APPENDIX E DFO DISTRIBUTION DEFICIENCY REPORT

EPCOR DISTRIBUTION & TRANSMISSION INC.

Distribution Deficiency Report (DDR) for Breakers Addition (14C and 24C) at Clover Bar

Revision 3

Company	Role	Name	Date	Signature
EDTI	Prepared	Michael Smeding, P. Eng.	March 28, 2017	

APEGA Permit to Practice P07061

Abbreviations

AESO: Alberta Electric System Operator

AUC: Alberta Utilities Commission

EDTI: EPCOR Distribution & Transmission Inc.

DDR: Distribution Deficiency Report

ISD: In Service Date

N-0: All transmission elements in service (normal state)

N-1: Failure of a single distribution circuit (emergency state)

PF: Power factor = MW/MVA

POD: Point of Delivery

Document History

Revision	Date	Author	Description
Rev 0	March 04, 2016	Justin Ngomsi	New release
Rev 1	March 15, 2016	Justin Ngomsi	1. Updated Table 5.0-1 in section 5 to show cost for solution alternatives 1 and 2 as non-applicable 2. Added in section 2.3 the timeframe that was used for determining the POD power factor of 0.93 3. Clarified that the loading data for year 2015, as shown in Table 2.3-1, represents actual values 4. Clarified that tie-away capacity during N-0 condition is determined using the circuit's design rating of 12 MVA, whereas the tie-away capacity during N-1 condition is determined using the circuit's e rating of 18 MVA
Rev 2	February 21, 2017	Michael Smeding	5. Clarified several points surrounding DTS contracts in section 1.0 6. Added further description to the geographic area in section 2.1 7. Added forecast timeframes in section 2.3 8. Further clarified tie-away capacity under N-1 conditions in section 3.2 9. Refined alternative 3 in section 4.3, updating scope based on new information 10. Updated costs for alternative 3 and alternative 4 in section 5.0, based on new information. 11. Updated recommendation in section 6.0

Rev 3	March 22, 2017	Michael Smeding	12. Clarified several points surrounding the 2017 capacity constraint in section 1.0 13. Added further description around North Calder to the geographic area in section 2.1 14. Provided further clarification around the 2016 summer actuals and upcoming customer connections in section 2.3

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1.0 EXECUTIVE SUMMARY

EPCOR Distribution & Transmission Inc. (EDTI) is requesting system access service from the Alberta Electric System Operator (AESO) to meet forecasted load growth in the Clover Bar area and to address reliability concerns by ensuring load restoration capability in the area. The Clover Bar service area is currently served by EDTI's Clover Bar substation. The load in the area is primarily commercial, and industrial. EDTI's preferred alternative is to add two circuit breakers at the Clover Bar substation to meet the forecasted load growth.

The Clover Bar substation is currently equipped with two 240/25 kV transformers. Each transformer is rated 37.5/50/63 MVA. There are eight 25 kV switchgear feeder cells, four of which are already furnished with feeder breakers for the existing distribution circuits 12C, 13C, 22C and 23C.

EDTI forecasted that the peak load on circuit 12C first exceeded EDTI's design rating for 25kV feeders of 12 MVA during 2016 winter peak load. EDTI also anticipated there would have been insufficient tie-away capacity during an N-1 (emergency) operation at 2016 summer peak. Moreover, during summer peak 2018, EDTI expects there will be insufficient tie-away capacity during N-0 (normal) operation as well. The severity of these EDTI criteria violations at the Clover Bar substation will increase with the forecasted load growth.

The tie-away capacity during N-0 is determined using the circuit's design rating of 12 MVA, whereas the tie-away capacity during N-1 is determined using the circuit's emergency rating of 18 MVA; see sections 2.4 and 2.5 for further detail. If no action is taken, the Clover Bar substation circuits will be unable to supply the Clover Bar area in a reliable manner.

Of the four solution alternatives identified, EDTI has determined that adding a new distribution circuit 24C at EDTI's Clover Bar substation is the preferred technically feasible option to service the load growth in the Clover Bar area. Clover Bar substation relies on a cubicle farm configuration, requiring the addition of two 25 kV circuit breakers (24C and 14C); refer to section 2.2 for further information. If the application is approved, EDTI will construct distribution circuit 24C in 2017 (approximately 4.4 km).

The estimated transmission capital cost to add the two Clover Bar 25 kV circuit breakers is $164,829 (+/- 30%, 2017$). The estimated distribution capital cost to construct the new Clover Bar 24C circuit is $3.9 million (+/-30%, 2017$).

EDTI has applied for a DTS increase from 20.1 MW to 32.2 MW at the Clover Bar substation as part of this request for system access service.

The requested in-service date for the preferred development is March 31, 2017 to accommodate three new customer connections in 2017 within the Clover Bar service area. The first customer connecting provided EDTI with an estimated energization timeframe of Q2 2017.

EDTI anticipates the need to construct distribution circuit 14C in 2021 (distance unknown); when the targeted ISD for this project is more certain, EDTI will apply for a DTS increase through a separate SASR application.

2.0 EXISTING SYSTEM

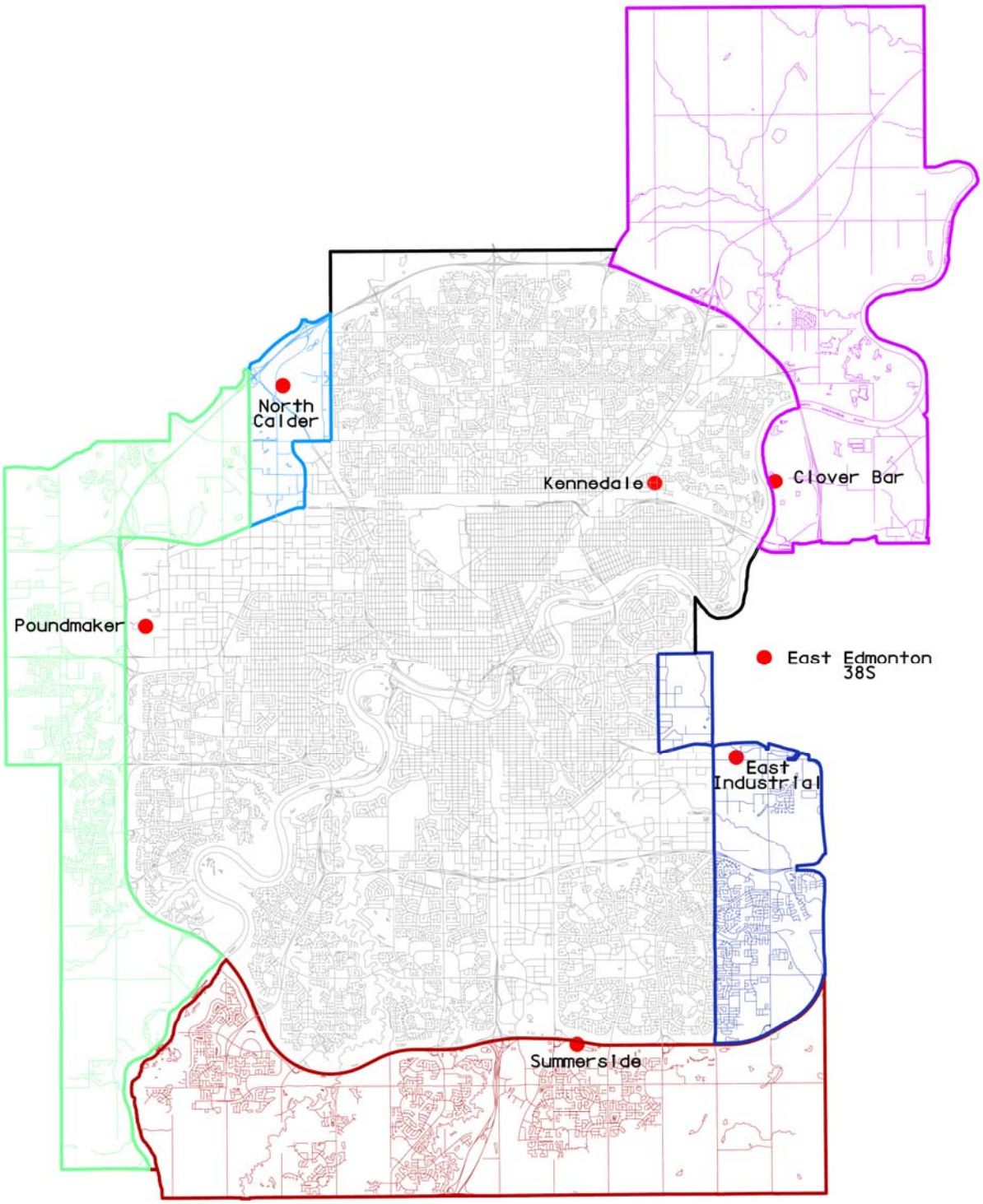
2.1 Geographic Area Description

The geographic study area discussed in this Distribution Deficiency Report (DDR) is depicted in blue in the upper-right corner of Figure 2.1-1. It covers the north-east quadrant of the city of Edmonton (approx. 8800 ha). This area, which continues to attract medium and heavy industrial developments, is supplied via the 25 kV distribution circuits out of EDTI's Clover Bar substation. This area is electrically-isolated with no distribution ties to other substations.

The closest adjacent 25 kV substations within EDTI's service area are Altalink's North Calder POD and EDTI's East Industrial substation. There are no other 25 kV substations inside of EDTI's service area that are closer than Altalink's North Calder POD and East Industrial substation. North Calder POD is geographically isolated from the 25 kV assets in the Clover Bar service area and is therefore not a suitable alternative. The nearby Kennedale substation operates at 15 kV and is therefore not suitable to servicing the 25kV assets in the Clover Bar service area.

The East Edmonton 38S substation is closer than East Industrial substation but is outside of EDTI's service area. East Edmonton 38S substation is also not as close as the existing Clover Bar substation. The use of East Edmonton 38S substation is not suitable because EDTI would be required to run distribution assets through Fortis Alberta Inc. service territory; something that EDTI is not permitted to do by Fortis Alberta Inc.

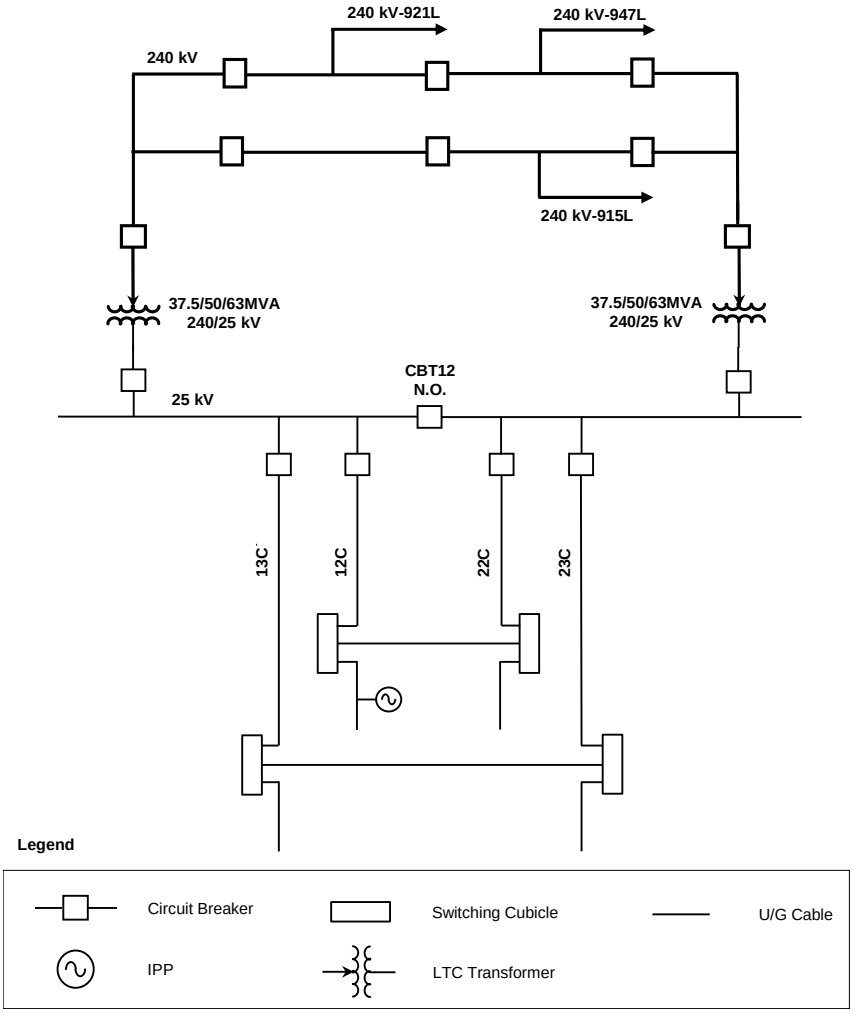
Figure 2.1-1
Geographic Study Area



2.2 Current System Configuration

The Clover Bar substation is currently equipped with two 240/25 kV transformers. Each transformer is rated 37.5/50/63 MVA. There are eight 25 kV switchgear feeder cells, four of which are already furnished with feeder breakers for the existing 12C, 13C, 22C and 23C circuits. The breaker arrangements at the Clover Bar substation are called cubicle farms; this design provides a cost effective alternative towards providing the required distribution ties for the Clover Bar service area. As per this design, creation of the necessary distribution ties requires that at any time a new circuit is added, two feeder breakers must be installed at the same time along with the distribution assets to support the configuration. As shown in Figure 2.2-1, circuits 12C and 22C and circuits 13C and 23C form two cubicle farms.

Figure 2.2-1
Existing System Configuration



2.3 Area Loading

Historical and forecasted peak loading information in the Clover Bar area is provided in Tables 2.3-1 and 2.3-2 respectively for the winter and summer peak conditions. Substation values are coincidental peaks at the Clover Bar substation. All values provided in Tables 2.3-1 and 2.3-2 are in MVA. The average hourly power factor at the Clover Bar substation over the past five years (2011-2015) is 0.93.

The forecasts in Table 2.3-1 and Table 2.3-2 were completed in March 2016 in-line with EDTI's annual forecast release. The 2016 summer actuals have been included in Table 2.3-2; however the corresponding forecast has not yet been updated to reflect the adjustments made. Two load transfers have occurred in preparation for three new customer connections within the Clover Bar service area in 2017. EDTI's next forecast of the Clover Bar substation for summer and winter peak conditions is anticipated to be available in April 2017.

Table 2.3-1
Historical & Forecast Peak Load – Winter Peak (MVA)

		Historical Load					Forecasted Load									
	Circuit	A 2011	B 2012	C 2013	D 2014	E 2015	F 2016	G 2017	H 2018	I 2019	J 2020	K 2021	L 2022	M 2023	N 2024	O 2025
1	12C	10.10	12.72	14.14	10.29	11.71	12.09	12.46	12.84	13.21	13.59	13.96	14.34	14.71	15.09	15.46
2	13C	5.11	8.86	9.12	8.22	10.44	11.51	12.58	13.65	14.72	15.79	16.86	17.93	19.00	20.07	21.13
3	22C	4.58	3.24	6.27	6.54	7.28	8.11	8.95	9.79	10.63	11.46	12.30	13.14	13.97	14.81	15.65
4	23C	n/a	n/a	4.41	3.98	5.00	5.56	5.61	5.65	5.70	5.75	5.80	5.85	5.90	5.95	6.00
5	POD [MVA]	19.26	21.01	26.44	26.81	29.70	32.16	34.62	37.08	39.54	42.00	44.46	46.92	49.38	51.84	54.30
6	POD [MW]	17.96	19.87	24.70	25.13	27.63	29.91	32.20	34.49	36.78	39.06	41.35	43.64	45.93	48.21	50.50

Table 2.3-2
Historical & Forecast Peak Load – Summer Peak (MVA)

		Historical Load					Forecasted Load									
	Circuit	A 2011	B 2012	C 2013	D 2014	E 2015	F 2016[1]	G 2017	H 2018	I 2019	J 2020	K 2021	L 2022	M 2023	N 2024	O 2025
1	12C	10.46	10.93	11.73	11.95	9.75	8.73	10.76	11.00	11.24	11.48	11.72	11.96	12.20	12.44	12.68
2	13C	4.80	7.43	8.08	8.01	10.50	5.83	11.62	12.53	13.45	14.37	15.28	16.20	17.12	18.03	18.95
3	22C	5.36	6.40	7.48	7.92	8.52	3.63	11.05	12.07	13.09	14.11	15.13	16.15	17.17	18.19	19.21
4	23C	n/a	n/a	n/a	3.28	3.63	7.78	4.33	4.68	5.03	5.38	5.73	6.08	6.43	6.78	7.13
5	POD [MVA]	19.44	24.41	25.69	25.47	27.69	30.32	32.33	34.32	36.30	38.29	40.28	42.26	44.25	46.24	48.22
6	POD [MW]	17.20	21.99	23.16	23.33	24.97	27.86	30.07	31.92	33.76	35.61	37.46	39.30	41.15	43.00	44.84

[1] The 2016 forecast does not take into consideration the 2016 actuals. In 2016, EDTI has adjusted circuit configurations to accommodate three new customer connections within the Clover Bar service area with estimated demands of: 3.7 MVA on circuit 13C by May 2017, 5 MVA on circuit 22C by July 2017and 4.9 MVA on circuit 12C by October 2017.

2.4 EDTI's Overload Policy

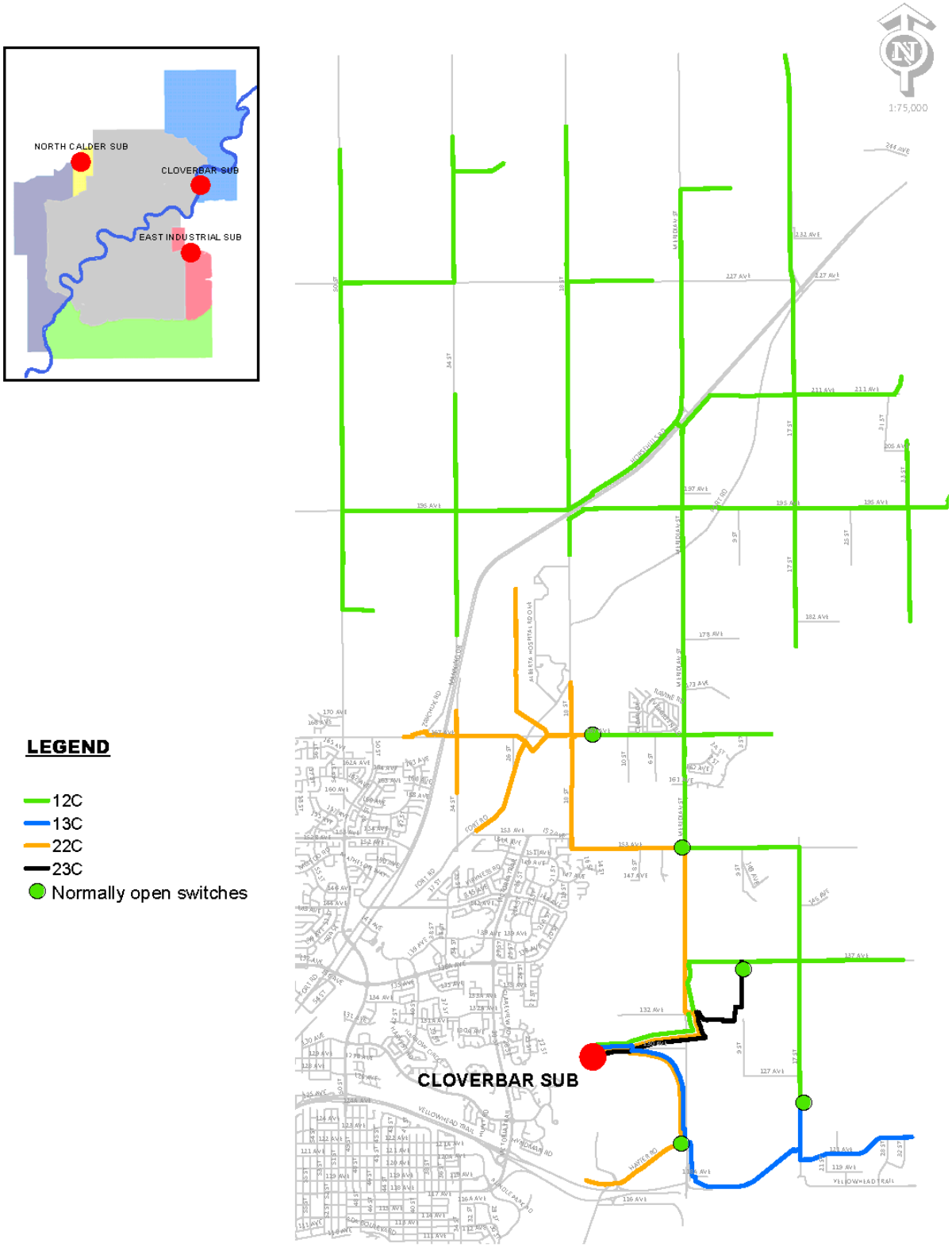
Each EDTI distribution circuit has 3 ratings: a design rating (the lowest rating), a standard rating and an emergency rating (the highest rating).

- During normal operating condition (N-0), the loading on an EDTI distribution circuit shall not exceed the circuit's design rating, which corresponds to 2/3 of the circuit's emergency rating
- During emergency condition (N-1), the loading on an EDTI distribution circuit shall not exceed the circuit's standard rating for a duration of more than three days
- At no time shall the loading on an EDTI distribution circuit exceed the circuit's emergency rating

2.5 Distribution Circuits

All existing distribution circuits at the Clover Bar substation are shown in Figure 2.4-1. Each of these circuits has an emergency rating of 18 MVA and a design rating of 12 MVA. In Tables 2.3-1 and 2.3-2 above, loads that exceed EDTI's N-0 overload policy limit are highlighted in red.

Figure 2.4-1
Existing Distribution Circuits Map



3.0 RISK ASSESSMENT

3.1 N-0 Assessment

The N-0 analysis is summarized in Tables 3.1-1 and 3.1-2 respectively for the winter and summer peak conditions. The analysis shows that EDTI's forecasted loads will be greater than circuit design capacity beginning in summer 2018. The amount of load that exceeds the design rating and cannot be transferred to adjacent circuits is shown in red and is referred to as "Load at Risk" in Tables 3.1-1 and 3.1-2. The tie-away capacity during N-0 condition is determined using the circuit's design rating of 12 MVA; see sections 2.4 and 2.5.

Table 3.1-1
N-0 Assessment – Winter Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	12C	Forecasted Load	12.09	12.46	12.84	13.21	13.59	13.96	14.34	14.71	15.09	15.46
2		Tie Away Capacity	0.90	0.46	0.84	1.21	1.59	1.96	2.34	2.71	3.09	2.36
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10
4	23C	Forecasted Load	5.56	5.61	5.65	5.70	5.75	5.80	5.85	5.90	5.95	6.00
5		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	22C	Forecasted Load	8.11	8.95	9.79	10.63	11.46	12.30	13.14	13.97	14.81	15.65
8		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	0.30	1.14	1.97	2.81	3.65
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	13C	Forecasted Load	11.51	12.58	13.65	14.72	15.79	16.86	17.93	19.00	20.07	21.13
11		Tie Away Capacity	n/a	0.58	1.65	1.37	0.54	0.00	0.00	0.00	0.00	0.00
12		Load at Risk	0.00	0.00	0.00	**1.35**	**3.25**	**4.86**	**5.93**	**7.00**	**8.07**	**9.13**

Table 3.1-2
N-0 Assessment – Summer Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	12C	Forecasted Load	10.52	10.76	11.00	11.24	11.48	11.72	11.96	12.20	12.44	12.68
2		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.20	0.44	0.68
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	23C	Forecasted Load	3.98	4.33	4.68	5.03	5.38	5.73	6.08	6.43	6.78	7.13
5		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	22C	Forecasted Load	10.04	11.05	12.07	13.09	14.11	15.13	16.15	17.17	18.19	19.21
8		Tie Away Capacity	n/a	n/a	0.07	1.09	2.11	3.13	4.15	5.17	5.22	4.87
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.97**	**2.34**
10	13C	Forecasted Load	10.70	11.62	12.53	13.45	14.37	15.28	16.20	17.12	18.03	18.95
11		Tie Away Capacity	n/a	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12		Load at Risk	0.00	0.00	**0.53**	**1.45**	**2.37**	**3.28**	**4.20**	**5.12**	**6.03**	**6.95**

3.2 N-1 Assessment

The N-1 assessment applied in this section evaluates the condition whereby each circuit is placed out of service and must rely on the tie-away capacity from adjacent circuits. Tables 3.2-1 and 3.2-2 show that EDTI's forecasted loads will be greater than the permitted capacity for the Clover Bar service area under emergency condition N-1 beginning in winter 2016. The tie-away capacity during N-1 emergency is determined using EDTI's defined circuit emergency rating of 18 MVA for 25 kV circuits; see sections 2.4 and 2.5 for further information. The amount of load that cannot be served because there is insufficient tie-away capacity at adjacent circuits is shown in red and is referred to as "Load at Risk" in Tables 3.2-1 and 3.2-2.

To help explain, in table 3.2-1 and table 3.2-2, cell K1 indicates the forecasted load on circuit 12C in 2025, whereas cell K2 indicates the capacity available on the adjacent circuits if circuit 12C were ever lost (The ideal tie-away capacity would be 6MVA from adjacent circuit 1 plus 6MVA from adjacent circuit 2 equals 12MVA total available tie-away capacity for EDTI's designed 12MVA circuit. However, this tie-away capacity could be greater if loading of the adjacent circuits is less than the ideal design. The tie-away capacity could be less if loading of the adjacent circuits is greater than the ideal design.) The Load at risk shown in cell K3 is the load on circuit 12C which cannot be transferred because of insufficient capacity on adjacent circuits.

Table 3.2-1
N-1 Assessment – Winter Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	Loss of 12C	Forecasted Load	12.09	12.46	12.84	13.21	13.59	13.96	14.34	14.71	15.09	15.46
2		Tie Away Capacity	12.09	12.46	12.84	13.21	13.59	13.96	14.34	14.71	15.09	14.35
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.11**
4	Loss of 23C	Forecasted Load	5.56	5.61	5.65	5.70	5.75	5.80	5.85	5.90	5.95	6.00
5		Tie Away Capacity	5.56	5.61	5.65	5.70	5.75	5.80	5.85	5.90	5.95	4.89
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.11**
7	Loss of 22C	Forecasted Load	8.11	8.95	9.79	10.63	11.46	12.30	13.14	13.97	14.81	15.65
8		Tie Away Capacity	8.11	8.95	9.79	10.63	11.46	12.30	12.22	12.10	12.05	12.00
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	**0.91**	**1.87**	**2.76**	**3.64**
10	Loss of 13C	Forecasted Load	11.51	12.58	13.65	14.72	15.79	16.86	17.93	19.00	20.07	21.13
11		Tie Away Capacity	9.89	9.05	8.21	7.37	6.54	5.70	4.86	4.03	3.19	2.35
12		Load at Risk	**1.63**	**3.53**	**5.44**	**7.35**	**9.25**	**11.16**	**13.06**	**14.97**	**16.88**	**18.78**

Table 3.2-2
N-1 Assessment – Summer Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	Loss of 12C	Forecasted Load	10.52	10.76	11.00	11.24	11.48	11.72	11.96	12.20	12.44	12.68
2		Tie Away Capacity	10.52	10.76	11.00	11.24	11.48	11.72	11.96	12.20	11.03	9.66
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.41**	**3.02**
4	Loss of 23C	Forecasted Load	3.98	4.33	4.68	5.03	5.38	5.73	6.08	6.43	6.78	7.13
5		Tie Away Capacity	3.98	4.33	4.68	5.03	5.38	5.73	6.08	6.43	5.56	5.32
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.22**	**1.81**
7	Loss of 22C	Forecasted Load	10.04	11.05	12.07	13.09	14.11	15.13	16.15	17.17	18.19	19.21
8		Tie Away Capacity	10.04	11.05	12.07	13.09	14.11	14.99	13.72	12.45	11.22	10.87
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	**0.14**	**2.43**	**4.72**	**6.97**	**8.34**
10	Loss of 13C	Forecasted Load	10.70	11.62	12.53	13.45	14.37	15.28	16.20	17.12	18.03	18.95
11		Tie Away Capacity	7.96	6.95	5.93	4.91	3.89	2.87	1.85	0.83	0.00	0.00
12		Load at Risk	**2.74**	**4.67**	**6.60**	**8.54**	**10.48**	**12.41**	**14.35**	**16.29**	**18.03**	**18.95**

4.0 TECHNICAL ANALYSIS OF ALTERNATIVES

The following four solution alternatives were identified to address the capacity and reliability constraints identified above:

Distribution Alternatives

1. Supply load utilizing existing Clover Bar distribution circuits
2. Transfer load between Clover Bar substation and adjacent substations

Transmission Alternatives

3. Construct a new distribution circuit from an adjacent 25 kV substation
4. Construct a new distribution circuit from EDTI's Clover Bar substation

4.1 Alternative 1: Supply load utilizing existing Clover Bar circuits

This alternative would involve transferring load between existing Clover Bar distribution circuits to accommodate the load growth in the area. As shown in Table 2.3-1, EDTI forecasts that the peak load on circuit 12C will exceed the circuit's design rating as of winter 2016. Moreover, Table 3.1-2 shows that, starting in summer 2018, there will be insufficient tie-away capacity in order to operate all Clover Bar distribution circuits below their design rating of 12 MVA.

EDTI rejects this alternative because it is not technically feasible; as of summer 2018 there will be insufficient capacity on the existing Clover Bar circuits during peak conditions.

4.2 Alternative 2: Transfer load between Clover Bar and adjacent substations

Clover Bar substation is isolated with no distribution ties to other substation service areas. Therefore, any distribution load transfers to other substations are not possible.

EDTI does not consider this alternative because it is not technically feasible.

4.3 Alternative 3: Construct a new distribution circuit from an adjacent substation

The closest 25 kV substation to the Clover Bar area is EDTI's East Industrial substation. The distance from the East Industrial substation to the load center is approximately 3 times longer than the distance from the Clover Bar substation to the load center. Moreover, to service any point within the Clover Bar service area from East Industrial substation, the new distribution circuit would be required to cross the North Saskatchewan River twice, introducing further risk, cost and reliability concerns when compared to Alternative 4.

This alternative consists of:

- Installation of one new 25 kV circuit breaker at the East Industrial substation
- Construction of approximately 11.0 km of distribution circuit (approximately 1 km of 750MCM Cu cable from the East Industrial new breaker to the closest load within Clover Bar's service area.
- Two North Saskatchewan River crossings – (assuming aerial crossings for a lesser cost) – dependent on environmental considerations and public consultation.

EDTI considers this alternative to be technically feasible.

4.4 Alternative 4: Construct a new distribution circuit from EDTI's Clover Bar Substation

This alternative consists of:

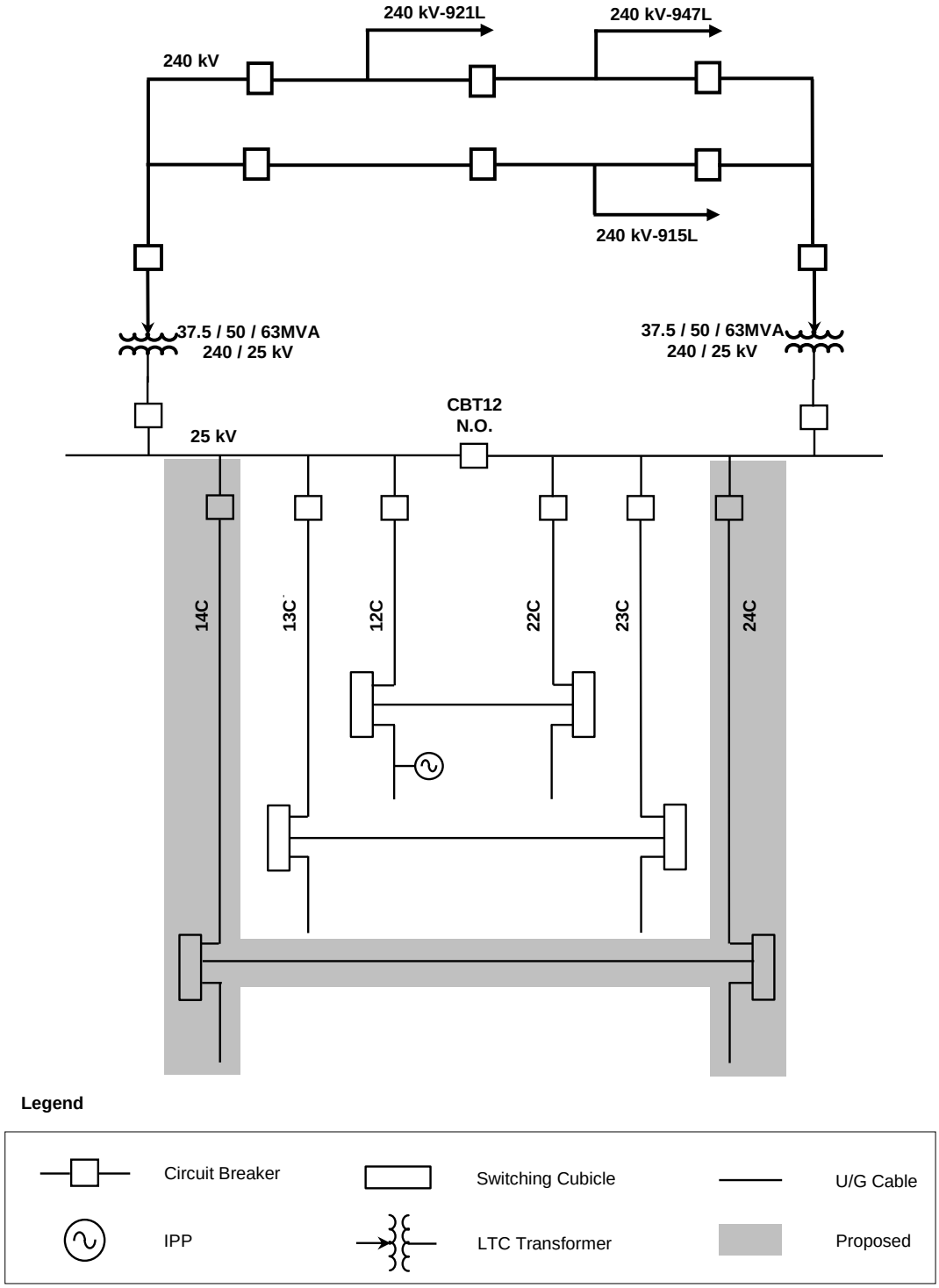
- Installation of two new 25 kV circuit breakers at the Clover Bar substation
- Installation of a pair of 1000MCM Cu cables from the substation new breakers to the new cubicle on the switchyard
- Construction of approximately 4.4 km of distribution circuit (approximately 1.1 km of 750MCM Cu cable in existing duct line exiting Clover Bar Substation, and approximately 3.3 km of 750MCM Cu cable from the duct line on 130 Avenue up to 17 Street NE to connect to the existing distribution system)

Distribution cables from both 24C and 14C breakers are to be routed into two corresponding switching cubicles located in the switchyard and tied together to ensure adequate reliability.

EDTI considers this alternative to be technically feasible.

A single line diagram of the preferred development is shown in Figure 4.4-1.

Figure 4.4-1
Preferred System Configuration



5.0 ECONOMIC ANALYSIS OF SOLUTION ALTERNATIVES

The cost comparison of the four alternatives is identified in Table 5.0-1 below.

The cost associated with alternative 1 and alternative 2 are not applicable because both alternatives would only rely on distribution switching to complete, which is an operational activity.

The cost in Alternative 3 is significantly higher than alternative 4 because of the added distribution cable required to service the Clover Bar service area and the two North Saskatchewan River crossings needed to reach the Clover Bar service area.

Table 5.0-1
Cost Comparison ($ Millions)

Alternative	Description	Cost (+/- 30%)
1	**Load transfers between Clover Bar distribution circuits**	
	Transmission cost	n/a
	Distribution cost	n/a
	Total for Alternative 1	**n/a**
2	**Transfer load between Clover Bar and adjacent substations**	
	Transmission cost	n/a
	Distribution cost	n/a
	Total for Alternative 2	**n/a**
3	**Build a new circuit from East Industrial substation**	
	Transmission cost	$0.08
	Distribution cost	$8.12
	Total for Alternative 3	**$8.20**
4	**Build new circuit from Clover Bar substation**	
	Transmission cost	$0.16
	Distribution cost	$3.90
	Total for Alternative 4	**$4.06**

6.0 RECOMMENDATION

Alternative 4, Construct a new distribution circuit from EDTI's Clover Bar substation, is EDTI's preferred alternative as it would enable EDTI to supply the load increase in the most cost-effective manner. Additional discussion on the effectiveness of the preferred solution is detailed in Section 7.

The requested in-service date ("ISD") for the circuit breakers 24C and 14C is March 31, 2017. This is necessary to support a March 31, 2017 ISD for distribution circuit 24C.

7.0 EFFECTIVENESS OF THE PREFERRED ALTERNATIVE

7.1 Impact of Preferred 24C Circuit

With the addition of the distribution circuit 24C in 2017, there is no load at risk under normal operating and emergency conditions until 2021. Results from N-0 and N-1 assessments are summarized in Tables 7.1-1 and 7.1-3 for the winter peak conditions and Tables 7.1-2 and 7.1-4 for the summer peak conditions. The tie-away capacity during N-0 condition is determined using the circuit's design rating of 12 MVA, whereas the tie-away capacity during N-1 condition is determined using the circuit's emergency rating of 18 MVA; see sections 2.4 and 2.5.

Table 7.1-1
N-0 Assessment with 24C addition - Winter Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	12C	Forecasted Load	12.09	7.23	7.44	7.66	7.88	8.10	8.32	8.53	8.75	8.97
2		Tie Away Capacity	0.09	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	23C	Forecasted Load	5.56	5.61	5.65	5.70	5.75	5.80	5.85	5.90	5.95	6.00
5		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	22C	Forecasted Load	8.11	8.95	9.79	10.63	11.46	12.30	13.14	13.97	14.81	15.65
8		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	0.30	1.14	1.97	2.81	3.65
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	13C	Forecasted Load	11.51	12.58	13.65	14.72	15.79	16.86	17.93	19.00	20.07	21.13
11		Tie Away Capacity	n/a	0.58	1.65	2.72	3.79	3.90	3.68	3.47	3.25	3.03
12		Load at Risk	0.00	0.00	0.00	0.00	0.00	**0.96**	**2.25**	**3.53**	**4.82**	**6.10**
13	24C	Forecasted Load	n/a	5.23	5.39	5.55	5.71	5.86	6.02	6.18	6.34	6.49
14		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
15		Load at Risk	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 7.1-2
N-0 Assessment with 24C addition - Summer Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	12C	Forecasted Load	10.52	6.24	6.38	6.52	6.66	6.80	6.94	7.08	7.22	7.36
2		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	23C	Forecasted Load	3.98	4.33	4.68	5.03	5.38	5.73	6.08	6.43	6.78	7.13
5		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	22C	Forecasted Load	10.04	11.05	12.07	13.09	14.11	15.13	16.15	17.17	18.19	19.21
8		Tie Away Capacity	n/a	n/a	0.07	1.09	2.11	3.13	4.15	5.17	5.22	4.87
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.97**	**2.34**
10	13C	Forecasted Load	10.70	11.62	12.53	13.45	14.37	15.28	16.20	17.12	18.03	18.95
11		Tie Away Capacity	n/a	n/a	0.53	1.45	2.37	3.28	4.20	4.92	4.78	4.64
12		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.20**	**1.25**	**2.31**
13	24C	Forecasted Load	n/a	4.52	4.62	4.72	4.82	4.92	5.02	5.12	5.23	5.33
14		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
15		Load at Risk	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 7.1-3
N-1 Assessment with 24C addition - Winter Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	Loss of 12C	Forecasted Load	12.09	7.23	7.44	7.66	7.88	8.10	8.32	8.53	8.75	8.97
2		Tie Away Capacity	12.09	7.23	7.44	7.66	7.88	8.10	8.32	8.53	8.75	8.97
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Loss of 23C	Forecasted Load	5.56	5.61	5.65	5.70	5.75	5.80	5.85	5.90	5.95	6.00
5		Tie Away Capacity	5.56	5.61	5.65	5.70	5.75	5.80	5.85	5.90	5.95	6.00
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Loss of 22C	Forecasted Load	8.11	8.95	9.79	10.63	11.46	12.30	13.14	13.97	14.81	15.65
8		Tie Away Capacity	8.11	8.95	9.79	10.63	11.46	12.30	12.22	12.10	12.05	12.00
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	**0.92**	**1.87**	**2.76**	**3.65**
10	Loss of 13C	Forecasted Load	11.51	12.58	13.65	14.72	15.79	16.86	17.93	19.00	20.07	21.13
11		Tie Away Capacity	11.51	12.58	13.65	14.72	15.79	15.60	14.55	13.49	12.44	11.38
12		Load at Risk	0.00	0.00	0.00	0.00	0.00	**1.26**	**3.38**	**5.51**	**7.63**	**9.75**
13	Loss of 24C	Forecasted Load	n/a	5.23	5.39	5.55	5.71	5.86	6.02	6.18	6.34	6.49
14		Tie Away Capacity	n/a	5.23	5.39	5.55	5.71	5.86	6.02	6.18	6.34	6.49
15		Load at Risk	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 7.1-4
N-1 Assessment with 24C addition - Summer Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	Loss of 12C	Forecasted Load	10.52	6.24	6.38	6.52	6.66	6.80	6.94	7.08	7.22	7.36
2		Tie Away Capacity	10.52	6.24	6.38	6.52	6.66	6.80	6.94	7.08	7.22	7.36
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Loss of 23C	Forecasted Load	3.98	4.33	4.68	5.03	5.38	5.73	6.08	6.43	6.78	7.13
5		Tie Away Capacity	3.98	4.33	4.68	5.03	5.38	5.73	6.08	6.43	6.78	7.13
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Loss of 22C	Forecasted Load	10.04	11.05	12.07	13.09	14.11	15.13	16.15	17.17	18.19	19.21
8		Tie Away Capacity	10.04	11.05	12.07	13.09	14.11	14.99	13.72	12.45	11.22	10.87
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	**0.14**	**2.43**	**4.72**	**6.97**	**8.34**
10	Loss of 13C	Forecasted Load	10.70	11.62	12.53	13.45	14.37	15.28	16.20	17.12	18.03	18.95
11		Tie Away Capacity	10.70	11.62	12.53	13.45	14.37	14.07	12.91	11.76	10.78	10.64
12		Load at Risk	0.00	0.00	0.00	0.00	0.00	**1.21**	**3.29**	**5.36**	**7.25**	**8.31**
13	Loss of 24C	Forecasted Load	n/a	4.52	4.62	4.72	4.82	4.92	5.02	5.12	5.23	5.33
14		Tie Away Capacity	n/a	4.52	4.62	4.72	4.82	4.92	5.02	5.12	5.23	5.33
15		Load at Risk	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

7.2 Impact of Preferred 14C and 24C Circuits

EDTI anticipates the need to construct distribution circuit 14C in 2021 (distance unknown); at this time EDTI will apply for a DTS increase through a separate SASR application. Therefore, with the subsequent addition of distribution circuit 14C in 2021, there will be no load at risk under normal operating and emergency conditions during the study period (2016-2026). Results from the N-0 and N-1 assessments are summarized in Tables 7.2-1 and 7.2-3 for the winter peak conditions and Tables 7.2-2 and 7.2-4 for the summer peak conditions. The preferred distribution circuits at the Clover Bar substation, 24C (in 2017) and 14C (in 2021), are shown in Figure 7.2-1. The tie-away capacity during N-0 condition is determined using the circuit's design rating of 12 MVA, whereas the tie-away capacity during N-1 condition is determined using the circuit's emergency rating of 18 MVA; see sections 2.4 and 2.5.

Table 7.2-1
N-0 Assessment with 14C and 24C addition - Winter Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	12C	Forecasted Load	12.09	7.23	7.44	7.66	7.88	7.68	7.89	8.09	8.30	8.50
2		Tie Away Capacity	0.09	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	23C	Forecasted Load	5.56	5.61	5.65	5.70	5.75	5.80	5.85	5.90	5.95	6.00
5		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	22C	Forecasted Load	8.11	8.95	9.79	10.63	11.46	12.30	13.14	13.97	14.81	15.65
8		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	0.30	1.14	1.97	2.81	3.65
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	13C	Forecasted Load	11.51	12.58	13.65	14.72	15.79	6.58	6.99	7.41	7.83	8.24
11		Tie Away Capacity	n/a	0.58	1.65	2.72	3.79	0.00	0.00	0.00	0.00	0.00
12		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	24C	Forecasted Load	n/a	5.23	5.39	5.55	5.71	8.22	8.64	9.06	9.49	9.91
14		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
15		Load at Risk	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	14C	Forecasted Load	n/a	n/a	n/a	n/a	n/a	8.35	8.75	9.14	9.54	9.94
17		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
18		Load at Risk	n/a	n/a	n/a	n/a	n/a	0.00	0.00	0.00	0.00	0.00

Table 7.2-2
N-0 Assessment with 14C and 24C addition - Summer Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	12C	Forecasted Load	10.52	6.24	6.38	6.52	6.66	6.45	6.58	6.71	6.84	6.98
2		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	23C	Forecasted Load	3.98	4.33	4.68	5.03	5.38	5.73	6.08	6.43	6.78	7.13
5		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	22C	Forecasted Load	10.04	11.05	12.07	13.09	14.11	15.13	16.15	17.17	18.19	19.21
8		Tie Away Capacity	n/a	n/a	0.07	1.09	2.11	3.13	4.15	5.17	6.19	7.21
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	13C	Forecasted Load	10.70	11.62	12.53	13.45	14.37	5.96	6.32	6.68	7.03	7.39
11		Tie Away Capacity	n/a	n/a	0.53	1.45	2.37	n/a	n/a	n/a	n/a	n/a
12		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	24C	Forecasted Load	n/a	4.52	4.62	4.72	4.82	7.27	7.62	7.97	8.32	8.66
14		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
15		Load at Risk	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	14C	Forecasted Load	n/a	n/a	n/a	n/a	n/a	7.33	7.65	7.97	8.28	8.60
17		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
18		Load at Risk	n/a	n/a	n/a	n/a	n/a	0.00	0.00	0.00	0.00	0.00

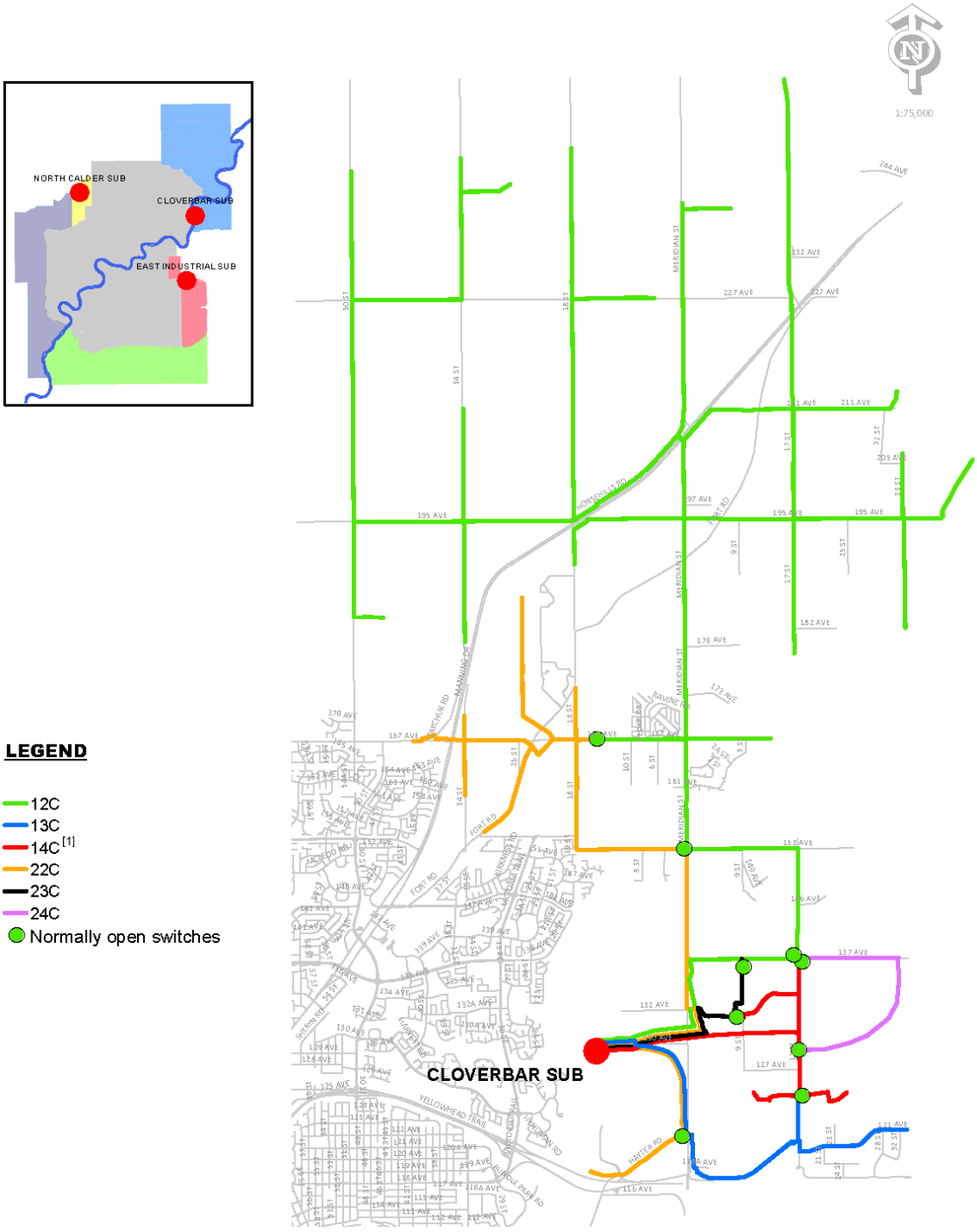
Table 7.2-3
N-1 Assessment with 14C and 24C addition - Winter Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	Loss of 12C	Forecasted Load	12.09	7.23	7.44	7.66	7.88	7.68	7.89	8.09	8.30	8.50
2		Tie Away Capacity	12.09	7.23	7.44	7.66	7.88	7.68	7.89	8.09	8.30	8.50
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Loss of 23C	Forecasted Load	5.56	5.61	5.65	5.70	5.75	5.80	5.85	5.90	5.95	6.00
5		Tie Away Capacity	5.56	5.61	5.65	5.70	5.75	5.80	5.85	5.90	5.95	6.00
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Loss of 22C	Forecasted Load	8.11	8.95	9.79	10.63	11.46	12.30	13.14	13.97	14.81	15.65
8		Tie Away Capacity	8.11	8.95	9.79	10.63	11.46	12.30	13.14	13.97	14.81	15.65
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Loss of 13C	Forecasted Load	11.51	12.58	13.65	14.72	15.79	6.58	6.99	7.41	7.83	8.24
11		Tie Away Capacity	11.51	12.58	13.65	14.72	15.79	6.58	6.99	7.41	7.83	8.24
12		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Loss of 24C	Forecasted Load	n/a	5.23	5.39	5.55	5.71	8.22	8.64	9.06	9.49	9.91
14		Tie Away Capacity	n/a	5.23	5.39	5.55	5.71	8.22	8.64	9.06	9.49	9.91
15		Load at Risk	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	Loss of 14C	Forecasted Load	n/a	n/a	n/a	n/a	n/a	8.35	8.75	9.14	9.54	9.94
17		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	8.35	8.75	9.14	9.54	9.94
18		Load at Risk	n/a	n/a	n/a	n/a	n/a	0.00	0.00	0.00	0.00	0.00

Table 7.2-4
N-1 Assessment with 14C and 24C addition - Summer Peak (MVA)

	Circuit		A 2016	B 2017	C 2018	D 2019	F 2020	G 2021	H 2022	I 2023	J 2024	K 2025
1	Loss of 12C	Forecasted Load	10.52	6.24	6.38	6.52	6.66	6.45	6.58	6.71	6.84	6.98
2		Tie Away Capacity	10.52	6.24	6.38	6.52	6.66	6.45	6.58	6.71	6.84	6.98
3		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Loss of 23C	Forecasted Load	3.98	4.33	4.68	5.03	5.38	5.73	6.08	6.43	6.78	7.13
5		Tie Away Capacity	3.98	4.33	4.68	5.03	5.38	5.73	6.08	6.43	6.78	7.13
6		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Loss of 22C	Forecasted Load	10.04	11.05	12.07	13.09	14.11	15.13	16.15	17.17	18.19	19.21
8		Tie Away Capacity	10.04	11.05	12.07	13.09	14.11	15.13	16.15	17.17	18.19	19.21
9		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Loss of 13C	Forecasted Load	10.70	11.62	12.53	13.45	14.37	5.96	6.32	6.68	7.03	7.39
11		Tie Away Capacity	10.70	11.62	12.53	13.45	14.37	5.96	6.32	6.68	7.03	7.39
12		Load at Risk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Loss of 24C	Forecasted Load	n/a	4.52	4.62	4.72	4.82	7.27	7.62	7.97	8.32	8.66
14		Tie Away Capacity	n/a	4.52	4.62	4.72	4.82	7.27	7.62	7.97	8.32	8.66
15		Load at Risk	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	Loss of 14C	Forecasted Load	n/a	n/a	n/a	n/a	n/a	7.33	7.65	7.97	8.28	8.60
17		Tie Away Capacity	n/a	n/a	n/a	n/a	n/a	7.33	7.65	7.97	8.28	8.60
18		Load at Risk	n/a	n/a	n/a	n/a	n/a	0.00	0.00	0.00	0.00	0.00

Figure 7.2-1
Preferred Distribution Circuits Map



[1] EDTI anticipates the need to construct distribution circuit 14C in 2021. Until this time, the 14C service area will be supplied from the 13C feeder.

Technical Supplement to Distribution Deficiency Report (DDR) for Breakers Addition (14C and 24C) at Clover Bar

1. EDTI's historical and forecasted peak loading information for East Industrial substation are provided in Table 1 and Table 2 for the winter and summer peak conditions respectively. The average hourly power factor at East Industrial substation over the past five years (2011-2015) is 0.948.

2. The forecasts provided in Table 1 and Table 2 were completed in March 2016 in-line with EDTI's annual forecast release. EDTI's next forecast of the East Industrial substation for summer and winter peak conditions is anticipated to be available in April 2017.

Table 1
East Industrial 2016 Substation Winter Forecast

		Historical Load					Forecasted Load									
East Industrial Winter		A 2011	B 2012	C 2013	D 2014	E 2015	F 2016	G 2017	H 2018	I 2019	J 2020	K 2021	L 2022	M 2023	N 2024	O 2025
1	POD [MVA]	49.3	51.3	53.6	55.3	54.1	55.8	58.3	61.1	63.9	66.7	69.6	72.6	75.6	78.8	82.1
2	POD [MW]	47.0	49.4	51.3	53.0	52.3	53.5	56.0	58.7	61.4	64.2	66.9	69.7	72.7	75.7	78.9

Table 2
East Industrial 2016 Substation Summer Forecast

		Historical Load					Forecasted Load									
East Industrial Summer		A 2011	B 2012	C 2013	D 2014	E 2015	F 2016	G 2017	H 2018	I 2019	J 2020	K 2021	L 2022	M 2023	N 2024	O 2025
1	POD [MVA]	44.8	52.1	51.9	55.9	58.5	60.3	63.0	66.1	69.1	72.1	75.3	78.5	81.7	85.2	88.8
2	POD [MW]	42.0	48.6	48.8	52.1	54.8	56.5	59.0	61.9	64.6	67.5	70.5	73.4	76.5	79.7	83.1

Note: 2016 summer actuals have been received for the substation at 52.5 MW (55.8 MVA). This is approximately 4 MW less than forecasted. The 'red' indicates that substation load is in excess of seasonal N-1 firm capacity.