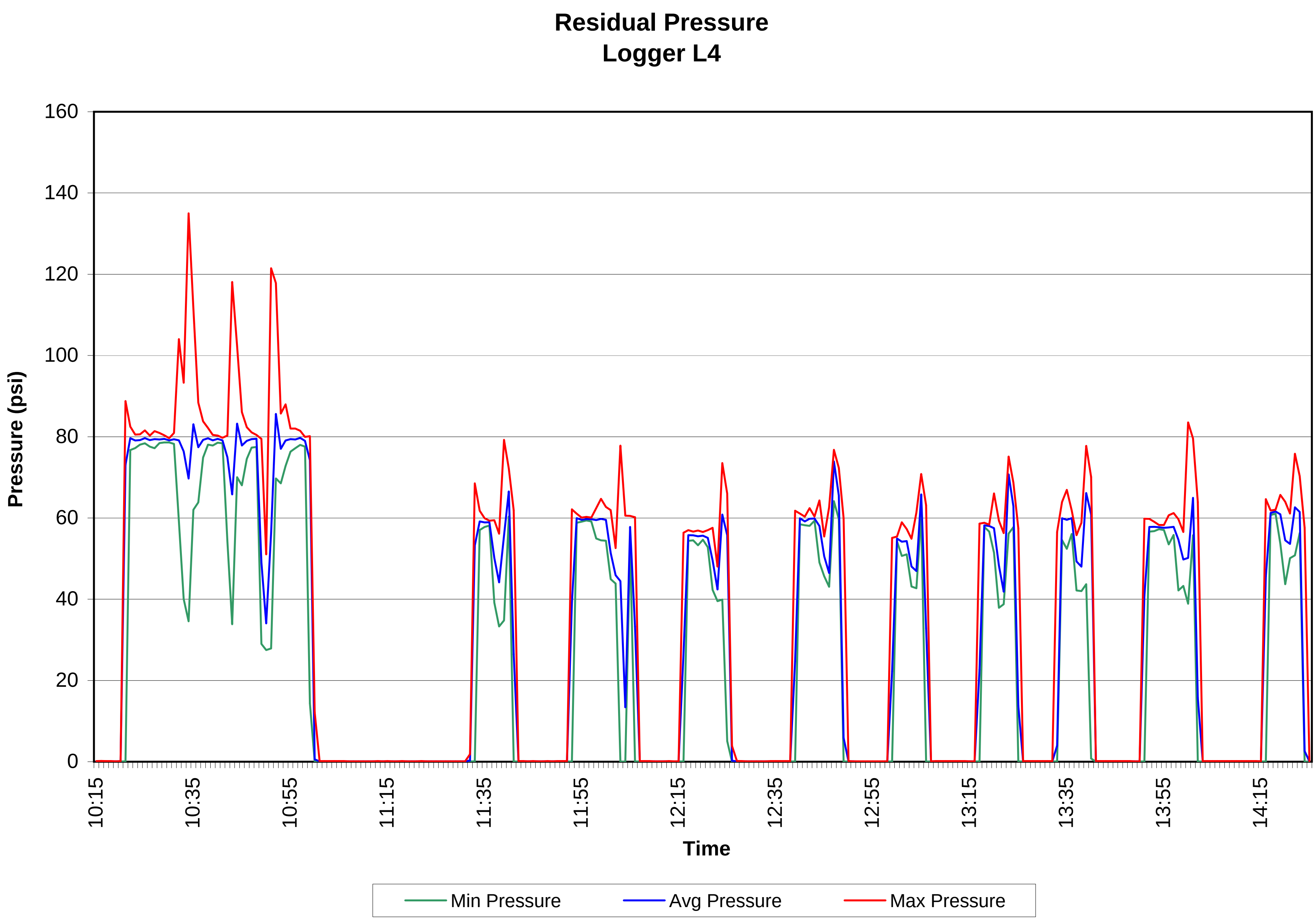
- Need for Personal Protective Equipment
- Working with water under pressure
- Pedestrian and vehicular traffic conditions
- Safe operation and shut down of fire hydrants

This project was conducted in accordance with the WCB and OSHA safety standards as documented in SFE's Safety Procedures Manual. The SFE crew reviewed the work to be completed and safety requirements at a tail-gate safety meeting held prior to commencing work.

Report End
November 2013

SFE Global
Project A13-183

Appendix I
Test Results


Residual Pressure
Logger L4
Pressure (psi)
160
140
120
100
80
60
40
20
0
10:15
10:35
10:55
11:15
11:35
11:55
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12:35
12:55
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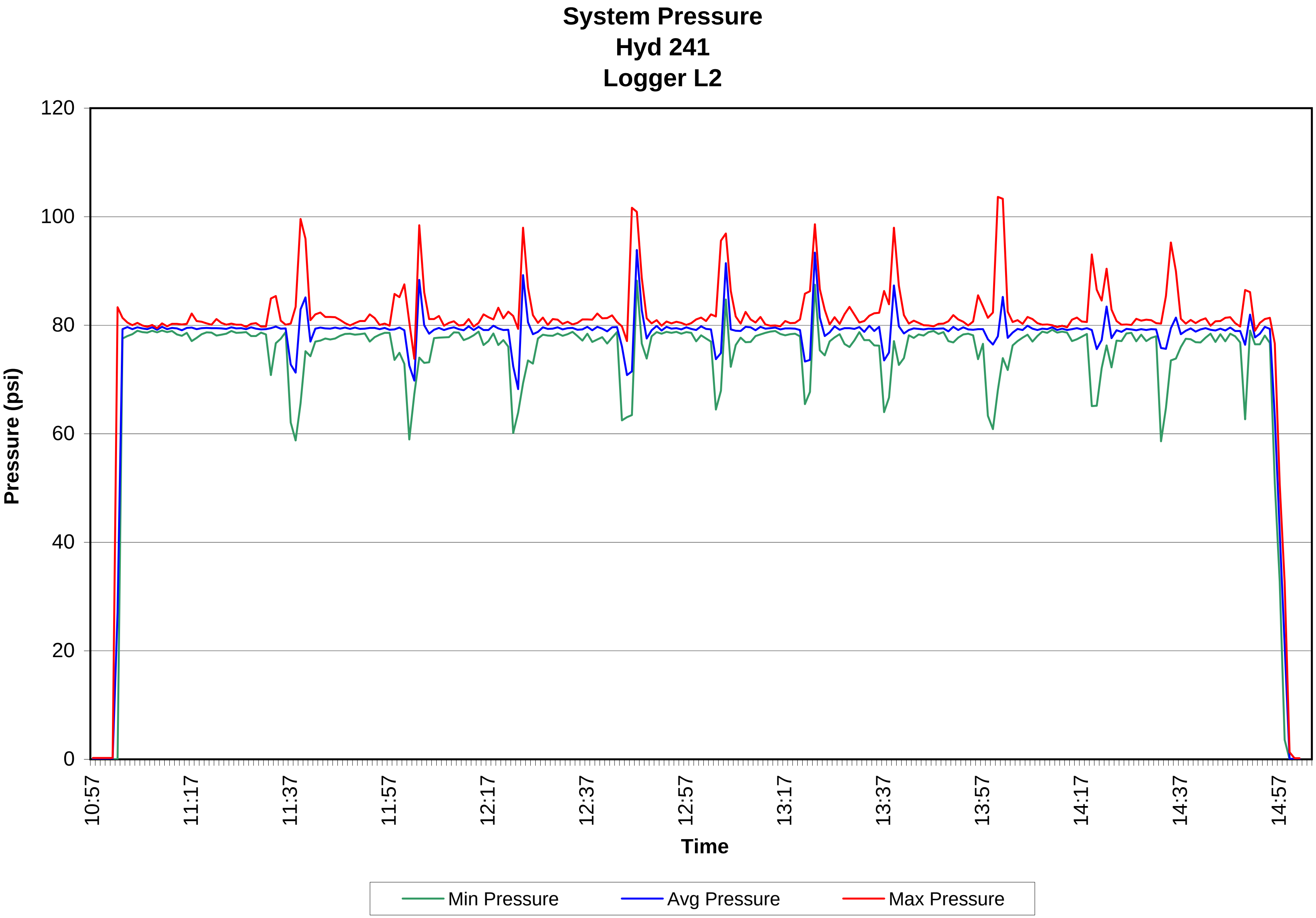
13:55
14:15
Time
Min Pressure
Avg Pressure
Max Pressure


System Pressure
Hyd 241
Logger L2
Pressure (psi)
120
100
80
60
40
20
0
10:57
11:17
11:37
11:57
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13:17
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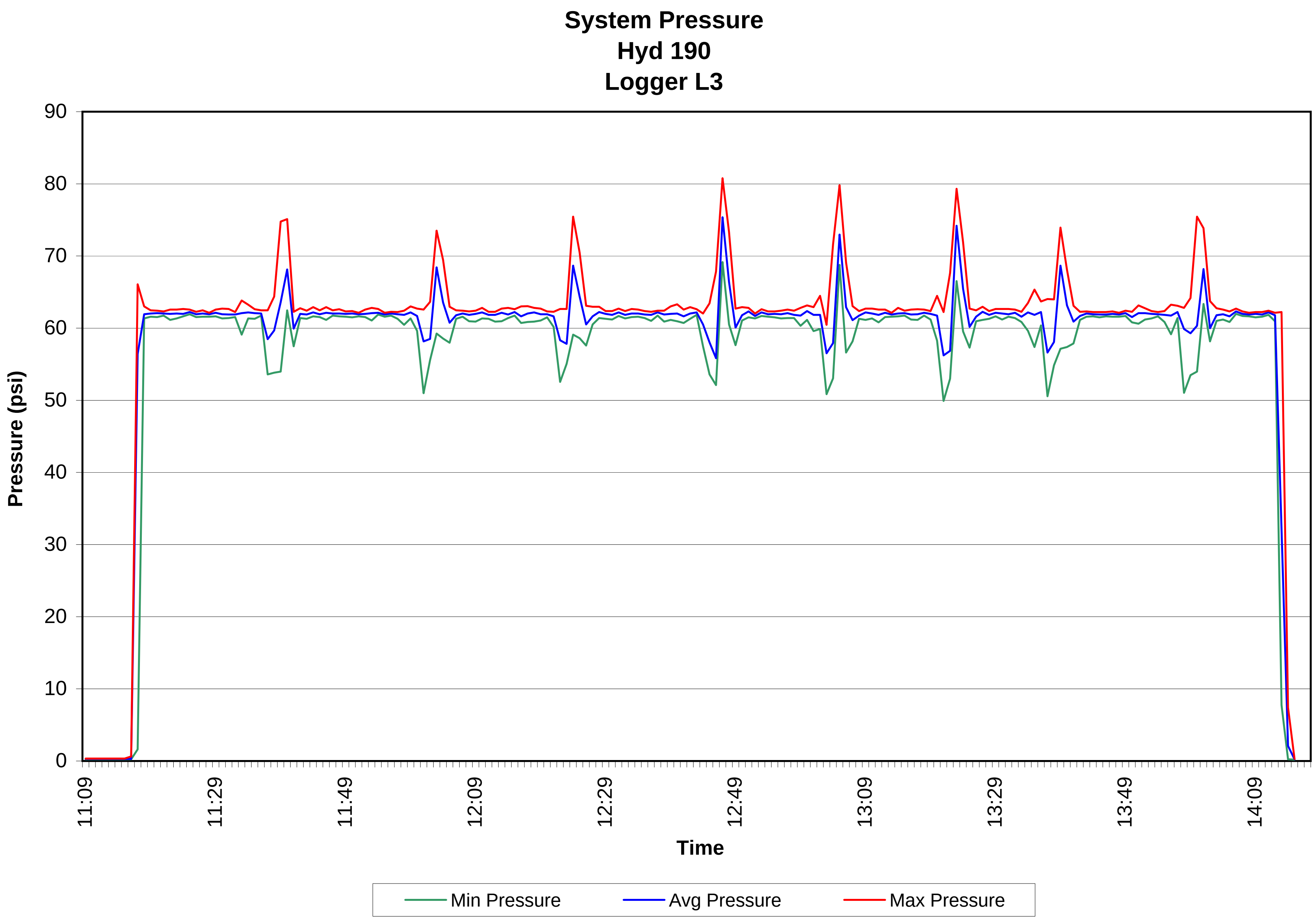
14:37
14:57
Time
Min Pressure
Avg Pressure
Max Pressure


System Pressure
Hyd 190
Logger L3
Pressure (psi)
90
80
70
60
50
40
30
20
10
0
11:09
11:29
11:49
12:09
12:29
12:49
13:09
13:29
13:49
14:09
Time
Min Pressure
Avg Pressure
Max Pressure

Fire Flow Test Report

Client Name:	Stantec	Hyd 1 - #/Port Size	2 - 2-1/2"	Flow Hyd 1 Addr.	243
Project Location:	Town of Blackfalds	Hyd 2 - #/Port Size	1 - 4"	Flow Hyd 2 Addr.	242
SFE Project #:	A13-183	Hyd 1 - Pito Types	HM - 2-1/2"	Resid Hyd Addr.	241
SFE Technicians:	Kevin McMillan	Hyd 2 - Pito Types	HM-4"	Fire Pump Status	**Auto**
	Town Staff (2)	Test Procedure	NFPA 291	(circle one)	Force On

Test ID: Figure 01 **Test :** 1 **of** 10 **Date:** 31-Oct-13

		Flow Hyd 1		**Flow Hyd 2**		**Residual Hydrant**		
Start Time	End Time	Port 1-1 psi	Port 1-2 psi	Port 2-1 psi	Port 2-2 psi	Static psi	Residual psi	Static psi
10:46	10:47	12	15			79	49	79
10:48	10:51	8	8	5		79	28	80

Notes:

Flow Summary (igpm)	
Flow 1-1	398
Flow 1-2	398
Flow 2-1	713
Flow 2-2	0
Total Flow	1509
Flow @ 20 psi	**1633**
Flow 1-1 usgpm	478
Flow 1-2 usgpm	478
Flow 2-1 usgpm	856

Flow Hydrant 1

Flow Hydrant 2

Residual Hydrant

GPS 52.36956/113.78441

GPS 52.36953/113.78605

GPS 52.36954/113.78737

Fire Flow Test Report

Client Name:	Stantec	Hyd 1 - #/Port Size	2 - 2-1/2"	Flow Hyd 1 Addr.	272
Project Location:	Town of Blackfalds	Hyd 2 - #/Port Size	1 - 4"	Flow Hyd 2 Addr.	270
SFE Project #:	A13-183	Hyd 1 - Pito Types	HM - 2-1/2"	Resid Hyd Addr.	223
SFE Technicians:	Kevin McMillan	Hyd 2 - Pito Types	HM-4"	Fire Pump Status	**Auto**
	Town Staff (2)	Test Procedure	NFPA 291	(circle one)	Force On

Test ID: Figure 02 **Test :** 2 **of** 10 **Date:** 31-Oct-13

		Flow Hyd 1		Flow Hyd 2		Residual Hydrant		
Start Time	End Time	Port 1-1 psi	Port 1-2 psi	Port 2-1 psi	Port 2-2 psi	Static psi	Residual psi	Static psi
11:35	11:36	18	8			58	48	58
11:37	11:39	8	8	5		58	35	63

Flow Summary (igpm)	
Flow 1-1	398
Flow 1-2	398
Flow 2-1	713
Flow 2-2	0
Total Flow	1509
Flow @ 20 psi	**1979**
Flow 1-1 usgpm	478
Flow 1-2 usgpm	478
Flow 2-1 usgpm	856

Notes:

Flow Hydrant 1

Flow Hydrant 2

Residual Hydrant

GPS 52.37861/113.76865

GPS 52.37852/113.76942

GPS 52.37875/113.77081

Fire Flow Test Report

Client Name:	Stantec	Hyd 1 - #/Port Size	2 - 2-1/2"	Flow Hyd 1 Addr.	264
Project Location:	Town of Blackfalds	Hyd 2 - #/Port Size	1 - 4"	Flow Hyd 2 Addr.	263
SFE Project #:	A13-183	Hyd 1 - Pito Types	HM - 2-1/2"	Resid Hyd Addr.	259
SFE Technicians:	Kevin McMillan	Hyd 2 - Pito Types	HM-4"	Fire Pump Status	**Auto**
	Town Staff (2)	Test Procedure	NFPA 291	(circle one)	Force On

Test ID: Figure 03 **Test :** 3 **of** 10 **Date:** 31-Oct-13

		Flow Hyd 1		Flow Hyd 2		Residual Hydrant		
Start Time	End Time	Port 1-1 psi	Port 1-2 psi	Port 2-1 psi	Port 2-2 psi	Static psi	Residual psi	Static psi
11:59	12:00	10	15			60	50	50
12:00	12:04	8	10	10		50	45	58

Flow Summary (igpm)	
Flow 1-1	398
Flow 1-2	445
Flow 2-1	1211
Flow 2-2	0
Total Flow	2054
Flow @ 20 psi	**5405**
Flow 1-1 usgpm	478
Flow 1-2 usgpm	534
Flow 2-1 usgpm	856

Notes: Flow hydrant 1, west 50 m from provided drawing location.

Flow Hydrant 1

Flow Hydrant 2

Residual Hydrant

GPS 52.38958/113.77501

GPS 52.38809/113.77427

GPS 52.38682/113.77399

Fire Flow Test Report

Client Name:	Stantec	Hyd 1 - #/Port Size	2 - 2-1/2"	Flow Hyd 1 Addr.	127
Project Location:	Town of Blackfalds	Hyd 2 - #/Port Size	1 - 4"	Flow Hyd 2 Addr.	147
SFE Project #:	A13-183	Hyd 1 - Pito Types	HM - 2-1/2"	Resid Hyd Addr.	176
SFE Technicians:	Kevin McMillan	Hyd 2 - Pito Types	HM-4"	Fire Pump Status	**Auto**
	Town Staff (2)	Test Procedure	NFPA 291	(circle one)	Force On

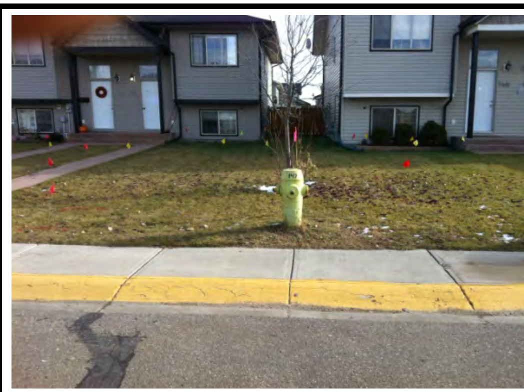
Test ID: Figure 04 **Test :** 4 **of** 10 **Date:** 31-Oct-13

		Flow Hyd 1		**Flow Hyd 2**		**Residual Hydrant**		
Start Time	End Time	Port 1-1 psi	Port 1-2 psi	Port 2-1 psi	Port 2-2 psi	Static psi	Residual psi	Static psi
12:20	12:20	15	10			55	45	55
12:21	12:23	12	10	11		55	40	59

Flow Summary (igpm)	
Flow 1-1	487
Flow 1-2	445
Flow 2-1	1211
Flow 2-2	0
Total Flow	2143
Flow @ 20 psi	**3387**
Flow 1-1 usgpm	585
Flow 1-2 usgpm	534
Flow 2-1 usgpm	1247

Notes:

Flow Hydrant 1



Flow Hydrant 2

Residual Hydrant

GPS 52.38288/113.78416

GPS 52.38387/113.78421

GPS 52.38458/113.78386

Fire Flow Test Report

Client Name:	Stantec	Hyd 1 - #/Port Size	2 - 2-1/2"	Flow Hyd 1 Addr.	123
Project Location:	Town of Blackfalds	Hyd 2 - #/Port Size	1 - 4"	Flow Hyd 2 Addr.	122
SFE Project #:	A13-183	Hyd 1 - Pito Types	HM - 2-1/2"	Resid Hyd Addr.	121
SFE Technicians:	Kevin McMillan	Hyd 2 - Pito Types	HM-4"	Fire Pump Status	**Auto**
	Town Staff (2)	Test Procedure	NFPA 291	(circle one)	Force On

Test ID: Figure 05 **Test :** 5 **of** 10 **Date:** 31-Oct-13

		Flow Hyd 1		**Flow Hyd 2**		**Residual Hydrant**		
Start Time	End Time	Port 1-1 psi	Port 1-2 psi	Port 2-1 psi	Port 2-2 psi	Static psi	Residual psi	Static psi
12:42	12:43	15	10			59	54	59
12:44	12:46	12	10	11		59	44	65

Flow Summary (igpm)	
Flow 1-1	487
Flow 1-2	445
Flow 2-1	1211
Flow 2-2	0
Total Flow	2143
Flow @ 20 psi	**3590**
Flow 1-1 usgpm	585
Flow 1-2 usgpm	534
Flow 2-1 usgpm	1247

Notes:

Flow Hydrant 1

Flow Hydrant 2

Residual Hydrant

GPS 52.38111/113.78897

GPS 52.38024/113.78938

GPS 52.37951/113.78973

Fire Flow Test Report

Client Name:	Stantec	Hyd 1 - #/Port Size	2 - 2-1/2"	Flow Hyd 1 Addr.	85	
Project Location:	Town of Blackfalds	Hyd 2 - #/Port Size	1 - 4"	Flow Hyd 2 Addr.	86	
SFE Project #:	A13-183	Hyd 1 - Pito Types	HM - 2-1/2"	Resid Hyd Addr.	87	
SFE Technicians:	Kevin McMillan	Hyd 2 - Pito Types	HM-4"	Fire Pump Status	**Auto**	
	Town Staff (2)	Test Procedure	NFPA 291	(circle one)	Force On	

Test ID: Figure 06 **Test :** 6 **of** 10 **Date:** 31-Oct-13

		Flow Hyd 1		**Flow Hyd 2**		**Residual Hydrant**		
Start Time	End Time	Port 1-1 psi	Port 1-2 psi	Port 2-1 psi	Port 2-2 psi	Static psi	Residual psi	Static psi
13:00	13:01	15	12			54	45	54
13:02	13:03	12	10	11		54	43	62

Flow Summary (igpm)	
Flow 1-1	545
Flow 1-2	445
Flow 2-1	1211
Flow 2-2	0
Total Flow	2201
Flow @ 20 psi	**4048**
Flow 1-1 usgpm	654
Flow 1-2 usgpm	534
Flow 2-1 usgpm	1247

Notes:

Flow Hydrant 1

Flow Hydrant 2

Residual Hydrant

GPS 52.38579/113.79540

GPS 52.38691/113.79551

GPS 52.38779/113.79554

Fire Flow Test Report

Client Name:	Stantec	Hyd 1 - #/Port Size	2 - 2-1/2"	Flow Hyd 1 Addr.	10
Project Location:	Town of Blackfalds	Hyd 2 - #/Port Size	1 - 4"	Flow Hyd 2 Addr.	11
SFE Project #:	A13-183	Hyd 1 - Pito Types	HM - 2-1/2"	Resid Hyd Addr.	12
SFE Technicians:	Kevin McMillan	Hyd 2 - Pito Types	HM-4"	Fire Pump Status	**Auto**
	Town Staff (2)	Test Procedure	NFPA 291	(circle one)	Force On

Test ID: Figure 07 **Test :** 7 **of** 10 **Date:** 31-Oct-13

		Flow Hyd 1		Flow Hyd 2		Residual Hydrant		
Start Time	End Time	Port 1-1 psi	Port 1-2 psi	Port 2-1 psi	Port 2-2 psi	Static psi	Residual psi	Static psi
13:18	13:19	12	10			57	45	57
13:20	13:22	12	10	11		57	38	65

Flow Summary (igpm)	
Flow 1-1	487
Flow 1-2	445
Flow 2-1	1211
Flow 2-2	0
Total Flow	2143
Flow @ 20 psi	**3071**
Flow 1-1 usgpm	585
Flow 1-2 usgpm	534
Flow 2-1 usgpm	1247

Notes:

Flow Hydrant 1

Flow Hydrant 2

Residual Hydrant

GPS 52.38293/113.80345

GPS 52.38291/113.80236

GPS 52.38290/113.80109

Fire Flow Test Report

Client Name:	Stantec	Hyd 1 - #/Port Size	2 - 2-1/2"	Flow Hyd 1 Addr.	51
Project Location:	Town of Blackfalds	Hyd 2 - #/Port Size	1 - 4"	Flow Hyd 2 Addr.	50
SFE Project #:	A13-183	Hyd 1 - Pito Types	HM - 2-1/2"	Resid Hyd Addr.	49
SFE Technicians:	Kevin McMillan	Hyd 2 - Pito Types	HM-4"	Fire Pump Status	**Auto**
	Town Staff (2)	Test Procedure	NFPA 291	(circle one)	Force On

Test ID: Figure 08 **Test :** 8 **of** 10 **Date:** 31-Oct-13

		Flow Hyd 1		**Flow Hyd 2**		**Residual Hydrant**		
Start Time	End Time	Port 1-1 psi	Port 1-2 psi	Port 2-1 psi	Port 2-2 psi	Static psi	Residual psi	Static psi
13:34	13:35	15	15			59	50	59
13:35	13:38	14	14	14		59	42	62

Flow Summary (igpm)	
Flow 1-1	526
Flow 1-2	526
Flow 2-1	1211
Flow 2-2	0
Total Flow	2264
Flow @ 20 psi	**3545**
Flow 1-1 usgpm	632
Flow 1-2 usgpm	632
Flow 2-1 usgpm	1407

Notes:

Flow Hydrant 1

Flow Hydrant 2

Residual Hydrant

GPS 52.37544/113.81053

GPS 52.37564/113.80983

GPS 52.37551/113.80733

Fire Flow Test Report

Client Name:	Stantec	Hyd 1 - #/Port Size	2 - 2-1/2"	Flow Hyd 1 Addr.	57
Project Location:	Town of Blackfalds	Hyd 2 - #/Port Size	1 - 4"	Flow Hyd 2 Addr.	56
SFE Project #:	A13-183	Hyd 1 - Pito Types	HM - 2-1/2"	Resid Hyd Addr.	55
SFE Technicians:	Kevin McMillan	Hyd 2 - Pito Types	HM-4"	Fire Pump Status	**Auto**
	Town Staff (2)	Test Procedure	NFPA 291	(circle one)	Force On

Test ID: Figure 09 **Test :** 9 **of** 10 **Date:** 31-Oct-13

		Flow Hyd 1		Flow Hyd 2		Residual Hydrant		
Start Time	End Time	Port 1-1 psi	Port 1-2 psi	Port 2-1 psi	Port 2-2 psi	Static psi	Residual psi	Static psi
13:56	13:57	15	15			55	48	55
13:58	13:59	14	14	14		55	40	70

Flow Summary (igpm)	
Flow 1-1	545
Flow 1-2	545
Flow 2-1	1211
Flow 2-2	0
Total Flow	2301
Flow @ 20 psi	**3635**
Flow 1-1 usgpm	654
Flow 1-2 usgpm	654
Flow 2-1 usgpm	1407

Notes:


Flow Hydrant 1


Flow Hydrant 2


Residual Hydrant

GPS 52.38248/113.81501

GPS 52.38125/113.81496

GPS 52.38006/113.81496

Fire Flow Test Report

Client Name:	Stantec	Hyd 1 - #/Port Size	2 - 2-1/2"	Flow Hyd 1 Addr.	192
Project Location:	Town of Blackfalds	Hyd 2 - #/Port Size	1 - 4"	Flow Hyd 2 Addr.	191
SFE Project #:	A13-183	Hyd 1 - Pito Types	HM - 2-1/2"	Resid Hyd Addr.	190
SFE Technicians:	Kevin McMillan	Hyd 2 - Pito Types	HM-4"	Fire Pump Status	**Auto**
	Town Staff (2)	Test Procedure	NFPA 291	(circle one)	Force On

Test ID: Figure 10 **Test :** 10 **of** 10 **Date:** 31-Oct-13

		Flow Hyd 1		Flow Hyd 2		Residual Hydrant		
Start Time	End Time	Port 1-1 psi	Port 1-2 psi	Port 2-1 psi	Port 2-2 psi	Static psi	Residual psi	Static psi
14:17	14:18	15	10			61	55	61
14:19	14:21	5	5	5		61	50	60

Flow Summary (igpm)	
Flow 1-1	314
Flow 1-2	314
Flow 2-1	1211
Flow 2-2	0
Total Flow	1839
Flow @ 20 psi	**3742**
Flow 1-1 usgpm	377
Flow 1-2 usgpm	377
Flow 2-1 usgpm	856

Notes:

Flow Hydrant 1

Flow Hydrant 2

Residual Hydrant

GPS 52.39404/113.80215

GPS 52.39330/113.80178

GPS 52.39227/113.80079