North Red Deer River Water Services Commission (NRDRWSC) First Nations Feasibility Study

FINAL REPORT

December 12, 2019

Prepared for:

NRDRWSC

Prepared by:

Stantec Consulting Ltd.

113929561

Revision	Description	Author		Quality Check		Independent Review	
0	Draft	Joon Choi	JC	Stephan Weninger	SW		
1	Final	Joon Choi	JC	Stephan Weninger	SW		

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STEPHAN WENINGER
2019-12-12

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STANTEC CONSULTING LTD.
Signature _____
Date 2019-12-12
PERMIT NUMBER: P 0268
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

Table of Contents

LIST OF TABLES

Executive Summary

As proactive supporters of the First Nations Participation in Regional Water System initiative of the Government of Alberta, the following study was conducted on behalf of the North Red Deer River Water Services Commission (NRDRWSC) to determine and document the feasibility of extending the existing regional water system to provide a secured water supply for the four First Nation bands of Maskwacis (Montana, Samson, Louis Bull, and Ermineskin).

Given the flow and population projections of the existing member communities as well as the four Maskwacis First Nations bands, it is expected that in 2048, the total annual volume of water diversion will be just over 8 million m^3 with the connection of all parties. This deems that capacity is not an issue within the 30-year design span, however, the License to Divert Water will need to be re-evaluated in the future as the license is set to expire in 2031.

Five separate alignments connecting the South of Ponoka to a terminus point at the southern boundary of Ermineskin have been considered for their length, cost, ease of ROW obtainment, and practicability. The hydraulics between the alignments are not expected to differ significantly but rather, only the hydraulic modelling between the scenario in which all First Nations bands join versus the scenario in which just Ermineskin join have been considered. In either case, it is feasible to extend the existing system with 500 mm diameter PVC pipe or 600 mm diameter HDPE DR11. In the case where all First Nations bands join, a booster station will be required as depicted by the hydraulic spike in Figure 5. The costs of the installations will depend largely on the usage of horizontal directional drilling versus open-cut trench installation.

In conclusion, as depicted in Figure 1, the Central-East or Central Alignments (Option 3, Magenta and Option 5, Violet, respectively) is preferred for their overall proximity to the First Nations and various connection intents. The approximate price range for the construction of the Central-East or East Alignment extension is expected to be approximately $30 million to $42 million, depending on the methods of pipe installation utilized.

Upon commissioning of the potential expansion and regardless of the service relationship between the Commission and any new system user, a “buy-in” or “access fee” proportionate to the new user’s flow allocation should be considered based on the total investments to date in debenture payments and reserves created.

Abbreviations

ADD	Average Day Demand
AT	Alberta Transportation
HDD	Horizontal Directional Drilling
HGL	Hydraulic Grade Line
LCPD	Litres Per Capita Per Day
LOS	Level of Service
MDD	Maximum Day Demand
NRDRWSC	North Red Deer River Water Services Commission
OPC	Opinions of Probable Cost
PF	Peaking Factor
SCN	Samson Cree Nation
WTP	Water Treatment Plant

1.0 THE NRDRWSC SYSTEM

This study explores alignment options, hydraulics and costing of a potential extension of the existing North Red Deer River Water Services Commission (NRDRWSC) pipeline from Ponoka to the four First Nations around Maskwacis. The Government of Alberta has advised that they have reached an agreement to supply Ermineskin Cree Nation with water through the NRDRWSC system, and have subsequently provided funding to the NRDRWSC to study the system extension to the four bands. The existing water systems within the First Nations bands can be summarized to be in need of improvements when considering long-term supply. The extension will fulfill the design intent of the original regional line and expand the network of the NRDRWSC as a regional Commission across the region. In accordance with the Alberta Environment (now Alberta Environment and Parks) License to Divert Water, effective August 3rd, 2006, the North Red Deer River Water Services Commission (NRDRWSC) is permitted to divert potable water from the City of Red Deer to a total annual volume of 13,391,000 m^3 within a rate of diversion (flow rate) of under 0.54 m^3/s. The existing NRDRWSC regional water transmission system services the Town of Blackfalds, City of Lacombe, Lacombe County, Town of Ponoka, and Ponoka County with a total annual volume of approximately 3 million m^3 currently being used.

1.1 HISTORICAL AND CURRENT USAGE

Usage of the system is primarily through to the Town of Blackfalds (which also supplies water to a Lacombe County development), the City of Lacombe, and the Town of Ponoka. Additionally, flow is provided to development in Ponoka County at Wolf Creek Village, though this is comparatively minor in the context of overall system flows. The actual flows pertaining to these connection points from 2014 to 2018 are tabulated below:

Table 1 : 2014-2018 Average Water Usage for Blackfalds, Lacombe, Ponoka

Connection	2014 Flow (m^3/day)	2014 Average Daily Demand (ADD, l/s)
Wolf Creek Village (Ponoka County)	20	0.23
Ponoka	1,936	22
Blackfalds	1,858	22
Lacombe	3,640	42

Total	7,454	86
	2015 Flow (m^3/day)	**2015 Average Daily Demand (ADD, l/s)**
Wolf Creek Village (Ponoka County)	23	0.27
Ponoka	1,959	23
Blackfalds	2,061	24
Lacombe	3,731	43
Total	7,774	90
	2016 Flow (m^3/day)	**2016 Average Daily Demand (ADD, l/s)**
Wolf Creek Village (Ponoka County)	27	0.31
Ponoka	1,907	22
Blackfalds	2,021	23
Lacombe	3,449	40
Total	7,404	86
	2017 Flow (m^3/day)	**2017 Average Daily Demand (ADD, l/s)**
Wolf Creek Village (Ponoka County)	27	0.32

Ponoka	1,886	22
Blackfalds	2,193	25
Lacombe	3,513	41
Total	7,619	88
	2018 Flow (m^3/day)	**2018 Average Daily Demand (ADD, l/s)**
Wolf Creek Village (Ponoka County)	25	0.29
Ponoka	1,948	23
Blackfalds	2,326	27
Lacombe	3,682	43
Total	7,981	92
	5-Year Average Flow (m^3/day)	**5 Year ADD Average (l/s)**
Wolf Creek Village (Ponoka County)	24	0.28
Ponoka	1,927	22
Blackfalds	2,092	24
Lacombe	3,603	42

Total	7,646	88

The past five complete years as displayed above do not provide trending signs of significant water usage increases in these communities. In fact, from the Preliminary Design Report developed by Associated Engineering (AE) in 2003, the average day water consumption in 2001 and 2002 for the Town of Ponoka was greater than that of more recent years (see Table 2 below). For future long-term projections, a standard 2% annual growth is applied to these municipalities. Although different growth rates may be assumed by individual municipalities, this standard rate is deemed acceptable for the purpose of forecasting and regional waterline modelling in this report. From the 5-Year Average Flows, the current total flow of the Town of Blackfalds, City of Lacombe, Lacombe County, Town of Ponoka, and Ponoka County is along the magnitude of approximately 2.8 million m^3 / year.

Table 2 : 2001-2002 Average Day Water Consumption for Blackfalds, Lacombe, Ponoka

Municipality	2001 Average Day Consumption (l/s)	2002 Average Day Consumption (l/s)
Ponoka	28.1	28.2
Blackfalds	11.6	11.6
Lacombe	37.5	35.3
Total	77.2	75.1

Flow projections with consideration for population growths are explored in the next section. However, from the sheer comparison of real data ADDs, the total liters per second usage of the three communities combined has experienced a 17.9 l/s increase in 16 years between 2002 and 2018. This translates to a combined annual growth rate of approximately 1.345%. As a result, a standard 2% growth rate for use in future projections can be deemed as conservative when compared to recent empirical data.

1.2 FLOW PROJECTIONS AND AVAILABLE CAPACITY

1.2.1 Existing System (30-Year Horizon)

The existing system does not include provisions for the proposed linkages to the four Maskwacis First Nation bands and considers only the existing connection of approximately 51 km between the City of Red Deer and the Town of Ponoka. To accommodate an extension of the system, a connection will have to be

made on the line at the south end of Ponoka where the mainline size is nominal 500 mm internal diameter PVC pipe.

For the purposes of this feasibility study, an analysis of the hydraulic implications of extending the system versus maintaining the existing system configuration was undertaken.

As described in Section 1.1, a 2% annual flow growth rate is a conservative estimate for the aggregate growth rates for Town of Blackfalds, City of Lacombe, Town of Ponoka, and Ponoka County. Applying this growth rate to a 30 – year horizon from the 2018 data results in the following projected ADD flow rates in 2048:

Table 3 : ADD and Annual Flow Projections to 2048

Municipality	2018 ADD (l/s)	2048 ADD (l/s)	2048 Annual Flow (m^3/year)
Wolf Creek Village (Ponoka County)	0.29	0.53	16,566
Ponoka	23	42	1,313,831
Blackfalds	27	49	1,542,324
Lacombe	43	78	2,456,293
Total	93	169	5,329,014

Using the combined daily outflow data of the City of Lacombe's Reservoirs A, B, and C between 2014 and 2018, the following peaking factors have been calculated:

Table 4 : City of Lacombe Peaking Factors (2014 – 2018)

Year	Peaking Factor (PF)
2014	1.49
2015	1.59
2016	1.47
2017	1.48
2018	1.37
Average	**1.48**

As such, an average rounded PF of **1.5** will be used for all applications in this feasibility study. Table 5 displays the information summarized in Table 3 with the addition of the Maximum Day Demand (MDD) calculated with a PF of 1.5:

Table 5 : Existing System ADD, MDD, and Annual Flow Projections to 2048

Municipality	2018 ADD (l/s)	2048 ADD (l/s)	2048 MDD (l/s)	2048 Annual Flow (m^3/year)
Wolf Creek Village (Ponoka County)	0.29	0.53	1	16,566
Ponoka	23	42	62	1,313,831
Blackfalds	27	49	73	1,542,324
Lacombe	43	78	117	2,456,293
Total	93	169	253	5,329,014

In terms of capacity, the 2048 Annual Flow will be representative of the total volume of water diversion required from the City of Red Deer, however, a water supply system needs to be able to accommodate daily fluctuations in demand. The MDD flow identifies the level of service (LOS) to which a system should perform under normal operating conditions.

1.2.2 Proposed System (30-Year Horizon)

The proposed system integrates the four Maskwacis First Nations into the regional waterline. The sequence and the extent of the First Nation connections is unknown at this time; however, the four communities are to be considered simultaneously from a technical capacity standpoint.

From the Government of Alberta Municipal Affairs Population Lists, the on-reserve population growth rates of the four bands for specific time intervals are tabulated below:

Table 6 : First Nations Population Growth Rates

	Populations and Growth Rates			
First Nations Band	**1997**	**2007**	**10-Year Growth Rate (%)**	**Equivalent Annual Growth Rate (%)**
Ermineskin	2,031	2,770	36	3.15
Louis Bull	1,089	1,498	38	3.24
Montana	479	685	43	3.64
Samson	4,328	5,469	26	2.37
	2007	**2017**	**10-Year Growth Rate (%)**	**Equivalent Annual Growth Rate (%)**
Ermineskin	2,770	3,602	30	2.66
Louis Bull	1,498	1,820	21	1.97
Montana	685	767	12	1.14
Samson	5,469	6,431	18	1.63
	2017	**2018**	**10-Year Growth Rate (%)**	**Equivalent Annual Growth Rate (%)**
Ermineskin	3,602	3,668	N/A	1.83
Louis Bull	1,820	1,873	N/A	2.91

Montana	767	784	N/A	2.22
Samson	6,431	6,673	N/A	3.76
	Average Annual Growth Rate (%)			
Ermineskin	2.55			
Louis Bull	2.71			
Montana	2.33			
Samson	2.59			
Total FN	**2.54**			

The average annual growth rate of the Maskwacis First Nation bands when considering the data from 1997 to 2018 comes to about 2.54% per year. This is slightly higher than the estimated 2% growth factor applied to the existing member municipalities.

The NRDRWSC Preliminary Design Report (AE, 2003) notes the use of 370 lcpd (liters per capita per day) for all urban areas and 180 lcpd for all First Nations rural areas. However, from the Government of Canada Census data in 2016, the Town of Blackfalds, City of Lacombe, and Town of Ponoka had a combined population of 29,614, and given the numbers in Table 1, the total water volume consumption of those municipalities in 2016 was 2,702,460 m^3/year.

As a result, the recent real-time lcpd can be calculated as follows:

$$\frac{2{,}702{,}460\ m^3}{year} \times \frac{1\ year}{365\ days} \times \frac{1000\ L}{1\ m^3} \times \frac{1}{29{,}614} = 250\ lcpd$$

To add an element of conservatism to this value, it is recommended to proceed with flow projections of the proposed system with **275 lcpd** for all First Nation bands.

Parameters for proposed expanded system flow projections:

- 275 lcpd
- Annual Growth Rate = 2.54%
- PF = 1.5

Table 7 below outlines flow projections of the proposed extension system:

Table 7 : Proposed System ADD, MDD, and Annual Flow Projections to 2048

First Nation Band	2018 ADD (l/s)	2048 ADD (l/s)	2048 MDD (l/s)	2048 Annual Flow (m^3/year)
Ermineskin Cree Nation	11.7	24.8	37.2	781,366
Louis Bull Tribe	6.0	12.7	19.0	398,991
Montana First Nation	2.5	5.3	7.9	167,009
Samson Cree Nation	21.2	45.1	67.6	1,421,497
Total	41.4	87.8	131.7	2,768,863

As previously mentioned in Section 1.1, the current total flow of the existing NRDRWSC members is approximately 2.8 million m^3/year. From Table 5, the existing system servicing the municipalities alone will be diverting approximately 5.3 million m^3/year in 2048. Finally, from Table 7, the potential addition of all 4 Maskwacis First Nations bands will increase the scale of diversion by another 2.8 million m^3 per year by 2048 – bringing the total annual flow to approximately 8.1 million m^3/year.

As per the License to Divert Water from 2006, the expected annual flows by 2048 are still well below the limit of 13,391,000 m^3/year. However, this threshold will need to be re-evaluated in the future as the license is set to expire in 2031.

1.3 HYDRAULICS AND WATERLINE MODELLING

1.3.1 Overview

The intent of the feasibility study is to assess the technical implications of extending the current terminus at the Town of Ponoka into the Maskwacis First Nations region. Upon discussions with the Commission and several associates of the First Nations, the exact location of the new terminus is currently unknown, however, through discussions with Alberta Transportation, for the purposes of project funding, it is considered to be the south boundary of Ermineskin, along Highway 2A.

As a result, two scenarios are currently considered for the purposes of the feasibility study:

- Connection to just Ermineskin;
- Connection to all four First Nations bands (Ermineskin Cree Nation, Louis Bull Tribe, Montana First Nation and Samson Cree Nation).

The scenarios aim to represent the minimum and maximum cases regarding potential future usage. As suggested by the population and flow projections in Section 1.2, the intent is to outline a 30-year demand design.

1.3.2 Pressure and Velocity Requirements

The analyses were constrained to ensure water pipeline pressures were maintained to at least 150 kPa (22 psi) throughout the system. This requirement was to ensure the distribution system could deliver water to each community in the system. Additionally, the system materials must be able to withstand normal operating pressures as well as pressure surges that are likely to occur as a result of system starts and stops, line breaks, power failures, and line tapping.

Water velocities in the system will vary in response to changes in demand. Expected water velocities affect pipe sizing and are related to construction costs. Flow velocities greater than 1.2 m/s are not recommended for regional lines of this length. High velocities are associated with higher friction values (decreased system efficiency) and system surges. To minimize capital costs, it is desirable to design a system with flow velocities as between 1.0 m/s and 1.2 m/s (given system pressures) for the maximum projected demands.

1.3.3 Conceptual Alignments

The alignment of the waterline extension requires a delicate balance between technical feasibility, alignment access, and border crossing permissions of the Maskwacis First Nation bands. Several variables have dictated the alignment options:

- The terminus of the expansion will be at the Ermineskin south boundary along Highway 2A;
- The alignment should follow existing road and/or highway pathways;
- The alignment is to have the least number of First Nation reserve border crossings as possible;
- Minimizing land acquisition and easement costs;
- Considering trenched line installations within existing road rights-of-way, if sufficient width;
- Avoiding wetlands where practical;
- Addressing proposed developments or other future servicing requirements;
- Minimizing impacts on existing infrastructure - roads and utilities;
- Avoiding treed areas when possible to reduce costs;

- Using or connecting to existing lines when possible;
- Remaining cost effective.

Figure 1 and Figure 2 on the following pages display the five proposed alignments. Figure 1 outlines the overall alignment starting from the City of Red Deer to a terminus at the southern border of Ermineskin, whereas Figure 2 provides a zoomed-in view within Maskwacis.

TWP-046 RGE-27 MER-4
TWP-046 RGE-26 MER-4
TWP-046 RGE-25 MER-4
TWP-046 RGE-24 MER-4
TWP-046 RGE-23 MER-4
N
822 Highway
TWP-045 RGE-27 MER-4
TWP-045 RGE-26 MER-4
LOUIS BULL I.R. 138B
TWP-045 RGE-25 MER-4
TWP-045 RGE-24 MER-4
ERMINESKIN I.R. 138
TWP-045 RGE-22 MER-4
TWP-045 RGE-23 MER-4
SAMSON I.R. 137
TWP-044 RGE-24 MER-4
TWP-044 RGE-27 MER-4
TWP-044 RGE-26 MER-4
TWP-044 RGE-25 MER-4
2A Highway
TWP-044 RGE-23 MER-4
SAMSON I.R. 137
795 Highway
SAMSON I.R. 137A
MONTANA I.R 139
TWP-043 RGE-27 MER-4
TWP-043 RGE-26 MER-4
2 Highway
TWP-043 RGE-25 MER-4
TWP-043 RGE-24 MER-4
TWP-043 RGE-23 MER-4
PONOKA COUNTY
PONOKA
53 Highway
53 Highway
815 Highway
TWP-042 RGE-27 MER-4
TWP-042 RGE-26 MER-4
TWP-042 RGE-25 MER-4
TWP-042 RGE-24 MER-4
TWP-042 RGE-23 MER-4
604 Highway
821 Highway
TWP-041 RGE-27 MER-4
TWP-041 RGE-26 MER-4
LACOMBE COUNTY
TWP-041 RGE-25 MER-4
TWP-041 RGE-24 MER-4
TWP-041 RGE-23 MER-4
LACOMBE
TWP-040 RGE-27 MER-4
TWP-040 RGE-26 MER-4
BLACKFALDS
TWP-039 RGE-27 MER-4
TWP-039 RGE-26 MER-4
RED DEER COUNTY
TWP-038 RGE-27 MER-4
TWP-038 RGE-26 M
RED DEER

Number of Crossings					
	Option 1	Option 2	Option 3	Option 4	Option 5
High Pressure Pipeline	8	12	12	7	11
Low Pressure Pipeline	15	20	38	13	23
Roads	20	26	27	17	26
Railway	0	1	0	0	0

Existing Alignment - Length = 52km
Option 1 - Length = 22km
Option 2 - Length = 29km
Option 3 - Length = 29km
Option 4 - Length = 25km
Option 5 - Length = 29km
Roads
Highway
High Pressure Pipelines
Low Pressure Pipelines
Railway
Fortis Powerline

0 2.5 5 10
Kilometers
1:175,000

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113929561
Prepared by AL on 2019-12-05
Review by JC on 2019-12-05

Project Location
RED DEER TO ERMINESKIN I.R. 138

Client/Project
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Figure No.
1

Title
Proposed Waterline Alignments

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TWP-045 RGE-25 MER-4

TWP-045 RGE-24 MER-4

N

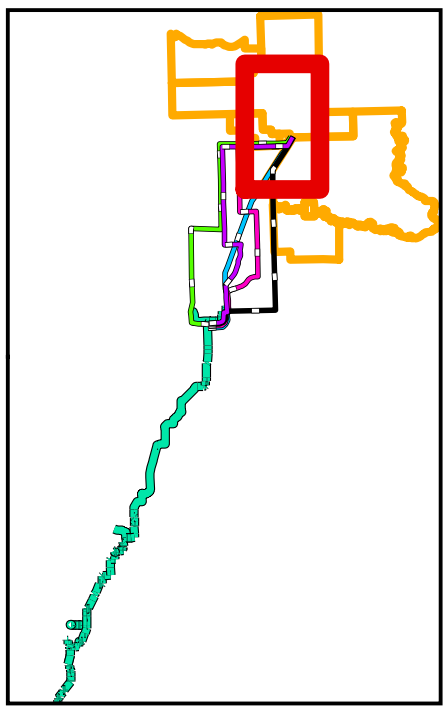
ERMINESKIN I.R. 138

SAMSON I.R. 137

TWP-044 RGE-25 MER-4

TWP-044 RGE-24 MER-4

2A Highway



Number of Crossings					
	Option 1	Option 2	Option 3	Option 4	Option 5
High Pressure Pipeline	8	12	12	7	11
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Roads	20	26	27	17	26
Railway	0	1	0	0	0

Existing Alignment - Length = 52km

Option 1 - Length = 22km

Option 2 - Length = 29km

Option 3 - Length = 29km

Option 4 - Length = 25km

Option 5 - Length = 29km

Roads

Highway

High Pressure Pipelines

Low Pressure Pipelines

Railway

Fortis Powerline

0 0.5 1 2

Kilometers

1:40,000

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Project Location

RED DEER TO ERMINESKIN I.R. 138

Client/Project

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First Nations Feasibility Study

Figure No.

2

Title

Proposed Waterline Alignments

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The following table summarizes some general information about each of the 5 alignments:

Table 8 : Proposed Alignment Details

Highway 2A Alignment (Blue in Figures 1 and 2)	Length: 22 km	8 High Pressure Pipeline Crossings	15 Low Pressure Pipeline Crossings	20 Road Crossings
West Alignment (Green in Figures 1 and 2)	Length: 29 km	12 High Pressure Pipeline Crossings	20 Low Pressure Pipeline Crossings	26 Road Crossings
Central-East Alignment (Magenta in Figures 1 and 2)	Length: 29 km	12 High Pressure Pipeline Crossings	38 Low Pressure Pipeline Crossings	27 Road Crossings
East Alignment (Black in Figures 1 and 2)	Length: 25 km	7 High Pressure Pipeline Crossings	13 Low Pressure Pipeline Crossings	17 Road Crossings
Central Alignment (Violet in Figures 1 and 2)	Length: 29 km	11 High Pressure Pipeline Crossings	23 Low Pressure Pipeline Crossings	26 Road Crossings

As shown in Figures 1 and 2, all alignments merge together along Highway 2A by the northeastern border of Samson Indian Reserve 137 and terminate at the southern border of Ermineskin. Information provided on behalf of Ermineskin suggests that crossing First Nation borders to service other First Nations is highly impractical and time-consuming. The currently proposed alignments do not have easily accessible connections to Louis Bull as their borders are enclosed within the larger Ermineskin when approaching from the South. An alignment tailored towards Louis Bull that heads strongly west and north of the Town of Ponoka will jeopardize the ease of access to the other First Nation bands. It is assumed that an agreement between Ermineskin and Louis Bull will be required in the future to allow for Louis Bull's connection to the extended regional system within Ermineskin's borders.

As a component of the feasibility study, it is important to understand the implications of alignment routing next to a highway. Upon discussions with Alberta Transportation (AT), the use of local and private roads is preferred prior to higher classification roads such as Highway 2A. Although it is possible, the use of Highway 2A to guide the regional alignment extension will require strong evidence and an analysis rationalizing why Highway 2A is the last remaining option and why the nearby local roads are not as feasible. The analysis will need to factor in the risk of potential future utility relocation which will inevitably add time, effort, and expenses to using a primarily Highway 2A guided alignment. It is also significant to

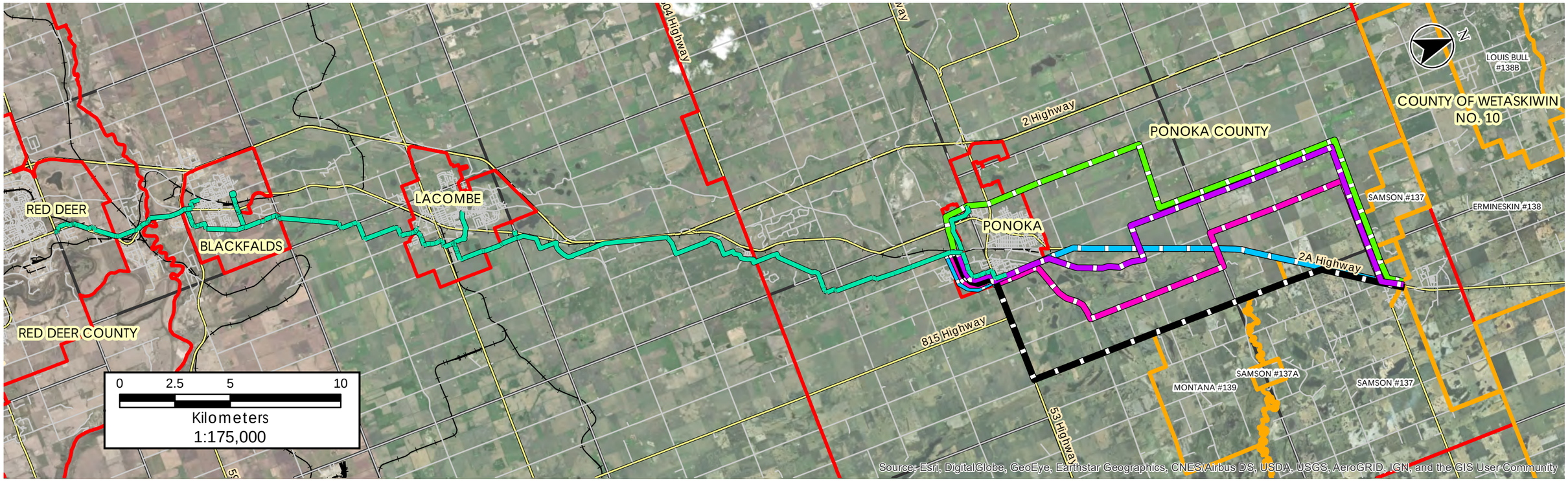
note that due to AT's future plans of expanding Highway 2A to the west, it may only be feasible to conduct drilling of the waterline off the east ROW in close proximity to powerlines and a railway.

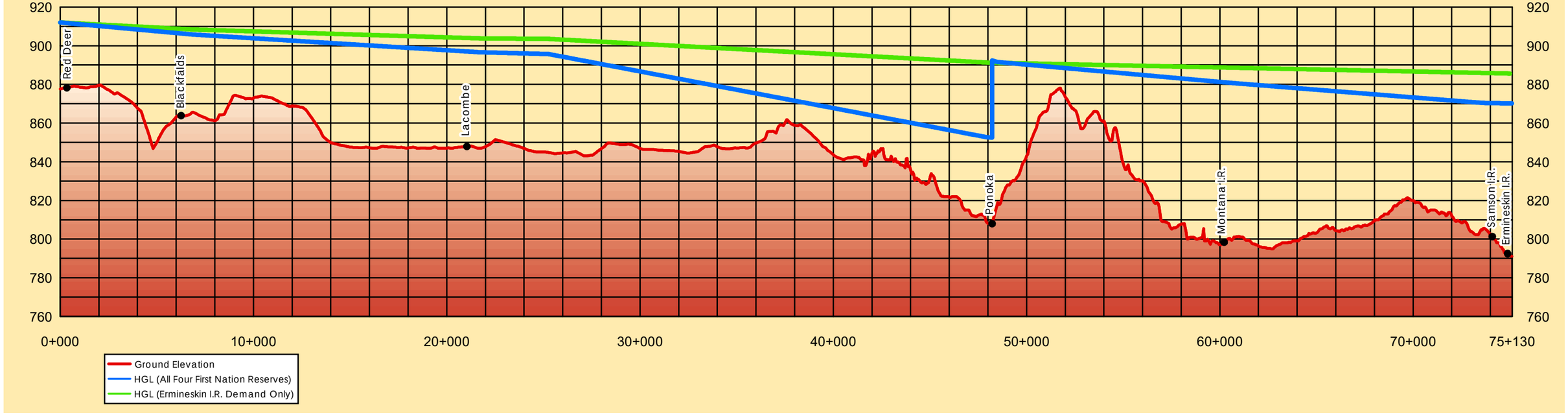
1.3.4 Hydraulic Modelling

As previously mentioned, the hydraulic modelling considers two scenarios that represent the minimum and maximum connections (Ermineskin only, and all four bands, respectively). Based on the flow projections, two hydraulic grade lines (HGL) have been generated using WaterCAD 8.0. Figure 3 portrays the hydraulic grade lines combined in one plan profile where the green line represents the case in which only Ermineskin is connected to the regional system and the blue line represents the case in which all four Maskwacis bands are connected. Figures 4 and 5 show the two HGLs as standalone profiles.

The five separate alignments themselves have minimal impacts to the HGLs. From a hydraulic standpoint, it is not the details of the connection from Ponoka to Ermineskin that matters but rather, the demand that is expected from the regional line. As a result, the two HGLs provided is to be used for all alignment scenarios.

The existing system utilizes 750 mm diameter PVC pipe from Red Deer to slightly north of Lacombe and 500 mm diameter PVC pipe from that point until Ponoka. The hydraulic analysis from Figure 3 suggest that for both connection scenarios, the HGL is above ground elevation from Ponoka to the Maskawacis bands and the extension can be carried out with continued 500 mm diameter PVC piping. However, in the case where all four bands are connected, a booster station will be required at Ponoka as graphically portrayed by a spike in the HGL. Depending on the method of pipeline installation, 600 mm diameter HDPE DR 11 is preferred for horizontal directional drilling as an alternative to 500 mm diameter PVC pipe.





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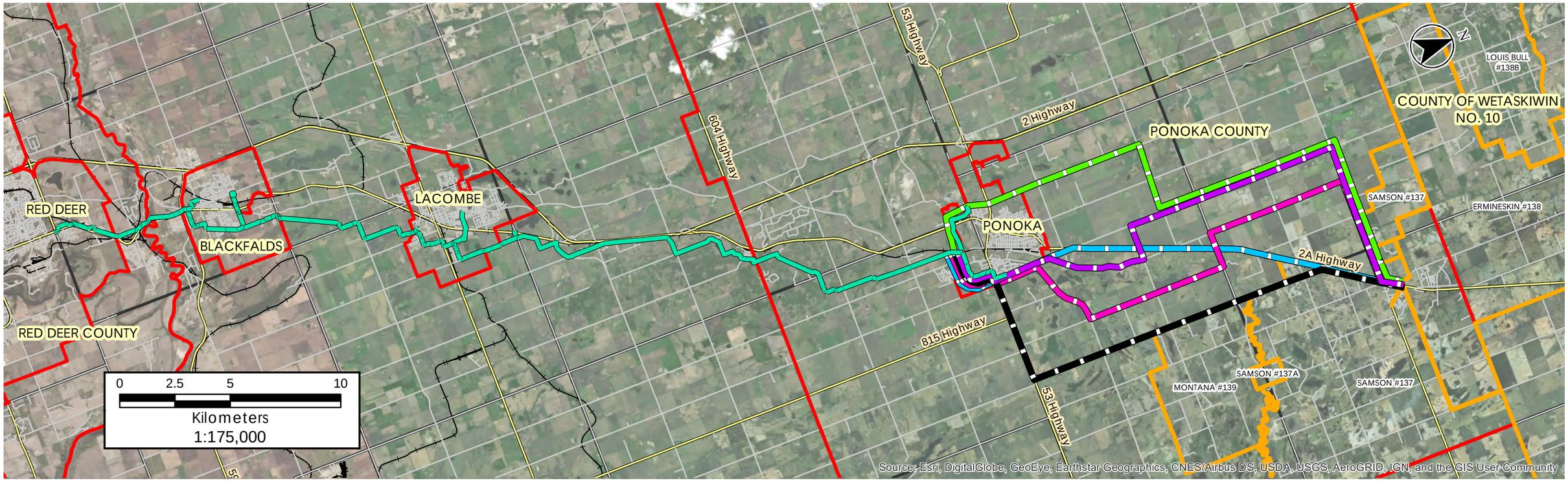
Project Number: 113929561
Prepared by AL on 19-12-05
Review by JC on 19-12-05

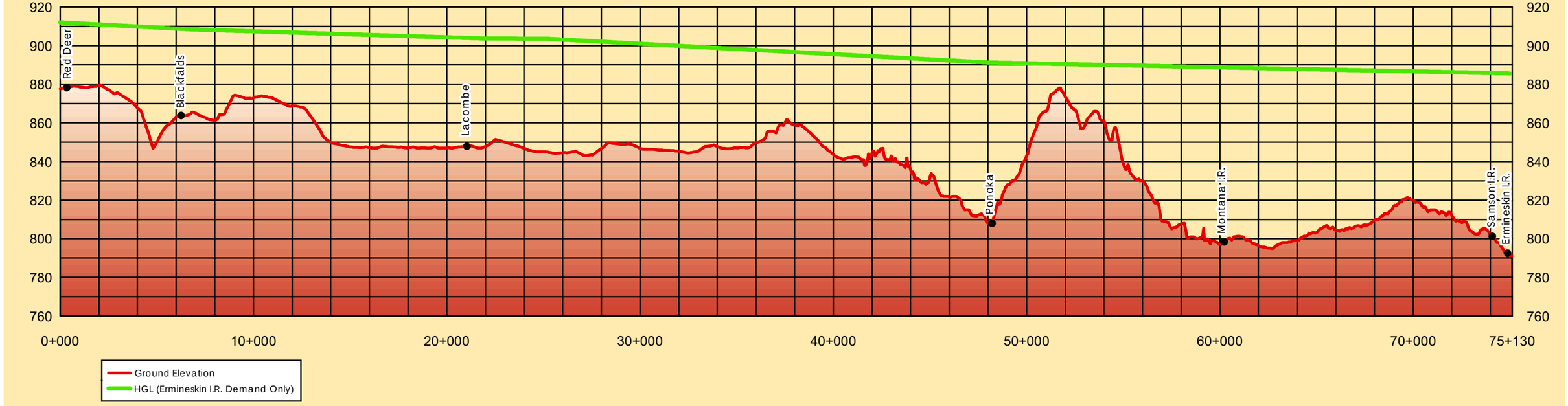
- Option 1 - Length = 22km
- Option 2 - Length = 29km
- Option 3 - Length = 29km
- Option 4 - Length = 25km
- Option 5 - Length = 29km
- Existing Alignment - Length = 52km

- Roads
- Highway
- Railway
- Counties

North Red Deer River Water Services Commission
First Nations Feasibility Study

Figure **3**: Plan Profile; Servicing Options to **All** Four First Nation Reserves, and Ermineskin I.R. Only
Red Deer to Ermineskin I.R. 138





Stantec

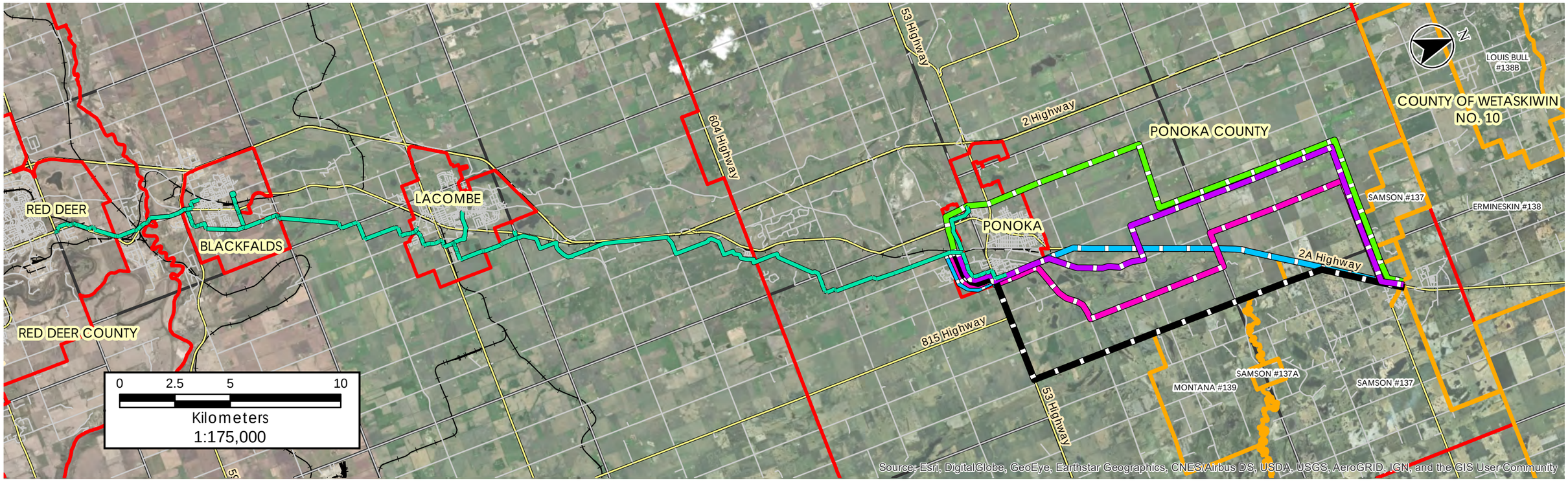
Project Number: 113929561
Prepared by AL on 19-12-05
Review by JC on 19-12-05

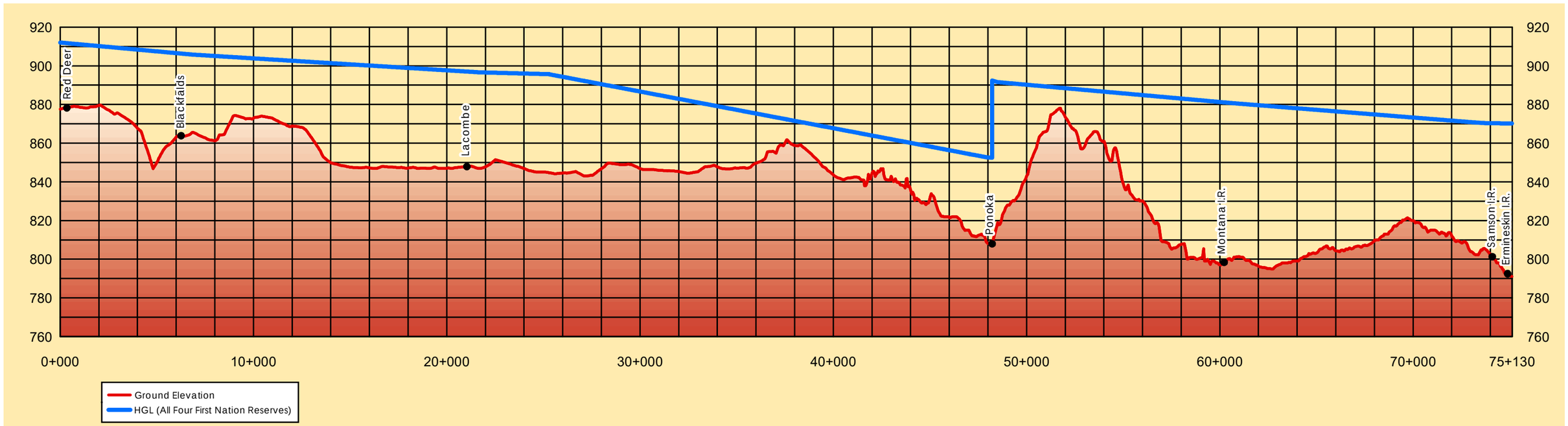
Option 1 - Length = 22km
Option 2 - Length = 29km
Option 3 - Length = 29km
Option 4 - Length = 25km
Option 5 - Length = 29km
Existing Alignment - Length = 52km

Roads
Highway
Railway
Counties

North Red Deer River Water Services Commission
First Nations Feasibility Study

Figure **4**: Plan Profile; Ermineskin I.R. Demand Only
Red Deer to Ermineskin I.R. 138





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Roads
Highway
Railway
Counties

North Red Deer River Water Services Commission
First Nations Feasibility Study
Figure **5**: Plan Profile; Servicing **All** Four First Nation Reserves
Red Deer to Ermineskin I.R. 138

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Table 9 : Hydraulic Analysis Summary

	Pipe Sizing (Internal Diameter, mm)		
Connection Scenario	**Red Deer to North Lacombe (STA 0+000 to STA 25+513)**	**North Lacombe to South Ponoka (STA 25+513 to 47+177)**	**South Ponoka to Ermineskin Terminus (STA 47+177 to ~STA 71+000)**
Ermineskin Only	750	500	500
All Bands	750	500	500 (with booster station at Ponoka)

1.3.5 Demand Sensitivity

1.3.5.1 Sensitivity of Line Sizing Under Varying Hydraulic Conditions

While conservative design assumptions are generally considered prudent, the integration of multiple elements of conservatism – such as growth projections, peaking factors, and per capita water demands – may collectively lead to system sizing beyond what is required over the long term. This can lead to higher operational and depreciation costs. As such, the impacts of reductions in the actual system demands in the four First Nations on system line sizing are displayed in the following table for reference purposes.

Table 10 : Line Size Sensitivity

Scenario	Total Demand for Four First Nations (L/s)	Total NRDRWSC System Demand (L/s)	Pipe Size in Nominal Internal Diameter (mm) + Booster Station Requirement
100% Projected Demand	136	387	500 (booster station required)
75% Projected Demand	102	353	400 (booster station required)

50% Projected Demand	68	319	400 (no booster station required)
25% Projected Demand	34	285	300 (no booster station required)

1.3.6 Water Quality Analysis

Water quality at the points of delivery to the required communities is a function of the water transmission time and the degradation rate of the chlorine residuals stemming from the chlorine disinfection inputs at the City of Red Deer Water Treatment Plant (WTP).

The chlorine input at the WTP is approximately 2.2 ppm, or 2.2 mg/L (equivalent units). The existing system stretches from the City of Red Deer to Ponoka which can used as the nodes to analyze the rate of chlorine degradation throughout the water transmission across the 52 km pipeline.

Riverside, 39th Avenue, and Lucas represent the three sample points in Ponoka in which the water is sampled. Table 11 below outlines the average chlorine concentration of the Ponoka water in each of these locations in the past months of 2019:

Table 11 : Average Chlorine Concentrations at Ponoka

	Chlorine Concentrations (ppm)		
Month (2019)	**Riverside**	**39th Avenue**	**Lucas**
January	1.82	1.83	1.80
February	1.80	1.84	1.88
March	1.88	1.90	1.88
April	1.66	1.70	1.66
May	1.54	1.60	1.60

June	1.56	1.63	1.61
July	1.41	1.52	1.44
August	1.44	1.55	1.48
September	1.42	1.60	1.42
October	1.59	1.63	1.66

During the initial years of system operation, when water demands are at their lowest, it is important to ensure that chlorine residuals are maintained at the downstream end of the system. The concentration of chlorine in the water within the pipeline will decay over time as demonstrated above. Currently, the chlorine concentration in the line is decreasing in the order of 0.2mg/L/day and arrive at Ponoka with a residual in the order of 1.4 - 1.8 mg/L (though both the decay rate and the residuals tend to fluctuate). With an internal diameter of 500 mm, the extended line will store in the order of 5,000 to 5,500 m^3 of water (depending on alignment) between the connection point at Ponoka and the Ermineskin boundary, we would expect the chlorine to be fully consumed in the order of 7 days of travel time, and therefore, the flow of water through the line at this size should be in the order of 800 m^3/day to maintain a chlorine residual in the system. Even at that flow rate, we would recommend any onsite storage infrastructure at Ermineskin be able to boost the chloramine disinfectant in the water to ensure potability.

1.3.7 Community Connections, Requirements, and Connection Points

1.3.7.1 Ermineskin Cree Nation

Details of the existing water supply system, current demands, and future projections were not provided by the Ermineskin Cree Nation for this study, nor was permission for a site visit granted to Stantec. Anecdotally, it is known that the Ermineskin Cree Nation is eager to connect to the regional water system, as its water supply is inadequate, and it resorts to hauling water for distribution to its residents. As such, it is assumed that no viable alternative water source is available to the Ermineskin Cree Nation, and that it will require the full projected water demands through the NRDRWSC system.

Determining the Ermineskin Cree Nation's termination of the regional line will require further investigation. For the purposes of this study, a termination point is assumed along Highway 2A within the urbanized area of Ermineskin.

1.3.7.2 Louis Bull Tribe

The Louis Bull Tribe's existing potable water treatment includes a water treatment plant that draws its raw water from ground water wells. The main treatment process is composed of green sand filtration and

chlorination. To connect the Louis Bull Tribe's potable water system to the NRDRWSC's regional waterline, we would recommend connecting into their existing reservoir at the WTP. This would allow the use of the existing distribution system while decommissioning the WTP components.

The Louis Bull Tribe has not been receptive to discussions with Stantec about the proposed regional waterline extension. As such, it is conservatively assumed that no viable alternative water source is available in the long-term, and that it will require the full projected water demands through the NRDRWSC system.

1.3.7.3 Montana First Nation

Upon discussions with senior Montana First Nation band officials, it is known that aside from the physical land boundary of the Montana Indian Reserve 139, Montana owns a section of undeveloped land enclosed by Highway 2A, Bobtail Road, and Range Road 252A. They also have land proposed for a hospital development and an elders centre at the southwest corner of the intersection between Highway 2A and Highway 611. Montana First Nation is interested in planning for a water supply specifically to those locations, and as such, the Highway 2A Alignment, the Central-East Alignment is the preferred alignment from their perspective.

The Montana First Nation currently operates a membrane water treatment plant with an upstream biofilter. The plant is well maintained and though it has a rated capacity of approximately 1,000 m^3/day, average daily flows are in the order of one tenth capacity, and a substantial amount of the reserve is serviced through water hauling from the plant. The First Nation intends to continue using their existing Water Treatment Plant assets as long as practical and envision extending water distribution line servicing from the plant to maximize its service reach. However, they acknowledge that it is likely not viable to service the aforementioned areas with their existing Water Treatment Plant, and as such, would like these areas incorporated into the planning of the regional system extension. Areas within their main reserve boundary are intended to be serviced from their existing Water Treatment Plant, and as such, they do not see the value in the East Alignment on, or adjacent to, their boundary.

1.3.7.4 Samson Cree Nation

The existing potable water facility has been investigated by Urban Systems to assess possible potable water sources to supply the Samson Cree Nation (SCN), in the Samson Cree Nation Water Servicing Feasibility Study dated July 19, 2019.

The existing Samson Cree potable water supply is sourced from four (4) water wells, located at the Samson Townsite, and is treated by chlorine injection and stored in their 4,700 m^3 reservoir. From the Samson Cree Nation Water Servicing Feasibility Study, it is estimated that, with upgrades, the long-term aquifer capacity is approximately 500,000 m^3/year, or roughly the amount needed to sustain water supply for the urban area only.

As expressed by the SCN operator and the report by Urban Systems, the water quality of the four water wells may not be outside of the recommended health guidelines, but it is not ideal for consumption. From

the report presented by Urban Systems, there could be disinfection by-products within the distribution system.

Located on Hwy 2A and Twp. Road 444, the WTP and reservoir can be used to connect to the NRDRWSC regional line via a branch from the transmission line towards Ermineskin Cree Nation. The connection into SCN can be connected to fill the reservoir while the WTP components can be decommissioned. As the regional water uses chloramine as a form of disinfectant, the existing chlorine water treatment system must be isolated from the new regional line. This is required as mixing the two water sources could create dichloramine or trichloramine.

Though SCN has expressed interest in connection of its urban water distribution system to the regional waterline extension, they have noted that high water losses within the distribution system would make cost of water from the regional commission prohibitively expensive in the short term. As such, it is SCN's objective to renew its aging and leaking urban water distribution system prior to connecting it to the regional system.

The SCN's rural residences, representing two thirds of the on-reserve population, are not serviced by the Townsite but through household wells, many of which are under boil water advisory order. No viable alternative water supply alternative has been identified, and the First Nation would like to resolve this pressing service issue with a rural water distribution system - a connection to the regional waterline extension being a suitable source.

2.0 COSTS

The costs will heavily depend on the alignment chosen and the implications of the alignment on construction. Primarily, the considerations for Horizontal Directional Drilling (HDD) versus trenched pipe installation will dictate the cost of the overall project. Depending on the method of pipe installation, the pipe material may also change. For primarily drilled installation, 600 mm diameter HDPE DR11 pipes are preferred and for trenched installation, 500 mm diameter PVC pipes are appropriate as previously mentioned. These pipes are very similar in their internal diameter in the context of hydraulic analyses.

From previous drilled waterline projects (HDD) with similar pipe sizes, a unit price cost for the entire project is estimated to about $1,440 per lineal meter of pipeline. Similarly, there is an expected difference of about $400 per lineal meter of pipeline between HDD installation and trenched installation (HDD is $400 more expensive on a per lineal meter basis). As such, the main basis for cost estimation depends on the method of installation and alignment length. Table 12 summarizes the overall cost estimation for each alignment.

Table 12 : Overall Cost Estimation of Each Extension Alignment

Alignments	Length	Drilled Cost (HDD)	Not Drilled Cost (Open-Cut and Trench)
Highway 2A Alignment (Blue)	22 km	$31.7 M	N/A*
West Alignment (Green)	29 km	$41.8 M	$30.2 M
Central-East Alignment (Magenta)	29 km	$41.8 M	$30.2 M
East Alignment (Black)	25 km	$36.0 M	$26.0 M
Central Alignment (Violet)	29 km	$41.8 M	$30.2 M

* Upon discussions with AT, it is evident that open-cut trenching will not be feasible along Highway 2A*

The current alignments bring the extension to the southern border of Ermineskin. According to AT, the extension beyond this point to service individual users inside the reserves was stated to be funded by the Federal Government. The estimated length from the Ermineskin southern border to an Ermineskin urban center is about 6 km - translating to a value of approximately $8.6 M to be funded by the Federal Government.

Opinions of Probable Cost (OPC) for the Central-East Alignment (Magenta) as well as the Central Alignment (Violet) are included in Appendix A. These cost estimates were generated with the following assumptions given the purpose of the feasibility study:

- 600 mm HDPE DR 11 Pipe
- 90% drill installation, 10% trench installation
- Number of valves is roughly half the number of road crossings
- 25% Contingency and Engineering Applied to Final Cost

The high contingency is to account for the generally large number of uncertain expenses at the time of this study. However, the cost estimates derived from the OPC are in line with the high-level total unit rate estimates of about $1,440 / m for the drilled waterline project.

3.0 RECOMMENDATIONS

Given the technical feasibility, practicality, and the cost implications, the recommended alignment would be the one of the Central-East or Central Alignments. At approximately 29 km, they are one of the longer alignments; however, the location of these alignments would provide the best reach towards all First Nations bands as well as special areas noted to be pending development and in need of water servicing. The advantage these alignments have over the shorter and simpler East Alignment is that the East Alignment is the option with the greatest amount of line being constructed in direct proximity of a First Nations band border (namely Samson and Montana). This is expected to require extensive cooperating and communication – posing a potentially significant schedule risk. Land assembly and crossing costs are naturally expected to increase as well. As such, for budgeting purposes, it is recommended to apply the estimated price range of the Central East or Central Alignments (approximately $30M - $42M).

Realistically, to service all four Maskwacis First Nation bands, the relatively western alignments are not ideal. Ultimately, Louis Bull will need to obtain service through an agreement with Ermineskin to use their land for the connection. With this logic, the eastern alignments are practical. It is probable that the sequence of connections to the regional line will not be simultaneous. Given the assumption that Ermineskin will be one of the first to connect, this is advantageous as giving access to Louis Bull after their connection will provide no delays to Ermineskin.

Due to this probable sequencing of connections, it is recommended to keep the addition of a booster station south of Ponoka as a provisional item to the extension as it will only be required at the time of multiple connections.

Although the portions of the alignment adjacent to Highway 2A will need to be horizontal directional drilled, it is recommended to incorporate sections of trenched installations along roads with a ROW of sufficient width to reduce construction costs.

To proceed with this endeavor, it is important to understand the Province of Alberta’s commitment to funding, as well as to begin a Facilitated Water Line Protocol Development.

APPENDIX A

Opinions of Probable Cost (OPC)

NRD FN - Opinion of Probable Cost

ITEM NO.	ITEM OF WORK	MEASUREMENT UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL
1 GENERAL					
1.1	Mobilization and Demobilization	Lump Sum	1	$250,000	$250,000
1.2	Traffic Accommodation	Lump Sum	1	$170,000	$170,000
1.3	Survey Layout and Asbuilts	Prime Cost Sum	1	$35,000	$35,000
1.4	3M Ball Markers & Utility Locates	Prime Cost Sum	1	$10,000	$10,000
1.5	Materials Testing	Prime Cost Sum	1	$25,000	$25,000
1.6	Site Occupancy	days	130	$1,500	$195,000
	TOTAL 1				$685,000
2 SITE WORK					
2.1	Clearing and Grubbing	Lump Sum	1	$20,000	$20,000
	TOTAL 2				$20,000
3 PIPELINE					
3.1	Pipe Supply and Install				
	600 mm HDPE DR 11 - via HDD	lm	26,100	$1,062	$27,718,200
	600 mm HDPE DR 11 - via Open Cut Trench Excavation (4.5 m and Shallower) and Backfill	lm	2,900	$640	$1,856,000
3.2	Case Bore Crossings				
a)	Highway 2A	ls	0	$150,000	$0

ITEM NO.	ITEM OF WORK	MEASUREMENT UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL
3.3	Pipe Bedding - Screened Rock	lm	2,900	$35	$101,500
3.4	Tracer Wire	lm	29,000	$3	$87,000
3.5	Isolation Valves				
	600 mm Dia. Plug Valve	each	14	$38,000	$532,000
3.6	Tees (600mm x 600mm x 600mm)	each	4	$7,000	$28,000
3.7	Foreign Utility Crossings				
a)	Pipelines	each	50	$3,000	$150,000
b)	Telecommunications/ Power Service Crossings / SuperNet	ls	1	$30,000	$30,000
3.8	Connection to Existing Systems	each	1	$5,000	$5,000
3.9	Commissioning	ls	1	$70,000	$70,000
	TOTAL 3				$30,577,700

ITEM NO.	ITEM OF WORK	MEASUREMENT UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL
SUMMARY					
1	GENERAL				$685,000
2	SITEWORK				$20,000
3	PIPELINE				$30,577,700
	SUBTOTAL				**$31,282,700**
	Contingency and Engineering Services - 25% of Subtotal				$7,820,675
	SUBTOTAL				$39,103,375
	Federal Goods and Services Tax at 5%				$1,955,169
	TOTAL PRICE (including GST)				**$41,058,544**

NRD FN - Opinion of Probable Cost (CENTRAL ALIGNMENT)

ITEM NO.	ITEM OF WORK	MEASUREMENT UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL
1 GENERAL					
1.1	Mobilization and Demobilization	Lump Sum	1	$250,000	$250,000
1.2	Traffic Accommodation	Lump Sum	1	$170,000	$170,000
1.3	Survey Layout and Asbuilts	Prime Cost Sum	1	$35,000	$35,000
1.4	3M Ball Markers & Utility Locates	Prime Cost Sum	1	$10,000	$10,000
1.5	Materials Testing	Prime Cost Sum	1	$25,000	$25,000
1.6	Site Occupancy	days	130	$1,500	$195,000
	TOTAL 1				$685,000
2 SITE WORK					
2.1	Clearing and Grubbing	Lump Sum	1	$20,000	$20,000
	TOTAL 2				$20,000
3 PIPELINE					
3.1	Pipe Supply and Install				
	600 mm HDPE DR 11 - via HDD	lm	26,100	$1,062	$27,718,200
	600 mm HDPE DR 11 - via Open Cut Trench Excavation (4.5 m and Shallower) and Backfill	lm	2,900	$640	$1,856,000
3.2	Case Bore Crossings				
a)	Highway 2A	ls	0	$150,000	$0

ITEM NO.	ITEM OF WORK	MEASUREMENT UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL
3.3	Pipe Bedding - Screened Rock	lm	2,900	$35	$101,500
3.4	Tracer Wire	lm	29,000	$3	$87,000
3.5	Isolation Valves				
	600 mm Dia. Plug Valve	each	13	$38,000	$494,000
3.6	Tees (600mm x 600mm x 600mm)	each	4	$7,000	$28,000
3.7	Foreign Utility Crossings				
a)	Pipelines	each	34	$3,000	$102,000
b)	Telecommunications/ Power Service Crossings / SuperNet	ls	1	$30,000	$30,000
3.8	Connection to Existing Systems	each	1	$5,000	$5,000
3.9	Commissioning	ls	1	$70,000	$70,000
	TOTAL 3				$30,491,700

ITEM NO.	ITEM OF WORK	MEASUREMENT UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL
SUMMARY					
1	GENERAL				$685,000
2	SITEWORK				$20,000
3	PIPELINE				$30,491,700
	SUBTOTAL				**$31,196,700**
	Contingency and Engineering Services - 25% of Subtotal				$7,799,175
	SUBTOTAL				$38,995,875
	Federal Goods and Services Tax at 5%				$1,949,794
	TOTAL PRICE (including GST)				**$40,945,669**