APPENDIX E DFO NEED FOR DEVELOPMENT REPORT

Need for Development

Dry Creek 186S Upgrade

July 11, 2016

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Executive Summary

FortisAlberta Inc. (FortisAlberta) is requesting for system access service to address a distribution system capacity concern at the Dry Creek 186S substation.

The load served by the 186S Dry Creek substation and distribution system in the area is comprised of a portion of the Town of Airdrie and the surrounding area to the south and west of the town. This load is subject to a concern related to the adequacy of the existing transmission and distribution facilities to provide capacity to meet customer needs.

Load studies indicate that three of the Dry Creek 186S feeders are predicted to exceed the 13 MVA normal feeder maximum.

- Feeder 186S-171LN is predicted to carry a peak load of 15.7 MVA in 2017, increasing to 18.9 MVA by 2025.
- Feeder 186S-442L is predicted to carry a peak load of 13.9 MVA in 2017, increasing to 16.3 MVA by 2025.
- Feeder 186S-436L is predicted to carry a peak load of 13.7 MVA in 2018, increasing to 16.8 MVA by 2025.
- Feeder 199S-2237L is predicted to carry a peak load of 14.4 MVA in 2018, increasing to 17.3 MVA by 2025.

Potential solutions were assessed for this capacity concern. Based on technical merit and lowest estimated distribution capital cost, the preferred solution involves transmission upgrades at Dry Creek 186S substation: the addition of two 25 kV feeder breakers.

The estimated distribution capital cost associated with this preferred solution is $3.5 million (±30%, 2017$).

The requested completion date for the requested Dry Creek 186S facility upgrade is August 1, 2017.

With the requested transmission system upgrade project, FortisAlberta requests for an increase in the Demand Transmission Service (DTS) contract at the Dry Creek 186S substation to 52.7 MW.

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1. Background

The Dry Creek 186S substation is located at LSD 03 SEC 25 TWP 26 RGE 01 W5M, on the southern border of the Town of Airdrie. The substation has two 138/25 kV 25/33/42 MVA LTC source transformers supplying five 25 kV distribution feeders. The distribution system supplied by the Dry Creek 186S substation serves a portion of the Town of Airdrie and the surrounding area to the south and west of the town. The East Airdrie 199S substation also supplies distribution service to the Town of Airdrie and the surrounding area to the north and east of the town.

The distribution load in this area is mixed consisting of residential, rural, commercial, and industrial loads. See Figure A-1, Appendix A.

The distribution load in the Airdrie area continues to grow at a steady pace fueled by population and business growth in and around the City of Calgary. Based on the historical load levels, forecast growth and committed load additions for the distribution systems supplied by the area substations, capacity-related issues are predicted at the Dry Creek 186S substation within the 10-year planning horizon. Three of the 25 kV distribution feeders supplied by the Dry Creek 186S substation are forecast to have load levels in excess of 13 MVA, the normal feeder maximum:

- Feeder 186S-171LN is predicted to carry a peak load of 15.7 MVA in 2017, increasing to 18.9 MVA by 2025.
- Feeder 186S-442L is predicted to carry a peak load of 13.9 MVA in 2017, increasing to 16.3 MVA by 2025.
- Feeder 186S-436L is predicted to carry a peak load of 13.7 MVA in 2018, increasing to 16.8 MVA by 2025.
- Feeder 199S-2237L is predicted to carry a peak load of 14.4 MVA in 2018, increasing to 17.3 MVA by 2025.

This exceeds FortisAlberta feeder loading criteria within the next ten years.

2. Criteria

The analysis for the requested development in the area served by the Dry Creek 186S substation has been conducted based upon the following criteria and assumptions:

- The maximum normal loading of FortisAlberta 25 kV distribution feeders is 13.0 MVA.
- FortisAlberta planning criteria for electrical load restoration requires that adequate backup supply for contingency situations be available subject only to switching time. Backup capability refers to the ability to restore service after an interruption without necessarily first repairing the cause of the interruption.
- Transmission equipment must not be operated at load levels in excess of the equipment ratings.

3. Existing System Assessment

The existing substations and distribution systems in the Dry Creek area are shown in Figure A-1 in Appendix A.

3.1 Load Forecast

Table 3-1 provides FortisAlberta historical and forecast peak load levels for the substations and feeders in the study area. The load forecast is based on historical data, expected development trends and contracted new loads. This load forecast was used to assess all the alternatives presented in this Need for Development document.

Table 3-1: FortisAlberta Load Forecast: Existing System

SUB No	Feeder	CAPACITY T/R	MVA	W or S	MVA LOADING - RECORDED 2011 Peak MVA	2012 Peak MVA	2013 Peak MVA	2014 Peak MVA	2015 Peak MVA	PF	MVA LOADING - PREDICTED 2016 Year 1 MVA	2017 Year 2 MVA	2018 Year 3 MVA	2019 Year 4 MVA	2020 Year 5 MVA	2021 Year 6 MVA	2022 Year 7 MVA	2023 Year 8 MVA	2024 Year 9 MVA	2025 Year 10 MVA
186S	Dry Creek	T1	25/33/ 42	W	**17.5**	**11.9**	**14.8**	**15.9**	**15.9**	100%	**20.9**	**24.5**	**26.4**	**26.7**	**27.0**	**27.3**	**27.6**	**27.9**	**28.2**	**28.5**
186S	171LN			W	13.1	7.4	8.8	10.0	10.1	100%	12.9	**15.7**	**17.5**	**17.7**	**17.9**	**18.1**	**18.3**	**18.5**	**18.7**	**18.9**
186S	156LS			W	4.4	4.9	6.1	6.3	6.1	100%	8.5	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0	10.1
186S	Dry Creek	T2	25/33/ 42	W	**14.9**	**22.8**	**25.4**	**26.8**	**26.2**	100%	**30.9**	**34.1**	**37.4**	**40.0**	**40.4**	**40.8**	**41.2**	**41.6**	**42.0**	**42.4**
186S	442L			W	10.2	10.6	12.1	12.4	12.0	100%	13.0	**13.9**	**14.8**	**15.1**	**15.3**	**15.5**	**15.7**	**15.9**	**16.1**	**16.3**
186S	436L			W	4.5	5.6	6.9	7.4	7.6	100%	9.7	**11.7**	**13.7**	**15.6**	**15.8**	**16.0**	**16.2**	**16.4**	**16.6**	**16.8**
186S	451L			W	0.3	7.1	6.8	7.0	7.0	100%	9.0	9.3	9.6	9.9	10.0	10.1	10.2	10.3	10.4	10.5
186S	Total Station			W	**31.5**	**34.7**	**39.7**	**43.1**	**42.1**	100%	**51.8**	**58.6**	**63.8**	**66.7**	**67.4**	**68.1**	**68.8**	**69.5**	**70.2**	**70.9**
199S	East Airdrie	T2	25/33/ 42	W	**36.0**	**23.5**	**25.7**	**24.9**	**24.6**	99%	**31.4**	**33.1**	**34.8**	**36.2**	**36.6**	**37.0**	**37.4**	**37.8**	**38.2**	**38.6**
199S	2156L			W	7.0	6.3	7.0	6.4	6.4	99%	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4
199S	340LS			W	8.4	8.6	9.6	9.1	8.9	93%	10.5	10.6	10.7	10.8	10.9	11.0	11.1	11.2	11.3	11.4
199S	2237L			W	8.9	8.5	9.1	9.3	9.1	100%	11.6	13.0	**14.4**	**15.5**	**15.8**	**16.1**	**16.4**	**16.7**	**17.0**	**17.3**
199S	339LW			W	13.7	2.4	2.5	2.5	2.4	100%	3.9	4.1	4.3	4.5	4.5	4.5	4.5	4.5	4.5	4.5
199S	East Airdrie	T1	25																	
199S	East Airdrie	VR1 Total Load	17		**9.2**	**9.6**	**6.1**	**6.4**	**10.2**	97%	**11.0**	**11.1**	**11.2**	**11.3**	**11.4**	**11.5**	**11.6**	**11.7**	**11.8**	**11.9**
199S	East Airdrie	Base Load		W	**6.1**	**6.6**	**2.9**	3.3	7.0	99%	**7.8**	**7.9**	**8.0**	**8.1**	**8.2**	**8.3**	**8.4**	**8.5**	**8.6**	**8.7**
199S	492LE			W	5.1	5.4	1.8	2.1	5.9	99%	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1
199S	2238L Total Load				4.3	4.3	4.5	4.7	4.3	97%	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
199S	2238L Base Load			W	1.2	1.3	1.3	1.6	1.2	99%	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
199S	Auto Transfer (316S 28LS)				3.2	3.2	3.2	3.1	3.1	97%	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
199S	Total Station- Base Load				**41.8**	**29.6**	**28.6**	**27.9**	**30.3**	99%	**38.4**	**40.2**	**41.9**	**43.4**	**43.9**	**44.4**	**44.9**	**45.4**	**45.9**	**46.4**
199S	Total Station - with Auto Transfer				**45.9**	**33.0**	**31.8**	**31.2**	**34.0**	97%	**42.4**	**44.2**	**46.0**	**47.5**	**48.0**	**48.5**	**49.0**	**49.5**	**50.0**	**50.5**
Total Area Load					73.3	64.3	68.3	71.0	72.4		90.2	98.8	105.7	110.1	111.3	112.5	113.7	114.9	116.1	117.3

Load Additions (MVA)		2016	2017	2018
186S	171LN	2.7	2.7	1.7
186S	156LS	2.2	0.7	
186S	442L	0.8	0.8	0.8
186S	436L	1.9	1.9	1.9
186S	451L	1.8	0.3	0.3
199S	2156L	0.5		
199S	340LS	0.6		
199S	2237L	2.0	1.2	1.2
199S	339LW	1.4	0.2	0.2
199S	492LE	2.3	1.9	1.9
199S	2238L	0.3	0.3	

- The load level on feeder 186S-171LN exceeds 13 MVA within the next 10 years.
- The load level on feeder 186S-442L exceeds 13 MVA within the next 10 years.
- The load level on feeder 186S-436L exceeds 13 MVA within the next 10 years.
- The load level on feeder 199S-2237L exceeds 13 MVA within the next 10 years.

4. Alternatives Analysis

Four alternatives were considered and presented in this document.

4.1 Alternative 1: Load Shifting or Distribution Upgrades

4.1.1 Description

The distribution system supplied by the Dry Creek 186S substation is well connected to adjacent distribution systems. However, there are no viable load shifting or distribution upgrades which can address the capacity concerns on 25 kV feeders 186-171LN and 186S-442L due to the following reasons:

- Generally high feeder load levels and continued steady load growth,
- The configuration of the existing feeders,
- The locations and concentrations of load growth in the Airdrie area.

4.2 Alternative 2: Upgrades at the Dry Creek 186S Substation

4.2.1 Description

In 2017, at the Dry Creek 186S substation:

- **Add two (2) 25 kV feeder breakers**

Alternative two includes the installation of a total of 9.7 km of 25 kV distribution line. Refer to Appendix B, Figure B-1 showing the system development for Alternative 2.

All 25 kV overhead conductors, new and existing, exiting the substation and distribution feeder ties shall be 477 MCM. All underground feeder cables, new and existing, shall be 750 MCM. All transmission components on the secondary side of the 25 kV source transformers, new and existing, shall be sized to enable the feeders to simultaneously supply 26 MVA per feeder. All 25 kV feeder breakers shall be equipped with associated equipment to enable under-frequency load shedding.

Transmission facilities must be equipped with the appropriate equipment for interconnection with FortisAlberta's Automated Metering system. Provisions must be available to interconnect the substation transformer neutrals and the distribution line neutrals, as per AltaLink Management Ltd. (AltaLink) standards.

All 138 kV and 25 kV buses shall have adequate switch points and protection to minimize frequency and duration of outages associated with the maintenance or failure of substation components upstream of the 25 kV bus. Failure of such upstream components must not result in a total substation outage.

4.2.2 Load Forecast

The load forecast resulting from Alternative 2 is provided in Table 4-1.

Table 4-1: FortisAlberta Load Forecast for Alternative 2 – Upgrades at the Dry Creek 186S

					MVA LOADING - RECORDED						MVA LOADING - PREDICTED									
				W	2011	2012	2013	2014	2015		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SUB No	Feeder	CAPACITY T/R	MVA	or S	Peak MVA	Peak MVA	Peak MVA	Peak MVA	Peak MVA	PF	Year 1 MVA	Year 2 MVA	Year 3 MVA	Year 4 MVA	Year 5 MVA	Year 6 MVA	Year 7 MVA	Year 8 MVA	Year 9 MVA	Year 10 MVA
186S	Dry Creek	T1	25/33/ 42	W	**17.5**	**11.9**	**14.8**	**15.9**	**15.9**	100%	**20.9**	**32.7**	**34.7**	**35.0**	**35.4**	**35.8**	**36.2**	**36.6**	**37.0**	**37.4**
186S	171LN			W	13.1	7.4	8.8	10.0	10.0	100%	12.9	5.3	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
186S	156LS			W	4.4	4.9	6.1	6.3	6.3	100%	8.5	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0	10.1
186S	1435L (NEW)			W						100%	0.0	10.4	10.6	10.8	11.0	11.2	11.4	11.6	11.8	12.0
186S	1243L (NEW)			W						100%	0.0	8.2	8.4	8.6	8.8	9.0	9.2	9.4	9.6	9.8
186S	Dry Creek	T2	25/33/ 42	W	**14.9**	**22.8**	**25.4**	**26.8**	**26.8**	100%	**30.9**	**25.5**	**28.7**	**31.2**	**31.5**	**31.8**	**32.1**	**32.4**	**32.7**	**33.0**
186S	442L			W	10.2	10.6	12.1	12.4	12.4	100%	13.0	7.5	8.3	8.5	8.6	8.7	8.8	8.9	9.0	9.1
186S	436L			W	4.5	5.6	6.9	7.4	7.4	100%	9.7	9.4	11.4	**13.3**	**13.4**	**13.5**	**13.6**	**13.7**	**13.8**	**13.9**
186S	451L			W	0.3	7.1	6.8	7.0	7.0	100%	9.0	9.3	9.6	9.9	10.0	10.1	10.2	10.3	10.4	10.5
186S	Total Station			W	**31.5**	**34.7**	**39.7**	**43.1**	**43.1**	100%	**51.8**	**58.2**	**63.4**	**66.2**	**66.9**	**67.6**	**68.3**	**69.0**	**69.7**	**70.4**
199S	East Airdrie	T2	25/33/ 42	W	**36.0**	**23.5**	**25.7**	**24.9**	**24.9**	99%	**31.4**	**33.1**	**34.8**	**36.2**	**36.6**	**37.0**	**37.4**	**37.8**	**38.2**	**38.6**
199S	2156L			W	7.0	6.3	7.0	6.4	6.4	99%	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4
199S	340LS			W	8.4	8.6	9.6	9.1	9.2	93%	10.5	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5
199S	2237L			W	8.9	8.5	9.1	9.3	9.3	100%	11.6	13.0	**14.4**	**15.5**	**15.8**	**16.1**	**16.4**	**16.7**	**17.0**	**17.3**
199S	339LW			W	13.7	2.4	2.5	2.5	2.5	100%	3.9	6.8	7.0	7.2	7.3	7.4	7.5	7.6	7.7	7.8
199S	East Airdrie	T1	25																	
199S	East Airdrie	VR1 Total Load	17		**9.2**	**9.6**	**6.1**	**6.4**	**6.4**	97%	**11.0**	**11.1**	**11.2**	**11.3**	**11.4**	**11.5**	**11.6**	**11.7**	**11.8**	**11.9**
199S	East Airdrie	Base Load		W	**6.1**	**6.6**	**2.9**	3.3	3.2	99%	**7.8**	**7.9**	**8.0**	**8.1**	**8.2**	**8.3**	**8.4**	**8.5**	**8.6**	**8.7**
199S	492LE			W	5.1	5.4	1.8	2.1	2.0	99%	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1
199S	2238L Total Load				4.3	4.3	4.5	4.7	4.7	97%	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
199S	2238L Base Load			W	1.2	1.3	1.3	1.6	1.6	99%	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
199S	Auto Transfer (316S 28LS)				3.2	3.2	3.2	3.1	3.1	97%	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
199S	Total Station- Base Load				**41.8**	**29.6**	**28.6**	**27.9**	**27.6**	99%	**38.4**	**40.2**	**41.9**	**43.4**	**43.9**	**44.4**	**44.9**	**45.4**	**45.9**	**46.4**
199S	Total Station - with Auto Transfer				**45.9**	**33.0**	**31.8**	**31.2**	**31.2**	97%	**42.4**	**44.2**	**46.0**	**47.5**	**48.0**	**48.5**	**49.0**	**49.5**	**50.0**	**50.5**
Total Area Load					73.3	64.3	68.3	71.0	70.7		90.2	98.4	105.3	109.6	110.8	112.0	113.2	114.4	115.6	116.8

Load Transfers (MVA)		2017
186S	171LN	-10.4
186S	1435L	+10.4
186S	1243L	+8.2
186S	442L	-6.4
186S	436L	-2.3
199S	340LS	-2.7
199S	339LW	+2.7

- The capacity concern on the 25 kV feeder 186S-436L will be addressed by subsequent distribution load transfers.
- The capacity concern on the 25 kV feeder 199S-2237L will be addressed by subsequent distribution load transfers.

4.2.3 Cost Estimate

If Alternative 2 is considered, AltaLink will prepare a facility application for the requested transmission upgrades. This facility application will include an estimate of the transmission capital cost.

The distribution capital cost for Alternative 2 is estimated to be $3.5 million (2017$, ±30%).

4.3 Alternative 3: Upgrades at the Dry Creek 186S and East Airdrie 199S substations

4.3.1 Description

In 2017, at the Dry Creek 186S substation:

- **Add one (1) 25 kV feeder breaker**

In 2017, at the East Airdrie 199S substation:

- **Add one (1) 25 kV feeder breaker**
- **Upgrade regulator to 25 MVA**

Alternative 3 includes the installation of a total of 8.6 km of distribution line through a developed urban area. This alternative also includes one major highway crossing.

All 25 kV overhead conductors, new and existing, exiting the substation and distribution feeder ties shall be 477 MCM. All underground feeder cables, new and existing, shall be 750 MCM. All transmission components on the secondary side of the 25 kV source transformers, new and existing, shall be sized to enable the feeders to simultaneously supply 26 MVA per feeder. All 25 kV feeder breakers shall be equipped with associated equipment to enable under-frequency load shedding.

Transmission facilities must be equipped with the appropriate equipment for interconnection with FortisAlberta's Automated Metering system. Provisions must be available to interconnect the substation transformer neutrals and the distribution line neutrals, as per AltaLink standards.

All 138 kV and 25 kV buses shall have adequate switch points and protection to minimize frequency and duration of outages associated with the maintenance or

failure of substation components upstream of the 25 kV bus. Failure of such upstream components must not result in a total substation outage.

4.3.2 Load Forecast

The load forecast resulting from Alternative 3 is provided in Table 4-2.

Table 4-2: FortisAlberta Load Forecast for Alternative 3 – Upgrades at the Dry Creek 186S and East Airdrie 199S substations

					MVA LOADING - RECORDED						MVA LOADING - PREDICTED									
				W	2011	2012	2013	2014	2015		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SUB		CAPACITY		or	Peak	Peak	Peak	Peak	Peak	PF	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
No	Feeder	T/R	MVA	S	MVA	MVA	MVA	MVA	MVA		MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA	MVA
186S	Dry Creek	T1	25/33/ 42	W	**17.5**	**11.9**	**14.8**	**15.9**	**15.9**	100%	**20.9**	**24.5**	**26.4**	**26.7**	**27.0**	**27.3**	**27.6**	**27.9**	**28.2**	**28.5**
186S	171LN			W	13.1	7.4	8.8	10.0	10.1	100%	12.9	5.3	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
186S	156LS			W	4.4	4.9	6.1	6.3	6.1	100%	8.5	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0	10.1
186S	NEW1			W						100%	0.0	10.4	10.6	10.8	11.0	11.2	11.4	11.6	11.8	12.0
186S	Dry Creek	T2	25/33/ 42	W	**14.9**	**22.8**	**25.4**	**26.8**	**26.2**	100%	**30.9**	**25.9**	**29.1**	**31.6**	**31.9**	**32.2**	**32.5**	**32.8**	**33.1**	**33.4**
186S	442L			W	10.2	10.6	12.1	12.4	12.0	100%	13.0	8.0	8.8	9.0	9.1	9.2	9.3	9.4	9.5	9.6
186S	436L			W	4.5	5.6	6.9	7.4	7.6	100%	9.7	9.4	11.4	**13.3**	**13.4**	**13.5**	**13.6**	**13.7**	**13.8**	**13.9**
186S	451L			W	0.3	7.1	6.8	7.0	7.0	100%	9.0	9.3	9.6	9.9	10.0	10.1	10.2	10.3	10.4	10.5
186S	Total Station			W	**31.5**	**34.7**	**39.7**	**43.1**	**42.1**	100%	**51.8**	**50.4**	**55.5**	**58.3**	**58.9**	**59.5**	**60.1**	**60.7**	**61.3**	**61.9**
199S	East Airdrie	T2	25/33/ 42	W	**36.0**	**23.5**	**25.7**	**24.9**	**24.6**	99%	**31.4**	**33.1**	**34.8**	**36.2**	**36.6**	**37.0**	**37.4**	**37.8**	**38.2**	**38.6**
199S	2156L			W	7.0	6.3	7.0	6.4	6.4	99%	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4
199S	340LS			W	8.4	8.6	9.6	9.1	8.9	93%	10.5	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5
199S	2237L			W	8.9	8.5	9.1	9.3	9.1	100%	11.6	13.0	**14.4**	**15.5**	**15.8**	**16.1**	**16.4**	**16.7**	**17.0**	**17.3**
199S	339LW			W	13.7	2.4	2.5	2.5	2.4	100%	3.9	6.8	7.0	7.2	7.3	7.4	7.5	7.6	7.7	7.8
199S	East Airdrie	T1	25																	
199S	East Airdrie	VR1 Total Load	17		**9.2**	**9.6**	**6.1**	**6.4**	**10.2**	97%	**11.0**	**19.4**	**19.6**	**19.8**	**20.0**	**20.2**	**20.4**	**20.6**	**20.8**	**21.0**
199S	East Airdrie	Base Load		W	**6.1**	**6.6**	**2.9**	3.3	7.0	99%	**7.8**	**16.2**	**16.4**	**16.6**	**16.8**	**17.0**	**17.2**	**17.4**	**17.6**	**17.8**
199S	492LE			W	5.1	5.4	1.8	2.1	5.9	99%	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1
199S	NEW			W						99%	0.0	8.3	8.5	8.7	8.9	9.1	9.3	9.5	9.7	9.9
199S	2238L Total Load				4.3	4.3	4.5	4.7	4.3	97%	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
199S	2238L Base Load			W	1.2	1.3	1.3	1.6	1.2	99%	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
199S	Auto Transfer (316S 28LS)				3.2	3.2	3.2	3.1	3.1	97%	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
199S	Total Station- Base Load				**41.8**	**29.6**	**28.6**	**27.9**	**30.3**	99%	**38.4**	**48.3**	**50.2**	**51.7**	**52.3**	**52.9**	**53.5**	**54.1**	**54.7**	**55.3**
199S	Total Station - with Auto Transfer				**45.9**	**33.0**	**31.8**	**31.2**	**34.0**	97%	**42.4**	**52.5**	**54.4**	**56.0**	**56.6**	**57.2**	**57.8**	**58.4**	**59.0**	**59.6**
Total Area Load					73.3	64.3	68.3	71.0	72.4		90.2	98.7	105.7	110.0	111.2	112.4	113.6	114.8	116.0	117.2

Load Transfers (MVA)		2017
186S	171LN	-10.4
186S	NEW1	+10.4
186S	442L	-5.9
186S	436L	-2.3
186S	NEW	+8.2
199S	340LS	-2.7
199S	339LW	+2.7

- The capacity concern on the 25 kV feeder 186S-436L will be addressed by subsequent distribution load transfers.
- The capacity concern on the 25 kV feeder 199S-2237L will be addressed by subsequent distribution load transfers.

4.3.3 Cost Estimate

If Alternative 3 is considered, AltaLink will prepare a facility application for the requested transmission upgrades. This facility application will include an estimate of the transmission capital cost.

The distribution capital cost for Alternative 3 is estimated to be $3.8 million (2017$, ±30%).

4.4 Alternative 4: Upgrades at the Dry Creek 186S and Balzac 391S substations

4.4.1 Description

In 2017, at the Dry Creek 186S substation:

- **Add one (1) 25 kV feeder breaker**

In 2017, at the Balzac 391S substation:

- **Add one (1) 25 kV feeder breaker**

Alternative four includes the installation of a total of 21.2 km of 25 kV distribution line. This additional line length will go through a developed commercial area. This alternative also requires one major highway crossing.

All 25 kV overhead conductors, new and existing, exiting the substation and distribution feeder ties shall be 477 MCM. All underground feeder cables, new and existing, shall be 750 MCM. All transmission components on the secondary side of the 25 kV source transformers, new and existing, shall be sized to enable the feeders to simultaneously supply 26 MVA per feeder. All 25 kV feeder breakers shall be equipped with associated equipment to enable under-frequency load shedding.

Transmission facilities must be equipped with the appropriate equipment for interconnection with FortisAlberta's Automated Metering system. Provisions must be available to interconnect the substation transformer neutrals and the distribution line neutrals, as per AltaLink standards.

All 138 kV and 25 kV buses shall have adequate switch points and protection to minimize frequency and duration of outages associated with the maintenance or failure of substation components upstream of the 25 kV bus. Failure of such upstream components must not result in a total substation outage.

4.4.2 Cost Estimate

If Alternative 4 is considered, AltaLink will prepare a facility application for the requested transmission upgrades. This facility application will include an estimate of the transmission capital cost.

The distribution capital cost for Alternative 4 is estimated to be $6.8 million (2017$, ±30%).

5. Alternatives Assessment

The following section presents the technical and economic analysis of the alternatives considered in this Need for Development.

5.1 Technical and Economic Analysis

5.1.1 Alternative 1 – Load Shifting or Distribution Upgrades

As per section 4.1.1, load shifting or distribution upgrades alone cannot eliminate the predicted excess feeder loading at the Dry Creek 186S substation. As Alternative 1 is not a solution to the capacity concern at the Dry Creek 186S substation.

5.1.2 Alternative 2 – Upgrades at the Dry Creek 186S Substation

The addition of two 25 kV feeder breakers to establish two additional 25 kV feeders supplied from the Dry Creek 186S substation can resolve the capacity concerns at the Dry Creek 186S substation. There are no major highway crossings and limited 25 kV distribution line installation through a developed urban area. Alternative 2 is an acceptable technical solution and is the preferred alternative.

5.1.3 Alternative 3 – Upgrades at the Dry Creek 186S and East Airdrie 199S substations

Although Alternative 3 is technically acceptable, it is not the preferred alternative due to:

- Upgrades required at both the East Airdrie 199S substation and the Dry Creek 186S substation will significantly increase project costs.
- One major highway crossing which increases cost risks due to the possible presence of sandstone.

- The full length of 25 kV distribution line goes through a developed urban area requiring a significant amount of directional drilling to cross driveways and roads.

The estimated distribution cost for Alternative 3 is higher than the preferred alternative. Therefore, this is not the preferred alternative.

5.1.4 Alternative 4 – Upgrades at the Dry Creek 186S and Balzac 391S substations

Although Alternative 4 is technically acceptable, it is not the preferred alternative due to:

- Upgrades required at both Dry Creek 186S substation and Balzac 391S substation will significantly increase project costs.
- Significantly higher distribution cost due to the extended 25 kV distribution line required to reach the area where the capacity concern is from the Balzac 391S substation.
- The additional line length from Balzac 391S substation will go through a developed commercial area requiring directional drilling to cross driveways and roads.
- One major highway crossing which increases cost risks due to the possible presence of sandstone.

The estimated distribution cost for Alternative 4 is higher than the preferred alternative. Therefore, this is not the preferred alternative.

6. Conclusion

After considering the alternatives to address the predicted capacity concerns for distribution service at the Dry Creek 186S substation, Alternative 2 is preferred because it is expected to have the lowest capital cost. Alternative 2 involves: the installation of two additional 25 kV feeder breakers at Dry Creek 186S substation.

An estimate for the transmission system capital cost will be provided by AltaLink.

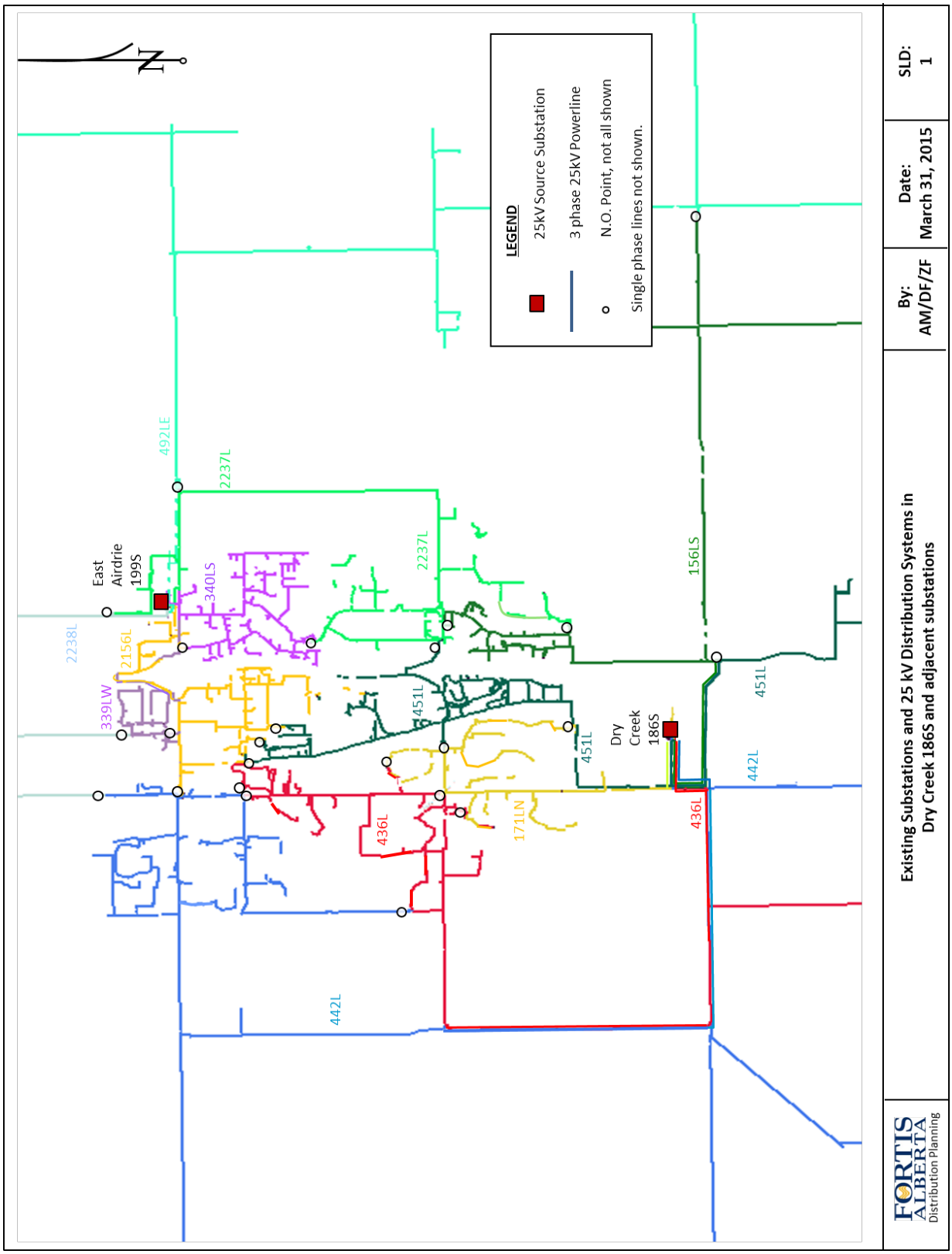
The estimated distribution capital cost associated with this recommendation is $3.5 million (±30%, 2017$).

The requested completion date for the recommended Dry Creek 186S substation upgrade is August 1, 2017.

With the requested transmission system upgrade project, FortisAlberta requests for an increase in the DTS contract at the Dry Creek 186S substation to 52.7 MW.

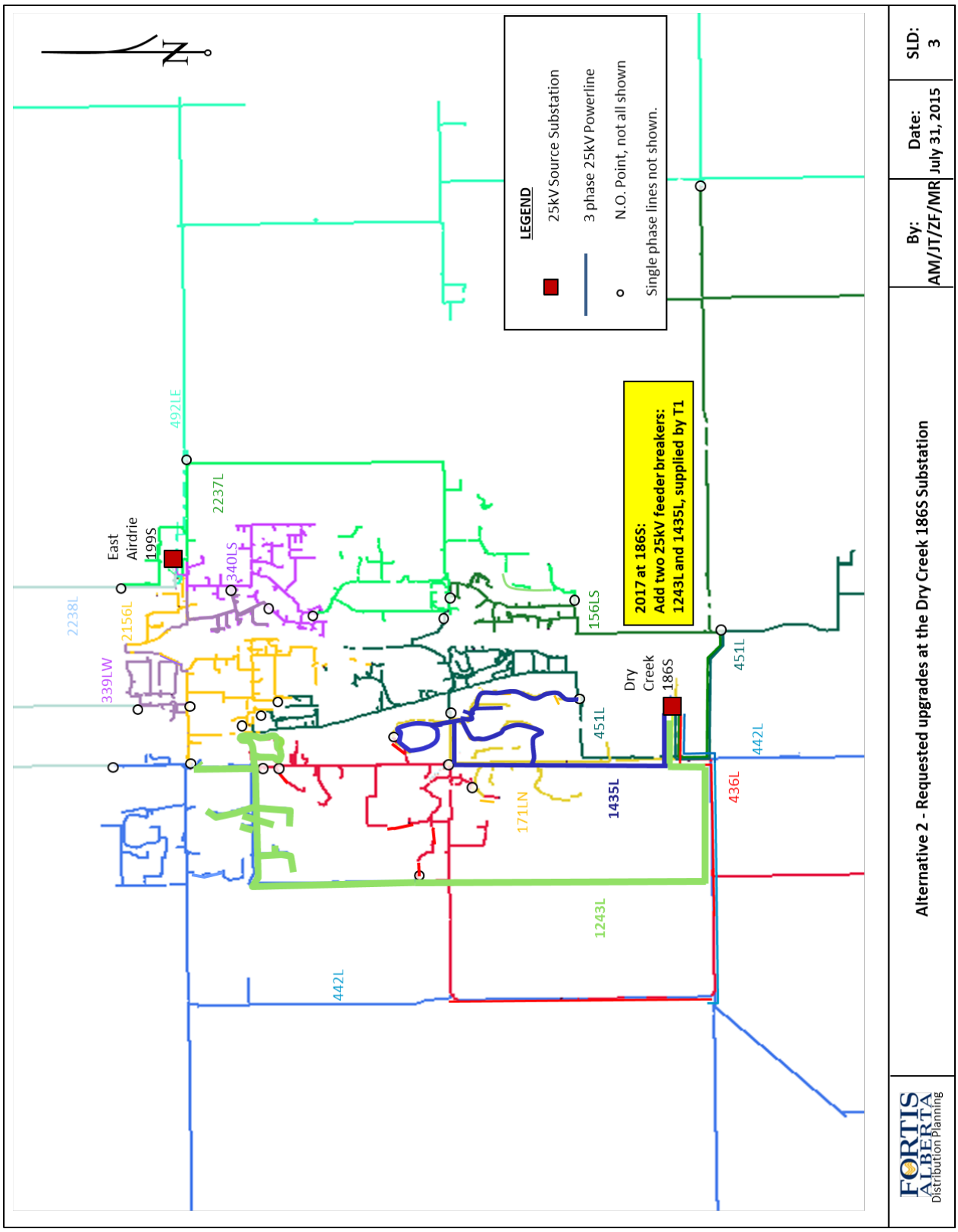
Appendix A – Existing System

Figure A-1: Existing System



Appendix B – Alternative 2 – Upgrades at the Dry Creek 186S

Figure B-2: Alternative 2: Upgrades at the Dry Creek 186S



Appendix C – Alternative 3 – Upgrades at the Dry Creek 186S and East Airdrie 199S

Figure C-3: Alternative 3: Upgrades at the Dry Creek 186S and East Airdrie 199S