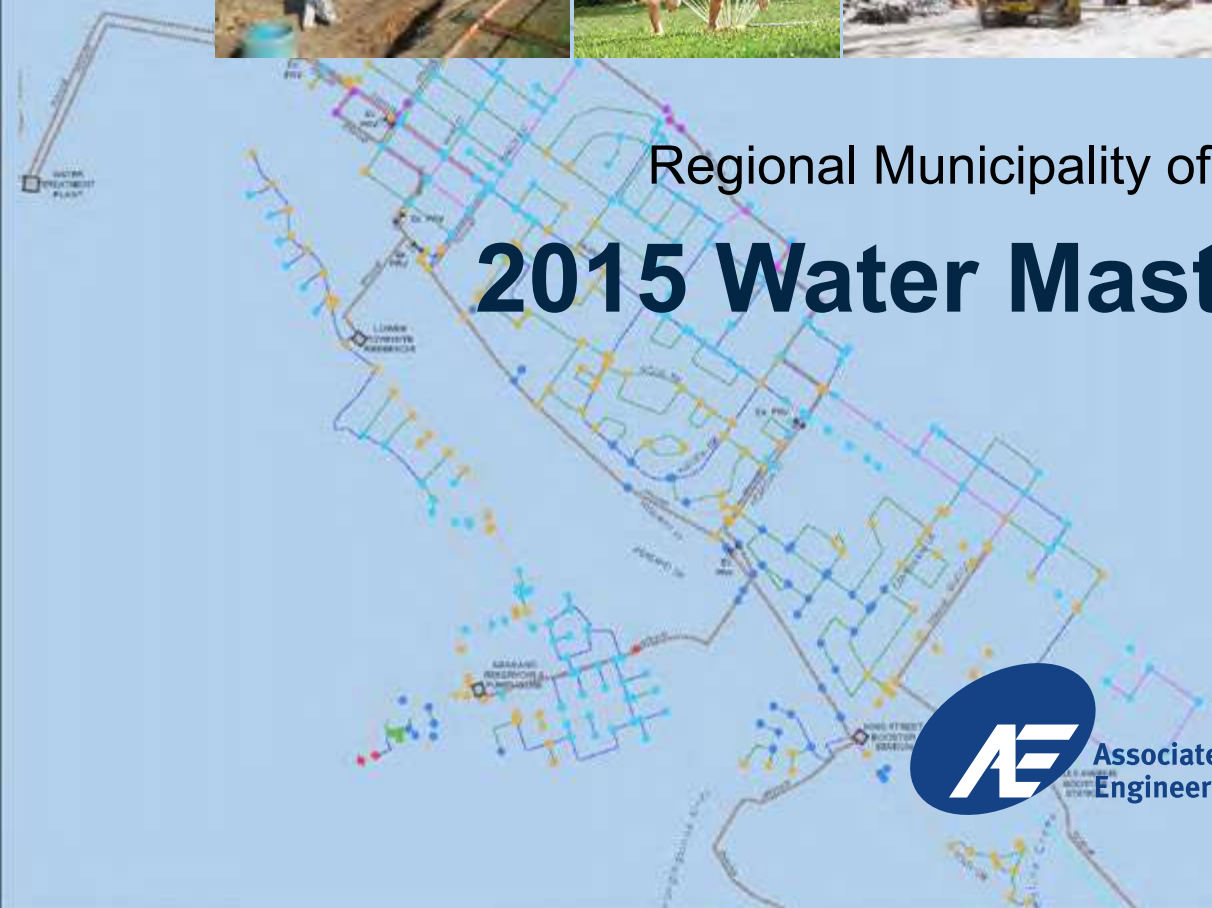
Regional Municipality of Wood Buffalo

October 2015

Regional Municipality of Wood Buffalo

2015 Water Master Plan



Associated Engineering

GLOBAL PERSPECTIVE. LOCAL FOCUS.

Executive Summary

The Regional Municipality of Wood Buffalo (the Municipality) is experiencing rapid growth due to resource activity in the area. Associated Engineering was retained to update the 2011 Water Master Plan and incorporate subsequent amendments to the plan. This 2015 Water Master Plan assesses the existing Fort McMurray and area water system capacity to determine the upgrading requirements in order to accommodate the anticipated growth.

The purpose of the 2015 Water Master Plan is to:

- Review and document the existing water distribution system.
- Study the impact of existing and future demands on the existing water system.
- Recommend necessary upgrades to meet existing and future demands.
- Provide an implementation strategy and cost estimates for the proposed upgrades.

The 2015 Master Plan will assist the Municipality to:

- Provide safe, effective and efficient supply of water.
- Co-ordinate infrastructure with development planning.
- Anticipate future growth to minimize “re-work”.
- Assist with urban infrastructure rehabilitation program development.
- Develop short and long term capital budgets.

The Municipality’s Municipal Development Plan (MDP) October, 2011, identifies the Vision Statement “A balanced future with opportunity for all.” The 2015 Water Master Plan meets this vision, and addresses a number of the goals identified within the MDP, by incorporating the following:

- Addressing servicing future land for both residential and commercial/industrial land uses, to support communities and promote economic development.
- Encouraging responsible investment in municipal infrastructure through identifying long term solutions and allowing for flexible future development and system operation.

The 2015 Water Master Plan provides for a high standard of safe and reliable water to address the community’s needs and requirements.

The envisioned Ultimate Expansion Area is presented in **Figure ES1-1**. It identifies existing and future development areas (as well as long term expansion areas) in addition to the water supply infrastructure which will be required to support the ultimate service area. The figure identifies future facilities including a new Water Treatment Plant, future reservoir and pumphouses, supply mains, etc. These facilities will

service new lands, but will also work toward creating a robust system with multiple supply possibilities to provide increasing resiliency for the areas over time.

A brief cost summary is provided below which includes existing system upgrades as well as water mains 400 mm in diameter and larger in future development/expansion areas. Additional information can be found within this report. **Figures ES 1-3** and **ES 1-4** identify the estimated short term (0-5 year) costs for existing development areas as well as short term supply costs.

		Short Term (0 – 5 Years)	Long Term (Ultimate)
	SHORT TERM (0-5 YEARS)	**MEDIUM TERM (5-15 YEARS)**	**LONG TERM (ULTIMATE)**
South Service Area:			
• Supply Lines	$ 80,857,000	$ 45,649,000	$ -
• Reservoir and Pumphouse	$ 30,450,000	$ -	$ 70,500,000
• Distribution System	$ 91,917,000	$ 86,477,000	$120,990,000
Total South Service Area	**$209,224,000**	**$132,126,000**	**$191,490,000**
North Service Area:			
• Supply Lines	$163,457,000	$ -	$ 44,308,000
• Reservoir and Pumphouse	$ 25,000,000	$ -	$ 70,000,000
• Distribution System	$ 43,246,000	$ 62,212,000	$100,683,000
Total North Service Area	**$231,704,000**	**$ 62,212,000**	**$214,991,000**
Future Southwest Service Area:			
• Supply Lines	$135,950,000	$ 69,045,000	$114,920,000
• Reservoir and Pumphouse	$ 88,000,000	$ 46,000,000	$ 58,000,000
• Distribution System	$ 1,791,000	$ 33,757,000	$ 59,227,000
• Future WTP	$ -	$255,000,000	$ 75,000,000
Total Future Southwest Service Area	**$225,741,000**	**$403,802,000**	**$307,147,000**
TOTAL PROPOSED UPGRADES/EXPANSION	**$666,668,000**	**$598,139,000**	**$713,628,000**

TO FORT MACKAY
PARSONS CREEK
TO WEST GROWTH
TO HWY CORRIDOR
HWY 63 CORRIDOR
FOREST HEIGHTS
TIMBERLEA
WEST GROWTH
ABRAMS LAND
THICKWOOD
FOREST HEIGHTS
Athabasca River
LOWER TOWNSITE
ABASAND
BEACON HILL
WATERWAYS
HORSE RIVER
QUARRY RIDGE
Clearwater River
DRAPER VALLEY
MACKENZIE
SALINE CREEK
HANGINGSTONE
HORSE RIVER SOUTH
SOUTHLANDS AREA 4
AIRPORT WEST INDUSTRIAL
AIRPORT LANDS
SAPRAE CREEK/ SPRUCE VALLEY
AIRPORT EAST INDUSTRIAL
ECO-INDUSTRIAL AND LANDFILL AREA
LYNTON
HANGINGSTONE SOUTH
SOUTHLANDS AREA 2
TO GREGOIRE LAKE ESTATES, GREGOIRE LAKE FIRST NATION, & ANZAC
HANGINGSTONE SOUTH
SOUTHLANDS AREA 1A
SOUTHLANDS AREA 1B

Associated Engineering

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Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN

ULTIMATE EXPANSION AREA SERVICING

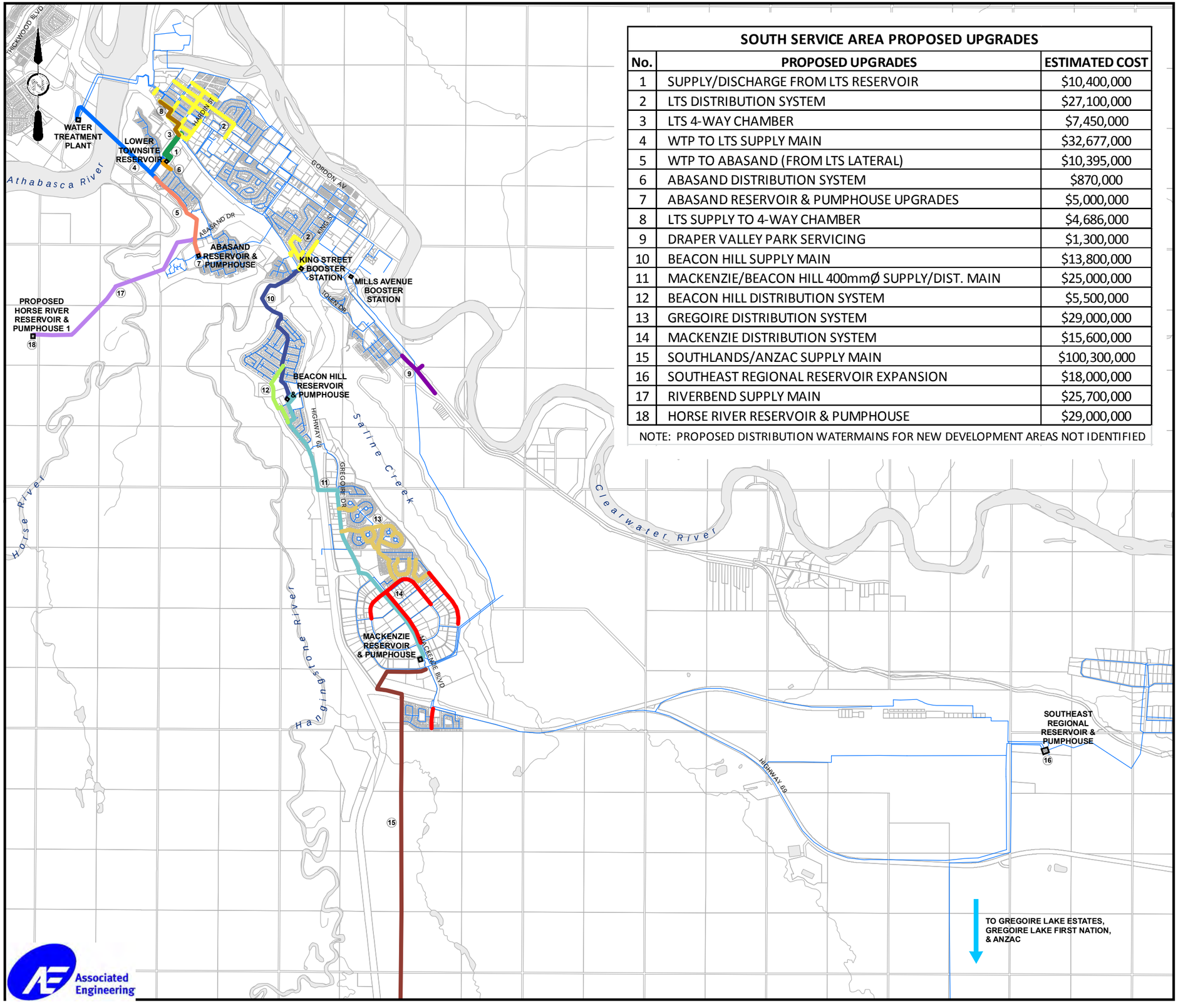
LEGEND:

- EXISTING DEVELOPMENT
- PROPOSED DEVELOPMENT
- FUTURE EXPANSION
- EXISTING HIGHWAY/ TRANSPORTATION CORRIDOR
- FUTURE HIGHWAY/TRANSPORTATION CORRIDOR CONCEPT
- EXISTING SUPPLY LINE
- FUTURE SUPPLY LINE
- FUTURE DISTRIBUTION LINE
- EXISTING RESERVOIR/PUMPHOUSE OR BOOSTER STATION
- EXISTING WATER TREATMENT PLANT
- FUTURE RESERVOIR/PUMPHOUSE OR BOOSTER STATION
- FUTURE WATER TREATMENT PLANT

SCALE 1:100,000

OCTOBER 2015

FIGURE ES 1-1



SOUTH SERVICE AREA PROPOSED UPGRADES

No.	PROPOSED UPGRADES	ESTIMATED COST
1	SUPPLY/DISCHARGE FROM LTS RESERVOIR	$10,400,000
2	LTS DISTRIBUTION SYSTEM	$27,100,000
3	LTS 4-WAY CHAMBER	$7,450,000
4	WTP TO LTS SUPPLY MAIN	$32,677,000
5	WTP TO ABASAND (FROM LTS LATERAL)	$10,395,000
6	ABASAND DISTRIBUTION SYSTEM	$870,000
7	ABASAND RESERVOIR & PUMPHOUSE UPGRADES	$5,000,000
8	LTS SUPPLY TO 4-WAY CHAMBER	$4,686,000
9	DRAPER VALLEY PARK SERVICING	$1,300,000
10	BEACON HILL SUPPLY MAIN	$13,800,000
11	MACKENZIE/BEACON HILL 400mmØ SUPPLY/DIST. MAIN	$25,000,000
12	BEACON HILL DISTRIBUTION SYSTEM	$5,500,000
13	GREGOIRE DISTRIBUTION SYSTEM	$29,000,000
14	MACKENZIE DISTRIBUTION SYSTEM	$15,600,000
15	SOUTHLANDS/ANZAC SUPPLY MAIN	$100,300,000
16	SOUTHEAST REGIONAL RESERVOIR EXPANSION	$18,000,000
17	RIVERBEND SUPPLY MAIN	$25,700,000
18	HORSE RIVER RESERVOIR & PUMPHOUSE	$29,000,000

NOTE: PROPOSED DISTRIBUTION WATERMAINS FOR NEW DEVELOPMENT AREAS NOT IDENTIFIED

Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN

PROPOSED UPGRADES (0 TO 5 YEARS) SOUTH SERVICE AREA EXISTING DEVELOPMENT

LEGEND:

- EXISTING WATERMAIN
- 1 - SUPPLY/DISCHARGE FROM LTS RESERVOIR
- 2 - LTS DISTRIBUTION SYSTEM
- 4 - WTP TO LTS SUPPLY MAIN
- 5 - WTP TO ABASAND (FROM LTS LATERAL)
- 6 - ABASAND DISTRIBUTION SYSTEM
- 8 - LTS SUPPLY TO 4-WAY CHAMBER
- 9 - DRAPER VALLEY PARK SERVICING
- 10 - BEACON HILL SUPPLY MAIN
- 11 - MACKENZIE/BEACON HILL 400mmØ SUPPLY/DIST. MAIN
- 12 - BEACON HILL DISTRIBUTION SYSTEM
- 13 - GREGOIRE DISTRIBUTION SYSTEM
- 14 - MACKENZIE DISTRIBUTION SYSTEM
- 15 - SOUTHLANDS/ANZAC SUPPLY MAIN
- 17 - RIVERBEND SUPPLY MAIN

SCALE 1:50,000

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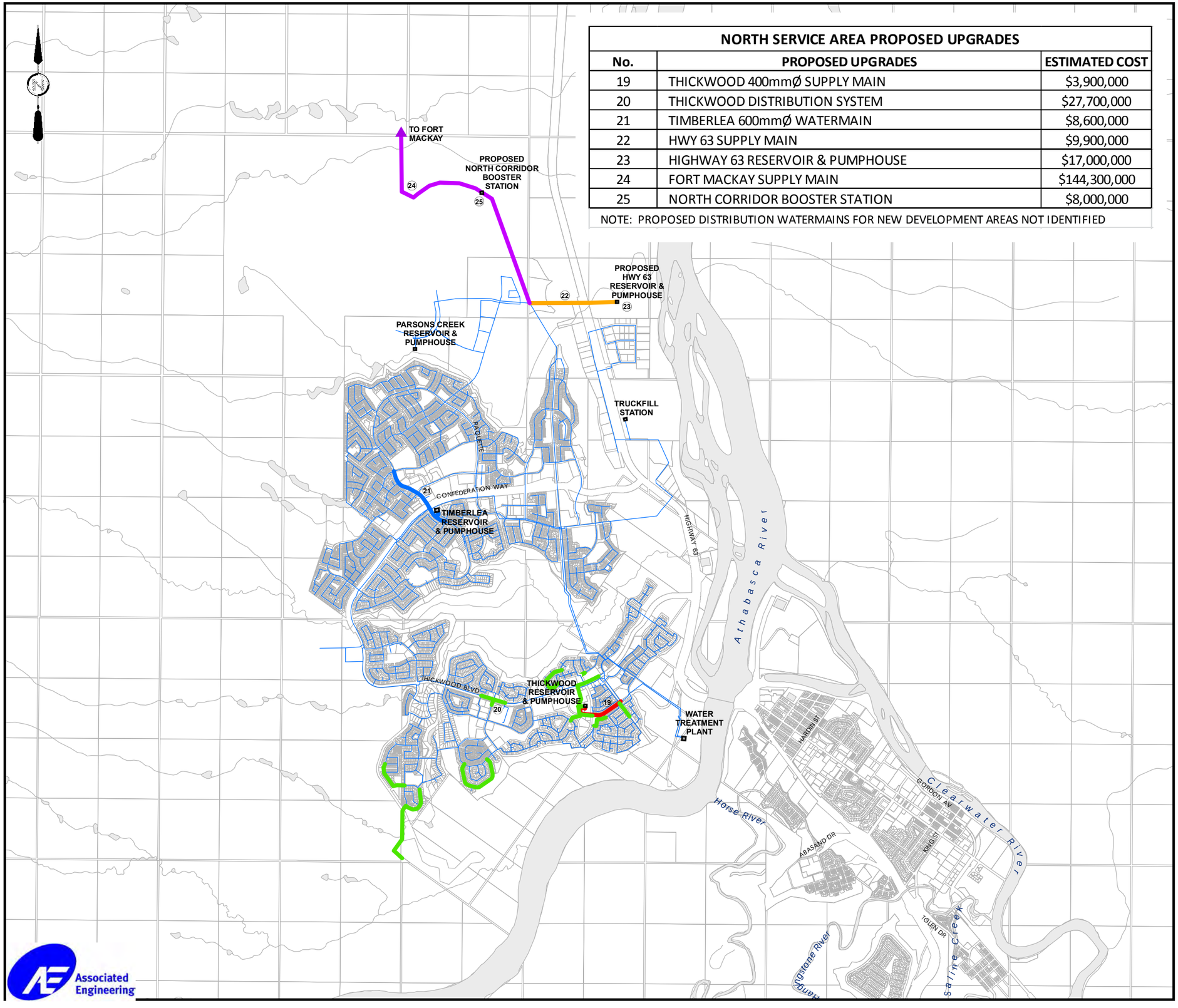
FIGURE ES 1-2

NORTH SERVICE AREA PROPOSED UPGRADES		
No.	**PROPOSED UPGRADES**	**ESTIMATED COST**
19	THICKWOOD 400mmØ SUPPLY MAIN	$3,900,000
20	THICKWOOD DISTRIBUTION SYSTEM	$27,700,000
21	TIMBERLEA 600mmØ WATERMAIN	$8,600,000
22	HWY 63 SUPPLY MAIN	$9,900,000
23	HIGHWAY 63 RESERVOIR & PUMPHOUSE	$17,000,000
24	FORT MACKAY SUPPLY MAIN	$144,300,000
25	NORTH CORRIDOR BOOSTER STATION	$8,000,000

NOTE: PROPOSED DISTRIBUTION WATERMAINS FOR NEW DEVELOPMENT AREAS NOT IDENTIFIED



REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

PROPOSED UPGRADES (0 TO 5 YEARS) NORTH SERVICE AREA EXISTING DEVELOPMENT

LEGEND:

- EXISTING WATERMAIN
- 19 - THICKWOOD 400mmØ SUPPLY MAIN
- 20 - THICKWOOD DISTRIBUTION SYSTEM
- 21 - TIMBERLEA 600mmØ WATERMAIN
- 22 - HWY 63 SUPPLY MAIN
- 24 - FORT MACKAY SUPPLY MAIN

SCALE 1:50,000

OCTOBER 2015

FIGURE ES 1-3

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1 Introduction

In 2011, the Regional Municipality of Wood Buffalo (the Municipality) adopted a comprehensive Water Master Plan (WMP) to assess the water distribution system requirements and identify future growth scenarios within the urban and connected rural service areas. The document was utilized to guide development on initiation of a number of capital projects. The Municipality identified two significant supply system revisions through preliminary design of two projects that led to this update, as outlined below.

- In February 2013, Associated Engineering undertook an amendment to the Water Master Plan in order to incorporate a revision to the supply system concept in the Lower Townsite (LTS) as well as the increased growth projections for the LTS (Amendment A).

- The Municipality identified additional routing and redundancy options to be considered during the preliminary design of the Southwest Supply Line in 2012, which resulted in several supply options for various routing and pipe scenarios. These were discussed and refined with the Municipality during a series of workshops which took place throughout 2013. The final revised concept included an alternative supply line alignment from the existing WTP. This provides additional redundancy and an advancement of a new WTP in the southwest in order to minimize the short term requirement and pipe oversizing across the river. Subsequently, the Municipality directed Associated Engineering to undertake a second amendment to the Water Master Plan to incorporate the proposed revisions to the southwest supply system concept (Amendment B). The final draft version was completed in March 2014.

A workshop was held in February, 2014 in order to review the concepts presented within the 2011 Water Master Plan and subsequent amendments. The Municipality determined that it would be beneficial to incorporate the amendments into an update within this current 2015 Water Master Plan.

The purpose of the 2015 Water Master Plan is to:

- Review and document the existing water distribution system.
- Study the impact of existing and future demands on the existing water system.
- Recommend the necessary upgrades to meet existing and future demands.
- Provide an implementation strategy and cost estimates for the proposed upgrades.

The Master Plan will assist the Municipality to:

- Provide safe, effective and efficient supply of water.
- Co-ordinate infrastructure with development planning.
- Anticipate future growth to minimize “re-work”.
- Assist with urban infrastructure rehabilitation program development.
- Develop short and long term capital budgets.

The Municipality's Municipal Development Plan (MDP), October, 2011, identifies the Vision Statement "A balanced future with opportunity for all." The 2015 Water Master Plan meets this vision, and addresses a number of the goals identified within the MDP. The 2015 Water Master Plan:

- Addresses servicing future land for both residential and commercial/industrial land uses, to support communities and promote economic development.
- Encourage responsible investment in municipal infrastructure through identifying long term solutions and allowing for flexible future development and system operation.
- Provides for a high standard of safe and reliable water to address the community's needs and requirements.

1.1 STUDY AREA

Figure 1-1 identifies the study area which has been assessed, and includes both existing and future development areas. Figure 1-2 illustrates the service areas and identifies existing and future development areas. The water system within the study area is currently comprised of a North Service Area and a South Service Area. A Future Southwest Area is proposed to comprise future development areas located in the west and south of the existing South Service Area. The following identifies existing and future areas (or developments) within each of the service areas:

1.1.1 South Service Area

- Lower Townsite
- Abasand
- Waterways
- Beacon Hill
- Saline Creek
- Gregoire
- Gateway
- Quarry Ridge
- Prairie Creek
- MacKenzie Industrial Park
- Airport Lands
- Airport West and East Industrial
- Saprae Creek, Spruce Valley, Lynton
- Highway 69 Corridor
- Anzac, Gregoire Lake First Nations, Gregoire Lake Provincial Park and Gregoire Lake Estates
- Southland Areas 2 and 4

1.1.2 North Service Area

- Thickwood
- Timberlea
- Highway 63 Industrial Corridor and Truckfill Station
- Parsons Creek
- West Growth
- Abrams Lands
- Fort MacKay / North Transmission Line

1.1.3 Future Southwest Service Area

- Horse River
- Hangingstone
- Southland Areas 1A & B
- Highway 881/63
- Future Anzac expansion

1.2 ACKNOWLEDGEMENTS

Associated Engineering Alberta Ltd. respectfully acknowledges the assistance provided by the Municipality administrative and operating staff. Several individuals have provided input during various workshop sessions and have contributed to the future system concept development.

1.3 REFERENCE REPORTS

Reference may be made to the following reports:

- Regional Municipality of Wood Buffalo – South East 881 Water Supply Line Constructability Review/Preliminary Review, May 2015, MMM Group.
- Regional Municipality of Wood Buffalo – Fort MacKay Water Treatment Plant, Water Supply & Feasibility Study, October 2012, Associated Engineering.
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- Regional Municipality of Wood Buffalo, Draft Water Master Plan - Amendment B (Southwest Supply Line Revision), March 2014, Associated Engineering Alberta Ltd.
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- Regional Municipality of Wood Buffalo, King Street Booster Pumphouse Relocation Feasibility Study Final Report, February 2009, AECOM.
- Regional Municipality of Wood Buffalo, Fort McMurray Regional Airport proposed New Airport Passenger Terminal Building Preliminary Master Report, 2009 Draft Report, Pryde Schropp McComb Inc.
- Regional Municipality of Wood Buffalo, Lower Townsite Area Redevelopment Plan, A Place for Revitalizing the Heart of the Region, 2009, By-Law #09/016.
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- Regional Municipality of Wood Buffalo, South Urban System Water Supply Network Analysis, December 2006, UMA Engineering Ltd.
- Regional Municipality of Wood Buffalo, 2010 Lower Townsite Projects Franklin Avenue revitalization Phase 2 and 3 Draft Preliminary Design Report, November 2010, Associated Engineering
- Regional Municipality of Wood Buffalo, Airport Sanitary Servicing Draft Report, October 2010, Associated Engineering
- Regional Municipality of Wood Buffalo, Urban Service Area Wastewater Master Plan, October 2009, Stantec Consulting Ltd.

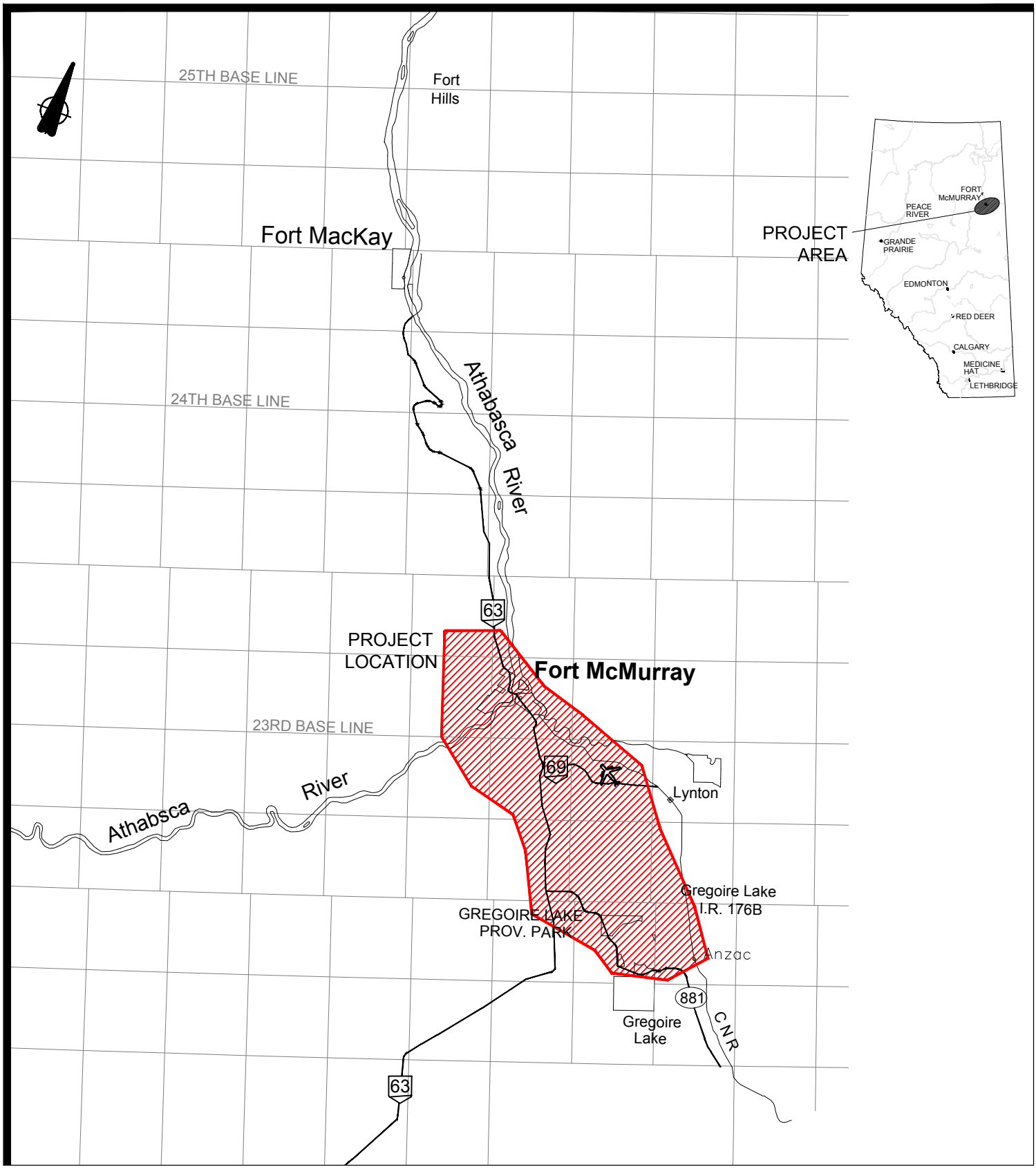
- Regional Municipality of Wood Buffalo, Parsons Creek Water Distribution System Model Draft Report, November 2010, Stantec Consulting Ltd.
- Regional Municipality of Wood Buffalo, Southeast Regional Water Supply Line Pre-Design Report, May 2003, Associated Engineering
- Regional Municipality of Wood Buffalo, MacKenzie Park Reservoir and Pumphouse Pre-Design Report, September 2006, UMA Engineering Ltd.
- Regional Municipality of Wood Buffalo, Beacon Hill Reservoir and Pumphouse Pre-Design Report, February 2009, AECOM Canada Ltd.
- Regional Municipality of Wood Buffalo, Thickwood Heights New Proposed Pumphouse Pre-Design Report, August 2004, UMA
- Regional Municipality of Wood Buffalo, Waterways/Draper Road Future Servicing Draft Report, March 2011, Associated Engineering

1.4 ABBREVIATIONS

AC	asbestos cement
AEP	Alberta Environment and Parks
Ha	hectare
km	kilometre
L/s	Litres per second
L	Litre
L/c/d	Litres per capita per day
m	metre
m/s	metres per second
m^3 /s	cubic metres per second
m^3	cubic metres
mm	millimetre
PRV	pressure reducing valve
psi	pounds per square inch
PVC	polyvinyl chloride
HDPE	high density polyethylene
DI	ductile iron
CA	cast iron
AEAL	Associated Engineering Alberta Ltd.
USGPM	United States Gallons per Minute

1.5 METRIC CONVERSIONS

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



REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

STUDY AREA

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FIGURE 1-1

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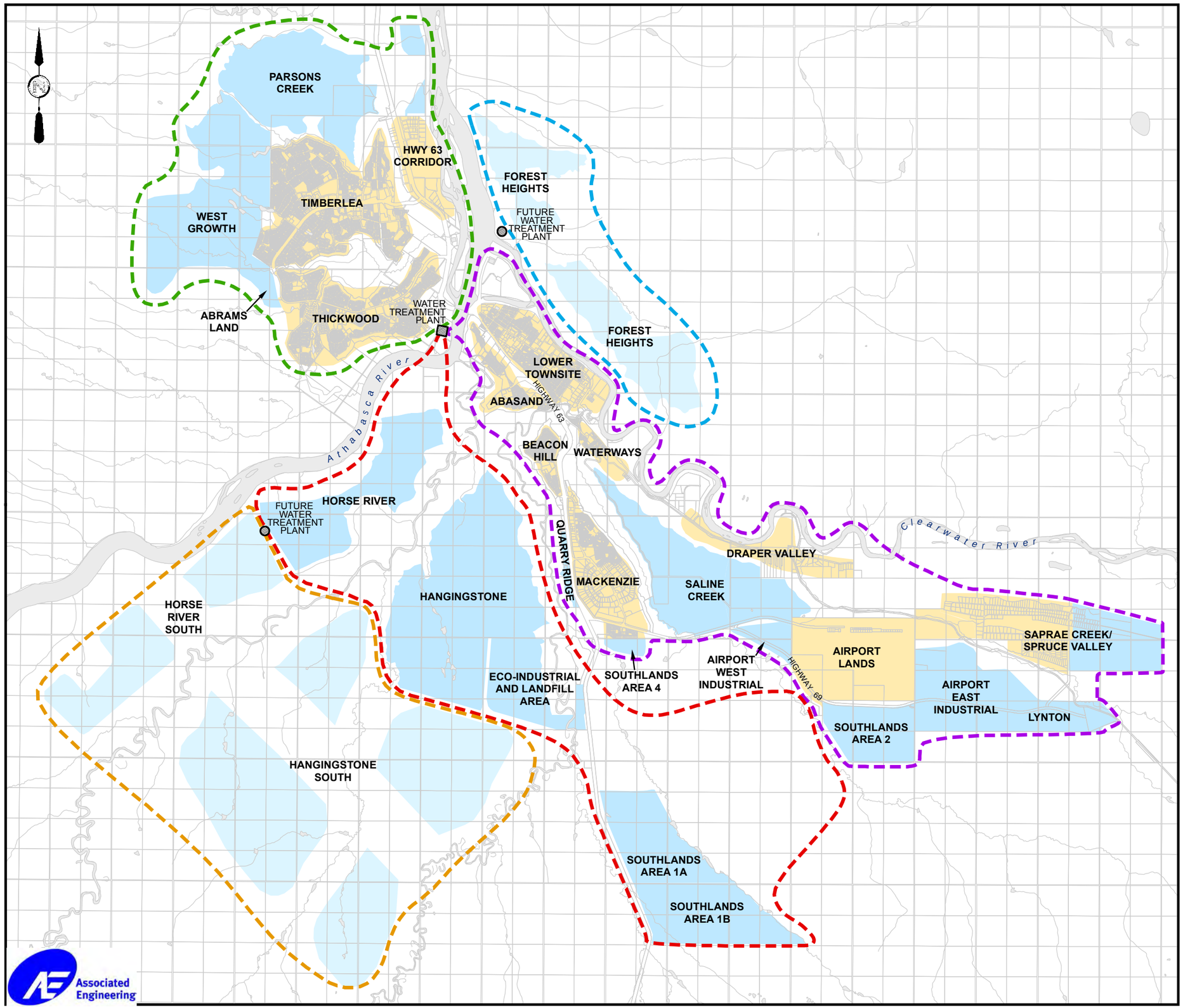

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

SERVICE AREAS

LEGEND:

- EXISTING DEVELOPMENT
- PROPOSED DEVELOPMENT
- FUTURE EXPANSION
- NORTH SERVICE AREA
- SOUTH SERVICE AREA
- FUTURE SOUTHWEST SERVICE AREA
- FUTURE NORTHEAST SERVICE AREA
- FUTURE SOUTHWEST EXPANSION SERVICE AREA

SCALE 1:100,000

OCTOBER 2015

FIGURE 1-2

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2 Design Criteria

2.1 REFERENCES

The design criteria adopted has been developed based on the following information:

- Technical Memorandum A.1.5 – Regional Municipality of Wood Buffalo - Urban Development Sub-Region Population Projection Technical Memorandum, by Associated Engineering, January 2014;
- Regional Municipality of Wood Buffalo – Engineering Servicing Standards and Development Procedures, 2013; and
- Alberta Environment and Parks (AEP) Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, April 2012.

2.2 POPULATION

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

- Determine the quantity of water consumed;
- Impact the peaking factor; and
- Impact the size of the distribution system (based on population density).

The current and projected population has been based on *Technical Memorandum A.1.5 Urban Development Sub-Region Population Projection Technical Memorandum, by Associated Engineering, January 2014*.

Table 2-1 presents the Design Projected Residential Population for the entire service area for 2013 through to the Ultimate development scenario. Information regarding projected populations for the Gregoire Lake First Nations has been based on the *Regional Municipality of Wood Buffalo – Southeast Regional Water Supply Line Pre-design Report, Associated Engineering, May 2003*.

The population projections presented in **Table 2-1** represent a 5% growth rate applied annually, as presented in the Urban Development Sub-Region Population Projection Technical Memorandum.

Table 2-1
Design Projected Residential Population[1]

LOCATION	YEAR					
	2013	2018	2023	2028	2033	ULTIMATE
SOUTH SERVICE AREA						
Lower Townsite Service Area						
Lower Townsite[2] + Shadow Pop	12,800	16,100	19,500	23,100	26,900	48,000
Waterways	800	1,000	1,100	1,300	1,500	2,700
Draper	200	300	300	300	400	400
Abasand Service Area						
Abasand	5,200	5,400	5,600	5,800	6,000	6,000
Beacon Hill Service Area						
Beacon Hill	2,200	2,300	2,600	2,600	2,600	2,600
MacKenzie Service Area						
MacKenzie/Gregoire/Prairie Creek	5,000	6,300	7,300	8,400	8,650	8,650
Saline Creek Plateau	0	3,000	4,500	6,000	7,500	20,000
Southeast Industrial Service Area						
Saprae Creek/Spruce Valley	900	1,500	1,900	2,400	2,900	5,000
Anzac Regional Pipeline						
Hamlet of Anzac[3, 4]	875	1,064	1,251	1,571	1,902	5,000
Gregiore Lake Estates[3]	255	264	274	290	303	303
Gregiore Lake First Nations[3]	390	465	540	615	690	990
Total South Service Area	**28,620**	**37,693**	**44,865**	**52,376**	**59,345**	**99,643**
NORTH SERVICE AREA						
Timberlea	33,500	39,400	42,000	42,000	42,000	42,000
Thickwood	17,500	19,200	19,200	19,200	19,200	19,200
Parson's Creek	0	5,000	7,500	10,000	12,500	26,000
West Growth	0	0	0	2,000	3,000	31,000
Fort MacKay/North Transmission Line[6]			1,360	1,620	1,865	2,250
Total North Service Area	**51,000**	**63,600**	**70,060**	**74,820**	**78,565**	**120,450**
SOUTHWEST SERVICE AREA						
Horse River	0	0	1,600	2,500	4,300	15,000
Hangingstone	0	0	1,800	2,700	4,500	42,000

LOCATION	YEAR					
	2013	2018	2023	2028	2033	ULTIMATE
Hamlet of Anzac (Additional 10,000 people)[4]	0	0	0	0	0	10,000
Total Southwest Service Area	**0**	**0**	**3,400**	**5,200**	**8,800**	**67,000**
TOTAL POPULATION	**79,620**	**101,293**	**118,325**	**132,396**	**146,710**	**287,093**
NORTHWEST SERVICE AREA (SUPPLIED BY FUTURE WTP)						
Forest Heights						24,000
EXPANDED SOUTHWEST SERVICE AREA (SUPPLIED BY FUTURE WTP)						
Future Urban Expansion Areas[5]						80,000
TOTAL POPULATION (INC. EXPANDED AREA)	**79,620**	**101,293**	**118,325**	**132,396**	**146,710**	**391,093**

Notes:

(1) Updated population projections from the Urban Development Sub-Region Population Projection Technical Memorandum

(2) Population identified for the Lower Townsite also includes a project accommodation or non-resident component. These are individuals who work and are housed within the service areas, however, consider themselves residents of a different municipality ("shadow" population).

(3) Population as presented in the 2011 Water Master Plan, but shifted by 3 years to reflect current table

(4) Hamlet of Anzac future projected population has been modelled based on a range of 3,000 to 15,000 people. The existing southeast Regional /waterline has been designed based on supplying a maximum Hamlet population of 3,000.

(5) Demands based on those presented in the 2011 Water Master Plan.

(6) Fort MacKay populations are estimated/interpolated from data provided in the Regional Municipality of Wood Buffalo – Fort MacKay Water Treatment Plant, Water Supply & Feasibility Study, October 2012, Associated Engineering. Supply to the Community is assured by 2023.

The above ultimate populations will form the design basis for the Water System Analysis. The Water Distribution Master Plan will primarily assess the 2013 and Ultimate water systems, however, the intermediate years will be considered where appropriate.

2.3 POPULATION DENSITY

Population densities are utilized to estimate the population, or equivalent population, based on different land uses. These values are used in conjunction with the per capita daily consumption rates to estimate the demands on the water system.

Technical Memorandum A.1.5 Urban Development Sub-Region (UDSR) Population Projection Technical Memorandum, by Associated Engineering, January 2014 identifies three important definitions:

Gross Area (GA): **Total land area, includes both developable and non-developable lands.**

Gross Developable Area (GDA): **Developable land area only, both non-populated and populated land, includes roadways, storm water management, park space etc.**

Net Residential Area (NRA): **Populated land area only, residential area.**

The Technical Memorandum provides Ultimate Population Projections (densities) as shown in Table 2-2 below.

Table 2-2
Ultimate Population Projections for UDSR

Developable Area	Residential Population Estimate	Commercial/Industrial Equivalent Population Estimate
GA	Further review required	Further review required
GDA	50 people/ha	37 equiv. people/ha
NRA	90 people/ha	50 equiv. people/ha

The Municipality's Engineering Servicing Standards and Development Procedures (ESS) provides further information on design densities for multi-family development as presented in Table 2-3. Although the ESS also provides information regarding single family residential densities, the information provided in Table 2-2 is both more current and more conservative.

Table 2-3
Multi-Family Equivalent Population Density

Land Use	Design Density	Minimum Design Population
Low Density Multifamily	44 units/net ha @ 3.5 people/unit	154 people/net ha
Medium Density Multifamily	148 units/net ha @ 2.5 people/unit	370 people/net ha
High Density Multifamily	296 units/net ha @ 2.5 people/unit	740 people/net ha

Table 2-4 below presents the projected equivalent design population for the study area, which includes the anticipated residential population, as well as the estimated equivalent population associated with non-residential land uses.

Table 2-4
Projected Equivalent Design Population[1]

LOCATION	YEAR					
	2013	2018	2023	2028	2033	ULTIMATE
SOUTH SERVICE AREA						
Lower Townsite Service Area						
Lower Townsite[2] + Shadow Pop	12,800	16,100	19,500	23,100	26,900	48,000
Waterways	800	1,000	1,100	1,300	1,500	2,700
Draper	200	300	300	300	400	400
Abasand Service Area						
Abasand	5,200	5,400	5,600	5,800	6,000	6,000
Beacon Hill Service Area						
Beacon Hill	2,200	2,300	2,600	2,600	2,600	2,600
MacKenzie Service Area						
MacKenzie/Gregoire/Prairie Creek	9,000	10,000	12,600	14,400	14,700	15,400
Saline Creek Plateau	0	5,000	10,000	15,000	20,000	20,000
Gateway/Quarry Ridge	0	1,000	1,800	2,500	3,300	7,500
Southlands Industrial Area 4	0	0	1,000	1,500	2,000	4,500
Southeast Industrial Service Area						
Airport and Airport West Industrial	0	1,000	2,300	2,800	3,400	8,550
Airport East Industrial and Lynton	0	1,000	1,300	1,500	1,800	6,200
Saprae Creek/Spruce Valley	900	1,500	1,900	2,400	2,900	5,000
Southlands Industrial Area 2	0	0	2,000	3,000	4,000	6,800
Anzac Regional Pipeline						
Hamlet of Anzac (existing pipeline)[3,4]	875	1,064	1,251	1,571	1,902	5,000
Gregiore Lake Estates and First Nations[3]	255	264	274	290	303	303
Gregiore Lake First Nations[3]	390	465	540	615	690	990
Total South Service Area	**32,620**	**46,393**	**64,065**	**78,676**	**92,395**	**139,943**

LOCATION	YEAR					
	2013	2018	2023	2028	2033	ULTIMATE
NORTH SERVICE AREA						
Timberlea	33,500	39,400	42,000	42,000	42,000	42,000
Thickwood	17,500	19,200	19,200	19,200	19,200	19,200
Parson's Creek	0	5,000	7,500	10,000	12,500	26,000
West Growth	0	0	0	2,000	3,000	31,000
Highway 63 Corridor	3,000	4,100	5,400	7,200	7,200	7,200
Highway 63 Truckfill	14,400	19,200	12,000	14,400	16,200	16,200
Fort MacKay/North Transmission Line[6]	0	0	3,172	5,244	9,113	20,370
Future North Truckfill[7]	0	0	12,000	14,000	16,200	16,200
Total North Service Area	**68,400**	**86,900**	**103,180**	**118,260**	**133,045**	**197,250**
SOUTHWEST SERVICE AREA						
North of Horse River	0	0	1,600	2,500	4,300	15,000
Hangingstone	0	0	1,800	2,700	4,500	42,000
Southlands Industrial Area 1A	0	1,000	1,500	2,000	2,500	5,200
Southlands Industrial Area 1B	0	0	0	2,000	3,000	5,900
Southlands Industrial Area 3A	N/A	N/A	N/A	N/A	N/A	N/A
Southlands Industrial Area 3B	N/A	N/A	N/A	N/A	N/A	N/A
HWY 881/63[5]	0	0	0	2,000	3,000	8,800
Hamlet of Anzac (Additional 10,000 people)[4]	0	0	0	0	0	10,000
Total Southwest Service Area	**0**	**1,000**	**4,900**	**11,200**	**17,300**	**86,900**
TOTAL POPULATION	**101,020**	**134,293**	**172,145**	**208,136**	**242,740**	**424,093**
NORTHWEST SERVICE AREA (SUPPLIED BY FUTURE WTP)						
Forest Heights						24,000

LOCATION	YEAR					
	2013	2018	2023	2028	2033	ULTIMATE
EXPANDED SOUTHWEST SERVICE AREA (SUPPLIED BY FUTURE WTP)						
Future Urban Expansion Area[5]						80,000
TOTAL POPULATION (INC. EXPANDED AREA)	**101,020**	**134,293**	**172,145**	**208,136**	**242,740**	**528,093**

Notes:

(1) Updated population projections from the Urban Development Sub-Region Population Projection Technical Memorandum

(2) Population identified for the Lower Townsite also includes a project accommodation or non-resident component. These are individuals who work and are housed within the service areas, however, consider themselves residents of a different municipality ("shadow" population).

(3) Population as presented in the 2011 Water Master Plan, but shifted by 3 years to reflect current table.

(4) Hamlet of Anzac future projected population has been modelled based on a range of 3,000 to 15,000 people. The existing southeast Regional waterline has been designed based on supplying a maximum Hamlet population of 3,000.

(5) Demands based on those presented in the 2011 Water Master Plan.

(6) Equivalent of 151 L/s industrial demand is added to Fort MacKay Population in Ultimate to reflect potential industrial. Flows of 10%, 20% and 40% of this demand have been added in the years 2023, 2028 and 2033, respectively.

(7) Future North Truckfill assumed operational by 2023. It is assumed that 50% of the flows originally projected for the Highway 63 Truckfill will be provided by the Fort MacKay Truckfill at this time.

Utilizing equivalent population densities is necessary for the design of individual developments; however, this can result in high water usage estimates, when compared to projected residential populations used for treatment and regional storage systems. As such, the ultimate equivalent population of 456,493 in **Table 2-4** is much higher than that of 287,093 as indicated in **Table 2-1** for the design residential population only.

2.4 LAND USE

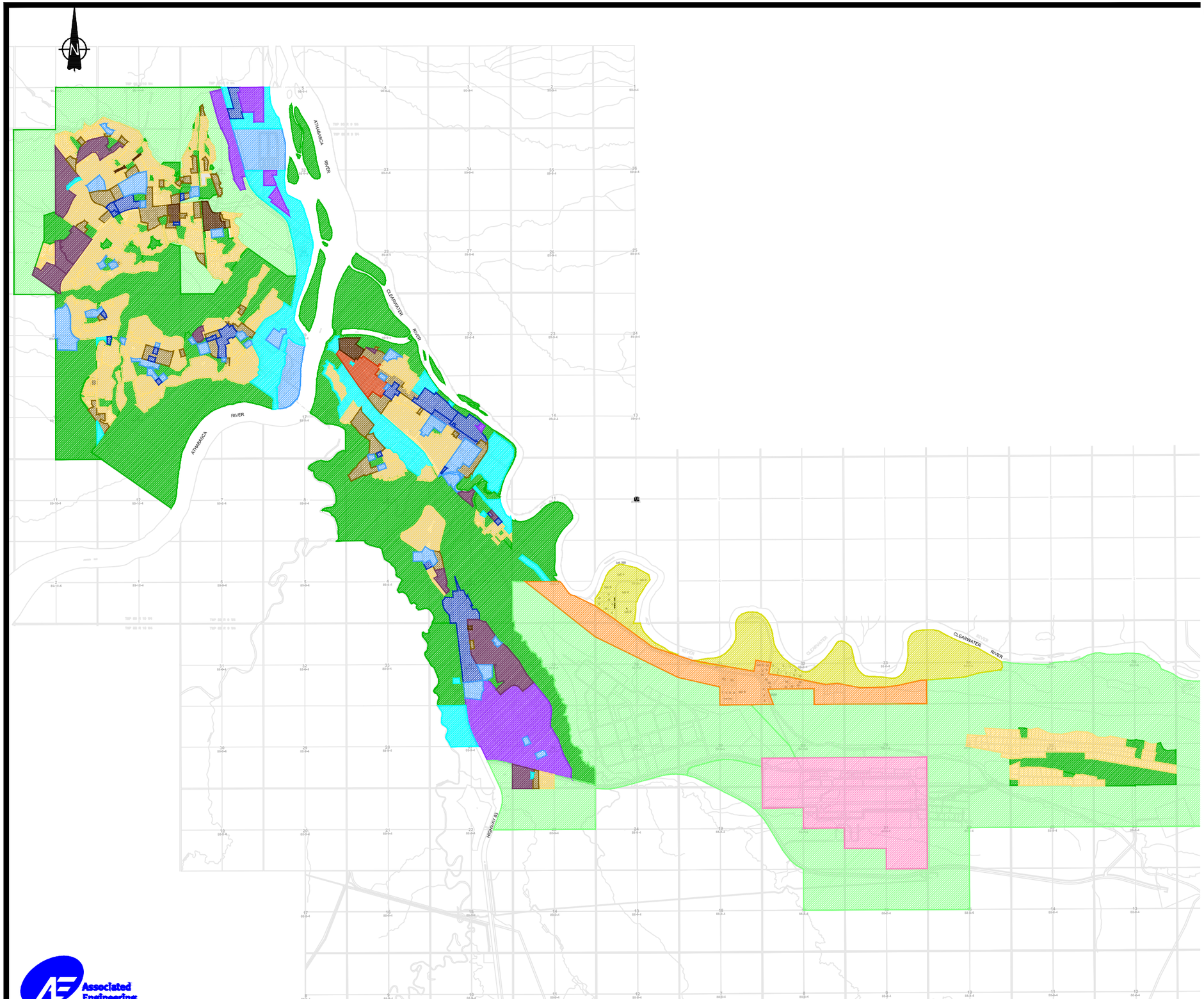
Land use information for existing development areas is presented in **Figure 2-1** and is reflective of the 2010 Land Use Bylaw. The information presented in the figure has been simplified or generalized from the original in some cases. Typical land uses consist of the following:

2.4.1 Existing Development

- Residential – Lower Townsite, Abasand Heights, Waterways, Beacon Hill, Gregoire Park, Prairie Creek, Thickwood, Timberlea, Spruce Valley.
- Country Residential – Saprae Creek, Draper Valley, Anzac, Gregoire Lake Estates.
- Industrial/Commercial – MacKenzie Industrial Park, Hwy 69 Industrial, Airport.

2.4.2 Future Development

- Residential – Saline Creek (initiated 2014), Parsons Creek (partially developed), West Growth, Gateway/Quarry Ridge (with some commercial), Horse River, Hangingstone.
- Industrial/Commercial – Highway 69 Industrial, Airport (Ongoing), Southlands Industrial, Highway 881/63.



REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

FORT MCMURRAY
LAND USE
(EXISTING DEVELOPMENT AREAS)

LEGEND:

- AIRPORT
- CENTRAL BUSINESS
- COMMERCIAL
- DIRECT CONTROL
- LOW DENSITY RESIDENTIAL
- MEDIUM DENSITY RESIDENTIAL
- HIGH DENSITY RESIDENTIAL
- INDUSTRIAL
- MANUFACTURE
- PARKS
- PUBLIC SERVICES
- SMALL HOLDINGS
- SUBURBAN RESIDENTIAL
- URBAN EXPANSION

SCALE 1 : 75,000

OCTOBER, 2015

Associated Engineering

FIGURE 2-1

2.5 WATER DEMAND

Water demand is a critical factor when determining the distribution network, pumping capability, and storage requirements for the water system.

There are three (3) important rates of demand normally used:

- Average Day.
- Peak Day.
- Peak Hour.

Fire flows, in conjunction with the peak day demand, are used to test the water system capability to deliver water and meet the system demand.

Average Day
The Average Day demand is determined by dividing the total annual consumption by 365 days. By dividing this rate by the population served, the "Per Capita per Day Demand" is derived. This rate is used primarily as a basis for the projection of the total water demand.

An Average Day demand of 360 L/c/d will be used for the study for piped distribution systems as per the Engineering Servicing Standards. An Average Day demand of 180 L/c/d will be used for Truckfill delivery systems as per the *Regional Municipality of Wood Buffalo Rural Servicing Study, April 2010, Associated Engineering*.

Peak Day
The Peak Day demand is the single day of maximum consumption observed in the distribution system during the year. In using the single day maximum flow, it is important to ensure that the record is not distorted by firefighting demand, equipment malfunction, or watermain breaks. To project the future peak demand, a peak day to average day ratio is used. The Peak Day demand is used in determining the delivery capacity required of the raw water supply mains, treatment and storage facilities, and transmission main and pumping facilities at the raw water treatment plant. This demand is used in conjunction with the fire flow in order to test the water system's capacity.

For the purpose of this report, a Peak Day demand of 2 times the Average Day will be used as per the Municipality's Engineering Servicing Standards and Development Procedures. This may be a conservative approach based on information presented in the 2011 Water Master Plan, however is reflective of values commonly observed in other communities.

A water demand of 0.5 USgm (0.032 L/s) restricted flow feeding into cisterns for a trickle fill system will be used for a single residential application.

Peak Hour

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

The existing facilities do not measure Peak Hour flows. A Peak Hour factor of 3 times the Average Daily Demand has been observed in similar communities and will be adopted for this report. Due to the flow restrictions on a truck fill system, the Peak Hour demand is considered equal to the Peak Day demand.

2.6 PROJECTED WATER DEMAND

Composite projected water demands have been developed for the 2013, 2018, 2020, 2023, 2033 and Ultimate projected development scenarios in keeping with the Urban Development Sub-Region Population Projection Technical Memorandum. The composite demand projections are enclosed in **Appendix A**.

A summary of the detailed water demand tables is provided below in **Table 2-5**, and includes the entire future service area.

Table 2-5
Projected Water Demand Summary

			Total Composite Demand (Includes Equivalent Population		
Year	Residential Population	Equivalent Population	Ave. Day (L/s)	Peak Day (L/s)	Peak Hour (L/s)
2013	79,620	101,020	421	842	1,263
2018	101,293	134,293	560	1,119	1,679
2023	118,325	170,237	709	1,419	2,128
2028	132,396	204,320	851	1,703	2,554
2033	146,710	235,080	980	1,959	2,939
Ultimate	391,093	509,103	2,121	4,242	6,363

Tables 2-6 through **2-8** identify the projected peak day demands for each Service Area. It is anticipated that the Southlands area will be temporarily supplied from the South Service Area (MacKenzie/Airport) up to the year 2028, until the proposed Southwest Supply Line is fully constructed. Ultimately, a portion of the South Service Area demand is projected to be provided by the Southwest Supply Line, as a supply deficit is projected.

Supply to Fort MacKay and the Proposed North Transmission line will be serviced off of the Parsons Supply Line, by borrowing water originally allotted for development in the West Growth Area. Ultimately, the supply shortfall will need to be provided via a new WTP and supply system.

Table 2-6
South Service Area – Projected Peak Day Demands

Service Area		Peak Day Demand (L/s)				
		2018	2023	2028	2033	Ultimate
WTP Supply to South Service Area						
	Lower Townsite	134	163	193	224	400
	Abasand	45	47	48	50	50
	Waterways/Draper	11	12	14	16	26
Urban Service Area						
	Beacon Hill	19	22	22	22	22
	MacKenzie/ Gregoire/ Prairie Creek	83	105	120	123	128
	Saline Creek	42	83	125	167	167
	Gateway/Quarry Ridge	8	15	21	28	63
	Southlands Industrial Area 4	0	8	13	17	38
Southeast Industrial Area						
	Airport and Airport West	8	19	23	28	71
	Airport East and Lynton	8	11	13	15	52
	Saprae / Spruce Valley	13	16	20	24	42
	Southlands Industrial Area 2	0	17	25	33	57
Anzac Regional System						
	Anzac/Gregoire/First Nations	15	17	20	25	53
Temporary Service to Southlands		**8**	**41**	**95**	**0**	**0**
Supply Deficit (filled by Southwest Service Area)						**-93**
	Total South Service Area	**394**	**576**	**752**	**772**	**1,076**

Table 2-7
North Service Area – Projected Peak Day Demands

Service Area	Peak Day Demand (L/s)				
	2018	2023	2028	2033	Ultimate
WTP Supply to North Service Area					
Timberlea	328	350	350	350	350
Thickwood	160	160	160	160	160
Parson's Creek	42	63	83	104	217
West Growth	0	0	17	25	258
Highway 63 Corridor	34	45	60	60	60
Highway 63 Truckfill	80	50	60	67.5	67.5
Fort MacKay/North Transmission Line[2,3]	0	26	44	76	170
Future North Truckfill[1]	0	50	60	67.5	67.5
Total North Service Area	**644**	**744**	**834**	**910**	**1,350**

Notes:
(1) Future North Truckfill assumed operational by 2023. It is assumed that 50% of the flows originally projected for the Highway 63 Truckfill will be provided by the Fort MacKay Truckfill at this time.
(2) Industry demands have been assumed starting in 2023. Flows of 10%, 20% and 40% of this demand have been added in the years 2023, 2028 and 2033, respectively.
(3) Ultimate North Industry peak day demand of 151 L/s is based on a 600 mm diameter waterline, as per the North Transmission Line Feasibility Study, August 2012, Associated Engineering.

Table 2-8
Southwest Service Area – Projected Peak Day Demands

Service Area	Peak Day Demand (L/s)				
	2018	2023	2028	2033	Ultimate
WTP Supply to Future Southwest Service Area					
Horse River	0	13	21	36	125
Hangingstone	0	15	23	38	350
Southlands Industrial Area 1A	8	13	17	21	43
Southlands Industrial Area 1B	0	0	17	25	49
HWY 881/63	0	0	17	25	73
Additional Anzac Supply (to 15,000 people)	0	0	0	0	83
Supply to Southeast	**0**	**0**	**0**	**0**	**93**
Total Southwest Service Area	8	41	95	145	723
Temporarily Serviced by South Service Area (To Southlands)	0	41	95	0	0
Required from SW Supply Line	0	0	0	145	816

2.7 FIRE FLOWS

The following Table 2-9 identifies the flow required in accordance with the suggested values by the Fire Underwriters Survey (FUS), and Regional Municipality of Wood Buffalo Engineering Servicing Standards:

Table 2-9
Fire Flows

	Description	Recommended Fire Flow	
		Litres/Minute	Litres/Second
1.	Single Family Residential Wood Frame construction, two stories or less 100 m^2 to 150 m^2 150 m^2 to 275 m^2	 5,000 6,000	 83 100
2.	Multi Family Residential Wood frame construction c/w fire separator Four units up to 100 m^2 each	8,000	133
3.	Walk-up Apartments Ordinary construction up to 3,200 m^2 (10-20 m separation)	12,000	200
4.	Schools Non-combustible construction (15% exposure) Up to 3,300 m^2 Up to 4,000 m^2 Up to 12,000 m^2	 10,000 11,000 19,000	 167 183 317
5.	Institutional, Churches Ordinary construction (15% exposure) up to 850 m2	6,000	100
6.	Commercial Non-combustible construction (5 % exposure) Up to 2,900 m^2 Up to 4,200 m^2	 11,000 14,000	 183 233
7.	Light Industry Non-combustible construction Up to 2,900 m^2 (25% exposure) Up to 2,900 m^2 (50% exposure)	 9,000 11,000	 150 183
8.	Low Density Rural Residential 2 stories or less over 30 m separation	2,000	33
9.	Medium Density Rural Residential 2 stories or less 10.1 to 30 m separation	3,000	50
10.	High Density Rural Residential 2 stories or less 3 to 10 m separation	4,000	66

The flows in Table 2-9 are based on Fire Underwriter's Guidelines and are determined as follows:

F= 220 C√ A where:

F = required fire flow in litres per minute (L/min)
C = 1.5 for wood frame construction
= 1.0 for ordinary construction
= 0.8 for non-combustible construction
= 0.6 for fire flow resistant construction (fully protected frame, floors and roof)
A = total floor area in square metres (including all stories) (m^2)

Other considerations when determining the fire flow requirements are:

- Occupancy hazard.
- Automatic sprinkler protection.
- Fire resistant construction materials.
- Exposure within 45 metres.

Table 2-10 summarizes the recommended fire flows and the minimum recommended pipe diameter based on land use.

Table 2-10
Recommended Fire Flows/Pipe Size – Based on Land Use

Description	Fire Flows, Q (L/s)	Min. Pipe Dia., D (mm)
High Density Mixed Use Commercial	233	300
Medium High Density Residential	200	300
Medium High Density Mixed Use Residential	133	250
Medium High Density Mixed Use	183	300
Medium Density Residential	133	250
Low Density Residential	83	200
Public Service	100	200

2.8 OPERATING PRESSURE ZONES

The Municipality's current servicing standards identify operating pressure guidelines between 280 kPa (40 psi) and 620 kPa (90 psi). It is recommended that the minimum operating pressure be increased to 345 kPa (50 psi) in order to achieve maximum user satisfaction. Higher than normal pressure increases

leakage, maintenance costs, and the frequency of mechanical failure of hydraulically operated valves and equipment.

Where localized pressures exceed 620 kPa (90 psi), and the economies or logistics of installing a PRV station are not justified, individual lot PRV's are recommended to be installed at the customer meter.

A minimum pressure of 138 kPa (20 psi) is recommended for trickle fill systems to ensure positive pressure throughout the line.

The Municipality's Standards recommend the following minimum pressures during a fire event:

- Residual pressure at demand hydrant 150 kPa (21 psi).
- Zone pressure without sprinklers 280 kPa (40 psi).
- Zone pressure with sprinklers 350 kPa (50 psi).

2.9 WATER STORAGE

It is good practice to provide adequate storage in a water system for operational needs (peak hour), supply interruption and fire flow demand. Design guidelines vary depending on the size of the community and the capital cost involved. AEP guidelines require:

- Equalization storage: 25% of maximum daily flow.
- Emergency storage: 15% of average daily flow.
- Fire storage: 233 L/s for 3 hours duration.
- Disinfection contact time (T10): to meet the CT requirements.

The Engineering Servicing Standards indicate that in general, reservoirs should be sized to accommodate one peak day plus fire flow requirements. The standards also indicate that each case should be looked at separately.

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

- Equalization & Emergency Storage One Peak Day.
- Fire Storage 233 L/s for 3 hour duration.

2.10 PIPE SIZE

Where upgrading of the existing watermains takes place, the following minimum main diameters will be used:

- Single Family Residential 200 mm
- Multi-Family Development 250 mm
- Industrial/Commercial 300 mm

Main sizes may be increased as considered necessary by the Engineering Services Division or as dictated by this Master Plan to accommodate future development.

All existing and proposed pipes are modelled using the nominal pipe diameter versus actual.

2.11 PIPE VELOCITY

Water velocity is the main criteria in pipeline design. Sudden changes in velocity can create pressure surges and possibly negative pressure, which can then cause serious pipe (equipment) damage. Increased velocities require higher pumping heads and can result in higher energy costs.

The Engineering Servicing Standards indicates that the maximum velocity shall not exceed 1.5 m/s during normal system operation. During fire flow scenarios, velocity is permitted to increase to a maximum of 3.0 m/s. Typically, a velocity of up to 1.5 m/s is recommended for all major supply and transmission mains. If higher velocities are to be used, water hammer analysis and energy life cycle cost analysis should be undertaken.

2.12 ROUGHNESS CO-EFFICIENT

The “C-Value” (roughness co-efficient) is one of the variables in the Hazen-Williams equation for determining the liquid flow through a pipe. It represents the material and condition of the pipe.

On August 4 through August 6, 2009 field “C” Value Calibration tests were conducted by Associated Engineering with assistance from the Municipality Public Works personnel. The results are presented in Table 2-11 below:

Table 2-11
C-Values (August 6, 2009 Results)

Material Type	C Value
Old Cast Iron (C.I.)	70 – 80
Old Ductile Iron (D.I.)	100
PVC	130

The above values for cast iron (C-Value of 80) and ductile iron pipe (C-value of 100) have been used in the model. A value of 125 for PVC pipe has been applied as per the Municipality's current servicing standards. A C-Value of 110 has been applied to steel pipes and new ductile iron pipes.

3 Water Treatment Plant

3.1 GENERAL

The Fort McMurray Water Treatment Plant (WTP) provides all treated water for the City of Fort McMurray (including the North and South Service Areas) and surrounding areas. The Water Treatment Plant is located along the west bank of the Athabasca River, south of the Grant McEwan Bridge.

The existing South Service Area facilities are comprised of the following facilities and are discussed in later sections of this report:

- Lower Townsite Reservoir (LTS).
- Abasand Reservoir and Pumphouse.
- King Street Booster Station.
- Mills Avenue Booster Station.
- Beacon Hill Reservoir and Pumphouse.
- MacKenzie Industrial Reservoir and Pumphouse.
- Southeast (SE) Reservoir and Pumphouse.

The North Service Area facilities are comprised of the following facilities and are discussed in later sections of this report:

- Thickwood Reservoir and Pumphouse.
- Timberlea Reservoir and Pumphouse.
- Parsons Creek Reservoir and Pumphouse (not currently operating)
- Highway 63 Industrial Corridor Truckfill Station.

Upgrades to the WTP were recently completed, which doubled the plant treatment rate from 52 mL/d to 104 mL/d gross (94 mL/d net).

Among the many upgrades completed was the construction of a new High Lift Pump Station (HLPS) and an on-site storage reservoir. The pumping station was designed to supply the future high pressure zone (North Service Area and future Southwest Service Area) as well, the future low pressure zone (South Service Area). The pumping station is now envisioned to service the future Southwest Service Area in the interim or emergency scenario only, as a future WTP has been proposed.

3.2 PUMPING CAPACITY

Existing System

The existing WTP and new HLPS are together currently comprised of seven (7) distribution pumps which supply water to the South and North Service Areas. **Photo 3-1** shows an overall picture of the new Water Treatment Plant site.

Photo 3-1
Water Treatment Plant

Two distribution pumps within the existing WTP (HLP 1 and HLP 2) deliver water to the South Service Area. Water is bypassed around the new HLPS and conveyed through two existing 750 mm diameter mains, which reduce to 600 mm diameter mains and cross the Athabasca River on the newly constructed Grant McEwan Bridge. The standby pump (HLP 3) within the existing WTP supplies the South Service Area as required. The two pumps (HLP 4 and 5), that previously serviced the North Service Area from the existing WTP, have been decommissioned. The North Service area is now serviced from the recently constructed HLPS.

Figure 3-1 shows a site plan of existing WTP supply piping as described above, including a pump schematic. The duty points for the three (3) remaining pumps within the WTP pumphouse are shown below in Table 3-1.

Table 3-1
WTP – Existing System Design Pumping Capacity (to South Service Area)

PUMP	FLOW (L/s)	TDH (m)	HGL (m)
SOUTH SERVICE AREA			
HLP 1	133	98	349.0
HLP 2	133	98	349.0
STANDBY PUMP			
HLP 3	338	98	349.0

The operating conditions of the three (3) remaining pumps are shown in Table 3-2 (based on Municipality records)

Table 3-2
WTP – Existing Pump Operating Conditions

PUMP	FLOW (L/s)	TDH (m)	HGL (m)
SOUTH SERVICE AREA			
HLP 1	150	72	322.0
HLP 2	150	72	322.0
HLP 1 + HLP 2	278	84	334
STANDBY PUMP			
HLP 3	278	112	362

The above table indicates that the pumps do not currently appear to be operating at the design setpoint of 98 m, and therefore are not operating at their most efficient point. The existing pump curves are included in **Appendix B**.

Four pumps (P-1, P-2, P-3 and P-4 on Standby) are located within the recently constructed HLPS. Each pump has the capacity to pump at 220 L/s at 137 m total dynamic head (TDH). Water is delivered to the North Service Area, through an existing 600 mm diameter pipeline, to the Thickwood and Timberlea Reservoirs. A newly constructed 900 mm diameter supply main has been installed up to the Thickwood lateral, which reduces to a 750 mm diameter main to both the Timberlea connection and to the new Parsons Creek Reservoir.

Table 3-3
High Lift Pumphouse – Existing Pump Operating Conditions

PUMP	FLOW (L/s)	TDH (m)	HGL (m)
NORTH SERVICE AREA			
P1	220	137	385
P2	220	137	385
P3	220	137	385
STANDBY PUMP			
P4	220	137	385

The current maximum pumping capacity of the existing WTP high lift pump station is:

- South Service Area – 278 L/s (24.0 ML/d).
- North Service Area – 660 L/s (57.0 ML/d)

Existing System Assessment

It is understood that pumping upgrades at the existing WTP will be undertaken to increase supply capacity to the South Service Area, however, they will occur following completion of the WTP expansion and supply line upgrades. Potential pumping capacities based on design projections are presented in **Table 3-4** below.

The projected future demands for each of the Service Areas are previously outlined in Tables 2-6 through 2-8 in Section 2 of this report.

Table 3-4
WTP – Pumping Capacity Assessment

PUMP	YEAR					
	2013	2018	2023	2028	2033	ULTIMATE
SOUTH SERVICE AREA						
Ex. HLP 1	133					
Ex. HLP 2	133					
P5		450	450	550	550	550
P6		450	450	550	550	550
P7 (Standby)		450	450	550	550	550
Combined Pumping Capacity (L/s)	278	900	900	1100	1100	1100
Estimated Peak Day Demand (L/s)	272	387	534	565	770	1076
Surplus/Shortfall (L/s)	6	513	366	535	330	24
NORTH SERVICE AREA						
P1	220	220	220	220	220	220
P2	220	220	220	220	220	400
P3	220	220	600	600	600	600
P4 (Standby)	220	220	600	600	600	600
Combined Pumping Capacity (L/s)	660	660	1040	1040	1040	1220
Estimated Peak Day Demand[(1)] (L/s)	511	644	744	834	910	1,092
Surplus/Shortfall (L/s)	149	16	296	206	130	128

Notes: (1) Fort MacKay and North Transmission Line flows will "borrow" off of West Growth Demands until such time as a new WTP is constructed. Ultimately the West Growth Area will likely require service from a new WTP, and is therefore not reflected in ultimate demand.

The existing South Service Area pumping capacity is calculated from the combined efforts of HLP 1 and HLP 2. The existing South Service Area pumps will need to be replaced shortly in order to address increased demand and a higher pumping head (345 m HGL). As such, new pumps have been identified to be installed within the HLPS.

Additionally, the pumps currently operating for the North Service Area may not be adequate to supply the peak day demands through to the year 2018 if the demand projections are met. In this case, it may be possible that one 220 L/s pump can be replaced with an ultimate pump at 600 L/s to increase the overall pumping capacity.

Upgrades to Existing System

The outgoing pressure from the WTP to the South Service Area will be revised to 345 m to provide the peak demand to the LTS Reservoir and downstream. This will require the following:

- Decommissioning of redundant existing PRV's,
- Upgrading of existing PRV's identified to remain in service, and
- Installation of new PRV's connecting the high pressure supply main to the distribution system from the Lower Townsite distribution system.

It is recommended that new pumps be installed to meet the estimated South Service Area 20 year peak day demand of 772 L/s in 2033, in order to accommodate the existing flows and anticipated outgoing pressure reduction.

Ultimate System

The South Service Area will be serviced from the new HLPS at the proposed outgoing HGL of 345 m. The new HLPS will allow the connection of the distribution mains to the Low Pressure Zone pump header consisting of two (2) 750 mm diameter pipes.

Both the High Pressure Zone (North Service Area plus interim supply to Southwest Service Area) and Low Pressure Zone (South Service Area) will require pumping upgrades to service the ultimate projected equivalent populations and associated peak day demands).

Ultimately, the Southwest Service Area will not be supplied via the existing WTP in the long term, but from a proposed new WTP to be located west of Horse River.

Figure 3-2 identifies the ultimate pumping schematic and supply piping from the Water Treatment Plant.

3.3 STORAGE

Existing System

Storage capacity is currently provided by the existing clearwell (recently upgraded to optimize 12,000 m^3 of storage) as well as a recently constructed storage reservoir which provides an additional 12,000 m^3 of storage. The completion of the upgrades at the WTP therefore resulted in a total on-site storage of 24,000 m^3.

Upgrades to Existing System

No further upgrades are required at this time.

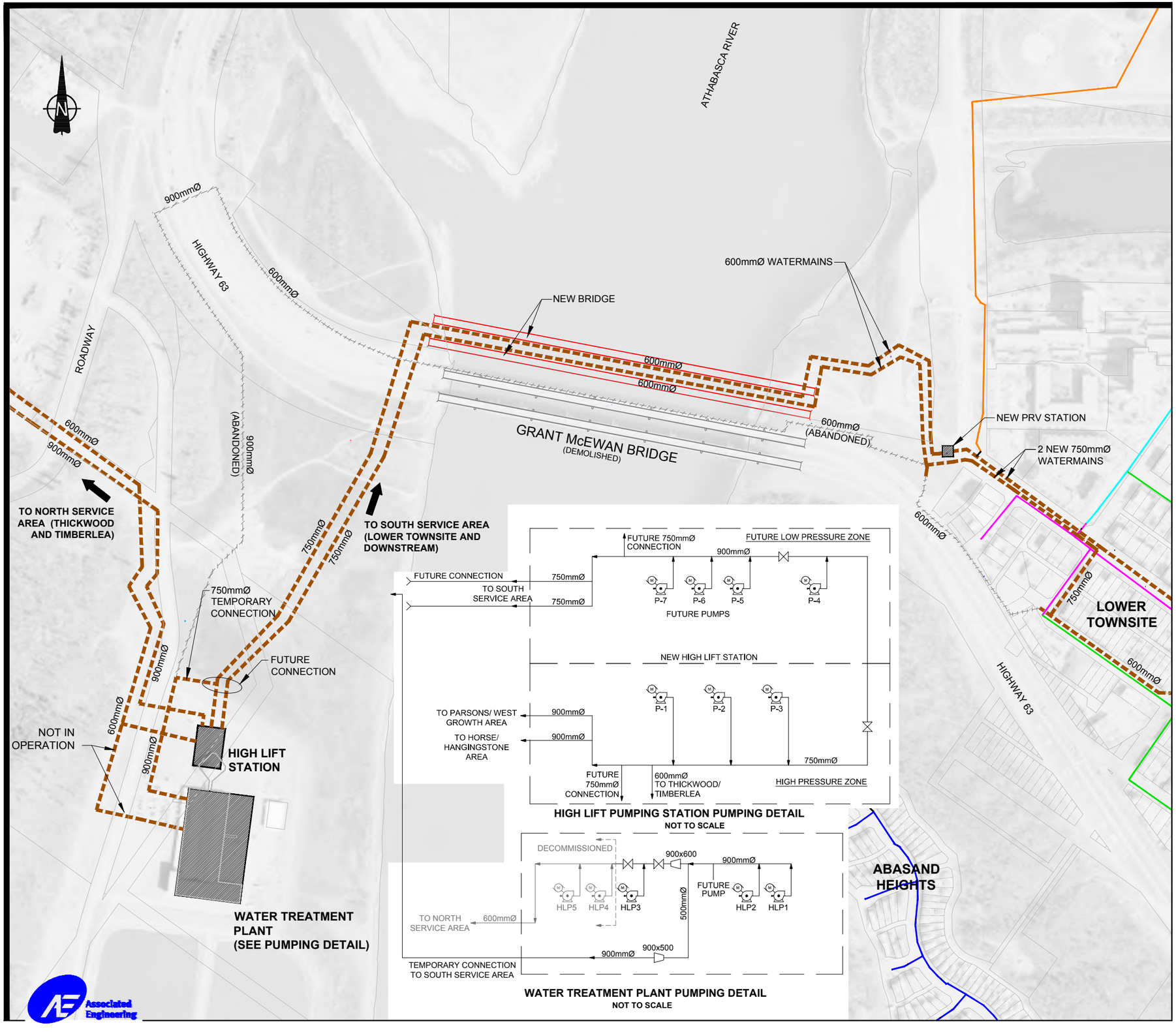
3.4 PROPOSED FUTURE WATER TREATMENT PLANT

A future south WTP is proposed to be located west of the Horse River Development Area, consisting of the following components:

- River intake.
- Raw water pumphouse.
- Raw water supply main.
- Water treatment facility.
- Treated water storage.
- Pumphouse.

The proposed south WTP will be sized to accommodate the Ultimate Service Area beyond the capacity of the existing WTP at 133,000 people. It will not be sized to accommodate the future Forest Heights development area, as this will require a separate WTP to be constructed. The proposed WTP can also be sized to accommodate the future supply shortfall in the North Service Area resulting from construction of the proposed North Transmission line (servicing Fort MacKay and adjacent industry).

Due to the close proximity to Horse River, it is proposed that storage and pumping capacity be constructed at the new south WTP to accommodate a portion of the Horse River requirements. It is suggested that the WTP be constructed in two stages as downstream development proceeds. An outgoing HGL in the order of 395 m will ultimately be required to supply the Hangingstone Reservoirs.



REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

WATER TREATMENT PLANT EXISTING SUPPLY SYSTEM

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- ABANDONED SUPPLY WATERMAIN

SCALE 1:5,000

OCTOBER, 2015

FIGURE 3-1

Associated Engineering

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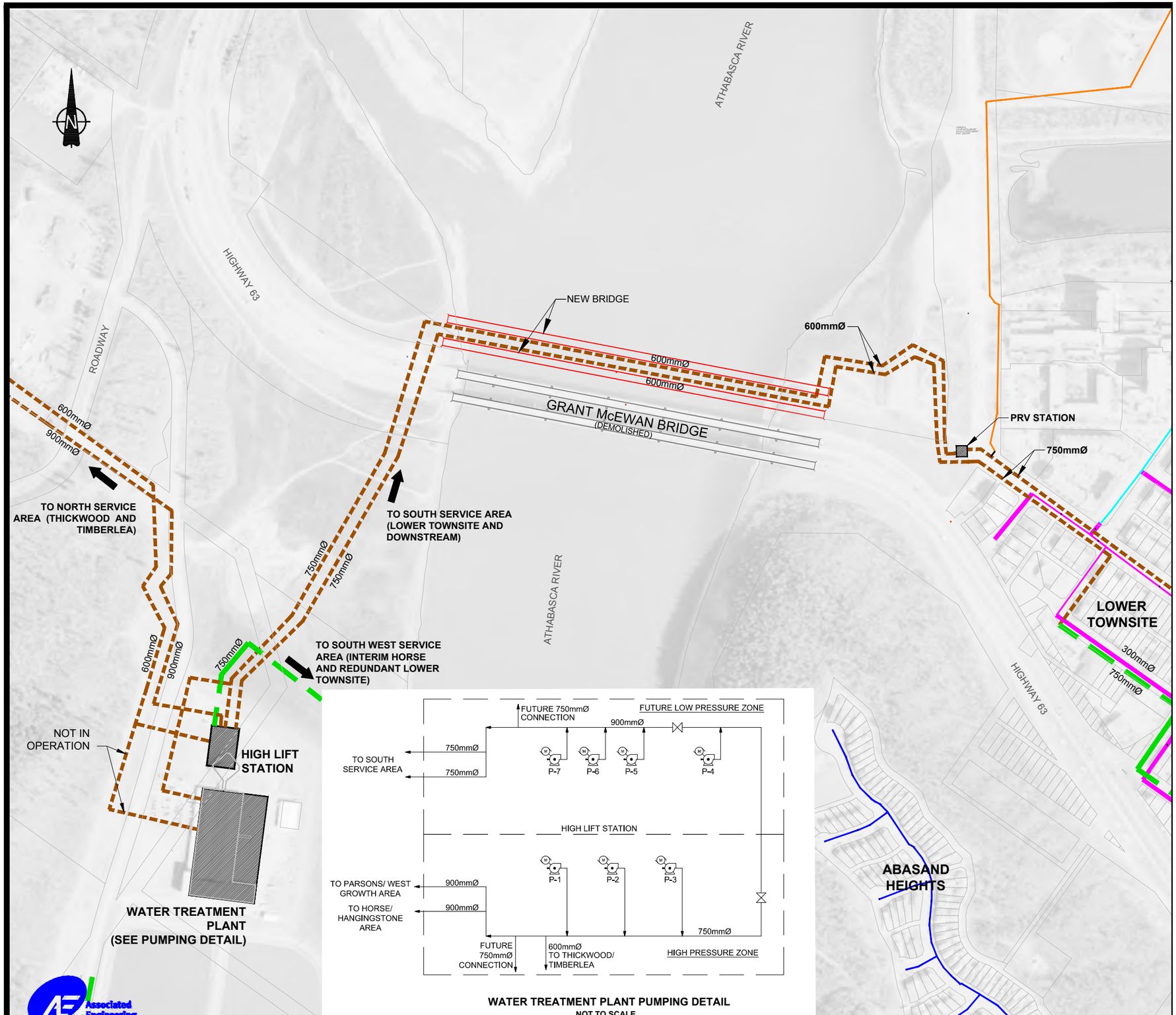

WATER TREATMENT PLANT PUMPING DETAIL
NOT TO SCALE

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

WATER TREATMENT PLANT ULTIMATE SUPPLY SYSTEM

LEGEND:

- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN

SCALE 1:2,500

OCTOBER, 2015

FIGURE 3-2

Associated Engineering

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4 Water Supply Pipelines/Booster Station

4.1 WATER TREATMENT PLANT SUPPLY TO SOUTH SERVICE AREA

4.1.1 Existing System/Assessment

The Water Treatment Plant south High Lift Pump Station typically operates at a hydraulic gradeline (HGL) of 322 m and supplies water to the South Service Area. This results in a higher delivery pressure than what is necessary/suitable for distribution, in order to fill the LTS and Abasand Reservoirs (with some filling constraints). The Lower Townsite distribution system is supplied through five Pressure Reducing Valve (PRV) stations, which reduce the distribution pressure to an HGL of 307 m from the high pressure supply main connections.

Much of the water supply system from the WTP to the South Service Area has undergone significant improvements in recent years. Two 600 mm diameter supply pipelines were constructed across the Athabasca River, on the new Grant McEwan Bridge. As well, two 750 mm diameter mains were completed in 2011 from the existing 900 mm pipeline (discharge pipe from the WTP) and connected to the 600 mm pipes along the bridge. Both mains increase to 750 mm in diameter after crossing the bridge.

A PRV Station was constructed at the north end of Franklin Avenue and a new 750 mm main was recently constructed along Franklin Avenue to Hardin Street. The main was also recently extended south along Hardin, and will connect to the proposed LTS 4-Way Chamber at the base of the LTS Reservoir supply.

After crossing the bridge, one of the 600 mm diameter mains supplies the new PRV station on Franklin Street and increases to 750 mm in diameter. The second supply main also increases to 750 mm, remains at high pressure, and travels south on Richard Street. The main reduces to 600 mm at MacDonald Avenue, then further reduces to two 400 mm diameter mains at Morrison Street and MacDonald Avenue. One of the 400 mm mains loops around the LTS (increasing to a 450 mm diameter main) to fill the Abasand Reservoir, while the other 400 mm main continues toward Saunderson Avenue where it reduces to 300 mm to fill the existing LTS reservoir. PRV stations reduce pressure from the reservoir and high pressure main, and flow is conveyed via the 300 mm watermain to further downstream.

In order to fill the Abasand Reservoir, the WTP must operate two pumps at an increased HGL of 334 m (in the overnight period).

The existing King Street Booster Station is fed off of the distribution system, which in turn supplies the Beacon Hill Reservoir and Pumphouse. An estimated 2013 peak day demand of 113 L/s is required at the booster station in order to supply the downstream users.

Figure 4-1 presents the existing supply system and pressure zones.

4.1.2 Upgrades to Existing System

The overall supply system concept for the South Service Area is not proposed to change significantly. The WTP will continue to operate at a higher pressure than is required for the City Center distribution system, in order to fill the LTS Reservoir. Multiple PRV stations will reduce the high pressure at connection points to the distribution system. The LTS Reservoir will contribute to provide peak demands; however, it will also have the capacity to fill the Abasand Reservoir.

Although the supply concept does not change significantly, several capacity related upgrades are proposed. Those anticipated to be addressed in the short term are as follows:

- Predesign is complete for the construction of two pipelines between the LTS Reservoir and the proposed LTS 4-Way Chamber (in the vicinity of Saunderson Avenue), and a detailed design is underway. This will allow for filling of the reservoir, as well as flow from the reservoir to supplement the LTS peak demand needs and supply emergency fire flow as necessary. Predesign of the proposed LTS 4-Way Chamber has also been completed. The station will reduce water pressure supplied from the Water Treatment Plant and LTS Reservoirs, to the distribution zone pressure equivalent to 307 m HGL. The pipelines will consist of:
    - 650 mm to supply the LTS Reservoir.
    - 750 mm main to provide peak demands/fire flows to the LTS.
- The proposed 750 mm supply main located along Highway 63 is currently under construction and is anticipated to be completed in 2015. This main will convey flow from the proposed LTS 4-Way Chamber at Saunderson to the existing 750 mm main on Tolen Drive, north of the King Street Booster Station. The 750 mm watermain along Hardin Street, from Franklin Avenue to Saunderson was also recently completed in 2015.
- The proposed 400 mm supply/distribution main along Prairie Loop Boulevard is also in design, and is anticipated to be constructed in stages as the roadway is extended further north.
- The section of 750 mm supply main from the WTP to the LTS reservoir is currently under construction, and will provide a redundant supply to the LTS Reservoir. The main will reduce to 600 mm and then supply the Abasand Reservoir, and is anticipated to be constructed within 5 years' time. This main will also allow for interim development of the Horse and Hangingstone areas and is further discussed below in the Ultimate System.

Additional information specific to the proposed operation of the Lower Townsite Reservoir and Pumphouse, the King Street Booster Station, Mills Avenue Booster Station, LTS distribution system and additional downstream distribution systems, is provided in Section 5 of this report.

4.1.3 Ultimate System

An overview of the proposed ultimate supply system concept is provided below:

- WTP will pump at 345 m HGL to supply ultimate peak day demand to LTS Reservoir. Pumping upgrades will be required to supply the peak day design flow of 476 L/s (48,000 LTS population, Abasand, Waterways and future Draper connection) to the LTS Reservoir.
- Utilize existing 2 x 600 mm mains across the Athabasca River to supply the peak day demand of 1076 L/s (LTS demand plus 600 L/s for Mills Avenue Booster Station).
- Extend 750 mm high pressure supply line from Richard Street to Saunderson Avenue.
- Install 650 mm supply main from Highway 63 to LTS reservoir (4-way chamber to LTS Reservoir).
- Install 750 mm from the LTS Reservoir to supply peak day plus fire flow demands to the LTS (LTS Reservoir to 4-way chamber).
- Install 750 mm main along Highway 63 to provide flow to the Mills Avenue Booster Station and downstream distribution system (to be completed in 2015).
- Install 400 mm supply/distribution main along Prairie Loop Blvd to operate under distribution system pressure. Decommission existing 400/450 mm main.
- Install 600 mm main along the remainder of Franklin Avenue.
- Install new or rehabilitate the existing 300 mm line from the Abasand Reservoir to the LTS distribution system, complete with a PRV Station.
- Reduce WTP/LTS Reservoir pressure into the distribution system to 307 m HGL at PRV Stations.
- The existing PRV stations identified to remain will require upgrading and possible relocation in order to accommodate the ultimate demand flows, plus additional PRV stations are recommended in strategic locations.

Figure 4-2 presents the proposed Lower Townsite Reservoir Fill Schematic. A maximum peak day flow of 1076 L/s has been allowed for crossing the Athabasca River, due to design constraints of the two existing 600 mm supply mains on the bridge. This design flow exceeds the maximum recommended velocity of 1.5 m/s (each pipe at approximately 1.9 m/s); however, this was accepted by the Municipality at the time of the bridge design.

As mentioned previously, the Municipality is currently installing a new 750 mm supply main beneath the Athabasca River from the WTP to the LTS Reservoir. This watermain will decrease to a 600 mm main following the LTS connection, and provide supply to the Abasand Reservoir, which is anticipated to be constructed within the next few years. In the future, the supply main will continue as a 600 mm main to supply the Horse River (Riverbend) Reservoir. Refer to **Figure 4-3**, to view the proposed supply concept.

The proposed water supply line will serve several purposes:

- Provides a redundant water supply to the LTS Reservoir in the event of supply interruption through the existing/upgraded supply system.
- Allows for interim development in the Horse and Hangingstone areas which may precede development of the proposed new WTP.

- Provides a redundant supply to the Horse/Hangingstone areas (and further downstream) in the event of supply interruption within the future Southwest Supply System.
- Provides a redundant supply to the LTS/Abasand Reservoirs in the event of supply interruption within the South Service Area
- Provides the additional supply required to the Abasand Reservoir to accommodate additional demand in the event that the high density City Centre Redevelopment Plan is resurrected.

The 750 mm supply main has been oversized to provide partial backup supply to the LTS if required. The main is not intended to provide full backup to the existing supply system, and therefore, will not provide the entire ultimate peak day demands for the South Service Area. If the new main is required to operate as the sole supply, average day demands can be supplied and water rationing may be necessary. Details are as follows:

- Approximately 660 L/s would be available through the proposed 750 mm main based on a recommended maximum velocity of 1.5 m/s. This will accommodate a redundant supply of the ultimate average day demand for the entire South Service Area. Depending on the construction of the supply main, it may be possible to exceed this velocity and convey additional water, if necessary.
- The proposed supply main would be supplied off of the north service area header within the WTP at a proposed ultimate HGL of 400 m. A pumping upgrade will be required to achieve this HGL.
- The proposed 600 mm main to be constructed along Athabasca Avenue (within Abasand), and further downstream to the Horse River Reservoir, will be sized on order to convey the interim supply to Riverbend (Horse River), Hangingstone, and ultimate emergency supply to the South Service Area or the Southwest Service Area.
- The proposed 600 mm pipeline will be capable of conveying peak day demand for a population in the order of 30,000 people.
- The pipeline will also be capable of supplying the average day demand flow for the entire Southwest Service Area, in the event of supply interruption of the proposed Southwest WTP. Alternatively, it can deliver the average day demand for the LTS, Waterways and Draper in the event that the existing WTP cannot provide service.
- It is assumed that the remaining flows will be conveyed via interconnections to the MacKenzie Reservoir, and through the Southlands Area 1A/1B Reservoir in the event of complete supply interruption.

It will not be necessary to re-pump water from the Abasand Pumphouse in order to provide interim supply to the future Horse River Reservoir, as the supply system will be tied into the North Service header. The ultimate peak day supply demands are anticipated to be in the order of 90 L/s, in line with the requirements for servicing the Riverbend development. Although ultimately, it is envisioned that the Horse River (Riverbend) Reservoir be supplied via the Hangingstone Reservoir, it may be necessary to supply a portion of this demand via the interim connection in order to maintain water quality within the pipe.

4.2 WATER SUPPLY FROM KING STREET BOOSTER STATION TO MACKENZIE RESERVOIR AND PUMPHOUSE

4.2.1 Existing System / Assessment

The existing King Street Booster Station is located at King Street and Highway 63, and supplies water to the Beacon Hill Reservoir and Pumphouse through a 350 mm diameter dedicated main. Currently, an estimated 113 L/s is pumped at the existing booster station during the peak day demand scenario. The existing supply system is shown in **Figure 4-1**.

The capacity of the existing King Street Booster pumps is shown in **Table 4-1** below. The existing pump curves are provided in **Appendix C**.

Table 4-1
Existing King Street Booster Station Pumps

Item No.	Pump Description	Flow (L/s)	TDH (m)	HGL* (m)
1.0	Distribution Pump	76.0	79.0	386
2.0	Distribution Pump	76.0	79.0	386
3.0	Distribution Pump	76.0	79.0	386

*Maximum HGL based on 307 m Zone HGL.

It would appear that the estimated 2013 peak day demand downstream of the King Street Booster Station (113 L/s) can be accommodated by operating two pumps simultaneously (for a total flow of 152 L/s), with the third pump remaining as backup. Based on a zone HGL of 307 m in the LTS, the outgoing HGL from the King Street Booster is 386 m HGL.

4.2.2 Upgrades to Existing System

The Mills Avenue Booster Station was constructed adjacent to the Ashter Club property and northwest of the future Clearwater Drive (Ashter Site). As well, a new 750 mm diameter dedicated supply main from the new booster station to the existing MacKenzie Reservoir and Pumphouse was recently constructed, however, is not yet operational (refer to **Figure 4-1**). The Mills Avenue Booster Station has been designed to service the ultimate anticipated growth to the south, and was completed near the end of 2010. The upgrades and relocation are described in the report entitled *King Street Booster Pumphouse Relocation Feasibility Study", February 2009, by AECOM.*

The Mills Avenue Booster Station is equipped with four 200 L/s variable speed pumps (one reserved as standby) to provide a maximum flow rate of 600 L/s, at a TDH of 97.5 m. The pumps will operate based on reservoir levels at the MacKenzie Reservoir and Pumphouse. Information regarding the King Street Booster Station operating philosophy has been taken from the *King Street Booster Pumphouse and Pipelines – PLC Programming Control Philosophy, AECOM, April 2010*.

The new 750 mm diameter dedicated water supply pipeline will be required in order to supply the Ultimate Peak Day water demand to the South Service Area. This dedicated 750 mm supply pipeline is routed from the Mills Avenue Booster Station east to Waterways and then to the MacKenzie Reservoir and Pumphouse, as shown in **Figure 4-1**. Further information regarding this proposed pipeline can be found in the "*Regional Municipality of Wood Buffalo – Water Supply Line from King Street Booster to MacKenzie Reservoir*" Pre-design report, Associated Engineering, 2010.

When both the Mills Avenue Booster Station and the new dedicated supply waterline are fully operational (anticipated for 2016), the existing King Street Booster Station and existing 350 mm diameter supply waterline to Beacon Hill will become a redundant supply to the MacKenzie Reservoir. The MacKenzie Area and downstream development will be supplied from the Mills Avenue Booster Station. Refer to **Figure 4-3** for further reference. The King Street Booster Station will be maintained to supply Beacon Hill, as well as to provide a redundant supply to MacKenzie, if required.

Figure 4-4 presents the Ultimate South Service Area Hydraulic Gradeline, identifying the peak day demand pumping concept. As well, **Figure 4.5** presents a Water Supply Overview of the Ultimate Peak Day Demands

The proposed new pumping capacity is presented in **Table 4-**2 below:

Table 4-2
Mills Avenue Booster Station – Pumping Capacity

Pump	Flow (L/s)	TDH (m)	HGL* (m)
P10	200	97.5	400
P11	200	97.5	400
P12	200	97.5	400
P13 (Stand-by)	200	97.5	400

*Assumed HGL for modelling purposes.

The projected pumping capacity of the Mills Avenue Booster Station is outlined in **Table 4-3**.

Table 4-3
Mills Avenue Booster – Projected Pumping Capacity

Year	Pumping Capacity (L/s)[1]	Peak Day Demand (L/s)[2]	Remark
2013	600	113	OK
2018	600	196	OK
2023	600	354	OK
2028	600	497	OK
2033	600	482	OK
Ultimate	600	600	OK

.1 The Mills Avenue Booster Station will have a pumping capacity of 600 L/s (3 pumps operating at 200 L/s and 1 standby pump with a capacity of 200 L/s).

.2 The peak day demand includes the requirements for Beacon Hill, as ultimately the Beacon Hill supply line may be extended and serviced via the Mills Avenue Booster Station, rather than by the King Street Booster.

The above table identifies that the Mills Avenue Booster Station is anticipated to meet the Peak Day Demand of the downstream users for many years into the future. It should be noted that the peak day demands for years 2023 and 2028 include allowance for temporary servicing for some Southlands developments which will ultimately be included within the Southwest Service Area.

The Mills Avenue Booster Station will operate based on a drop in the MacKenzie Reservoir level by pre-set amount which will determine both the number of pumps operating and the pumping rate. Water levels will be monitored continuously at the MacKenzie Reservoir. Pump curves are enclosed in **Appendix D.**

The discharge pressure from the booster station will be dependent on the inlet pressure.

- Based on a maximum zone HGL of 307 m, the resulting highest discharge HGL would be 404.5 m assuming that the variable speed drive pumps are set to maintain the TDH of 97.5 m.
- Based on a minimum allowable suction pressure of 410 kPa (HGL of 293.1 m), the resulting minimum discharge HGL would be 390.6 m based on the pump centreline elevation of 251.3 m.
- For modelling purposes, an HGL of 400 m has been applied.

The King Street Booster Station will be maintained to supply Beacon Hill. It is understood that the existing Beacon Hill supply main will be replaced with a 400 mm main from the King Street Booster to the Beacon Hill Reservoir. If the King Street Booster is removed due to highway widening at some point in the future, it may be necessary to extend this supply main to the 750 mm main downstream of the Mills Avenue Booster. As well, a new 400 mm diameter supply main is proposed along MacKenzie Boulevard to allow for backup filling of the MacKenzie Reservoir.

Following completion of the proposed supply system upgrades, the MacKenzie and Beacon Hill systems will be able to provide back-up supply to each other.

4.3 WATER SUPPLY FROM MACKENZIE RESERVOIR AND PUMPHOUSE TO THE SOUTHEAST REGIONAL RESERVOIR AND PUMPHOUSE

4.3.1 Existing System / Assessment

The areas downstream of the MacKenzie Reservoir and Pumphouse (to the southeast) are supplied through a 400 mm diameter waterline located along Highway 69. The 400 mm diameter pipe continues along the Highway to Range Road 83 where it travels north and supplies the Southeast Reservoir and Pumphouse. Refer to **Figure 4-1** to view the existing supply system.

Due to the construction of the 400 mm and 300 mm water lines, the Airport Reservoir and Pumphouse was previously abandoned. Fire flows to the Airport are now provided from the Southeast Industrial Reservoir and Pumphouse due to recent pumping and piping upgrades.

The estimated 2013 Peak Day demand of 20 L/s can be supplied to the Southeast Industrial Reservoir and Pumphouse at a pressure of 524 kPa (76 psi) at the reservoir.

4.3.2 Upgrades to Existing System

There are no upgrades required at the MacKenzie Reservoir in order to supply water to the Southeast Industrial Reservoir and Pumphouse. It is envisioned that water will typically be supplied during the overnight period, when typical operating demands are low. As well, it is anticipated that the existing distribution system is capable of providing interim service to Southlands 1A/1B, as well as a redundant supply to Anzac.

4.3.3 Ultimate System

Ultimately (at beyond 25 years), a peak day demand of 182 L/s can be delivered through the existing supply lines to the Southeast Reservoir and Pumphouse. This will not be sufficient to meet the ultimate peak day demands for the future development area. The associated shortfall of 93 L/s is anticipated to be supplied from the future Southwest Service Area, with a new reservoir and pumphouse to be located at the Southlands Industrial Area 1A. Refer to **Figures 4-3, 4-4** and **4-5** for the ultimate supply system concept.

The supply system will have the capacity to provide the total peak day demands for the downstream service area as well as for those development areas outside of the South Service Area, to beyond the year 2033. However, by the ultimate scenario there will be a peak day demand deficit and additional supply will be required from the Southwest Service Area. As it is anticipated that the future Southwest Service Area supply main (Hangingstone main) will be in full service prior to a South Service Area supply deficit, and that there will be sufficient capacity to allow for continued, and uninterrupted, development. This concept is presented in **Table 4-4** below:

Table 4-4
Southeast Industrial Servicing Capacity

Service Area	Peak Day Demand (L/s)				
	2018	2023	2028	2033	Ultimate
WTP Supply to South Service Area					
Lower Townsite	134	163	193	224	400
Abasand	45	47	48	50	50
Waterways/Draper	11	12	14	16	26
Mills Ave Booster (max capacity)	**600**	**600**	**600**	**600**	**600**
Urban Service Area					
Beacon Hill	19	22	22	22	22
MacKenzie/ Gregoire/ Prairie Creek	83	105	120	123	128
Gateway/Quarry Ridge	8	15	21	28	63
Southlands Industrial Area 4	0	8	13	17	38
Saline Creek	42	83	125	167	167
Southeast Industrial Area					
Airport West Industrial	8	19	23	28	71
Airport East Industrial	8	11	13	15	52
Saprae / Spruce Valley	13	16	20	24	42
Southlands Industrial Area 2	0	17	25	33	57
Anzac Regional System					
Anzac/Gregoire/First Nations	15	17	20	25	53
Subtotal Urban Service/Southeast/Anzac	**196**	**313**	**402**	**482**	**693**
Residual Capacity Remaining (Mills Ave minus Subtotal)	**404**	**287**	**198**	**118**	**-93**

4.4 WATER SUPPLY FROM SOUTHEAST INDUSTRIAL RESERVOIR TO SOUTHEAST REGIONAL SYSTEM

4.4.1 Existing System / Assessment

Water to the Southeast Regional system and the Anzac Reservoir is supplied from the Southeast Reservoir and Pumphouse through an existing 300 mm diameter supply waterline, as shown in Figure 4-1. An existing booster station is located approximately 19 km from the pumphouse. It boosts the incoming

pressure by an additional 54.6 m of pressure head during the peak day conditions. The HGL at the booster station will be pumping from approximately 517.2 m, to an HGL of 571.8 m.

The existing 300 mm diameter supply line has been designed to supply a peak day demand of 44.6 L/s from the Southeast Regional Pumphouse, however, the existing pumping capacity supplies only 20 L/s.

The Regional Municipality of Wood Buffalo – Southeast Regional Water Supply Line Predesign Report, May 2003 by Associated Engineering identifies the following 2052 peak day design flows:

• Gregoire Lake Estates	2.5 L/s
• Gregoire Lake First Nations	8.5 L/s
• Hamlet of Anzac (based on 3000 people)	25.0 L/s
• Anzac Service Growth	5.3 L/s
• Regional Allowance	3.3 L/s
PEAK DAY DESIGN FLOW	44.6 L/s

For the purpose of this Master Plan, the above ultimate design flows have been modified. Since the existing pipe has the potential capacity to transport additional flow (based on velocity), the above criteria has been simplified to increase the Hamlet of Anzac future population to 5,000 people, and exclude the Anzac Service Growth and Regional Allowance. The regional growth allowance was originally intended to supply potential camps, and was assumed to decrease over time. The Anzac Service Growth was an allowance of 20% which was included for community support services such as hotels and restaurants.

If a significant demand does occur along the line in the future, this will decrease the potential population to be served in Anzac.

4.4.2 Upgrades to Existing System

It is understood that the Municipality has experienced maintenance issues (waterline breaks) along the existing Anzac supply line, which have been difficult to access to repair. As a result, the Municipality is planning to move ahead with a secondary waterline to Anzac, in order to provide a redundant and more reliable supply to the community.

This will involve conveying water south from MacKenzie via the proposed Southeast Supply Line. Water will be pumped from the MacKenzie Pumphouse, through a connection to the MacKenzie distribution system, to a reservoir and pumphouse located at the Southlands 1A/1B site. The *South East 881 Water Supply Line (SESL) Report, MMM, 2015*, indicates that water would then be boosted at the Southlands pumphouse, the remainder of the way to Anzac. Additional pumping will be required near Highway 881 to supply the ultimate design demands.

It is also understood that the Municipality is planning on installing a third pump at the Southeast Regional Pumphouse, in order to increase the reliability of the existing system.

4.4.3 Ultimate System

In order to deliver the full pipeline design flows, further pump upgrades will be required at the Southeast Regional Reservoir and Pumphouse, as well as the existing Anzac Booster Station. To supply a future population of 5,000 people at the Hamlet of Anzac, an additional booster station will be required upstream from the existing booster station at approximately 15 km from the Pumphouse (Refer to **Figure 4-3**). This is in addition to pumping upgrades at the Southeast Regional Pumphouse and at the existing Anzac Booster Station. It should be noted that depending on the time frame of the SESL line construction, the proposed Booster Station may not be required. It is possible that populations beyond 5,000 can be supplied using the existing 300 mm diameter pipeline, however, additional booster stations will be required as will a sufficient upstream supply of water.

For the ultimate scenario, a number of threshold populations were previously investigated and a maximum ultimate population of 15,000 people was adopted for the Hamlet of Anzac (in addition to those already serviced along the line).

4.5 WATER SUPPLY FROM WTP TO NORTH SERVICE AREA

4.5.1 Existing System / Assessment

The WTP supplies the Thickwood and Timberlea neighbourhoods through an existing 600 mm diameter supply pipeline, as shown in **Figure 4-1**. The 600 mm line extends from the Water Treatment Plant to the Timberlea Reservoir and Pumphouse, while a 300 mm diameter lateral supplies the Thickwood Reservoir and Pumphouse. A new 900 mm diameter main was recently constructed from the WTP to the Thickwood lateral connection and is interconnected to the existing 600 mm supply line at this location.

Immediately downstream of the Thickwood lateral connection, the 900 mm diameter supply main reduces to a 750 mm diameter main. A second interconnection is made to the existing 600 mm main at Loutit Road in Timberlea. This connection reduces the velocity within the 600 mm diameter main to within acceptable limits. The remainder of the new supply line (from the Timberlea lateral to the Parsons Creek Reservoir) has recently been constructed, however is not yet operational.

A hydraulic review of the pipelines was previously carried out by Associated Engineering. Although a 750 mm diameter pipe would have the capacity to service the expansion areas, a 900 mm diameter main was proposed and constructed from the WTP to the Thickwood lateral connection. The watermain is interconnected to the existing 600 mm supply line at this location, and will have sufficient remaining capacity in order to reduce the flow (and resulting high velocity) in the existing main.

The 300 mm lateral to the Thickwood Reservoir and Pumphouse will experience a velocity of 2.3 m/s during the ultimate peak day demand scenario. Velocities are recommended to be in the order of 1.5 m/s as per the design criteria outlined within this report.

A once abandoned 300 mm diameter waterline located along Confederation Way and Thickwood Blvd. was recently put back into service. A PRV station was installed north of the Dickinsfield connection in order to allow the Timberlea system to reinforce the Thickwood system during periods of low pressure (during high peak demands or emergency conditions). The PRV will reduce the Timberlea zone pressure (412 m HGL) to the Thickwood zone pressure (405 m HGL), providing improved system redundancy and reliability.

4.5.2 Upgrades to Existing System

As identified in the existing system assessment, upgrades are required in order to supply the peak day flows. A new 900/750 mm supply main is under construction (to be completed in 2015) in order to service the Parsons Creek area.

It is recommended that the existing 300 mm lateral pipeline to the Thickwood Reservoir, be upgraded to a 400 mm diameter pipeline which will result in decreasing the velocity and head loss to meet peak day demands.

4.5.3 Ultimate System

Figure 4-3 presents the ultimate supply system concept. Following the construction of the 900 mm and 750 mm diameter supply main to Parsons Creek and the 400 mm lateral to Thickwood, there will be sufficient capacity within the supply mains to convey the ultimate design flows (exclusive of the Fort MacKay and North Transmission line demands). It is proposed that a 600 mm diameter supply main be installed to service the future West Growth area. A booster station will be required at the Parsons Creek Reservoir and Pumphouse to increase the delivery pressures to the future West Growth Reservoir in interim years, until the outgoing pressure at the WTP is increased to a proposed 400 m HGL. A Hydraulic Gradeline of the proposed Ultimate North Service Area Supply System is included as **Figure 4-6**.

A new reservoir is proposed to be located north of the existing Highway 63 Corridor development, with a lateral from the Parsons supply line. The reservoir will allow for additional land to be serviced (including fire flows) and will provide a redundant supply to the heavily used truckfill.

A future regional line north to Fort MacKay is also proposed to be serviced off of the Parsons supply line. The pipeline is planned to service the Hamlet of Fort MacKay as well as a future truckfill and potentially industrial users. The *Regional Municipality of Wood Buffalo – Fort MacKay Intake and Raw Water Reservoir, Fort McMurray North Transmission Line Feasibility Study, August 2012*, *Associated Engineering*, identifies the projected demands for the future watermain as follows:

- Fort MacKay: 24 L/s
- Truckfill: 135

The available water for industry will depend on the pipe size ultimately selected. It has been assumed that a 600 mm diameter main will be installed for the purpose of this report, resulting in a total peak day flow of 310 L/s.

It should be noted that installing a large truckfill north of the Municipality may significantly reduce the demand for water at the Highway 63 Corridor truckfill. As such, both the Highway 63 Truckfill and Future North Truckfill have been assumed will operate at 50% of the original design flows, i.e. at 67.5 L/s rather than 135 L/s. Further work will be required to develop the overall servicing concept for the North Service Area. There are two potential supply options:

- A booster pumphouse
- Reservoir and pumphouse

Either one of these facilities is anticipated to be constructed at the north end of the Parsons Creek development. If a booster station is to be constructed, a SCADA system will be required in order to ensure that the WTP pumps will operate as required. If it is found that the WTP cannot provide the necessary level of service to support a booster station, then a Reservoir and Pumphouse will be required. Only equalization storage will be necessary, as typical Peak Day plus Fire Flow storage will be required at the downstream customer locations.

In order to supply Fort MacKay (and potential industrial users along the alignment), water demand will need to be borrowed from the future West Growth Area allocation. Ultimately, another supply from the future WTP to the North Service Area will be required in order to make up the demand shortfall.

4.6 WATER SUPPLY TO THE SOUTHWEST SERVICE AREA

4.6.1 Ultimate System

The *Fringe Area Development Assessment" report, performed by Armin Preiksaitis & Associates and Associated Engineering*, identifies two new potential urban areas located southwest of the existing South Service Area, between the Athabasca River and the Hangingstone River. The two new developments are referenced in the 2015 Water Master Plan as the Horse River area and the Hangingstone area (refer to **Figure 4-3**).

Water will be supplied to the Southwest Service Area (Horse, Hangingstone and Southlands) via the existing WTP in the short term, and a new future south WTP in the ultimate development scenario. The proposed south WTP will not be required until such time as the existing WTP is nearing capacity. Based on the current population projections, this may not be required for approximately 20 years.

In the short term, the Southwest Service area will be supplied off of the same header as the North Service Area, and will therefore have the same initial supply pressure from the WTP. The outgoing pressure is currently at 385 m HGL, and is anticipated to be increased to 400 m HGL in the ultimate development scenario. Water will be conveyed via the 750 mm supply line to the LTS lateral (currently under construction), continuing as a 600 mm supply line to the Abasand lateral. The pipeline will be extended as a 600 mm main to provide interim service to the Horse and Hangingstone Areas and future emergency supply

if required. The proposed 600 mm pipeline will be capable of conveying a population in the order of 30,000 people.

It will not be necessary to re-pump water from the Abasand Pumphouse in order to provide interim supply to the future Horse River Reservoir 1, as the supply system will be tied into the North Service header. The ultimate peak day supply demands are anticipated to be in the order of 90 L/s, in line with the requirements for servicing the proposed Riverbend development. Although ultimately, it is envisioned that the Horse River (Riverbend) Reservoir be supplied via the Hangingstone Reservoir, it may be necessary to supply a portion of this demand via the interim connection, in order to maintain water quality within the pipe.

In the ultimate system, water will be conveyed from the proposed south WTP to the Hangingstone Reservoir and Pumphouse 1, for further re-distribution to the Horse, Southlands 1A/1B and other downstream users. It is anticipated that an ultimate HGL in the order of 395 m will be required from the South WTP.

Two 750 mm mains are proposed to be constructed form the South WTP to the central Hangingstone Reservoir and Pumphouse 1. The pumphouse will supply the local Hangingstone area, as well as ultimate supply to the Horse (Riverbend area) and south to the Southlands, Highway 881/63 and beyond to Anzac. It is proposed that one 750 mm main from the new WTP to the central Hangingstone Reservoir 1 be constructed initially, with the second one constructed as demands warrant.

New 600 mm diameter supply mains are proposed downstream of the Hangingstone Reservoir heading north to the Horse River Reservoir 1, as well as south the Southlands 1A Reservoir. A 600 mm interconnection is proposed to be constructed between the southwest supply main and the MacKenzie Reservoir, which can operate as a backup supply to the MacKenzie distribution system as well as further downstream users.

Figure 4-7 presents a Hydraulic Gradeline of the proposed Ultimate Southwest Service Area supply system.

4.7 WATER SUPPLY FROM SOUTHWEST HANGINGSTONE RESERVOIR AND PUMPHOUSE TO FUTURE SOUTHLANDS INDUSTRIAL RESERVOIR AND PUMPHOUSE

In addition to the above mainly residential areas, the Southwest Service Area will also include substantial industrial and commercial developments located south of Highway 69 and east of Highway 63. Ultimately, the supply line will be extended to provide service from the Hangingstone Reservoir #1, the Southlands Industrial Reservoir and Pumphouse. The section of main from the MacKenzie Reservoir south to Southlands 1A/1B, Highway 881 and Anzac, is now referred to as the Southeast Supply Line (SESL).

Initially, water can be supplied to the proposed pumphouse via constructing a portion of the proposed 600 mm SESL from the MacKenzie distribution system to the Southlands Reservoir. It should be noted that the 2015 SESL Report indicates a pipe internal diameter of 615 mm.

The MacKenzie distribution system will supply the Southlands 1A development in the interim condition, or until such time as the upstream portion of the Southwest Supply Line is constructed and supplied from the Hangingstone Reservoir and Pumphouse. At this time the South East Supply Line (SESL) at MacKenzie will be disconnected from the distribution system, and a fill line could be constructed for redundant supply.

A Hydraulic Gradeline of the proposed Ultimate Southwest Service Area supply system is provided as **Figure 4-7**. **Figure 4-8** shows the Ultimate Expansion Area Servicing concept for the Municipality.

4.8 WATER SUPPLY FROM THE FUTURE SOUTHLANDS INDUSTRIAL RESERVOIR AND PUMPHOUSE TO THE HAMLET OF ANZAC

The 2011 Water Master Plan proposed that a population beyond 5,000 for the Hamlet of Anzac would be supplied from the Southwest Service Area. This was deemed necessary due to a shortfall in the supply capacity in the South Service Area at the Ultimate service population. As such, a second supply main was proposed to service the Hamlet.

The 2011 Water Master Plan assessed various threshold populations and the associated pipeline sizes. As the estimated pipe sizes (and therefore costs) do not increase significantly between the threshold populations, it was recommended that an ultimate population of 15,000 people at the Hamlet of Anzac be identified. This includes 5,000 people serviced from the existing Southeast Regional pipeline (South Service Area) plus 10,000 people from the future Southwest Service area via Southlands. It was determined that to accommodate an additional 10,000 people (for a total population of 15,000), that a 400 mm diameter would be required downstream of Southlands 1A/1B (2015 SESL Report, indicates an internal diameter of 427 mm).

In the Ultimate demand scenario, water will be pumped from the Southlands Industrial Reservoir and Pumphouse to an HGL of 480 m and re-pumped at Highway 881/63 development, to an HGL of 530 m to the Hamlet of Anzac. The 2015 SESL Report indicates interim pumping to approximately 512 mm HGL at Southlands, to delay pumping requirements at Highway 881.

Figure 4-7 presents the Hydraulic Gradeline for the Ultimate Peak Day Demand. Twinning of the pipeline will not be required if the population does not grow beyond 5,000 at Anzac, other than for redundancy.

4.9 ULTIMATE EXPANSION AREA SERVICING

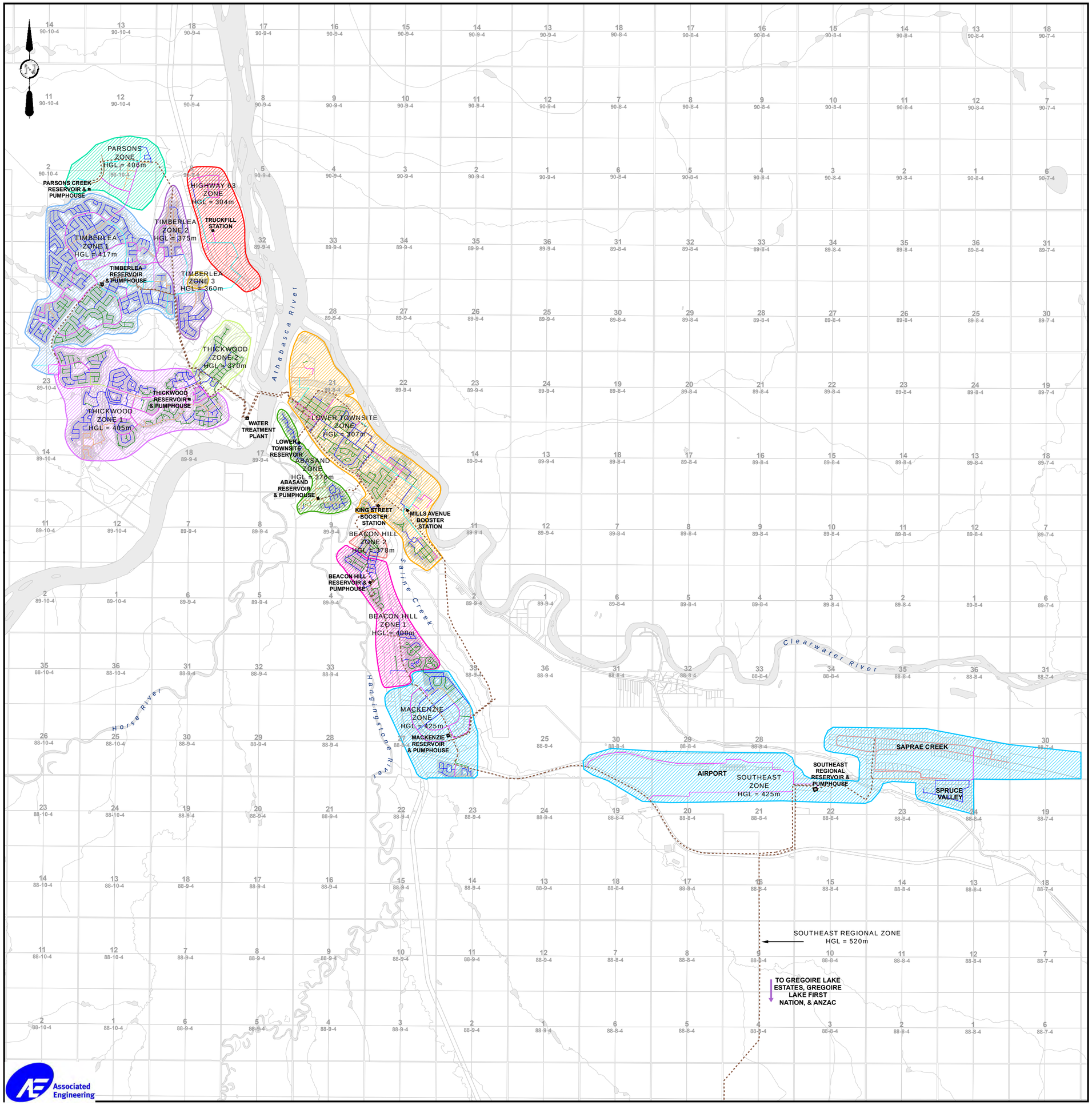
Figure 4-8 presents the Ultimate Expansion Area Servicing concept for the Municipality. Although highly conceptual, it shows the future water expansion areas to the south of Horse River and Hangingstone and in the Forest Heights areas. An additional WTP is identified in order to service future populations, as well as to provide some redundancy to existing service areas. In the west, a future Transportation Utility Corridor (TUC) is proposed adjacent to the future highway bypass concept. This will provide land within which pipelines and power lines could be located in an orderly, controlled fashion.

4.10 SUPPLY SYSTEM FLEXIBILITY

It is generally recommended that the supply system be designed to allow for backflow to upstream areas, in case of supply interruption. This is envisioned to occur at the reservoir and pumphouses, by installing a zone bypass. The zone bypass could consist of a gravity connection out of the reservoir, which provides back pressure based on the reservoir water level. Alternatively, the bypass could connect the distribution pump header pipe to the inlet pipe, thorough a PRV. **Figure 4-9** illustrates these concepts.

4.11 COMPREHENSIVE WATER SUPPLY SYSTEM MAP

Figure 4-10 presents the Comprehensive Water Supply System Map. This figure combines the various supply system components including supply mains, storage and pumping facilities with the ultimate distribution system, pressure zones and future projected demands.



Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN

EXISTING WATER SUPPLY SYSTEM AND PRESSURE ZONES

FIGURE 4-1

LEGEND:

- EXISTING 100mmØ WATERMAIN
- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 350mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

SCALE 1:60,000

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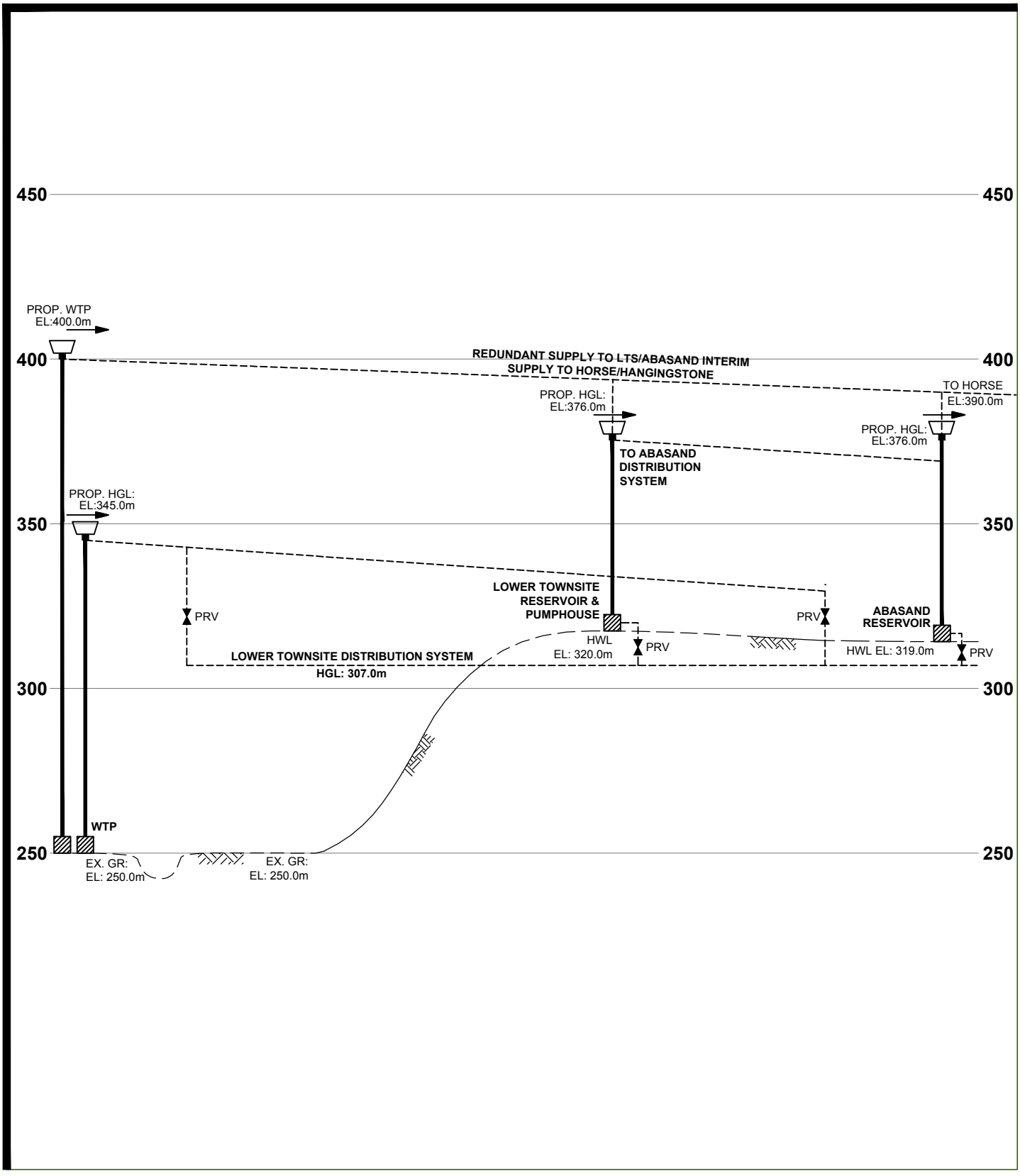

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2015 WATER MASTER PLAN

PROPOSED LOWER TOWNSITE RESERVOIR FILL SCHEMATIC

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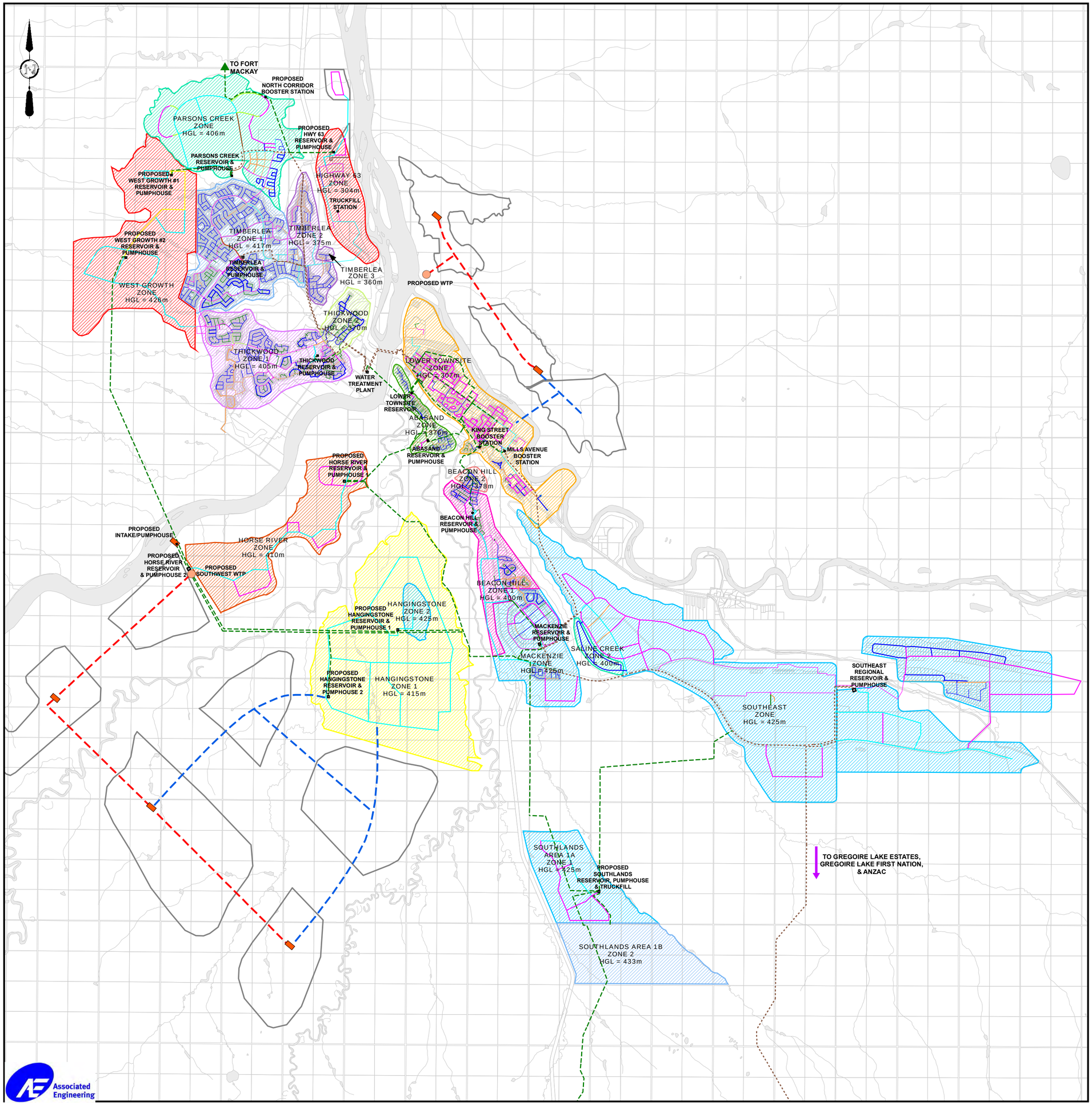
FIGURE 4-2



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2015 WATER MASTER PLAN

ULTIMATE WATER SUPPLY SYSTEM AND PRESSURE ZONES

FIGURE 4-3

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 350mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- PROPOSED 150mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 350mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- PROPOSED 450mmØ WATERMAIN
- PROPOSED 500mmØ WATERMAIN
- PROPOSED 600mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- FUTURE EXPANSION AREAS
- FUTURE WATER TREATMENT PLANT
- FUTURE RESERVOIR/ PUMPHOUSE OR BOOSTER STATION
- FUTURE SUPPLY LINE
- FUTURE DISTRIBUTION LINE

SCALE 1:70,000

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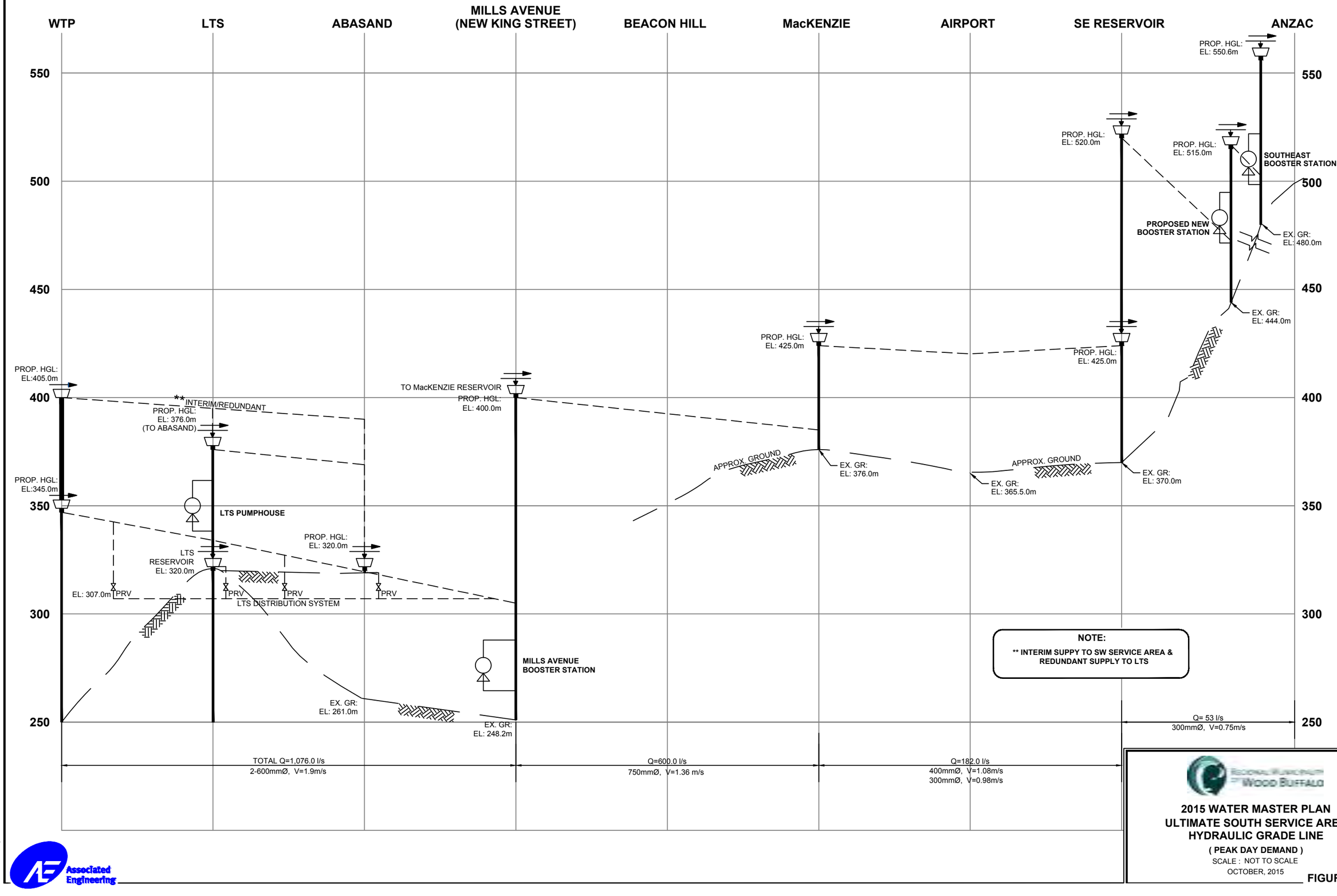

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Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN
ULTIMATE SOUTH SERVICE AREA
HYDRAULIC GRADE LINE
(PEAK DAY DEMAND)
SCALE : NOT TO SCALE
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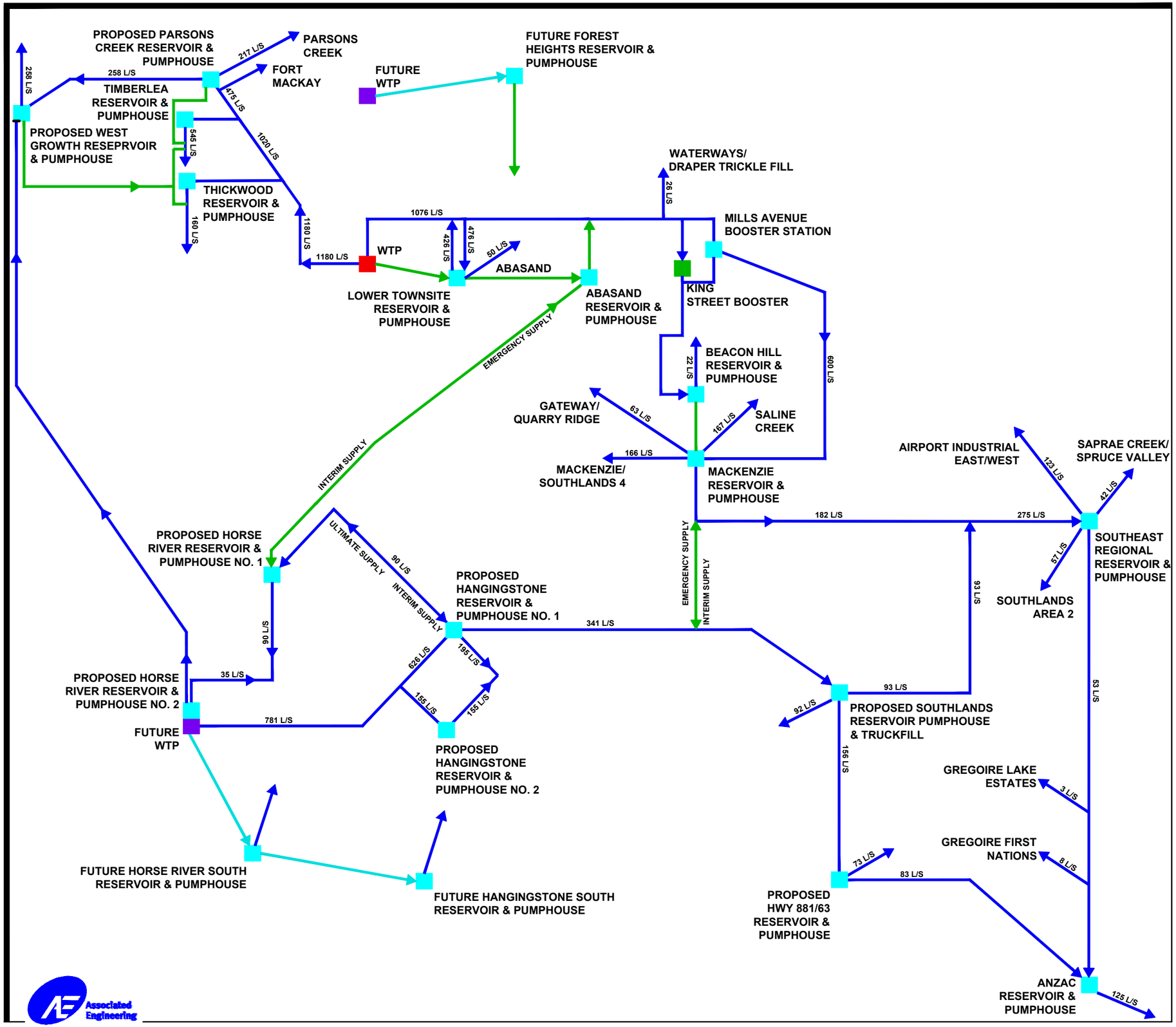
FIGURE 4-4



2015 WATER MASTER PLAN

FORT McMURRAY WATER SUPPLY OVERVIEW

ULTIMATE PEAK DAY DEMANDS

LEGEND:

SYSTEM INTERCONNECTION (FOR EMERGENCY/BACK-UP PURPOSES)

NOT TO SCALE

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FIGURE 4-5

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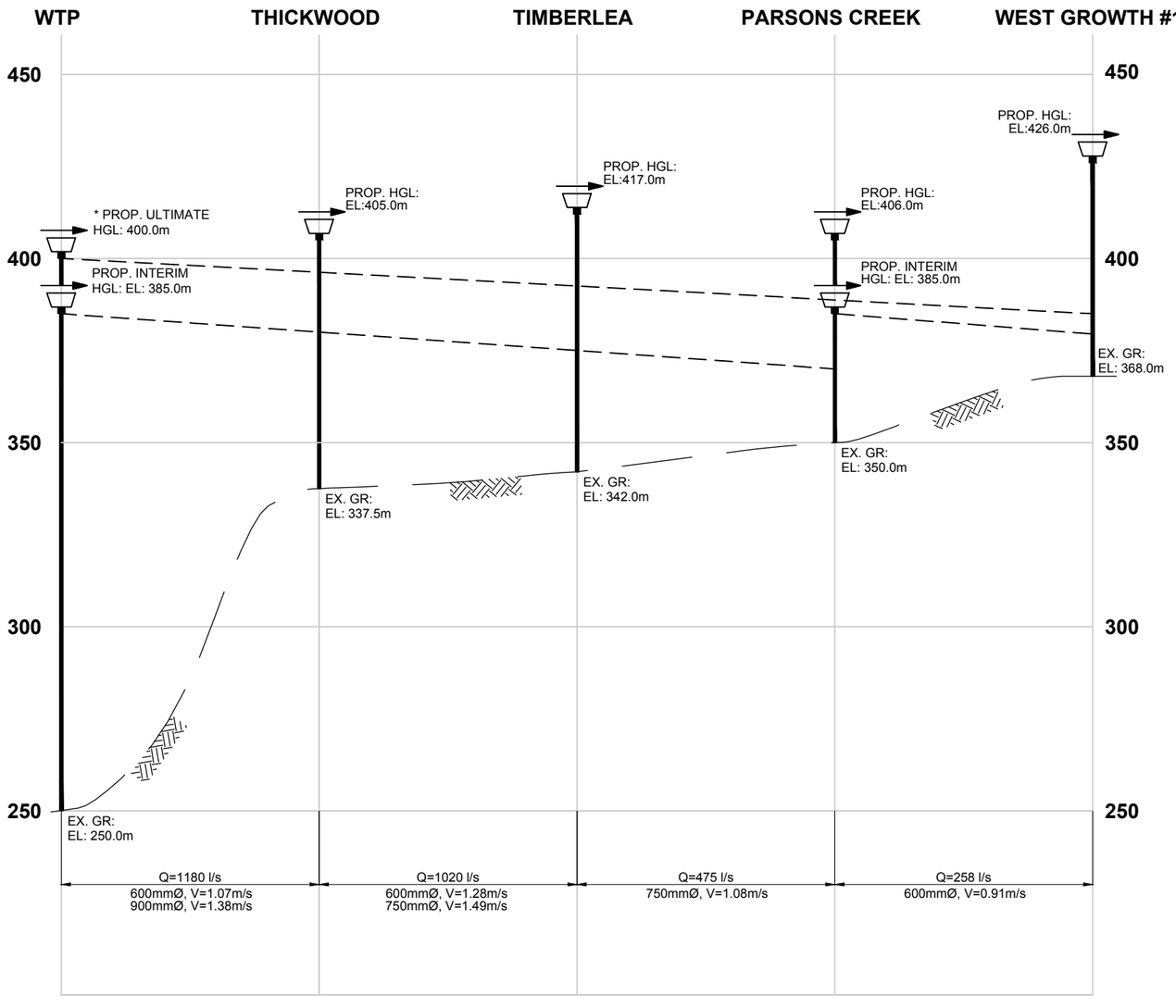

* HGL WILL INCREASE TO 400m IF INTERIM SUPPLY IS REQUIRED TO HANGING STONE, OR IF THE BOOSTER TO WEST GROWTH IS ELIMINATED.

Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN
ULTIMATE NORTH SERVICE AREA
HYDRAULIC GRADE LINE
(PEAK DAY DEMAND)
SCALE :NOT TO SCALE
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FIGURE 4-6

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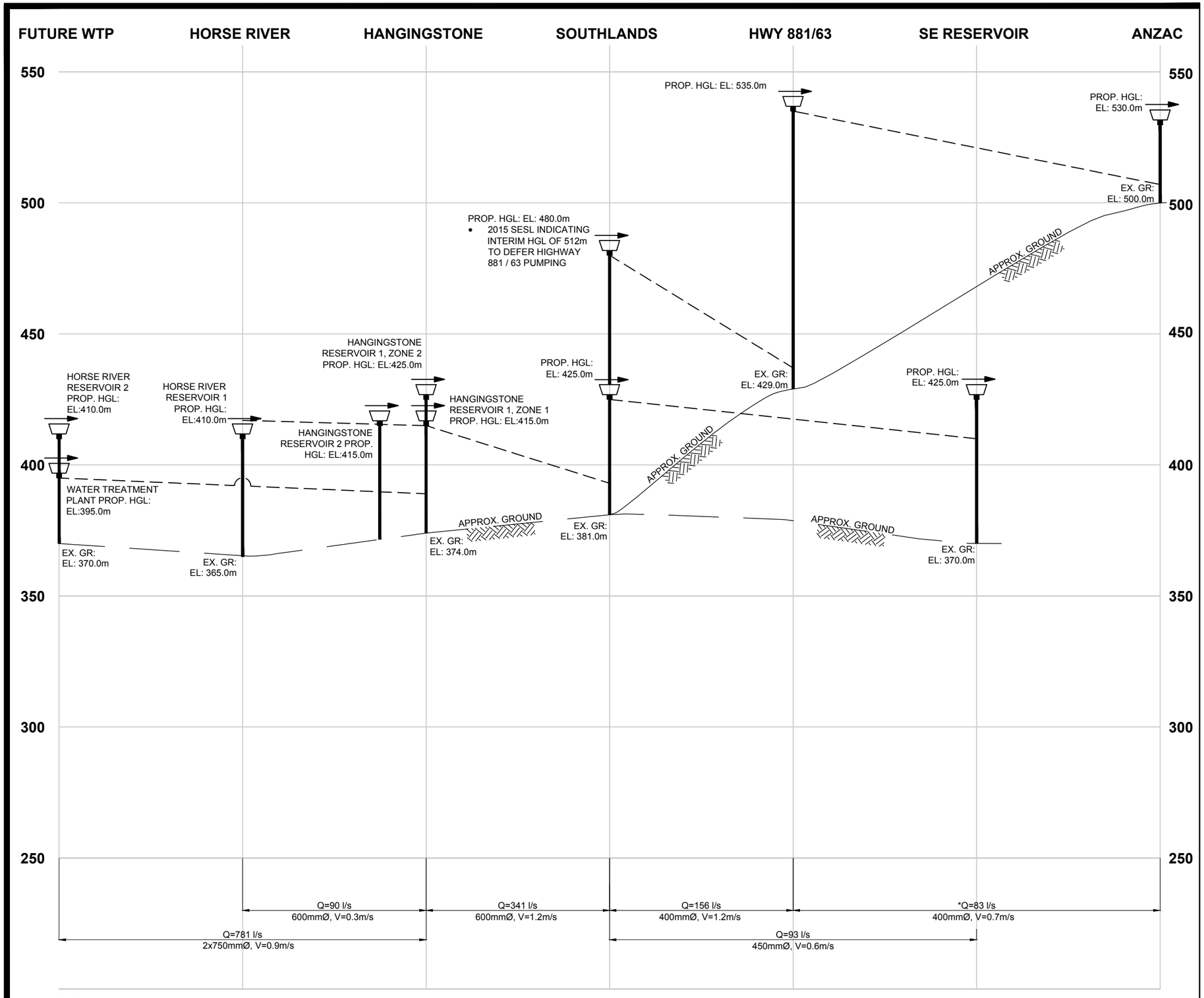

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REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

ULTIMATE SOUTHWEST SERVICE AREA HYDRAULIC GRADE LINE (PEAK DAY DEMAND)

NOT TO SCALE

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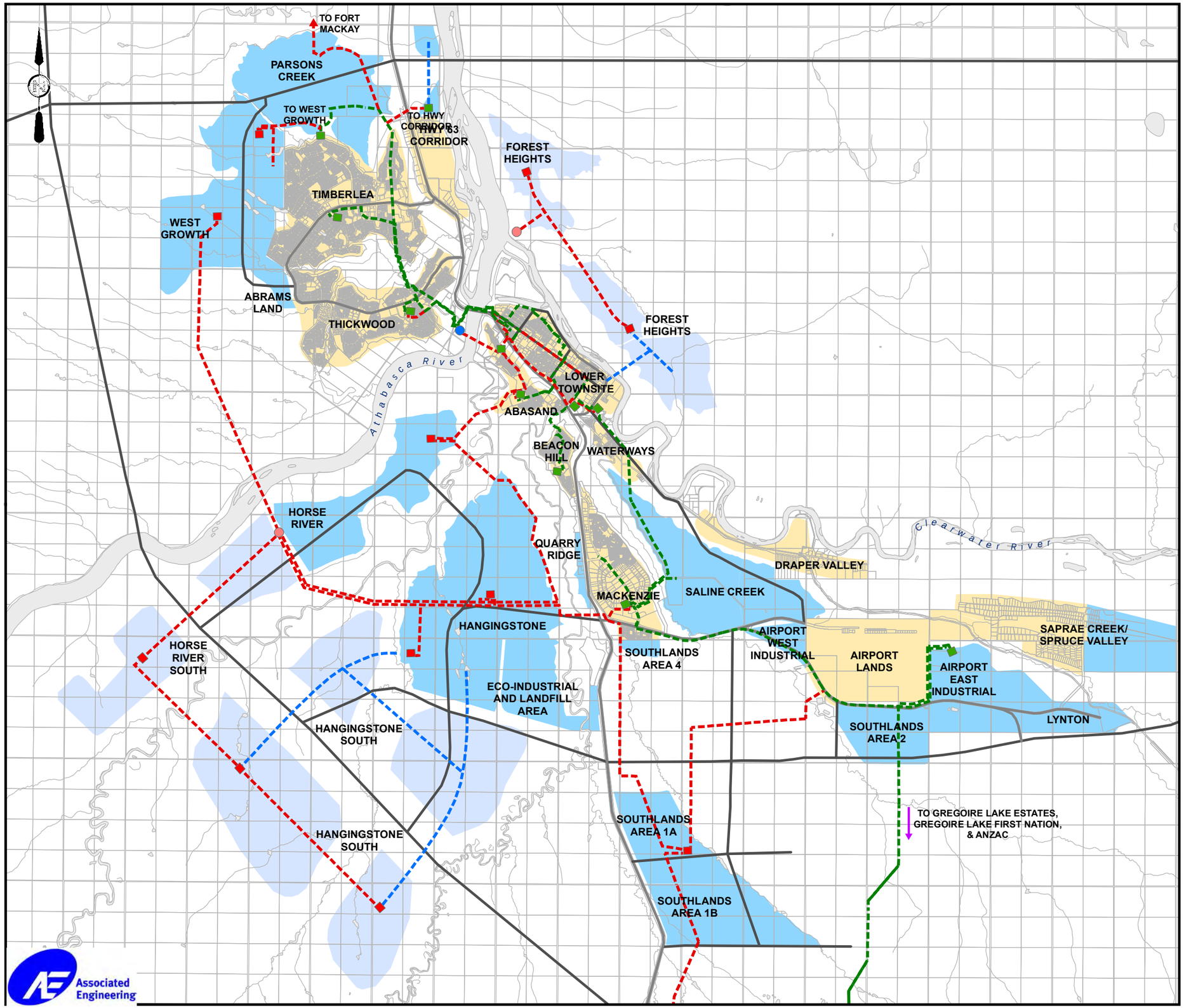
FIGURE 4-7



Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN

ULTIMATE EXPANSION AREA SERVICING

LEGEND:

- EXISTING DEVELOPMENT
- PROPOSED DEVELOPMENT
- FUTURE EXPANSION
- EXISTING HIGHWAY/ TRANSPORTATION CORRIDOR
- FUTURE HIGHWAY/TRANSPORTATION CORRIDOR CONCEPT
- EXISTING SUPPLY LINE
- FUTURE SUPPLY LINE
- FUTURE DISTRIBUTION LINE
- EXISTING RESERVOIR/PUMPHOUSE OR BOOSTER STATION
- EXISTING WATER TREATMENT PLANT
- FUTURE RESERVOIR/PUMPHOUSE OR BOOSTER STATION
- FUTURE WATER TREATMENT PLANT

SCALE 1:100,000

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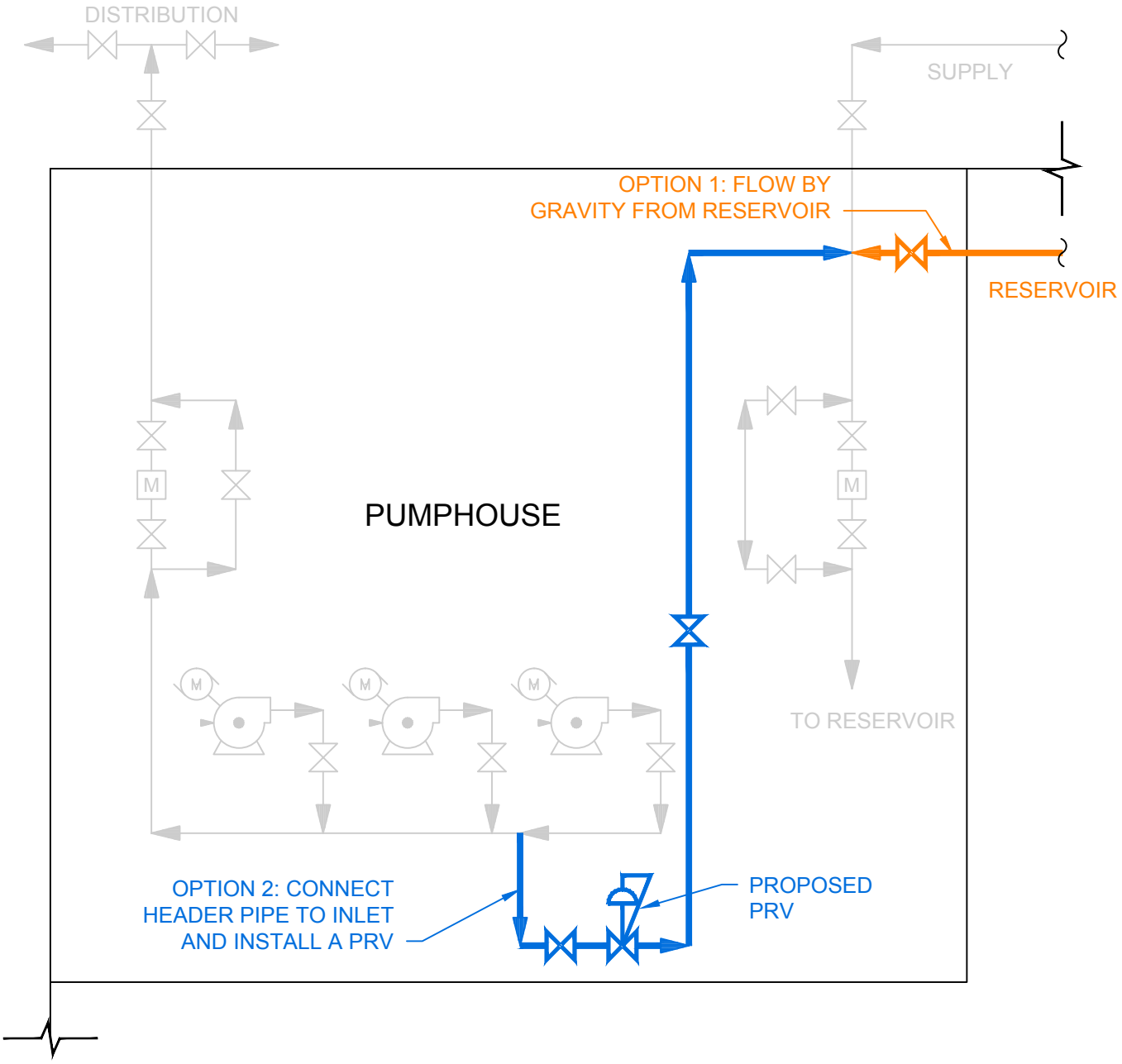
FIGURE 4-8



NOTE:
THE ZONE BYPASS WOULD REQUIRE MANUAL OR REMOTE CLOSURE OF THE INLET VALVES IN THE PUMPHOUSE.

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

TYPICAL ZONE BYPASS DETAIL

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FIGURE 4-9

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Ultimate Peak Day Demands (L/s)			
South Service Area		**North Service Area**	
LTS	400	Thickwood	160
Abasand	50	Timberlea	350
Waterways / Draper	26	Parsons Creek	217
Beacon Hill	22	West Growth	258
Mackenzie	128	Highway 63 Corridor	60
Saline Creek	167	Highway 63 Truckfill	67.5
Southlands 4	38	Fort MacKay / North Transmission*	170
Gateway / Quarry Ridge	63	Future North Truckfill*	67.5
Airport Industrial / East / West	94		
Saprae Creek / Spruce Valley	42	**Southwest Service Area**	
Southlands 2	57	Horse River	125
Anzac	53	Hangingstone	350
		Southlands 1A/1B	92
		Highway 881/63	73
		Anzac	83

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

COMPREHENSIVE WATER SUPPLY SYSTEM MAP ULTIMATE PEAK DAY DEMANDS

FIGURE 4-10

LEGEND:

- EXISTING DISTRIBUTION LINE
- PROPOSED DISTRIBUTION LINE
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- FUTURE EXPANSION AREAS
- FUTURE WATER TREATMENT PLANT
- FUTURE RESERVOIR/ PUMPHOUSE OR BOOSTER STATION
- FUTURE SUPPLY LINE
- FUTURE DISTRIBUTION LINE

*** Demands associated with Fort MacKay and the North Transmission Line will be 'borrowed' from the West Growth allocation. These demands are conceptual and are therefore not currently shown on the supply system.**

Note: Pumping heads are not identified for pumphouses with zone HGL's presented.

SCALE 1:70,000

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5 South Service Area

5.1 GENERAL

The water system within the study area has been assessed using the computer modelling software "WaterCAD" by Bentley. The distribution system will generally be assessed based on the following scenarios:

- Peak Hour Demand.
- Peak Day plus Fire Flow Demand.

In addition, maximum system pressures will be presented based on the design zone HGL.

In general, the ultimate system upgrades presented have been based on meeting minimum recommended fire flows, as well as to account for increased demand due to population growth. The upgrades do not necessarily identify all locations which do not meet the minimum recommended sizes (as per Section 2 Design Criteria). These upgrades are suggested to be implemented when infrastructure upgrading opportunities arise (i.e. roadway rehabilitation).

Figures 5-1 and 5-2 identify the overall ultimate system concept for the South Service Area. Figures 5-3 through 5-14 provide information specific to each neighbourhood.

5.2 PRESSURE ZONES

5.2.1 Existing Pressure Zones

The South Service Area is comprised of six (6) existing pressure zones. Pressure zones are labelled and referred to by the typical zone HGL (delivery pressure plus elevation, as determined from pumphouse outgoing pressures and/or PRV settings). The existing South Service Area pressure zones are identified on Figure 4-1. These include:

- **Zone 307 m HGL Lower Townsite Zone** - The existing Lower Townsite pressure zone as defined by five PRV's.

- **Zone 376 m HGL Abasand Zone** - The existing Abasand pressure zone as defined by the LTS Reservoir and Pumphouse outgoing pressure (and the Abasand Reservoir and Pumphouse outgoing pressure as required) .

- **Zone 400 m HGL Beacon Hill Zone 1** – The existing pressure zone for the majority of the Beacon Hill subdivision (south of the existing PRV's), including the industrial lots along Gregoire Drive and the northern section of Gregoire Park. Gregoire Park is divided into two zones by a closed valve at Greeley Road. The pressure zone is defined by the outgoing pressure from the Beacon Hill Reservoir and Pumphouse.

- **Zone 378 m HGL Beacon Hill Zone 2** – The existing pressure zone at the north end of the Beacon Hill subdivision as defined by three PRV's.

- **Zone 425 m HGL MacKenzie/Southeast Industrial Zone** – This pressure zone is comprised by two pumping facilities:
  - The MacKenzie Industrial Reservoir and Pumphouse.
  - The Southeast Industrial Reservoir and Pumphouse

  The zone includes the MacKenzie Industrial Park and the southern portion of Gregoire Park, Prairie Creek subdivision. The MacKenzie Pumphouse also supplies the Southeast Industrial Reservoir. The Southeast Industrial Reservoir operates within the same pressure zone as MacKenzie, and supplies the Airport, Saprae Creek and Spruce Valley developments when operating.

- **Zone 520 m HGL Southeast Regional Zone** – The existing pressure zone for the Southeast Regional System as defined by the outgoing pressure from the Southeast Reservoir and Pumphouse.

5.2.2 Ultimate Pressure Zones

In the future, some modifications to the South Service Area pressure zones are anticipated (refer to **Figure 4-3**):

- **Zone 376 m HGL Abasand Zone** - The Lower Townsite Reservoir and Pumphouse will supply the Abasand Area at this outgoing HGL, without assistance from the Abasand Pumphouse (other than during fire/emergency scenarios).

- **Zone 400 m HGL Gregoire Park Zone** - The MacKenzie Industrial Reservoir and Pumphouse will supply the Gregoire Park area through PRV's which will reduce the MacKenzie zone pressure of 425 m HGL to a proposed 400 m HGL in Gregoire Park. This area currently experiences a zone HGL of 400 mm, however, it is supplied solely from Beacon Hill.

- **Zone 425 m HGL Saline Creek Zone 1** - The existing MacKenzie zone of 425 m HGL will be extended to supply the Saline Creek development and Gateway/Quarry Ridge. The majority of Saline Creek will become part of the greater MacKenzie/Southeast Industrial Zone.

- **Zone 400 m HGL Saline Creek Zone 2**- The future Saline Creek area will require PRV's to create a small zone in the southwest. It is proposed that the zone be set at an HGL of 400 m.

5.3 LOWER TOWNSITE

5.3.1 Lower Townsite – Existing System

The LTS Reservoir is located east of the WTP on the south side of Highway 63 in the Abasand development area. The supply system is fully described in Section 4.1. In short, water is supplied from the WTP via high pressure water lines which fill the LTS Reservoir, or are reduced through PRV's into the distribution system at an HGL of 307m.

The LTS Reservoir is filled by the existing 300 mm diameter high pressure main through a three way valve. This enables the LTS Reservoir to feed back into the distribution system in order to help supply peak demand periods. The LTS distribution system is fed from high pressure mains at five locations through pressure reducing valve (PRV) stations. Photo 5-1 below identifies the Lower Townsite Reservoir.

Photo 5-1
Lower Townsite Reservoir

Table 5-1
Lower Townsite Projected Water Demand

Water Demand (L/s) Supply to LTS Reservoir			
Year	Peak Hour Demand (LTS + Waterways + Draper)	Peak Day Demand (Abasand)	Total
2013	116	43	159
2018	145	45	190
2023	175	47	222
2028	207	48	255
2033	240	50	290
Ultimate	426	50	476
Supply from LTS Reservoir (LTS + Waterways + Draper)			
	Peak Hour Demand	**Peak Day plus Fire Flow**	
2013	172	349	
2018	217	378	
2023	260	408	
2028	308	440	
2033	358	473	
Ultimate	637	659	

Table 5-1 shows the projected water demands for the area. The values are based on supplying the Peak Hour demands for the Lower Townsite and Waterways distribution systems, while ensuring that the Peak Day demands can be supplied to the Abasand Reservoir and Pumphouse. The demands also include a peak day component for future servicing of the Draper Road area (shown for 2015 and on). Also shown for the year 2015 and beyond, is a Peak Hour demand for Abasand, which is anticipated to be provided from the Lower Townsite Pumphouse.

5.3.2 Lower Townsite – Existing System Assessment

The Lower Townsite (LTS) is fed directly from the WTP. Excess pressure from the WTP fills the existing LTS Reservoir. Normal operating pressure at the WTP is approximately 710 kPa (72.4 m or HGL of 322.4 m based on a WTP elevation of 250.0 m). The average elevation in the Lower Townsite is approximately 250.0 m; therefore, typical system pressures would be approximately 103 psi or 72.4 m if not for the existing PRV's within the Lower Townsite.

The supply mains connect to the distribution system through five PRV stations. These stations have been set to reduce the pressure to 307 m HGL. The resulting maximum pressure based on this maximum gradeline is approximately 631 kPa (91 psi), with much of the Lower Townsite exceeding 550 kPa (80 psi) during the peak hour. The minimum pressure modelled during the peak hour demand scenario was 426 kPa (62 psi). Figure 5-3 identifies the peak hour pressures within the Lower Townsite distribution system.

Some nodes along existing supply lines experience pressures beyond 620 kPa during typical operating conditions.

The existing distribution system is not capable of supplying the recommended minimum fire flows to some locations within the Lower Townsite (refer to **Figure 5-4**). This is mainly the result of undersized mains, many of which are 150 mm in diameter and were installed in 1963. The figure identifies those nodes which do not meet the minimum recommended peak day plus fire flow demands, and identifies the severity of the deficiency.

The existing Lower Townsite Storage Reservoir is 16,200 m^3, which includes a recent expansion. A pumphouse was also constructed at the reservoir in order to service the Abasand area. The pumphouse will supply typical demands to the Abasand area when fully operational. It is understood that the LTS Pumphouse is currently operating, with some support from the Abasand Pumphouse. The Abasand Reservoir and Pumphouse will retain its fire pumps to provide fire flow for the Abasand Area, and will need to back feed into the Lower Townsite to provide circulation of the reservoir.

Table 5-2 presents the storage capacity analysis, based on the requirements outlined by AEP. The demands include those for the Lower Townsite, Waterways and Draper as well as for Abasand.

Table 5-2
Lower Townsite Reservoir – Projected Storage Volume (m^3)

Year	Existing Storage Volume (m^3)	Existing Avg. Day Flow (L/s)	15% Avg. Day Flow (m^3)	25% Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Req'd Storage (m^3)	Surplus/ Deficit (m^3)
2013	16,200	57	739	2,462	2,516	5,717	10,483
2018	16,200	95	1,231	4,104	2,516	7,851	8,349
2023	16,200	110	1,426	4,752	2,516	8,694	7,506
2028	16,200	126	1,620	5,400	2,516	9,536	6,664
2033	16,200	145	1,879	6,264	2,516	10,659	5,541
ULTIMATE	16,200	238	3,084	10,282	2,516	15882	318

As shown in the above table, the Lower Townsite Reservoir has sufficient storage capacity to provide the ultimate demands for the Lower Townsite, Waterways, Abasand and Draper area.

5.3.3 Lower Townsite – Upgrades to Existing System

Several upgrades are recommended within the LTS system, although many relate to the supply system and the ability to provide peak flow further downstream. In moving toward developing the future ultimate supply/distribution system in the LTS area, the following short term (interim upgrades) have been proposed:

- Construct the LTS 4-Way Chamber in the vicinity of Saunderson Avenue.
- Construct a 650 mm high pressure supply line to the LTS Reservoir Station.
- Construct a 750 mm high pressure supply line from the LTS Reservoir to the proposed LTS 4-Way Chamber.
- Construct a 750 mm main along Hardin Street from Franklin Avenue to Highway 63 (complete in 2015).
- Construct a 750 mm supply main along Highway 63, at King Street, complete with PRV stations (complete in 2015).

In the interim scenario, the high pressure main will supply the LTS Reservoir, and will reduce in pressure through the LTS 4-Way Chamber. Water will be conveyed from the Reservoir (or WTP) through the LTS 4-Way Chamber to the 750 mm supply main located along Highway 63. Water can also be conveyed through the distribution system and along Hardin Street to the proposed 750 mm main. The 750 mm supply main will operate at distribution system pressure (307 m HGL), until the remainder of the supply system is in place and new pumps are installed within the WTP.

5.3.4 Lower Townsite – Ultimate System

The proposed ultimate system concept is shown in **Figure 5-5**. The ultimate system upgrades will include the completion of upgrades to the supply system, as well as upgrading of local mains in order to provide the recommended fire flows.

Ultimate system upgrades include:

- Revise the WTP supply pressure to an HGL of 345 m to provide the peak demand to the LTS Reservoir and downstream.
- Construct the remainder of the 600 mm main along Franklin Avenue
- Upgrade the existing 300 mm supply main from the Abasand Reservoir to the LTS due to age and suspected shallow cover above the pipe. Install a new PRV station to connect to the distribution system at Hospital Street.
- Replace the existing 400/450 mm high pressure supply line along Prairie Loop Boulevard due to age and depth, with a 400 mm main to operate at the zone pressure of 307 m HGL.
- Upgrade existing PRV's identified to remain in service to accommodate future flow requirements.
    - Abasand discharge line at Highway 63.
    - 600 mm supply line near Athabasca River on Franklin Avenue.

- Install new PRV's connecting the proposed high pressure supply main to the distribution system as identified on **Figure 5-5**.
  - Proposed 400 mm main on Morrison Street north of MacDonald Avenue.
  - Proposed 400 mm main on Main Street north of Biggs Avenue.
  - 400 mm main on Hospital Street north of Highway 63.
  - 750 mm King Street north of Highway 63.
- Design PRV stations such that multiple settings can be accommodated at each site in the future, if necessary.
- Decommission those PRV's which will not be required in the future concept.
  - Existing PRV at Morrison Street and Franklin Avenue.
  - Existing PRV on Hospital Street south of Franklin Avenue.
  - Existing PRV on Main Street north of Saunderson Avenue.
  - Existing PRV on Saunderson Avenue west of Hardin Street.
- Construct all mains identified for upgrading as per **Figure 5-5**.
- Upgrade mains throughout the LTS to 300 mm diameter as re-development proceeds in order to accommodate potential future changes in land use including potential densification.
- In addition to the upgrades identified on **Figure 5-5**, install minimum main sizing as identified in the WMP design criteria when undertaking neighbourhood redevelopment or rehabilitation projects.
- All distribution system lateral connections to the existing and proposed 600/750 mm and 300 mm diameter mains along Franklin Avenue are recommended to be installed as a minimum of 300 mm mains to allow for future redevelopment flexibility.

5.4 ABASAND

5.4.1 Abasand – Existing System

The Abasand Reservoir and Pumphouse is located on Abbotswood Drive in Abasand. The reservoir is currently fed from the 400/450 mm high pressure supply pipeline which loops around the Lower Townsite to Hospital Street and Bell Crescent. The supply pipeline reduces to a 300 mm diameter which feeds the reservoir. As the elevation of the existing Abasand Reservoir and Pumphouse is approximately 321 m, the WTP is required to operate two South Service Area pumps in order to fill the reservoir. This is supported by record data which indicates that the Abasand reservoir was filled during the night when both WTP pumps were operating.

Photo 5-2
Abasand Reservoir and Pumphouse

The existing Abasand Pumphouse is comprised of three distribution pumps and one fire pump. Currently, the distribution pumps are used to supplement system pressure during LTS pump operation, and to ensure turnover of the Abasand Reservoir. The pumping capacity is shown in the following table:

Table 5-3
Abasand Reservoir and Pumphouse – Existing Pumping Capacity

Pump Description	Flow (L/s)	TDH (m)
P6 – Distribution Pump	39	56.4
P7 – Distribution Pump	39	56.4
P8 – Distribution Pump	39	56.4
P9 – Fire Pump	227	56.4

The existing pumphouse is understood to operate at an HGL of 376 m.

5.4.2 Abasand – Existing System Assessment

The pumping capacity of the Abasand Pumphouse is shown in the following table:

Table 5-4
Abasand Reservoir and Pumphouse – Existing Capacity Assessment

Year	Pumping Capacity (L/s)	Peak Hour Demand (L/s)	Remark
2013	78 (distribution)	65	OK
2018	227 (fire)	-	OK
2023	227 (fire)	-	OK
2028	227 (fire)	-	OK
2033	227 (fire)	-	OK
Ultimate	227 (fire)	-	OK

It is anticipated that the distribution pumps will be removed from the Abasand Pumphouse in the near future, and that the distribution system demands will be supplied solely from the Lower Townsite Reservoir and Pumphouse. The existing fire pump will remain in operation and will be available to support the Abasand area during fire scenarios. The LTS Pumphouse is outfitted with 4 pumps, each rated at 45 L/s at 63 m TDH. As the ultimate peak hour demand for Abasand is projected at 75 L/s, there is ample pumping capacity to accommodate existing and future flows.

The existing peak hour pressures are identified on **Figure 5-3**, and are typically within the recommended pressures identified in the design criteria section of this report. However, the extreme west edge of Abasand will experience pressure as low as 330 kPa (48 psi) in the peak hour scenario.

Figure 5-4 identifies the results of the peak day plus fire flow analysis. As shown, some locations do not meet the minimum fire flow recommendations. These are generally located in the north end of Abasand where the distribution system is not looped, as well as the west side of Abasand, which is higher in elevation and also does not have sufficient looping.

The assessment of the Abasand Reservoir has been based on the AEP recommendations, and is summarized in the following table:

Table 5-5
Abasand Reservoir – Projected Storage Volume (m^3)

Year	Existing Storage Volume (m^3)	Existing Avg. Day flow (L/s)	15% Avg. Day Flow (m^3)	25% Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Req'd Storage (m^3)	Surplus/ Deficit (m^3)
2013	9,000	22	285	950	2,516	3,751	5,249
2018	9,000	0	0	0	2,516	2,516	6,484
2023	9,000	0	0	0	2,516	2,516	6,484
2028	9,000	0	0	0	2,516	2,516	6,484
2033	9,000	0	0	0	2,516	2,516	6,484
ULTIMATE	9,000	0	0	0	2,516	2,516	6,484

The above table shows that the Abasand Reservoir has the capacity to meet the existing demands, as well as provide future fire flow; therefore, no storage upgrades are required.

5.4.3 Abasand – Upgrades to Existing System

As mentioned, upgrades were recently completed to significantly expand the storage capacity at the Lower Townsite Reservoir, as well as to construct a pumphouse at the site. The Lower Townsite Pumphouse will supply the Abasand demands at a zone pressure of 376 m HGL. Although originally envisioned to fill the Abasand Reservoir and Pumphouse, the Reservoir will now be supplied directly from a proposed 600 mm supply main, therefore a new fill station will be required at the reservoir.

The new Lower Townsite Pumphouse will operate to maintain the Abasand distribution system pressure. Fire flows (and other rare, high demand occurrences) will continue to be provided by the existing Abasand fire pump. The existing distribution pumps will be removed from the Abasand Reservoir, as distribution system pumping will be supplied from the LTS Reservoir and Pumphouse. It may be useful to retain some distribution pumping capacity, however, in order to ensure turnover of the Abasand Reservoir and new 600 mm supply line (through intermittent pumping to the Abasand distribution system), a condition assessment of the reservoir is also recommended to be performed.

It will be necessary for the Abasand Reservoir to reverse flow and to regularly supply the Lower Townsite distribution system through the existing 300 mm diameter main, in order to ensure that water quality is maintained in the Abasand Reservoir. This will work off of the reservoir level, and will require a PRV be installed prior to connecting to the existing Lower Townsite distribution system on Hospital Street. As there will be a significant surplus of available storage, it may be beneficial to lower the reservoir operating level (if practical) so as to improve water quality and ensure timely turnover of the reservoir.

The proposed 750/600 mm supply main will eliminate potential filling constraints as the reservoir will not be filled directly off of the distribution system. However, limited filling could occur through the distribution system if required.

5.4.4 Abasand – Ultimate System

The ultimate system concept is presented in **Figure 5-5.** As shown in the figure, the proposed upgrades are generally located in residential areas, with some upgrades proposed for more significant mains adjacent to the pumphouses. Recent infrastructure upgrading in the area has addressed many of the previously identified locations.

Pipe diameter upgrades are not identified for the north end of Abasand, although it is shown to be deficient in fire flow in the existing system. Operating the Lower Townsite Pumphouse in conjunction with the Abasand Pumphouse will increase the flow and pressure in this area, and therefore improve the fire flow availability.

5.5 WATERWAYS

5.5.1 Waterways – Existing System

The Waterways area is located to the south of the Lower Townsite, within the same pressure zone as the LTS (307 m HGL). Up until recently, Waterways was supplied by 250 mm and 200 mm diameter mains from the Lower Townsite (refer to **Figure 5-6**). A washout of the 200 mm main crossing the Hangingstone occurred in June of 2013 as a result of flooding, leaving the 250 mm main as the only source of potable water. To ensure continued water supply to the area, a 400 mm supply line was recently constructed along Saline Drive.

5.5.2 Waterways – Existing System Assessment

During normal operating conditions, the pressures within the Waterways area are within the design criteria. Based on an HGL of 307 m, the minimum pressure would be approximately 337 kPa (49 psi) at the highest elevation. The maximum pressure would be approximately 597 kPa (87 psi), which would typically occur during low flow conditions such as overnight. During the peak hour demand, these pressures reduce to a minimum of 310 kPa (45 psi) and a maximum of 558 kPa (81 psi), based on the maximum operation of the Mills Avenue Booster Station. At times, the maximum and minimum pressures appear to be outside of the recommended design criteria, however, they fall within the Municipality's design standards. **Figure 5-6** presents the existing distribution system and the associated peak hour pressures.

Figure 5-7 illustrates the modelled fire flow deficiencies in the area. It is particularly difficult to maintain pressure at the extreme west end of Tomlinson Street due to the extreme rise in topography. As such, minimum pressure during fire flow will not be maintained at the single farthest west node, and has been allowed to fall below the minimum of 350 kPa (40 psi) during the existing fire flow condition. This situation will improve over time as local mains are upsized.

Fire flows and system pressure in the area are affected by the operation of the King Street and Mills Avenue Booster Stations.

Storage and pumping requirements are provided from the Lower Townsite system, and are therefore not included in this analysis.

5.5.3 Waterways – Upgrades to Existing System

Upgrades are required to the local distribution system in order to satisfy the recommended peak day plus fire flows. It is recommended that the upgrades consider the ultimate development of the area, and are presented in the Ultimate System discussion below.

5.5.4 Waterways – Ultimate System

Upgrades to the distribution system have been proposed with consideration for the ultimate development scenario. The ultimate scenario for Waterways is based on densification of the existing development area, to significantly increase the population to 2,700 people. This is anticipated to include a number of walk up apartments, which will increase the recommended fire flow to 200 L/s as a minimum. A concept for servicing this area, with increased design flows and fire flows, is presented in **Figure 5-8**.

In addition to the new 400 mm diameter supply line, it is also recommended that one PRV Station be constructed in the ultimate scenario to interconnect the new 750 mm diameter supply line to Saline Creek Plateau to the Waterways distribution system at Park Street and Railway Avenue. This connection will allow for full fire flow to be provided to the area, while maintaining pumping through the Mills Avenue Booster Station. The PRV is initially proposed to be set at an HGL of 300 m. A check valve could be required on the 400 mm diameter supply line in order to ensure that water does not circulate back to the Mills Avenue Booster Station in the ultimate system; however, modifying the PRV setpoint could also alleviate any re-circulation.

The PRV will open based on a pressure drop in the Waterways system below an HGL elevation of 300 m. A modification to the programming of the MacKenzie Reservoir will be required in order to allow the supply line to remain charged when the Mills Avenue Booster Station is not pumping (by allowing flow back through the supply line from MacKenzie). No upgrades are anticipated at the Mills Avenue Booster Station.

Figure 5-8 identifies the ultimate system concept for the area. This concept may require modification depending on the future development of the area. Any location with higher density residential land uses will likely require a minimum of a 300 mm diameter main.

5.6 DRAPER

5.6.1 Draper – Existing System

Draper Road is located along the south shore of the Clearwater River, east of Fort McMurray. Residents are provided water by truck haul from the Fort McMurray Water Treatment Plant. The treated water is discharged into cisterns with pumps that provide the necessary flow and pressure to each residence. There currently is no existing distribution system servicing the Draper Road area.

It is currently understood that the Municipality is planning to provide piped, trickle fill water service to Draper. An allowance has been made for a future trickle fill system in the design demand tables. Details of the future system are not provided.

5.6.2 Draper – Ultimate System

It was previously understood that the Municipality may develop a park facility to the east of Waterways adjacent to the Clearwater River (refer to **Figure 5-8**). It has been assumed that this facility will require a water service off of the distribution system as well as fire protection. As the concept for the future park facility is not known at this time, an assumed fire flow of 100 L/s has been adopted for this analysis. An estimated peak demand of 2.0 L/s has been applied to the park. No information has been provided regarding the facility, and these flows are assumptions in order to complete the analysis.

In order to provide a fire flow of 100 L/s to the future park, a section of 250 mm diameter pipe will be required from the connection point at Waterways, to the park. At the proposed park, the pipe will reduce to two 200 mm diameter mains. This servicing concept will require review as further details are developed for the park facility and internal servicing requirements are established. It is recommended that a hydrant be located at the eastern end of the proposed 200 mm diameter pipe in order to provide a location for water supply for emergency vehicles/fire trucks and for flushing purposes. This could help to improve the firefighting capacity in the Draper area by reducing the travel time between the fire and filling station (hydrant).

5.7 BEACON HILL

5.7.1 Beacon Hill – Existing System

Beacon Hill is located south of the Lower Townsite and west of Hwy 63. The Beacon Hill Reservoir and Pumphouse is located along Beachwood Road adjacent to the arena in the Beacon Hill subdivision. Currently, the pumphouse currently supplies water to the Beacon Hill area and portions of Gregoire Park, as well as the MacKenzie Reservoir (refer to **Figure 5-6**).

The underground concrete reservoir has a storage capacity of approximately 9,200 m^3. A new Pumphouse (**Photo 5-3**) was recently constructed and four new pumps were installed (as per the *Regional Municipality of Wood Buffalo, Beacon Hill Reservoir and Pumphouse Pre-Design Report, February 2009 by AECOM Canada Ltd.*). All four pumps are able to operate simultaneously, with no redundant pumping capacity installed. Information on the proposed pumps is compiled in **Table 5-9** below. Refer to **Appendix E** for the existing pump information.

Table 5-6
Beacon Hill Pumps

Pump(s)	Flow (L/s)	TDH (m)
P-1 (Duty, VFD)	22	50
P-2 (Duty, VFD)	22	50
P-3 (Standby, Constant Speed)	105	50
P-4 (Standby, Constant Speed)	105	50

The two duty pumps have VFD's to control the pumphouse pressure to a zone pressure of 400 m HGL as indicated in the Beacon Hill Reservoir and Pumphouse Pre-Design report. A zone pressure of 400 m HGL will match the proposed MacKenzie PRV settings, and will create one zone for Beacon Hill, Gregoire and the Future Waterway/Quarry Ridge area.

Photo 5-3
Beacon Hill Pumphouse

Three PRV's protect the northern end of the Beacon Hill water distribution system from high pressure, as the area is significantly lower than the pumphouse and surrounding area. The locations of the PRV's are indicated on **Figure 5-6**. Upgrades to the Beacon Hill distribution system (Beale and Beaumont Crescents) were completed in 2013 as part of the 2012 Infrastructure Rehabilitation Program.

The Beacon Hill pumphouse currently supplies the Beacon Hill subdivision, a portion of the MacKenzie Industrial area and Gregoire Park, as well as the MacKenzie Reservoir and Pumphouse through a 300 mm diameter ductile iron supply main (some of which is believed to actually be constructed of asbestos cement pipe). The Beacon Hill and MacKenzie zones are currently separated by a closed valve located at Grey Crescent and Greely Road, resulting in a dedicated main into the MacKenzie Reservoir.

5.7.2 Beacon Hill – Existing System Assessment

Under the current operating conditions, the Beacon Hill Pumphouse provides the peak hour demand for the Beacon Hill area and the peak day demand for the MacKenzie Industrial Reservoir and Pumphouse, as well as for all of the downstream users. The pumping capacity assessment is summarized in Table 5-7 and is based on all pumps operating.

Table 5-7
Beacon Hill – Pumping Capacity Assessment

Pumping Capacity (L/s)	2013 ESTIMATED WATER DEMAND			Remark
	Peak Hour (Beacon Hill) L/s)	Peak Day (Downstream Users) (L/s)	Total (L/s)	
250	28	143	171	OK

Table 5-7 shows that the Beacon Hill Pumphouse has the pumping capacity to meet the estimated 2013 water demand for all downstream users, assuming no redundant pumping. Once the Saline Creek Supply Line is operational, the Beacon Hill Pumphouse will not typically supply any downstream users.

The resulting peak hour pressures are indicated on Figure 5-6, and range from 351 kPa (51 psi) to 579 kPa (84 psi). The maximum pressure based on a zone HGL of 400 m is 590 kPa (86 psi).

According to the Pre-Design report, the total capacity of the pumphouse will be 250 L/s at a TDH of 50 m. This will come close to satisfying the peak day plus fire flow recommendations. Additional flow can also be provided from the MacKenzie area through the proposed PRV's, if necessary.

The existing peak day plus fire flow analysis results are indicated on Figure 5-7. As shown on the figure, minimum fire flows are achieved throughout most of the Beacon Hill area.

A storage assessment of the existing Beacon Hill Reservoir is summarized in Table 5-8. It is based on meeting the Municipality's recommended storage volume of one peak day plus fire flow.

Table 5-8
Beacon Hill Reservoir – Projected Storage Volume (m^3)

Year	Existing Storage Volume (m^3)	1 X Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)	Surplus / Deficit (m^3)
2013	9,200	1,555	2,516	4,071	5,129
2018	9,200	1,642	2,516	4,158	5,042
2023	9,200	1,901	2,516	4,417	4,783
2028	9,200	1,901	2,516	4,417	4,783
2033	9,200	1,901	2,516	4,417	4,783
ULTIMATE	9,200	1,901	2,516	4,417	4,783

The above table indicates that there is ample storage capacity to meet the ultimate anticipated demands, based on the Municipality's Standard of 1 peak day demand plus fire flow. The fire flow storage has been based on 233 L/s for a duration of 3 hours. As indicated in the *Regional Municipality of Wood Buffalo - Beacon Hill Reservoir and Pumphouse Pre-Design Report, February 2009, AECOM Canada Ltd.*, stagnation could be an issue due to the existing reservoir capacity. As such, the Pre-Design Report recommends that the reservoir be operated at a lesser volume of 6,650 m^3.

5.7.3 Beacon Hill – Upgrades to Existing System

Following the completion of the Mills Avenue Booster Station and the new 750 mm diameter supply main, the Beacon Hill Reservoir and Pumphouse will no longer be the primary supply to the MacKenzie Reservoir and Pumphouse, and to downstream users. However, Beacon Hill will be able to provide emergency and backup supply to the MacKenzie Reservoir through the existing 300 mm diameter main (recommended for replacement due to condition). The supply main is recommended to be increased to a 400 m diameter main upon replacement.

The Beacon Hill area is essentially at its maximum projected population; therefore, future demands are not anticipated to increase significantly over the existing estimated demands. The resulting estimated peak day flows will vary between 18 L/s and 22 L/s, and the fire flow is assumed at 233 L/s. Therefore, the maximum anticipated peak day plus fire flow is approximately 255 L/s. This is supported by modelling results which indicate that during typical demand scenarios, Beacon Hill will be supplied by the Beacon Hill Pumphouse. The Gregoire area and future Gateway/Quarry Ridge will be supplied by the MacKenzie pumphouse, although all one pressure zone.

Upgrades are recommended in order to satisfy the minimum recommended fire flows.

5.7.4 Beacon Hill – Ultimate System

The ultimate system concept indicates the anticipated peak hour pressures, and is shown in **Figure 5-8**. Under typical operating conditions, the Beacon Hill pumphouse will be able to satisfy the zone demands for the local Beacon Hill area.

Various distribution system upgrades are recommended. A new 300 mm diameter watermain is proposed to be located west of the existing reservoir and pumphouse in order to improve fire flows. The existing 300 mm diameter supply main is recommended to be replaced due to condition, and upsized to 400 mm in order to provide back-up supply to MacKenzie.

It is proposed that supply be maintained directly to Beacon Hill in order to establish supply redundancy to the farther reaches of the South Service Area. As such, the existing King Street Booster is proposed to be maintained, which will provide water to the Beacon Hill Reservoir. It is understood that the existing 350 mm diameter supply main will soon be replaced with a 400 mm diameter main. The Beacon Hill pumphouse will then provide back-up supply to the MacKenzie Reservoir through a partially dedicated supply main. The zone pressure in Beacon Hill would likely need to be increase during this scenario (to approximately 407 m HGL) in order to adequately fill the MacKenzie Reservoir. In the long term the 400 mm supply main may need to be connected to the Mills Avenue Booster due to the future highway widening, which may not be required due to revised highway functional plans.

It should be noted that upgrading of the existing supply mains to and from Beacon Hill cannot be completed until the 750 mm Saline Creek supply line to MacKenzie is fully operational, in order to maintain supply.

Back-up supply can be provided from MacKenzie to Beacon Hill through the proposed PRV's and distribution system. Modifications including fill mechanisms and flow control will be required at each reservoir.

5.8 MACKENZIE INDUSTRIAL

5.8.1 MacKenzie Industrial – Existing System

MacKenzie (Industrial) Reservoir and Pumphouse is located along MacKenzie Boulevard between MacDonald and McAlpine Crescents. The reservoir and pumphouse have recently undergone a major expansion, with the new reservoir having a total storage capacity of 14,000 m^3.

All pumps have been removed from the existing pumphouse and four new pumps installed in the newly constructed pumphouse in 2010 (with a provision for an ultimate fifth pump). **Table 5-9** below identifies the existing and future pumps. Refer to **Appendix F** for pump curve information.

Photo 5-4
MacKenzie Industrial Reservoir and Pumphouse

Table 5-9
MacKenzie – New Pump Information

Pump	Flow (L/s)	TDH (m)
P-1 (200 HP Variable Speed)	250	48.5
P-2 (200 HP Variable Speed)	250	48.5
P-3 (100 HP Constant Speed)	125	48.5
P-4 (100 HP Constant Speed)	125	48.5
P-5 (Future 100 HP Constant Speed)	125	48.5

The initial maximum capacity will be 500 L/s which is based on P-1 or P2 operating with P-3 and P-4. This leaves either P-1 or P-2 as 50% backup. In the future, P-5 will also operate, increasing the maximum flow rate to 625 L/s (however available backup will decrease to 40%). The VFD's are understood to operate to maintain an HGL of approximately 425 m. The reservoir is typically filled overnight and drains during the daytime, in an effort to provide water quality benefits

The MacKenzie Industrial Reservoir and Pumphouse currently supplies the southern portion of Gregoire Park, the remainder of the MacKenzie Industrial Park and the Southeast Regional Reservoir and Pumphouse (including the Airport lands, Saprae Creek, Spruce Valley and The Anzac Regional System). The supply to the Airport lands and Southeast Industrial area is through existing 400 mm and 300 mm diameter watermains.

5.8.2 MacKenzie Industrial – Existing System Assessment

Based on the existing zone pressure of 425 m HGL, a number of locations within the MacKenzie area will exceed the maximum recommended pressure, the highest reaching approximately 681 kPa (99 psi) during

low demand conditions at the eastern edge of MacKenzie/Gregoire Park. The highest pressures in the lower Gregoire Park area (zone HGL 400 m) would be approximately 531 kPa (77 psi). **Figure 5-9** presents the existing distribution system and associated peak hour pressures. As shown in the figure, some low pressures are experienced in the Gregoire Park area during the peak hour demand scenario, the lowest pressure being 315 kPa (46 psi).

Figure 5-10 presents those locations which do not meet the recommended minimum fire flows. Several nodes within the Gregoire Park area do not meet the minimum recommendations. Mains in Gregoire Park appear to be undersized to convey the recommended fire flows.

As mentioned in the Beacon Hill discussion, the MacKenzie Industrial Reservoir and Pumphouse will be directly supplied by the Mills Avenue Booster Station, following the operation of the new 750 mm diameter supply main. This is assumed to occur by 2016.

Table 5-10 below provides a pumping capacity assessment of the MacKenzie Industrial Pumphouse. The table indicates a peak hour demand, which is necessary for all directly connected developments (MacKenzie, Prairie Creek, future Saline Creek, future Gateway/Quarry Ridge as well as future Southlands Industrial Area 4). The peak day demand is to supply the Southeast Regional Reservoir and Pumphouse (as well as interim supply to Southlands 1A,1B and Highway 881/63 up to the year 2028).

Table 5-10
MacKenzie Pumphouse – Pumping Capacity Assessment

Year	Pumping (L/s)	Typical Water Demand (L/s)			Peak Day Demand (Distribution) plus 233 L/s fire flow (L/s)[2]
		Peak Hour[3] (Distribution)	Peak Day[4] (Supply)	Total	
2013	500	113	20(1)	133	308
2018	500	201	52(1)	253	367
2023	500	319	93(1)	412	446
2028	625	418	152(1)	570	512
2033	625	500	125	625	566
Ultimate	700 (Upgrade)	593	182(1)	775	628

Note: (1) Peak day demands in 2018, 2023 and 2028 have been increased by 8 L/s, 13 L/s and 51 L/s respectively in order to provide temporary servicing to the future Southlands Industrial 1A and 1B, and Highway 881/63 developments. The Ultimate peak day demand has been reduced by 93 L/s which is anticipated to be supplied from the future Southwest Service Area.

(2) Peak day plus fire flow demands do not include supply to the Southeast Regional Reservoir as it is assumed that reservoir filling can be interrupted during fire situations.

(3) Peak Hour demands include directly connected developments such as MacKenzie, Prairie Creek future Saline Creek, future Gateway/Quarry Ridge and future Southlands Industrial Area 4.

(4) Peak Day demands include supply to the Southeast Regional Reservoir and Pumphouse; however, are anticipated to be supplied primarily during the overnight period.

Based on the above table, the 500 L/s existing pumping rate will be adequate beyond the year 2023, when an upgrade to the full 625 L/s could be required. It would also appear from the table that the pumping capacity at MacKenzie may require an additional upgrade in the Ultimate scenario. This may not be necessary as it is anticipated that much of the downstream peak day reservoir re-supply will actually occur during the night, during low overall demand conditions. This also assumes that the estimated equivalent populations will ultimately be realized.

As the projected peak day plus fire flow demand slightly exceeds the ultimate pumping capacity, it appears that an upgrade beyond 625 L/s could be necessary in the ultimate scenario.

A storage assessment of the existing MacKenzie Industrial Reservoir is summarized in the **Table 5-11**. It is based on providing Peak Day plus Fire Flow as per the Municipality's Engineering Servicing Standards. The storage is calculated based on the existing and future demands for MacKenzie, Saline Creek, Gateway/Quarry Ridge and Southlands Industrial Area 4. Although MacKenzie may temporarily supply the Southlands 1A/1B Area (and potentially further downstream), storage for these areas will be provided in their local reservoirs.

Table 5-11
MacKenzie Industrial Reservoir – Projected Storage Volume (m^3)

Year	Existing Storage Volume (m^3)	1 x Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Req'd Storage (m^3)	Surplus/ Deficit (m^3)
2013	14,000	6,480	2,516	8,996	5,004
2018	14,000	11,491	2,516	14,007	-7
2023	14,000	18,230	2,516	20,746	-6,746
2028	14,000	24,106	2,516	26,622	-12,622
2033	14,000	28,944	2,516	31,460	-17,460
ULTIMATE	14,000	34,214	2,516	36,730	-22,730

As shown in the above table, there will be a deficit of approximately 23,000 m^3 of storage available in the ultimate system. If applying AEP recommendations, a surplus of 364 m^3 would be available in the Ultimate system.

5.8.3 MacKenzie Industrial – Upgrades To Existing System

Currently, the MacKenzie Industrial Reservoir and Pumphouse is filled by the Beacon Hill distribution pressure. Once the dedicated 750 mm supply line is completed, it will supply the MacKenzie Reservoir. The

MacKenzie Pumphouse will continue to supply the existing demands in the MacKenzie and Prairie Creek areas, as well as supplying the Southeast Regional Reservoir. In the future it will also supply Saline Creek, Gateway/Quarry Ridge and the Southlands Industrial Area 4. It no longer provides peak hour demands to the Airport area, which is provided by the Southeast Regional Reservoir and Pumphouse.

It is proposed that a separate zone be established to reduce the north MacKenzie/Gregoire area pressures. One PRV is proposed on the existing distribution system at the east end of Greely Road. An additional PRV is proposed to be located on the future 400 m diameter supply line at the MacKenzie Pumphouse. These PRV's will be required in order to reduce the MacKenzie zone pressure of 425 m HGL to a proposed HGL of 400 m (to be referred to as the Gregoire Park zone).

5.8.4 MacKenzie Industrial – Ultimate System

The ultimate system concept is enclosed as **Figure 5-11**. As shown in the figure, 300 mm diameter mains are proposed in some areas of the MacKenzie Industrial Park. Upgrades are also recommended throughout much of Gregoire Park.

As mentioned in the Beacon Hill discussion (Section 5.7), a back-up supply to MacKenzie will be provided from the Beacon Hill Reservoir, as well as a proposed 400 mm partially dedicated supply main to the MacKenzie Reservoir. Back-up supply can be provided from MacKenzie to Beacon Hill through the PRV's and distribution system. Modifications including fill mechanisms and flow control will be required at each reservoir.

Ultimately, the MacKenzie Industrial Reservoir and Pumphouse (HGL of 425 m) will also supply the future Saline Creek development, and the future Gateway/Quarry Ridge development. A 600 mm diameter distribution line has recently been constructed, and will operate as the main supply line from MacKenzie into the Saline Creek development. The Gateway/Quarry Ridge development will primarily be serviced by a future 400 mm diameter waterline, with interconnections to the MacKenzie distribution system. This area is proposed to operate within the same future zone as Gregoire Park and Beacon Hill, at an HGL of 400 m. This area will therefore require an additional PRV at the south end of the development.

Upgrading to the minimum recommended sizes (as outlined within the design criteria) is generally recommended during local system improvement opportunities. These types of upgrades are typically undertaken during localized roadway or other infrastructure improvements.

5.9 SOUTHEAST REGIONAL RESERVOIR AND PUMPHOUSE

5.9.1 Southeast Regional Reservoir and Pumphouse – Existing System

The Southeast Regional Reservoir and Pumphouse was constructed in 2007 and is located east of the Fort McMurray airport, adjacent to the dry industrial park. It has a 2000 m^3 underground reservoir with a pumphouse located above.

Photo 5-5
Southeast Regional Reservoir and Pumphouse

The pumphouse has two separate banks of pumps drawing water from the underground reservoir: Refer to **Appendix G** for pump information.

- **Southeast Industrial/Airport Area**: One set of pumps currently provides distribution and fire flow to the Airport and Saprae Creek/Spruce Valley.

- **Southeast (Anzac) Regional System**: A second set of pumps supplies the regional system, which is comprised of the Hamlet of Anzac, Gregoire Provincial Park and Estates, and the Gregoire Lake First Nations.

5.9.2 Southeast Regional Reservoir and Pumphouse – Existing System Assessment

Pumping and distribution system assessments are included in separate sections for the Southeast Industrial Area and for the Southeast (Anzac) Regional System.

A storage capacity assessment of the Southeast Regional Reservoir is summarized in **Table 5-12**. It includes storage for the Airport and Airport West and East Lands, Saprae Creek/Spruce Valley and for the Southlands Industrial Area 2. Storage capacity is not required for the Anzac Regional Demands. The storage capacity is based on storing one peak day demand plus fire flows (233 L/s for 3 hours), as per the Municipality's Standards.

Table 5-12
Southeast Regional Reservoir – Storage Capacity Assessment

Year	Existing Storage Volume (m^3)	1 X Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)	Surplus/Deficit (m^3)
2013	2000	691	2,516	3,207	-1,207
2018	2000	2,506	2,516	5,022	-3,022
2023	2000	5,443	2,516	7,959	-5,959
2028	2000	6,998	2,516	9,514	-7,514
2033	2000	8,640	2,516	11,156	-9,156
Ultimate	2000	19,181	2,516	21,697	-19,697

The above table shows that the existing reservoir does not have the capacity to meet the projected water demands. A reservoir expansion is recommended.

5.9.3 Southeast Regional Reservoir and Pumphouse – Upgrades to Existing System

The Southeast Regional Reservoir and Pumphouse is recommended to be expanded by approximately 9,000 m^3 in order to accommodate the projected Year 2033 storage requirements for the area. This is based on providing one peak day of storage in addition to fire flow. It is suggested that the expansion be limited to this threshold in consideration of potential reservoir turnover times. Based on the 2013 estimated average day demands, (approximately 11 L/s including the Anzac Regional demands), an 11,000 m^3 storage reservoir would require over 11 days to turn over completely. However, the reservoir could initially be operated at a significantly lower level in order to improve potential water quality issues.

When the demands rise due to increased development in the area, the operating level of the reservoir can be increased accordingly. It should also be noted that the average day demands applied are the estimated design demands, and may exceed actual. It is recommended that the reservoir be designed to be easily expanded, in case the area develops faster than anticipated.

5.9.4 Southeast Regional Reservoir and Pumphouse – Ultimate System

Ultimately, a total expansion volume of 20,000 m^3 is recommended to accommodate the ultimate design demands.

The ultimate system concept is enclosed as **Figure 5-14**. Separate report sections are included below for the Southeast Industrial Area and for the Southeast (Anzac) Regional System.

5.9.5 Southeast Industrial Area – Existing System

Up until recently, the existing Southeast Industrial distribution service area was comprised of the Spruce Valley residential development. The main sizes range from 150 mm to 300 mm in diameter to service the

Spruce Valley neighbourhood. This system also supplied the recently decommissioned Saprae Creek Reservoir and Pumphouse through 300 and 100 mm diameter mains. New pumps were recently installed within the pumphouse in 2014, and the piping modified so that the reservoir will supply the entire Airport Industrial area in addition to its previous service area. As the reservoir must be filled from the MacKenzie Reservoir, the entire service area will also be supplied (and system pressure maintained) from MacKenzie during periods of reservoir filling.

The new reservoir pumping capacity is identified in Table 5-13:

Table 5-13
Southeast Industrial Area – New Pumping Capacity

Pump	Flow (L/s)	TDH (m)
Distribution Pump	35	61
Distribution Pump	35	61
Fire Pump	178	61
Fire Pump	178	61

All pumps were installed with variable frequency drives (VFD's). The typical zone pressure is set at 425 m HGL in order to match the current MacKenzie zone pressure.

5.9.6 Southeast Industrial Area – Existing System Assessment

An assessment of the existing pumping capacity is provided in Table 5-14. The peak hour demands indicated include the demands for the Airport Industrial, Saprae Creek, Spruce Valley and the future Southlands Area 2.

Table 5-14
Southeast Industrial Area – Pumping Capacity Assessment

Year	Pumping Capacity (L/s)	Typical Water Demand (L/s)		
		Peak Day Demand (L/s)	Peak Hour Demand (L/s)	Peak Day plus 233 L/s Fire Flow (L/s)
2013	426	8	11	241
2018	426	29	45	262
2023	426	63	94	296
2028	426	81	122	314
2033	426	100	152	333
Ultimate	426	129*	333	362*

*The ultimate peak day demand of 129 L/s does not include the 93 L/s shortfall which will be provided by the Southwest Service Area.

As the estimated 2013 peak hour demand is 11 L/s for the area, there is currently sufficient existing pumping capacity based on one distribution pump operating. The distribution pumps were sized to accommodate the anticipated short term growth in the area, which is much larger than the demand currently experienced. As such, the pumps may need to operate at a lower speed in order to reduce the output, and/or re-circulate back into the reservoir until the local demand increases with further development.

During the Peak Hour scenario, the pressures range from 450 kPa (65 psi) to 695 kPa (101 psi) within the Airport area, with pressures exceeding 620 kPa (90 psi) along the 300 mm diameter supply main. In Saprae Creek/Spruce Valley, pressures will vary from 464 kPa (67 psi) to 644 kPa (93 psi) during the peak hour conditions. The maximum available fire flows range from 17 L/s to 50 L/s in Spruce Valley, where 50 L/s is recommended for fire flows in rural residential areas. The existing system peak hour pressures and available fire flows are presented in **Figures 5-12** and **5-13**, respectively.

5.9.7 Southeast Industrial Area – Upgrades to Existing System

Upgrades were recently undertaken which combined the Saprae Creek and Spruce Valley pressure zones with the Airport zone, supplying an HGL of 425 m to the entire service area. This will effectively create one large pressure zone including both the MacKenzie and Southeast Industrial areas. This large pressure zone at the Southeast Industrial Reservoir and Pumphouse is beneficial in that fire flow capacity does not need to be duplicated in order to provide flow to both east and west of the pumphouse.

The Southeast Regional Reservoir and Pumphouse is envisioned to operate during daytime hours at a zone HGL of 425 m, in order to match the MacKenzie Zone pressure. Therefore, during normal daytime operation, the supply to the airport area will be provided from both pumphouses. This will become

increasingly beneficial as the demands in the area increase over time. During set hours overnight, the Southeast Regional Pumphouse will not operate, and the reservoir will be allowed to fill.

5.9.8 Southeast Industrial Area – Ultimate System

The ultimate system concept is presented in **Figure 5-14**. Significant development is anticipated in the area in order to provide additional industrial lands. As such, the Southeast Industrial area is anticipated to service an ultimate equivalent population of approximately 26,550 people (including the Airport Lands, Lynton, Saprae Creek/Spruce Valley and Southlands Area 2). The main distribution waterlines are proposed to be 300 mm and 400 mm in diameter.

In the Ultimate development scenario, the Southeast Regional Reservoir and Pumphouse will be supplied by the MacKenzie Pumphouse as well as the future Southlands Industrial Pumphouse. This will be required in order to address the supply shortfall to the area, which is projected to occur sometime after 2033.

5.9.9 Southeast (Anzac) Regional System – Existing System

The Southeast Regional System consists of the Hamlet of Anzac, Gregoire Lake Estates, and the Gregoire Lake First Nations. The system is supplied water from the Southeast Regional Reservoir and Pumphouse through a 300 mm diameter supply waterline; approximately 35 km long (refer to **Figure 5-2**).

An inline booster station is located next to SR 881 near the Provincial Park which re-pumps the water to the Anzac Reservoir. The outgoing pressure at the reservoir is at an HGL of 520 m, while the booster station pumps the water to an HGL of 571.8 m.

The current estimated design peak day demand equals 12 L/s based on the populations identified in **Table 2-2**. Population projections were not updated for the Anzac Regional Line as part of the Wastewater Master Plan project, and have therefore been maintained at the 2011 Water Master Plan values.

In the 2011 Water Master Plan, record data indicated that actual water use was much lower than the design value applied, which was attributed with lower consumption rates typical of truckfill systems. However, it appears that consumption may have recently increased a significant amount, due to the construction of a new reservoir and truckfill at Anzac. It is understood that the Municipality has had to operate both pumps simultaneously in recent months, indicating that the downstream demand has been in excess of 20 L/s. The existing pumping capacity is identified in **Table 5-15**.

Table 5-15
Southeast (Anzac) Regional System – Pumping Capacity

Pump	Flow (L/s)	TDH (m)
Distribution Pump	20	133.0
Distribution Pump	20	133.0

5.9.10 Southeast (Anzac) Regional System – Existing System Assessment

Table 5-16 summarizes the pumping capacity based on the estimated future demands for the Southeast (Anzac) Regional System. A pumping capacity of 20 L/s is used in the analysis to represent one distribution pump operating (leaving one remaining as backup). The ultimate peak day demand of 53 L/s is based on an ultimate population of 5,000 people in the Hamlet of Anzac plus the other regional users along the line. The basis for this design flow is discussed in Section 4.

Table 5-16
Southeast (Anzac) Regional System – Pumping Capacity Assessment

Year	Water Demand		Assessment
	Pumping Capacity (L/s)	Peak Day Demand (L/s)	
2013	20	12	OK
2018	20	15	OK
2023	20	17	OK
2028	20	20	Upgrade
2033	20	25	Upgrade
Ultimate	20	53	Upgrade

As shown in Table 5-16, there appears to be sufficient pumping capacity to accommodate up to the year 2028 design population. However, if significant increase in the Truckfill activity has (or does) occur, it is recommended that the usage be reviewed and reflected in further updates.

5.9.11 Southeast (Anzac) Regional System – Upgrades To Existing System

It is understood that the Municipality is currently experiencing issues along the existing Anzac supply line including low supply pressure and waterline breaks. As a result, the Municipality is planning to move ahead with a secondary waterline to Anzac, in order to provide a redundant and reliable supply to the community. It is anticipated that this waterline will be constructed from MacKenzie to the Southlands Industrial Area, Highway 881/63 and then proceed to Anzac.

It has been previously recommended the Municipality construct a service road along the existing supply line in order to facilitate maintenance and repair of the waterline and booster station, as well as to ease the construction of a future booster station, if this line is to remain in service long term.

Although the current design populations indicate that a pumping upgrade is not required for another 10 years or so, it is understood that the Municipality currently requires additional pumping capacity.

5.9.12 Southeast (Anzac) Regional System – Ultimate System

The ultimate servicing concept for the area is shown in **Figure 5-2**. A pumping upgrade is anticipated to be required in order to accommodate additional growth. In order to deliver the pipeline design flows (based on a future population of 5,000 people at Anzac), pump upgrades will be required at the Southeast Regional Reservoir and Pumphouse, as well as the Anzac Booster Station. Also, an additional booster station will be required upstream from the existing booster station at approximately 15 km from the pumphouse. The pressure is proposed to be maintained at the pumphouse at 520 m HGL. The new booster station is proposed to increase the pipeline pressure by approximately 418 kPa (42.6 m or 60 psi) to an outgoing HGL of 515.1 m. The existing booster station is proposed to increase the pumping head to an outgoing HGL of 550.6 m (696 kPa,101 psi).

In order to supply a population in excess of 5,000 (or equivalent), it will be necessary to construct an additional supply main. Further information is provided in Section 7 – Southwest Service Area.

It is anticipated that the community will move toward a full distribution system which will increase per capita demands and may encourage further development and population growth.

5.10 SAPRAE CREEK

5.10.1 Saprae Creek – Existing System

Saprae Creek is located east of the Airport lands. The Saprae Creek Reservoir and Pumphouse was recently decommissioned in terms of distribution pumping, however remains in use for the filling of fire trucks. Water is supplied to the area through 100 mm and 300 mm diameter supply mains. (Refer to **Figure 5-12**).

Photo 5-6
Saprae Creek Reservoir and Pumphouse

5.10.2 Saprae Creek – Existing System Assessment

Based on an existing zone pressure of 425 m, the maximum system pressure during low demand periods would be 654 kPa (95 psi). During the Peak Hour scenario, pressures will range from 461 kPa (67 psi) to 644 kPa (93 psi). **Figure 5-12** presents the existing distribution system and the maximum peak hour pressures.

The existing Saprae Creek residences are currently serviced by 100 mm diameter mains, which have not been sized to convey fire flow. It has been assumed that this system could be replaced with a typical distribution system (with fire flow provision) in the future. As such, **Figure 5-13** identifies the entire area to be fire flow deficient.

5.10.3 Saprae Creek – Upgrades to Existing System

It is recommended that the supply and distribution systems be interconnected in order to ensure maximum system performance. No further upgrades are required at this time.

5.10.4 Saprae Creek – Ultimate System

Upgrades to the distribution system will be required if fire flows are to be provided, and are identified on **Figure 5-14**. An allowance has been made for significant expansion east of the existing development. Servicing of these eastern lands will require more detailed study to develop a future servicing concept and establish future land use. The potential future demand has been incorporated into the model to accommodate the future development.

5.11 HAMLET OF ANZAC

5.11.1 Hamlet of Anzac – Existing System

The Hamlet of Anzac receives potable water from the Southeast Regional System. A new Reservoir and Pumphouse has recently been constructed which includes 2,400 m^3 of potable water storage, a new pump station, and a truckfill. It is understood that 3 distribution pumps have been installed rated for 14.7 L/s each. These pumps supply a small piped distribution system consisting of the school, fire hall, senior citizens centre and the Community Centre. It is understood that a fire pump has been stipulated, but details have not been provided. The remainder of the community receive water by truck haul. The truckfill is comprised of:

- Two potable pumps rated for 30 L/s each.
- One non-potable pump rated for 22.5 L/s.
- One barrel fill with pump rated for 1.9 L/s.

5.11.2 Hamlet of Anzac – Existing System Assessment

An assessment of the existing Anzac pumping or distribution system is not within the scope of this study. Refer to the *Regional Municipality of Wood Buffalo, Rural Servicing Study, Associated Engineering, April 2010*, for servicing alternatives.

An assessment of the existing storage capacity is provided in **Table 5-17** and is based on providing one peak day plus fire storage, as per the Municipality's Standards. The minimum fire flow storage is based on a value of 233 L/s for potential future high density/value development. **Table 5-17** indicates that there is currently a storage deficit, based on an assumed fire flow of 233 L/s. Should fire flows to this standard be desired in the future, a storage expansion as indicated below may be required.

Table 5-17
Hamlet of Anzac – Projected Storage Volume (m^3)

Year	Existing Storage Volume (m^3)	1 X Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)	Surplus/ Deficit (m^3)
2013	2,400	605	2,516	3,121	-721
2018	2,400	778	2,516	3,294	-894
2023	2,400	864	2,516	3,380	-980
2028	2,400	1,123	2,516	3,639	-1,239
2033	2,400	1,382	2,516	3,898	-1,498
ULTIMATE	2,400	10,800	2,516	13,316	-10,916

(*) The ultimate system peak day demand is based on a future population of 15,000 in the Hamlet of Anzac.

5.11.3 Hamlet of Anzac – Upgrades To Existing System

The existing pumping capacity and distribution system were not assessed, and therefore recommendations are not provided.

5.11.4 Hamlet of Anzac – Ultimate System

Based on an ultimate projected population of 15,000 people in the Hamlet of Anzac, it is recommended that approximately 11,000 m^3 of additional storage capacity be provided.

5.12 GREGOIRE LAKE FIRST NATIONS

5.12.1 Gregoire Lake First Nations – Existing Systems

The Gregoire Lake First Nations receives potable water from the Southeast Regional System. The existing reservoir provides approximately 61 m^3 of storage and operates as a truckfill station. An assessment of the existing truckfill station is not within the scope of this study.

5.12.2 Gregoire Lake First Nations – Existing System Assessment

An assessment of the existing storage capacity is provided in Table 5-18 and is based on providing 1 peak day of storage. An allowance for fire flow is not included as there is no existing distribution system.

Table 5-18
Gregoire Lake First Nations – Projected Storage Volume (m^3)

Year	Existing Storage Volume (m^3)	1 X Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)	Surplus/ Deficit (m^3)
2013	61	259	0	259	-198
2018	61	346	0	346	-285
2023	61	346	0	346	-285
2028	61	432	0	432	-371
2033	61	518	0	518	-457
ULTIMATE	61	691	0	691	-630

5.12.3 Gregoire Lake First Nations – Upgrades to Existing System

Based on a per capita consumption rate of 360 L/c/d, and the projected populations outlined within this report, additional storage capacity is likely required. It is recommended that the actual water usage for the community be reviewed against reliable population data prior to undertaking an expansion of the existing storage tank.

Based on the design criteria outlined within this report, an expansion of approximately 460 m^3 would meet the projected requirements for the next 20 years.

5.12.4 Gregoire Lake First Nations – Ultimate System

The anticipated storage requirements for the ultimate system are identified in **Table 5-18**. The anticipated storage requirements could be increased if the community were to provide fire storage for filling of fire trucks or to supply a future distribution system.

5.13 GREGOIRE LAKE ESTATES

5.13.1 Gregoire Lake Estates – Existing System

Gregoire Lake Estates is located at the west side of Willow (Gregoire) Lake, 32 km southeast of Fort McMurray. Potable water is delivered via truck haul from the Hamlet of Anzac to residential cisterns. A 200 mm lateral connection has been constructed from the regional supply line to Gregoire Lake Estates for a future water supply.

5.13.2 Gregoire Lake Estates – Existing System Assessment

The existing system was assessed in the *Regional Municipality of Wood Buffalo – Rural Servicing Study, Associated Engineering, February 2010*.

A trickle fill water system was later recommended in the *Regional Municipality of Wood Buffalo – Draft Rural Servicing Concept Design Report, Associated Engineering, April 2010.*

5.13.3 Gregoire Lake Estates – Upgrades to Existing System

It is understood that the Municipality is proceeding based on the recommendations in the Draft Rural Servicing Concept Design Report, and that it is currently underway on a trickle fill water distribution system for the area. A reservoir of 210 m^3 would be required for a trickle fill system.

5.13.4 Gregoire Lake Estates – Ultimate System

A trickle fill system will be designed to accommodate the ultimate development scenario, which is anticipated to remain residential and experience little growth.

5.14 ULTIMATE SYSTEM EXPANSION AREAS

5.14.1 Saline Creek – Ultimate System

This new development is anticipated to accommodate an ultimate population of 20,000 people. The development will be serviced primarily by a new 600 mm diameter waterline from the MacKenzie Reservoir and Pumphouse at the common zone pressure of 425 m HGL. Four additional connections to the downstream supply main to the Southeast Regional Reservoir and Pumphouse are also proposed. **Figure 5-1** presents the ultimate servicing concept for the area.

Pressures in the upper Saline Creek zone will range from 441 kPa (64 psi) to 600 kPa (87 psi) during the peak hour scenario. The maximum pressure will approach 634 kPa (92 psi) in a small location during the low flow condition. PRV's are currently anticipated to be required in order to reduce the system pressure in the southwest section of the neighbourhood (due to lower ground elevations). The PRV's are proposed to be set at approximately 400 m HGL. Pressure in the lower zone will range from 356 kPa (51 psi) to 534 kPa (78 psi) during the peak hour scenario. During the peak day plus fire flow scenario, all recommended fire flows will be satisfied by the proposed piping identified on **Figures 5-1** and **5-11**.

It is anticipated that this development will be under construction in the near future. As such, **Table 2-4** identifies an estimated population of 5,000 people in 2018.

5.14.2 Gateway/Quarry Ridge – Ultimate System

The proposed developments of Gateway and Quarry Ridge will be located to the west of the MacKenzie Industrial Park, as identified on **Figure 5-1**. It is anticipated that these developments will be under construction in the near future, as **Table 2-4** identifies an equivalent population of 1,000 people in 2018. The ultimate projected equivalent population for the two developments equals 7,500 people.

These developments will be serviced off of the MacKenzie Reservoir and Pumphouse by connections to the existing MacKenzie distribution system. The proposed development will tie into the existing distribution system at multiple locations, and will primarily be located in the proposed 400 m HGL zone. As such, PRV's will be required to reduce the maximum pressures to 400 m HGL at any connection to the MacKenzie distribution system (425 HGL zone). Peak hour pressures in this area will range from 407 kPa (59 psi) to 503 kPa (73 psi). During the peak day plus fire flow scenario, all recommended fire flows will be satisfied by the proposed piping identified on **Figures 5-1** and **5-11**.

As shown on the figures, the main waterline through the area is proposed to be a 400 mm diameter pipe.

5.14.3 Southlands Industrial Area 2/Airport West and East/Lynton – Ultimate System

The Southlands Industrial Area 2 and Airport Lands (West and East) encompass a very large development area, and will ultimately require servicing from both the South Service Area and the future Southwest Service Area. Much of the development will be serviced directly off of mains running from either the MacKenzie Industrial Reservoir and Pumphouse or the future Southlands Reservoir and Pumphouse to the Southeast Regional Reservoir and Pumphouse. The Southeast Regional Reservoir will be responsible for storing the recommended peak flows for the area, and will pump to maintain system pressures during typical demand scenarios. During fire scenarios, flow can be supplied from all reservoirs. **Figure 5-2** presents the ultimate servicing concept for the area. The major watermains in the area are proposed to consist of 300 mm diameter and 400 mm diameter pipes.

The proposed 450 mm from the Airport Lands to Southlands 1A/1B is anticipated to be required in the ultimate scenario in order to re-supply the Southeast Industrial Reservoir during off peak periods, and maintain minimum supply pressure while filling. It will also provide a redundant supply of water to the area

which is otherwise completely dependent upon the MacKenzie Reservoir and Pumphouse operation. The future waterline can also service additional future development in the area, if required.

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2015 WATER MASTER PLAN

ULTIMATE WATER DISTRIBUTION SYSTEM

FIGURE 5.1

TO FORT MACKAY
PROPOSED NORTH CORRIDOR BOOSTER STATION
PARSONS CREEK
PROPOSED HWY 63 RESERVOIR & PUMPHOUSE
PROPOSED WEST GROWTH #1 RESERVOIR & PUMPHOUSE
PARSONS CREEK RESERVOIR & PUMPHOUSE
HWY 63 CORRIDOR TRUCKFILL STATION
PROPOSED WEST GROWTH #2 RESERVOIR & PUMPHOUSE
TIMBERLEA RESERVOIR & PUMPHOUSE
ABRAMS LAND
FOREST HEIGHTS
THICKWOOD RESERVOIR & PUMPHOUSE
WATER TREATMENT PLANT
LOWER TOWNSITE RESERVOIR
Athabasca River
ABASAND RESERVOIR & PUMPHOUSE
KING STREET BOOSTER STATION
MILLS AVENUE BOOSTER STATION
PROPOSED HORSE RIVER RESERVOIR & PUMPHOUSE 1
BEACON HILL RESERVOIR & PUMPHOUSE
PROPOSED INTAKE/PUMPHOUSE
PROPOSED HORSE RIVER RESERVOIR & PUMPHOUSE 2
PROPOSED SOUTHWEST WTP
Horse River
Hangingstone River
Saline Creek
Clearwater River
DRAPER
SALINE CREEK
QUARRY RIDGE
PROPOSED HANGINGSTONE RESERVOIR & PUMPHOUSE 1
HANGINGSTONE
MACKENZIE RESERVOIR & PUMPHOUSE
AIRPORT WEST INDUSTRIAL
SAPRAE CREEK/ SPRUCE VALLEY
HORSE RIVER SOUTH
PROPOSED HANGINGSTONE RESERVOIR & PUMPHOUSE 2
ECO-INDUSTRIAL AND LANDFILL AREA
AIRPORT LANDS
SOUTHEAST REGIONAL RESERVOIR & PUMPHOUSE
AIRPORT EAST INDUSTRIAL
HIGHWAY 63
LYNTON
SOUTHLANDS AREA 2
HANGINGSTONE SOUTH
TO GREGOIRE LAKE ESTATES, GREGOIRE LAKE FIRST NATION, & ANZAC
SOUTHLANDS AREA 1A
PROPOSED SOUTHLANDS RESERVOIR, PUMPHOUSE & TRUCKFILL
SOUTHLANDS AREA 1B
TO PROPOSED HIGHWAY 881/63 RESERVOIR AND PUMPHOUSE

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 350mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- PROPOSED 150mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 350mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- PROPOSED 450mmØ WATERMAIN
- PROPOSED 500mmØ WATERMAIN
- PROPOSED 600mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- DEVELOPMENT BOUNDARY
- FUTURE WATER TREATMENT PLANT
- FUTURE RESERVOIR/ PUMPHOUSE OR BOOSTER STATION
- FUTURE SUPPLY LINE
- FUTURE DISTRIBUTION LINE
- FUTURE INTAKE

SCALE 1:70,000

OCTOBER 2015

Associated Engineering

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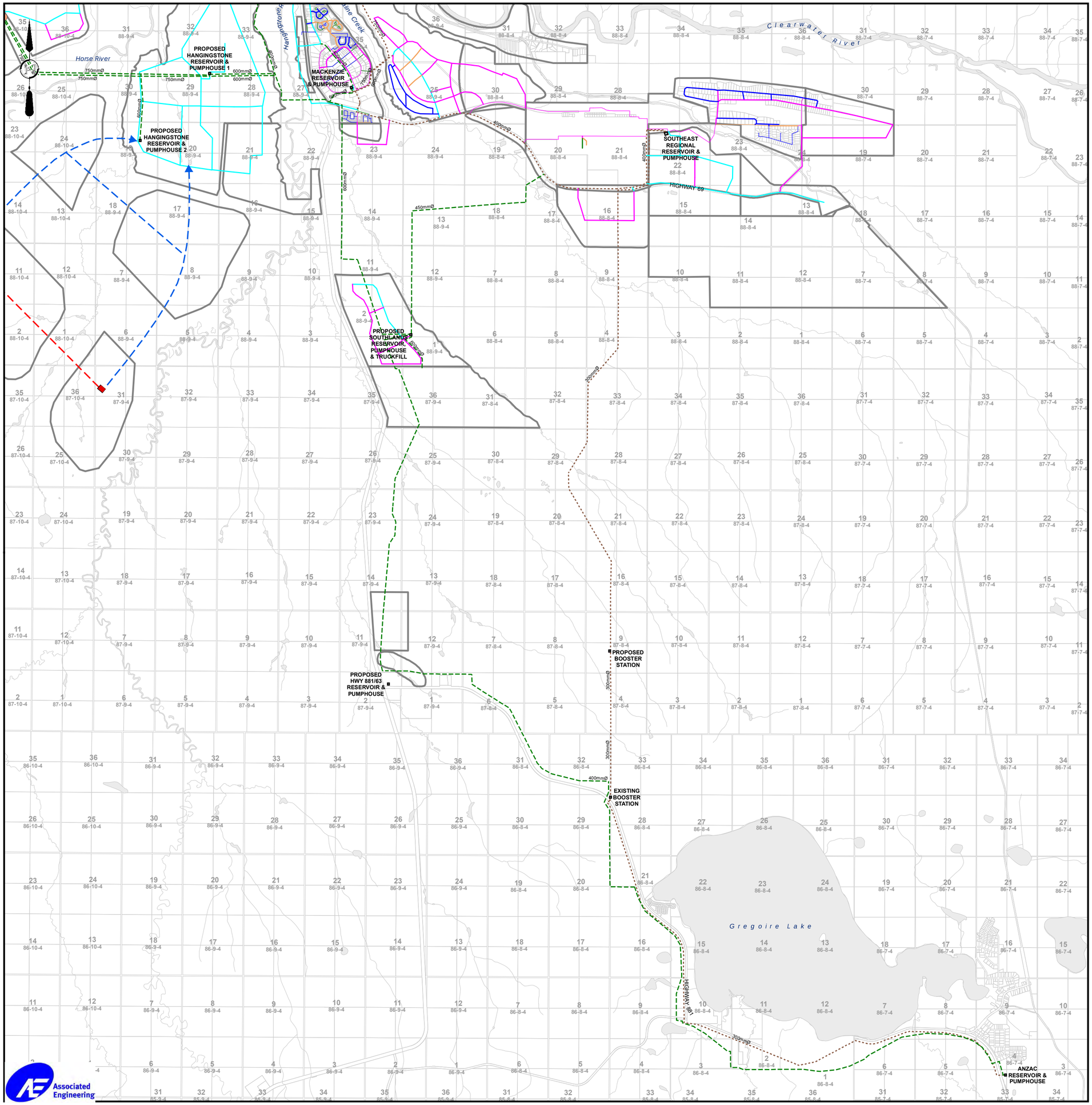
FIGURE 5-1



REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

ULTIMATE WATER DISTRIBUTION SYSTEM SOUTHEAST SYSTEM

FIGURE 5-2

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- PROPOSED 150mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- DEVELOPMENT BOUNDARY
- FUTURE WATER TREATMENT PLANT
- FUTURE RESERVOIR/ PUMPHOUSE OR BOOSTER STATION
- FUTURE SUPPLY LINE
- FUTURE DISTRIBUTION LINE

SCALE 1:70,000

OCTOBER 2015

Associated Engineering

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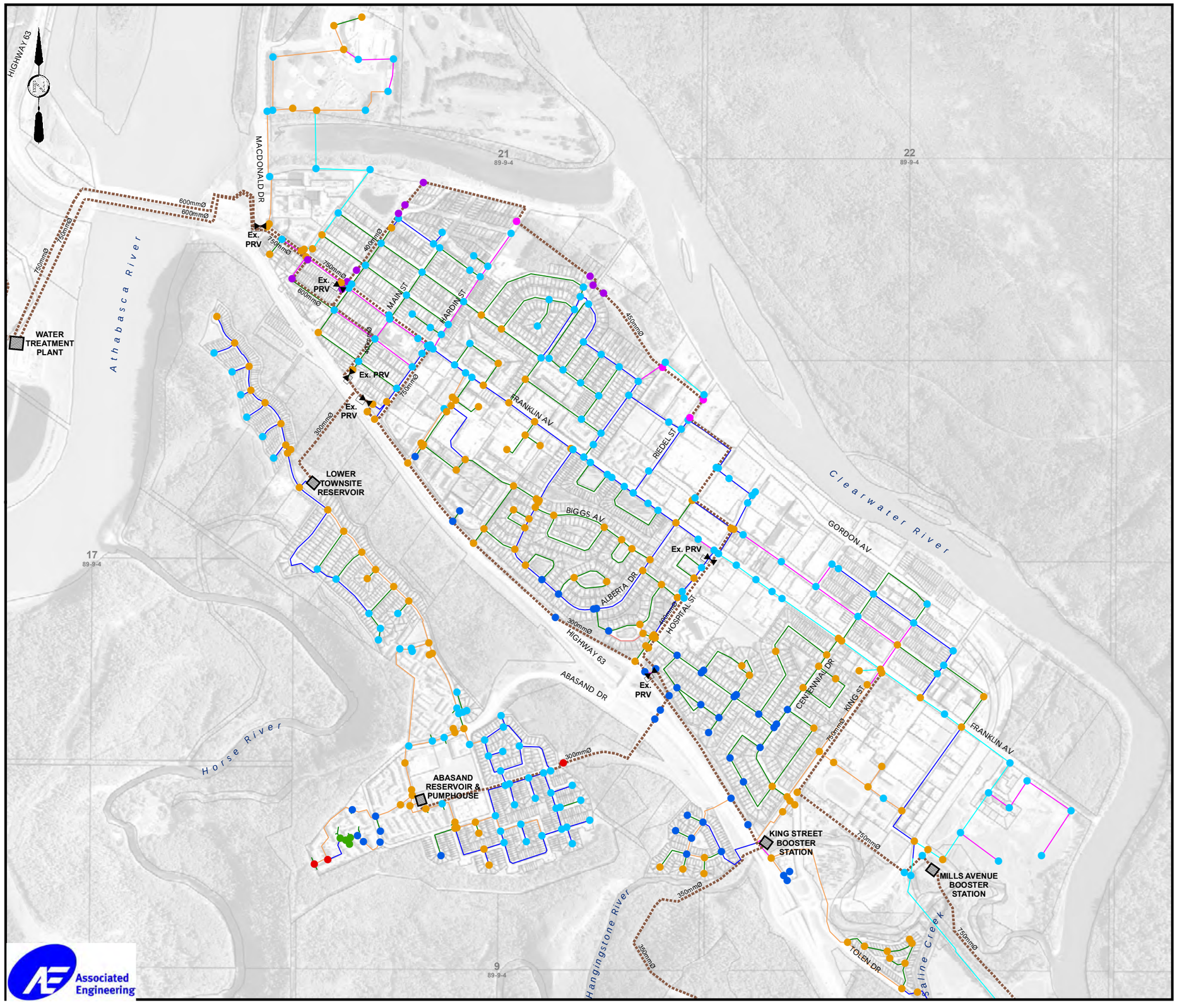

2015 WATER MASTER PLAN

LOWER TOWNSITE & ABASAND HEIGHTS
EXISTING WATER DISTRIBUTION SYSTEM

LEGEND:

- EXISTING 100mmØ WATERMAIN
- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

PEAK HOUR PRESSURE (kPa)

- <350 (50psi)
- 350 - 415 (50 - 60psi)
- 415 - 480 (60 - 70psi)
- 480 - 550 (70 - 80psi)
- 550 - 620 (80 - 90psi)
- 620 - 690 (90 - 100psi)
- >690 (100psi)

PRESSURE REDUCING VALVE (PRV)

SCALE 1:15,000
OCTOBER 2015

FIGURE 5-3

Associated Engineering

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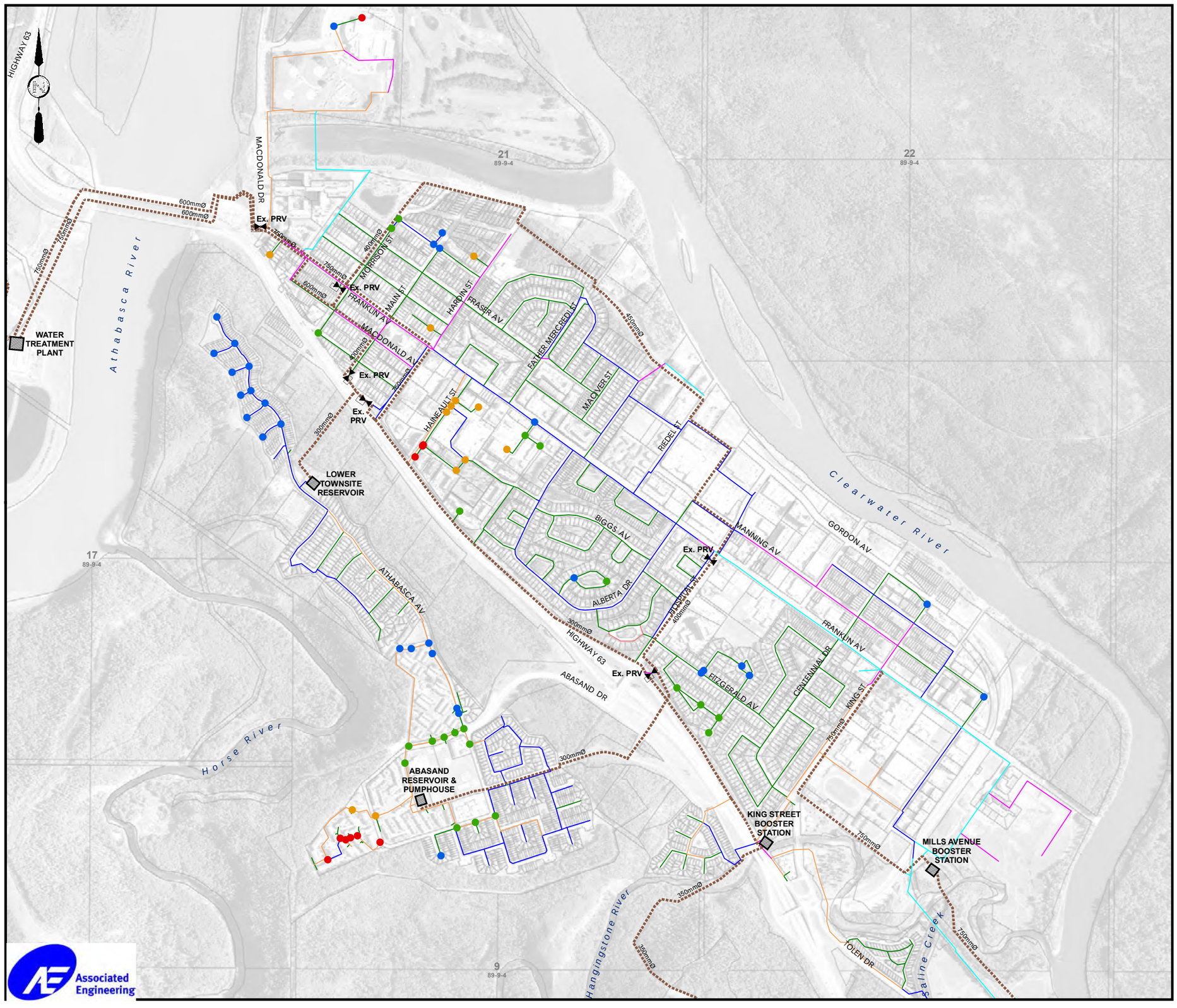

2015 WATER MASTER PLAN

LOWER TOWNSITE & ABASAND HEIGHTS

EXISTING WATER DISTRIBUTION SYSTEM WITH FIRE FLOW DEFICIENCIES

LEGEND:

- EXISTING 100mmØ WATERMAIN
- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

FIRE FLOW DEFICIENCY

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

PRESSURE REDUCING VALVE (PRV)

SCALE 1:15,000

OCTOBER 2015

FIGURE 5-4

Associated Engineering

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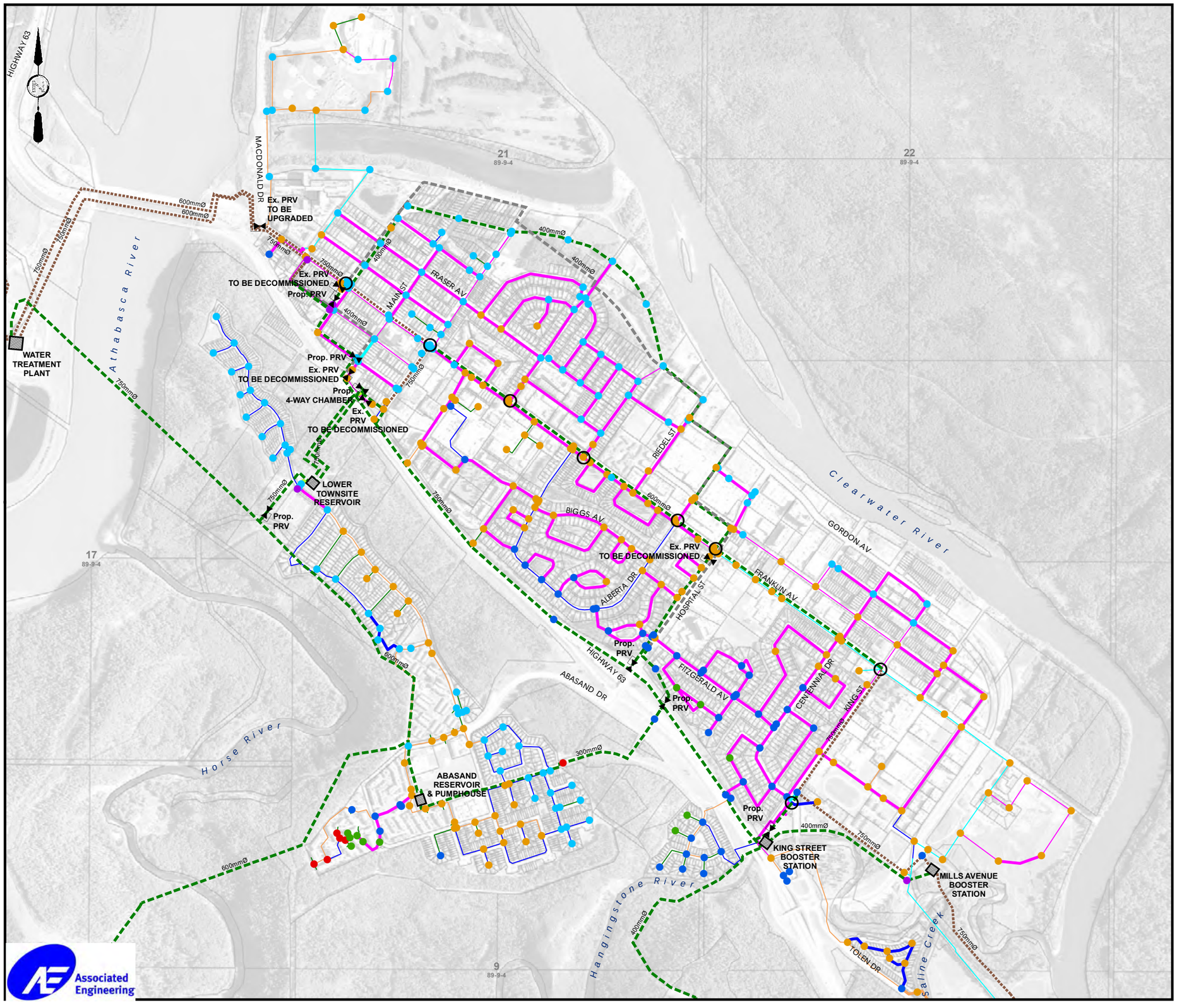

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Associated Engineering

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

LOWER TOWNSITE & ABASAND HEIGHTS

ULTIMATE WATER DISTRIBUTION SYSTEM WITH PROPOSED UPGRADES

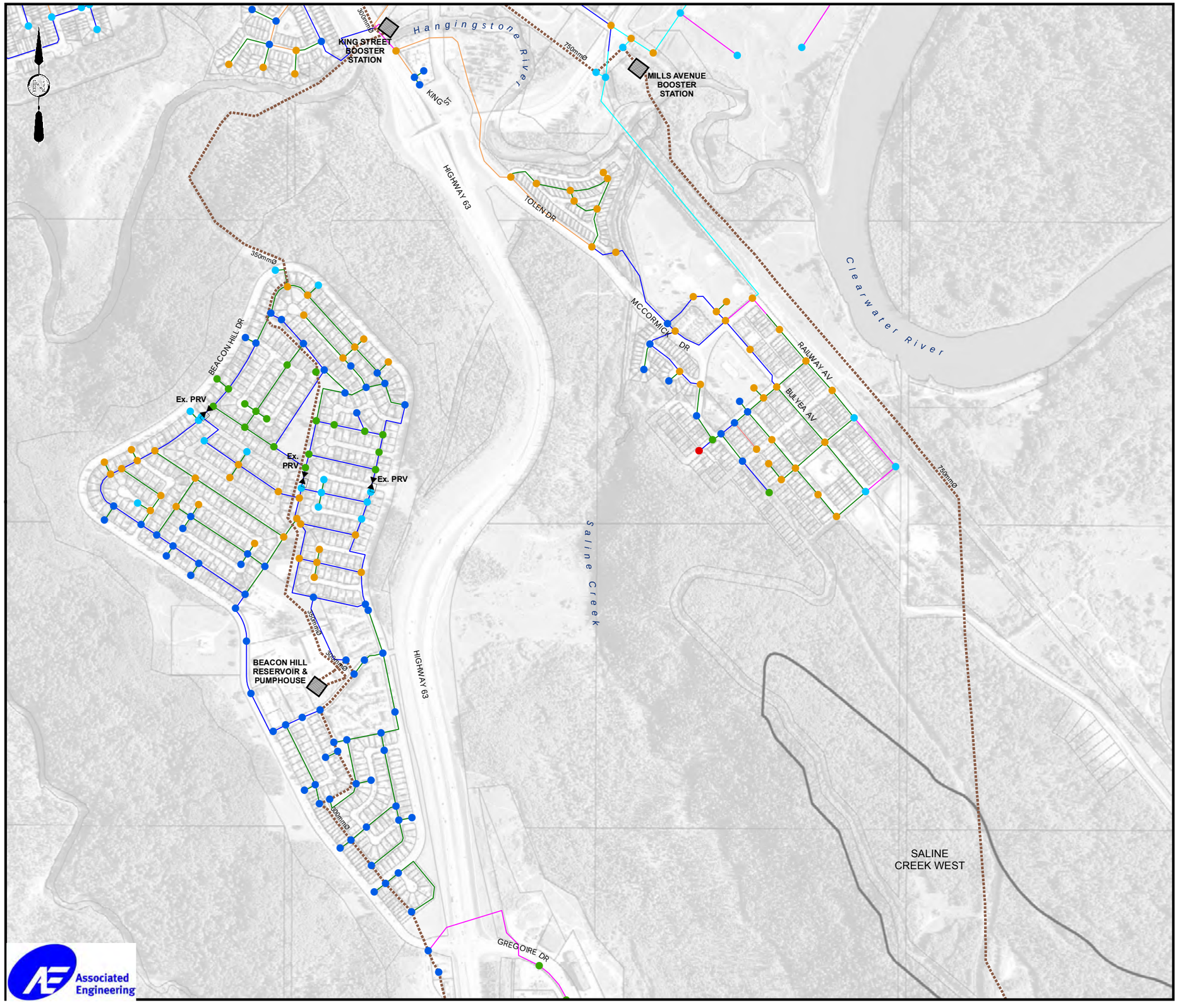
LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 350mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- ABANDON EXISTING SUPPLY WATERMAIN
- PRESSURE REDUCING VALVE (PRV)
- INTERCONNECTION

SCALE 1:15,000

OCTOBER 2015

FIGURE 5-5



REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

BEACON HILL & WATERWAYS
EXISTING WATER DISTRIBUTION SYSTEM

LEGEND:

- EXISTING 100mmØ WATERMAIN
- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

PEAK HOUR PRESSURE (kPa)

- <350 (50psi)
- 350 - 415 (50 - 60psi)
- 415 - 480 (60 - 70psi)
- 480 - 550 (70 - 80psi)
- 550 - 620 (80 - 90psi)
- >690 (100psi)
- PRESSURE REDUCING VALVE (PRV)

SCALE 1:10,000
OCTOBER 2015

FIGURE 5-6

Associated Engineering

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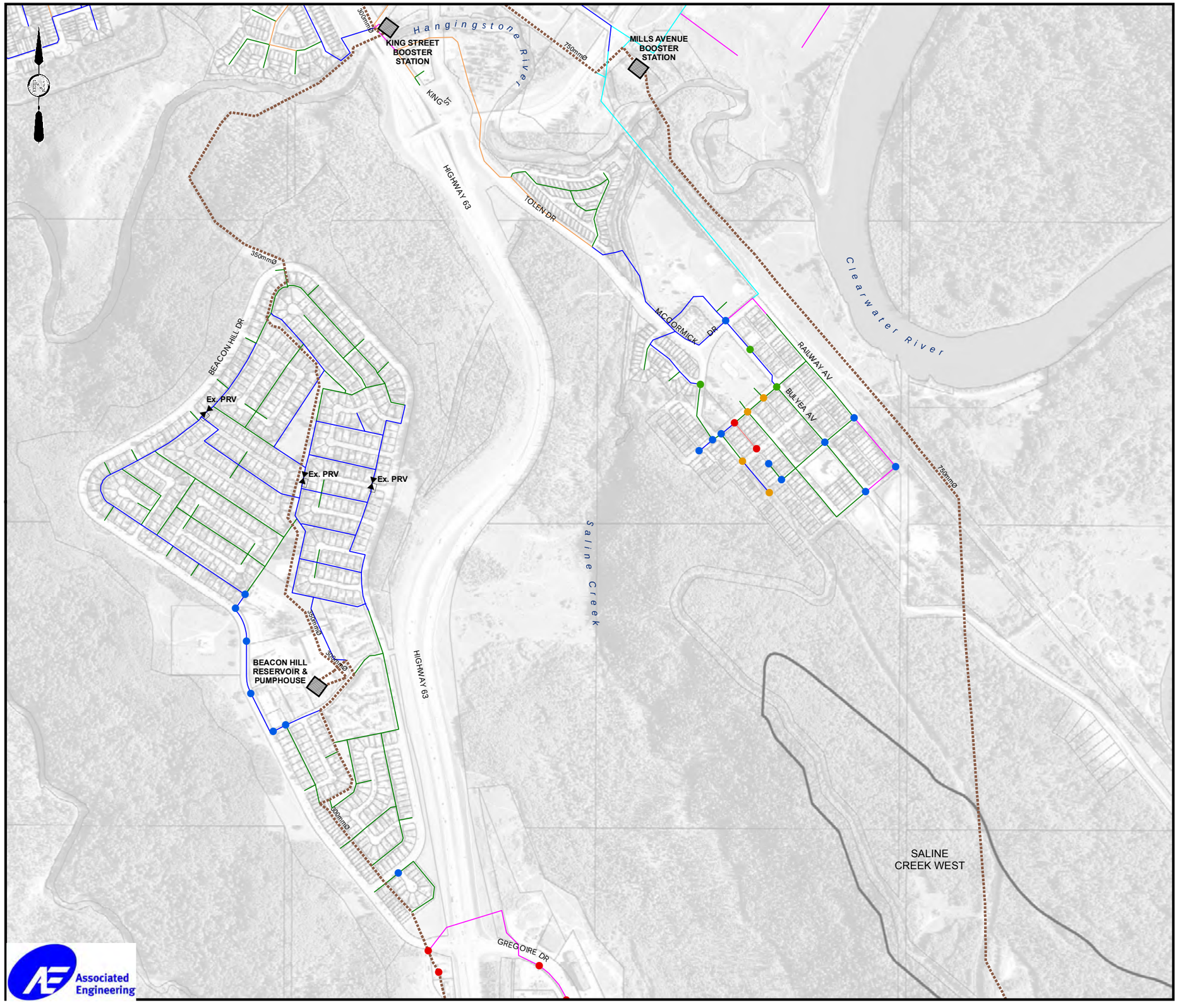

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

BEACON HILL & WATERWAYS

EXISTING WATER DISTRIBUTION SYSTEM WITH FIRE FLOW DEFICIENCIES

LEGEND:

- EXISTING 100mmØ WATERMAIN
- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

FIRE FLOW DEFICIENCY

- < 20%
- 20% - 40%
- 40% - 60%
- > 60%
- PRESSURE REDUCING VALVE (PRV)

SCALE 1:10,000

OCTOBER 2015

FIGURE 5-7

Associated Engineering

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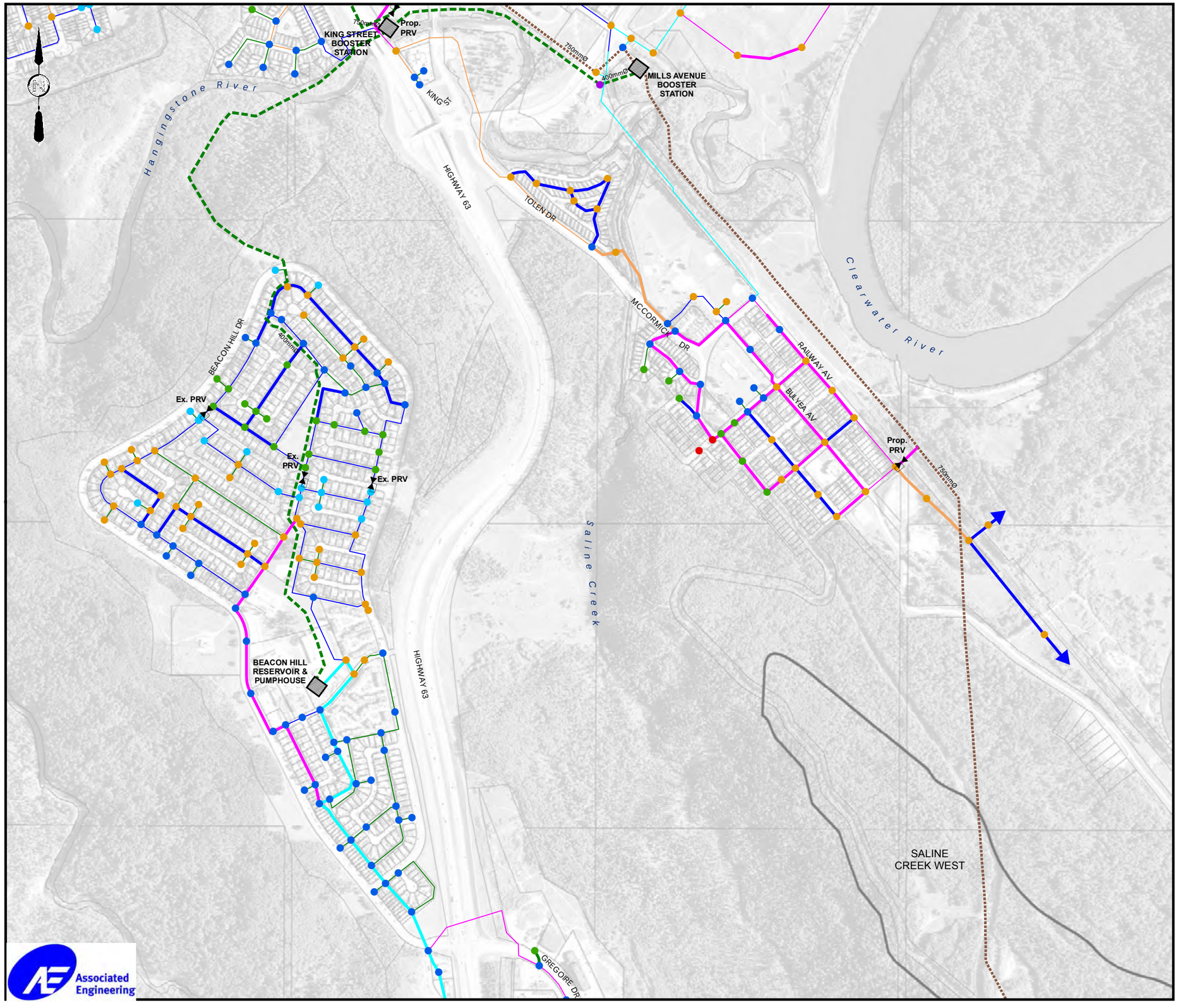

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

BEACON HILL & WATERWAYS

ULTIMATE WATER DISTRIBUTION SYSTEM WITH PROPOSED UPGRADES

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- PROPOSED 150mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- PRESSURE REDUCING VALVE (PRV)
- DEVELOPMENT BOUNDARY

SCALE 1:10,000
OCTOBER 2015

FIGURE 5-8

Associated Engineering

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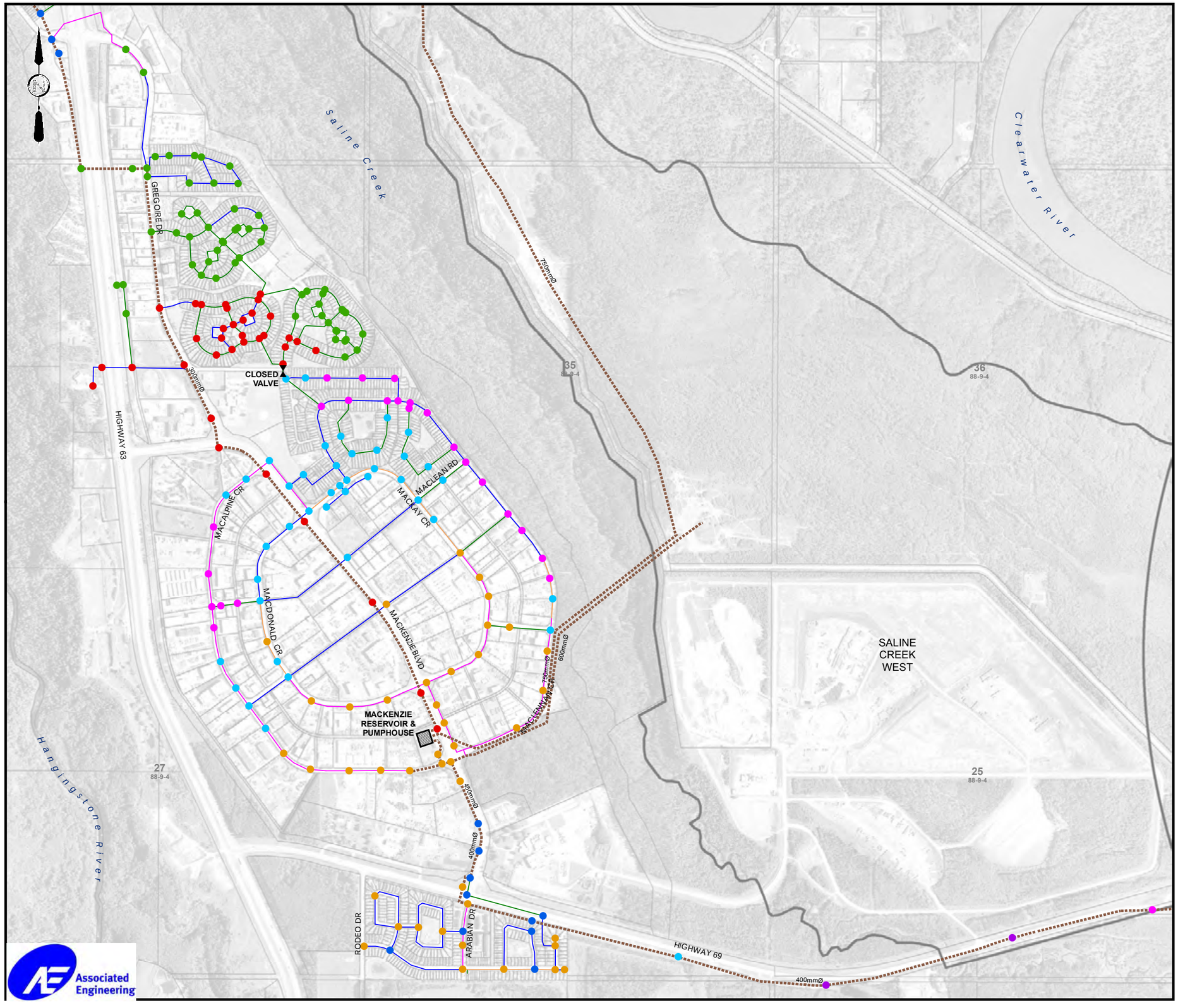

Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN

MACKENZIE INDUSTRIAL PARK
EXISTING WATER DISTRIBUTION SYSTEM

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

PEAK HOUR PRESSURE (kPa)

- <350 (50psi)
- 350 - 415 (50 - 60psi)
- 415 - 480 (60 - 70psi)
- 480 - 550 (70 - 80psi)
- 550 - 620 (80 - 90psi)
- 620 - 690 (90 - 100psi)
- >690 (100psi)

PRESSURE REDUCING VALVE (PRV)

SCALE 1:15,000
OCTOBER 2015

FIGURE 5-9

Associated Engineering

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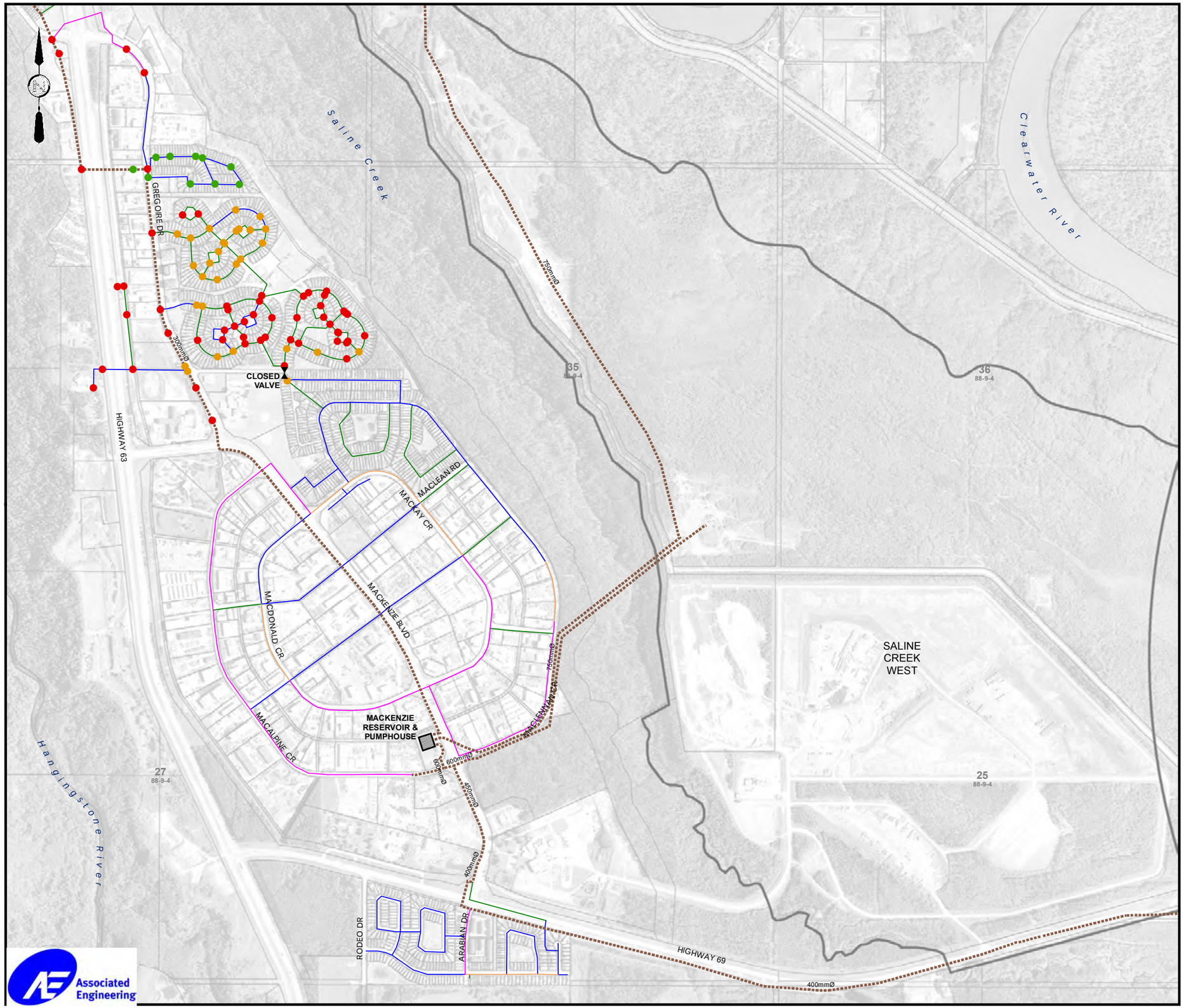

2015 WATER MASTER PLAN

MACKENZIE

EXISTING WATER DISTRIBUTION SYSTEM WITH FIRE FLOW DEFICIENCIES

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

FIRE FLOW DEFICIENCY

- 20% - 40%
- 40% - 60%
- > 60%
- PRESSURE REDUCING VALVE (PRV)

SCALE 1:15,000
OCTOBER 2015

FIGURE 5-10

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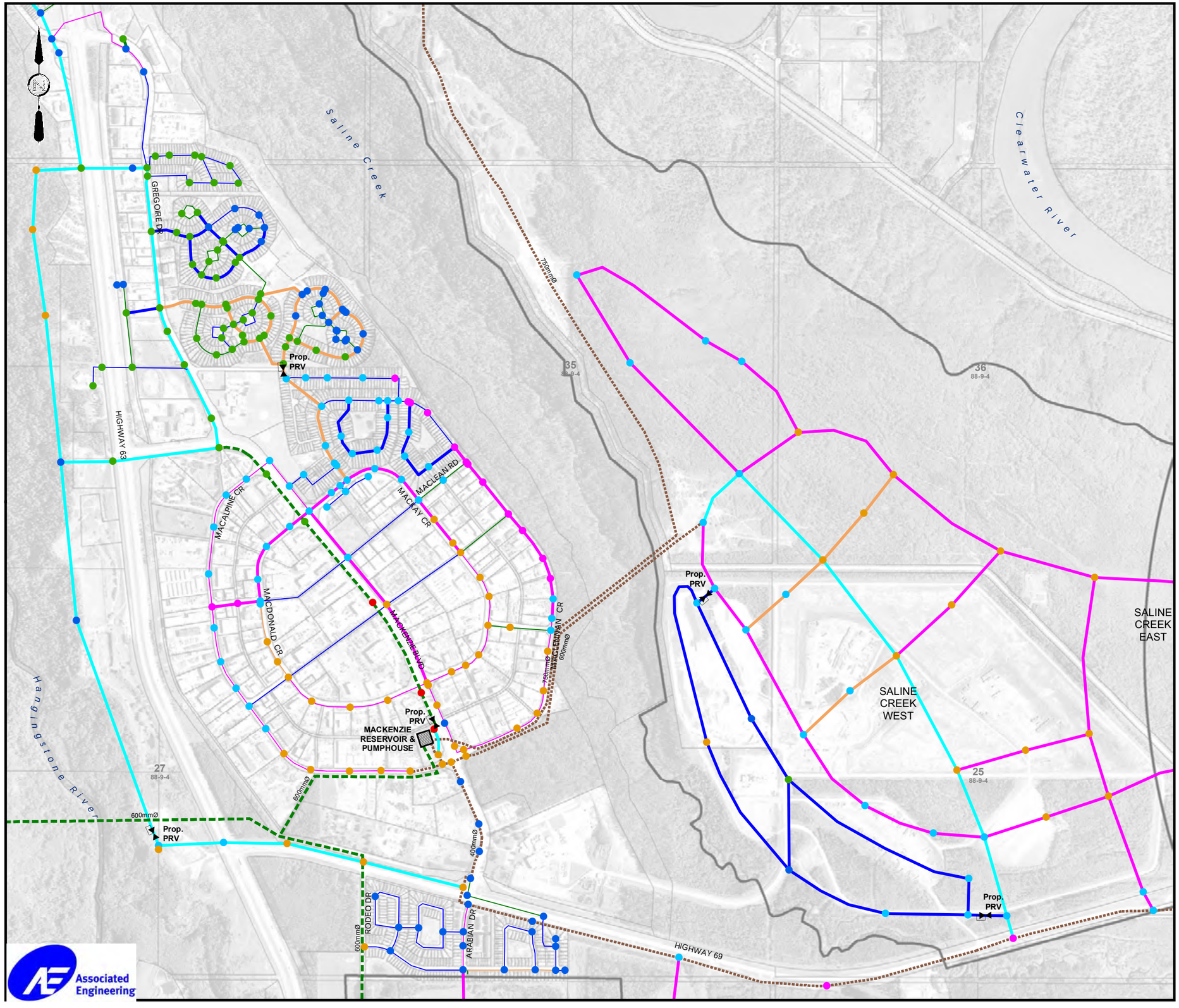
Associated Engineering



Associated Engineering

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REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

MACKENZIE INDUSTRIAL PARK

ULTIMATE WATER DISTRIBUTION SYSTEM WITH PROPOSED UPGRADES

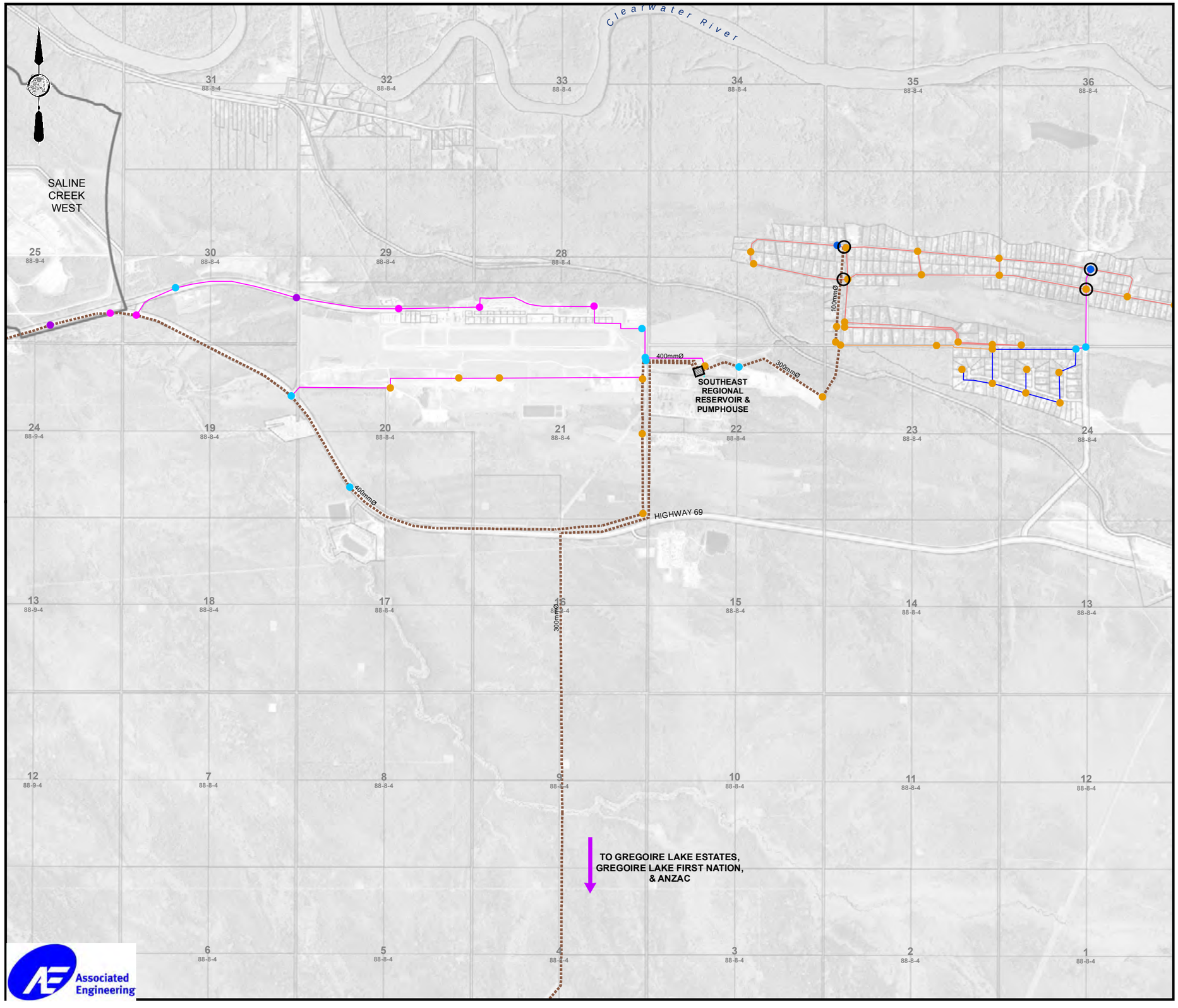
LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- PROPOSED 150mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- PRESSURE REDUCING VALVE (PRV)
- DEVELOPMENT BOUNDARY

SCALE 1:15,000

OCTOBER 2015

FIGURE 5-11



Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN

AIRPORT & SAPRAE CREEK/SPRUCE VALLEY EXISTING WATER DISTRIBUTION SYSTEM

LEGEND:

- EXISTING 100mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

PEAK HOUR PRESSURE (kPa)

- 415 - 480 (60 - 70psi)
- 480 - 550 (70 - 80psi)
- 550 - 620 (80 - 90psi)
- 620 - 690 (90 - 100psi)
- >690 (100psi)
- PRESSURE REDUCING VALVE (PRV)
- INTERCONNECTION

SCALE 1:35,000
OCTOBER 2015

FIGURE 5-12

Associated Engineering

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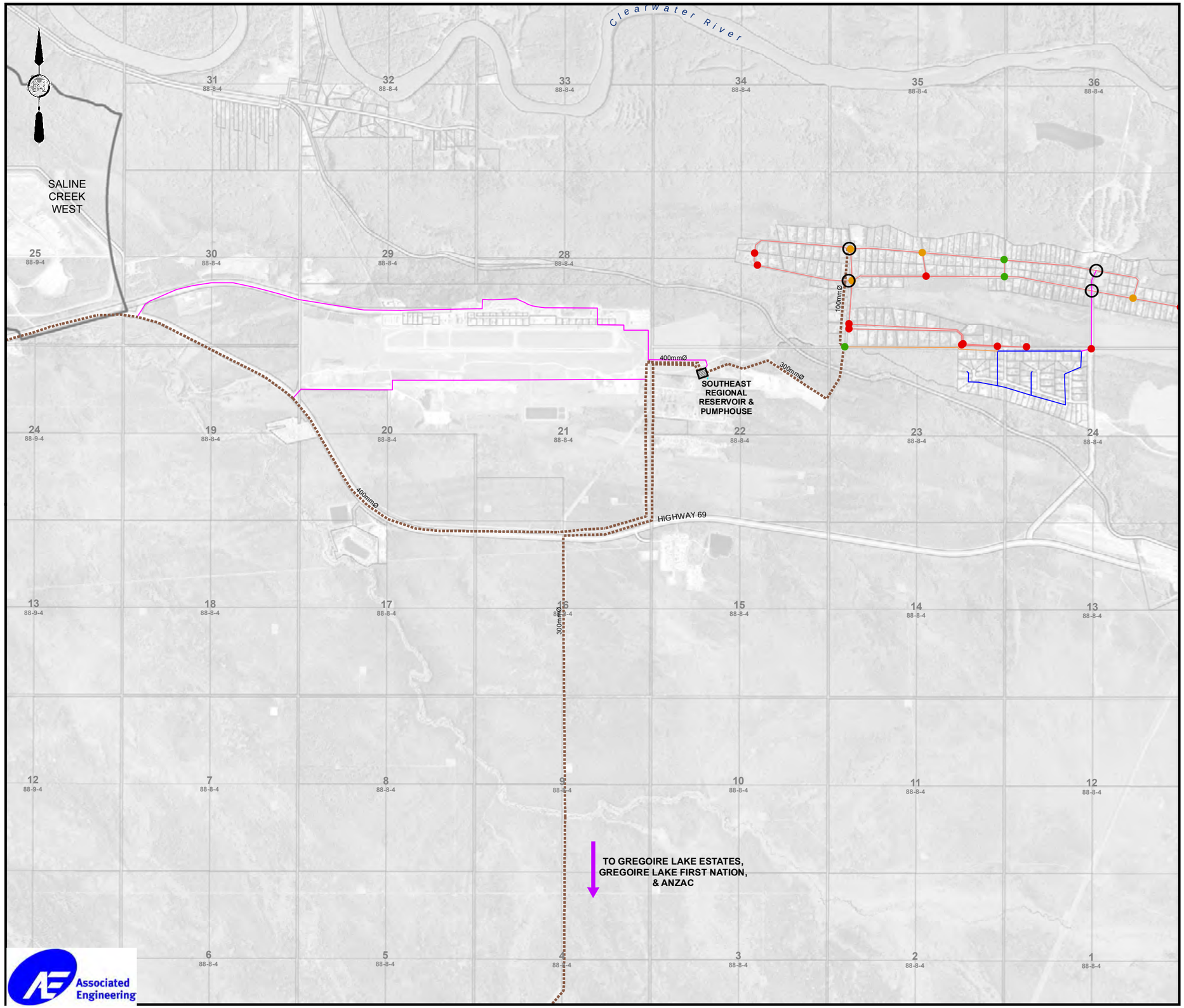

Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN

AIRPORT & SAPRAE CREEK/SPRUCE VALLEY

EXISTING WATER DISTRIBUTION SYSTEM WITH FIRE FLOW DEFICIENCIES

LEGEND:

- EXISTING 100mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

FIRE FLOW DEFICIENCY

- 20% - 40%
- 40% - 60%
- > 60%
- PRESSURE REDUCING VALVE (PRV)
- INTERCONNECTION

SCALE 1:35,000
OCTOBER 2015

FIGURE 5-13

Associated Engineering

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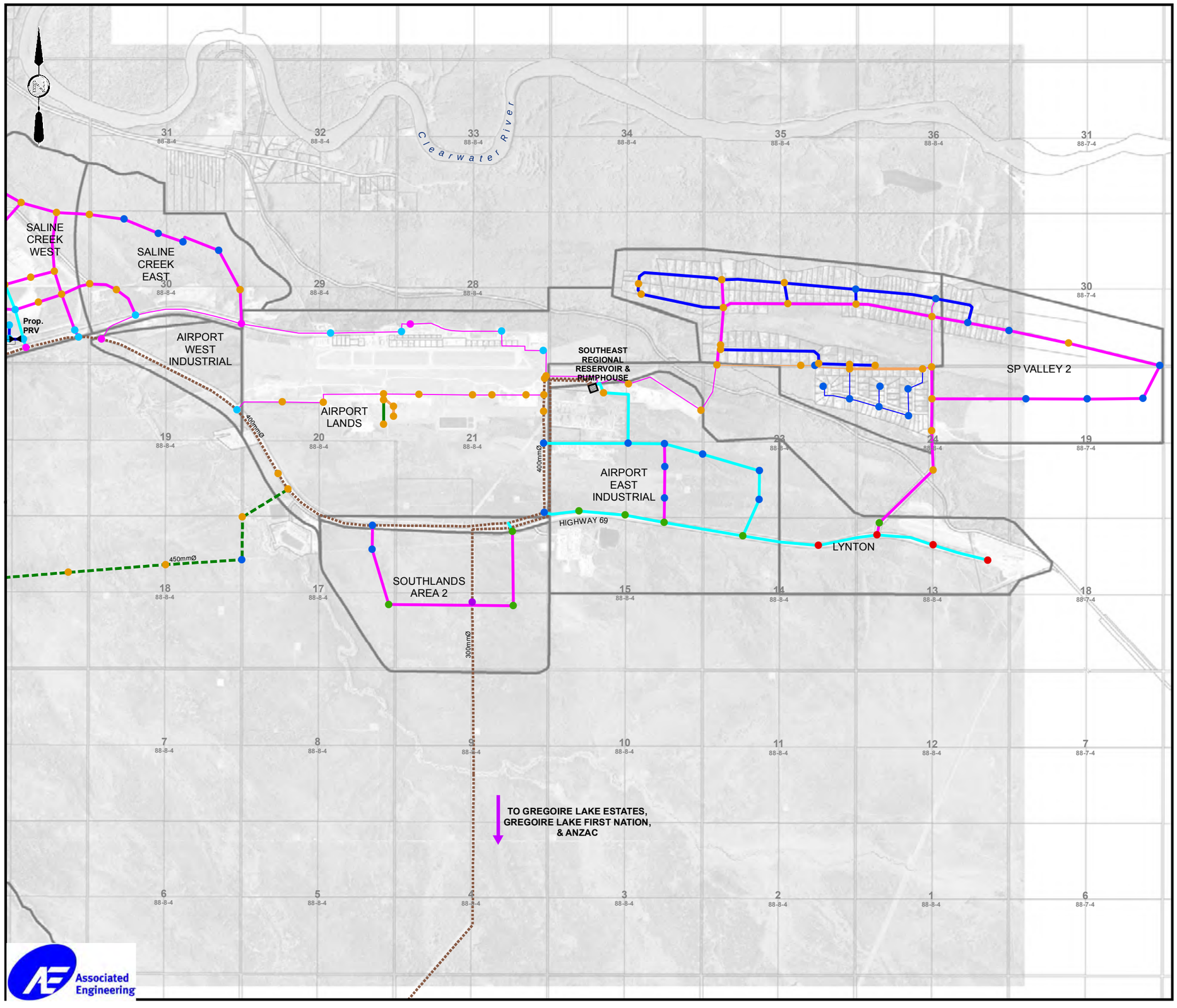

Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN

AIRPORT & SAPRAE CREEK/SPRUCE VALLEY

ULTIMATE WATER DISTRIBUTION SYSTEM WITH PROPOSED UPGRADES

LEGEND:

- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- PROPOSED 150mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- PRESSURE REDUCING VALVE (PRV)
- DEVELOPMENT BOUNDARY

SCALE 1:40,000
OCTOBER 2015

FIGURE 5-14

Associated Engineering

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6 North Service Area

6.1 GENERAL

The water system within the study area has been assessed using the computer modelling software "WaterCAD" by Bentley. The distribution system will generally be assessed based on the following scenarios:

- Peak Hour Demand.
- Peak Day plus Fire Flow Demand.

In addition, maximum system pressures will be presented based on the design zone HGL.

In general, the ultimate system upgrades presented have been based on meeting minimum recommended fire flows, as well as to provide for increased demand due to population growth. The upgrades do not necessarily identify all locations which do not meet the minimum recommended sizes (as per Section 2). These upgrades are suggested to be implemented when infrastructure upgrading opportunities arise (i.e. roadway rehabilitation).

Figure 5-1 identifies the overall ultimate system concept for the North Service Area. Figures 6-1 through 6-7 provide information specific to each neighbourhood.

6.2 PRESSURE ZONES

6.2.1 Existing Pressure Zones

The North Service Area is comprised of six existing pressure zones. Pressure zones are labelled and referred to by the typical zone HGL (delivery pressure plus elevation as determined from pumphouse outgoing pressures and/or PRV settings). The existing North Service Area pressure zones are identified on Figure 4-1. These include:

- **Zone 405 m HGL Thickwood Zone 1** – The pressure zone in the Thickwood area as defined by the Thickwood Reservoir and Pumphouse outgoing pressure.
- **Zone 370 m HGL Thickwood Zone 2** –The pressure zone located in the east section of the Thickwood neighbourhood as defined by three PRV's. This area is supplied via the Thickwood Reservoir and Pumphouse.
- **Zone 417 m HGL Timberlea Zone 1** – The main Timberlea pressure zone as defined by the outgoing pressure from the Timberlea Reservoir and Pumphouse.
- **Zone 375 m HGL Timberlea Zone 2** – The pressure zone within Timberlea which includes Eagle Ridge and Stone Creek Areas (Parcel D and Parcel F) and as defined by three PRV's.
- **Zone 360 m HGL Timberlea Zone 3** – A small pressure zone within Timberlea defined by one PRV and includes the subdivision located east of Zone 375 and north of Confederation Way.

- **Zone 305 m HGL Highway 63 Zone** – The eastern pressure zone within Timberlea defined by two PRV's in series and includes the Industrial/Commercial area along Highway 63 and the Truckfill Station.

6.2.2 Ultimate Pressure Zones

In the future, some modifications to the North Service Area pressure zones are anticipated (refer to Figure 4-2):

- **Zone 406 m HGL Parsons Creek Zone** - The future Parsons Creek pressure zone will be defined by the outgoing pressure from the proposed Parsons Creek Reservoir and Pumphouse.
- **Zone 426 m HGL West Growth Zone** – The future West Growth area pressure zone will be defined by the outgoing pressure from two proposed Reservoirs and Pumphouses.

6.3 THICKWOOD

6.3.1 Thickwood – Existing System

The Thickwood neighbourhood is located northwest of the WTP and west of Hwy 63. The Thickwood Reservoir is supplied from the WTP through a 600 mm diameter steel pipe, which runs along Hwy 63, then connects to a 300 mm steel pipe at the intersection of Thickwood Boulevard (tees off of 600 mm). The distribution system is comprised of pipes ranging in size from 150 mm to 450 mm (refer to Figure 6-1).

The existing Thickwood Pumphouse and Reservoir is located south of Thickwood Boulevard and west of Signal Road.

Photo 6-1
Thickwood Reservoir and Pumphouse

The existing Thickwood Pumphouse is equipped with four pumps (refer to Appendix H for pump curves). The existing pumphouse is understood to operate at an HGL of 405 m. Information on the existing pumps is presented in Table 6-1 below.

Table 6-1
Thickwood – Existing Pump Information

Description	Flow (L/s)	TDH (m)
P-1 Lead Pump (VFD)	200	59
P-2 Lag Pump (VFD)	200	59
P–3 Service Pump (Constant Speed)	100	59
P-4 Service Pump (Constant Speed)	100	59

The maximum design flow rate is 400 L/s and can be provided by operating both service pumps and one of the lead or lag pumps.

6.3.2 Thickwood – Existing System Assessment

Based on an existing zone pressure of 405 m HGL, the maximum pressure during low demand periods in the upper Thickwood area is 763 kPa (111 psi), and in the lower zone (370 m HGL) is 620 kPa (90 psi). During the peak hour scenario, the minimum pressure within the Thickwood upper zone (405 m HGL) is 352 kPa (51 psi), and is 310 kPa (45 psi) in the lower zone.

A number of locations do not meet the pressure recommendations outlined within the design criteria section of this report. Figure 6-1 presents the existing distribution system, and indicates the associated peak hour pressures.

Figure 6-2 identifies fire flow deficiencies in the existing distribution system during the Peak Day scenario. The deficiencies are primarily located along the edges of the development.

A pumping capacity assessment based on future projected demands is provided in Table 6-2 below.

Table 6-2
Thickwood Pumphouse – Pumping Capacity Assessment

Year	Pumping Capacity	Peak Hour Demand (L/s)	Peak Day Demand plus 233 L/s Fire Flow (L/s)
2013	400	219	379
2018	400	240	393
2023	400	240	393
2028	400	240	393
2033	400	240	393
Ultimate	400	240	393

As indicated in the above table, as well as in the design criteria of this report, it is assumed that the Thickwood area is near its maximum development capacity and therefore will experience little additional population increase over time. As such, it appears that the Thickwood pumphouse has sufficient capacity to meet both the peak hour demand flows as well as the peak day plus fire flows.

An assessment of the existing storage capacity at the Thickwood Reservoir is provided in Table 6-3. The assessment is based on meeting the recommendations set out by AEP.

Table 6-3
Thickwood – Projected Storage Volume Requirements (m^3)

Year	Existing Storage Volume (m^3)	Existing Average Day Flow (L/s)	15% Ave. Day Flow (m^3)	25% Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Req'd Storage (m^3)	Surplus/ Deficit (m^3)
2013	9,100	73	946	3,154	2,516	6,616	2,484
2018	9,100	80	1,037	3,456	2,516	7,089	2,011
2023	9,100	80	1,037	3,456	2,516	7,089	2,011
2028	9,100	80	1,037	3,456	2,516	7,089	2,011
2033	9,100	80	1,037	3,456	2,516	7,089	2,011
ULTIMATE	9,100	80	1,037	3,456	2,516	7,089	2,011

Based on the above table, the reservoir can provide the recommended storage to meet the ultimate projected water demands.

6.3.3 Thickwood – Upgrades to Existing System

As mentioned above, the existing pumping and storage capacity at the Thickwood Reservoir and Pumphouse appear to be sufficient to meet both the existing and ultimate demands. However, upgrades are proposed to the distribution system in order to satisfy the recommended fire flow criteria.

It appears that high pressures may be experienced during very low flow scenarios. As such, it may be beneficial to review the PRV locations in order to reduce the maximum pressures to acceptable levels.

Figure 6-1 identifies the nodes which will exceed 690 kPa (100 psi) based on an HGL of 405 m, during low demand periods. **It is recommended that pressure in the area be monitored, and individual lot pressure tests be undertaken to confirm whether these high pressures are actually occurring within this section of the distribution system**. If confirmed, then individual PRV's may be recommended at each residence (at the water meter), or if the affected area is large enough, PRV stations may be required on the distribution system in order to reduce the maximum pressures.

A 300 mm diameter main which at one time supplied the Timberlea Reservoir off of the Thickwood distribution system, has been placed back into service in order to supply water into Thickwood and Abrams Lands. This will provide temporary servicing to the Abrams Lands via the Timberlea system and will reinforce the Thickwood distribution system at Dickensfield (refer to **Figure 6-1**).

A PRV has been installed in order to reduce the Timberlea pressures to 400 m HGL (5 m below the Thickwood Zone pressure), and to provide additional water supply to the Thickwood system in case of emergency. An additional PRV is proposed to be set at 400 m HGL to provide emergency supply from Thickwood to Abrams Lands.

6.3.4 Thickwood – Ultimate System

The ultimate system concept is shown on the attached **Figure 6-3**. As the population is not expected to grow significantly in the future, there are no distribution system upgrades recommended in order to accommodate future population growth. The upgrades identified address shortcomings of the existing system to accommodate the recommended fire flows.

Upgrading is recommended north and south of the existing Thickwood Reservoir and Pumphouse to 400 mm in diameter. Other upgrades are identified throughout Thickwood which address system shortcomings. These are recommended to be addressed during neighbourhood rehabilitation projects (refer to **Figure 6-3**).

It is proposed that the PRV identified to provide emergency flow to the future West Growth area of Thickwood, be maintained in the Ultimate scenario. It is proposed to remain set at approximately 400 m HGL (equal to 5 m HGL below the Thickwood zone pressure). This will allow Thickwood to provide water during emergency conditions to the adjacent West Growth area, even though the West Growth area is at a significantly higher pressure zone. The PRV would only operate during a significant pressure reduction, such as a fire or supply interruption.

Upgrading to the minimum recommended pipe size (as outlined within the design criteria) is generally recommended during local system improvement opportunities. These types of upgrades are typically undertaken during localized roadway or other infrastructure improvements.

6.4 TIMBERLEA

6.4.1 Timberlea – Existing System

The Timberlea area is located north of Thickwood and west of Hwy 63. The Timberlea Reservoir and Pumphouse is supplied by the WTP through an existing 600 mm diameter watermain which also supplies the Thickwood Reservoir and Pumphouse. The 600 mm main reduces to a 400 mm watermain and supplies the Timberlea Reservoir and Pumphouse (located on the Southeast corner of Confederation Way and Brett Drive). Water is then pumped into the distribution system through a 400 mm diameter watermain. **Figure 6-4** shows the location of the existing watermains and facilities.

In 2007 the water supply to the Highway 63 Corridor and the Truckfill Station was disconnected from the WTP supply and connected to the Timberlea distribution system.

Photo 6-2
Timberlea Reservoir and Pumphouse

Photo 6-3
Hwy 63 – Truckfill Station

The Timberlea Pumphouse has recently been upgraded, and new pumps have been installed. Pump curves are included in **Appendix I**. There are currently 5 new electric motor pumps which have been installed, rated at 260 L/s and 58 m TDH each, 3 pumps with VFD's and 2 pumps which are constant speed. A maximum of 3 pumps will operate at any given time. The pumphouse operates at an HGL of 417 m.

The new pumping capacity is summarized in **Table 6-4.**

Table 6-4
Timberlea – New Pump Information

Pump	Flow (L/s)	TDH (m)
P – 401 (VFD)	260	58
P – 402 (VFD)	260	58
P – 403 (VFD)	260	58
P – 404 (Constant Speed)	260	58
P – 405 (Constant Speed)	260	58

6.4.2 Timberlea – Existing System Assessment

The Timberlea area consists of 4 pressures zones; the main pressure zone which is regulated by the pumphouse, and three additional pressure zones to the east, which are controlled by various PRV stations. The following are the maximum pressures that each zone will experience during low demand periods:

- Timberlea (Zone 417 m HGL) - 772 kPa (112 psi).
- Eagle Ridge/Stone Creek areas (Zone 375 m HGL) - 694 kPa (101 psi).
- Northeast (Zone 360 m HGL) - 476 kPa (70 psi).
- Highway 63 Industrial/Commercial (Zone 305 m HGL) - 626 kPa (91 psi).

The following are the minimum pressures that each zone will experience during the peak hour demand scenario. **Figure 6-4** identifies the peak hour pressures within the Lower Townsite.

- Timberlea (Zone 417 m HGL) - 371 kPa (54 psi).
- Eagle Ridge/Stone Creek areas (Zone 375 m HGL) - 2 kPa (47 psi).
- Northeast (Zone 360 m HGL) - 462 kPa (67 psi).
- Highway 63 Industrial/Commercial (Zone 305 m HGL) - 410 kPa (74 psi).

As indicated above, pressures in the main Timberlea zone and the Eagle Ridge/Stone Creek Zone both exceed recommended maximum pressures during low demand periods.

The model results indicate that the majority of peak day plus fire flow demands are satisfied within the Timberlea service area (refer to **Figure 6-5**). A significant number of existing 150 mm diameter waterlines will experience higher than recommended velocities under the peak day plus fire flow demand scenario. As well, some nodes within the Highway 63 Corridor do not meet the recommended fire flows when the Truckfill is operating. Therefore during major fire demands, the truckfill is assumed to be shut down until a reservoir is built to service the future Hwy 63 North Commercial Area.

An assessment of the new pumping capacity is provided in **Table 6-5**.

Table 6-5
Timberlea Pumphouse – Pumping Capacity Assessment

Year	Pumping Capacity (L/s)	Water Demand (L/s)			Peak Day Demand plus 233 L/s Fire Flow (L/s)
		Peak Hour (Timberlea)	Peak Day (Hwy 63 and Truck Fill Station[(1)(2)]	Total	
2013	780	419	86	505	598
2018	780	493	114	607	675
2023	780	525	96	621	679
2028	780	525	120	645	703
2033	780	525	128	653	711
Ultimate	780	525	128	653	711

Note: 1) The Ultimate Hwy 63 demands were originally based on a peak day flow demand of 195 L/s; Truckfill – 3 @ 40 L/s; 1 @ 15 L/s; Hwy 63 demands – 60 L/s). It is assumed that the truckfill demands will reduce by 50%, following construction of the Fort MacKay North Transmission Line.

2) During a major fire in the Hwy 63 area, it is assumed that the truckfill will be shut down to provide the required 183 L/s.

A peak day demand has been applied for the Highway 63 Corridor as well as for the Truckfill, due to the nature of these demands. The truckfill demand is expected to remain fairly constant and is limited to the number of bays and pumping capacity. The maximum demand (PH) available is 135 L/s, even though it is not expected to operate 24 hours/day. However, with the construction of the future North Truckfill (assumed for 2023), it is assumed that the original design demands will decrease by 50%, (135 L/s peak demand reduces to 67.5 L/s).

The Highway 63 Corridor is mainly industrial and is not expected to have a significant peak hour demand due to the type of industries in the area (i.e. Lafarge, Diversified Bus Barns etc.). Although the ultimate demand for the Highway 63 Corridor is listed as 60 L/s, it appears that it could be closer to 25 L/s during the peak day scenario. Therefore, there may be remaining demand available for more development; however, this would provide typical operational water only. There is no remaining capacity in regards to fire flow.

Based on **Table 6-5**, it is anticipated that the Timberlea Reservoir and Pumphouse has sufficient pumping capacity to meet the ultimate projected demands for the area. It is recommended that the proposed

Highway 63 Reservoir and Pumphouse be constructed prior to 2033, when the Peak Day plus Fire Flow demand for Timberlea will approach the theoretical pumping capacity (at full development and maximum truckfill operation).

An assessment of the Timberlea Reservoir storage capacity is provided in **Table 6-6** and has been based on the AEP recommendations. The demands identified include those for Timberlea and the Highway 63 Corridor, however, they do not include estimated Truckfill demands. The truckfill demand is not included as it is considered to be a "flow through" supply only.

Table 6-6
Timberlea – Projected Storage Volume Requirements (m^3)

Year	Existing Storage Volume (m^3)	Existing Average Day Flow (L/s)	15% Average Day Flow (m^3)	25% Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)	Surplus/ Deficit (m^3)
2013	13,600	153	1,983	6,610	2,516	11,109	2,491
2018	13,600	181	2,346	7,819	2,516	12,681	919
2023	13,600	198	2,566	8,554	2,516	13,636	36
2028	13,600	205	2,657	8,856	2,516	14,234	-634
2033	13,600	205	2,657	8,856	2,516	14,234	-634
ULTIMATE	13,600	205	2,657	8,856	2,516	14,234	-634

Based on the above table, the total required storage volume is anticipated be exceeded sometime after 2023. As such, it is recommended that the Highway 63 Reservoir and Pumphouse be constructed by approximately 2023, which will eliminate any storage shortfalls in Timberlea. This is 10 years earlier than would be required due to the pumping capacity, as discussed previously.

It is not recommended that the Truckfill be directly connected to the supply main, versus the Timberlea distribution system. The Truckfill operation is intermittent and can affect distribution system pressures. This is due to the delay in the Truckfill pump, start/stop, and resulting VFD responses at the Timberlea Reservoir and Pumphouse. Connecting to the supply main would require a signal at the Truckfill in order to start the WTP pumps. In addition, the WTP pumps have a much larger capacity than the required flows for the Truckfill, and there are no VFD's at the WTP to slow the pumps down.

6.4.3 Timberlea – Upgrades to Existing System

As discussed in Section 6.4.1, upgrades have recently been completed to the Timberlea Pumphouse. As a result, the ultimate projected peak hour pumping demands can be met for the area. Although a potential storage shortfall of 600 m^3 has been identified, it will be eliminated with the construction of the Highway 63 Reservoir and Pumphouse.

Figure 6-4 identifies the nodes which will exceed 690 kPa (100 psi) based on an HGL of 417 m, during low demand periods. **It is recommended that pressure in the area be monitored, and individual lot pressure tests be undertaken to confirm whether these high pressures are actually occurring within this section of the distribution system.** If confirmed, then individual PRV's may be recommended at each residence (at the water meter), or if the affected area is large enough, PRV stations may be required on the distribution system in order to reduce the maximum pressures.

Significant upgrades to the existing distribution system are not required in order to satisfy fire flow recommendations. The upgrades identified on Figure 6-6 have been recommended in order to address high velocities within the existing mains.

6.4.3.1 Abrams Lands

The Timberlea system will also supply water to the Abrams Lands, until such time as the future West Growth area has been developed. These lands (which are located immediately west of the Thickwood area) will be serviced off of the 300 mm main Timberline main at a zone pressure of 417 m HGL. One additional PRV has also been installed at the connection between the Abrams Lands and Thickwood. This PRV is proposed to be set at 400 m HGL to allow the Thickwood area to support the Abrams Lands during low pressure/fire flow scenarios.

6.4.3.2 Timberlea to Parsons Creek Supply

A 300 mm diameter supply line from Timberlea to Parsons Creek has been installed along Rainbow Drive. This pipeline provides water supply to the area, which allowed development to proceed prior to the completion of the Parsons Supply Line and Parsons Creek Reservoir and Pumphouse. A PRV has been installed on the line in order to reduce the existing Timberlea pressures (at HGL of 417 m) to the proposed Parsons Creek zone HGL of 406 m. Ultimately this waterline will not be required to supply the new reservoir, but will provide increased redundancy to the system and can contribute during higher demand periods. It may be useful to install a flow meter on the PRV to monitor usage in Parsons Creek during construction, as well as to monitor for stagnation following completion of the Parsons Creek Supply Line.

6.4.3.3 Highway 63 Corridor

The two existing PRV's servicing the Highway 63 Corridor are understood to have recently been adjusted in terms of the pressure settings, in order to satisfy fire flows in the area. Based on the information provided, it appears that the PRV's may not have been set to the recommended HGL's. The upper PRV is recommended to have been increased from 314 m HGL to 346 m HGL, and the lower PRV from 292 m HGL to 305 m HGL, **as there is still some question as to the operation of the PRV's, it is recommended that the settings be confirmed and the pressure in the area monitored**.

6.4.4 Timberlea – Ultimate System

The ultimate system concept is identified in **Figure 6-6**. Upgrades are proposed mainly in order to reduce distribution system velocities.

Upgrading to the minimum recommended sizes (as outlined within Section 2.10 of the design criteria) is generally recommended during local system improvement opportunities. These types of upgrades are typically undertaken during localized roadway or other infrastructure improvements.

6.4.4.1 Abrams Lands

In the Ultimate system, the Abrams Lands will be supplied from the West Growth Area and not Timberlea, which is intended to provide interim servicing. The PRV identified between Abrams and Thickwood will remain so that Thickwood can provide emergency supply to the West Growth Area. One additional PRV station is proposed to be installed between Abrams Lands and Timberlea, which allows Timberlea to be supported from the West Growth Area during emergency conditions. The PRV identified between Timberlea and Thickwood is proposed to remain in the Ultimate scenario in order to allow Timberlea to support Thickwood with emergency water supply.

6.4.4.2 Highway 63 Corridor

A new reservoir and pumphouse is proposed to be located north of the existing Highway 63 Corridor development, it will be serviced via a new supply lateral off of the Parsons supply line. The new reservoir and pumphouse will:

- Allow for additional commercial/industrial development north.
- Provide a back-up supply to the area (including the heavily used truckfill).
- Reduce the effect on the upstream distribution system and the Timberlea Pumphouse due to truckfill operations.

6.5 PARSONS CREEK – ULTIMATE SYSTEM

The new Parsons Creek development is located north of Timberlea and is currently under construction. It will consist of primarily residential development, and will also include a number of commercial and public service districts. The area will be supplied from the 750 mm diameter supply main (and 900 mm diameter section from WTP), which is nearing completion. A new Parsons Creek Reservoir and Pumphouse has recently been constructed to supply distribution system flows throughout the new community. It is projected that approximately 24,000 people will reside in the area and that an additional 2,000 equivalent people will work at or use the services within the neighbourhood. Residential development has been occurring in recent years and it is anticipated that approximately 5,000 people are estimated to be living in the area by 2018.

A model of the ultimate distribution system was previously provided by Stantec as part of the *Regional Municipality of Wood Buffalo – Parsons Creek Water Distribution System Model Draft Report, November 2010*. The ultimate distribution system is presented in **Figure 6-7**, which also identifies the anticipated peak hour pressures. Areas of high pressure are located along the eastern edge of the development. This is based on a proposed ultimate zone pressure of 406 m HGL. All recommended fire flows are anticipated to be met based on the pipe sizes shown, and the noted zone pressure. Based on the future pumphouse HGL of 406 m, the maximum zone pressure will be 680 kPa (98.7 psi). Individual lot PRV's may be required to control the pressure in certain areas.

From the *Regional Municipality of Wood Buffalo - Parsons Creek Water Reservoir, Pump Station and Trunk Main Preliminary Design Report, August 2010*, *Stantec*, it is understood that one jockey pump and four distribution pumps will be installed at the future pumphouse to service the Parsons Creek Area. A transfer pump will also be installed to supply the future West Growth Area. The jockey pump has been proposed at 62 L/s, and the four distribution pumps at 133 L/s each. All pumps are indicated to pump at 55 m TDH. The jockey pump and three of the distribution pumps will be installed initially, and will result in a total pumping capacity of 328 L/s. The fifth pump is anticipated to be installed at Stage 2 and will increase the total pumping capacity to 461 L/s.

Table 6-7 below identifies the projected demands for the Parsons Creek area. The ultimate pumping capacity must be able to accommodate either demand scenario.

Table 6-7
Parsons Creek – Projected Demands/Pumping Capacity Requirements

Year	Peak Hour (L/s)	Peak Day Demand plus 233 L/s Fire Flow (L/s)
2018	63	275
2023	94	296
2028	125	316
2033	156	337
Ultimate	325	450

As the ultimate pumping rate is understood to be 461 L/s, there will be sufficient pumping capacity to meet the projected peak demand flows as outline above.

The proposed storage volume based on the AEP recommendations as presented in the *Regional Municipality of Wood Buffalo - Parsons Creek Water Reservoir, Pump Station and Trunk Main Preliminary Design Report, August 2010,* Stantec is 8,600 m^3. Ideally one peak day plus fire flow would be stored as per the Municipality's Engineering Servicing Standards. This would require a total storage volume of approximately 21,300 m^3 for the ultimate system as presented in **Table 6-8**.

Table 6-8
Parsons Creek – Projected Storage Volume Requirements (m^3)

Year	Existing Storage Volume (m^3)	1 x Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)	Surplus / Deficit (m^3)
2018	8,600	3,629	2,516	6,145	2,455
2023	8,600	5,443	2,516	7,959	641
2028	8,600	7,171	2,516	9,687	-1,087
2033	8,600	8,956	2,516	11,472	-2,872
ULTIMATE	8,600	18,749	2,516	21,265	-12,665

A 300 mm diameter supply line from Timberlea to Parsons Creek has been constructed on Rainbow Drive to allow residential development to proceed prior to the completion of the Parsons Supply Line and Parsons Creek Reservoir and Pumphouse. A PRV was installed along the line in order to reduce the existing Timberlea pressure (HGL of 417 m) to the proposed Parsons Creek zone HGL of 406 m. Ultimately this waterline won't be required in order to supply the reservoir, but will provide increased redundancy to the system, and can contribute during higher demand periods or in the case of supply interruption. This PRV will need to operate with minimal flow, however on a regular basis, in order to ensure that water does not become stagnant within the line.

6.6 WEST GROWTH AREA – ULTIMATE SYSTEM

The future West Growth Area is located to the west of Parsons Creek. The future West Growth Area will ultimately be serviced via a 600 mm extension of the 750 mm supply line to Parsons Creek. The WTP North Service Area pumping head will need to be increased to a minimum of 400 m HGL in order to supply the ultimate design flows at a suitable reservoir inlet pressure, or the transfer pump currently proposed will be required long-term at the future Parsons Creek Reservoir and Pumphouse.

Two new West Growth Area Reservoirs and Pumphouses will be constructed to supply distribution system flows throughout the new community. It is projected that approximately 31,000 people will reside in the area. It is anticipated that development of this area is at least 10 years into the future, and a population of 2,000 people has been projected for the year 2028.

The ultimate distribution system is presented in **Figure 5-1**. All recommended fire flows are anticipated to be met based on the pipe sizes shown at the noted zone pressure.

Initially, the Timberlea area will supply the east portion of the West Growth Area (referred to as Abrams Lands), until the future West Growth area has been developed. A PRV has been installed at the connection between the Abrams Lands and Thickwood and set at 400 m HGL, which will allow the Thickwood area to

supply the Abrams Lands during low pressure/fire flow scenarios. An additional PRV has been installed at the connection with Thickwood, in order to allow Thickwood to provide flow during emergency conditions.

In the ultimate system, an additional PRV is proposed to connect the West Growth Area to Timberlea, in order to allow the West Growth Area to support Timberlea (and Thickwood), if required.

Table 6-9
West Growth – Proposed Pumping Capacity

Year	Peak Hour Demand (L/s)	Peak Day Demand plus 233 L/s Fire Flow (L/s)
2028	25	250
2033	38	258
Ultimate	388	491

Table 6-9 above identifies the projected demands for the West Growth Area. The ultimate pumping capacity must be designed to accommodate both demand scenarios.

The minimum recommended storage volume is presented in Table 6-10 and has been based on storing one peak day plus fire flow as per the Municipality's Engineering Servicing Standards. This results in a total recommended storage volume of approximately 25,000 m^3 in the ultimate system.

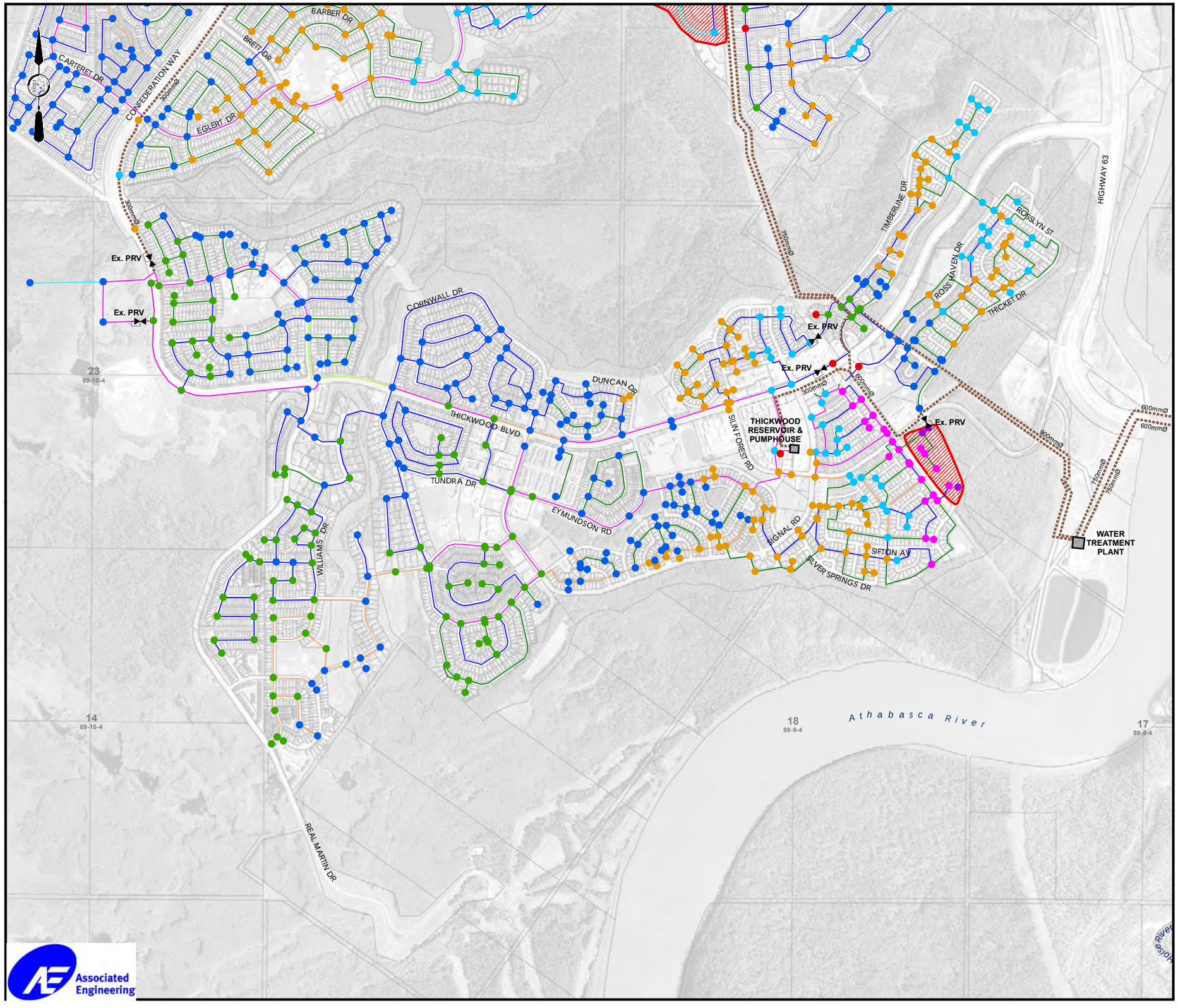
Table 6-10
West Growth – Projected Storage Volume Requirements (m^3)

Year	Existing Storage Volume (m^3)	1 x Peak Flow Day (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)
2028	0	1,469	2,516	3,985
2033	0	2,160	2,516	4,676
ULTIMATE	0	22,291	2,516	24,807

6.7 FORT MACKAY NORTH TRANSMISSION LINE

A future supply line to Fort MacKay is anticipated to be serviced off of the 750 mm diameter Parsons supply main. A lateral has been conceptually shown taking off north from the supply main to a proposed new booster station (or reservoir and pumphouse) located in north Parsons Creek. From the pumphouse, water will be pumped west through Parsons Creek, then north alongside an existing right of way. Further study will be required in order to establish the required design flows and both the size and location of the pumping facility.

As the North Service Area was not designed with consideration for additional demand to the north, supply will need to be “borrowed” from the demand allocation for the future West Growth Area. Ultimately, a future supply main from the future WTP is envisioned to provide the demand shortfall as well as provide back-up supply to the West Growth Area, and North Service Area in general.



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Associated Engineering

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

THICKWOOD HEIGHTS
EXISTING WATER DISTRIBUTION SYSTEM

LEGEND:

- EXISTING 100mmØ WATERMAIN
- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 350mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

PEAK HOUR PRESSURE (kPa)

- <350 (50psi)
- 350 - 415 (50 - 60psi)
- 415 - 480 (60 - 70psi)
- 480 - 550 (70 - 80psi)
- 550 - 620 (80 - 90psi)
- 620 - 690 (90 - 100psi)
- >690 (100psi)

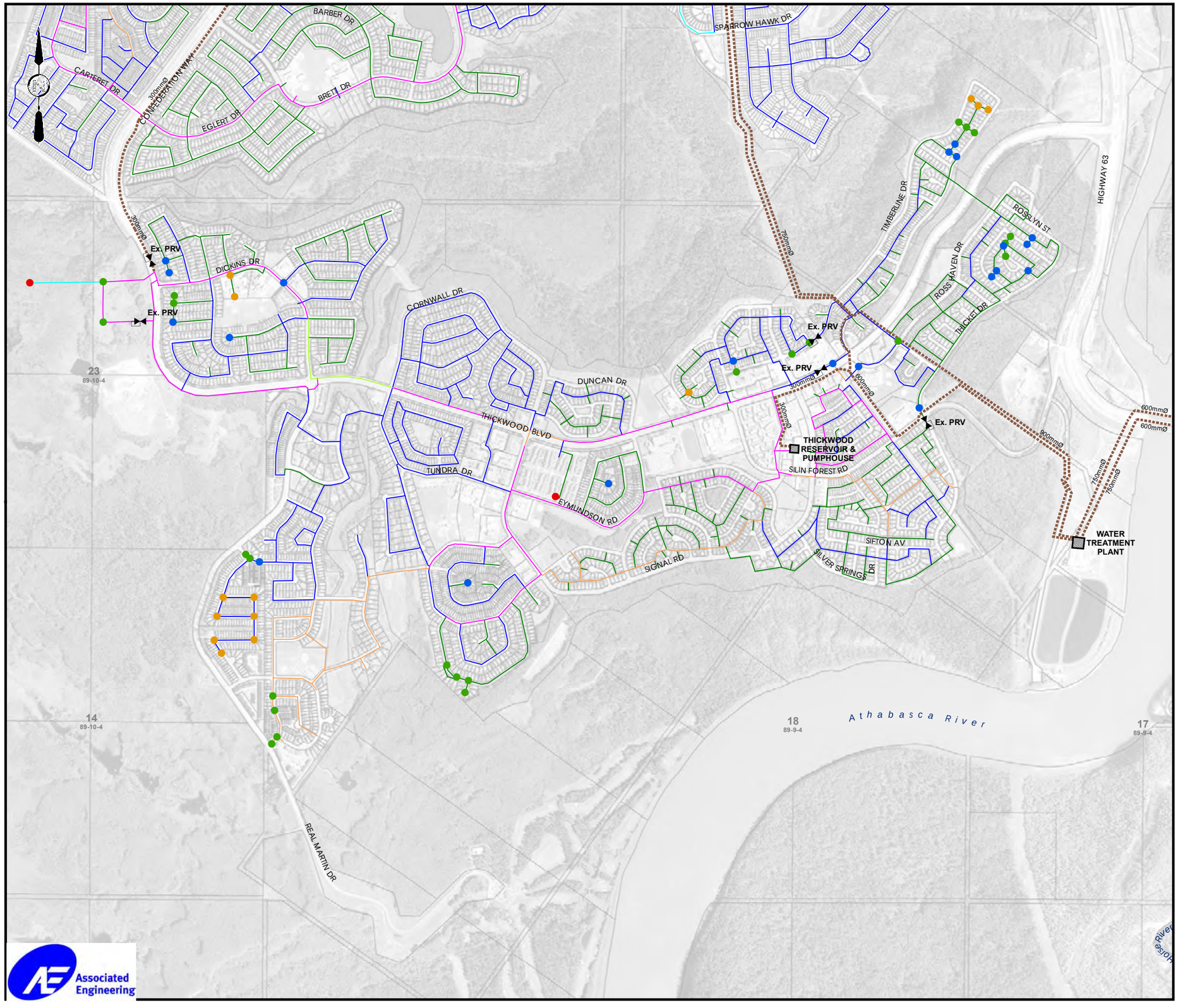
PRESSURE REDUCING VALVE (PRV)

EXCEED 690 kPa (100psi) IN STATIC CONDITION

SCALE 1:17,500

OCTOBER 2015

FIGURE 6-1



2015 WATER MASTER PLAN

THICKWOOD HEIGHTS

EXISTING WATER DISTRIBUTION SYSTEM WITH FIRE FLOW DEFICIENCIES

LEGEND:

- EXISTING 100mmØ WATERMAIN
- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 350mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

FIRE FLOW DEFICIENCY

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

PRESSURE REDUCING VALVE (PRV)

SCALE 1:17,500

OCTOBER 2015

FIGURE 6-2

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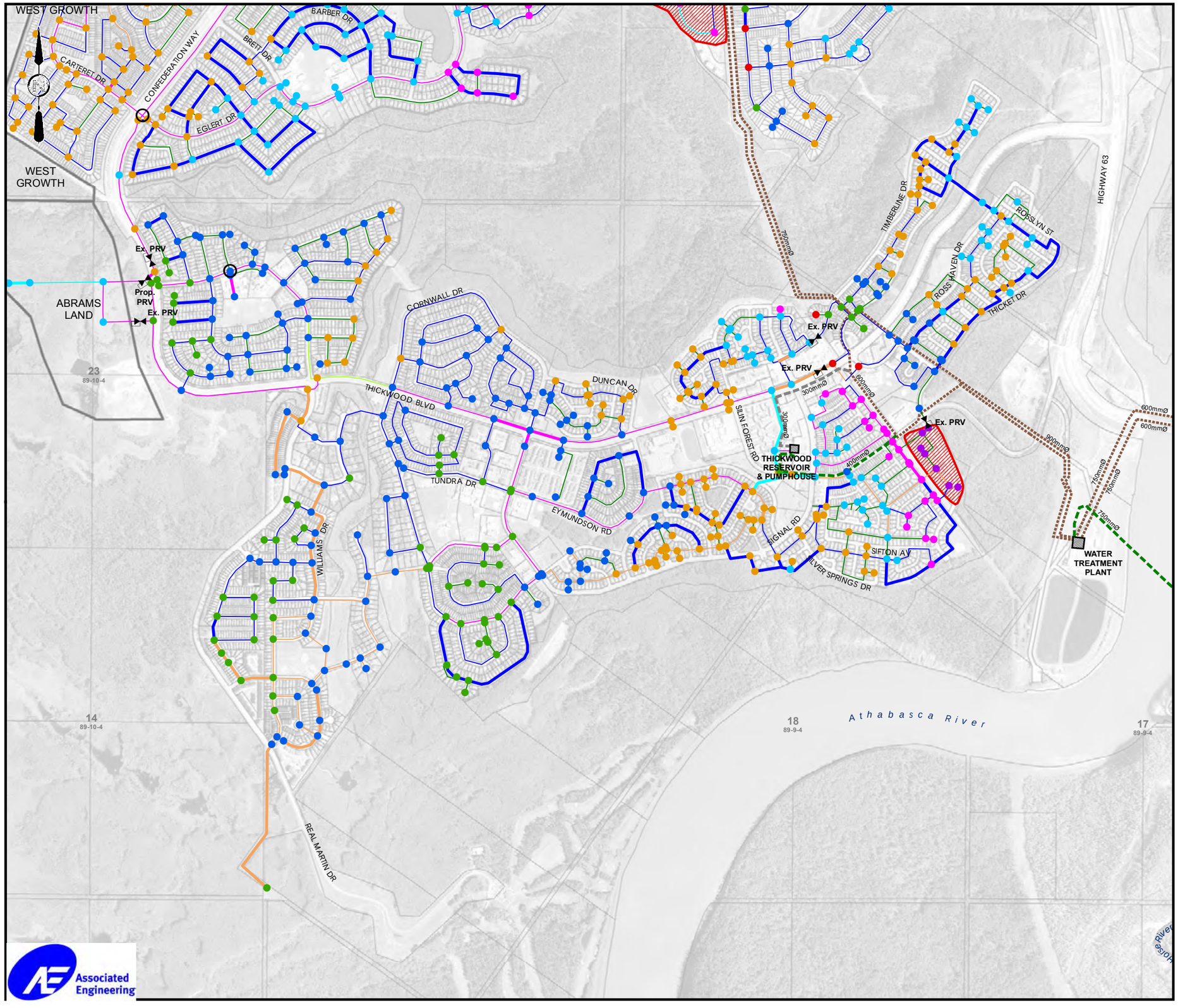

2015 WATER MASTER PLAN

THICKWOOD HEIGHTS

ULTIMATE WATER DISTRIBUTION SYSTEM WITH PROPOSED UPGRADES

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 350mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- ABANDON EXISTING SUPPLY WATERMAIN
- PRESSURE REDUCING VALVE (PRV)
- EXCEED 690 kPa (100psi) IN STATIC CONDITION
- INTERCONNECTION
- DEVELOPMENT BOUNDARY

SCALE 1:17,500
OCTOBER 2015

FIGURE 6-3

Associated Engineering

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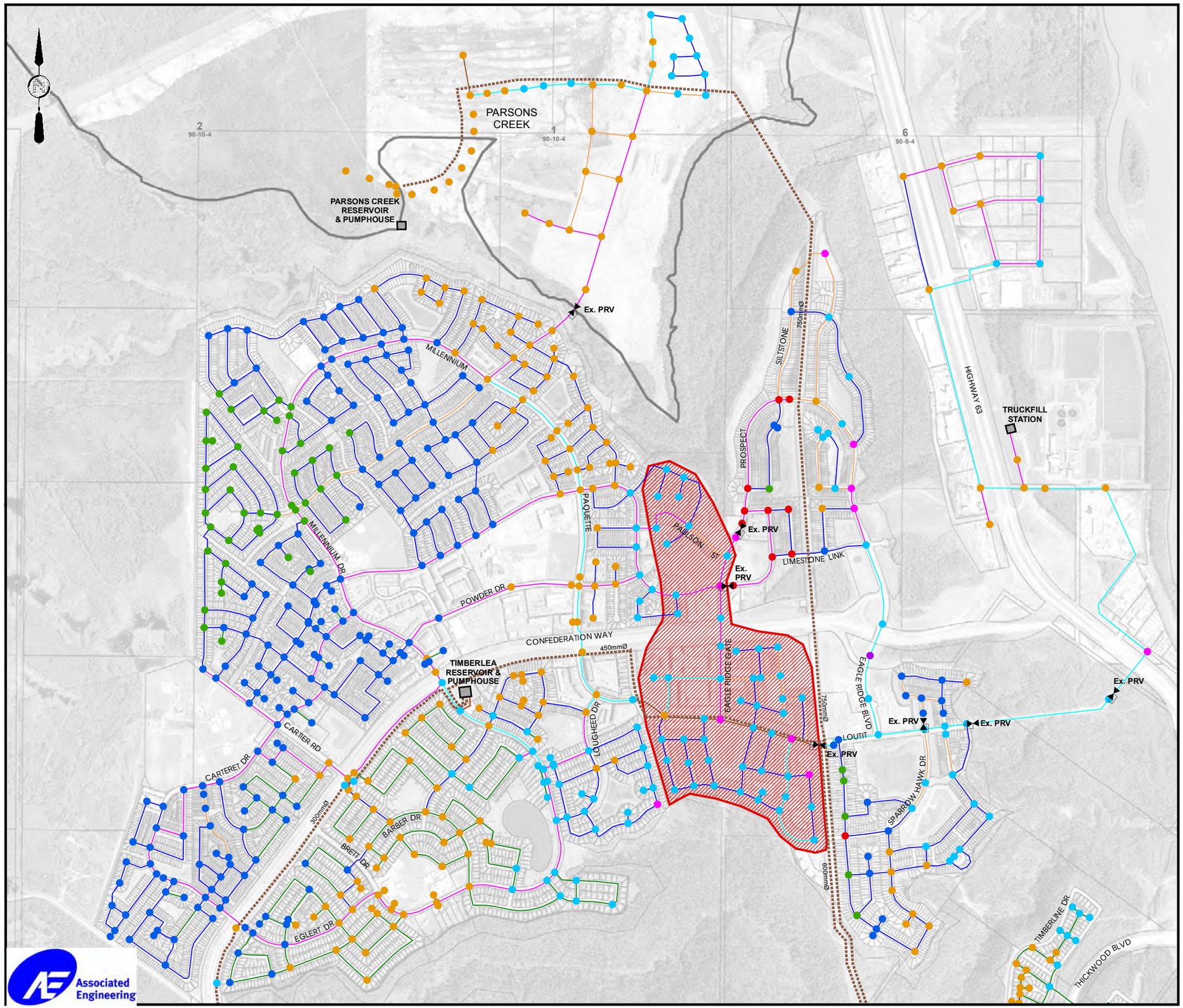

2015 WATER MASTER PLAN

TIMBERLEA

EXISTING WATER DISTRIBUTION SYSTEM

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- EXISTING 600mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

PEAK HOUR PRESSURE (kPa)

- <350 (50psi)
- 350 - 415 (50 - 60psi)
- 415 - 480 (60 - 70psi)
- 480 - 550 (70 - 80psi)
- 550 - 620 (80 - 90psi)
- 620 - 690 (90 - 100psi)
- >690 (100psi)

PRESSURE REDUCING VALVE (PRV)

EXCEED 690 kPa (100psi) IN STATIC CONDITION

SCALE 1:17,500

OCTOBER 2015

FIGURE 6-4

Regional Municipality of Wood Buffalo

Associated Engineering

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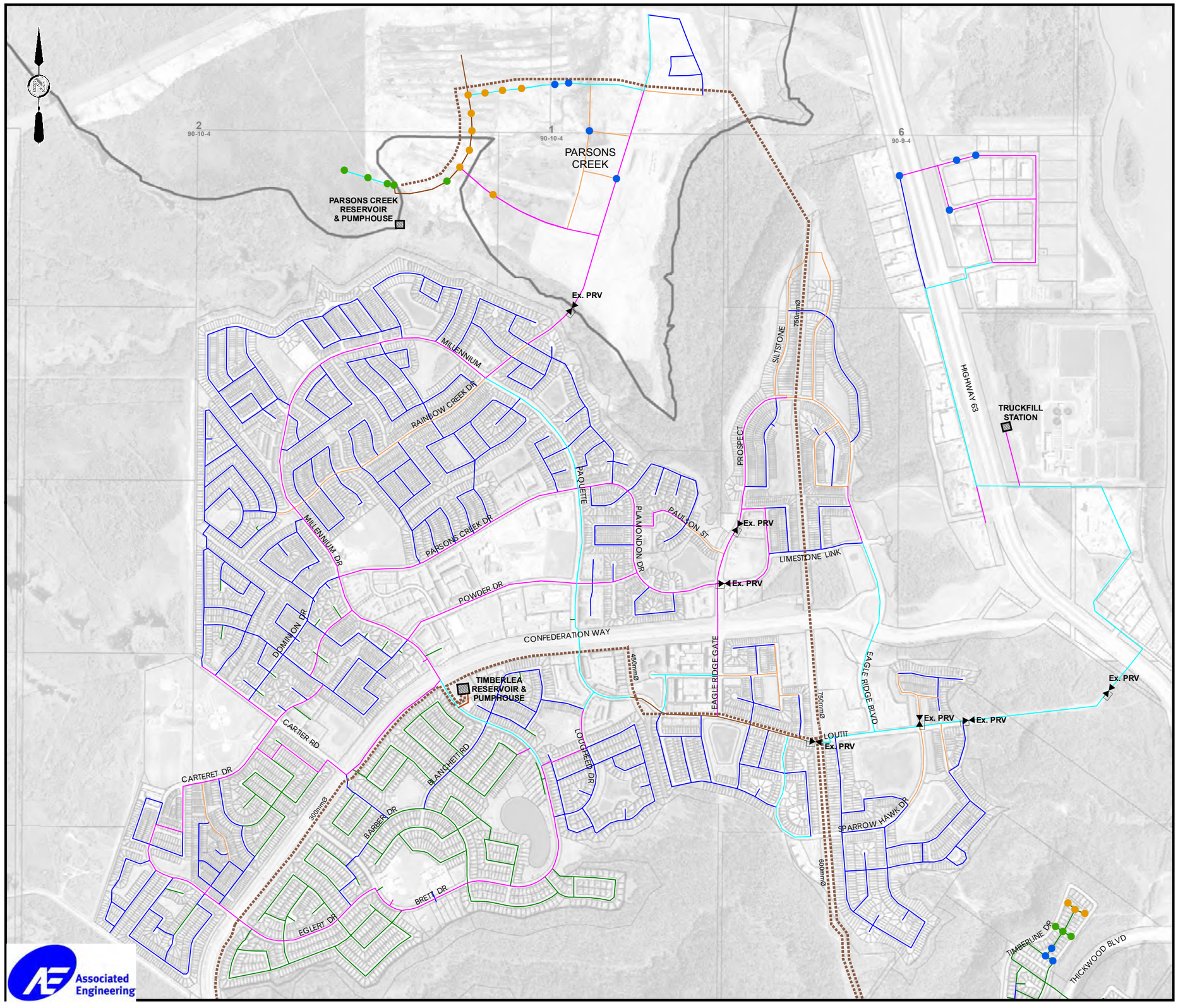

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Associated Engineering

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

TIMBERLEA

EXISTING WATER DISTRIBUTION SYSTEM WITH FIRE FLOW DEFICIENCIES

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- EXISTING 600mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN

FIRE FLOW DEFICIENCY

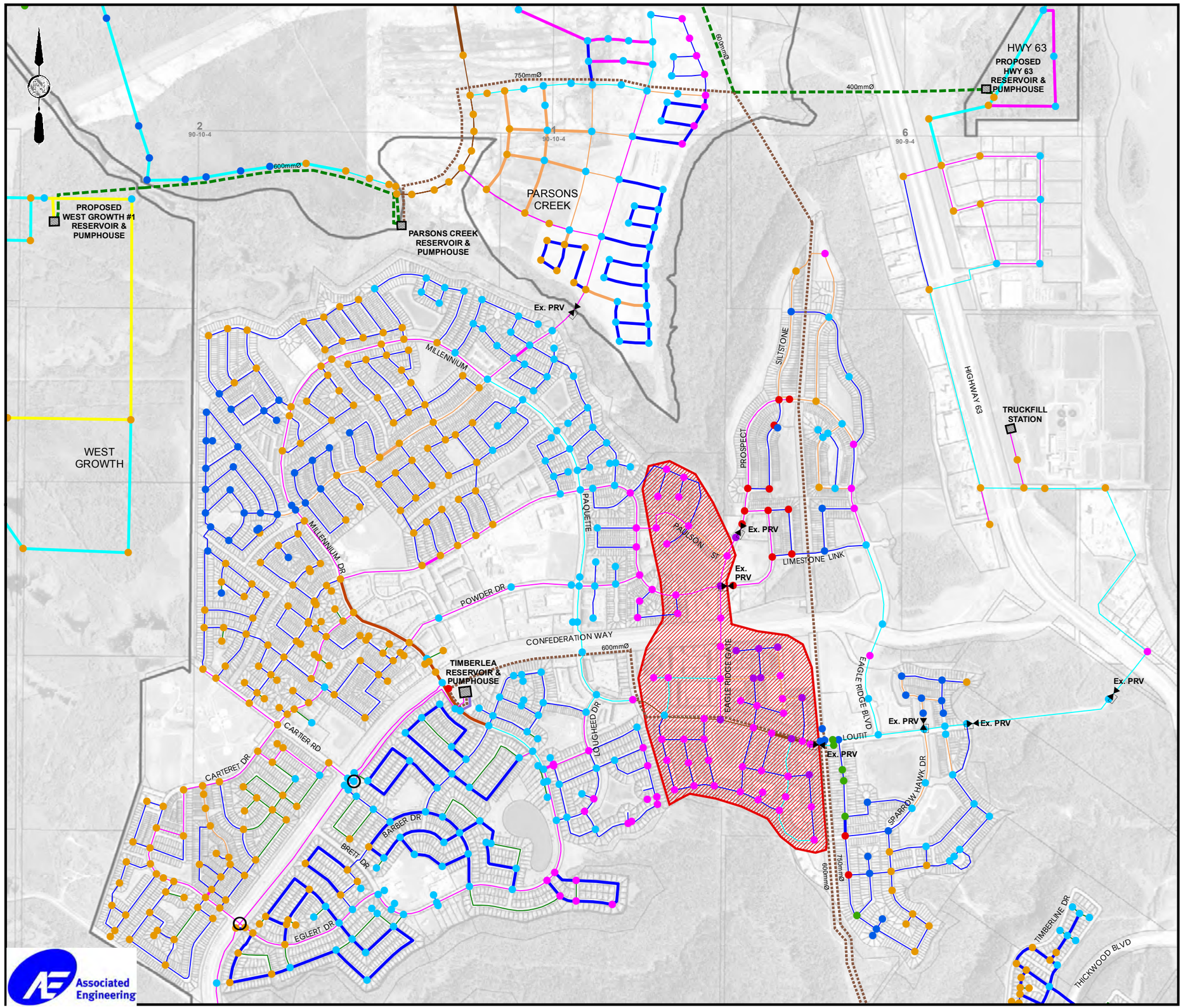
- < 20%
- 20% - 40%
- 40% - 60%

PRESSURE REDUCING VALVE (PRV)

SCALE 1:17,500

OCTOBER 2015

FIGURE 6-5



2015 WATER MASTER PLAN

TIMBERLEA

ULTIMATE WATER DISTRIBUTION SYSTEM WITH PROPOSED UPGRADES

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- PROPOSED 450mmØ WATERMAIN
- PROPOSED 500mmØ WATERMAIN
- PROPOSED 600mmØ WATERMAIN
- PROPOSED 750mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- PRESSURE REDUCING VALVE (PRV)
- EXCEED 690 kPa (100psi) IN STATIC CONDITION
- INTERCONNECTION
- DEVELOPMENT BOUNDARY

SCALE 1:17,500
OCTOBER 2015

FIGURE 6-6

Associated Engineering

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TO FORT MACKAY

HIGHWAY 63

600mmØ

PROPOSED NORTH CORRIDOR BOOSTER STATION

10
90-10-4

12
90-10-4

7
90-9-4

PARSONS CREEK

750mmØ

400mmØ

HWY 63

PROPOSED HWY 63 RESERVOIR & PUMPHOUSE

3
90-10-4

2
90-10-4

6
90-9-4

600mmØ

PROPOSED WEST GROWTH #1 RESERVOIR & PUMPHOUSE

PARSONS CREEK RESERVOIR & PUMPHOUSE

WEST GROWTH

Ex. PRV

MILLENNIUM

SILTSTONE

PROSPECT

TRUCKFILL STATION

34
89-10-4

PAQUETTE

PAULSON ST

Ex. PRV

LIMESTONE LINK

POWDER DR

Ex. PRV

CONFEDERATION WAY

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Associated Engineering

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

PARSONS CREEK

ULTIMATE WATER DISTRIBUTION SYSTEM WITH PROPOSED UPGRADES

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 350mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- PROPOSED 450mmØ WATERMAIN
- PROPOSED 500mmØ WATERMAIN
- PROPOSED 600mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- PRESSURE REDUCING VALVE (PRV)
- EXCEED 690 kPa (100psi) IN STATIC CONDITION
- DEVELOPMENT BOUNDARY

SCALE 1:20,000

OCTOBER 2015

FIGURE 6-7

7 Southwest Service Area

7.1 GENERAL

The water system within the study area has been assessed using the computer modelling software "WaterCAD" by Bentley. The distribution system will generally be assessed based on the following scenarios:

- Peak Hour Demand.
- Peak Day plus Fire Flow Demand.

In addition, maximum system pressures will be presented based on the design zone HGL.

Figures 5-1 and 5-2 identify the overall ultimate system concept for the future Southwest Service Area.

7.2 PRESSURE ZONES

The Southwest Service Area will have seven pressure zones, as shown in Figure 4-3. Pressure zones are labelled and referred to by the typical zone HGL (delivery pressure plus elevation as determined from pumphouse outgoing pressures and/or PRV settings). The proposed Southwest Service Area pressure zones include:

- **Zone 410 m HGL Horse River Zone** - The future Horse River pressure zone at 410 m HGL as defined by the Horse River Reservoir and Pumphouse 1 and 2 discharge pressures.

- **Zone 415 m HGL Hangingstone Zone 1** - The future lower Hangingstone pressure zone 1 at 415 m HGL as defined by the Hangingstone Reservoir and Pumphouse discharge pressure (from both future facilities 1 and 2).

- **Zone 425 m HGL Hangingstone Zone 2** – The future upper Hangingstone pressure zone 2 at 425 m HGL as defined by the Hangingstone Reservoir and Pumphouse 1 discharge pressure which will service the upper Hangingstone zone. This pressure zone will also supply the future Southlands Reservoir and Pumphouse, and will be interconnected with the MacKenzie pressure zone, also at an HGL of 425 m.

- **Zone 425 m HGL Southland Area Zone 1** - The supply pressure from the future Southlands Reservoir and Pumphouse to Southlands Areas 1A, and the Southeast Regional Reservoir and Pumphouse.

- **Zone 433 m HGL Southlands Zone 2** – The supply pressure from the future Southlands Reservoir and Pumphouse to Southlands Area 1B to the south.

- **Zone 480 m HGL Southlands Area Zone 3**- The supply pressure from the future Southlands Reservoir and Pumphouse to the future Highway 881/63 Reservoir and Pumphouse. The SESL Report identifies an HGL in the order of 512 m in the interim supply scenario to defer Hwy 881/63 pumping.

- **Zone 485 m HGL Highway 881/63 Zon**e - The supply pressure from the future Highway 881/63 Reservoir and Pumphouse to the immediate area.

- **Zone 535 m HGL Anzac Zone** - The supply pressure from the future Highway 881/63 Reservoir and Pumphouse to the Hamlet of Anzac.

7.3 HORSE RIVER – ULTIMATE SYSTEM

The Horse River area is located south of the Athabasca River and west of the existing South Service Area. The supply to the Horse River Area is further discussed in Section 4 of this report. The ultimate system concept for the area is enclosed as **Figure 7-1**.

Two Reservoir and Pumphouse locations are ultimately proposed with the Horse River area, as identified on **Figure 7-1**. The first Reservoir is anticipated to be constructed in the Riverbend area, and operate at an HGL of 410 m. The second pumphouse will be located at the site of the proposed future WTP and will also pump to the zone pressure of 410 m HGL. It is envisioned that using the proposed zone pressure at Horse River of 410 m HGL will be adequate in order to provide flow from the Horse River Reservoir to the Hangingstone Reservoir during potential interim development stages, or in the event of supply interruption, if necessary. Therefore, a future fire pump or bank of distribution pumps, should be adequate to supply flow to Hangingstone from Horse River if required. An HGL of 410 m will also be adequate to provide flow from the Horse to Abasand, and the LTS, during an emergency event.

Supply will be provided via the existing WTP through a proposed 750/600 mm main in the interim scenario. In the Ultimate scenario, water will be provided via the proposed new WTP from the Hangingstone Reservoir and Pumphouse 1, or the Horse River Reservoir and Pumphouse 2.

It is anticipated that the population will be at approximately 1,600 in 2023, which will require that the Horse River Reservoir and Pumphouse 1 be constructed sometime prior. The proposed pumping capacity based on the estimated future demands is provided in **Table 7-1** below, however, will be provided from the two pumphouses within the zone. Future pumping capacity must be able to meet the peak hour demands, as well as the peak day plus fire flow recommendations (minimum fire flow assumed to be 233 L/s).

Table 7-1
Horse River – Proposed Pumping Capacity (Total)

Year	Peak Hour Demand (L/s)	Peak Day plus 233 L/s Fire Flow	HGL (m)
2023	20	246	410
2028	31	254	410
2033	54	269	410
Ultimate	188	358	410

The projected reservoir capacity is shown in **Table 7-2**, and is based on storing 1 peak day plus fire flow demand. It is anticipated that the storage volume will be accommodate within the two reservoir locations.

Table 7-2
Horse River Reservoir – Projected Storage Volume Total (m^3)

Year	Existing Storage Volume (m^3)	1 X Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)
2023	—	1,123	2,516	3,639
2028	—	1,814	2,516	4,330
2033	—	3,110	2,516	5,626
ULTIMATE	—	10,800	2,516	13,316

A total ultimate storage capacity of approximately 13,500 m^3 is recommended to be constructed at the future Horse River Reservoir and Pumphouse sites.

7.4 HANGINGSTONE – ULTIMATE SYSTEM

A new development area has also been proposed for the area identified as Hangingstone. The supply to Hangingstone is previously discussed in Section 4 of this report. The ultimate system concept for the area is enclosed as **Figure 7-1**.

It is proposed that two pressure zones be established within the Hangingstone development in order to accommodate development on the large hill located in the centre of the Hangingstone area. The Reservoir and Pumphouse is proposed to be located south of the hill in the centre of the development area, as shown on **Figure 7-1**. Three banks of pumps are envisioned at the pumphouse:

1. Distribution pumps for the lower zone (majority of development area).
2. Distribution pumps for the higher distribution zone plus a fire pump to service both zones.

3. Transmission pumps to supply water to Southlands 1A Reservoir and Pumphouse and to the Horse River Reservoir and Pumphouse.

The upper distribution zone pressure has been modelled at 425 m HGL and the lower distribution zone pressure at 415 m HGL. Water to the Horse and Southlands 1A will be supplied from the Hangingstone pumphouse at an HGL of 425 m (outgoing). In the event of an emergency, water can also be provided to the Abasand, LTS and MacKenzie Reservoirs at an HGL of 425 m.

A second reservoir and pumphouse has been proposed for the Hangingstone Area in order to:

- Address fire flows in the southern portion of the development;
- Separate storage facilities to provide more even distribution of flow and pressure; and
- Separate storage facilities in order to provide a level of backup in case of emergency.

It is anticipated that the population will be at approximately 1,800 in 2023, which will require that the Hangingstone Reservoir and Pumphouse 1 be constructed sometime prior. The proposed pumping capacity based on the estimated future demands is provided in **Table 7-3**.

Table 7-3
Hangingstone – Proposed Pumping Capacity

Year	Peak Hour Demand (L/s)	Peak Day plus 233 L/s Fire Flow	Downstream Peak Day Demand (L/s)
2023	23	248	—
2028	34	256	51
2033	56	271	71
Ultimate	525	583	431

Future pumping capacities are not identified at this time as development of this area remains a number of years in the future. However, it is recommended that growth projections for the area be undertaken prior to development, and to be done in conjunction with the overall growth in the Municipality and within new development areas.

Ideally, future pumping capacity for the Hangingstone Pumphouse would meet the peak hour demands plus the downstream peak day demands; however, the downstream reservoirs may be required to fill primarily at night due to the extremely large flows. The pumphouse must also be able to satisfy the peak day plus fire flow recommendations (minimum fire flow assumed to be 233 L/s). The downstream peak day demands refer to the Horse (Riverbend), Southlands Areas 1A, 1B, Highway 881/63, 10,000 additional residents in the Hamlet of Anzac, as well as the 93 L/s shortfall to the South Service Area in the ultimate scenario. It is

assumed that one bank of pumps will be adequate to deliver these flows, as the immediate downstream area is proposed to operate at an HGL of 425 m.

The projected reservoir capacity is shown in **Table 7-4** below, and is based on storing 1 peak day plus fire flow demand. Storage is not required for the downstream demands, as it will be accounted for in the proposed receiving reservoirs. A total of 33,000 m^3 of storage is recommended to be constructed within two separate reservoirs.

Table 7-4
Hangingstone Reservoir – Projected Storage Volume (m^3)

Year	Existing Storage Volume (m^3)	1 X Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)
2023	—	1,296	2,516	—
2028	—	1,987	2,516	4,503
2033	—	3,283	2,516	5,799
ULTIMATE	—	30,240	2,516	32,756

As shown in **Figure 7-1**, the proposed 600 mm supply line from the Hangingstone Reservoir and Pumphouse is envisioned to be extended to provide an alternate supply the MacKenzie Reservoir. It will not be possible to supply typical peak day demands to the MacKenzie area through the supply line (at the proposed diameter). Additionally, water rationing would likely be required to reduce overall water consumption. This will provide a viable emergency backup supply to MacKenzie (and downstream) and improve overall system redundancy.

7.5 SOUTHLANDS INDUSTRIAL – ULTIMATE SYSTEM

The proposed Southlands Industrial Reservoir and Pumphouse will service Southlands Areas 1A and 1B. It will also provide the estimated 93 L/s shortfall to the South Service Area. It is anticipated that Southlands 1A will begin to develop prior to 2018. Therefore, it is proposed that the Southeast Supply Line (SESL) be constructed from MacKenzie to Southlands 1A, consisting of a 600 mm main. The supply main will be interconnected to the MacKenzie distribution system in order to provide supply on an interim basis. At such time as the upstream Southwest Supply Line is fully constructed, the portion of the line at MacKenzie will be disconnected from the distribution system, and will be supplied from the Hangingstone Reservoir and Pumphouse.

A reservoir and pumphouse will be required at Southlands 1A at the onset of development; however, the proposed Southwest Service Area supply lines can be delayed until such time as the South Service

Area/MacKenzie cannot support the additional demands. Refer to **Figure 5-1** to view the ultimate system concept for the area.

Future pumping capacities are not identified at this time as development of this area remains a number of years in the future. Ideally, future pumping capacity for the Southlands Industrial Pumphouse would be able to meet the peak hour demands plus the downstream peak day demands; however, it is not unreasonable that the downstream reservoirs be required to fill at night due to the extremely large flows. The pumphouse must also be able to satisfy the peak day plus fire flow recommendations (minimum fire flow assumed to be 233 L/s). The downstream peak day demands refer to the Southlands Areas 1A, 1B, Highway 881/63, 10,000 additional residents in the Hamlet of Anzac, as well as the 93 L/s shortfall to the South Service Area in the ultimate scenario. It is assumed that three banks of pumps may be required to deliver these flows to:

- **Southlands Zone 1** –To address peak hour demands and peak day plus fire flow demands for Southlands Area 1A, as well as to provide the supply shortfall to the Southeast Regional Reservoir and Pumphouse.
- **Southlands Zone 2** - To address peak hour demands and peak day plus fire flow demands (HGL 433 m) for Southlands Area 1B.
- **Southlands Zone 3** – To supply the proposed Highway 881/63 Reservoir and Pumphouse (HGL 480 m). The 2015 SESL Report indicates interim pumping to approximately 512 m HGL.

It may be possible to supply both Southlands 1A and 1B off of the same pressure zone, depending on the ultimate development boundary and more detailed topographic information for Southlands 1B. Southlands 1A could operate initially at the proposed HGL of 425 m. In the future, the pumps can be upgraded to provide the additional water demand and higher pressures required to serve Southlands 1B. This will require further analysis and a more detailed review of the Southlands 1B development lands to determine if it is viable.

The projected storage volumes at the Future Southlands Industrial Area 1A/1B Reservoir are presented in **Table 7-5**. The required storage volumes presented are based on storing 1 peak day plus fire flow demand. It is assumed that the Southlands Industrial Reservoir will be constructed prior to the year 2018, in keeping with the growth projections presented in **Table 2-4**, and will ultimately service Southlands Areas 1A and 1B.

Table 7-5
Southlands Industrial Reservoir – Projected Storage Volume (m^3)

Year	Existing Storage Volume (m^3)	1 X Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)
2013	-	-	-	-
2018	-	691	2,516	3,207
2023	-	1,123	2,516	3,639
2028	-	2,938	2,516	5,454
2033	-	3,974	2,516	6,490
ULTIMATE	-	7,949	2,516	10,465

As shown in the above table, an ultimate reservoir capacity of approximately 10,500 m^3 is anticipated to be required.

It is proposed that a truckfill station be constructed at the future Southlands Reservoir and Pumphouse. This will:

- Reduce travel time for water haulers.
- Reduce demand at existing truckfill.
- Eliminate some traffic from urban roadways.

7.6 HIGHWAY 881/63 – ULTIMATE SYSTEM

The Highway 881/63 area is not anticipated to be developed until after the year 2023. At this time a reservoir and pumphouse will be required to provide typical demand flows to the area, as well as to provide peak day demands to the downstream area (additional 10,000 people at the Hamlet of Anzac). The timing of the supply main may move ahead sooner than projected, in order to provide a redundant supply main to Anzac.

A 400 mm (427 mm ID, as per 2015 SESL Report) diameter supply main is proposed downstream of the pumphouse and reservoir, which will be pumped at a proposed HGL of 535 m. The immediate area is proposed to be supplied at a pressure of 485 m HGL, which will result in two separate banks of pumps required. Refer to **Figure 5-2** to view the ultimate system concept for the area.

The projected reservoir capacity is shown in **Table 7-6** below, and is based on storing 1 peak day plus fire flow demand. Storage is not required for the downstream demands, as it will be accounted for in the proposed receiving reservoirs. It is assumed that the Highway 881/63 Reservoir and Pumphouse will be constructed around the year 2025.

Table 7-6
Highway 881/63 Reservoir – Projected Storage Volume (m^3)

Year	Existing Storage Volume (m^3)	1 X Peak Day Flow (m^3)	Existing Fire Flow (m^3)	Total Required Storage (m^3)
2028	—	1,469	2,516	3,985
2033	—	2,160	2,516	4,676
ULTIMATE	—	6,307	2,516	8,823

As shown in the above table, an ultimate reservoir capacity of approximately 9,000 m^3 is anticipated to be required.

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

ULTIMATE WATER SUPPLY SYSTEM HORSE/HANGINGSTONE

FIGURE 7-1

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 350mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- PROPOSED 150mmØ WATERMAIN
- PROPOSED 200mmØ WATERMAIN
- PROPOSED 250mmØ WATERMAIN
- PROPOSED 300mmØ WATERMAIN
- PROPOSED 350mmØ WATERMAIN
- PROPOSED 400mmØ WATERMAIN
- PROPOSED 450mmØ WATERMAIN
- PROPOSED 500mmØ WATERMAIN
- PROPOSED 600mmØ WATERMAIN
- EXISTING SUPPLY WATERMAIN
- PROPOSED SUPPLY WATERMAIN
- EXISTING TOP OF BANK
- EXISTING 1.3FS URBAN DEVELOPMENT BOUNDARY
- EXISTING 1.5FS URBAN DEVELOPMENT BOUNDARY
- PROPOSED RIVERBEND
- FUTURE EXPANSION AREAS
- EXISTING ELECTRICAL/OIL PIPELINE ROW
- PRESSURE REDUCING VALVE (PRV)

SCALE 1:30,000

OCTOBER 2015

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8 Staging Plan

Proposed staging plans are enclosed in **Figures 8-1** through **8-3**. They are intended to provide the Municipality with assistance in establishing priority upgrades, as well as planning for future expenditures.

Pricing has not been provided for the Future Urban Expansion Areas including Horse River South, Hangingstone South and Forest Heights areas. These areas are shown in concept only and are therefore not identified on the enclosed Staging Plan.

There are a number of interdependencies between the projects that must be considered in the planning stages. These include (among others):

- The upgrading of the Beacon Hill supply main cannot be fully completed until the Saline Creek supply main is fully operational and upgrades in the MacKenzie area have been undertaken, so as to fill the Beacon Hill Reservoir in the interim.
- The Fort MacKay supply main is recommended to be installed through the Parsons Creek development area either prior to, or as local development occurs.
- Local Reservoir and Pumphouses are recommended to be constructed prior to allowing development within the future development areas (rather than relying on supply mains alone).
- It is generally recommended that the Municipality secure lands to accommodate future facility/infrastructure expansion.

REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

STAGING PLAN

ULTIMATE WATER DISTRIBUTION SYSTEM
SOUTH SERVICE AREA AND
FUTURE SOUTHWEST SERVICE AREA

FIGURE 8-1

WATER TREATMENT PLANT
LOWER TOWNSITE RESERVOIR
ABASAND RESERVOIR & PUMPHOUSE
KING STREET BOOSTER STATION
MILLS AVENUE BOOSTER STATION
PROPOSED HORSE RIVER RESERVOIR & PUMPHOUSE 1
BEACON HILL RESERVOIR & PUMPHOUSE
PROPOSED INTAKE/PUMPHOUSE
PROPOSED SOUTHWEST WTP
PROPOSED HORSE RIVER RESERVOIR & PUMPHOUSE 2
PROPOSED HANGINGSTONE RESERVOIR & PUMPHOUSE 1
PROPOSED HANGINGSTONE RESERVOIR & PUMPHOUSE 2
MACKENZIE RESERVOIR & PUMPHOUSE
HIGHWAY 69
Athabasca River
Clearwater River
Saline Creek
Horse River
Hangingstone River

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 350mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- EXISTING 600mmØ WATERMAIN
- EXISTING 750mmØ WATERMAIN
- EXISTING 900mmØ WATERMAIN
- PROPOSED UPGRADES (0 - 5 YEARS)
- PROPOSED UPGRADES (5 - 15 YEARS)
- PROPOSED UPGRADES (15 - 25 YEARS)
- PROPOSED UPGRADES (ULTIMATE)
- DEVELOPMENT BOUNDARY

SCALE 1:35,000

OCTOBER 2015

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REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

STAGING PLAN

ULTIMATE WATER DISTRIBUTION SYSTEM
RURAL SERVICE AREA

FIGURE 8-2

LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 350mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- EXISTING 600mmØ WATERMAIN
- EXISTING 750mmØ WATERMAIN
- EXISTING 900mmØ WATERMAIN
- PROPOSED UPGRADES (0 - 5 YEARS)
- PROPOSED UPGRADES (5 - 15 YEARS)
- PROPOSED UPGRADES (15 - 25 YEARS)
- PROPOSED UPGRADES (ULTIMATE)
- DEVELOPMENT BOUNDARY

SCALE 1:35,000

INSET SCALE 1:90,000

OCTOBER 2015

Associated Engineering

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FIGURE 8-2

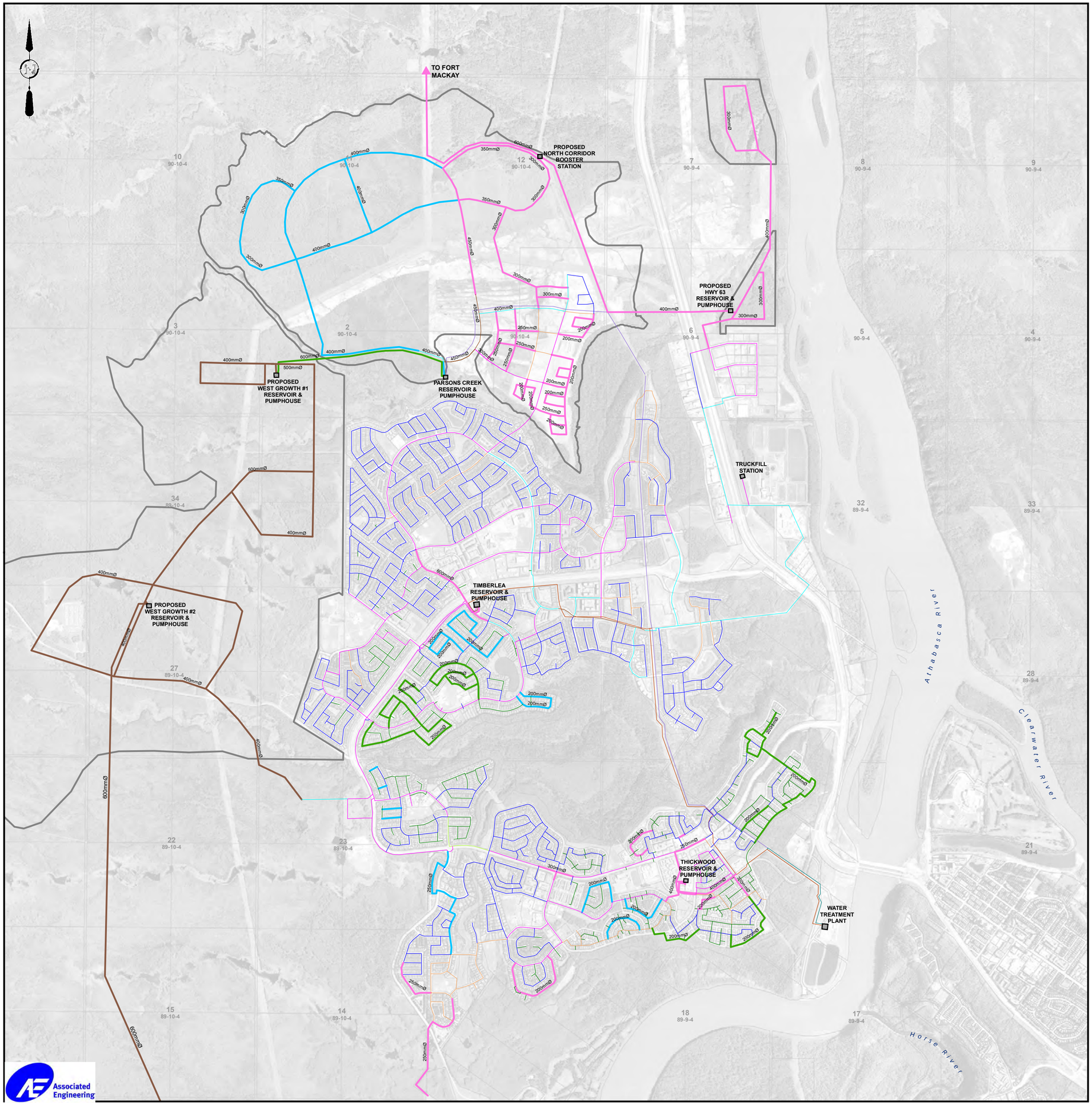
REGIONAL MUNICIPALITY OF WOOD BUFFALO

2015 WATER MASTER PLAN

STAGING PLAN

ULTIMATE WATER DISTRIBUTION SYSTEM
NORTH SERVICE AREA

FIGURE 8-3



LEGEND:

- EXISTING 150mmØ WATERMAIN
- EXISTING 200mmØ WATERMAIN
- EXISTING 250mmØ WATERMAIN
- EXISTING 300mmØ WATERMAIN
- EXISTING 350mmØ WATERMAIN
- EXISTING 400mmØ WATERMAIN
- EXISTING 450mmØ WATERMAIN
- EXISTING 600mmØ WATERMAIN
- EXISTING 750mmØ WATERMAIN
- EXISTING 900mmØ WATERMAIN
- PROPOSED UPGRADES (0 - 5 YEARS)
- PROPOSED UPGRADES (5 - 15 YEARS)
- PROPOSED UPGRADES (15 - 25 YEARS)
- PROPOSED UPGRADES (ULTIMATE)
- DEVELOPMENT BOUNDARY

SCALE 1:25,000

OCTOBER 2015

Associated Engineering

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9 Chlorine Analysis

A chlorine residual analysis was undertaken in the 2011 Water Master Plan. The analysis was based on the Municipality's use of chloramine as a primary disinfectant, which is one of two commonly used disinfectants (the other is chlorine gas). An extended period simulation (EPS) was performed (using "WaterCAD" software by Bentley) to estimate the chloramine levels within the existing system (chloramine tracing). The model was calibrated using field sampling data provided by the Municipality. Model results were presented to identify areas of existing low chloramine residual within the existing system, and to predict the levels in future development areas (and partially developed areas).

The model results indicated that the lowest disinfectant residuals occur in parts of the distribution system that experience long travel times from the WTP. Based on the model, the following areas were found to experience chloramine concentrations less than 0.2 mg/L (minimum recommended residual based on the *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, Alberta Environment*).

- Stonecreek Subdivision, Timberlea.
- River View Heights, Abasand.
- Aspen Gardens, Abasand.

The low concentration results for Abasand were based on periods when additional chloramine had not been added to the Abasand Reservoir. During boosting, the chloramine levels were found to improve in the area. The 2011 Water Master Plan recommended that the Municipality sample water from the above noted areas to compare against the model results. The report also identified that additional booster chlorination could be required at Timberlea to overcome the estimated low chloramine levels.

In the ultimate development concept, the model results indicated that booster chlorination may be required at the following reservoirs:

- Southeast Regional Reservoir.
- Future Downstream West Growth Reservoir (Southwest).
- Future Southlands Reservoir.
- Hwy 881/63 Reservoir.

The above results were based on the ultimate system demands, and therefore identified optimum chlorine residual levels due to high flows. The report indicated that booster chlorination may be required at all new reservoirs due to the initial low demands in the service areas, in the interim scenario.

The chlorine analysis has not been updated for the purpose of the 2015 Water Master Plan, as the results are not anticipated to change significantly from those previously presented. Further information, including result figures, can be found in the 2011 Water Master Plan report.

10 Cost Estimates

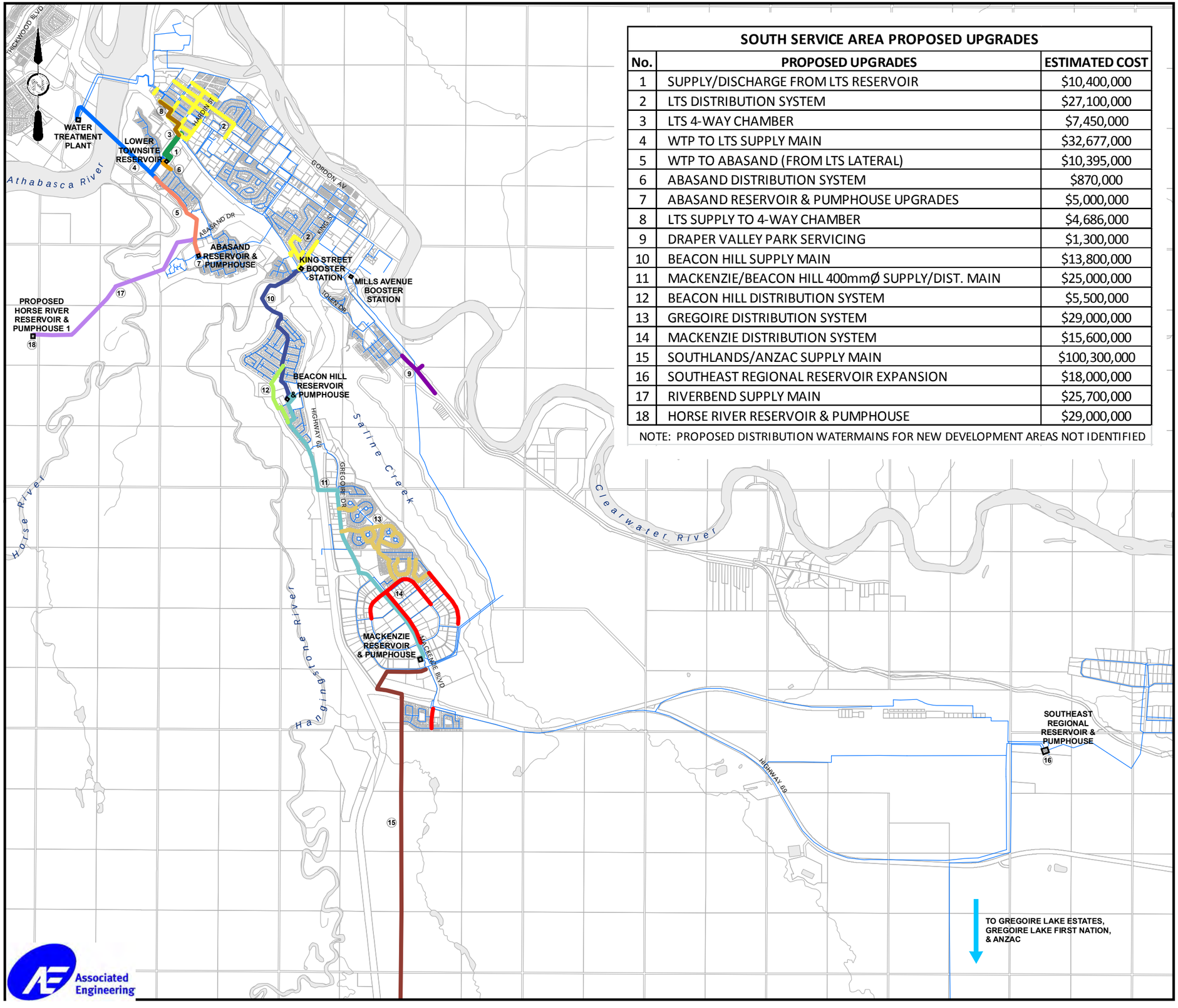
The cost estimates presented in **Table 10-1** include an allowance for engineering (10%) and contingency (25%), but do not include G.S.T. The costs are based on 2015 construction dollars. Detailed cost estimates are provided in **Appendix J**, and identify the extent of distribution system upgrades which are anticipated in each neighbourhood. Costs provided below are based on all existing system upgrades identified in the document, including mains 400 mm diameter and larger in future development/expansion areas. Costs are not included for watermains considered to be existing (to be completed by the end of 2015). Costs have not been included for rural distribution system upgrades/expansion. Short term costs are those identified as proposed upgrades (0 – 5 Years) on the enclosed Staging Plans. Medium-term costs include the 5-15 Year upgrades and Long-term costs include the 15 – 25 Year and ultimate upgrades as identified on the Staging Plans.

Figures 10-1 and **10-2** identify the estimated short term costs for the existing development areas as well as the short term supply system costs.

Table 10-1
Summary of Estimated Costs

DESCRIPTION	SHORT TERM (0 - 5 YEARS)	MEDIUM TERM (5-15 YEARS)	LONG TERM (ULTIMATE)
South Service Area			
Supply Lines	$80,857,000	$45,649,000	$0
Reservoir and Pumphouses			
LTS 4-Way Cmbr/PRV Station	$7,450,000	$0	$0
Abasand Reservoir Modifications	$5,000,000	$0	$0
MacKenzie Reservoir Expansion	$0	$0	$46,000,000
SE Reservoir Expansion	$18,000,000	$0	$22,000,000
Anzac Booster Station	$0	$0	$2,500,000
Distribution System			
Lower Townsite	$27,091,000	$56,936,000	$36,171,000
Abasand	$870,000	$3,882,000	$0
Waterways	$0	$0	$19,553,000
Draper	$1,332,000	$0	$0
Beacon Hill	$5,526,000	$10,065,000	$0
Mackenzie/Gregoire	$54,662,000	$0	$0
Airport Industrial/Southlands	$0	$0	$0
Saprae Creek/Spruce Valley	$0	$0	$65,266,000
Gateway/Quarry Ridge	$0	$15,594,000	$0
Saline Creek	$8,436,000	$0	$0
TOTAL SOUTH SERVICE AREA	**$209,224,000**	**$132,126,000**	**$191,490,000**
North Service Area			
Supply Lines	163,457,000	0	44,308,000
Reservoir and Pumphouses			
West Growth Res & PH 1&2	0	0	70,000,000
Hwy 63 Corridor Res & PH	17,000,000	0	0
North Corridor Booster Station	8,000,000	0	0
Distribution System			
Thickwood	27,699,000	21,308,000	26,119,000
Timberlea	8,640,000	19,323,000	28,438,000
Parsons Creek	6,907,000	21,581,000	0
West Growth Area	0	0	46,126,000
TOTAL NORTH SERVICE AREA	**231,703,000**	**62,212,000**	**214,991,000**

DESCRIPTION	SHORT TERM (0 - 5 YEARS)	MEDIUM TERM (5-15 YEARS)	LONG TERM (ULTIMATE)
Future Southwest Service Area			
Supply Lines	135,950,000	69,045,000	114,920,000
Reservoir and Pumphouses			
Horse River Res & PH 1&2	29,000,000	0	18,000,000
Hangingstone Res & PH 1&2	0	46,000,000	40,000,000
Southlands 1A/1B Res & PH	31,000,000	0	0
HWY 881/63 Res & PH	28,000,000	0	0
Distribution System			
Horse River	1,791,000	6,125,000	12,954,000
Hangingstone	0	20,528,000	42,640,000
Southlands Industrial	0	7,104,000	3,633,000
South WTP	$0	$255,000,000	$75,000,000
TOTAL SOUTHWEST SERVICE AREA	**225,741,000**	**403,802,000**	**307,147,000**
TOTAL PROPOSED UPGRADES/EXPANSION	**$666,668,000**	**$598,140,000**	**$713,628,000**



SOUTH SERVICE AREA PROPOSED UPGRADES		
No.	**PROPOSED UPGRADES**	**ESTIMATED COST**
1	SUPPLY/DISCHARGE FROM LTS RESERVOIR	$10,400,000
2	LTS DISTRIBUTION SYSTEM	$27,100,000
3	LTS 4-WAY CHAMBER	$7,450,000
4	WTP TO LTS SUPPLY MAIN	$32,677,000
5	WTP TO ABASAND (FROM LTS LATERAL)	$10,395,000
6	ABASAND DISTRIBUTION SYSTEM	$870,000
7	ABASAND RESERVOIR & PUMPHOUSE UPGRADES	$5,000,000
8	LTS SUPPLY TO 4-WAY CHAMBER	$4,686,000
9	DRAPER VALLEY PARK SERVICING	$1,300,000
10	BEACON HILL SUPPLY MAIN	$13,800,000
11	MACKENZIE/BEACON HILL 400mmØ SUPPLY/DIST. MAIN	$25,000,000
12	BEACON HILL DISTRIBUTION SYSTEM	$5,500,000
13	GREGOIRE DISTRIBUTION SYSTEM	$29,000,000
14	MACKENZIE DISTRIBUTION SYSTEM	$15,600,000
15	SOUTHLANDS/ANZAC SUPPLY MAIN	$100,300,000
16	SOUTHEAST REGIONAL RESERVOIR EXPANSION	$18,000,000
17	RIVERBEND SUPPLY MAIN	$25,700,000
18	HORSE RIVER RESERVOIR & PUMPHOUSE	$29,000,000

NOTE: PROPOSED DISTRIBUTION WATERMAINS FOR NEW DEVELOPMENT AREAS NOT IDENTIFIED

Regional Municipality of Wood Buffalo

2015 WATER MASTER PLAN

PROPOSED UPGRADES (0 TO 5 YEARS) SOUTH SERVICE AREA EXISTING DEVELOPMENT

LEGEND:

- EXISTING WATERMAIN
- 1 - SUPPLY/DISCHARGE FROM LTS RESERVOIR
- 2 - LTS DISTRIBUTION SYSTEM
- 4 - WTP TO LTS SUPPLY MAIN
- 5 - WTP TO ABASAND (FROM LTS LATERAL)
- 6 - ABASAND DISTRIBUTION SYSTEM
- 8 - LTS SUPPLY TO 4-WAY CHAMBER
- 9 - DRAPER VALLEY PARK SERVICING
- 10 - BEACON HILL SUPPLY MAIN
- 11 - MACKENZIE/BEACON HILL 400mmØ SUPPLY/DIST. MAIN
- 12 - BEACON HILL DISTRIBUTION SYSTEM
- 13 - GREGOIRE DISTRIBUTION SYSTEM
- 14 - MACKENZIE DISTRIBUTION SYSTEM
- 15 - SOUTHLANDS/ANZAC SUPPLY MAIN
- 17 - RIVERBEND SUPPLY MAIN

SCALE 1:50,000

OCTOBER 2015

Associated Engineering

FIGURE 10-1

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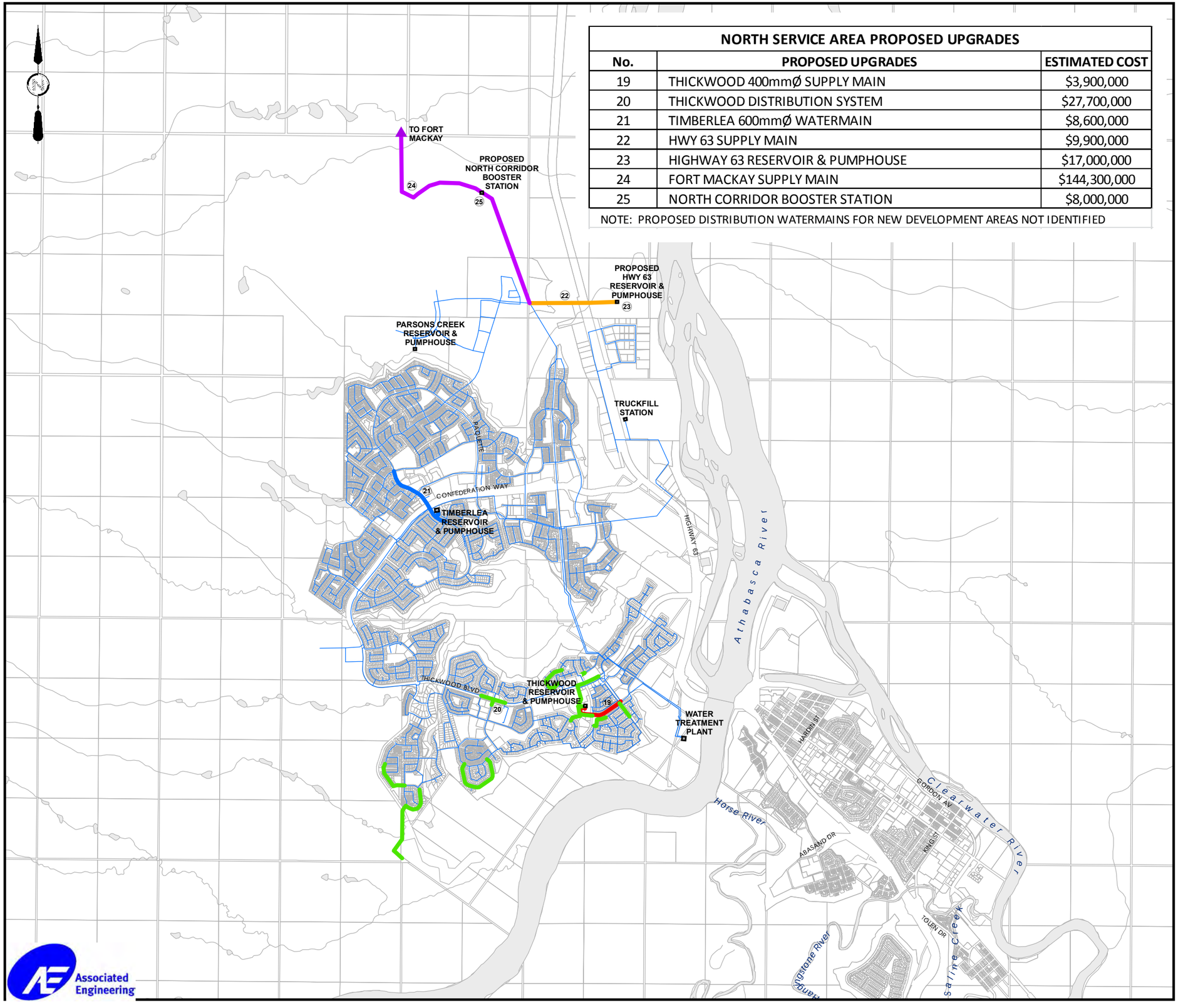
NORTH SERVICE AREA PROPOSED UPGRADES		
No.	**PROPOSED UPGRADES**	**ESTIMATED COST**
19	THICKWOOD 400mmØ SUPPLY MAIN	$3,900,000
20	THICKWOOD DISTRIBUTION SYSTEM	$27,700,000
21	TIMBERLEA 600mmØ WATERMAIN	$8,600,000
22	HWY 63 SUPPLY MAIN	$9,900,000
23	HIGHWAY 63 RESERVOIR & PUMPHOUSE	$17,000,000
24	FORT MACKAY SUPPLY MAIN	$144,300,000
25	NORTH CORRIDOR BOOSTER STATION	$8,000,000

NOTE: PROPOSED DISTRIBUTION WATERMAINS FOR NEW DEVELOPMENT AREAS NOT IDENTIFIED



2015 WATER MASTER PLAN

PROPOSED UPGRADES (0 TO 5 YEARS) NORTH SERVICE AREA EXISTING DEVELOPMENT

LEGEND:

- EXISTING WATERMAIN
- 19 - THICKWOOD 400mmØ SUPPLY MAIN
- 20 - THICKWOOD DISTRIBUTION SYSTEM
- 21 - TIMBERLEA 600mmØ WATERMAIN
- 22 - HWY 63 SUPPLY MAIN
- 24 - FORT MACKAY SUPPLY MAIN

SCALE 1:50,000

OCTOBER 2015

FIGURE 10-2

Associated Engineering

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11 Conclusions

11.1 WATER TREATMENT PLANT

- Upgrades at the WTP have increased the previous production capacity of 52 ML/d to 104 ML/d (gross) and result in a total on-site storage of 24,000 m^3.
- The existing South Service Area pumps cannot meet the estimated Peak Day water demand for 2013.
- The new pumps recently installed for the North Service Area may not be adequate to supply the peak day demands through the year 2018 if the demand projections are met.
- Ultimately, the South Service Area will be serviced from the new High Lift Pumphouse at the proposed outgoing HGL of 345 m.
- A future south WTP is proposed to be located south of the Athabasca River, to the west of the current development, which will service the future Southwest Service Area and potential shortfall in the North Service Area due to possible future servicing north to Fort MacKay.
- Both the High Pressure Zone (North Service Area plus future interim Southwest Service Area) and Low Pressure Zone (South Service Area) will require pumping upgrades to service the ultimate projected equivalent populations and associated peak day demands).

11.2 SOUTH SERVICE AREA

11.2.1 Supply System

- The outgoing pressure from the WTP will be increased to an HGL of 345 m to fill the LTS Reservoir in the ultimate demand scenario.
- Upgrades to the supply system will be required to convey the ultimate design flows to the Mills Avenue Booster Station. (Underway – pending completion in 2015.)
- The proposed LTS 4-Way Chamber will be required to reduce pressure from the LTS Reservoir (and/or high pressure supply from the WTP) to the Lower Townsite distribution zone pressure.
- The Mills Avenue Booster Station and the new dedicated supply waterline (anticipated to be operational in 2016) will become the primary supply for MacKenzie and downstream users. The existing King Street Booster Station and supply waterline to Beacon Hill can be retained as the primary supply to the Beacon Hill zone. It is understood that the existing 350 mm supply main will soon be replaced with a new 400 mm main.
- Beacon Hill and MacKenzie will have the capability to provide back-up supply for one another.
- Ultimately, there will be a supply shortfall of 93 L/s within the South Service Area which is proposed to be supplied from the Future Southwest Service Area

11.2.2 Lower Townsite

- There are minimal nodes which experience pressures beyond 620 kPa during the peak hour scenario.

- The existing distribution system is not capable of supplying the recommended minimum fire flows to some locations within the Lower Townsite, mainly the result of undersized mains and pending higher density redevelopment.
- Upgrading will be required to the distribution mains in order to provide the recommended fire flows. Upgrades to the supply system will further improve fire flow.
- The Lower Townsite distribution system is currently operating at a pressure of 307 m HGL through PRV stations. This pressure will be maintained in the ultimate development scenario.
- The Lower Townsite Pumphouse is currently operational.

11.2.3 Abasand

- The WTP is currently required to operate two South Service Area pumps in order to fill the reservoir during the night.
- The Abasand Pumphouse is operating at an HGL of 376 m.
- The existing peak hour pressures are typically within the recommended pressures identified in the design criteria section of this report.
- Some locations within Abasand do not meet the minimum fire flow recommendations.
- The Abasand Reservoir has the capacity to meet the existing and ultimate water demand.
- Upgrading will be required to the supply system, as well as to the distribution mains in order to provide the recommended fire flows.
- In order to maintain water quality within the Abasand Reservoir, water will need to circulate to the Lower Townsite utilizing the existing 300 mm supply main.
- The existing 300 mm diameter supply main connecting the Abasand Reservoir and Pumphouse to Hospital Street will be sufficiently sized to convey the peak flows out of the reservoir to support peak demands in the Lower Townsite and result in turnover of the reservoir storage at Abasand.
- It may be appropriate to maintain limited distribution system pumping within the Abasand Reservoir, to further ensure supply line and reservoir turnover.
- A PRV will be required in order to reduce the Abasand Reservoir pressure to supply the Lower Townsite peak day demand.
- The Abasand Reservoir and Pumphouse will require modifications based on the revised design concept.

11.2.4 Waterways

- Storage and pumping requirements are provided from the Lower Townsite system.
- During normal operating conditions, the pressures within the Waterways area fall within the Municipality's design standards.
- Peak operation of the King Street Booster Station (and Mills Avenue Booster Station) reduces the pressure and available fire flow to Waterways.
- Upgrades are required in order to satisfy the recommended peak day plus fire flows.
- The ultimate scenario for Waterways is based on densification of the existing development area to significantly increase the population. This is anticipated to include a number of walk up apartments.

11.2.5 Draper

- There currently is no existing distribution system servicing the Draper Road area.
- Treated water is hauled by truck and discharged into cisterns with pumps that provide the necessary flow and pressure to each residence.
- It is understood that the Municipality will be constructing a trickle fill water system to service the Draper area.

11.2.6 Beacon Hill

- All pressures during the peak hour scenario fall within the Municipality's design standards.
- The existing peak day plus fire flow analysis results indicate that minimum fire flows are achieved throughout most of the Beacon Hill area.
- There is ample storage capacity to meet the ultimate anticipated demands based on the Municipality's Standard of 1 peak day demand plus fire flow.
- The new pumphouse operates at an HGL of a 400 m. A reduction in the outgoing Beacon Hill Pumphouse pressure will reduce zone pressures to within recommended limits.
- In order to provide back-up supply to the MacKenzie Reservoir, the Beacon Hill Pumphouse will need to operate at a higher level (approximately 407 m HGL) during emergency supply scenarios.
- According to the pre-design report, the total capacity of the pumphouse will be 250 L/s at a TDH of 50 m. This will come close to satisfying the estimated peak day plus fire flow demands.
- Upgrading will be required to the existing 300 mm supply main, as well as to the distribution mains in order to provide the recommended fire flows.
- Upon completion of the 750 mm supply line, PRV Stations are recommended to reduce the MacKenzie operating pressure to an HGL of 400 m at the connection to the Beacon Hill/Gregoire zone (PRV's proposed to be located at Gregoire and within the MacKenzie Pumphouse).

11.2.7 MacKenzie Industrial

- Both low and high pressures are experienced in the Gregoire Park area during the existing peak hour demand scenario (depending on the associated zone pressure).
- Several nodes within the Gregoire Park area do not meet the minimum fire flows recommendations.
- The existing 500 L/s pumping rate will be adequate beyond the year 2023, when an upgrade to the full 625 L/s could be required.
- The pumphouse is operating at 425 m HGL.
- The existing storage reservoir will have a storage deficit of 22,730 m^3 in the Ultimate system based on the Municipality's Engineering Servicing Standards, however, it is adequately sized based on providing a minimum storage capacity as per AEP's recommendations.
- Once the MacKenzie reservoir is supplied directly from the Mills Avenue Booster, it is proposed that a separate zone be established to reduce the north MacKenzie/Gregoire area pressures.
- The MacKenzie distribution system will be capable of filling the Beacon Hill reservoir as a back-up supply, if required. PRV's at 400 m hydraulic head, will be required to reduce the pressure into the Beacon Hill/Gregoire distribution systems.

11.2.8 Southeast Regional Reservoir and Pumphouse

- The existing reservoir does not have sufficient storage capacity to meet the projected water demands based on providing one peak day plus fire flows.
- The recently upgraded pumps can accommodate the existing peak hour demands and peak day plus fire flow demands for the service area (Airport, Saprae Creek and Spruce Valley).
- The pumphouse has recently been upgraded to operate at an HGL of 425 m to the local distribution system, and operates at an HGL of 520 m to the Hamlet of Anzac.
- The Southeast Regional Reservoir and Pumphouse is currently supplied by the MacKenzie Pumphouse and will require additional supply from the proposed Southlands Industrial Pumphouse in the Ultimate scenario.
- Based on the design demands, there appears to be sufficient pumping capacity to accommodate up to the year 2028 projected population along the Anzac Waterline. However, the Municipality is looking to install an additional pump at the Southeast Pumphouse, which may indicate that downstream demands have increased significantly in recent years (potentially due to a newly constructed truckfill).
- To supply a future population of 5,000 people at the Hamlet of Anzac, an additional booster station will be required. This is in addition to pumping upgrades at the Southeast Regional Pumphouse and at the Anzac Booster Station.

11.2.9 Saprae Creek

- The Saprae Creek Reservoir and Pumphouse has recently been decommissioned due to recent upgrades of the distribution system and at the Southeast Reservoir and Pumphouse.

11.2.10 Hamlet of Anzac

- A new reservoir and pumphouse has recently been constructed with a storage volume of 2,400 m^3. This will require an expansion if a significant fire flow standard is to be provided in the short term.
- Ultimately, to service a projected population of 15,000 people in the Hamlet of Anzac, approximately 13,400 m^3 of storage capacity will be required.
- The existing pumping capacity and distribution system were not assessed.

11.2.11 Gregoire Lake First Nations

- The existing storage reservoir is undersized to accommodate the projected requirements.
- The existing pumping capacity and distribution system were not assessed.

11.2.12 Gateway/Quarry Ridge

- These developments are proposed to be supplied by the MacKenzie Reservoir and Pumphouse through connections to the existing MacKenzie distribution system.

- PRV's will be required to reduce the operating pressure.

11.2.13 Saline Creek

- The development will be supplied from the MacKenzie Reservoir and Pumphouse at the common zone pressure of 425 m HGL.
- PRV's are proposed to reduce the pressure in the southwest area of the development to an HGL of 400 m.

11.2.14 Southlands Industrial/Airport West and East

- The Southlands Industrial Area 2 and Airport Lands (West and East) will ultimately require servicing from both the South Service Area and future Southwest Service Area.
- The Southeast Regional Reservoir will be responsible for storing the recommended peak flows for the area, and will pump to maintain system pressures during typical demand scenarios.
- Future Commercial/Industrial development has been identified east of Spruce Valley, although the actual location of the proposed development area is not fully known. As such, the servicing of these eastern lands will require more detailed study to develop a future servicing concept.

11.3 NORTH SERVICE AREA

11.3.1 Supply System

- The completion of the new 900/750 mm diameter supply line to service the Parsons Creek and West Growth Area will reduce velocities within the existing 600 mm supply line to Thickwood and Timberlea (due to interconnections).
- The existing Thickwood lateral (300 mm pipeline) has greater than recommended velocities.
- A 600 mm diameter supply main is proposed to service the future West Growth area.
- A booster station will be required at the Parsons Creek Reservoir and Pumphouse to increase the delivery pressures to the future West Growth Reservoir in interim years (until the outgoing pressure at the WTP is increased to a proposed 400 m HGL).

11.3.2 Thickwood

- Some pressures in the Thickwood area do not meet the recommendations outlined within the design criteria section of this report. Pressures exceeding 690 kPa (100 psi) occur in some locations.
- Very few locations are found to have insufficient fire flows during the peak day plus fire flow scenario.
- The pumphouse operates at an HGL of 405 m.
- It appears that the Thickwood pumphouse has sufficient capacity to meet both the peak hour demand flows as well as the peak day plus fire flows.

- The reservoir can provide the recommended storage to meet the ultimate projected water demands based on AEP's recommendations.
- Upgrades are proposed to the distribution system in order to satisfy the recommended fire flow criteria.
- Some nodes are anticipated to exceed 690 kPa (100 psi) based on an HGL of 405 m, during very low demand periods (overnight).

11.3.3 Timberlea

- The Timberlea Pumphouse has recently been upgraded, and new pumps have been installed.
- Pressures in the main Timberlea zone and the Eagle Ridge/Stone Creek Zone both exceed recommended maximum pressures during low demand periods.
- The model results indicate that the majority of peak day plus fire flow demands are satisfied within the Timberlea service area.
- The pumphouse operates at an HGL of 417 m.
- A number of existing 150 mm diameter waterlines will experience higher than recommended velocities under the peak day plus fire flow demand scenario.
- It is anticipated that the Timberlea Reservoir and Pumphouse will have sufficient pumping capacity to meet the ultimate projected demands for the area.
- The total required storage volume is anticipated to be exceeded in 2028 by over 600 m^3 based on meeting the AEP recommendations. The construction of a proposed new reservoir in the Highway 63 Corridor will eliminate this shortfall.
- Some nodes are anticipated to exceed 690 kPa (100 psi) based on an HGL of 417 m, during very low demand periods (overnight).

11.3.4 Parson's Creek

- Areas of high pressure are located along the eastern edge of the development, based on a proposed ultimate zone pressure of 406 m HGL.
- It is anticipated that there will be sufficient pumping capacity to meet the projected peak demand flows as outline above (based on the pre-design report).
- A minimum storage capacity of 21,300 m^3 is recommended to be constructed at the future Parsons Creek Reservoir, based on the Municipality's Engineering Servicing Standards.
- A 300 mm supply line has been constructed along Rainbow Creek Drive to provide temporary servicing to the Parson's Creek area until the supply line, and reservoir and pumphouse have been completed.

11.3.5 West Growth Area

- The West Growth Area will be supplied from a 600 mm extension off of the 750 mm diameter supply line to Parsons Creek.
- Additional future supply will be required from the proposed future WTP, if water is to be "borrowed" from the West Growth allotment to service the Fort MacKay and North Transmission Line areas.

- A minimum combined storage capacity of 24,800 m^3 is recommended to be constructed at the Future West Growth Reservoirs, based on the Municipality's Engineering Servicing Standards.

11.3.6 Hwy 63 Commercial

- A new reservoir and pumphouse is proposed to be constructed in order to support additional commercial/industrial development, reinforce the existing Hwy 63 Industrial Area and reduce the effect on the distribution system due to truckfill operations.
- A 400 mm supply line is proposed from the Parsons supply line to provide water to the reservoir and pumphouse.

11.3.7 Fort MacKay Supply

- Water will be supplied from the Parsons supply line using "borrowed" West Growth demand allocation.
- A booster station or reservoir and pumphouse is proposed to be located at the north end of Parsons Creek.
- Future servicing strategies for the North Service Area will need to be reviewed if supply is to be provided to Fort MacKay and area.

11.4 FUTURE SOUTHWEST SERVICE AREA

11.4.1 Supply System

- Interim water will be supplied from the new High Lift Pumphouse (north header), recently constructed at the WTP.
- Ultimately, the future Southwest Service area will be supplied off of a proposed future South Water Treatment Plant to be constructed at the western boundary of Horse River at an HGL of 395 m.
- Based on the projected design demands, the future Southwest Service Area will be required to provide a supply shortfall of 93 L/s to the Southeast Industrial Area in the Ultimate development scenario.
- The Southwest Service Area will be capable of supplying emergency supply to the Lower Townsite/Abasand and MacKenzie areas (as well as downstream areas).
- The long term future Horse River South and Hangingstone South will be service off of the proposed new WTP.

11.4.2 Horse River

- A future zone HGL of 410 m will service the development area.
- Two future reservoirs and pumphouses are envisioned, with one to be located at the proposed new WTP.

11.4.3 Hangingstone

- Future HGL's of 415 m in the lower zone and 425 m in the upper zone and downstream supply system are proposed.
- Two future reservoirs and pumphouses are envisioned.

11.4.4 Southlands 1A/1B

- Future HGL's of 425 m within Southlands 1A and 433 m within Southlands 1B are envisioned.
- Detailed review of the area may determine that the development area can be sufficiently serviced within the zone.
- An HGL of 480 m will be required to pump to Hwy 881/63, based on the ultimate design demands.
- One future reservoir and pumphouse will be required.
- The SESL Report identifies an HGL in the order of 512 m in the interim supply scenario to defer Hwy 881/63 pumping.

11.4.5 Hwy 881/63

- Future HGL's of 485 m within the local area and 535 m to pump to the Hamlet of Anzac are proposed, based on the ultimate design demands.

11.4.6 Hamlet of Anzac

- It is recommended that an ultimate population of 15,000 people at the Hamlet of Anzac be identified at this time.
- It is proposed that Hamlet of Anzac populations beyond 5,000 will be supplied from the future Southwest Service Area.

11.5 FUTURE GROWTH AREA

11.5.1 Forest Heights

- To service the area east of Athabasca River and north of the Lower Townsite will require a new WTP and supply system to meet the system demands.

12 Recommendations

12.1 WATER TREATMENT PLANT

Short Term (0-5 years)

- Upgrade the WTP pumps which supply the South Service Area, as per **Table 3-4**.

Long Term (Ultimate)

- The pumps currently proposed for the North Service Area may not be adequate to supply the peak day demands through to the year 2018 if the demand projections are met. An ultimate pump at 600 L/s may be required.
- The High Pressure Zone (North Service Area plus interim Southwest Service Area) will require future pumping upgrades to service the interim and ultimate population at an HGL of 400 m.
- The Low Pressure Zone (South Service Area) will require future pumping upgrades to service the ultimate population at an ultimate HGL of 345 m.
- A new WTP is proposed to service the future Southwest Service Area, and potential shortfall in the North Service Area due to possible future servicing north to Fort MacKay.
- A new WTP is proposed to service the future Forest Heights area.

12.2 SOUTH SERVICE AREA

12.2.1 Supply System

Short Term (0-5 years)

- Complete and operate the 750 mm main from the Mills Avenue Booster Station to the MacKenzie Reservoir and Pumphouse.
- Construct the proposed LTS 4-Way Chamber station at Saunderson.
- Construct a 650 mm supply main to the LTS Reservoir.
- Construct a 750 mm supply main from the LTS Reservoir to the LTS 4-Way Chamber.
- Construct a 750 mm supply main along Highway 63 from the LTS 4-Way Chamber to King Street (to be completed in 2015).
- Install a 750 mm main along Hardin Street from Franklin Avenue to Highway 63. (To be completed in 2015).
- Install a 750 mm high pressure supply main from Richards Street and MacDonald Avenue to the LTS 4-Way Chamber.
- Install 750 mm supply crossing the Athabasca River from the WTP to the LTS Reservoir and a 600 mm to Abasand. (Underway – complete 2016.)
- Following construction of the new 750 mm supply line to MacKenzie, rehabilitate/replace the Beacon Hill main and upsize to 400 mm (currently underway).
- Install dedicated supply line within MacKenzie in order to allow for back-up supply from Beacon Hill.

Long Term (Ultimate)

- Future shortfall of supply capacity for South Service Area peak day demand to be provided from the Future Southwest Service Area.

12.2.2 Lower Townsite

Short Term (0-5 years)

- Install new PRV stations along proposed 750 mm supply main along Highway 63.
- Decommission identified PRV's (when appropriate).
- Construct all mains identified for short term upgrading as per **Figure 10-1**.

Long Term (Ultimate)

- Construct proposed ultimate system concept as shown in **Figure 5-5**.
- Construct the remainder of the Franklin Avenue 600 mm supply main.
- Extend proposed 400 mm supply main from King Street Booster Station to Mills Avenue Booster Station and decommission King Street Booster Station (if required due to highway widening).
- Construct the proposed 400 mm main along Prairie Loop Blvd and Hospital Street and abandon existing 400/450 mm main.
- Upgrade watermains to the minimum recommended sizes (as outlined within Section 2 of the design criteria) during local system improvement programs.
- In general, watermains are proposed to be upgraded to 300 mm minimum diameter in order to accommodate future changes in land use including potential densification.

12.2.3 Abasand

Short Term (0-5 years)

- Install new 300/350 mains at the Lower Townsite Reservoir and Pumphouse.
- Install new 300 mm main at the Abasand Reservoir and Pumphouse.
- Abandon existing distribution pumps at the Abasand Reservoir following full operation of the Lower Townsite Pumphouse. Retain stand-by pumps and consider installation of a jockey pump.
- Install a new fill station at the Abasand Reservoir to accommodate the proposed 600 mm supply line.
- Modify the Abasand Reservoir and circulate water to the Lower Townsite utilizing the existing 300 mm supply main.
- Operate the Abasand Reservoir at the existing HGL of 376 m.
- Install PRV on existing 300 mm main to the Lower Townsite system.
- Construct all mains identified for short term upgrading as per **Figure 10-1**.

Long Term (Ultimate)

- Construct proposed ultimate system concept as shown in **Figure 5.5**.
- Upgrade watermains to the minimum recommended sizes (as outlined within Section 2 of the design criteria) during local system improvement programs.
- Supply water to the Lower Townsite from the Abasand Reservoir to circulate water.

12.2.4 Waterways

Short Term (0-5 years)

- No activity. Subject to neighbourhood redevelopment and/or rehabilitation.

Long Term (Ultimate)

- Construct all mains identified for upgrading as per **Figure 8-1**.
- Construct one future PRV Station to connect to the new 750 mm diameter supply line from the Mills Avenue Booster Station to the MacKenzie Reservoir and Pumphouse.
- Programming modifications will be required at the MacKenzie Reservoir and Pumphouse in order to accommodate the proposed PRV station.
- Construct proposed ultimate system concept as shown in **Figure 5-8**. This concept may require modification depending on the future development of the area. Any location with higher density residential land uses will require a minimum of a 300 mm diameter main.

12.2.5 Draper

Short Term (0-5 years)

- Construct future park service and truck fill service to residents.

Long Term (Ultimate)

- Construct watermains and hydrants to service the proposed park facility to the east of Waterways adjacent to the Clearwater River.

12.2.6 Beacon Hill

Short Term (0-5 years)

- Replace existing 300 mm supply main from MacKenzie to the Beacon Hill Reservoir and Pumphouse with a 400 mm diameter supply/distribution main.
- Install a new 300 mm watermain west of the existing Pumphouse.
- Construct all mains identified for short term upgrading as per **Figure 10-1**.

Long Term (Ultimate)

- Construct proposed ultimate system concept as shown in **Figure 5-8**.
- Upgrade watermains to the minimum recommended sizes (as outlined within Section 2 of the design criteria) during local system improvement programs.

12.2.7 MacKenzie Industrial

Short Term (0-5 years)

- Complete and operate the Saline supply main.
- Establish back-up supply from Beacon Hill following the completion of the 750 mm supply main to MacKenzie.

- Modify MacKenzie/Gregoire pressure zones following completion of the 750 mm supply main.
- Open existing closed valve at Grey Crescent and Greely Road.
- Install a PRV Station at 400 m HGL to reduce the north MacKenzie/Gregoire area pressures.
- Construct a PRV Station within the MacKenzie pumphouse to reduce MacKenzie supply pressure to Beacon Hill/Gregoire, to 400 m HGL.
- Continue to operate the MacKenzie Pumphouse at HGL 425 m.
- Replace existing 300 mm main with a new 400 mm supply/distribution main from the MacKenzie Reservoir, along MacKenzie Boulevard and Gregoire Drive.
- Construct mains identified for short term upgrading, as per **Figure 10-1**.

Long Term (Ultimate)

- Expand the existing storage reservoir.
- Construct proposed Ultimate system concept as shown in **Figure 5-11**.
- Upgrade watermains to the minimum recommended sizes (as outlined within Section 2 of the design criteria) during local system improvement programs.

12.2.8 Southeast Regional

Short Term (0-5 years)

- Continue to operate the pumphouse at 425 m HGL.
- Construct storage expansion at the existing reservoir.

Long Term (Ultimate)

- Construct proposed ultimate system concept as shown in **Figure 5-14**.
- Install an additional booster station to supply a future population of 5,000 people at the Hamlet of Anzac, if the SESL pipeline is not constructed in sufficient time.
- Upgrades at the Southeast Regional Pumphouse will also be required at this time.

12.2.9 Saprae Creek

Short Term (0-5 years)

- Interconnect mains as shown on **Figure 5-14**.

Long Term (Ultimate)

- Construct proposed ultimate system concept as shown in **Figure 5-14** to provide fire flow capacity to the area.

12.2.10 Hamlet of Anzac

Short Term (0-5 years)

- Identify the water distribution system requirements for the Hamlet of Anzac.
- Expand Reservoir storage to meet fire flow requirements.

12.2.11 Gregoire Lake First Nations

Short Term (0-5 years)

- Expand the existing storage reservoir.
- Identify the water distribution system requirements for the community.

12.2.12 Gateway/Quarry Ridge

Short Term (0-5 years)

- No activity. Subject to development.

Long Term (Ultimate)

- Install PRV Stations to reduce MacKenzie pressures to 400 m HGL.
- Construct proposed ultimate system concept as shown in **Figure 5-1**.

12.2.13 Saline Creek

Short Term (0-5 years)

- Connect to the downstream supply main in multiple locations.
- Install PRV's to reduce the system pressure to 400 m HGL in the southwest section of the neighbourhood.

Long Term (Ultimate)

- Construct proposed ultimate system concept as shown in **Figure 5-1**.

12.2.14 Southlands Industrial/Airport West and East

Short Term (0-5 years)

- Local development and expansion.

Long Term (Ultimate)

- Construct proposed ultimate system concept as shown in **Figure 5-2**.
- Undertake detailed study to determine location and develop a future servicing concept for East Industrial lands located east of Spruce Valley.

12.3 NORTH SERVICE AREA

12.3.1 Supply System

Short Term (0-5 years)

- Install new 400 mm lateral to the Thickwood Reservoir and Pumphouse.
- Construct supply lateral from Parsons supply main and construct new reservoir/pumphouse in order to service additional development north of the existing Highway 63 Corridor.

- Construct new regional line from Parsons supply main north to Fort MacKay. As a minimum, construct mains within the Parsons area as local development occurs. Install a booster station (or reservoir and pumphouse) depending on the level of service available from the WTP.

Long Term (Ultimate)

- Install new 600 mm supply main to the future West Growth Reservoirs and Pumphouses.
- Construct West Growth Area Reservoirs and Pumphouses.

12.3.2 Thickwood

Short Term (0-5 years)

- Install new 400 mm mains north and south of the existing reservoir and pumphouse.
- Construct all mains identified for short term upgrading as per **Figure 10-2**.
- Undertake individual lot pressure tests to confirm whether modelled high pressures are occurring within the distribution system and to what extent.
- Depending on the test results, individual PRV's may be recommended at each residence, or, on the distribution system to accommodate larger areas.

Long Term (Ultimate)

- Construct proposed ultimate system concept as shown in **Figure 6-3**.
- Upgrade watermains to the minimum recommended sizes (as outlined within Section 2 of the design criteria) during local system improvement programs.

12.3.3 Timberlea

Short Term (0-5 years)

- Confirm Highway 63 Corridor PRV settings and adjust if necessary. Monitor pressure in the downstream area.
- Install 600 mm main from south of Timberlea Reservoir and Pumphouse to Parsons Creek Drive.
- Construct all mains identified for short term upgrading as per **Figure 10-2**.
- Undertake individual lot pressure tests to confirm whether modelled high pressures are occurring within the distribution system, and to what extent.
- Depending on the test results, individual PRV's may be recommended at each residence or on the distribution system to accommodate larger areas.

Long Term (Ultimate)

- Construct proposed ultimate system concept as shown in **Figure 6-6**.
- Upgrade watermains to the minimum recommended sizes (as outlined within Section 2.10 of the design criteria) during local system improvement programs.

12.3.4 Parson's Creek

Short Term (0-5 years)

- Operate the newly constructed Parsons Creek Reservoir and Pumphouse at a pressure of 406 m HGL.
- Local development and expansion.

Long Term (Ultimate)

- Construct proposed ultimate system concept as shown in **Figure 6-7**.

12.3.5 West Growth Area

Short Term (0-5 years)

- No activity.

Long Term (Ultimate)

- Install new 600 mm supply main to the future West Growth Reservoir and Pumphouse.
- Construct two new reservoir and pumphouses.
- Construct proposed ultimate system concept as shown in **Figure 5-1**.

12.4 FUTURE SOUTHWEST SERVICE AREA

12.4.1 Supply System

Short Term (0 – 5 Years)

- Construct the proposed 600 mm water supply mains from Abasand to Riverbend (Horse River).
- Construct the proposed 600 mm supply main from the MacKenzie distribution system to Southlands 1A.
- Construct 400 mm supply main from Southlands to Highway 881/63.
- Construct 400 mm supply main from Highway 881/63 to Anzac.

Long Term (Ultimate)

- Construct 2 x 750 mm supply mains from WTP to Hangingstone
- Construct 600 mm supply main from Hangingstone north to Horse River and South to MacKenzie (to connect to 600 mm section proposed to have been previously constructed to Southlands).
- Construct 450 mm supply main from Southlands to Southeast Industrial Area
- Future shortfall of supply capacity for South Service Area peak day demand to be provided from the Southwest Service Area.
- Populations beyond 5,000 for the Hamlet of Anzac will be supplied from the future Southwest Service Area. The SESL may be constructed prior to this in order to facilitate growth along the route, and to provide redundancy to downstream locations.

12.4.2 Horse River

Short Term (0-5 years)

- Provide interim water supply to proposed Riverbend development from new 750/600 mm supply from WTP through Abasand and 600 mm supply main from Abasand to Horse River.
- Construct Horse River Reservoir and Pumphouse 1 within the Riverbend development.
- Operate pumphouses at 410 m HGL.

Long Term (Ultimate)

- Construct Horse River Reservoir and Pumphouse 2 at the future WTP site.
- An ultimate reservoir storage capacity of approximately 13,300 m^3 will be required between the two future reservoirs, based on storing one peak day plus fire flow.
- Construct proposed ultimate system concept as shown in **Figure 5-1**.

12.4.3 Hangingstone

Short Term (0-5 years)

- No activity. Subject to development.

Long Term (Ultimate)

- Construct two future reservoirs and pumphouses.
- Operate pumphouse 1 at 425 m HGL for upper zone and 415 m HGL for lower zone.
- Operate pumphouse 2 at 415 m HGL.
- Pumphouse 1 to be designed to provide for the Hangingstone development as well as downstream peak day demands (in terms of pumping capacity).
- An ultimate storage capacity of approximately 32,800 m^3 will be required, based on storing one peak day plus fire flow.
- Construct proposed ultimate system concept as shown in **Figure 5-1.**
- Construct new supply lines and reservoirs to service the South Horse and South Hangingstone Areas.

12.4.4 Southlands Industrial

Short Term (0-5 years)

- Install a 600 mm supply main to the Southlands Reservoir and Pumphouse from the MacKenzie distribution system.
- Construct Southlands Reservoir and Pumphouse.
- Operate pumphouse at:
    - 425 m HGL to supply Southeast Regional Reservoir and immediate area (Southlands Area 1A).
    - 480 m HGL to supply the Highway 881/63 Reservoir. Higher HGL's may be required to accommodate the interim servicing concept.
    - 433 m HGL to supply Southlands Area 1B.

Long Term (Ultimate)

- Construct 600 mm supply main from Hangingstone to MacKenzie, complete with dedicated fill line to the MacKenzie Reservoir.
- Construct 450 mm main to provide the supply shortfall to the South Service Area.
- Ultimately, pumphouse to be designed to accommodate the Southlands development as well as downstream peak day demands (in terms of pumping).
- An ultimate storage capacity of approximately 10,465 m^3 will be required, based on storing one peak day plus fire flow.
- Construct proposed ultimate system concept as shown in **Figure 5-1**.

12.4.5 Highway 881/63

Short Term (0-5 years)

- Install a 400 mm supply main to the Highway 881/63 Reservoir and Pumphouse from the Southlands Pumphouse.
- Construct future reservoir and pumphouse.
- Operate pumphouse at:
  - 530 m HGL to supply the Hamlet of Anzac. Higher HGL's may be required depending on design demands and interim servicing concept.
  - 485 m HGL to supply the immediate area.

Long Term (Ultimate)

- Pumphouse to be designed to accommodate the Highway 881/63 development as well as downstream peak day demands (in terms of pumping).
- An ultimate storage capacity of approximately 8,800 m^3 will be required, based on storing one peak day plus fire flow.
- Construct proposed ultimate system concept as shown in **Figure 5-2**.

12.5 GENERAL

- Undertake a system wide risk review of the Waterworks system in order to identify and mitigate potential risks to the Municipality.
- Consider adjacent land uses when locating and setting PRV's.
- Service lands to accommodate future facility/infrastructure expansion.

Closure

This report was prepared for the Regional Municipality of Wood Buffalo as a 2015 Water Master Plan. The report assesses the existing water system and determines the upgrading and expansion requirements to meet the existing and project future demands.

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

Respectfully submitted,
Associated Engineering Alberta Ltd.

Jeff Fetter, P. Eng.
Project Manager

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Project Engineer

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature:
Date: Oct 20, 2015

APEGGA Permit to Practice P 3979

Appendix A - Projected Water Demands

YEAR 2013 ESTIMATED WATER DEMANDS

	LOCATION	2013 EQUIV. POPULATION	CONSUMPTION (L/c/d)	AVE. DAY	PEAK DAY	PEAK HOUR
1.0	SOUTH SERVICE AREA					
1.1	**Lower Townsite Service Area**					
	Lower Townsite + Shadow Pop	12,800	360	53	107	160
	Waterways	800	360	3	7	10
	Draper	200	360	1	2	2
1.2	**Abasand Service Area**					
	Abasand	5,200	360	22	43	65
1.3	**Beacon Hill Service Area**					
	Beacon Hill	2,200	360	9	18	26
1.4	**MacKenzie Service Area**					
	MacKenzie/Gregoire/Prairie Creek	9,000	360	38	75	113
	Saline Creek Plateau	0	360	0	0	0
	Gateway/Quarry Ridge	0	360	0	0	0
	Southlands Industrial Area 4	0	360	0	0	0
1.5	**Southeast Industrial Service Area**					
	Airport and Airport West	0	360	0	0	0
	Airport East and Lynton	0	360	0	0	0
	Saprae Creek/Spruce Valley	900	360	4	8	11
	Southlands Industrial Area 2	0	360	0	0	0
1.6	**Anzac Regional Pipeline**					
	Hamlet of Anzac	875	360	4	7	11
	Gregiore Lake Estates	255	360	1	2	3
	Gregiore Lake First Nations	390	360	2	3	5
	Total South Service Area	**32,620**		**136**	**272**	**407**
2.0	NORTH SERVICE AREA					
2.1	Timberlea	33,500	360	140	279	419
2.2	Thickwood	17,500	360	73	146	219
2.3	Parson's Creek	0	360	0	0	0
2.4	West Growth	0	360	0	0	0
2.5	Highway 63 Corridor	3,000	360	13	26	26
2.6	Highway 63 Truckfill	14,400	180	60	60	60
2.7	Fort MacKay/North Transmission Line	0	360	0	0	0
2.8	Future North Truckfill	0	180	0	0	0
	Total North Service Area	**68,400**		**286**	**511**	**724**
3.0	SOUTHWEST SERVICE AREA					
3.1	Horse River	0	360	0	0	0
3.2	Hangingstone	0	360	0	0	0
3.3	Southlands Industrial Area 1A	0	360	0	0	0
3.4	Southlands Industrial Area 1B	0	360	0	0	0
3.5	Southlands Industrial Area 3A	0	360	0	0	0
3.6	Southlands Industrial Area 3B	0	360	0	0	0
3.7	HWY 881/63	0	360	0	0	0
3.8	Hamlet of Anzac (Additional 10,000 people)	0	360	0	0	0
	Total Southwest Service Area	**0**		**0**	**0**	**0**
	TOTAL POPULATION	101,020		421	783	1,130

YEAR 2018 ESTIMATED WATER DEMANDS

	LOCATION	2018 EQUIV. POPULATION	CONSUMPTION (L/c/d)	AVE. DAY	PEAK DAY	PEAK HOUR
1.0	**SOUTH SERVICE AREA**					
1.1	**Lower Townsite Service Area**					
	Lower Townsite	16,100	360	67	134	201
	Waterways	1,000	360	4	8	13
	Draper	300	360	1	3	3
1.2	**Abasand Service Area**					
	Abasand	5,400	360	23	45	68
1.3	**Beacon Hill Service Area**					
	Beacon Hill	2,300	360	10	19	29
1.4	**MacKenzie Service Area**					
	MacKenzie/Gregoire/Prairie Creek	10,000	360	42	83	125
	Saline Creek Plateau	5,000	360	21	42	63
	Gateway/Quarry Ridge	1,000	360	4	8	13
	Southlands Industrial Area 4	0	360	0	0	0
1.5	**Southeast Industrial Service Area**					
	Airport and Airport West	1,000	360	4	8	13
	Airport East and Lynton	1,000	360	4	8	13
	Saprae Creek/Spruce Valley	1,500	360	6	13	19
	Southlands Industrial Area 2	0	360	0	0	0
1.6	**Anzac Regional Pipeline**					
	Hamlet of Anzac	1,064	360	4	9	13
	Gregiore Lake Estates	264	360	1	2	3
	Gregiore Lake First Nations	465	360	2	4	6
	Total South Service Area	**46,393**		**193**	**386**	**579**
2.0	**NORTH SERVICE AREA**					
2.1	Timberlea	39,400	360	164	328	493
2.2	Thickwood	19,200	360	80	160	240
2.3	Parson's Creek	5,000	360	21	42	63
2.4	West Growth	0	360	0	0	0
2.5	Highway 63 Corridor	4,100	360	17	34	17
2.6	Highway 63 Truckfill	19,200	180	80	80	80
2.7	Fort MacKay/North Transmission Line	0	360	0	0	0
2.8	Future North Truckfill	0	180	0	0	0
	Total North Service Area	**86,900**		**362**	**644**	**892**
3.0	**SOUTHWEST SERVICE AREA**					
3.1	Horse River	0	360	0	0	0
3.2	Hangingstone	0	360	0	0	0
3.3	Southlands Industrial Area 1A	1,000	360	4	8	13
3.4	Southlands Industrial Area 1B	0	360	0	0	0
3.5	Southlands Industrial Area 3A	N/A	360	0	0	0
3.6	Southlands Industrial Area 3B	N/A	360	0	0	0
3.7	HWY 881/63	0	360	0	0	0
3.8	Hamlet of Anzac (Additional 10,000 people)	0	360	0	0	0
	Total Southwest Service Area	**1,000**		**4**	**8**	**13**
	TOTAL POPULATION	**134,293**		**559**	**1,038**	**1,484**

YEAR 2023 ESTIMATED WATER DEMANDS

	LOCATION	2023 EQUIV. POPULATION	CONSUMPTION (L/c/d)	AVE. DAY (L/s)	PEAK DAY	PEAK HOUR
1.0	**SOUTH SERVICE AREA**					
1.1	**Lower Townsite Service Area**					
	Lower Townsite	19,500	360	81	163	244
	Waterways	1,100	360	5	9	14
	Draper	300	360	1	3	2
1.2	**Abasand Service Area**					
	Abasand	5,600	360	23	47	70
1.3	**Beacon Hill Service Area**					
	Beacon Hill	2,600	360	11	22	33
1.4	**MacKenzie Service Area**					
	MacKenzie/Gregoire/Prairie Creek	12,600	360	53	105	158
	Saline Creek Plateau	10,000	360	42	83	125
	Gateway/Quarry Ridge	1,800	360	8	15	23
	Southlands Industrial Area 4	1,000	360	4	8	13
1.5	**Southeast Industrial Service Area**					
	Airport and Airport West	2,300	360	10	19	29
	Airport East and Lynton	1,300	360	5	11	16
	Saprae Creek/Spruce Valley	1,900	360	8	16	24
	Southlands Industrial Area 2	2,000	360	8	17	25
1.6	**Anzac Regional Pipeline**					
	Hamlet of Anzac	1,251	360	5	10	16
	Gregiore Lake Estates	274	360	1	2	3
	Gregiore Lake First Nations	540	360	2	5	7
	Total South Service Area	**64,065**		**267**	**535**	**799**
2.0	**NORTH SERVICE AREA**					
2.1	Timberlea	42,000	360	175	350	525
2.2	Thickwood	19,200	360	80	160	240
2.3	Parson's Creek	7,500	360	31	63	94
2.4	West Growth	0	360	0	0	0
2.5	Highway 63 Corridor	5,400	360	23	45	45
2.6	Highway 63 Truckfill	12,000	180	50	50	50
2.7	Fort MacKay/North Transmission Line	3,172	360	13	26	26
2.8	Future North Truckfill	12,000	180	50	50	50
	Total North Service Area	**101,272**		**422**	**744**	**1,030**
3.0	**SOUTHWEST SERVICE AREA**					
3.1	Horse River	1,600	360	7	13	20
3.2	Hangingstone	1,800	360	8	15	23
3.3	Southlands Industrial Area 1A	1,500	360	6	13	19
3.4	Southlands Industrial Area 1B	0	360	0	0	0
3.5	Southlands Industrial Area 3A	N/A	360	0	0	0
3.6	Southlands Industrial Area 3B	N/A	360	0	0	0
3.7	HWY 881/63	0	360	0	0	0
3.8	Hamlet of Anzac (Additional 10,000 people)	0	360	0	0	0
	Total Southwest Service Area	**4,900**		**20**	**41**	**61**
	TOTAL POPULATION	**170,237**		**710**	**1,320**	**1,890**

YEAR 2028 ESTIMATED WATER DEMANDS

	LOCATION	2028 EQUIV. POPULATION	CONSUMPTION (L/c/d)	AVE. DAY	PEAK DAY	PEAK HOUR
1.0	**SOUTH SERVICE AREA**					
1.1	**Lower Townsite Service Area**					
	Lower Townsite	23,100	360	96	193	289
	Waterways	1,300	360	5	11	16
	Draper	300	360	1	3	3
1.2	**Abasand Service Area**					
	Abasand	5,800	360	24	48	73
1.3	**Beacon Hill Service Area**					
	Beacon Hill	2,600	360	11	22	33
1.4	**MacKenzie Service Area**					
	MacKenzie/Gregoire/Prairie Creek	14,400	360	60	120	180
	Saline Creek Plateau	15,000	360	63	125	188
	Gateway/Quarry Ridge	2,500	360	10	21	31
	Southlands Industrial Area 4	1,500	360	6	13	19
1.5	**Southeast Industrial Service Area**					
	Airport and Airport West	2,800	360	12	23	35
	Airport East and Lynton	1,500	360	6	13	19
	Saprae Creek/Spruce Valley	2,400	360	10	20	30
	Southlands Industrial Area 2	3,000	360	13	25	38
1.6	**Anzac Regional Pipeline**					
	Hamlet of Anzac	1,571	360	7	13	20
	Gregiore Lake Estates	290	360	1	2	4
	Gregiore Lake First Nations	615	360	3	5	8
	Total South Service Area	**78,676**		**328**	**657**	**986**
2.0	**NORTH SERVICE AREA**					
2.1	Timberlea	42,000	360	175	350	525
2.2	Thickwood	19,200	360	80	160	240
2.3	Parson's Creek	10,000	360	42	83	125
2.4	West Growth	2,000	360	8	17	25
2.5	Highway 63 Corridor	7,200	360	30	60	60
2.6	Highway 63 Truckfill	14,400	180	60	60	60
2.7	Fort MacKay/North Transmission Line	5,244	360	22	44	44
2.8	Future North Truckfill	14,400	180	60	60	60
	Total North Service Area	**114,444**		**477**	**834**	**1,035**
3.0	**SOUTHWEST SERVICE AREA**					
3.1	Horse River	2,500	360	10	21	31
3.2	Hangingstone	2,700	360	11	23	34
3.3	Southlands Industrial Area 1A	2,000	360	8	17	25
3.4	Southlands Industrial Area 1B	2,000	360	8	17	25
3.5	Southlands Industrial Area 3A	N/A	360	0	0	0
3.6	Southlands Industrial Area 3B	N.A	360	0	0	0
3.7	HWY 881/63	2,000	360	8	17	25
3.8	Hamlet of Anzac (Additional 10,000 people)	0	360	0	0	0
	Total Southwest Service Area	**11,200**		**47**	**95**	**140**
	TOTAL POPULATION	**204,320**		**851**	**1,586**	**2,161**

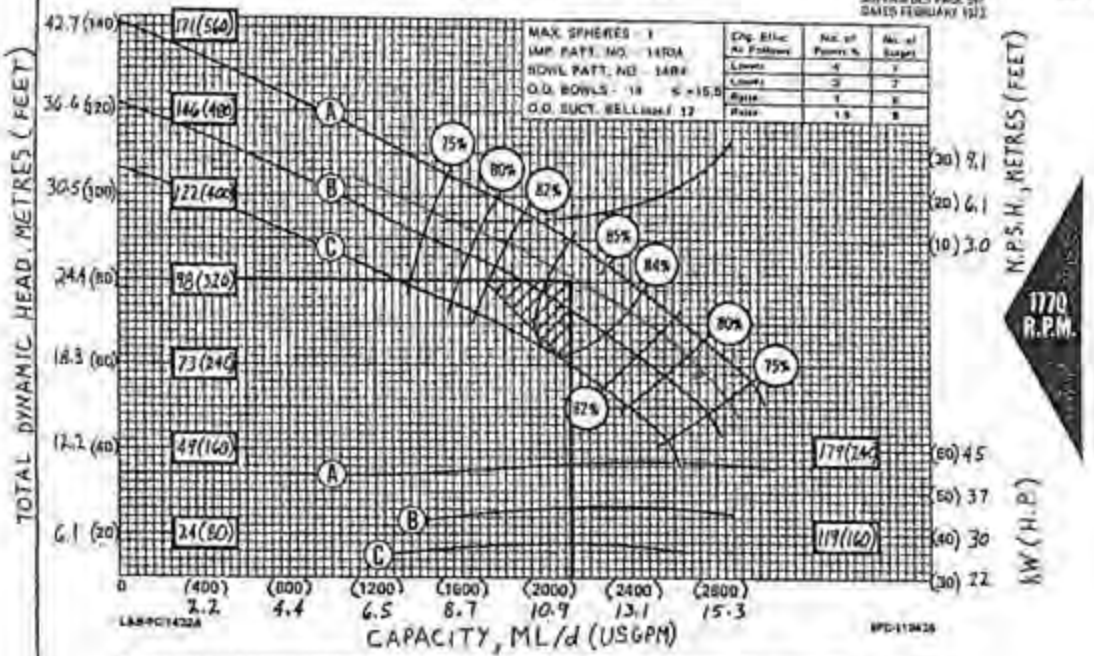
YEAR 2033 ESTIMATED WATER DEMANDS

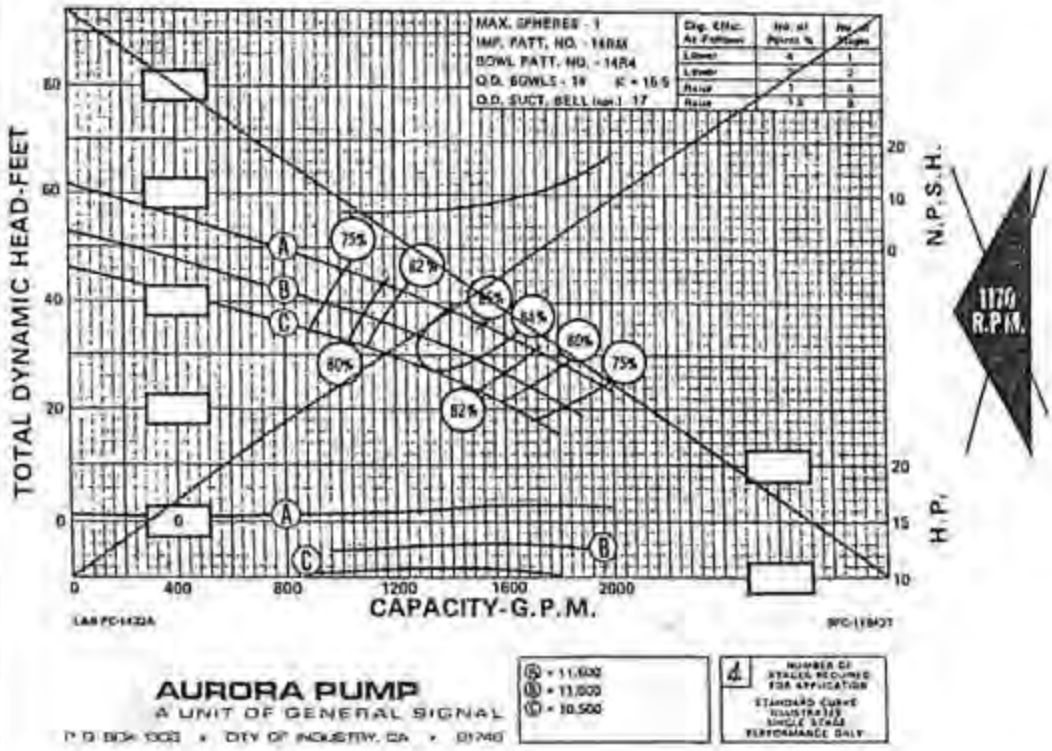
	LOCATION	2033 EQUIV. POPULATION	CONSUMPTION (L/c/d)	AVE. DAY	PEAK DAY	PEAK HOUR
1.0	**SOUTH SERVICE AREA**					
1.1	**Lower Townsite Service Area**					
	Lower Townsite	26,900	360	112	224	336
	Waterways	1,500	360	6	13	19
	Draper	400	360	2	3	3
1.2	**Abasand Service Area**					
	Abasand	6,000	360	25	50	75
1.3	**Beacon Hill Service Area**					
	Beacon Hill	2,600	360	11	22	33
1.4	**MacKenzie Service Area**					
	MacKenzie/Gregoire/Prairie Creek	14,700	360	61	123	184
	Saline Creek Plateau	20,000	360	83	167	250
	Gateway/Quarry Ridge	3,300	360	14	28	41
	Southlands Industrial Area 4	2,000	360	8	17	25
1.5	**Southeast Industrial Service Area**					
	Airport and Airport West	3,400	360	14	28	43
	Airport East and Lynton	1,800	360	8	15	23
	Saprae Creek/Spruce Valley	2,900	360	12	24	36
	Southlands Industrial Area 2	4,000	360	17	33	50
1.6	**Anzac Regional Pipeline**					
	Hamlet of Anzac	1,902	360	8	16	24
	Gregiore Lake Estates	303	360	1	3	4
	Gregiore Lake First Nations	690	360	3	6	9
	Total South Service Area	**92,395**		**385**	**772**	**1,155**
2.0	**NORTH SERVICE AREA**					
2.1	Timberlea	42,000	360	175	350	525
2.2	Thickwood	19,200	360	80	160	240
2.3	Parson's Creek	12,500	360	52	104	156
2.4	West Growth	3,000	360	13	25	38
2.5	Highway 63 Corridor	7,200	360	30	60	60
2.6	Highway 63 Truckfill	16,200	180	68	68	68
2.7	Fort MacKay/North Transmission Line	9,113	360	38	76	76
2.8	Future North Truckfill	16,200	180	68	68	68
	Total North Service Area	**125,413**		**523**	**910**	**1,230**
3.0	**SOUTHWEST SERVICE AREA**					
3.1	Horse River	4,300	360	18	36	54
3.2	Hangingstone	4,500	360	19	38	56
3.3	Southlands Industrial Area 1A	2,500	360	10	21	31
3.4	Southlands Industrial Area 1B	3,000	360	13	25	38
3.5	Southlands Industrial Area 3A	N/A	360	0	0	0
3.6	Southlands Industrial Area 3B	N/A	360	0	0	0
3.7	HWY 881/63	3,000	360	13	25	38
3.8	Hamlet of Anzac (Additional 10,000 people)	0	360	0	0	0
	Total Southwest Service Area	**17,300**		**72**	**145**	**216**
	TOTAL POPULATION	**235,108**		**980**	**1,827**	**2,601**

ULTIMATE SYSTEM ESTIMATED WATER DEMANDS

	LOCATION	ULTIMATE EQUIV. POPULATION	CONSUMPTION (L/c/d)	AVE. DAY (L/s)	PEAK DAY (L/s)	PEAK HOUR (L/s)
1.0	**SOUTH SERVICE AREA**					
1.1	**Lower Townsite Service Area**					
	Lower Townsite	48,000	360	200	400	600
	Waterways	2,700	360	11	23	34
	Draper	400	360	2	3	3
1.2	**Abasand Service Area**					
	Abasand	6,000	360	25	50	75
1.3	**Beacon Hill Service Area**					
	Beacon Hill	2,600	360	11	22	33
1.4	**MacKenzie Service Area**					
	MacKenzie/Gregoire/Prairie Creek	15,400	360	64	128	193
	Saline Creek Plateau	20,000	360	83	167	250
	Gateway/Quarry Ridge	7,500	360	31	63	94
	Southlands Industrial Area 4	4,500	360	19	38	56
1.5	**Southeast Industrial Service Area**					
	Airport and Airport West	8,550	360	36	71	107
	Airport East and Lynton	6,200	360	26	52	78
	Saprae Creek/Spruce Valley	5,000	360	21	42	63
	Southlands Industrial Area 2	6,800	360	28	57	85
1.6	**Anzac Regional Pipeline**					
	Hamlet of Anzac	5,000	360	21	42	63
	Gregiore Lake Estates	303	360	1	3	4
	Gregiore Lake First Nations	990	360	4	8	12
	Total South Service Area	**139,943**		**583**	**1,169**	**1,750**
2.0	**NORTH SERVICE AREA**					
2.1	Timberlea	42,000	360	175	350	525
2.2	Thickwood	19,200	360	80	160	240
2.3	Parson's Creek	26,000	360	108	217	325
2.4	West Growth	31,000	360	129	258	388
2.5	Highway 63 Corridor	7,200	360	30	60	60
2.6	Highway 63 Truckfill	16,200	180	68	68	68
2.7	Fort MacKay/North Transmission Line	20,370	360	85	170	170
2.8	Future North Truckfill	16,200	180	68	68	68
	Total North Service Area	**178,170**		**743**	**1,350**	**1,843**
3.0	**SOUTHWEST SERVICE AREA**					
3.1	Horse River	15,000	360	63	125	188
3.2	Hangingstone	42,000	360	175	350	525
3.3	Southlands Industrial Area 1A	5,200	360	22	43	65
3.4	Southlands Industrial Area 1B	5,900	360	25	49	74
3.5	Southlands Industrial Area 3A	N/A	360	0	0	0
3.6	Southlands Industrial Area 3B	N/A	360	0	0	0
3.7	HWY 881/63	8,800	360	37	73	110
3.8	Hamlet of Anzac (Additional 10,000 people)	10,000	360	42	83	125
	Total Southwest Service Area	**86,900**		**362**	**723**	**1,086**
	TOTAL POPULATION	**405,013**		**1,688**	**3,242**	**4,679**

Appendix B - Water Treatment Plant Pump Curves





AURORA PUMP
A UNIT OF GENERAL SIGNAL
P.O. BOX 1003 • CITY OF INDUSTRY, CA • 91749

Ⓢ = 11,600
Ⓜ = 11,800
Ⓛ = 10,500

4 NUMBER OF STAGES REQUIRED FOR APPLICATION
STANDARD CURVE ILLUSTRATED SINGLE STAGE PERFORMANCE ONLY

PROJECT: Fort McMurray Water Treatment
MECHANICAL ENGINEER: Stanley Associates Ltd.
MECHANICAL CONTRACTOR: Comstock International Ltd. REF: #4120702-18
SUPPLIER: WilRon Equipment Ltd. REF: U35590
ITEM: H.L.P. 2, 3 Vertical turbine pump units 11.5 ML/d (2110 USgpm) @ 98m(321.5')TDH (133 4/3)
ELECTRICAL DATA: 186.5 KW (250 hp) 1800 rpm, 4160/3/60, WP), 1.15 S.F. (5008P)

CERTIFIED FOR CONSTRUCTION BY: [signature]
DATE: May 2nd, 1986

Report - High Lift Pumps 1 & 2 (existing)

Pump Data Sheet - Layne/Verti-Line

Company: National Process Equipment
Name: Associated Engineering
Date: 11/5/2009

Fort Mac WTP High Lift Pumps – New North Service Area pumps

Layne/Verti-Line
Pentair Water

Pump:

Size: 17EM (5 stage)
Type: Vertical Turbine
Synch speed: 1800 rpm
Speed: 1770 rpm
Dia: 262.5 mm
Curve:
Impeller:
Specific Speeds:
nq: —
S: —
Dimensions:
Suction: 350 mm
Discharge: 350 mm
Vertical Turbine:
Bowl size: 430 mm
Max lateral: — mm
Thrust K factor: 31.4 kg/m

Pump Limits:

Temperature: 66 °C
Pressure: 3172 kPa g
Sphere size: 35.1 mm
Power: — kW
Eye area: 36742 mm²

Search Criteria:

Flow: 220 l/s
Head: 137 m

Fluid:

Water
Density: 997.2 kg/m³
Viscosity: 1.104 cP
Temperature: 15.6 °C
Vapor pressure: 1.773 kPa a
Atm pressure: 101.4 kPa a
NPSHa: — m

Motor:

Standard: IEC
Enclosure: TEFC
Size: 375 kW
Speed: 1800
Frame: 355L
Sizing criteria: Max Power on Design Curve

— Data Point —

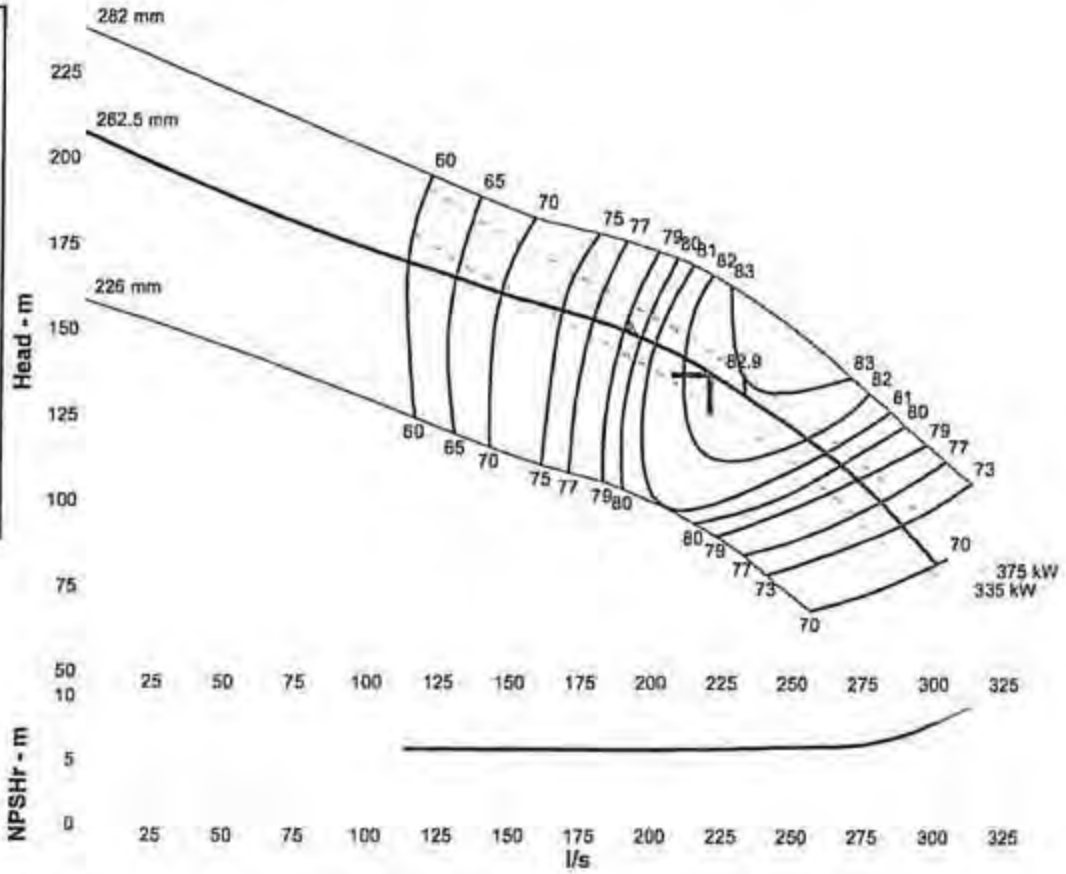
Flow:	220 l/s
Head:	137 m
Eff:	82.4%
Power:	359 kW
NPSHr:	5.99 m

— Design Curve —

Shutoff head:	208 m
Shutoff dP:	2030 kPa
Min flow:	— l/s
BEP:	82.9% @ 232 l/s
NOL power:	362 kW @ 266 l/s

— Max Curve —

Max power: 443 kW @ 313 l/s



Performance Evaluation:

Flow l/s	Speed rpm	Head m	Efficiency %	Power kW	NPSHr m
264	1770	113	80.4	362	6.24
220	1770	137	82.4	359	5.99
176	1770	154	76.6	346	5.94
132	1770	165	65.6	325	5.94
88	1770	—	—	—	—

Selected from catalog: Layne-Vertiline.60 Vers: 1

Pump Data Sheet - Layne/Verti-Line

Company: National Process Equipment
Name: Associated Engineering
Date: 7/15/2009

Layne/Verti-Line
Pentair Water

WTP - Future North + Southwest Service Area Pumps

Pump:

Size: 27EM (5 stage)
Type: Vertical Turbine
Synch speed: 1200 rpm
Speed: 1170 rpm
Dia: 420 mm
Curve:
Impeller:
Specific Speeds:
ns: —
S: —
Dimensions:
Suction: 714 mm
Discharge: 500 mm
Vertical Turbine:
Bowl size: 676 mm
Max lateral: — mm
Thrust K factor: 72.4 kg/m

Search Criteria:

Flow: 600 l/s
Head: 150 m

Fluid:

Water
Density: 997.2 kg/m³
Viscosity: 1.104 cP
Temperature: 15.6 °C
Vapor pressure: 1.773 kPa a
Atm pressure: 101.4 kPa a
NPSHa: — m

Motor:

Standard: IEC
Enclosure: TEFC
— kW
Speed: —
Frame: —
Sizing criteria: Max Power on Design Curve

Pump Limits:

Temperature: 66 °C
Pressure: 2600 kPa g
Sphere size: 69.8 mm
Power: — kW
Eye area: 89909.9 mm²

— Data Point —

Flow:	600 l/s
Head:	150 m
Eff:	84.6%
Power:	1039 kW
NPSHr:	5.68 m

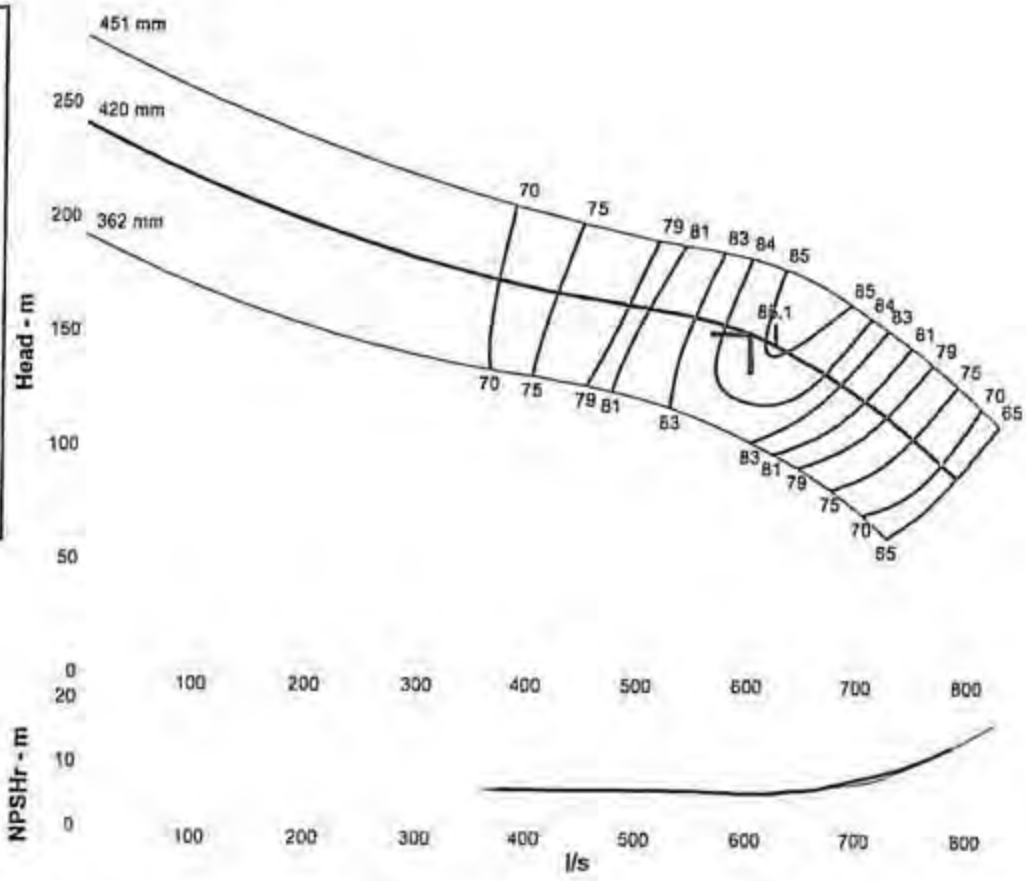
— Design Curve —

Shutoff head:	241 m
Shutoff dP:	2358 kPa
Min flow:	— l/s

BEP: 85.1% @ 623 l/s
NOL power:
1043 kW @ 787 l/s

— Max Curve —

Max power:
1376 kW @ 827 l/s



Performance Evaluation:

Flow l/s	Speed rpm	Head m	Efficiency %	Power kW	NPSHr m
720	1170	116	79.5	1029	8.59
600	1170	150	84.6	1039	5.68
480	1170	163	78.4	978	6.01
360	1170	175	69	893	6
240	1170	—	—	—	—

Selected from catalog: Layne-Vertiline.60 Vers: 1

Appendix C - King Street Booster Station Pump Curves

Section 1440

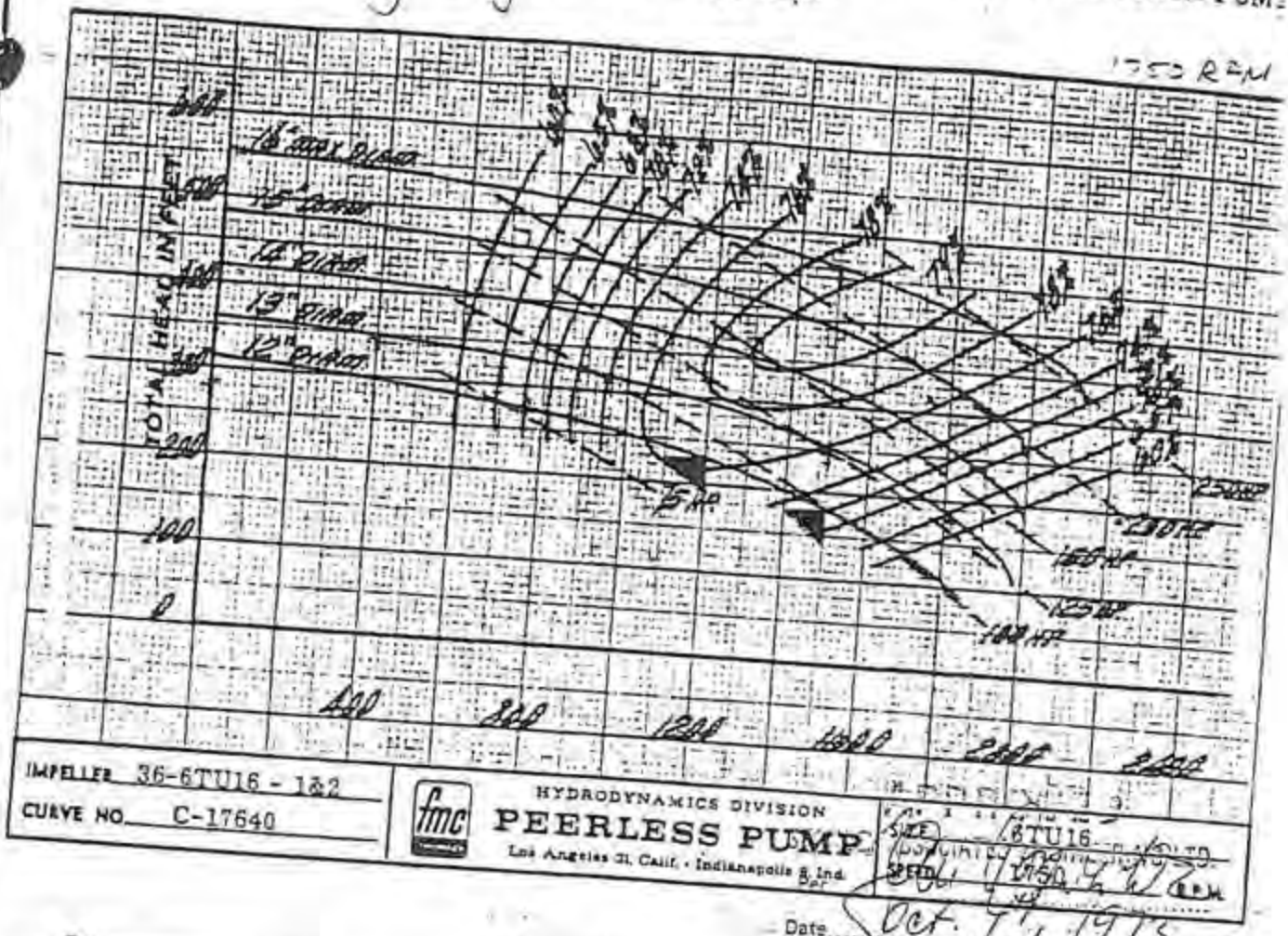
AREA 2 BOOSTER PUMP

Beacon Hill —

Existing King Street Booster

HORIZONTAL MULTI-STAGE PUMP

1750 R.P.M.



IMPELLER 36-6TU16 - 1&2

CURVE NO. C-17640

fmc

HYDRODYNAMICS DIVISION

PEERLESS PUMP

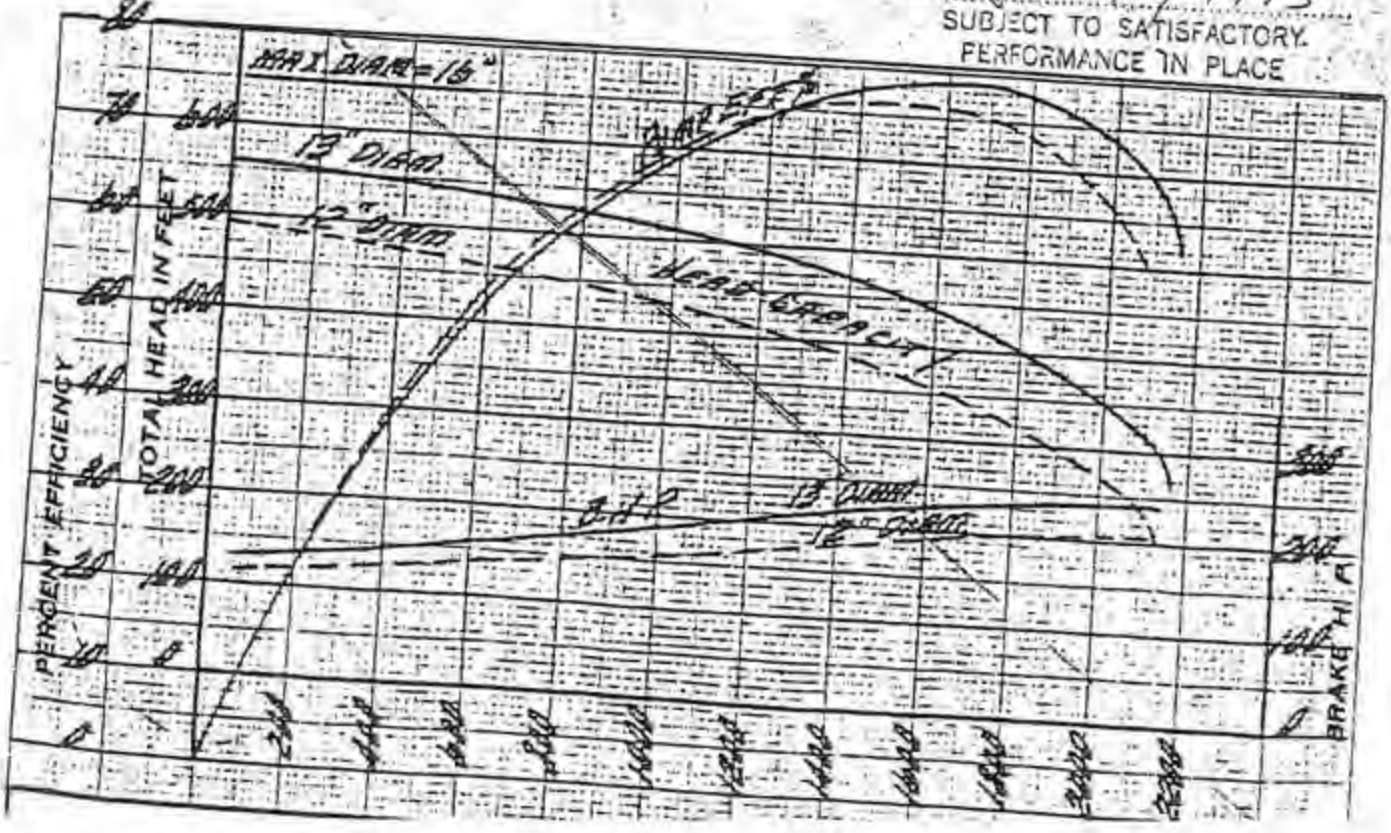
Los Angeles 31, Calif. • Indianapolis 8, Ind.

SIZE 36TU16 STG.

SPEED 1750 R.P.M.

Date Oct. 7, 1953

SUBJECT TO SATISFACTORY PERFORMANCE IN PLACE



Appendix D - Mills Avenue Booster Station Pump Curves

New King Street Booster Pumps

Pump Data Sheet - AURORA PUMPS

Company: National Process Equipment
Name: Regional Municipality of Wood Buffalo
Date: 8/5/2009

King Street Booster Pumps
P-101, P-102, P-103, P-104

AURORA
Pentair Water

Pump:

Size: 8x10x21

Type: 410 1 STG SPLIT CASE
Synch speed: 1800 rpm

Speed: 1775 rpm
Dia: 19.4375 in

Curve: 2PC-140831B

Impeller: 444A279

Specific Speeds:

Ns: 1049
Nss: 8404.76

Dimensions:

Suction: 10 in
Discharge: 8 in

Pump Limits:

Temperature: 275 °F
Pressure: 250 psi g
Sphere size: 1 in

Power: — hp
Eye area: — in²

Search Criteria:

Flow: 3170 US gpm
Head: 325 ft

Fluid:

Water
Density: 62.25 lb/ft³
Viscosity: 1.105 cP

Temperature: 60 °F
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: — ft

Motor:

Standard: NEMA
Enclosure: ODP

Size: 350 hp
Speed: 1800
Frame: 449T

Sizing criteria: Max Power on Design Curve

— Data Point —

Flow: (200%)	3170 US gpm
Head:	327 ft
Eff:	80%
Power:	324 hp
NPSHr:	25.1 ft

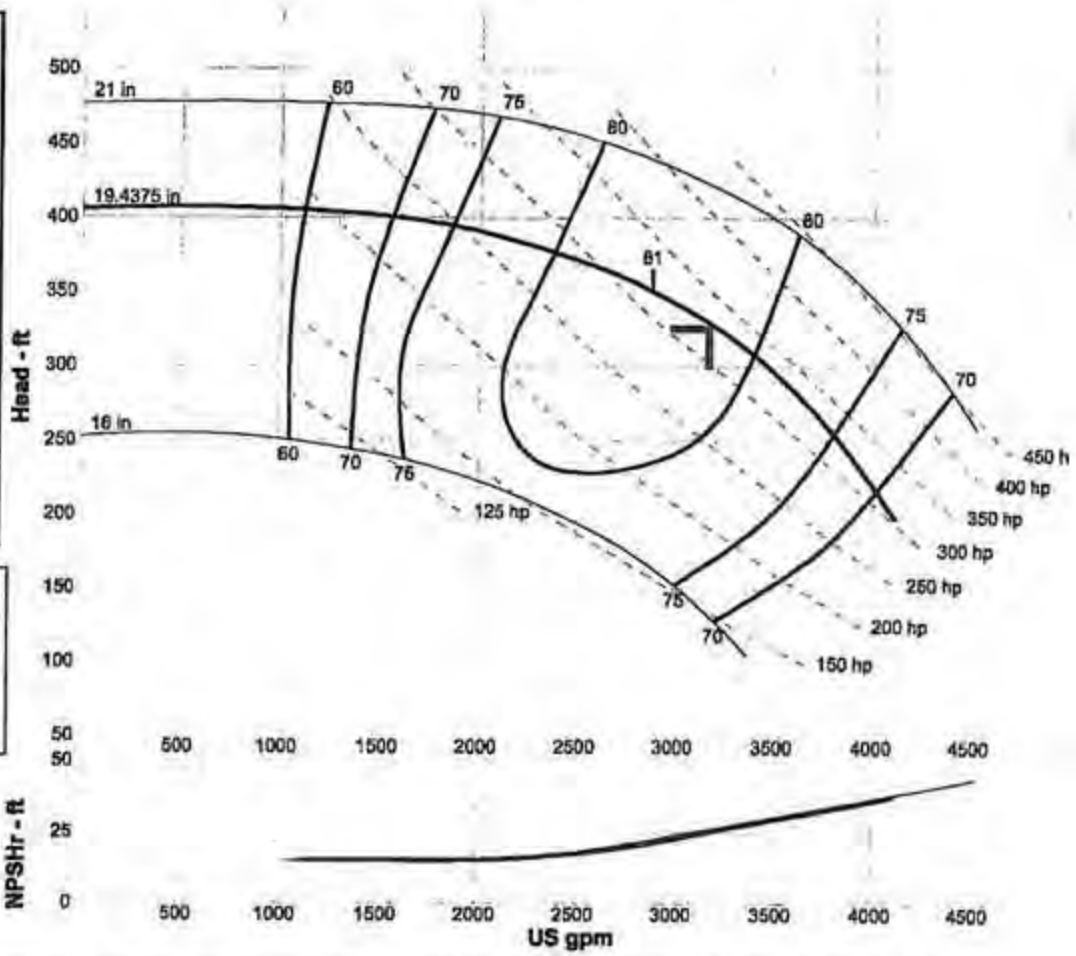
— Design Curve —

Shutoff head:	405 ft
Shutoff dP:	175 psi
Min flow:	— US gpm
BEP:	81% @ 2880 US gpm

NOL power:
330 hp @ 3395 US gpm

— Max Curve —

Max power:
455 hp @ 4141 US gpm



Doc 4
Pump datasheet and curve
Schendel Mechanical
PO# 44885
Nov. 16, 2009

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
3804	1775	253	75	325	33.5
3170	1775	327	80	324	25.1
2538	1775	388	80	283	18.3
1902	1775	393	75	250	15.2
1268	1775	404	63	203	15

Selected from catalog: Aurora Pumps 60 Hz Vers: 3.4

Appendix E - Beacon Hill Pump Curves

New Beacon Hill Duty pumps

Performance
1800 RPM Performance Curves

OPERATING POINT PROJECTED TO ONE STAGE PERFORMANCE

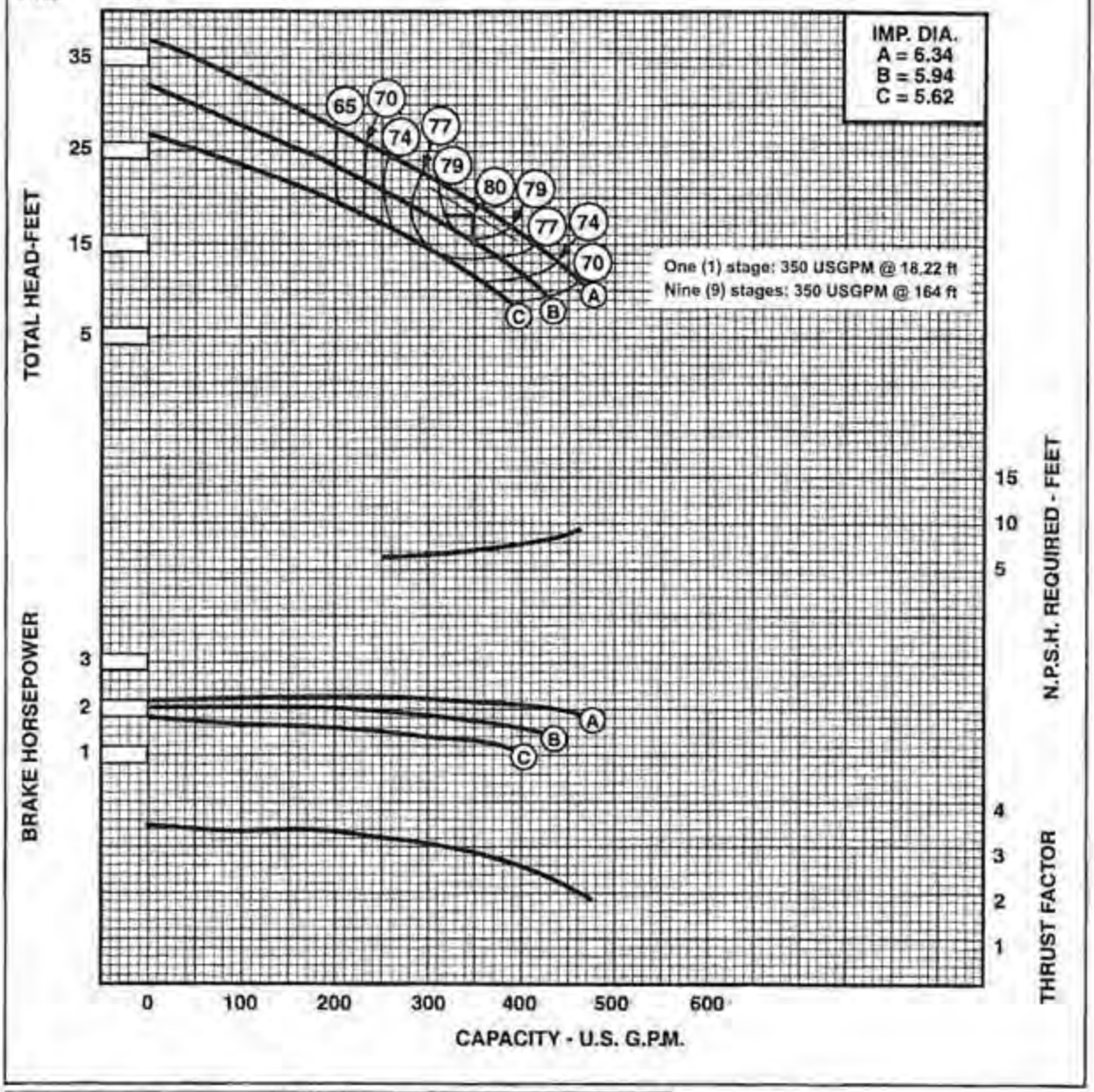
Layne/Verti-Line
Pentair Water

No. Stages	Eff. Change	MATERIAL	Eff. Change
1	-3	IMP.– C.I.	-1
2	-2	IMP.– NI-RI	-1
3	-1	BOWL– BRZ.	-1
4	0	BOWL– NI-R.	-1

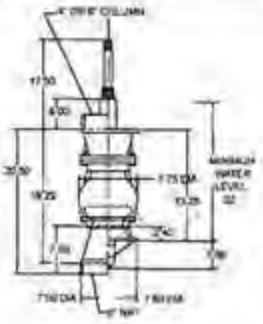
8 TM **1750** R.P.M.

SINGLE STAGE LAB PERFORMANCE WITH STANDARD MATERIALS. EFFICIENCY SHOWN FOR 4 OR MORE STAGES. HORSE POWER SHOWN FOR ONE STAGE BASED ON 4 STAGE EFFICIENCY. CORRECTIONS SHOULD BE MADE FOR STAGES AND MATERIAL.

PUMP PERFORMANCE



Maximum Operating Speed	3600	Maximum Sphere Size – Inches	0.66
Pump Shaft Diameter – Inches	1.188	Thrust Factor - K_t	3.00
Bowl Weight, 1st Stage – Lbs	110	WR^2	0.16
Bowl Weight, Ea. Add. Stage–Lbs	32	Running Position (above seat)-In	0.125
Allowable Shaft Stretch – Inches	0.3	Submergence- Inches	22
Maximum Working Pressure – PSI	350	Max. Bowl Brg Clearance-In Dia	0.009
Maximum Hydro Pressure – PSI	525	Max Wear Ring Clearance-In Dia	0.018
Impeller Eye Area – Sq. In.	12.90	Max Bowl O.D. – Inches	7.75
Rotor Weight 1st/add stages-(K_a)	18.2/6.7	Suct Bell O.D. – Inches	7.50
Add 6.5' per additional stage		Maximum Number of Stages	20
Discharge – Inches	4, 6	Suction - Inches	6



Layne/Verti-Line

Pump Data Sheet - Layne/Verti-Line

Company: National Process Equipment
Name: Regional Municipality of Wood Buffalo
Date: 8/10/2009

Distribution Pumps P-103, P-104

New Beacon Hill Standby pumps

Layne/Verti-Line
Pentair Water

Pump:

Size: 12TLC (4 stage)
Type: Vertical Turbine
Synch speed: 1800 rpm
Speed: 1760 rpm
Dia: 250.5 mm
Curve: Impeller:
Specific Speeds: nq: ---
S: ---
Dimensions: Suction: 250 mm
Discharge: --- mm
Vertical Turbine: Bowl size: 298 mm
Max lateral: --- mm
Thrust K factor: 12.6 kg/m

Search Criteria:

Flow: 105 l/s
Head: 50 m

Fluid:

Water
Density: 997.2 kg/m³
Viscosity: 1.104 cP
Temperature: 15.6 °C
Vapor pressure: 1.773 kPa a
Atm pressure: 101.4 kPa a
NPSHa: — m

Motor:

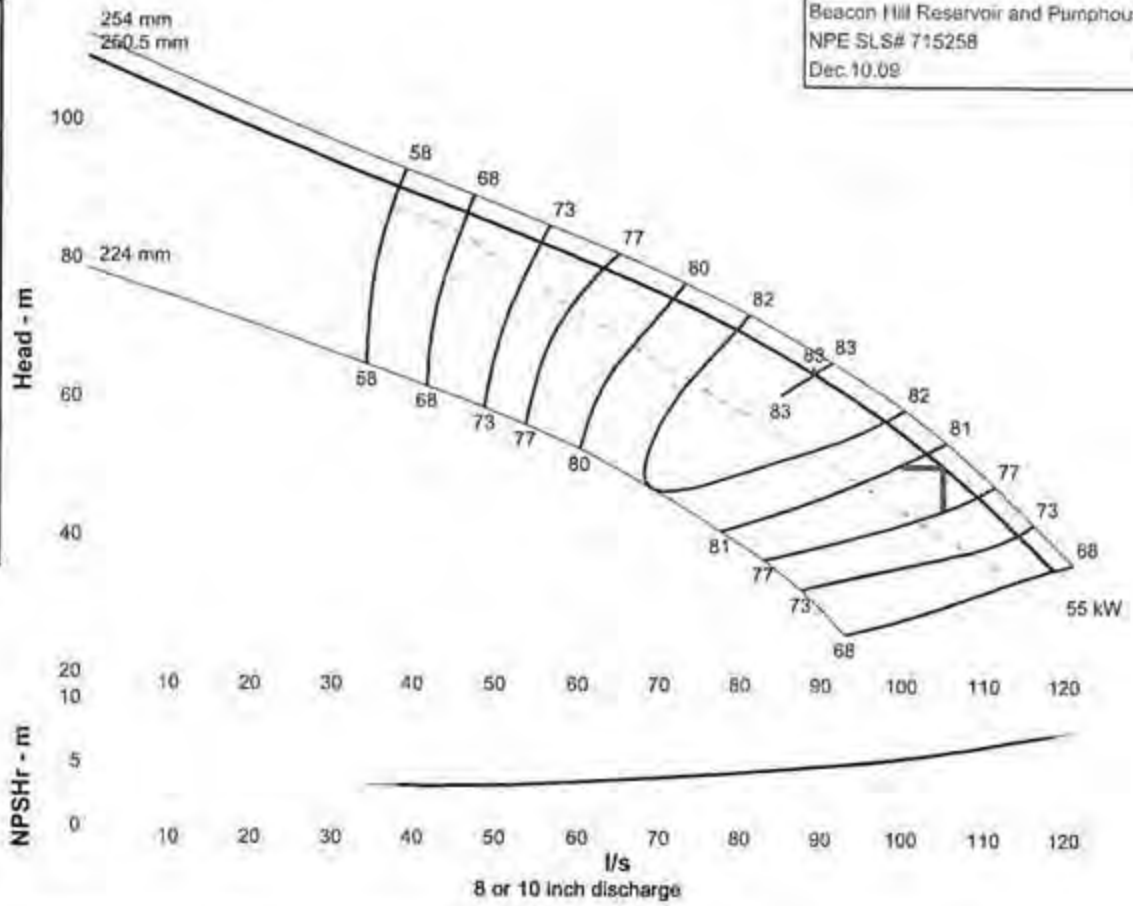
Standard: IEC
Enclosure: TEFC
Size: 75 kW
Speed: 1800
Frame: 250M
Sizing criteria: Max Power on Design Curve

Pump Limits:

Temperature: 66 °C
Pressure: 2828 kPa g
Sphere size: 28.4 mm
Power: --- kW
Eye area: 18258.1 mm²

Doc 25
Pump Datasheet and curve "B"
Schendel Mechanical Contracting
PO# 44881
Beacon Hill Reservoir and Pumphouse
NPE SLS# 715258
Dec.10.09

---- Data Point ----	
Flow:	105 l/s
Head:	50.1 m
Eff:	79.7%
Power:	64.5 kW
NPSHr:	5.89 m
— Design Curve —	
Shutoff head:	109 m
Shutoff dP:	1067 kPa
Min flow:	— l/s
BEP:	83% @ 89 l/s
NOL power:	66.7 kW @ 89 l/s
-- Max Curve --	
Max power:	70.2 kW @ 91.2 l/s



Performance Evaluation:

Flow l/s	Speed rpm	Head m	Efficiency %	Power kW	NPSHr m
126	1760	---	---	---	---
105	1760	50.1	79.7	64.5	5.89
84	1760	66.9	82.5	66.5	4.5
63	1760	78.6	77	63	3.59
42	1760	88.5	62.7	57.9	3.2

Selected from catalog: Layne-Vertiline.60 Vers: 1

Appendix F - MacKenzie Industrial Pump Curves

MacKenzie P101 & P102 - 250 h/s

Company: National Process Equipment
Name: MacKenzie Ind. Park P101 P102
Date: 9/27/2006

Layne/VertiLine
Pentair Water

Pump
Size: 150M (2 stage)
Type: Vertical Turbine
Synch speed: 1800 rpm
Curve:
Specific Speed:
Dimensions:
Vertical Turbine

Speed: 1770 rpm
Dia: 12.625 in
Impeller:
Ns: —
Nss: —
Suction: — in
Discharge: 12 in
Bowl size: 16.25 in
Max lateral: — in
Thrust K factor: 22 lb/ft

Duty Point
Flow: 3960 US gpm
Head: 159 ft

Fluid
Water
Density: 62.26 lb/ft³
Viscosity: 1.105 cP
NPSHr: — ft
Temperature: 80 °F
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

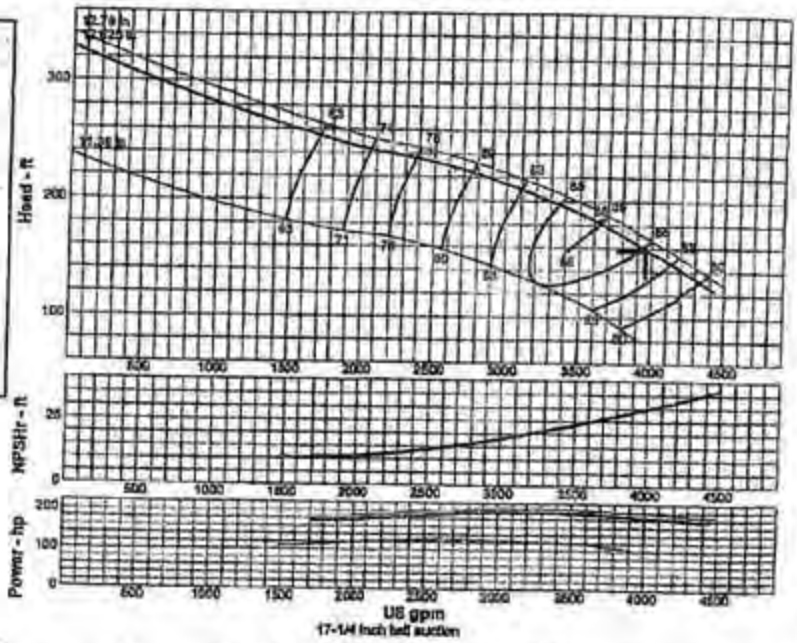
Motor
Standard: NEMA
Enclosure: TEFC
Size: 200 hp
Speed: 1800
Frame: 447T
Sizing criteria: Use Power on Design Curve

Pump Limits
Temperature: 150 °F
Pressure: 300 psi g
Sphere size: 1.42 in

Power: — hp
Eye area: 61.2 in²

Duty Point
Flow: 3960 US gpm
Head: 159 ft
Eff: 84.8%
Power: 188 hp
NPSHr: 29.4 ft

Design Curve
Shutoff head: 220 ft
Shutoff dP: 143 psi
Min flow: — US gpm
BEP: 86% @ 3647 US gpm
NOL power:
198 hp @ 3102 US gpm
Max power:
207 hp @ 3135 US gpm



Performance Schedule

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
4752	1770	—	—	—	—
3960	1770	159	84.8	188	29.4
3168	1770	207	83.5	198	16.9
2376	1770	236	75.9	187	13.2
1584	1770	260	60.3	173	10.9

Selected from catalog: Layne-VertiMax 60 Vers: 1

+ Future P105

MacKenzie P103 & P104 - 125 %s

Company: National Process Equipment
Name: MacKenzie Int. Park P103 P104
Date: 9/27/2006

Powered By PUMP-FLO

Pump

Size: 12THC3+ (3 stage)
Type: VERT. TURBINE
Synch speed: 1800 rpm
Curve: 16-136
Specific Speeds:
Dimensions:
Vertical Turbine:

Speed: 1770 rpm
Dia: 8.625 in
Impeller:
No: —
Max: —
Suction: 10 in
Discharge: 8 in
Bowl size: 11.75 in
Max lateral: 0.5 in
Thrust K factor: 8 lbf/ft

Power: 344 hp
Eye area: — in²

Design Criteria

Flow: 1900 US gpm
Head: 150 ft

Fluid

Water
Density: 62.25 lb/ft³
Viscosity: 1.105 cP
NPSHa: — ft

Temperature: 80 °F
Vapor pressure: 0.5563 psi a
Atm pressure: 14.7 psi a

Motor

Standard: NEMA
Enclosure: TEFC
Size: 400 hp
Speed: 1800
Frame: 405T

Sizing criteria: Max Power on Design Curve

Finish Diam. 1

Temperature: 150 °F
Pressure: 410 psi g
Sphere size: 1.00 in

Duty Point

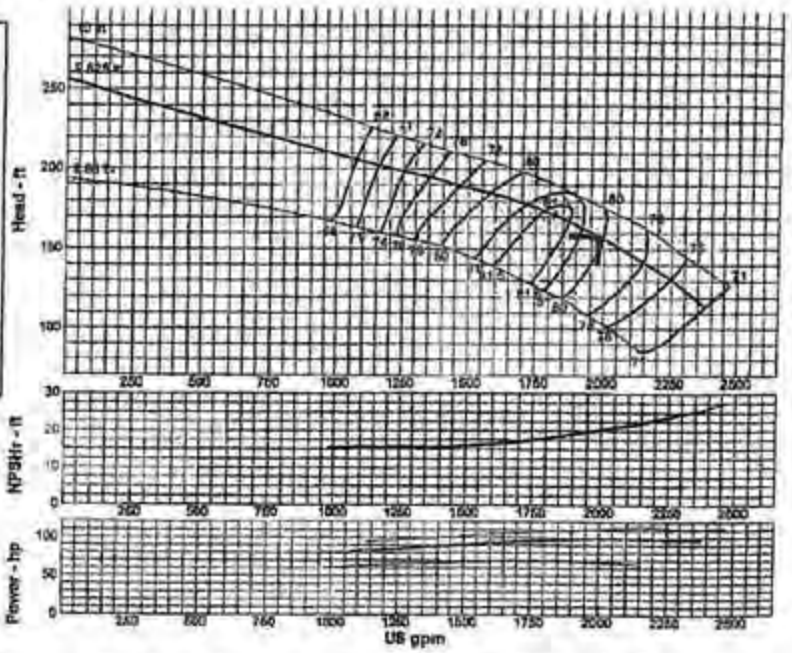
Flow: 1 US gpm
Head: — ft
Eff: — %
Power: — hp
NPSHr: — ft

Design Curve

Shutoff head: 255 ft
Shutoff dP: 111 psi
Min flow: — US gpm
BEP: 81.6% @ 1824 US gpm
NOL power:
98.8 hp @ 1848 US gpm

Max Curve

Max power:
114 hp @ 2155 US gpm



Performance Evaluation

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
2375	1770	115	71.2	96.7	25.4
1880	1770	158	80.2	98.8	20.1
1584	1770	185	80	92.5	16.5
1186	1770	201	71.8	85.9	15.5
792	1770	—	—	—	—

Layne-Verti-Line 8

Selected from catalog: Layne VertLine 60 Vers.: 1

Appendix G - Southeast Regional Pump Curves

PUMP DATA SHEET LAYNE / VERTI-LINE, 60 Hz

Company: National Process Equipment
Name: PWP-1401 & PWP-1402
Date: 09/06/06

To Southeast Regional System (Anzac) - 20 l/s pumps

Powered By PUMP-FLO

Pump:

Size: 10RKLC.4+ (11 stages)

Type: VERT.TURBINE
Synch speed: 1800 rpm

Speed: 1760 rpm
Dia: 190 mm

Curve: 18-061

Impeller:

Specific Speeds:

nq: —
S: —

Dimensions:

Suction: — mm
Discharge: — mm

Vertical Turbine:

Bowl size: 245 mm
Max lateral: 23.4 mm
Thrust K factor: 5.06 kg/m

Search Criteria:

Flow: 20 l/s

Head: 133 m

Fluid:

Water
SG: 1
Viscosity: 1.104 cP

Temperature: 15.6 °C
Vapor pressure: 1.773 kPa a
Atm pressure: 101.4 kPa a

NPSHa: — m

Motor:

Standard: IEC
Enclosure: TEFC

Size: 37 kW
Speed: 1800
Frame: 225S

Sizing criteria: Max Power on Design Curve

Pump Limits:

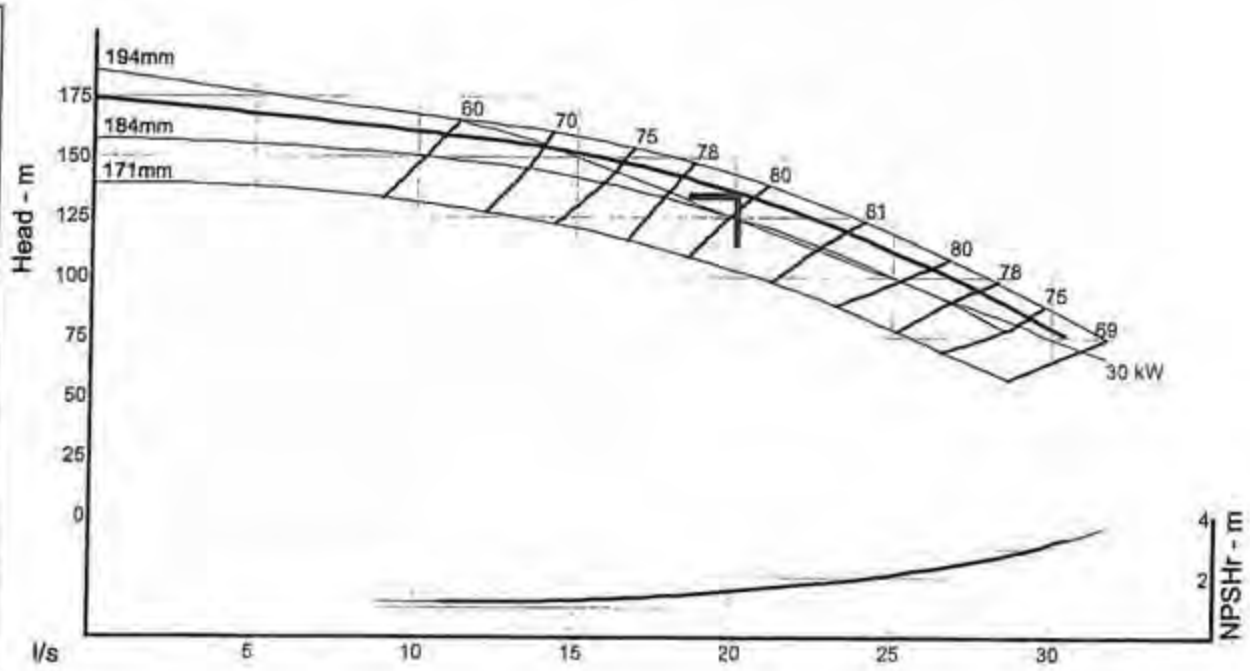
Temperature: 66 °C
Pressure: 3655 kPa g
Sphere size: 11.9 mm

Power: 211 kW
Eye area: — mm²

— Data Point —
Flow: 20 l/s
Head: 134 m
Eff: 79.6%
Power: 32.9 kW
NPSHr: 1.57 m

Design Curve –
Shutoff Head: 173 m
Shutoff dP: 1693 kPa
Min Flow: --- l/s
BEP: 81% eff
@ 23.4 l/s
NOL Pwr: 33.4 kW
@ 23.4 l/s

– Max Curve –
Max Pwr: 35.4 kW
@ 24 l/s



Performance Evaluation:

Flow l/s	Speed rpm	Head m	Pump %eff	Power kW	NPSHr m
24	1760	115	80.8	33.3	1.99
20	1760	134	79.6	32.9	1.57
16	1760	148	74.3	31	1.3
12	1760	156	63.8	28.6	1.22
8	1760	162	50.7	26.2	1.22

PENTAIR

Encompass 2.0 - 13.1.0.9

Pump Performance Datasheet

Customer	:	Quote number	: 233066
Customer reference	:	Size	: 10EM-SS
Item number	: 006	Stages	: 5
Service	:	Based on curve number	: 10_TURB_2260_1800_SS
Quantity	: 1	Date last saved	: 24 Oct 2013 9:24 AM

Operating Conditions

Flow, rated	: 35.00 l/s
Differential head / pressure, rated (requested)	: 61.56 m
Differential head / pressure, rated (actual)	: 61.82 m
Suction pressure, rated / max	: 0.00 / 0.00 bar.g
NPSH available, rated	: Ample
Frequency	: 60 Hz

Performance

Speed, rated	: 1,775 rpm
Impeller diameter, rated	: 174 mm
Impeller diameter, maximum	: 179 mm
Impeller diameter, minimum	: 152 mm
Efficiency (bowl / pump)	: 80.85 / - %
NPSH required / margin required	: 3.77 / 0.00 m
nq (imp. eye flow) / S (imp. eye flow)	: 42 / 125 Metric units
Minimum Continuous Stable Flow	: 19.05 l/s
Head, maximum, rated diameter	: 87.46 m
Head rise to shutoff	: 42.08 %
Flow, best eff. point (BEP)	: 30.55 l/s
Flow ratio (rated / BEP)	: 114.58 %
Diameter ratio (rated / max)	: 97.17 %
Head ratio (rated dia / max dia)	: 90.20 %
Cq/Ch/Ce [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 mm
Solids concentration, by volume	: 0.00 %
Temperature, max	: 20.00 deg C
Fluid density, rated / max	: 0.998 / 0.998 kg/dm3
Viscosity, rated	: 1.00 cSt
Vapor pressure, rated	: 0.02 bar.a

Material

Material selected	: Cast Iron / Stainless Steel

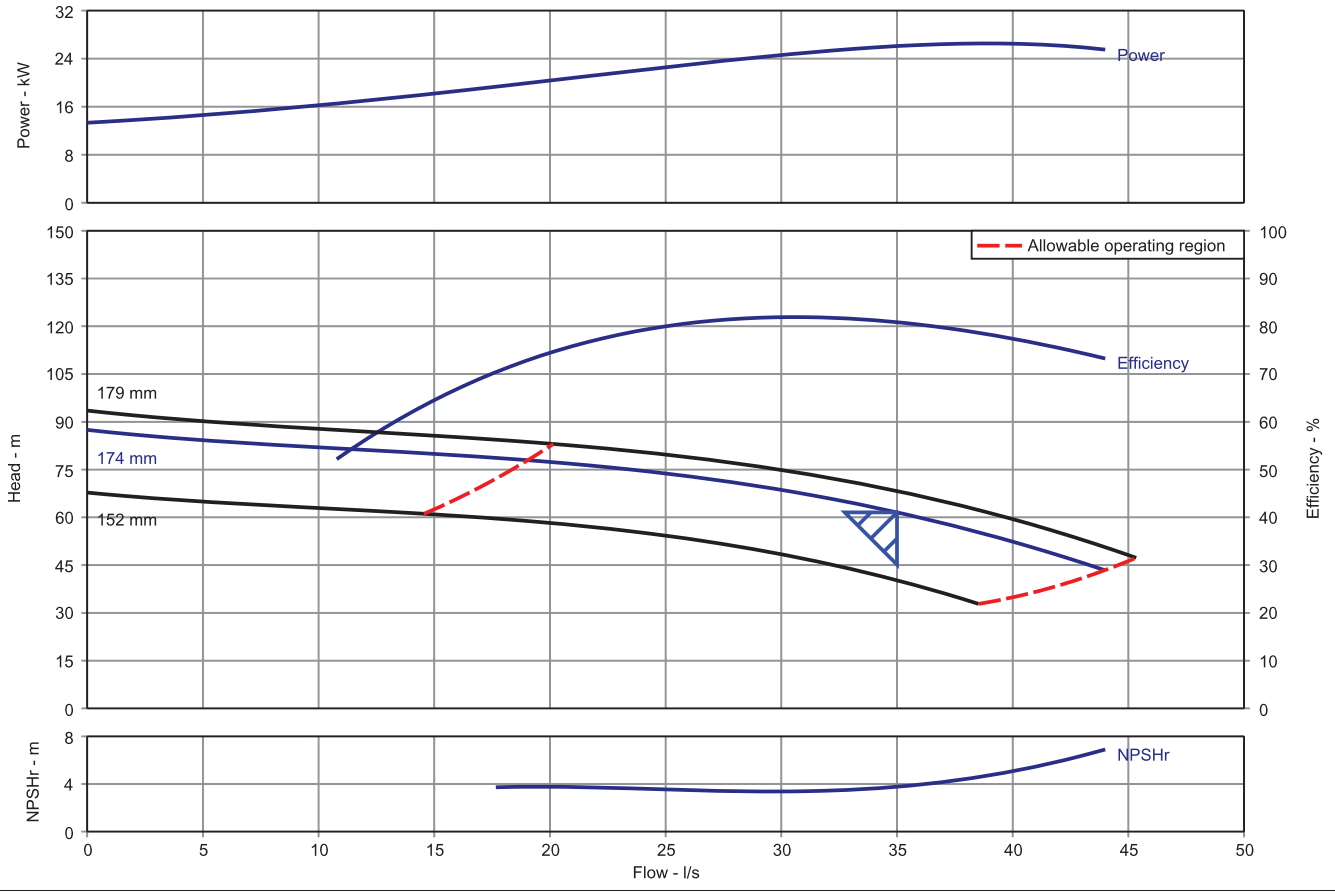
Pressure Data

Maximum working pressure	: See the Additional Data page
Maximum allowable working pressure	: See the Additional Data page
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: See the Additional Data page

Driver & Power Data

Driver sizing specification	: Maximum power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 21.09 kW
Power (bowl / pump)	: 26.08 / -
Power, maximum, rated diameter	: 26.53 kW
Minimum recommended motor rating	: 29.83 kW / 40.00 hp

Pump performance. Adjusted for construction, viscosity, static lift to discharge nozzle centerline, friction and power losses of lineshaft and thrust bearings.
The duty point represents the head at the bowl.



NOTE: The spec does not call for certified performance tests, but only for hydrostatic tests. Thus we cannot guarantee performance characteristics such as min efficiency, rated TDH and flow. Please check HI standard 14.6-2011 for hydraulic performance acceptance tests. A summary is provided in the last pages of this submittal

PENTAIR

Encompass 2.0 - 13.1.0.9

Pump Performance Datasheet

Customer	:	Quote number	: 233066
Customer reference	:	Size	: 15EH-BRZ
Item number	: 006	Stages	: 3
Service	:	Based on curve number	: 15_TURB_3010_1800_BR
Quantity	: 1	Date last saved	: 24 Oct 2013 9:27 AM

Operating Conditions

Flow, rated	: 178.0 l/s
Differential head / pressure, rated (requested)	: 61.46 m
Differential head / pressure, rated (actual)	: 61.48 m
Suction pressure, rated / max	: 0.00 / 0.00 bar.g
NPSH available, rated	: Ample
Frequency	: 60 Hz

Performance

Speed, rated	: 1,770 rpm
Impeller diameter, rated	: 220 mm
Impeller diameter, maximum	: 251 mm
Impeller diameter, minimum	: 203 mm
Efficiency (bowl / pump)	: 80.37 / - %
NPSH required / margin required	: 6.70 / 0.00 m
nq (imp. eye flow) / S (imp. eye flow)	: 68 / 184 Metric units
Minimum Continuous Stable Flow	: 110.3 l/s
Head, maximum, rated diameter	: 86.87 m
Head rise to shutoff	: 41.35 %
Flow, best eff. point (BEP)	: 187.1 l/s
Flow ratio (rated / BEP)	: 95.14 %
Diameter ratio (rated / max)	: 87.47 %
Head ratio (rated dia / max dia)	: 70.85 %
Cq/Ch/Ce [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 mm
Solids concentration, by volume	: 0.00 %
Temperature, max	: 20.00 deg C
Fluid density, rated / max	: 0.998 / 0.998 kg/dm3
Viscosity, rated	: 1.00 cSt
Vapor pressure, rated	: 0.02 bar.a

Material

Material selected	: Cast Iron / Bronze

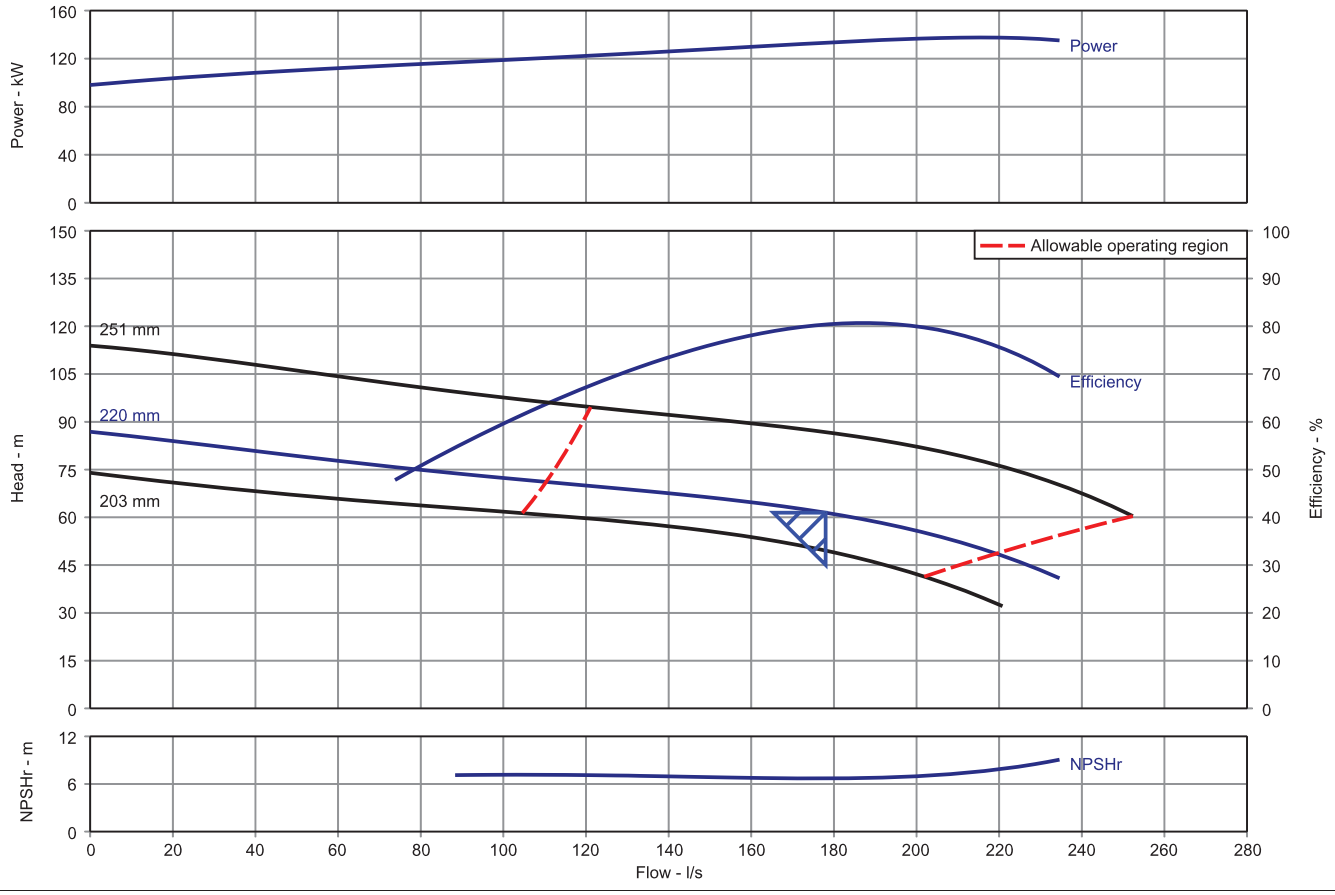
Pressure Data

Maximum working pressure	: See the Additional Data page
Maximum allowable working pressure	: See the Additional Data page
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: See the Additional Data page

Driver & Power Data

Driver sizing specification	: Maximum power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 107 kW
Power (bowl / pump)	: 133 / -
Power, maximum, rated diameter	: 138 kW
Minimum recommended motor rating	: 149 kW / 200 hp

Pump performance. Adjusted for construction, viscosity, static lift to discharge nozzle centerline, friction and power losses of lineshaft and thrust bearings.
The duty point represents the head at the bowl.



NOTE: The spec does not call for certified performance tests, but only for hydrostatic tests. Thus we cannot guarantee performance characteristics such as min efficiency, rated TDH and flow. Please check HI standard 14.6-2011 for hydraulic performance acceptance tests. A summary is provided in the last pages of this submittal

National Process Equipment Inc. · · ,
phone: · fax:

Appendix H - Thickwood Pump Curves

National Process Equipment
RMWB-Thickwood heights
Dist Pumps - ~~P103 & P104~~ P1, P2

PUMP DATA SHEET
LAYNE / VERTI-LINE, 60 Hz

03/24/05

Selection list: —

Search Criteria:
'ow: 200 l/s
ead: 59.1 m
Tolerance: — % of head

Fluid: Water
Temperature: 15.6 °C
SG: 1
Viscosity: 1.104 cP
Vapor pressure: 1.773 kPa a
Atm pressure: 101.4 kPa a

NPSHa: — m

Advanced Criteria:
Preferred Operating Area: —
Secondary Operating Point: —
Max temperature: — °C
Max suction pressure: — kPa g
Max sphere size: — mm
Max power: — kW
Max suction specific speed: — (S)
Min trim: — % of max diameter
Min head rise: — % to shutoff

Curve Corrections: none

Catalog: Layne Vertiline 60 vers .1

Pump: 16GM.2+ (3 stages)
Type: VERT.TURBINE
Synch speed: 1800 rpm
Speed: 1770 rpm
Dia: 289 mm
Curve no.: 18-177

Specific Speeds
nq: — S: —

Dimensions:
Suction: — mm Discharge: — mm

Vertical Turbine:
Bowl size: 413 mm
Max lateral: 11.2 mm
Thrust K factor: 32.7 kg/m

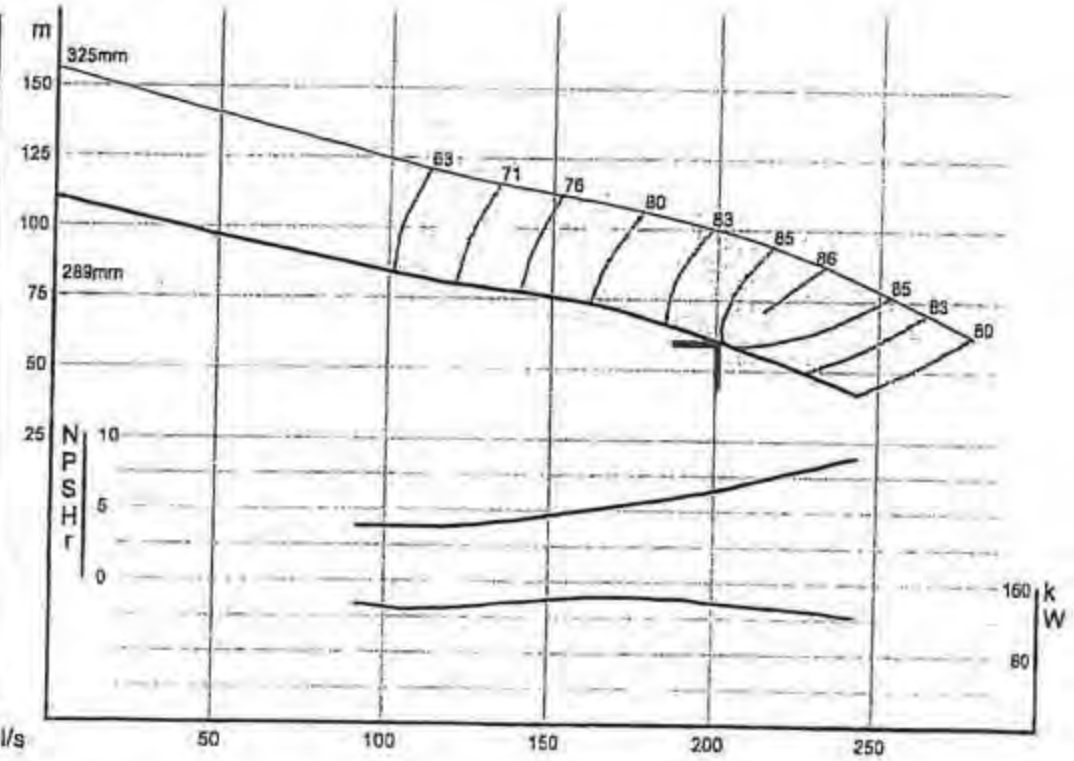
Pump Limits:
Temperature: 66 °C
Pressure: 2069 kPa g
Sphere size: 36.1 mm
Power: 582 kW

Motor: 150 kW
Speed: 1800
Frame: 315M
Standard: IEC
Enclosure: TEFC
Sizing criteria: Max Power on Design Curve

— Data Point —
Flow: 200 l/s
Head: 59.8 m
Eff: 84.7%
Power: 138 kW
NPSHr: 6.51 m

– Design Curve –
Shutoff Head: 110 m
Shutoff dP: 1072 kPa
Min Flow: — l/s
BEP: 85% eff
@ 203 l/s
NOL Pwr: 143 kW
@ 161 l/s

– Max Curve –
Max Pwr: 232 kW
@ 216 l/s



H2Optimize vers 7.1a

National Process Equipment
RMWB-Thickwood heights
Dist Pumps ~~P101 & P102~~

PUMP DATA SHEET

LAYNE / VERTI-LINE, 60 Hz

03/24/05

Selection list: — P3, P4

Search Criteria:
Flow: 100 l/s
Head: 59.1 m
Tolerance: — % of head

Fluid: Water
Temperature: 15.6 °C
SG: 1
Viscosity: 1.104 cP
Vapor pressure: 1.773 kPa a
Atm pressure: 101.4 kPa a

NPSHa: — m

Advanced Criteria:
Preferred Operating Area: —
Secondary Operating Point: —
Max temperature: — °C
Max suction pressure: — kPa g
Max sphere size: — mm
Max power: — kW
Max suction specific speed: — (S)
Min trim: — % of max diameter
Min head rise: — % to shutoff

Curve Corrections: none

Catalog: Layne Vertiline 60 vers .1

Pump: 12TLC.3+ (4 stages)
Type: VERT.TURBINE
Synch speed: 1800 rpm
Speed: 1760 rpm
Dia: 254 mm
Curve no.: 18-126

Specific Speeds
nq: — S: —

Dimensions:
Suction: — mm Discharge: — mm

Vertical Turbine:
Bowl size: 298 mm
Max lateral: 12.7 mm
Thrust K factor: 12.6 kg/m

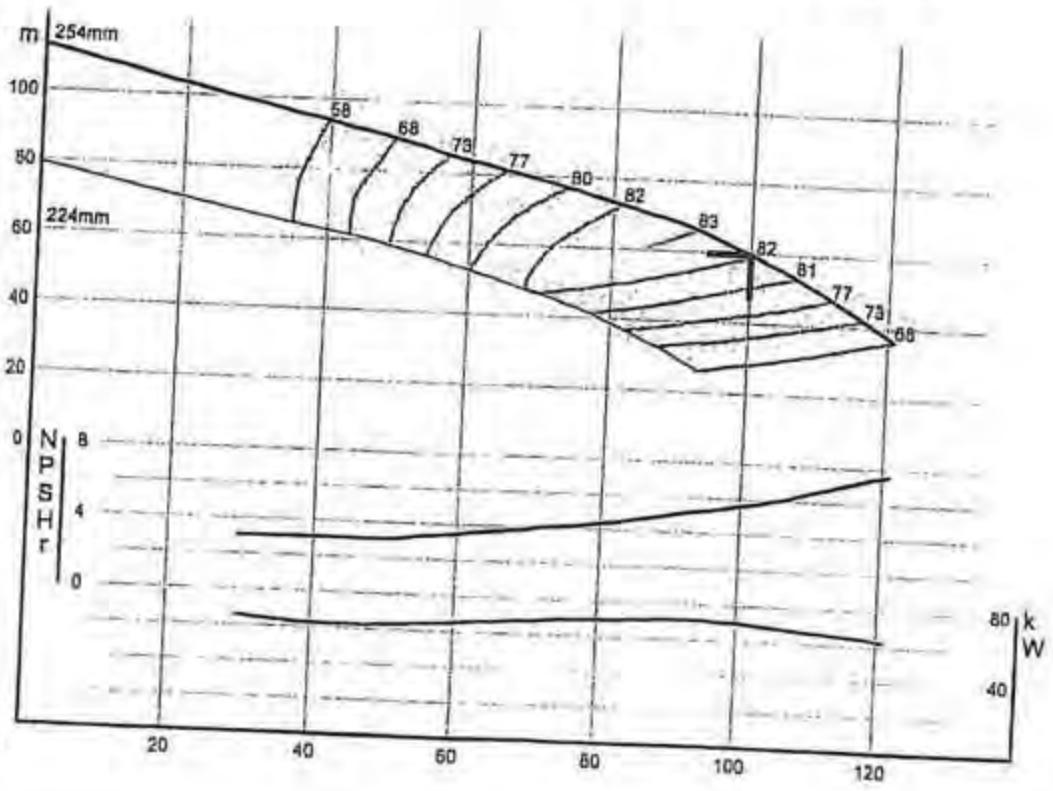
Pump Limits:
Temperature: 66 °C
Pressure: 2828 kPa g
Sphere size: 28.4 mm
Power: 257 kW

Motor: 75 kW
Speed: 1800
Frame: 250M
Standard: IEC
Enclosure: TEFC
Sizing criteria: Max Power on Design Curve

— Data Point —
Flow: 100 l/s
Head: 59 m
Eff: 82.1%
Power: 70.2 kW
NPSHr: 5.57 m

– Design Curve –
Shutoff Head: 112 m
Shutoff dP: 1097 kPa
Min Flow: — l/s
BEP: 83% eff
@ 92.2 l/s
NOL Pwr: 71.2 kW
@ 92.2 l/s

– Max Curve –
Max Pwr: 71.2 kW
@ 92.2 l/s



Optimize vers 7.1a

Appendix I - Timberlea Pump Curves

Pump Data Sheet - Layne/VertiLine

Company: Associated Engineer
Name: Updated Curve 260l/s 58m
Date: 10/1/2008

Layne/VertiLine
Pentair Water

Pump:

Size: 18GM (2 stage)
Type: Vertical Turbine
Synch speed: 1800 rpm
Speed: 1770 rpm
Dia: 331.5 mm
Curve:
Impeller:
Specific Speeds:
ns: —
S: —
Dimensions:
Suction: — mm
Discharge: — mm
Vertical Turbine:
Bowl size: 441 mm
Max lateral: — mm
Thrust K factor: 40.2 kg/m

Pump Limits:

Temperature: 66 °C
Pressure: 2069 kPa g
Sphere size: 41.1 mm
Power: — kW
Eye area: 38064.6 mm²

Search Criteria:

Flow: 260 l/s
Head: 58 m

Fluid:

Water
SG: 1
Viscosity: 1.104 cP
Temperature: 15.6 °C
Vapor pressure: 1.773 kPa a
Atm pressure: 101.4 kPa a
NPSHa: — m

Motor:

Standard: IEC
Enclosure: TEFC
Size: 185 kW
Speed: 1800
Frame: 315L
Sizing criteria: Max Power on Design Curve

Data Point

Flow:	260 l/s
Head:	58.5 m
Eff:	85.9%
Power:	173 kW
NPSHr:	8.62 m

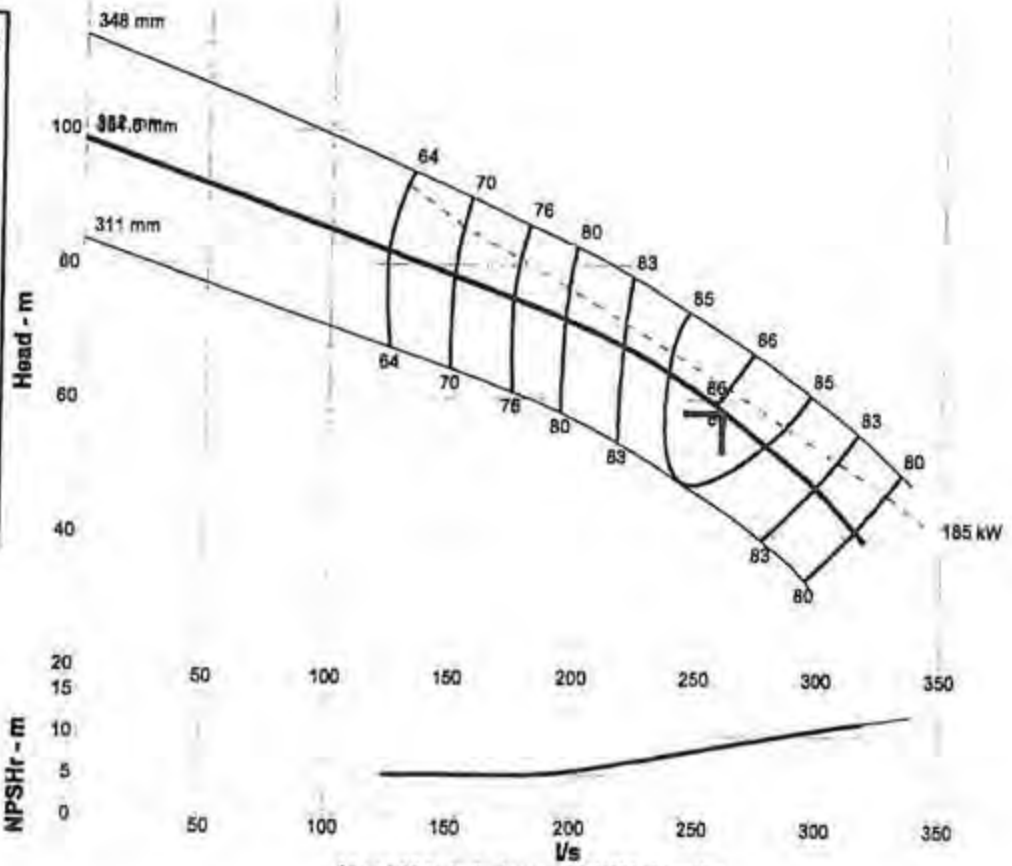
Design Curve

Shutoff head:	95.4 m
Shutoff dP:	962 kPa
Min flow:	— l/s

BEP: 86% @ 258 l/s
NOL power:
176 kW @ 238 l/s

Max Curve

Max power:
208 kW @ 273 l/s



14 and 12 inch discharge, 17-1/4" bell suction

Performance Evaluation:

Flow l/s	Speed rpm	Head m	Efficiency %	Power kW	NPSHr m
312	1770	41.7	80.5	158	11.3
260	1770	58.5	85.9	173	8.62
208	1770	69.8	81.6	174	5.89
156	1770	77.6	71.3	166	5.03
104	1770	—	—	—	—

Selected from catalog: Layne-Vertline.60 Vers: 1

Appendix J - Cost Estimates

TABLE J.1 - SUMMARY OF ESTIMATED COSTS

DESCRIPTION	SHORT TERM (0 - 5 YEARS)	MEDIUM TERM (5-15 YEARS)	LONG TERM (ULTIMATE)
SUPPLY LINES:			
1. South Service Area	80,857,000	45,648,600	0
2. North Service Area	163,457,200	0	44,308,000
3. Southwest Service Area	135,950,000	69,045,000	114,920,000
Subtotal	**380,264,200**	**114,693,600**	**159,228,000**
WATER DISTRIBUTION SYSTEM:			
1. South Service Area			
1.1 Lower Townsite	27,091,100	56,936,200	36,171,100
1.2 Abasand	870,000	3,881,500	0
1.3 Waterways	0	0	19,553,000
1.4 Draper	1,332,000	0	0
1.5 Beacon Hill	5,526,000	10,065,400	0
1.6 Mackenzie/Gregoire	54,661,900	0	0
1.7 Airport Industrial/Southlands	0	0	0
1.8 Saprae Creek/Spruce Valley	0	0	65,265,500
1.9 Gateway/Quarry Ridge	0	15,594,000	0
1.10 Saline Creek	8,436,000	0	0
Subtotal	**97,917,000**	**86,477,100**	**120,989,600**
2. North Service Area			
2.1 Thickwood	27,699,400	21,308,400	26,119,300
2.2 Timberlea	8,640,000	19,322,500	28,438,000
2.3 Parsons Creek	6,906,900	21,580,800	0
2.4 West Growth Area	0	0	46,126,000
Subtotal	**43,246,300**	**62,211,700**	**100,683,300**
3. Southwest Service Area			
3.1 Horse River	1,790,600	6,124,800	12,953,600
3.2 Hangingstone	0	20,528,000	42,640,000
3.3 Southlands Industrial	0	7,104,000	3,633,400
Subtotal	**1,790,600**	**33,756,800**	**59,227,000**
RESERVOIR AND PUMP STATION			
1. South Service Area			
1.1 LTS 4-Way Cmbr/PRV Station	7,450,000	0	0
1.2 Abasand Reservoir Modifications	5,000,000	0	0
1.3 MacKenzie Reservoir Expansion	0	0	46,000,000
1.4 SE Reservoir Expansion	18,000,000	0	22,000,000
1.5 Anzac Booster Station	0	0	2,500,000
Subtotal	**30,450,000**	**0**	**70,500,000**
2. North Service Area			
2.1 West Growth Reservoir /Pumphouse 1&2	0	0	70,000,000
2.2 Hwy 63 Corridor Reservoir /Pumphouse	17,000,000	0	0
2.3 North Corridor Booster Station	8,000,000	0	0
Subtotal	**25,000,000**	**0**	**70,000,000**
3. Southwest Service Area			
3.1 Horse River Reservoir/Pumphouse 1&2	29,000,000	0	18,000,000
3.2 Hangingstone Reservoir/Pumphouse 1&2	0	46,000,000	40,000,000
3.4 Southlands Reservoir/Pumphouse	31,000,000	0	0
3.5 HWY 881/63 Reservoir/Pumphouse	28,000,000	0	0
Subtotal	**88,000,000**	**46,000,000**	**58,000,000**
TOTAL	**666,668,100**	**343,139,200**	**638,627,900**

TABLE J-2
SUPPLY LINES
SOUTH SERVICE AREA

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)	($)	($)
Franklin Avenue	Hardin St.	J-2473	King St.	J-2651	2224	600	6,400		14,233,600	
750 mm supply line to LTS Reservoir:										
From Franklin/McDonald to Saunderson	Franklin Ave.	J-2466	Saunderson	J-2378	660	750	7,100	4,686,000		
Saunderson to LTS Reservoir[1]	Saunderson	J-2378			576	650	9,000	5,184,000		
750 mm discharge from LTS Reservoir:										
LTS Reservoir to Sauderson[1]	LTS Res.		Sounderson Ave	J-2734	576	750	9,000	5,184,000		
Replace Existing LTS Supply Mains:										
Morrison St.		J-2467	Selby Ave	J-2902	550	400	6,100		3,355,000	
Along Clearwater River		J-2902		J-LTS-1226	2400	400	6,100		14,640,000	
Abbottswood Drive		J-LTS-2036		J-1519	1300	400	6,100		7,930,000	
Beacon Hill/MacKenzie supply:										
Beacon Hill Supply Rehabilitation		J-1715		J-BH-336	2250	400	6,100	13,725,000		
BH supply main ext to Mills Ave Booster		J-LTS-1001		J-1761	900	400	6,100		5,490,000	
Mackenzie-Beacon Hill Supply Main		J-MK-6081		J-MK-387	1460	400	6,100	8,906,000		
WTP to LTS Reservior (to Alexander Ave)[3]		WTP		J-2931	1629	750		32,677,000		
LTS Reservoir to Abasand Reservoir[3]		J-2931		J-2941	1100	600	9,450	10,395,000		
Abandon PRV					5		20,000	100,000		
TOTAL								**80,857,000**	**45,648,600**	**0**

[1] As per Concept Review of the Lower Townsite Water Supply Report, October 2012, AE.
[2] Average Unit Rate from Separate Estimate
[3] From SWSL tender price plus engineering allowance

TABLE J-3
SUPPLY LINES
NORTH SERVICE AREA

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)		($)
Parsons to West Growth	Parsons Res			J-2692	1720	600	6,400			11,008,000
Supply to Hwy 63 Corridor		J-PC-1735		J-3076	1100	600	9,000	9,900,000		
		J-3083		J-3086	1671	400	3,200	5,347,200		
Thickwood lateral (Silin Forest Rd.)		J-2702		J-2706	700	400	5600	3,920,000		
Supply from New WTP to West Growth #2					9000	600	3,700			33,300,000
Supply to North Corridor Booster/Res					1700	600	3,700	6,290,000		
Supply to Fort McKay[1]						600		138,000,000		
TOTAL								**163,457,200**		**44,308,000**

[1] Estimated Cost from Separate Estimate

TABLE J-4
SUPPLY LINES
SOUTHWEST SERVICE AREA

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)		($)
Abasand to Horse River[1]		J-2906		J-2452	2850	600	9,000	25,650,000		
Horse River to Hangingstone[1]		J-3055		J-3035	7300	600	7,000		51,100,000	
MacKenzie to Anzac[2]		J-3329		J-2500	42200	600/400		110,300,000		
Hangingstone to MacKenzie		J-3009		J-3329	4200	600	3,700		15,540,000	
MacKenzie Lateral		J-3093		FCV-60	650	600	3,700		2,405,000	
New WTP to Hangingstone (2x750)[1]	Based on Phased single main installation			J-3002	13000	750	6,500			84,500,000
SW Lateral to Hanginstone Res #2		J-3050		J-3053	1800	600	3,700			6,660,000
Southlands to Airport		J-2733		J-2318	7200	450	3,300			23,760,000
TOTAL								**135,950,000**	**69,045,000**	**114,920,000**

[1] Average Unit Rate from Separate Estimate

[2] Estimated cost from SESL Constructability Review Preliminary Report, MMM Group, May 2015

TABLE J-5
LOWER TOWNSITE PROPOSED UPGRADES

Location (Roadway or Township Plan)	From		To		Quantity	Ex. Pipe Diameter	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	(mm)	($)	($)	($)	($)
Sutherland St.	HWY 63	J-LTS_1342	Franklin Ave.	J-LTS_1320	80	150	300	6,000	480,000		
Franklin Ave.		J-LTS_1206		J-1225	1,406	200	300	6,000		8,436,000	
Manning Ave.		J-LTS_1311		J-LTS-1266	400	150	300	6,000	2,400,000		
Manning Ave.		J-LTS-1262		J-LTS-1254	370	150	200	5,900		2,183,000	
Fraser Ave.		J-LTS_1317		J-LTS-1261	1,016	150	300	6,000	6,096,000		
Fraser Ave.		J-2246		J-LTS-203	248	150	200	5,900		1,463,200	
Fraser Ave.		J-LTS-1116		J-LTS-1106	315	200	300	6,000		1,890,000	
Fraser Ave.		J-LTS-1107		J-LTS-1102	258	200	300	6,000		1,548,000	
Marshall	Franklin	J-LTS-1104	Manning Ave.	J-LTS--1105	162	200	300	6,000		972,000	
Gordon Ave.	Morrison St.	J-LTS_1302	Main St.	J-LTS_1301	206	200	300	6,000	1,236,000		
Gordon Ave.	Main St.	J-LTS_1301	Hardin St.	J-LTS-1267	197	150	300	6,000	1,182,000		
Hainault	Charles Ave.	J-2656	Franklin Ave.	J-LTS-1208	355	150	300	6,000		2,130,000	
Charles/Biggs	Hainault	J-LTS-1231	Nixon	J-LTS_1234	573	150	300	6,000			
Nixon/Saunderson	Biggs Ave.	J-LTS-_1233	Alberta Dr.	J-LTS_1239	363	150	300	6,000		2,178,000	
Fitzsimmons Ave.	Hill Dr.	J-LTS-1257	McLeod St.	J-LTS-1252	334	200	250	5,900		1,970,600	
Gordon White Ave.	McLeod St.	J-LTS-1252		J-LTS-1253	510	200	250	5,900		3,009,000	
Reidel	Gordon White Ave.	J-LTS-1253	Franklin Ave.	J-LTS-1326	343	200	300	5,900		2,023,700	
		J-1568	Hospital St.	J-1573	373	200	300	6,000		2,238,000	
Centennial Dr.	Fraser	J-LTS-1108	Manning Ave.	J-LTS-1114	112	150	300	6,000		672,000	
Gordon Ave.		J-LTS-1108		J-LTS-1107	398	150	300	6,000		2,388,000	
Fraser Ave.		J-LTS-1108		J-LTS-1107	198	150	300	6,000		1,188,000	
Goolosky Ave.	Marshall St.	J-LTS-1102	Penhornwood St.	J-LRS-1103	362	150	300	6,000		2,172,000	
Penhornwood St.	Franklin Ave.	J-LTS-1103		J-LTS-1120	413	200	300	6,000		2,478,000	
Hill Dr.	Fraser Ave.	J-LTS-1263	F.Mercredi St.	J-LTS-1422	495	150	200	5,900		2,920,500	
Demers Dr.	Franklin Ave.	J-LTS-1264	F.Mercredi St.	J-LTS-1260	360	150	200	5,900		2,124,000	
Biggs Ave.	Morrison St.	J-LTS_1309	Hardin St.	J-LTS-1204	491	150	300	6,000	2,946,000		
Mac Donald Ave.	Richard Street	J-LTS_1313	Morrison St.	J-LTS_1309	200	150	300	6,000	1,200,000		
Biggs Ave.	Alberta Dr.	J-LTS_1235	Alberta Dr.	J-LTS-1244	514	150	200	5,900			3,032,600
Morrison St.	Biggs Ave.	J-LTS_1308	Franklin Ave.	J-LTS-1302	200	150	300	6,000	1,200,000		
Main St.	Sounderson Ave.	J-LTS_2021	McDonald	J-LTS-1304	190	150	300	6,000	1,140,000		
	Franklin	J-LTS-1304	Gordon Ave.	J-LTS_1301	350	150	300	6,000	2,100,000		
Clearwater Cres.	Franklin Ave.	J-LTS-1212	Franklin Ave.	J-LTS-1213	350	150	200	5,900			2,065,000
Father Mercredi St.	Franklin Ave.	J-LTS-214	Fraser Ave.	J-LTS-1261	225	150	300	6,000	1,350,000		
Father Mercredi St.	Fraser Ave.	J-2246	Hill Dr.	J-LTS-204	280	150	200	5,900		1,652,000	
Hill Dr.	Fraser Ave.	J-LTS-205	Fitzsimmons Ave.	J-LTS-1257	139	150	200	5,900		820,100	
Wagner St.	Fraser Ave.	J-LTS-206	Fitzsimmons Ave.	J-LTS-1258	141	150	200	5,900		831,900	
MacIlver St.	Manning Ave.	J-LTS-202	Fitzsimmons Ave.	J-LTS-1259	257	150	200	5,900		1,516,300	

TABLE J-5
LOWER TOWNSITE PROPOSED UPGRADES

Location (Roadway or Township Plan)	From		To		Quantity	Ex. Pipe Diameter	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	(mm)	($)	($)	($)	($)
MacLeod St.	Franklin Ave	J-LTS_1218		J-LTS-1255	26	150	200	5,900		153,400	
Pond Cr	Franklin Ave	J-LTS_1219	Franklin Ave	J-LTS-1220	265	150	200	5,900			1,563,500
Poplar Cr	Franklin Ave	J-LTS-1221	Franklin Ave	J-1222	310	150	200	5,900			1,829,000
Blair Cr	Alberta Dr.	J-LTS-1238	Alberta Dr.	J-LTS-1240	230	150	200	5,900			1,357,000
Harris Cr.	Alberta Dr.	J-LTS_1236	Alberta Dr.	J-LTS-1237	191	150	200	5,900			1,126,900
Clark Cr	Alberta Dr.	J-LTS-1241		J-LTS-1656	409	150	200	5,900			2,413,100
	Franklin Ave	J-1223	Manning Ave	J-1251	113	150	300	6,000			678,000
Ells Cr.	Biggs Ave	J-LTS-1245	Biggs Ave	J-LTS-1246	370	150	200	5,900			2,183,000
Peden Cr.	Biggs Ave	J-LTS-1247	Biggs Ave	J-LTS-1362	197	100, 150	200	5,900			1,162,300
Crescent Heights		J-LTS-1242		J-LTS-1323	315	150	200	5,900		1,858,500	
Fitzgerald Ave	Crescent Heights	J-LTS_1365	King Street	J-LTS-5004	1,020	150	300	6,000		6,120,000	
Bell Cr	Fitzgerald Ave	J-LTS-1138	Fitzgerald Ave	J-LTS-1134	480	150	200	5,900			2,832,000
May Cr	Fitzgerald Ave	J-LTS-1134		J-LTS-1136	263	150	200	5,900			1,551,700
Barry Cr.	Fitzgerald Ave	J-LTS-1137		J-LTS-1136	218	150	200	5,900			1,286,200
Birch Road	Fitzgerald Ave	J-LTS-1131	Centennial Dr.	J-LTS-1133	600	150	200	5,900			3,540,000
Bennett Cr	Centennial Dr.	J-LTS-1150	Centennial Dr.	J-LTS-1129	364	150	200	5,900			2,147,600
Centennial Dr.	Franklin Ave	J-LTS-1115	Fitzgerald Ave	J-LTS-1127	436	150	250	5,900			2,572,400
Rae Cr	Centennial Dr.	J-LTS-1128		J-LTS-1123	412	150	200	5,900			2,430,800
Moberly Cr	Centennial Dr.	J-LTS-1124	Centennial Dr.	J-LTS-1123	422	150	200	5,900	2,489,800		
King Str	Franklin Ave	J-LTS-LTS-1118	HWY63	J-LTS-1001	440	250	300	6,000	2,640,000		
		J-2284		J-LTS-1418	107		200	5,900	631,300		
Penhornwood		J-LTS-1120		J-LTS-LTS-1118	400	250	300	6,000			2,400,000
							Total		**27,091,100**	**56,936,200**	**36,171,100**
4-Way Chamber PRV Stn					1			5,800,000	5,800,000		
PRV Station					5			330,000	1,650,000		
							Total		**7,450,000**		

TABLE J-6
ABASAND PROPOSED UPGRADES

Location (Roadway or Township Plan)	From		To		Length	Ex. Pipe Diameter	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	(mm)	($)	($)	($)	($)
Athabasca Ave.		J-2323		J-1449	145	200	300	6,000	870,000		
Atkinson Lane	Atkinson Rd.	J-1457		J-1463	125	150	200	5,900		737,500	
		J-1463		J-1461	120		200	5,900		708,000	
		J-476		J-1530	170	250	300	6,000		1,020,000	
Abasand Dr.		J-1530		J-1531	65	150	300	5,900		383,500	
		J-1531		J-1547	175	250	300	5,900		1,032,500	
Total									**870,000**	**3,881,500**	**0**
Reservoir/Pumpstation mods					1			5,000,000	5,000,000		
							Total		**5,000,000**		

TABLE J-7
WATERWAYS PROPOSED UPGRADES

Location (Roadway or Township Plan)	From		To		Quantity	Ex. Pipe Diameter	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	(mm)	($)	($)	($)	($)
Railway Ave	McCormick Dr.	J-WTW-11	Huggard St.	J-WTW-22	410	150	300	6,000			2,460,000
Bulyea Ave	McCormick Dr.	J-WTW-12	Tomlinson St.	J-WTW-18	226	200	300	6,000			1,356,000
Bulyea Ave	Tomlinson St.	J-WTW-18	Park St.	J-WTW-23	371	150	300	6,000			2,226,000
Hughes Ave	Tomlinson St.	J-WTW-17	Park St.	J-2018	370	150	200	5,900			2,183,000
Cliff Ave	Tomlinson St.	J-WTW-1591	Bishop St.	J-WTW-1592	92	150	300	6,000			552,000
Cliff Ave	Bishop St.	J-WTW-1592	Huggard St.	J-2015	105		300	6,000			630,000
Tomlinson St.		J-WTW-15		J-WTW-1591	36	150	300	6,000			216,000
Tomlinson St.		J-WTW-1591		J-WTW-1593	60	200	300	6,000			360,000
Tomlinson St.		J-WTW-1593	Bulyea Ave	J-WTW-18	153	150	300	6,000			918,000
Tomlinson St.	Bulyea Ave	J-WTW-18	Railway Ave	J-WTW-19	100	150	300	6,000			600,000
Huggard St.	Railway Ave	J-WTW-22	Bulyea Ave	J-WTW-21	100	150	200	5,900			590,000
Huggard St.	Bulyea Ave	J-WTW-21		J-2016	152	150	300	6,000			912,000
Huggard St.		J-2016	Cliff	J-2015	51		300	6,000			306,000
McCormick Dr.		J-WTW-1588	Bulyea Ave	J-WTW-12	198	200	300	6,000			1,188,000
Pearson Dr.		J-WTW-1009		J-WTW-24	172	200	300	6,000			1,032,000
Pearson Dr.		J-WTW-24		J-WTW-15	157	150	300	6,000			942,000
Tolen Drive	Ptarmigan P.	J-LTS-1007		J-WTW-1588	320	200	250	5,900			1,888,000
Park Street		J-2018		J-WTW-23	144	150	300	6,000			864,000
PRV Station					1			330,000			330,000
Total									**0**	**0**	**19,553,000**

TABLE J-8
DRAPER ROAD FUTURE DEVELOPMENT

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)	($)	($)
		J-2410		J-2032	300	250	2,200	660,000		
		J-2032		J-2406	320	200	2,100	672,000		
Total								1,332,000		

TABLE J-9
BEACON HILL PROPOSED UPGRADES

Location (Roadway or Township Plan)	From		To		Quantity	Ex. Pipe Diameter	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	(mm)	($)	($)	($)	
Supply	Res	J-BH-332	BH Limits	J-BH-1614	1000	300	400	6,100	6,100,000		
Beacon Hill Dr.		J-BH-2030A		J-BH-2023	646	150	200	5,900		3,811,400	
Beaverlodge Cl.		J-BH-2032B		J-BH-54	270	150	200	5,900		1,593,000	
Beaverglen Cl.		J-BH-2032C		J-BH-49	195	150	200	5,900		1,150,500	
Beaconsfield Rd.		J-BH-2043		J-BH-2044B	220	150	200	5,900		1,298,000	
	Beacon Hill Dr.	J-BH-2043A		J-BH-2050B	375	150	200	5,900		2,212,500	
Beale Cr.		J-BH-2052A		J-BH-2049B	246	150	300	6,000	1,476,000		
Beacon Hill Dr.		J-BH-2052A	Beaconwood Rd.	J-BH-2010A	445	200	300	6,000	2,670,000		
Beacon Hill Dr.		J-BH-2010A		J-BH-2008B	230	150	300	6,000	1,380,000		
Total									**5,526,000**	**10,065,400**	**0**

TABLE J-10

MACKENZIE / GREGOIRE PROPOSED UPGRADES

Location (Roadway or Township Plan)	From		To		Quantity	Ex. Pipe Diameter	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	(mm)	($)	($)	($)	($)
GREGOIRE											
Gregoire Cr.		J-MK-105		J-MK-176	267	150	200	5,900	1,575,300		
Gregoire Cr.		J-MK-175		J-MK-213	525	150	200	5,900	3,097,500		
Grenfell Cr.		J-MK-106		J-MK-227	150	200	250	5,900	885,000		
Grenfell Cr.		J-MK-227		J-MK-G-221	510	150	250	5,900	3,009,000		
Grenfell Cr.		J-MK-G-221		J-MK-225	170	150	250	5,900	1,003,000		
		J-MK-185		J-MK-186	205	150	250	5,900	1,209,500		
		J-MK-220		J-MK-G-236	156	150	250	5,900	920,400		
Greenwood Place		J-MK-208		J-MK-183	240	150	200	5,900	1,416,000		
Grey Cr.		J-MK-G-236		J-MK-192	574	150	250	5,900	3,386,600		
Grey Cr.		J-MK-193		J-MK-206a	495	150	250	5,900	2,920,500		
		J-MK-G-236		J-MK-238	241	150	250	5,900	1,421,900		
		J-MK-238		J-MK-6049	328	200	250	5,900	1,935,200		
Greenbriar Bay		J-MK-245		J-MK-246	560	150	200	5,900	3,304,000		
Grenoble Cr.		J-MK-252		J-MK-255	495	150	200	5,900	2,920,500		
Subtotal									**29,004,400**		
MACKENZIE											
400 mm main from Mk Supply to BH limits		J-MK-6081	MacAlpine Cres	J-BH-1614	1,650	300	400	6,100	10,065,000		
MacKenzie Blvd.	MacDonald Cres.	J-MK-6047A	MacDonald Cres.	J-MK-6034A	700		300	6,000	4,200,000		
MacLennan Cr.		J-MK-255		J-MK-6058	570	200	300	5,900	3,363,000		
MacLennan Cr.		J-MK-6058		J-MK-6061A	295	250	300	5,900	1,740,500		
MacDonald Cres.		J-MK-6042A		J-MK-6047A	350	200	300	6,000	2,100,000		
MacKay Cr.	Mackenzie B.	J-MK-6047A		J-MK-6073	710	250	300	5,900	4,189,000		
Subtotal									**25,657,500**		
Total									**54,661,900**	**0**	**0**
23,000 m^3 Reservoir Expansion					23,000			2,000			46,000,000
							Total		**0**	**0**	**46,000,000**

TABLE J-11
AIRPORT INDUSTRIAL/ SOUTHLANDS PROPOSED UPGRADES

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)	($)	($)
		J-1659		J-2464	830	400	3,200		2,656,000	
		J-2727		J-2125	670	400	6,100		4,087,000	
		J-3134		J-2133	1,257	400	3,200		4,022,400	
		J-2745		J-3131	1,264	400	3,200		4,044,800	
		J-2133		J-3131	2,630	400	3,200			8,416,000
		J-3130		J-3124	2,656	400	3,200			8,499,200
Total								0	**14,810,200**	**16,915,200**
Anzac Booster Station					1		2,500,000			2,500,000
9,000 m^3 SE Reservoir Expansion					9,000		2,000	18,000,000		
11,000 m^3 SE Reservoir Expansion					11,000		2,000			22,000,000
							Total	**18,000,000**	**0**	**24,500,000**

TABLE J-12
SAPRAE CREEK / SPRUCE VALLEY PROPOSED UPGRADES

Location (Roadway or Township Plan)	From		To		Quantity	Ex. Pipe Diameter	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	(mm)	($)	($)	($)	($)
		J-453		J-SC-327	936	100	300	6,000			5,616,000
		J-SC-329		J-SC-324	3073	100	300	6,000			18,438,000
		J-SC-329		J-SC-322	4850	100	200	5,900			28,615,000
		J-SC-325		J-SC-331	160	100	200	5,900			944,000
		J-SC-326		J-SC-330	225	100	200	5,900			1,327,500
		J-SC-328		J-2415	1750	100	200	5,900			10,325,000
Total											**65,265,500**

TABLE J-13
SALINE CREEK FUTURE DEVELOPMENT

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)	($)	($)
		J-1767		J-3154	2430	400	3,200	7,776,000		
PRV Station					2		330,000	660,000		
Total								8,436,000	0	0

TABLE J-14
GATEWAY / QUARRY RIDGE FUTURE DEVELOPMENT

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)	($)	($)
Along HWY 59		J-2097		J-2207	1240	400	3,200		3,968,000	
Along HWY 63		J-2207		J-331	2880	400	3,200		9,216,000	
		J-2180		J-MK-6079A	650	400	3,200		2,080,000	
PRV Station (400 mm main)					1		330,000		330,000	
Total								0	**15,594,000**	0

TABLE J-15
THICKWOOD PROPOSED UPGRADES

Location (Roadway or Township Plan)	From		To		Quantity	Ex. Pipe Diameter	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	(mm)	($)	($)	($)	($)
J.W.Mann Drive		TW-894		TW-920	1392	200	250	6,000		8,352,000	
Thickwood Blvd		TW-734		TW-732	336	250	300	6,000	2,016,000		
	Thicwood Blvd	TW-729	Hillcrest Dr.	TW-724	580	300	400	6,200	3,596,000		
Tamarack Way (Alley)	Woodland	TW-1069	Alley	TW-749	500	150	200	5,900	2,950,000		
Alley	Silin Forest Road	TW-1178		TW-1188	214	200	300	6,000	1,284,000		
Thickwood Blvd	Res ROW	TW-729		TW-746	317	200	250	5,900	1,870,300		
Kennedy Cr.		TW-834		TW-835	82	150	200	5,900		483,800	
Kennedy Cr.		TW-832		TW-836	84	150	200	5,900		495,600	
Oaks Cr.	Fullerton Dr.	TW-844		TW-845	182	150	200	5,900		1,073,800	
Oaks Cr.	Fullerton Dr.	TW-847		TW-846	182	150	200	5,900		1,073,800	
Wilson Dr.		J-2194		J-2193	404		250	5,900	2,383,600		
		TW-930		TW-1796	308		250	5,900	1,817,200		
		J-2192		J-2435	800		250	5,900	4,720,000		
Ermine Cr	Wolverine Dr.	TW-780		TW-776	953	150	200	5,900	5,622,700		
Eymundson Rd.		TW-1047		TW-728	616	150	200	5,900		3,634,400	
Hilltop Cr		TW-771		TW-769	500	150	200	5,900		2,950,000	
Signal Rd	Signal Bay	TW-1023	Sicamore Pl.	TW-1245	580	150	200	5,900			3,422,000
Sifton Ave.		TW-765		TW-1236	244	150	200	5,900	1,439,600		
South West Of Thicket Dr		TW-1221		TW-1188	750	150	200	5,900			4,425,000
Hillcrest Dr.		TW-727		TW-725	550	150	200	5,900		3,245,000	
Timberline Dr.		TW-1110		TW-1121	690	150	200	5,900			4,071,000
Timberline Dr.		TW-760		TW-1115	360	150	200	5,900			2,124,000
	Timberline Dr.	TW-762	Ross Haven Dr	TW-1127	390	150	200	5,900			2,301,000
Rosslyn St.		TW-1127		TW-1131	640	150	200	5,900			3,776,000
Thicket Dr		TW-1131		TW-1167	705	150	200	5,900			4,159,500
Ross Haven Dr (ALLEY)	Romany St.	TW-1159	Rowam	TW-1151	312	150	200	5,900			1,840,800
Total									**27,699,400**	**21,308,400**	**26,119,300**

TABLE J-16
TIMBERLEA PROPOSED UPGRADES

Location (Roadway or Township Plan)	From		To		Quantity	Ex. Pipe Diameter	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	(mm)	($)	($)	($)	($)
Millenium Dr.	Dominion Dr.	Tim -103	Confederation Way	Tim -210	710	300	600	6,400	4,544,000		
Millenium Dr.	Confederation Way	Tim-210	Laffont Way	Tim-190	640	400	600	6,400	4,096,000		
Burton Pl.	Eglert Dr.	Tim-521	Berard Cr.	Tim-508	775	150	200	5,900			4,572,500
Berard Cr.	Burton Pl.	Tim-508	Bussieres Dr.	Tim-505	595	150	200	5,900			3,510,500
Bussieres Dr.		Tim-505	Burry Rd.	Tim-519	965	150	200	5,900			5,811,500
Burry Rd.	Eglert Dr.	Tim-520	Bussieres Dr.	Tim-517	290	150	200	5,900			1,711,000
Boisvert Pl		Tim-513		Tim-492	490	150	200	5,900			2,891,000
Barber Dr.	Breukel Cr	Tim-491	Brett Dr.	Tim-487	780	150	200	5,900			4,602,000
Breukel Cr.	Barber Dr.	Tim -491	Barber Dr.	Tim -485	520	150	200	5,900			3,068,000
Brebeuf Cr.	Breukel Cr.	Tim-489	Barber Dr.	Tim-486	385	150	200	5,900			2,271,500
Bacon Pl		Tim-480		Tim-479	450	150	200	5,900		2,655,000	
Burns Pl.		Tim-497		Tim-496	760	150	200	5,900		4,484,000	
Ball Pl		Tim-467		Tim-476	760	150	200	5,900		4,484,000	
Beaton Pl	Blanchett Rd.	Tim-466	Blanchett Rd.	Tim-465	860	150	200	5,900		5,074,000	
Berens Pl	Blanchett Rd.	Tim-466		Tim-474	445	150	200	5,900		2,625,500	
Total									**8,640,000**	**19,322,500**	**28,438,000**
3,500 m^3 Highway 63 Reservoir					3,500			2,000	**7,000,000**		
Highway 63 Pumphouse					1			10,000,000	**10,000,000**		
Total									**17,000,000**	**0**	**0**

TABLE J-17
PARSONS CREEK FUTURE DEVELOPMENT

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)	($)	($)
		J-2507		J-2510	292	250		0		
		J-2511		J-2508	323	200		0		
		J-2514		J-2664	146	200		0		
		J-2511		J-2526	914	200		0		
		J-2516		J-2519	465	200		0		
		J-2521		J-2524	316	200		0		
		J-2507		J-2527	258	250		0		
		J-2527		J-2643	2,233	300		0		
		J-2666		J-2668	299	300		0		
		J-2554		J-2564	836	300		0		
		J-2527		J-2540	746	300		0		
		J-2507		J-2531	587	200		0		
		J-2531		J-2530	130	200		0		
		J-2526		J-2538	541	250		0		
		J-2541		J-2544	574	250		0		
		J-2530		J-2555	772	250		0		
		J-2536		J-2556	627	250		0		
		J-2539		J-2557	481	250		0		
		J-2555		J-2563	198	200		0		
		J-2644		J-2564	631	450	3,300	2,082,300		
		J-2564		J-2619	1,462	400	3,300	4,824,600		
		J-2619		J-2571	4,343	400	3,200		13,897,600	
		J-2621		J-2582	1,656	400	3,200		5,299,200	
		J-2596		J-2590	745	400	3,200		2,384,000	
		J-2621		J-2634	655	350		0		
		J-2634		J-2630	726	300		0		
		J-2630		J-2619	694	350		0	0	
		J-2586		J-2611	215	350				0
		J-2611		J-2602	1,229	300				0
		J-2602		J-2582	198	350				0
PRV Station					0		330,000	0		
Total								**6,906,900**	**21,580,800**	**0**
Booster Station					1		8,000,000	8,000,000		
Total								**8,000,000**	**0**	**0**

TABLE J-18
WEST GROWTH FUTURE DEVELOPMENT

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)	($)	($)
		Res.24		J-WG-1964	410	400	3,200			1,312,000
		J-WG-1964		J-2050	265	400	3,200			848,000
		J-2050		J-2793	1,000	400	3,200			3,200,000
		J-WG-1960		J-2058	3,620	500	3,500			12,670,000
		J-2057		J-2280	3,200	400	3,200			10,240,000
		J-2057		J-WG-1751	2,400	400	3,200			7,680,000
		J-2058		J-2054	1,580	400	3,200			5,056,000
		J-WG-1967		J-2051	1,600	400	3,200			5,120,000
Total										**46,126,000**
10,000 m^3 Reservoir #1					10,000		2,000			20,000,000
Pump Station #1					1		10,000,000			10,000,000
15,000 m^3 Reservoir 2					15,000		2,000			30,000,000
Pump Station #2					1		10,000,000			10,000,000
Total								**0**	**0**	**70,000,000**

TABLE J-19
HORSE RIVER FUTURE DEVELOPMENT

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)		($)
		Res		J-3054	50	450	3,300	165,000		
		J-3040		J-3054	412	400	3,200	1,318,400		
		J-3054		J-3041	96	400	3,200	307,200		
		J-3041		J-HR-1824	1206	400	3,200		3,859,200	
		J-HR-1824		J-HR-1865	708	400	3,200		2,265,600	
		J-HR-1865		J-2061	676	400	3,200			2,163,200
		J-2061		J-2065	1236	400	3,200			3,955,200
		J-2065		J-2066	1001	400	3,200			3,203,200
		J-2066		WTP	1135	400	3,200			3,632,000
Total								**1,790,600**	**6,124,800**	**12,953,600**
9,500 m^3 Reservoir #1					9500		2,000	19,000,000		
Pump Station #1					1		10,000,000	10,000,000		
4,000 m^3 Reservoir 2					4000		2,000			8,000,000
Pump Station #2					1		10,000,000			10,000,000
Total								**29,000,000**	**0**	**18,000,000**

TABLE J-20
HANGINGSTONE FUTURE DEVELOPMENT

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)	($)	($)
		J-3014		J-3016	1,169	400	3,200		3,740,800	
		J-BHH-1812		J-2084	1,502	400	3,200		4,806,400	
		J-BHH-1812		J-3021	1,729	400	3,200		5,532,800	
		J-3021		J-BHH-1809	3,078	400	3,200			9,849,600
		J-BHH-1809		J-2084	2,015	400	3,200		6,448,000	
		J-BHH-1812		J-BHH-1876	1,981	400	3,200			6,339,200
		J-2084		J-BHH-1876	1,589	400	3,200			5,084,800
		J-2084		J-3048	1,828	400	3,200			5,849,600
		J-BHH-1876		J-BHH-1858	2,419	400	3,200			7,740,800
		J-BHH-1875		J-3049	2,430	400	3,200			7,776,000
Total								**0**	**20,528,000**	**42,640,000**
18,000 m^3 Reservoir #1					18,000		2,000		36,000,000	
Pump Station #1					1		10,000,000		10,000,000	
15,000 m^3 Reservoir #2					15,000		2,000			30,000,000
Pump Station #2					1		10,000,000			10,000,000
Total									**46,000,000**	**40,000,000**

TABLE J-21
SOUTHLANDS FUTURE DEVELOPMENT

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)	($)	($)
		J-3195		J-3195	2220	400	3,200		7,104,000	
		J-3205		J-3206	982	600	3,700			3,633,400
Total								0	7,104,000	3,633,400
10,500 m^3 Reservoir					10500		2,000	21,000,000		
Pump Station					1		10,000,000	10,000,000		
Total								31,000,000	0	0

TABLE J-22
HIGHWAY 881/63 INDUSTRIAL FUTURE DEVELOPMENT

Location (Roadway or Township Plan)	From		To		Quantity	Prop. Pipe Diameter	Unit Price	Short Term (0 - 5 years)	Medium Term (5 - 15 Years)	Long Term (Ultimate)
	Roadway	*Node #	Roadway	*Node #	(m)	(mm)	($)	($)		($)
9,000 m^3 Reservoir					9,000		2,000	18,000,000		
Pump Station					1		10,000,000	10,000,000		
Total								**28,000,000**		

TABLE J-23
FORT MCMURRAY WATER DISTRIBUTION SYSTEM
UNIT COSTS/METER

Watermains (Developed Land)

Item	Pipe Diameter (mm)								
	200	250	300	350	400	450	600	750	900
1.Site Work									
1.1 Removals	380	380	380	380	380	380	380	380	380
1.2 Road Reconstruction	2600	2600	2600	2600	2600	2600	2600	2600	2600
1.3 Traffic Controls	140	140	140	140	140	140	140	140	140
2. Water Distribution									
2.1 Watermain Supply and Install Complete	1240	1260	1300	1350	1400	1460	1650	2120	2380
2014 Rate Subtotal	**4,360**	**4,380**	**4,420**	**4,470**	**4,520**	**4,580**	**4,770**	**5,240**	**5,500**
Engineering (10 %)	436	438	442	447	452	458	477	524	550
Contingency (25 %)	1,090	1,095	1,105	1,118	1,130	1,145	1,193	1,310	1,375
Total	5,886	5,913	5,967	6,035	6,102	6,183	6,440	7,074	7,425
Total (rounded)	**5,900**	**5,900**	**6,000**	**6,000**	**6,100**	**6,200**	**6,400**	**7,100**	**7,400**

Watermains (Undeveloped Land)

Item	Pipe Diameter (mm)								
	200	250	300	350	400	450	600	750	900
1.Site Work	320	320	320	530	970	970	1080	1080	1510
2. Water Distribution									
2.1 Watermain Supply and Install Complete	1240	1260	1300	1350	1400	1460	1650	2120	2380
2014 Rate Subtotal	**1,560**	**1,580**	**1,620**	**1,880**	**2,370**	**2,430**	**2,730**	**3,200**	**3,890**
Engineering (10 %)	156	158	162	188	237	243	273	320	389
Contingency (25 %)	390	395	405	470	593	608	683	800	973
Total	2,106	2,133	2,187	2,538	3,200	3,281	3,686	4,320	5,252
Total (rounded)	**2,100**	**2,100**	**2,200**	**2,500**	**3,200**	**3,300**	**3,700**	**4,300**	**5,300**