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REPORT

Capital Region Northeast Water Services Commission

Supplemental Report to the 2020 Master Plan

MAY 2023

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1 INTRODUCTION

1.1 Project Description and Background

The Capital Region Northeast Water Services Commission (the Commission) owns potable waterlines located northeast of the City of Edmonton. These waterlines supply EPCOR Water Services Inc. treated water to several municipalities in the area, other water commissions, as well as to rural and industrial customers as described below and shown in **Figure 1-1**:

- City of Fort Saskatchewan;
- Town of Gibbons;
- Town of Bon Accord;
- Hewitt Estates;
- Town of Redwater;
- Hwy 28/63 Regional Water Services Commission;
- John S. Batiuk Regional Water Commission; and
- Industrial and Private Customers within Sturgeon County.

In 2020, Associated Engineering completed the 2020 Master Plan report for the Commission. The Commission has since requested that Associated Engineering incorporate changes in future planning to the prior 2020 Master Plan as described below:

- The Bremner Area is no longer included in the future servicing concepts.
- Design demands have been updated and are projected to 50 years rather than 20 years.
- Contribution from the Southside Meter Vault is included in the servicing concepts. The Southside Meter Vault will be relocated to a location at the Fort Saskatchewan City limits.

The 2020 Master Plan also included a desktop Life Expectancy Assessment for the Commission's waterlines. The following recommendations were made based on the results of the assessment:

- Assess the Commissions existing cathodic protection system.
- Inspect the Northside, Southside, and Gibbon's waterlines via SmartBall®.
- Scan the Northside Waterline for wire breaks.
- Update the 2020 Master Plan to include the results of the above investigations.

The above recommended inspections have since been completed by the Commission.

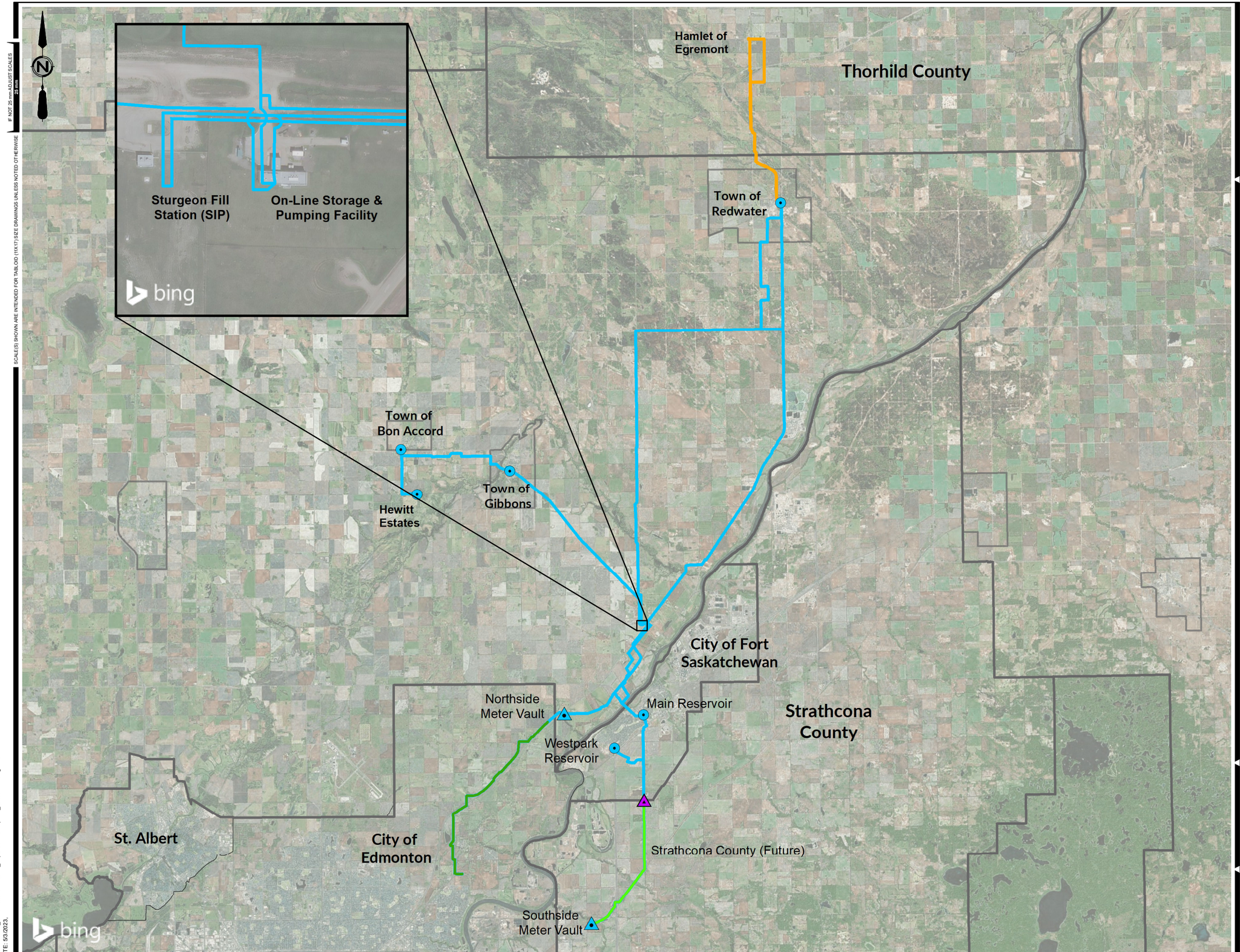
1.2 Objective and Scope

The purpose of this report is to supplement the information provided in the 2020 Master Plan. This report should be read in conjunction with the prior report for greater detail. The following was completed as part of this report:

- Assess the needs of the above customers and members against the capacity of the existing system.
- Recommend solutions to satisfy the Commission's future 50-year water demand projections and development changes.
- Review the inspection reports completed for the Northside, Southside, Gibbons, and Redwater Waterlines.

- Review the previously completed Life Expectancy Assessment, completed as part of the 2020 Master Plan, and update it to reflect observed conditions.
- Provide updated Opinion of Probable Cost for waterline replacement.
- Development of a 5, 10, and 20-year Capital Plan.

This supplemental report will accommodate annual growth for current customers, as well as planned expansion of the system and downstream users.



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Legend:

- Meter Vault
- New SSMV (Future)
- CRNWSC Fill Station

Ownership

- CRNWSC Waterline
- Highway 28/63 RWSC
- EPCOR
- Strathcona County

FIGURE No. 1-1

CAPITAL REGION NORTHEAST WATER SERVICES COMMISSION - SUPPLEMENTAL REPORT TO THE 2020 MASTER PLAN

OVERALL SYSTEM

AE PROJECT No.	2021-3015
SCALE	1:200,000
APPROVED	
DATE	2023 MAY
REV	
DESCRIPTION	ISSUED FOR REPORT

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DATE: 5/3/2023.

2 DESIGN CRITERIA

2.1 Population

One of the key variables in assessing the water system of a community is the population to be served. In terms of the Master Plan, the population helps to provide a basis to establish water use. As well, the projected growth rate will vary primarily on the size and type of community.

2.2 Population and Growth Rate

2.2.1 The Commission

Growth rates for the 2020 Master Plan were based on recent historical population growth and increase in water use in the area. Recent historical growth rates for Towns and Cities have been updated to reflect 2021 Statistics Canada census data and are outlined below:

Town of Bon Accord

- 2011 Population = 1488
- 2016 Population = 1529
- 2021 Population = 1461
- 5-year annual growth rate = 0.55%
- 10-year annual growth rate = -0.19%

Town of Gibbons

- 2011 Population = 3030
- 2016 Population = 3159
- 2021 Population = 3218
- 5-year annual growth rate = 0.84%
- 10-year annual growth rate = 0.6%

Town of Redwater

- 2012 Population = 2116
- 2016 Population = 2053
- 2021 Population = 2115
- 4-year annual growth rate = -0.75%
- 9-year annual growth rate = 0%

City of Fort Saskatchewan

- 2014 Population = 22,808
- 2015 Population = 24,040
- 2016 Population = 24,569
- 2017 Population = 25,533
- 2018 Population = 26,328
- 2019 Population = 26,942

- 2021 Population = 27,088
- 7-year annual growth rate = (2014-2021) = 2.49%
- 3-year annual growth rate = (2018-2021) = 0.95%

In keeping with the 2020 Master Plan, a growth rate of 1% will be applied to the Towns.

The 2020 Master Plan adopted a 3% growth rate for the City of Fort Saskatchewan, which was reflective of recent historical growth at the time. However, the growth rate in the City of Fort Saskatchewan has reduced over the past few years. It is proposed that the growth rate be reduced to 2.5%, which is in line with the 7-year annual growth rate as shown above. This is also within the range of projected annual growth provided by the City of Fort Saskatchewan for the purpose of this assessment, which indicated a low growth rate of 2.2% and a high growth rate of 3.0%.

In keeping with the 2020 Master Plan, a future growth rate of 1% will be applied to Sturgeon County and the Regional Commissions to accommodate potential future growth of the system. The Strathcona County water demands will be removed after 2023 as the Southside Meter Vault will be relocated to the City of Fort Saskatchewan municipal boundary.

The projected growth rates are as shown below in **Table 2-1**, along with projected populations for the urban centres based on the 2021 census populations.

Table 2-1 Projected Design Growth Rates and Urban Population

	Growth Rate (%)	Population				
		2023	2028	2033	2043	2073
City of Fort Saskatchewan	2.5%	28,459	32,199	36,430	46,634	97,818
Town of Gibbons	1%	3,283	3,450	3,626	4,005	5,399
Town of Bon Accord	1%	1,490	1,566	1,646	1,819	2,451
Town of Redwater	1%	2,158	2,268	2,383	2,633	3,548
Strathcona County	1%	Not Assessed				
Sturgeon County	1%	Not Assessed				
Hwy 28/63 RWSC	1%	Not Assessed				
John S. Batiuk Regional Water Commission	1%	Not Assessed				

2.3 Water Demand

Water demand is critical in determining the waterline size requirements, pumping capability, and storage required for a water system. Two critical rates of demand are normally used to evaluate a water supply system, including: Average Day and Peak Day Demand. The following briefly describes each of the critical flow conditions.

2.3.1 Average Day

In the absence of updated water use data, the 2018 Average Day Demand has been used and projected forward. Detailed information on historical water usage from 2015 through 2018 can be found in the 2020 Master Plan.

Future water demand projections are based on actual water usage rather than a per capita consumption rate. A per capita consumption rate of 275 L/c/d is proposed for future urban demand calculations where appropriate. This in in keeping with the 2020 Master Plan.

2.4 Peaking Factor

In keeping with the 2020 Master Plan, a design Peak Day Factor of 1.8 times the Average Day Demand will be applied.

2.5 Projected Water Demands

2.5.1 Commission Water Demands

Average Day and Peak Day water demand projections have been developed for the next 50 years based on the 2018 historical water usage and the projected growth rates, as shown in **Table 2-2** and **Table 2-3**. The 2018 historical water usage has been increased by 1% per year for all members and customers other than for Fort Saskatchewan. A growth rate of 1% has been used from 2018 through 2021 for Fort Saskatchewan, to reflect the recent reduction in growth rate. All other Fort Saskatchewan projections are based on a growth rate of 2.5%.

New and anticipated demands as identified in the 2020 Master Plan are detailed below:

- In Sturgeon County, no growth has been considered for the large industrial customers.
- The Highway 28/63 Regional Water Services Commission has experienced recent growth, with further plans for expansion of the system. The extension into the County of St. Paul from Ashmont to Mallaig was completed at the end of 2018 and will not have been included in the historical review. For the purpose of this report, a population of 200 has been assumed at a water consumption of 275 L/c/d, for a total Average Day Demand of 0.6 L/s. This is lower than considered in the design of the waterline extension but is considered reasonable for water supply purposes and can be revisited in the future.
- An extension from the Highway 28/63 Regional Water Services Commission to the Whitefish First Nation has recently been completed and been put into operation. The design flow of 4 L/s for 2020 has been applied based on the 2020 Master Plan and has been increased at 3% for a projected 2023 design demand of 4.4 L/s. Although a growth rate of 3% was estimated for the community, this is anticipated to be mitigated by the size of the Highway 28/63 and downstream system, and as such, a composite growth rate of 1% will be applied beyond 2023.

The average day demands as included in the WaterCAD model are shown in Table 2-2. The table identifies the average day demands along each waterline, as well as the total demand attributed to the On-Line Station.

It has been assumed that the Fort Saskatchewan flows will be evenly divided between the two reservoirs.

Strathcona County demands are excluded in 2028 and thereafter, as relocation of the Southside Meter Vault to the City of Fort Saskatchewan municipal boundary will remove these demands from the Commission's system.

Table 2-2 Detailed Average Day Demands

	Average Day Demand (L/s)					
	2018	2023	2028	2033	2043	2073
Mainline System						
City of Edmonton	1.4	N/A	N/A	N/A	N/A	N/A
Strathcona County	0.6	0.6	N/A	N/A	N/A	N/A
Sturgeon County	0.7	0.7	0.8	0.8	0.9	1.2
City of Fort Saskatchewan	78.1	84.6	95.7	108.3	138.6	177.4
Sturgeon Reservoir	5.2	5.5	5.7	6.0	6.7	9.0
Total Mainline System	**86.0**	**91.4**	**102.2**	**115.1**	**146.2**	**187.6**
Gibbons System						
Sturgeon County	0.4	0.4	0.4	0.5	0.5	0.7
Town of Gibbons	8.2	8.7	9.1	9.6	10.6	14.3
Town of Bon Accord	4.6	4.8	5.1	5.3	5.9	7.9
Hewitt Estates	0.7	0.7	0.8	0.8	0.9	1.2
Total Gibbons System	**13.9**	**14.7**	**15.4**	**16.2**	**17.9**	**24.1**
Redwater System						
Sturgeon County	4.3	4.5	4.7	5.0	5.5	7.4
Evonik	12.4	12.4	12.4	12.4	12.4	12.4
Town of Redwater	6.3	6.6	6.9	7.3	8.1	10.9
Hwy 28/63 Regional Water Services Commission	10.2	15.6	16.4	17.2	19.0	25.6
Total Redwater System	**33.2**	**39.1**	**40.5**	**41.9**	**45.0**	**56.3**
John S. Batiuk Regional Water Commission	63.5	66.7	70.1	73.7	81.4	109.7
Demand to On-Line Pumping Station	110.6	120.5	126.0	131.8	144.3	190.1
Total All Demands	**196.6**	**211.8**	**228.2**	**246.9**	**290.4**	**377.7**

The Peak Day Demands as included in the WaterCAD model are presented in **Table 2-3**.

Table 2-3 Detailed Peak Day Demands

	Peak Day Demand (L/s)					
	2018	2023	2028	2033	2043	2073
Mainline System						
City of Edmonton	2.5	N/A	N/A	N/A	N/A	N/A
Strathcona County	1.0	1.0	N/A	N/A	N/A	N/A
Sturgeon County	1.3	1.3	1.4	1.5	1.6	2.2
City of Fort Saskatchewan	140.7	152.2	172.3	194.9	249.5	319.4
Sturgeon Reservoir	9.4	9.8	10.3	10.9	12.0	16.2
Total Mainline System	**154.8**	**164.5**	**184.0**	**207.2**	**263.1**	**337.7**
Gibbons System						
Sturgeon County	0.7	0.8	0.8	0.8	0.9	1.2
Town of Gibbons	14.8	15.6	16.4	17.2	19.0	25.7
Town of Bon Accord	8.3	8.7	9.1	9.6	10.6	14.3
Hewitt Estates	1.3	1.3	1.4	1.5	1.6	2.2
Total Gibbons System	**25.1**	**26.4**	**27.7**	**29.1**	**32.2**	**43.4**
Redwater System						
Sturgeon County	7.7	8.1	8.5	9.0	9.9	13.4
Evonik	22.3	22.3	22.3	22.3	22.3	22.3
Redwater	11.3	11.9	12.5	13.1	14.5	19.6
Hwy 28/63 Regional Water Services Commission	18.4	28.0	29.5	31.0	34.2	46.1
Total Redwater System	**59.8**	**70.4**	**72.8**	**75.4**	**81.0**	**101.4**
John S. Batiuk Regional Water Commission	114.3	120.1	126.2	132.6	146.5	197.5
Demand to On-Line Pumping Station	199.1	216.8	226.7	237.2	259.7	342.2
Total All Demands	**353.9**	**381.3**	**410.7**	**444.4**	**522.7**	**679.9**

Notes: Peak Day Demand is based on 1.8 times the Average Day Demand

2.6 Fire Flow

Fire flow is not provided via the Commission waterlines as fire flow provision is the responsibility of the individual customers

2.7 Operating Pressure

The minimum recommended system pressure for supply waterlines is 140 kPa (20 psi) to maintain positive pressure within the waterline. The maximum recommended system pressure must account for potential surge pressures and must not exceed the maximum allowable pipe pressure based on AWWA standards.

Table 2-4 presents the maximum allowable pipe pressure based on the pipe materials within the CRNWSC system.

Table 2-4 Maximum Pipe Pressure

Location	Material	Nominal Diameter	Max Rated Pipe Pressure		
			(kPa)	(psi)	(m)
Mainline	Asbestos Cement - Class 150	250	1034	150	106
Mainline	Asbestos Cement - Class 150	300	1034	150	106
Mainline	Asbestos Cement - Class 200	300	1378	200	141
Mainline	Steel Pipe (4.78 mm thick)	400	2467	358	252
Mainline	Steel Pipe (5.56 mm thick)	400	2873	417	294
Mainline	PVC DR 18	400	1619	235	165
Mainline	Concrete Pressure Pipe - Class 14	600	1350	196	138
Mainline	Concrete Pressure Pipe - Class 16 (assumed)	750	1543	224	158
Mainline	Concrete Pressure Pipe - Classes 12 to 20	900	1157-1929	168-280	118-197
Redwater	Asbestos Cement - Class 150	250	1034	150	106
Redwater	Asbestos Cement - Class 150	300	1034	150	106
Redwater	PVC DR 25		1137	165	116
Gibbons	Steel Pipe (3.96 mm thick)	250	3273	475	335
Gibbons	Steel Pipe (4.78 mm thick)	250	3948	573	404
Gibbons	PVC DR 18	200	1619	235	165
Gibbons	PVC DR 14	200	2101	305	215
Gibbons	HDPE DR 17	150	689	100	70

2.8 Water Storage

Water storage will not be assessed in the current update. Further information can be found in the 2020 Master Plan.

2.9 Pipe Roughness Coefficient (C-Factor)

The roughness coefficient is one of the many variables in the Hazen-Williams equation when determining liquid flow through pipe. It represents friction and varies dependent on the material and the condition of the pipe. Table 2-5 presents the C-Factor values used for this study.

Table 2-5 C-Factor Values

Material Type	C-Factor
Concrete	120
Asbestos Cement	120
Concrete Lined Steel Pipe	120
Epoxy Lined Steel Pipe	120
PVC	130
HDPE	130

Note: A lower C-Factor represents a higher level of friction and a higher C-Factor represents a lower level of friction.

2.10 Velocity

A maximum velocity of 1.5 m/s is recommended for supply waterlines.

3 EXISTING SYSTEM ASSESSMENT

Note that the existing system overview including pipe diameter, routing, and filling rates, is extensively detailed in the 2020 Master Plan and is therefore not described in the current report. Figure 3-1 identifies the location of each facility described as well as the location of the waterlines.

3.1 Historical Data Review

A historical review of SCADA data was undertaken as part of the 2020 Master Plan to establish peaking factors as well as to validate the existing WaterCAD model. The review determined that the existing model is believed to be an adequate representation of the existing system overall. However, it was identified that there may be a discrepancy occurring at Bon Accord, suspected to worsen during high flow periods. The 2020 Master Plan recommended that the Commission ensure that the pressure gauge is calibrated and working properly at Bon Accord.

3.2 Northside Meter Vault Boundary Condition Assumptions

To perform the modelling exercise, assumptions must be made regarding supply pressure to the Northside Meter Vault. The 2020 Master Plan assumed an incoming hydraulic grade line (HGL) of 694 m, irrespective of the design flowrate. This is approximately equal to 500 kPa inlet pressure and is assumed to be met throughout the study period. Losses through the Northside Meter Vault are then subtracted to calculate boundary conditions. Refer to the 2020 Master Plan for further explanation of the boundary condition assumptions.

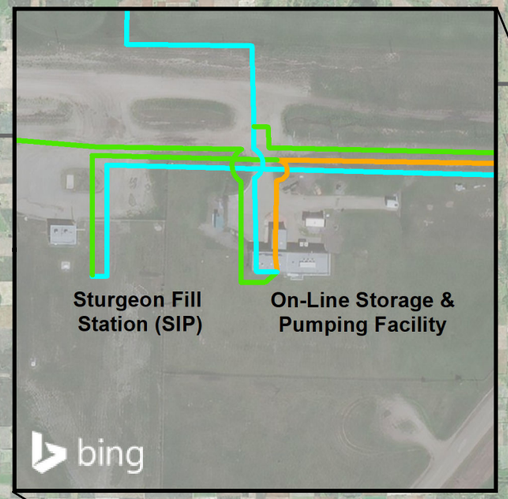
Table 3-1 below outlines the proposed Northside Meter Vault model boundary conditions, which have been updated to reflect the new design flows.

Table 3-1 Assumed Discharge HGL at the Northside Meter Vault[1]

Demand Scenario	Proposed HGL	Demand Scenario	Proposed HGL
2023 Average Day	693.3	2023 Peak Day	691.7
2028 Average Day	693.2	2028 Peak Day	691.3
2033 Average Day	693.0	2033 Peak Day	690.9
2043 Average Day	692.6	2043 Peak Day	689.7
2073 Average Day	691.8	2073 Peak Day	687.1

[1] Design HGL at meter vault discharge based on 694 m HGL (500 kPa inlet pressure)

These assumptions are further complicated by potential contribution from the Southside Meter Vault, as both the supply pressure and station losses will decrease based on a lower flowrate. For the purpose of this assessment, the above HGLs will be applied regardless of operation of the Southside Meter Vault.



Hamlet of Egremont

300mmø PVC

200mmø HDPE

Town of Redwater

400mmø PVC

250mmø AC

Redwater System

300mmø PVC

400mmø PVC

Town of Bon Accord

150mmø HDPE

200mmø PVC

Town of Gibbons

250mmø Steel

Town of Morinville

Gibbons System

300mmø AC

400mmø PVC SIP (Not in Model)

750mmø CONC

City of Fort Saskatchewan

Northside Meter Vault

Main Reservoir

Strathcona County

900mmø CONC (not in model)

Westpark Reservoir

St. Albert

City of Edmonton

400mmø Steel

Mainline System

Southside Meter Vault (Assumed Open)

bing

Legend:

- Meter Vault
- New SSMV (Future)
- CRNWSC Fill Station

Existing Pipe Diameter

- 150mmø
- 200mmø
- 250mmø
- 300mmø
- 400mmø
- 600mmø
- 750mmø
- 900mmø

FIGURE No. 3-1

CAPITAL REGION NORTHEAST WATER SERVICES COMMISSION - SUPPLEMENTAL REPORT TO THE 2020 MASTER PLAN

MODELLED SYSTEM

AE PROJECT No.	2021-3015
SCALE	1:200,000
APPROVED	
DATE	2023 MAY
REV	
DESCRIPTION	ISSUED FOR REPORT

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DATE: 5/3/2023.

3.3 Southside Meter Vault Boundary Condition Assumptions

The primary difference between this assessment and the 2020 Master Plan is the consideration for peak flow through the Southside Meter Vault. Previous assessments have been based on no flow allowance through the station, requiring all present and future flows to be delivered solely through the Northside Meter Vault.

Boundary conditions at the Southside Meter Vault must be established to facilitate the modelling. Previously, an HGL of 720 m was provided by Strathcona County to the Commission. It is unknown whether this was in reference to the existing Southside Meter Vault's location or the planned relocation. To be conservative, this is assumed to be at the existing location. Historical data for the Southside Meter Vault was reviewed by Associated Engineering in 2022. Key information is outlined below:

- Southside Meter Vault assumed to operate at 600 kPa (710.3 m HGL) in 2016 and 2020 Master Plans
- Historical data:
- Southside Meter Vault suction/upstream pressure is/ was around 780-795 kPa at zero flow
- Based on Southside Meter Vault Flow Control Valve (FCV) elevation of 649.07 m, 780 kPa = 728.8 m HGL
    - 0 L/s = 780 kPa (728.8 m HGL)
- At the flow of 13.9 L/s the upstream pressure varied from 712-843 kPa
- Historical high flows and upstream suction pressure:
    - 22.5 L/s = 680 kPa (718.5 m HGL)
    - 111.4 L/s = 583 kPa (708.6 m HGL)
    - 114.4 L/s = 575 kPa (707.7 m HGL)
        - Discharge pressure around 15-20 kPa lower than suction pressure
        - Southside Meter Vault suction/discharge pressures observed to get closer as flows increased, likely less influence from the Northside Meter Vault.
- As flow rates exceed 100 L/s, upstream pressure will fall below the assumed boundary condition of 710.3 m HGL

Based on the historical information above, an HGL of 720 m as provided would be associated with a flow rate of less than 22.5 L/s. As such, the previous assumption of 710.3 m HGL at the existing Southside Meter Vault will be maintained to reflect potential higher flow rates and to maintain conservatism in the model. It is recommended that these assumptions be verified where possible.

The existing Southside Meter Vault location has been maintained for modelling purposes. Revised boundary conditions for the new location would need to consider headloss along the existing waterline. Moving the Southside Meter Vault in the model will not change the results.

3.4 Existing System Model Results

The water model was developed and analyzed using the computer program WaterCAD, by Bentley. The following sections describe the model results for the existing design conditions. This Section has been updated from the 2020 Master Plan to reflect contribution through the Southside Meter Vault in all modelled scenarios.

Existing pump Variable Frequency Drive (VFD) setpoints are based on those identified in the 2020 Master Plan.

3.4.1 Mainline System

Velocities along the Mainline System remain below the recommended maximum of 1.5 m/s and all pressures exceed the recommended minimum of 140 kPa (20 psi) in both the Average Day and Peak Day demand scenarios.

The model results are based on the following assumptions:

- City of Fort Saskatchewan flows are evenly divided between the two reservoirs.
- Contribution from the Southside Meter Vault (Southside waterline) of 80 L/s during Average Day Demand and 91 L/s during Peak Day demand.
- Discharge pressure of 489 kPa (71 psi, 693.3 m HGL) at the Northside Meter Vault during the Average Day scenario.
- Discharge pressure of 475 kPa (69 psi, 691.7 m HGL) at the Northside Meter Vault during the Peak Day scenario.
- Discharge pressure of 598 kPa (87 psi, 710.3 m HGL) at the Southside Meter Vault during the Average Day and Peak Day scenarios.

3.4.2 Redwater System

Velocities along the Redwater System remain below the recommended maximum of 1.5 m/s and all pressures exceed the recommended minimum of 140 kPa (20 psi) in both the Average Day and Peak Day demand scenarios. Based on the current VFD setpoint of 692.4 m HGL, the pressures along the line will vary from 287 kPa (41.6 psi) to 898 kPa (130.4 psi) based on the 2023 Peak Day design demands. The lowest pressures are found along the twinned section of the waterline, while the highest pressures are found along the original waterline at the Sturgeon River crossing. This section of waterline is constructed of cement mortar lined steel pipe and although the waterline is identified to be rated at 150 psi on the record drawings, this section is presumably rated higher to accommodate a deep crossing. As such, the modelled pressures appear to remain below the rated capacity of the pipe; however, this does not consider transient pressures.

3.4.3 Gibbons System

Pressures vary greatly along the Gibbons Waterline due to the rising topography near the Town of Bon Accord. The line currently experiences somewhat less than the recommended pressure in the Town of Bon Accord area during the 2023 Peak Day design demands, to a low of approximately 89 kPa (13 psi). This assumes that the model results are reasonably reflective of the actual conditions; however, as identified in the 2020 Master Plan, there may be a discrepancy between the recorded and modelled results at the Town of Bon Accord.

During low flow conditions, pressures as high as 1048 kPa (152 psi) will be experienced at the Sturgeon River crossing, based on the current VFD setpoint of 731.8 m (860 kPa). This is within the design pressure of the waterline.

Other than meeting minimum pressure at the Town of Bon Accord, the waterline has ample capacity to supply the design flows for 2023 and velocities remain below the recommended maximum of 1.5 m/s.

3.5 Pumping Assessment

Pumping capacity for the Redwater and Gibbons pumps was fully assessed in the 2020 Master Plan. The assessment determined that both sets of pumps would meet the projected water demands and no pump upgrades were proposed at the time. Refer to the 2020 Master Plan for the assessment in its entirety including system curves.

3.5.1 Redwater Pumps

The 2020 assessment found that the Redwater pump VFD setpoint could be reduced to approximately 687 m HGL (422 kPa) and still meet the existing Peak Day Demands. It was recommended that a minimum sustaining valve pressure of 462 kPa (67 psi, 674.7 m HGL) be set at the Redwater Fill Station, to ensure that the minimum waterline pressure is maintained.

The projected design flows for the Redwater System have decreased, as the proposed Canada Kuwait Petrochemical Corp. demands are not included at this time. As such, the previous determination of adequate pump capacity remains true. As well, the projected 2073 peak demands are minimally higher than the previously projected 2040 demands due to removal of Canada Kuwait Petrochemical Corp. (PD demand of 101.4 L/s for 2073 versus previous projected PD demand of 96.7 L/s for 2040), and remain well within the capacity of the existing pumps. It is acknowledged that pump upgrades due to age are anticipated prior to that time.

The 2020 assessment also found that the Redwater pumps can be bypassed under specific flow conditions. Based on the assumed boundary conditions at the Northside Meter Vault, and projected increase in water demand, it was anticipated that the 20-year Average Day Flows could bypass the On-Line Pumping Station. Existing Peak Day flows were found likely to bypass but not likely future Peak Day demands. Based on the revised demand projections, it now appears that bypassing the On-Line Station may be possible for peak demands though 2033. This will be dependant on the supply pressure to the Northside Meter Vault and if significant growth is achieved in the downstream system. As well, operation of the Southside Meter Vault will likely increase supply pressure to the On-Line Pumping Station somewhat, through reduction of waterline and meter vault headloss.

It is recommended that a detailed SCADA review be undertaken of incoming and outgoing pressure at the On-Line Pumping Station, to verify the model results prior to undertaking system modifications.

3.5.2 Gibbons Pumps

In terms of the Gibbons pumps, the current VFD setpoint of 731.8 m HGL (860 kPa) is insufficient to meet the minimum pressure requirements for the existing Peak Day demand. It is recommended that the outgoing HGL be increased to meet or exceed the system curve for this demand scenario, so a minimum of 737 m HGL (910 kPa).. As flows increase over time, it is recommended that the system curve be referenced to increase the pump VFD setpoint to a suitable HGL. As identified in the 2020 Master Plan, it also recommended that a minimum sustaining valve pressure of 165 kPa (24 psi, 718.9 m HGL) be set at the Bon Accord Fill Station, to ensure that the minimum waterline pressure is maintained. This is based on an elevation of 702 m at the fill station. Pressure above this must be provided to Bon Accord at all times.

Although the 20-year design flows have increased slightly for the Gibbons line, there remains sufficient pumping capacity to meet the projected demands. The VFD setpoints will need to be increased over time as the demand increases, in addition to the recommended increase to accommodate the existing low pressures along the waterline. New higher head pumps will be required to meet the projected 2073 Peak Day Demand, at an approximate HGL of 764 m. It is acknowledged that pump upgrades due to age are anticipated prior to that time.

4 PROPOSED SYSTEM UPGRADES

4.1 Upgrades to Existing System

4.1.1 Main Waterline

During the 2023 Peak Day Demand scenario, the model results indicate that the supply pressure to the Fort Saskatchewan Main Reservoir will be 559 kPa (81.2 psi) and 462 kPa (67.1 psi) to the Westpark Reservoir. The pressure to the On-Line Pumping Station is anticipated to be in the order of 434 kPa (63 psi). The above results are based on operation of both the Northside Meter Vault and Southside Meter Vault, and the boundary conditions described earlier in this report. Note that delivery pressure to the Fort Saskatchewan reservoirs are increased through operation of the Southside Meter Vault.

No upgrades are recommended to the existing system. It is understood that the Southside Meter Vault will be relocated to the southern boundary of the Fort Saskatchewan City limits within the next 5-years.

4.1.2 Redwater Waterline

The current VFD setpoint of 692.4 m HGL (475 kPa) can be reduced and continue to meet projected short-term needs. It is proposed that the VFD could be reduced to an HGL of 687 m (422 kPa), which would meet the 2033 peak demand (allowing for continued growth).

It appears that it will be possible to bypass the On-Line Pumping Station. Inlet pressure at the On-Line Pumping Station is anticipated to exceed the Redwater System curve during modelled Average Day Demand scenarios. Based on the revised demand projections, it is anticipated that this will also be possible up to the 2033 Peak Day demand scenario. The existing pumps should be maintained to provide minimum pressure in the event that the upstream pressures cannot be maintained.

It will be necessary to install bypass piping outside of the pumphouse and a control valve along the line which will close due to low pressure and direct all flow to the On-Line Pumping Station. This will allow the water supplied to the Redwater line to bypass the On-Line Pumping Station entirely during normal operation. It is also recommended to set the sustaining valve at the Redwater Reservoir at 462 kPa (67 psi. 674.6 m HGL) so that filling of the reservoir does not reduce the line pressure to below 20 psi at the high point.

, it is recommended that a detailed SCADA review be undertaken of incoming and outgoing pressure at the On-Line Pumping Station, to verify the model results prior to undertaking system modifications. As well, operation of the Southside Meter Vault may increase supply pressure to the On-Line Pumping Station through reduction of waterline and meter vault headloss.

No other upgrades are recommended to the existing system.

4.1.3 Gibbons Waterline

It is recommended that the outgoing pressure from the On-Line Pumping Station be increased for the Gibbons Waterline to meet minimum recommended pressure during the Peak Day Demand scenario. This would require that the VFD setpoint be increased to a setpoint of 737 m HGL (910 kPa). The existing pumps have capacity to accommodate the proposed increase in operating pressure.

It is recommended that the pressure gauge at the Bon Accord Fill Station be inspected to ensure that it is calibrated and working properly. No other upgrades are recommended to the existing system.

4.2 Future Growth

4.2.1 Main Waterline

In the 2033 Peak Day scenario (10 Year), increased demand at Fort Saskatchewan will result in a velocity of 1.45 m/s within the 300 mm lateral supply waterline to the Westpark Reservoir. It is recommended that a second feed to the Westpark Reservoir be built at around this time to meet system demand requirements.

Additional capacity can be accommodated by installing a 400 mm waterline from the 900 mm Northside line directly to the Westpark Reservoir, or through twinning of the existing 300 mm lateral supply waterline. It is currently proposed that the 400 mm river crossing be constructed, for the following reasons:

- It will likely cause fewer disruptions to Fort Saskatchewan Residents (than twinning of the 300 mm lateral supply waterline).
- An additional river crossing is anticipated to be required at some point in the future (between 2043 and 2073)
- The additional river crossing will provide the CRNWSC with the ability to reduce or eliminate water purchased through the SSMV for an extended period of time.
- It will provide redundancy to the supply system in case of emergency or to accommodate planned maintenance/upgrades.

It should be noted that the proposed 400 mm river crossing is no longer required to address velocity constraints within the existing 400 mm river crossing due to the planned long-term operation of the Southside Meter Vault. Contribution from the Southside Meter Vault which will delay the requirement for an additional river crossing until some time beyond 2043.

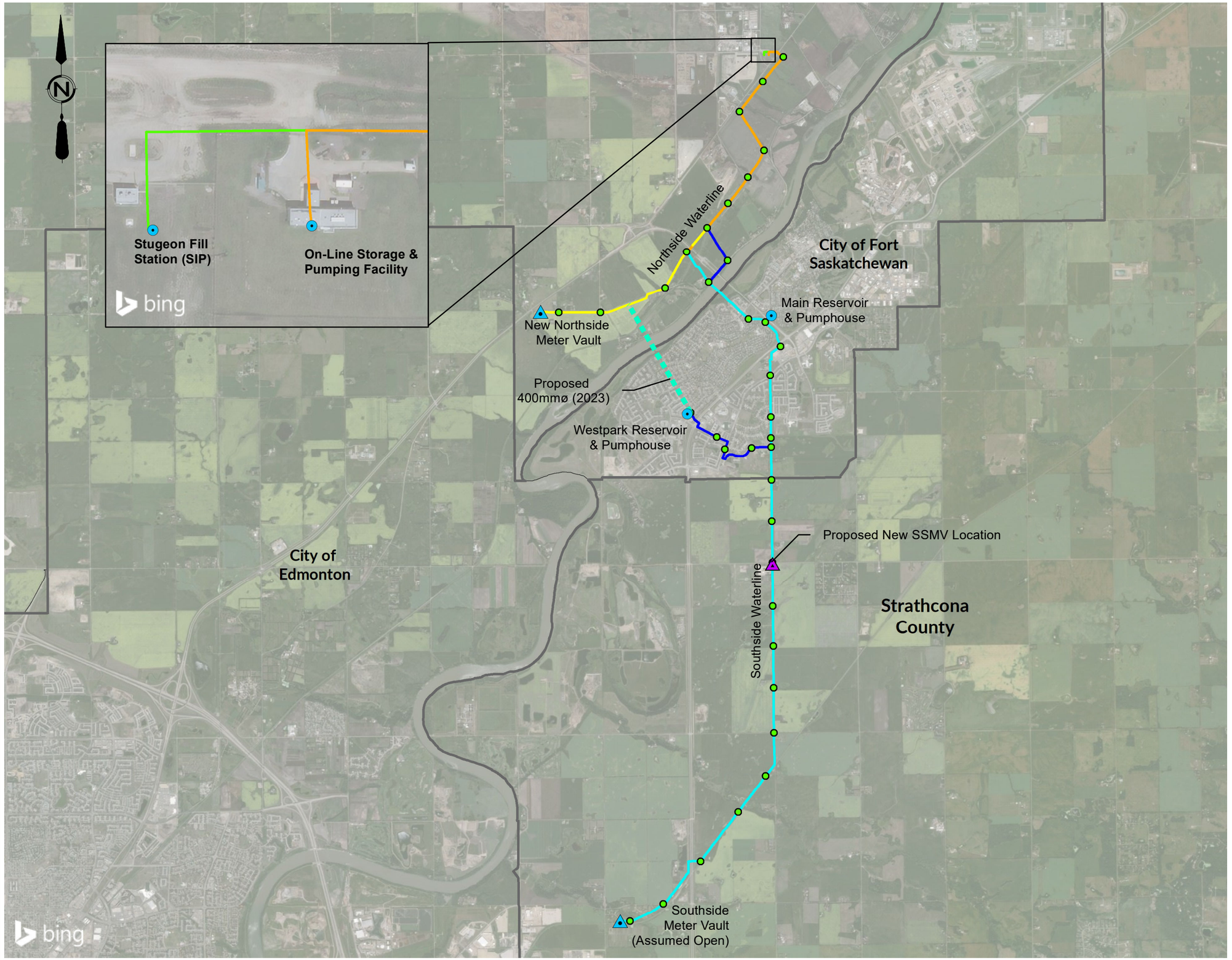
In addition to the 400 mm waterline, approximately 65 m of 300 mm waterline that connects directly into the Westpark Reservoir will require twinning around 2033. The proposed pipe size is to be evaluated during pre-design.

Note that continued reduction in per capita water consumption and/or reduced growth rates may delay the projected upgrade timelines.

No other upgrades are anticipated other than scheduled repairs and replacement. **Figure 4-1** presents the upgrade concept.

IF NOT 25 mm ADJUST SCALES 25 mm

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



Associated Engineering

BEST MANAGED COMPANIES Platinum member

Legend

- Meter Vault
- New SSMV (Future)
- CRNWSC Fill Station

Peak Day Pressure

- < 138 kPa (< 20 psi)
- 138 kPa - 689 kPa (20 psi - 100 psi)
- 689 kPa - 1034 kPa (100 psi - 150 psi)
- >1034 kPa (>150 psi)

Existing Pipe Diameter

- 200mmø
- 250mmø
- 300mmø
- 400mmø
- 750mmø
- 900mmø

Proposed Pipe Diameter

- 400mmø

FIGURE NO. 4-1

CAPITAL REGION NORTHEAST WATER SERVICES COMMISSION - SUPPLEMENTAL REPORT TO THE 2020 MASTER PLAN

MAINLINE SYSTEM
EXISTING PEAK DAY DEMAND

AE PROJECT No.	2021-3015
SCALE	1:70,000
APPROVED	
DATE	2023MAY03
REV	
DESCRIPTION	ISSUED FOR DRAFT

SAVE DATE: 5/3/2023 9:27:53 AM SAVED BY:
DRAWING PATH: C:\2021-3015_CRNWSC\2021-3015_Imported\ArcMap\4-1_CRNWSC_MainlineSystem.mxd
DATA SOURCE: © 2023 Microsoft Corporation © 2023 Maxar ©CNES (2023) Distribution Airbus DS;

4.2.2 Redwater Waterline

Based on the revised water demand projections, it appears that the On-Line Pumping Station can be bypassed during average day demands and existing Peak Day Demands through 2033. This is dependent upon both growth in water demand and upstream supply pressure. As the upstream pressure can fluctuate, it will be imperative that pumping capacity be maintained should it be required during high flow low pressure periods.

Other than a proposed reduction in operating HGL (for the existing system), no upgrades are anticipated other than scheduled repairs and replacement.

4.2.3 Gibbons Waterline

The outgoing On-Line Pumping Station pressure will require incremental increases to maintain minimum pressure along the waterline in the Bon Accord area. The existing pumps are anticipated to be sufficiently sized to accommodate the design flow and pressure to beyond 20 years.

New higher head pumps will be required to meet the projected 2073 Peak Day Demand, at an approximate HGL of 764 m. This operating HGL will result in the static pressure approaching waterline design pressures at the Sturgeon River Crossing during low flow conditions (1365 kPa versus waterline design pressure of 1482 kPa). Should this occur, a PRV station could be installed upstream of the crossing, reducing downstream pressure during low flow (high pressure) conditions.

No other upgrades are anticipated, other than scheduled repairs and replacement.

4.3 Fill Station Operation and Pressure Performance

Fill station operation and pressure performance was assessed in the 2020 Master Plan. Refer to the prior report for further information.

4.4 Control System Operations

Control system operations were outlined in the 2020 Master Plan. Refer to the document for further information. As per the 2020 Master Plan recommendations, the On-Line Pumping Station Human-machine interface (HMI) computers were replaced and software upgraded in 2022, and the Gibbon's VFD's have been replaced. Two of the three Redwater VFD's need to be upgraded.

5 SUMMARY OF CONDITION ASSESSMENTS

5.1 Northside Waterline Condition Assessment

Pure Technologies, a Xylem Brand (Pure Technologies) was retained to preform an inspection and condition assessment of the Northside Waterline. The Northside Waterline is composed of 750 and 900 mm Prestressed Concrete Cylinder Pipe (PCCP) installed in 1981. The waterline transmits water from the Northside Meter Vault to the On-Line Pumping Station within Sturgeon Industrial Park. The inspections and assessments completed by Pure Technologies included the following:

- Acoustic leak and gas pocket detection;
- Electromagnetic inspection for broken wires in the PCCP;
- Transient pressure monitoring;

- Structural analysis; and
- Useful life statistical analysis.

The waterline was divided into two parts and inspected as described in **Table 5-1** below:

Table 5-1 Northside Waterline Inspection Methodology

Section No.	Length	Description	Date of Inspection
1	3.26 km	900 mm PCCP between the Northside Meter Vault and Highway 15	August 2021
2	4.46 km	900 and 750 mm PCCP between Highway 15 and the On-Line Pumping and Storage Facility	October 2022

The results of the above inspections and assessments is summarized below.

5.1.1 Acoustic Leak and Gas Pocket Detection Results

The results of the acoustic leak and gas pock detection is summarized in **Table 5-2** below for **Section 1**. Figures detailing the location of the leaks created by Pure Technologies are provided in **Appendix A**.

Table 5-2 Northside Waterline Acoustic Testing Results

Leak Number	Waterline Section	Type of Leak	Size of Leak (Provided by Pure Technologies)	Comments
1	1	Joint Leak	Medium (7.5 to 37.5 L/min)	None
2	1	Joint Leak	Small (< 7.5 L/min)	Near a vertical elbow
3	1	Feature Leak	Small (< 7.5 L/min)	Near a 150 mm Blow-off

No leaks were detected along Section 2 of the Northside Waterline; however, an acoustic anomaly near WFT51031 (a 50 mm ARV and manhole) was detected.

5.1.2 Electromagnetic Inspection Results

No broken wires were detected during the electromagnetic inspection of the waterline. Of the 1,121 pipes sections inspected, ten were noted has having a thicker steel cylinder. Due to limits of the technology used to inspect the waterline, there is a greater level of uncertainty in the results for these pipes. However, no distresses were identified for these pipes. Two pipes had anomalous signals that could not be identified as either non-distressed pipe or broken wires. These signals may be a result of an unknown feature along the waterline or change in pipe property.

5.1.3 Transient Pressuring Monitoring Results

The pressures within the waterline were monitored over a period of 48-days from August 31, 2023 to September 30, 2021. The pressure monitor was installed within the Northside Meter Vault. **Table 5-3** below summarizes the results of the monitoring:

Table 5-3 Northside Waterline Transient Pressure Monitoring Results

Maximum Pressure (psi)	Minimum Pressure (psi)	Average Pressure (psi)	Standard Deviation (psi)
88.9	48.6	72.7	5.4

Based on the recorded pressure in the Northside Meter Vault, the maximum pressure at the low point of the waterline was (860 kPa) 124.8 psi and the at the high point was 340 kPa (49.3 psi). This information was used as part of the below structural analysis.

5.1.4 Structural Analysis Results

Pure Technologies completed a structural analysis for both sections of the waterline based on the original AWWA C301 design standard aswell as the current AWWA C304 design standard and determine both sections met the design standards. Furthermore, a Finite Element Analysis was completed for the waterline to determine how many broken wire wraps can be present in a pipe until it should be replaced (the Yield Limit). Based on the results of the analysis, the maximum number of wire wraps that can be present for the 750 mm and 900 mm diameters PCCP pipes are 14 and 15 respectively.

The Finite Element Analysis was completed assuming a soil unit weight of 1920 kg/m^3 (120 lb/ft^3). However, geotechnical survey of Section 2 of the Northside Waterline indicidate a soil weight of 2080 to 2400 kg/m^3 (130 to 150 lb/ft^3). As no broken wires were detected during the inspection, the Finite Element Analysis model was not updated.

5.1.5 Remaining Useful Life Analysis Results

Pure Technologies utilized a perdictive model to determine the future deterioration of the waterline by 2051. The results of the model are summarized below in **Table 5-4**:

Table 5-4 2051 Deterioration Results

Pipe	Probability of Requiring Replacement
900 mm Class 14 Pipes	1 to 10%
900 mm Class 16 Pipes	<1%
900 mm Class 16 Pipes	<1%
All 750 mm Pipes	1 to 10%

Based on the modelling, ten pipes in the Northside Waterline are expected to expected to require replacing by 2051. Although the number of pipes requiring replacement is low, the number of projected broken wires is expected to increase between now and 2051 as the waterline ages.

5.1.6 Recommendations

The following recommendations were made by Pure Technologies:

- Verify, excavate, and rehabilitate the identified leaks.
- Investigate the air release valve and access manhole as a possible source of the acoustic anonmaly.
- Operate the Northside Waterline following industry best practicies.
- Preform a valve assessment for large diameter valves along the waterline as one was found to be broken during the inspection and had to be replaced.
- Re-inspect the Northside Waterline acoustically and electromagneticlaly in 7 to 10 years.
- Update the Finite Element Analysis to account for a soil weight of 2400 kg/m (150 lb/ft^3) should broken wires be detected as part of future inspections.

5.2 Southside Waterline SmartBall® Inspection

Pure Technologies completed acoustic leak and gas pocket detection for the Southside Waterline on May 24, 2022. The Southside Waterline is a 400 mm steel pipe, which was mostly installed in 1970, that transmits water from the Southside Meter Vault to a tie-in to the Northside Waterline on the north side of the North Saskatchewan River, adjacent to Highway 15.

5.2.1 Acoustic Leak and Gas Pocket Detection Results

No leaks or gas pockets were detected along the waterline. One acoustic anomaly was identified, which could be an unknown feature along the waterline. The anomaly was detected 6 m upstream from the EMIS Enterprises Ltd Meter Vault. A figure detailing the location of the leaks created by Pure Technologies is provided in **Appendix A**.

5.2.2 Recommendations

Pure Technologies recommended the Commission inspect the location of the anomaly to confirm no issues are present.

5.3 Gibbons Waterline SmartBall® Inspection

Pure Technologies completed acoustic leak and gas pocket detection for the Gibbons Waterline on October 17, 2022. The Gibbons Waterline is a 250 mm steel pipe installed in 1977 that transmits water from the On-Line Pumping Station to a tie-in to the Town of Gibbon's Reservoir.

No leaks, gas pockets, or anomalies were detected along the waterline.

5.4 Cathodic Protection Assessment

Corrosion Services Company Limited (CSCL) completed a cathodic protection evaluation for the following lines:

- 400 mm steel Southside Waterline;
- 250 mm steel Gibbons Waterline; and
- Two 300 mm steel sections of the Redwater Waterline.

The following indirect inspections were complete as part of the assessment:

- Influence Testing;
- Close Interval Potential Survey;
- Direct Current Voltage Gradient Survey;
- Alternating Current Voltage Gradient Survey;
- Depth of Covery Survey;
- Alternating Current Current Attenuation Survey;
- Soil Resistivity Measurements; and
- Alternating Current Voltage Measurements.

The results of the above inspections are summarized below.

5.4.1 Southside Waterline

The Southside Waterline was found to be protected and well coated along the majority of its length. An approximately 350 m length of plastic pipe within the City of Fort Saskatchewan along Highway 21 was not included within the survey. This length of pipe was installed as part of the realignment of the waterline to accommodate development of a commercial area.

As a result of the plastic pipe, the remaining 2,000 m of the Southside Waterline north of Highway 21 to Lamourex drive is electronically isolated. Furthermore, this length of pipe was found to have sub-criterion cathodic protection, which is expected to be a result of reduced output from rectifier R5. In 2022, the Commission replaced rectifier R5 and restored adequaent cathodic protection to this length of ppipe.

Small coating defects were identifed along an approximately 1,000 m length of the waterline just south of Township Road 542. However, the length of line has adequate cathodic protection and corrision is not expected to occur. An exploratory dig could be preformed at one of the locations with a larger coating defect to investigate any potential corrosion.

Potential coating defects along an approximately 980 m length of the waterline north of Highway 15, centred around rectifier R5, could not be veritifed due to interference from the rectifier.

Recommendations

The following recommendations were made regarding the Southside Waterline:

- Repair or increase output of rectifier R5 (*completed in 2022).*
- Preform additional coating assessment surveys with rectifier R5 de-energized for 980 m length of pipe north of Highway 15.
- Monitor locations where coating defects were identified along 1,000 m length of waterline south of Township Road 542. If cathodic protection levels drop, investigate and repair the defects.

5.4.2 Gibbons Waterline

The Gibbons Waterline was found to be protected and well coated along the majority of its alignment. Only a few sections were found to have sub-crierion cathodic protection. An approximately 150 m length of was found to have a minor coating defects; however, the line has adequate cathodical protection in this location and no corrision is expected.

At the location of the Pembina and Imperial Oil pipeline crossings, the line was found to be unprotected as a result of interference with the oil pipelines cathodic protection system. This length of waterline was replaced with HDPE in 2019 due to corrosion issues as a result of the pipeline crossing.

Twelve minor and one moderate coating defect was identified along the waterline. One of the minor defects is located in an area with sub-criterion cathodic protection, south of the oil and gas pipeline crossing.

Recommendations

The following recommendations were made regarding the Gibbons Waterline:

- Investigate and perform interference testing at the Pembina and Imperial Oil pipeline crossings. Preform a dig following testing to identify any corrosion and install mitigation measures (*this length of waterline was replaced in 2019*).
- Increase rectifier output to improve protection levels at locations that have sub-criterion cathodic protection.
- Monitor the locations where coating defects were identified between Township Road 554 and Sturgeon Industrial Park. If cathodic protection levels drop, investigate and repair the defects.
- Expose the pipe at the coating defect found in conjuction with sub-criterion cathodic protection south of the Pembina and Imperial Oil pipeline crossings.

5.4.3 Redwater Waterline

The length of steel waterline crossing the creek near Pembina's Redwater Facility was found to be unprotected along its length. It was anticipated that this length of waterline was protected with anodes; however, none were identified at the test station. This section of waterline was found to be well coated with no coating defects being identified.

The length of steel waterline crossing the creek near Hu Haven could not be surveyed as no test station or suitable connection to the line was found. Similar to the other creek crossing, it was expected that this length of waterline was protected with anodes; however, the lack of testing station suggests that this area is not protected.

The Commissioning currenting plans to install anodes and a testing station in Spring 2023.

Recommendations

The following recommendations were made regarding the Redwater Waterline:

- Install a new test station, pipe leads, and anodes for the steel section crossing the creek near Hu Haven.
- Install new anodes at the existing test station for the steel section crossing the creek near Pembina's Redwater Facility.
- Complete additional testing for the two steel sections following installation of the above items.

6 LIFE EXPECTANCY ASSESSMENT UPDATE

6.1 Summary of Prior Assessment

The prior Life Expectancy Assessment utilized assigned a risk-based score to each line based on the following Risk Factors:

- Percent of used design life;
- Alignment location and resulting consequences of failure; and
- Availability of an alternative water supply.

The Percent Of Used Design Life was based on the age of material compared to the assumed design lives noted below:

- **PVC/HDPE** 100-years
- **Asbestos Cement** 70-year
- **Steel** 50-years
- **Hyprescon** 50-years

Table 6-1 below provides the criteria and scoring used to assess each line:

Table 6-1 Waterline Rating Criteria

Risk Factor	Description	Points	Maximum Possible Points
Percent of Used Design Life	0-20%	2	10
	21-40%	4	
	41-60%	6	
	61-80%	8	
	81-100%	10	
Alignment Location*	Minor Impact (Open/Agricultural Land)	0	5
	Medium Impact (Rural Roadways and Minor Highways)	2.5	
	High Impact (Urban/Industrial/Railways/Major Highways)	5	
Alternate Water Supply	Alternate supply available	0	5
	Alternate supply unavailable	5	
		TOTAL POSSIBLE POINTS	**20**

*Based on location of majority of alignment

Table 6-2 defines the relative risk of each line based on its score:

Table 6-2 Relative Risk Score

Score	Relative Risk
2 - 9.5	Low Risk
10 - 14.5	Medium Risk
15 - 20	High Risk

6.2 Methodology

In order to update the prior risk-based scoring, each waterline within the system was reviewed and any changes to the Risk Factors for each waterline was identified. Table 6-3 below outlines the identified changes to each waterline that could effect the scoring for each Risk Factor:

Table 6-3 Potential Changes to Waterline Risk Factors

Risk Factor	Changes to Each Waterline
Percent of Used Design Life	• All waterlines are three years older. • The condition assessment reports provided insight on the Design Life of the Northside, Southside, and Gibbons waterlines.
Alignment Location	• There have been no changes in the alignment of each waterline.
Alternative Water Supply	• There have been no changes in alternative water supply for each waterline.

The below sub-sections outline the changes made to the risk-based scoring for the Northside Waterline, the Southside Waterline, and the Gibbons Waterline based on the results of the condition assessments. The changes made to the risk-based scoring for all the remaining waterlines, including the Redwater Waterline, is also discussed.

6.2.1 Northside Waterline

The following was considered when updating the risk-based scoring for the Northside Waterline:

- The Northside Waterline was installed in 1981 and is 42-years, which is 84% of its assumed 50-year design life.
- Two small leaks and one medium leak were identified along the waterline's alignment
- The condition assessment report found that the pipes that make up the waterline had a medium (1 to 10%) to low (<1%) probability of requiring replacement by 2051.
- The report additionally found that ten pipes are expected to have required replacement by 2051.

Based on the above, the design life for the waterline was extended from the 50-years used in the prior assessment to 70-years, which is the age waterline will be in 2051.

Table 6-4 below provides the updated assessment for the Northside Waterline:

Table 6-4 Updated Northside Waterline Relative Risk Assessment

	Northside Meter Vault to Railroad Intersection	Railroad Intersection to On-Line Pumping and Storage Facility
Waterline Characteristics		
Material	Hyprescon	Hyprescon
Age	42	42
Percent of Used Design Life	60%	60%
Waterline Rating		
Percent of Used Design Life	6	6
Alignment Location*	2.5	5
Alternate Water Supply	0	0
Total Points	**8.5**	**11**
Relative Risk	Low	Medium

Compared to the prior assessment, the total points for each section has decreased by two. The portion of the waterline from the Northside Meter Vault to the railroad intersection as reduced from medium to low risk; however, the latter portion of the waterline remains medium risk due to its alignment near the existing railroad.

6.2.2 Southside Waterline

The following was considered when updating the risk-based scoring for the Southside Waterline:

- The majority of the Southside Waterline was installed in 1970 and is 53-years old, which is 106% of its assumed 50-year design life.
- No leaks were detected along the length of the waterline.
- The waterline is protected and well coated along the majority of its length with only minor coating defects identified.
- Issues relating to sub-criterion cathodic protection due to rectified R5 have since been repaired.

Based on the above findings, the design life for the waterline was extended from the 50-years used in the prior assessment to 70-years for the steel section of the waterline. The design life for the asbestos cement and PVC portions remained unchanged.

Table 6-5 below provides the updated assessment for the steel portion of the Southside Waterline:

Table 6-5 Updated Southside Waterline Relative Risk Assessment

	Southside Meter Vault to Range Road 225 (Strathcona Owned)	Range Road 225 to Ft. Sask. (Strathcona Owned)	Ft. Sask. to Lamoureux Drive
Waterline Characteristics			
Material	Steel	Steel	Steel
Age	53	53	53
Percent of Used Design Life	76%	76%	76%
Waterline Rating			
Percent of Used Design Life	8	8	8
Alignment Location*	5	2.5	5
Alternate Water Supply	0	0	0
Total Points	**13**	**10.5**	**13**
Relative Risk	Medium	Medium	Medium

Compared to the prior assessment, the total points for each section has decreased by two. The portion from the Southside Meter Vault to Range Road 225 and the portion from Ft. Saskatchewan to Lamoureux Drive has decreased from high to medium risk. The portion from Range Road 225 to Fort Saskatchewan remains medium risk.

6.2.3 Gibbons Waterline

The following was considered when updating the risk-based scoring for the Gibbons Waterline:

- No leaks, gas pockets, or anomalies were detected along the waterline.
- The waterline is protected and well coated along the majority of its length.
- Only a few sections of the waterline were found to have sub-criterion cathodic protection.
- A 150 m length of the waterline was found to have minor coating defects; however, this length had suitable cathodic protection and hence no corrosion is expected.
- The length of waterline that is unprotected due to the oil and gas pipeline crossings was replaced with HDPE in 2019.
- Only one location was found to have a minor coating defect in conjunction with sub-criterion cathodic protection.

Based on the above findings, the design life for the waterline was extended from the 50-years used in the risk-based scoring to 70-years.

Table 6-6 below provides the updated assessment for steel portion of the Southside Waterline:

Table 6-6
Updated Gibbons Waterline Relative Risk Assessment

	On-Line Pumping and Storage Facility to Gibbons Town Limits	Within the Town of Gibbons
Waterline Characteristics		
Material	Steel	Steel
Age	46	46
Percent of Used Design Life	66%	66%
Waterline Rating		
Percent of Used Design Life	8	8
Alignment Location*	0	5
Alternate Water Supply	5	5
Total Points	**13**	**18**
Relative Risk	Medium	High

Compared to the prior assessment, the total points for each section has decreased by two. The portion from On-Line Pumping and Storage Facility to Gibbons Town Limits decreased from high to medium risk. The portion within the Town of Gibbons remain high risk due to its alignment.

6.2.4 Remaining Waterlines

As noted previously, no changes to the Alignment Location or Alternative Water Supply Risk Factors have been made since the prior assessment. Therefore, only the Percent of Used Design Life Risk Factor was updated to reflect the increased age of the remaining waterlines since the 2020 assessment. This did not affect the assigned Risk Score for the remaining waterlines.

Table 6-7 summarizes the new risk-based scoring and relative risk for all waterlines.

Table 6-7
Updated Waterline Risk Assessment Results

Waterline	2020		2023	
	Score	Relative Risk	Score	Relative Risk
Northside Waterline				
Northside Meter Vault to Railroad Intersection	10.5	Medium	8.5	Low
Railroad Intersection to On-Line Pumping and Storage Facility	13	Medium	11	Medium
Southside Waterline				
Southside Meter Vault to Township Road 225	15	High	13	Medium
Township Road 225 to Ft. Saskatchewan	12.5	Medium	10.5	Medium
Ft. Sask. To Lamoureux Drive	15	High	13	Medium
Lamoureux Drive to Rail Crossing	10.5	Medium	10.5	Medium
Rail Crossing to On-Line Pumping and Storage Facility	2	Low	2	Low
Redwater Waterline				
On-Line Pumping and Storage Facility to Township Road 555	10.5	Medium	10.5	Medium
Township Road 555 to Township Road 564 (Sturgeon Industrial Park)	13	Medium	13	Medium
Township Road 564 to Redwater Town Limits	10.5	Medium	10.5	Medium
Within the Town of Redwater	13	Medium	13	Medium
Heartland Waterline				
On-Line Pumping and Storage Facility to Red Water Town Limits	4.5	Low	4.5	Low
Within the Town of Redwater	7	Low	7	Low
Gibbons Waterline				
On-Line Pumping and Storage Facility to Gibbons Town Limits	15	High	13	Medium
Within the Town of Gibbons	20	High	18	High
Bon Accord Waterline	7	Low	7	Low
Hewitt Estates Waterline	9.5	Low	9.5	Low

7 OPINION OF PROBABLE COST

7.1 Capital Plan

The year 5-year Capital Plan from the 2020 Master Plan was updated to reflect updated timing for capital projects as well as completed projects. The following projects from the 2020 Master Plan have been completed.

- Assessment of the entire systems cathodic protection.
- SmartBall® inspection and electromagnetic wire break scan of the Northside Waterline.
- SmartBall® inspection of the Southside Waterline.
- SmartBall® inspection of the Gibbon's Waterline.
- HMI Upgrades.
- Gibbons VFD Replacement.

Work related to the Southside Meter Vault was removed from the Capital Plan as the Commission plans to transfer this infrastructure to Strathcona County.

The updated 5-year Capital Plan is provided below in **Table 7-1**. An opinion of probable cost for upgrades to achieve the 5, 10, and 20-year phased growth projections is presented in **Table 7-2** below.

Table 7-1 Updated 5-Year Capital Plan

Item	Cost
2024 Capital Projects	
Redwater VFD Replacement	$52,000
Install 2 new CAV with Chambers	$80,000
Subtotal – 2024 Capital Projects	**$132,000**
2025 Capital Projects	
No Upgrades Recommended	
Subtotal – 2025 Capital Projects	**$0.00**
2026 Capital Projects	
No Upgrades Recommended	
Subtotal – 2025 Capital Projects	**$0.00**
2027 Capital Projects	
No Upgrades Recommended	
Subtotal – 2025 Capital Projects	**$0.00**
2028 Capital Projects	
No Upgrades Recommended	
Subtotal – 2025 Capital Projects	**$0.00**
TOTAL – 5-Year Capital Plan	**$132,000**

Table 7-2 Upgrades to Achieve 5, 10, and 20-Year Growth Projections

Item	Length (m)	Diameter (mm)	Unit Cost ($/m)	Extension
5-Year Growth (2028)				
Redwater VFD Replacement				$52,000
Install 2 New CAV with Chamber				$80,000
Subtotal – 5-Year Growth (2028)				**$132,000**
10-Year Growth (2033)				
Cathodic Protection Assessment				$210,000
SmartBall®/Electromagnetic Investigation – Northside, Southside, and Gibbons				$1,500,000
Westpark Lateral	65	300	$1,300	$84,500
West 400 mm Watermain	1,400	400	$1,600	$2,240,000
400 mm River Crossing	1,000	400	$9,500	$9,500,000
Subtotal – 10-Year Growth (2033)				**$132,000**
20-Year Growth (2043)				
Cathodic Protection Assessment				$210,000
SmartBall®/Electromagnetic Investigation – Northside, Southside, and Gibbons				$1,500,000
Subtotal – 20-Year Growth (2043)				**$1,710,000**
TOTAL – 20-Year Capital Plan				**$15,377,000**

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Water System

8.1.1 Conclusions

- Flow is assumed to occur through the Southside Meter Vault at a constant boundary condition of 600 kPa (710.3 m HGL)
- An incoming pressure of approximately 500 kPa (694 m HGL) at the Northside Meter Vault has been assumed for this assessment, irrespective of the design flow rate. Losses through the new Northside Meter Vault have been considered to establish discharge pressure boundary conditions.
- The current VFD setpoint for the Redwater pumps can be reduced
- It is anticipated that there is sufficient upstream pressure to supply the Redwater System by bypassing the On-Line Pumping Station up to the 2033 Peak Day scenario and average day demands beyond that. This will depend upon actual demands as well as upstream supply pressure.
- The current VFD setpoint for the Gibbons pumps is insufficient to meet the minimum pressure requirements for the 2023 Peak Day Demand.
- Refer to the 2020 Master Plan for additional conclusions.

8.1.2 Recommendations

- Lower the current VFD setpoint for the Redwater pumps to 687 m (422 kPa).
- Raise the current VFD setpoint for the Gibbons pumps to at least 737 m HGL (910 kPa).
- Undertake Upgrades as per **Figure 4-1**.
- Install a new 400 mm waterline from the 900 mm Northside Waterline directly to the Westpark Reservoir around 2033.
- Twin approximately 65 m of 300 mm lateral to the Westpark Reservoir in approximately 2033.
- Make modifications to supply the Redwater System by bypassing the On-Line Pumping Station entirely. The existing pumps should be maintained to provide minimum pressure in the event that the required upstream pressure cannot be maintained.
- Refer to the 2020 Master Plan for additional recommendations.

8.2 Condition Assessment

8.2.1 Conclusions

- The Northside Waterline assessment identified three leaks, did not identified any broken wires, determine the waterline has sufficient structural capacity, and anticipated the replacement of 10 pipes by 2051.
- The large diameter valves along the Northside Waterline should be inspected to confirm condition and operability.
- The Southside Waterline assessment did not identify any leaks or gas pockets; however, one acoustic anomaly was detected.
- The Gibbons Waterline assessment did not identify any leaks, gas pockets, or acoustic anomalies.
- The Southside and Gibbons Waterlines are cathodically protected and well coated along the majority of there length.

- The section of the Redwater Waterline crossing the creek near Pembina's Redwater Facility was found to be unprotected, and the section crossing the creek near Hu Havon could not be assessed.

8.2.2 Recommendations

- Repair the leaks identified along the Northside Waterline.
- Investigate the acoustic anomaly along the Northside Waterline.
- Assess the condition of the large diameter valves along the Northside Waterline.
- Investigate the acoustic anomaly along the Southside Waterline.
- Preform additional coating assessment surveys with rectifier R5 de-energized for the 980 m length of the Southside Waterline north of Highway 15.
- Preform an investigative dig in areas where coating defects were found in conjunction with sub-criterion cathodic protection.
- Monitor coating defects found in conjunction with sufficient levels of cathodic protection.
- Increase rectifier output to improve protection levels at locations that have sub-criterion cathodic protection along the Gibbons Waterline.
- Preform another SmartBall®/electromagnetic investigation of the waterlines in 10 years.
- Preform another cathodic protection assessment of the waterlines in 10 years.

CLOSURE

This report was prepared for the Capital Region Northeast Water Services Commission to supplement the 2020 Master Plan and incorporate the latest planning and water use projections as well as the results of completed condition assessments.

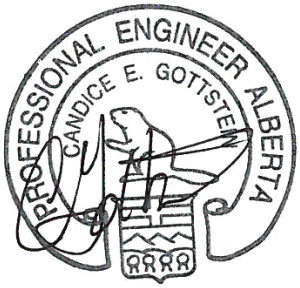
The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,

Associated Engineering Alberta Ltd.

ID #153331
2023-05-25

Chris Parfitt, P.Eng.
Project Manager



2023-05-25
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Candice Gottstein, P.Eng.
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PERMIT TO PRACTICE
ASSOCIATED ENGINEERING ALBERTA LTD.
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ID: 84469
26 May. 2023
PERMIT NUMBER: P 03979
The Association of Professional Engineers and Geoscientists of Alberta

APPENDIX A - LEAK LOCATION FIGURES

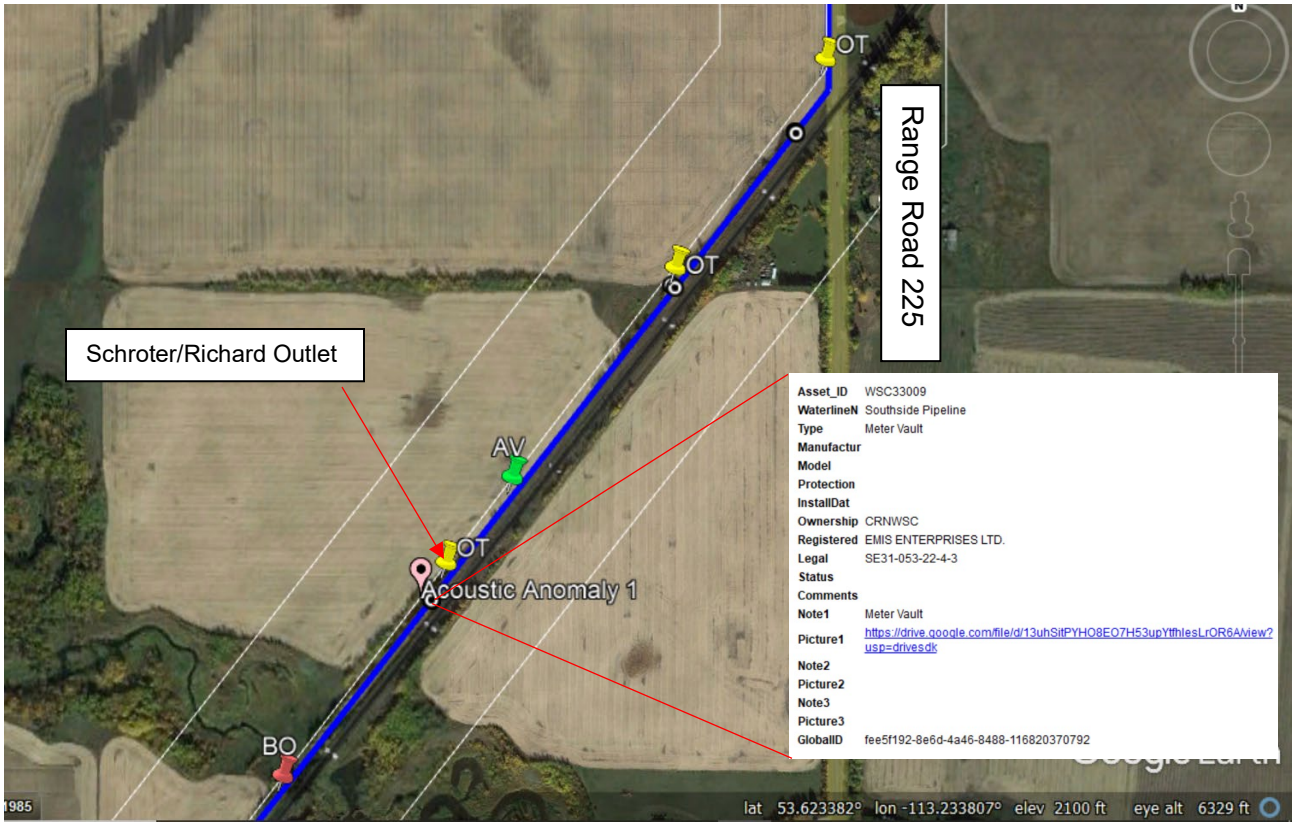


Figure 2.1: Approximate Location of Acoustic Anomaly

The acoustic intensity of the event detected by the SmartBall technology is presented in Figure 2.2.

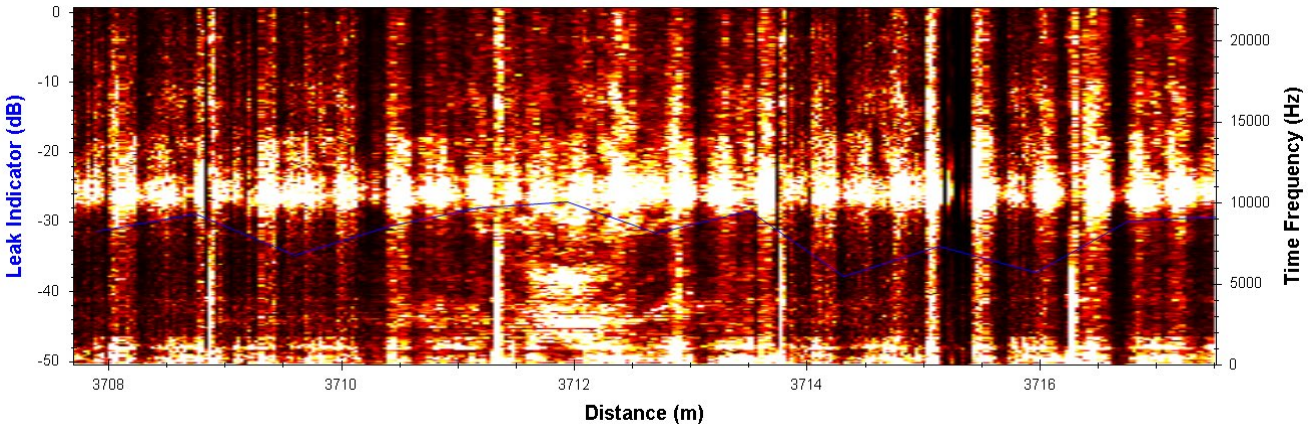


Figure 2.2: Acoustic Intensity of Acoustic Anomaly #1

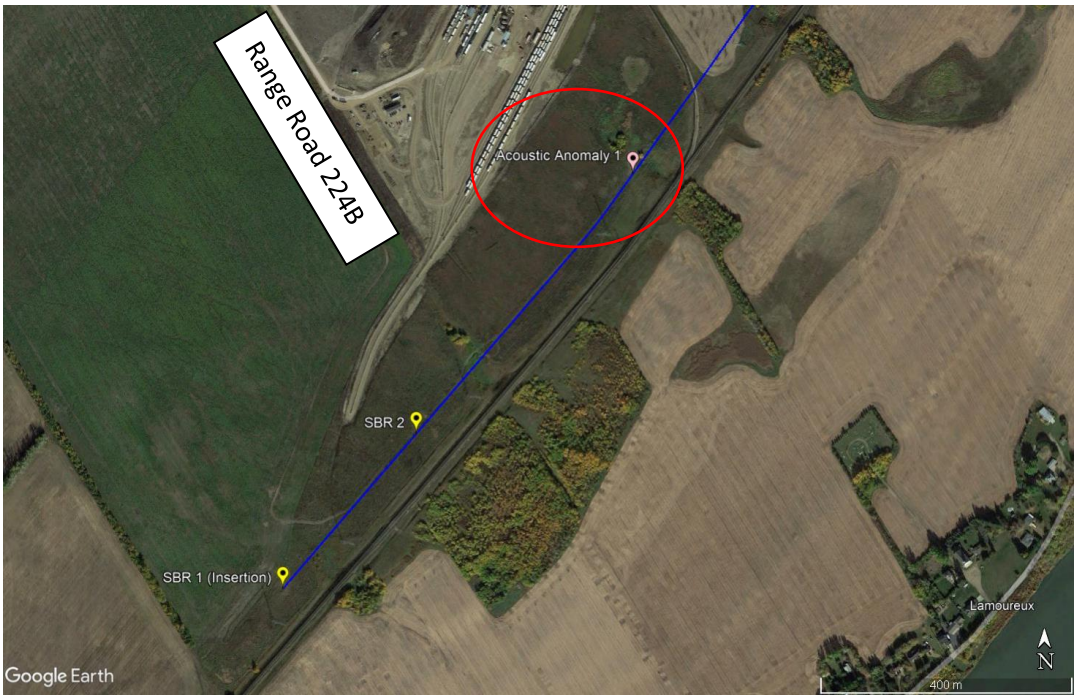


Figure 1: Approximate Location of Acoustic Anomaly on the Northside Waterline

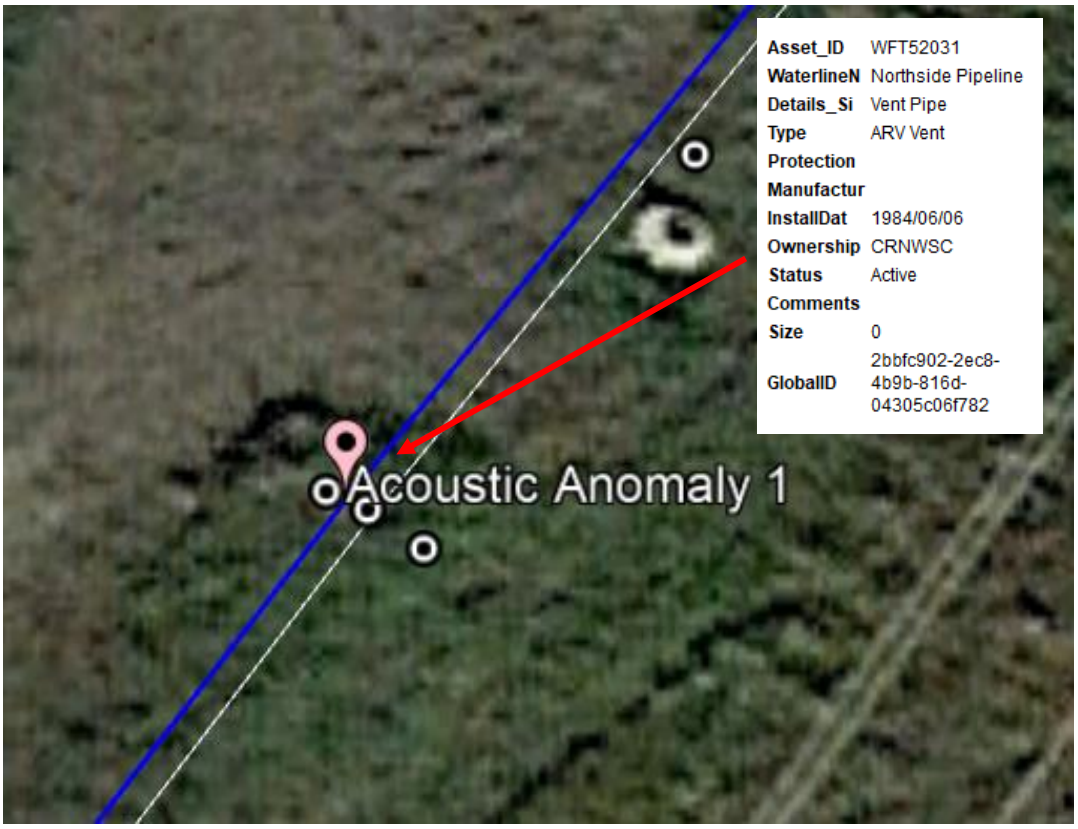
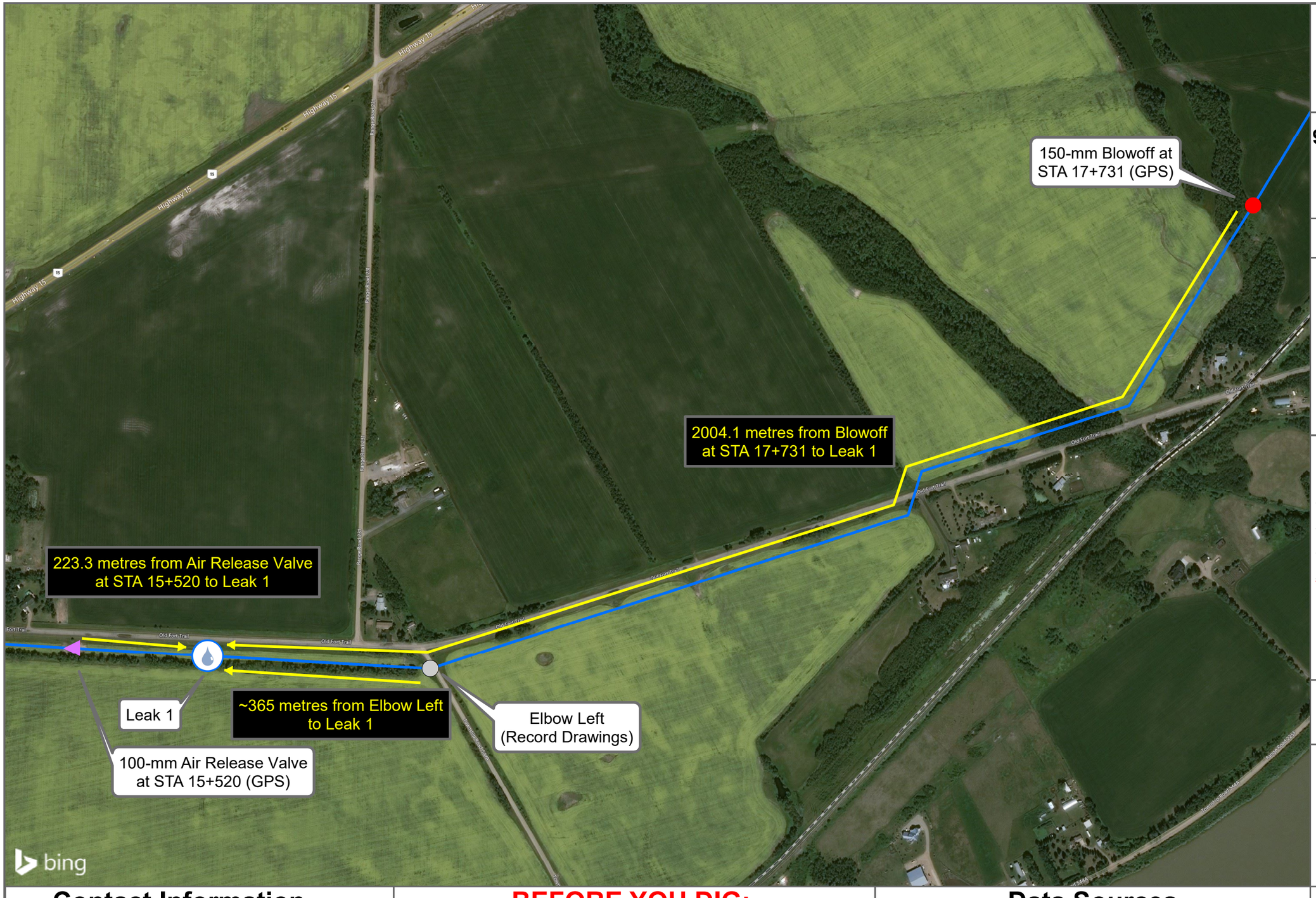


Figure 2: Location of Acoustic Anomaly



900mm Northside Waterline Leak 1

DIG SHEET

Map Date: 09/03/2021

Legend

- Leak
- Air Release Valve
- Blowoff
- Elbow
- 900mm Northside Waterline

Feature of Interest Coordinates

Feature	X (WGS84)	Y (WGS84)
15+520	-113.277539	53.700898
17+731	-113.248675	53.708000

Supplied coordinates are for reference only. Please refer to leak locating best practices for proper usage of these coordinates.

Distance to Leak

Dist. From 15+520	Dist. From 17+731
223.3 metres	2004.1 metres

N

0 50 100 150 200 250 300

Meters

Contact Information

Project Manager: Jackson Nzainga
Mobile: (647) 272-2358
Email: Jackson.Nzainga@Xylem.com

BEFORE YOU DIG:

Please contact the Xylem Project Manager prior to excavating or conducting repairs. Read and understand the locating procedures outlined in the associated Report. Measure from both the upstream and downstream features. Notify Xylem of any uncertainties in the associated Report or this Dig Sheet.

Data Sources

Pipeline Mapping: CRNWSC record drawings
GPS Equipment Accuracy: ~1 Metre

Leak locations derived from Xylem's proprietary tools and methods. Please see the associated technology report for more details.

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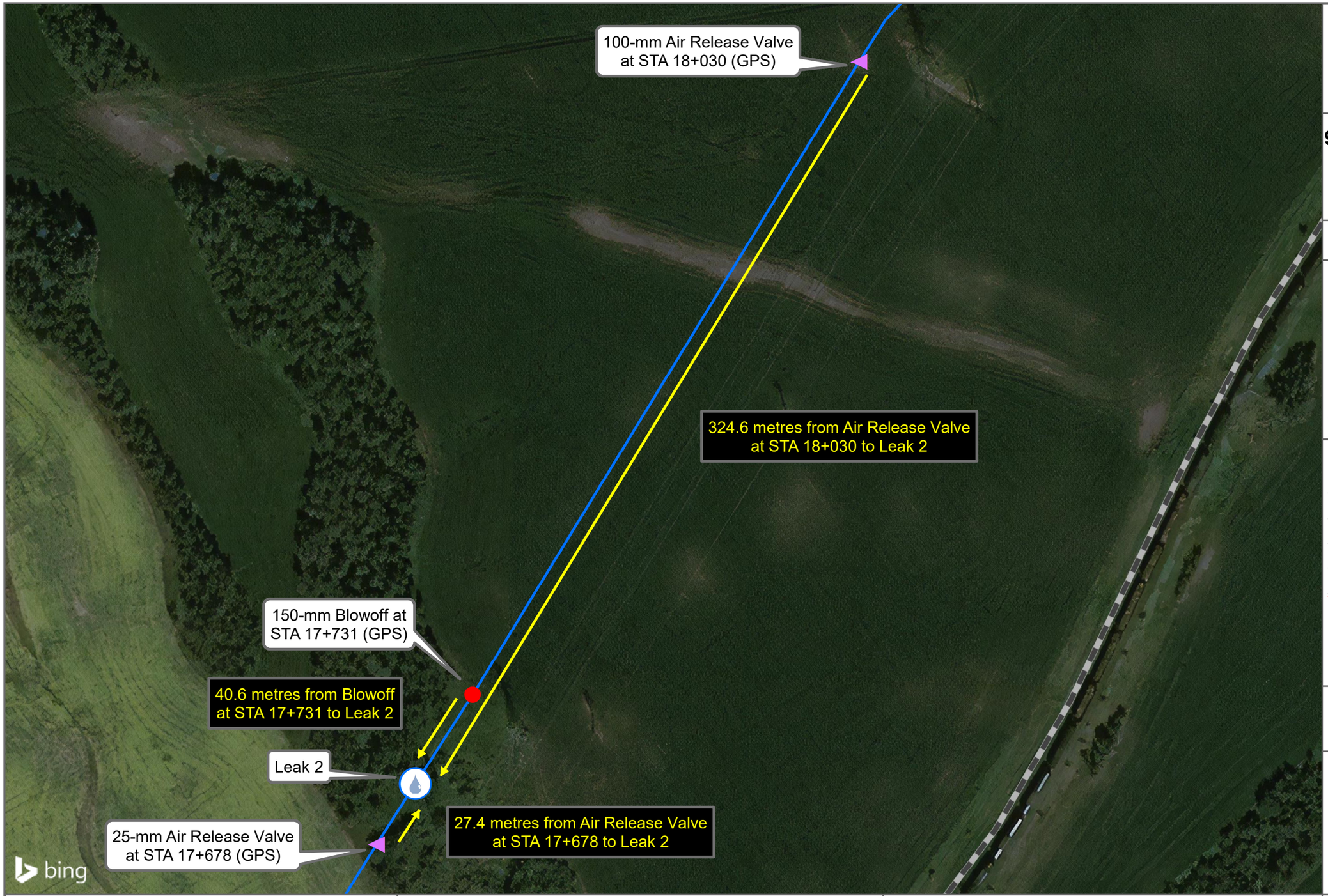

900mm Northside Waterline Leak 2

DIG SHEET

Map Date: 09/03/2021

Legend

- Leak
- Air Release Valve
- Blowoff
- 900mm Northside Waterline

Feature of Interest Coordinates

Feature	X (WGS84)	Y (WGS84)
17+678	-113.249176	53.707487
17+731	-113.248675	53.708000
18+030	-113.246523	53.710194

Supplied coordinates are for reference only. Please refer to leak locating best practices for proper usage of these coordinates.

Distance to Leak

Dist. From 17+678	Dist. From 18+030
27.4 metres	324.6 metres

N

0 20 40 60 80

Meters

Contact Information

Project Manager: Jackson Nzainga
Mobile: (647) 272-2358
Email: Jackson.Nzainga@Xylem.com

BEFORE YOU DIG:

Please contact the Xylem Project Manager prior to excavating or conducting repairs. Read and understand the locating procedures outlined in the associated Report. Measure from both the upstream and downstream features. Notify Xylem of any uncertainties in the associated Report or this Dig Sheet.

Data Sources

Pipeline Mapping: CRNWSC record drawings
GPS Equipment Accuracy: ~1 Metre

Leak locations derived from Xylem's proprietary tools and methods. Please see the associated technology report for more details.

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SmartBall tool detected a leak signature near 150-millimetre BO at Station 17+731.
It is recommended that the BO should be investigate prior to excavations.

C·R·N·W·S·C

900mm Northside Waterline Leak 3

DIG SHEET

Map Date: 09/03/2021

Legend

- Leak
- Air Release Valve
- Blowoff
- 900mm Northside Waterline

Feature of Interest Coordinates

Feature	X (WGS84)	Y (WGS84)
17+678	-113.249176	53.707487
17+731/ Leak 3	-113.248675	53.708000
18+030	-113.246523	53.710194

Supplied coordinates are for reference only. Please refer to leak locating best practices for proper usage of these coordinates.

Distance to Leak

Dist. From 17+678	Dist. From 18+030
68.0 metres	284.0 metres

N

0 20 40 60 80

Meters

Contact Information

Project Manager: Jackson Nzainga
Mobile: (647) 272-2358
Email: Jackson.Nzainga@Xylem.com

BEFORE YOU DIG:

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Data Sources

Pipeline Mapping: CRNWSC record drawings
GPS Equipment Accuracy: ~1 Metre

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