Calgary

Glenmore Trail East Interchanges Functional Planning Study

Appendix K - Option Evaluation

Prepared By:

PARSONS

ISL Engineering and Land Services

Glenmore Trail East Study 100 Street SE to Conrich Road
Comparative Study Between Full Diamond and Diverging Diamond Estimate
Glenmore Trail / 100 St SE

Item No.	Description of Items	Unit	Unit Price	Diamond Interchange (DI) Estimated Quantity	Diamond Interchange (DI) Cost	Diverging Diamond Interchange (DDI) Estimated Quantity	Diverging Diamond Interchange (DDI) Cost	Notes
	Glenmore Trail Widening				**9,210,890**		**9,245,900**	
1.0	Asphalt Pavement	m2	$ 125.00	70,282	$ 8,785,250	70,552	$ 8,819,000	
2.0	Fill	m3	$ 15.00	28,376	$ 425,640	28,460	$ 426,900	
	Ramps				**5,444,825**		**6,917,330**	
1.0	NW Ramp - Asphalt Pavement	m2	$ 125.00	5,896	$ 737,000	5,672	$ 709,000	
2.0	NW Ramp - Fill	m3	$ 15.00	50,824	$ 762,360	71,248	$ 1,068,720	
4.0	NE Ramp - Asphalt Pavement	m2	$ 125.00	4,810	$ 601,250	4,925	$ 615,625	
5.0	NE Ramp - Fill	m3	$ 15.00	55,096	$ 826,440	67,695	$ 1,015,425	
7.0	SW Ramp - Asphalt Pavement	m2	$ 125.00	5,175	$ 646,875	5,979	$ 747,375	
8.0	SW Ramp - Fill	m3	$ 15.00	42,341	$ 635,115	57,253	$ 858,795	
10.0	SE Ramp - Asphalt Pavement	m2	$ 125.00	3,644	$ 455,500	4,239	$ 529,875	
11.0	SE Ramp - Fill	m3	$ 15.00	52,019	$ 780,285	91,501	$ 1,372,515	
	100 Street				**4,468,835**		**4,540,525**	
1.0	Asphalt Pavement	m2	$ 125.00	15,106	$ 1,888,250	17,882	$ 2,235,250	
2.0	Fill	m3	$ 15.00	172,039	$ 2,580,585	153,685	$ 2,305,275	
	Bridge Structure	**LS**			**11,864,000**		**10,440,000**	
1.0	New Bridge	m2	$ 4,000.00	2,966	$ 11,864,000	2,610	$ 10,440,000	
	Construction Items Sub-Total				**$ 30,988,550**		**$ 31,143,755**	
	Construction Items Sub-Total (Rounded)				**$ 30,989,000**		**$ 31,144,000**	
	Contingency -- (30%)				$ 9,296,700		$ 9,343,200	
	Total Including Contingency				**$ 40,285,700**		**$ 40,487,200**	
	Engineering & Testing -- (15%)				$ 6,042,855		$ 6,073,080	
	Property Acquisition				**38,332,500**		**41,947,500**	
1.0	NW Ramp	Acre	$ 750,000.00	9.29	$ 6,967,500	10.89	$ 8,167,500	
2.0	NE Ramp	Acre	$ 750,000.00	9.52	$ 7,140,000	10.82	$ 8,115,000	
3.0	SW Ramp	Acre	$ 750,000.00	16.43	$ 12,322,500	17.99	$ 13,492,500	
4.0	SE Ramp	Acre	$ 750,000.00	15.87	$ 11,902,500	16.23	$ 12,172,500	
	Construction Items Total + Property Acquisition				**$84.7 M**		**$88.5 M**	
	Budgeting Variance of (-40%)				**$50.8 M**		**$53.1 M**	
	Budgeting Variance of (+75%)				**$148.2 M**		**$154.9 M**	

Assumptions & Exclusions:

1 - This estimate is solely for comparing the two types of interchanges and includes only the major items as noted

2 - East and west limits on Glenmore Trail is taken arbitrarily but at the same locations for both interchanges

2 - Property for stormwater pond is not included

3 - Earthwork excavation and retaining wall are not included

4- 100 St is assumed to crossover Glenmore Trail

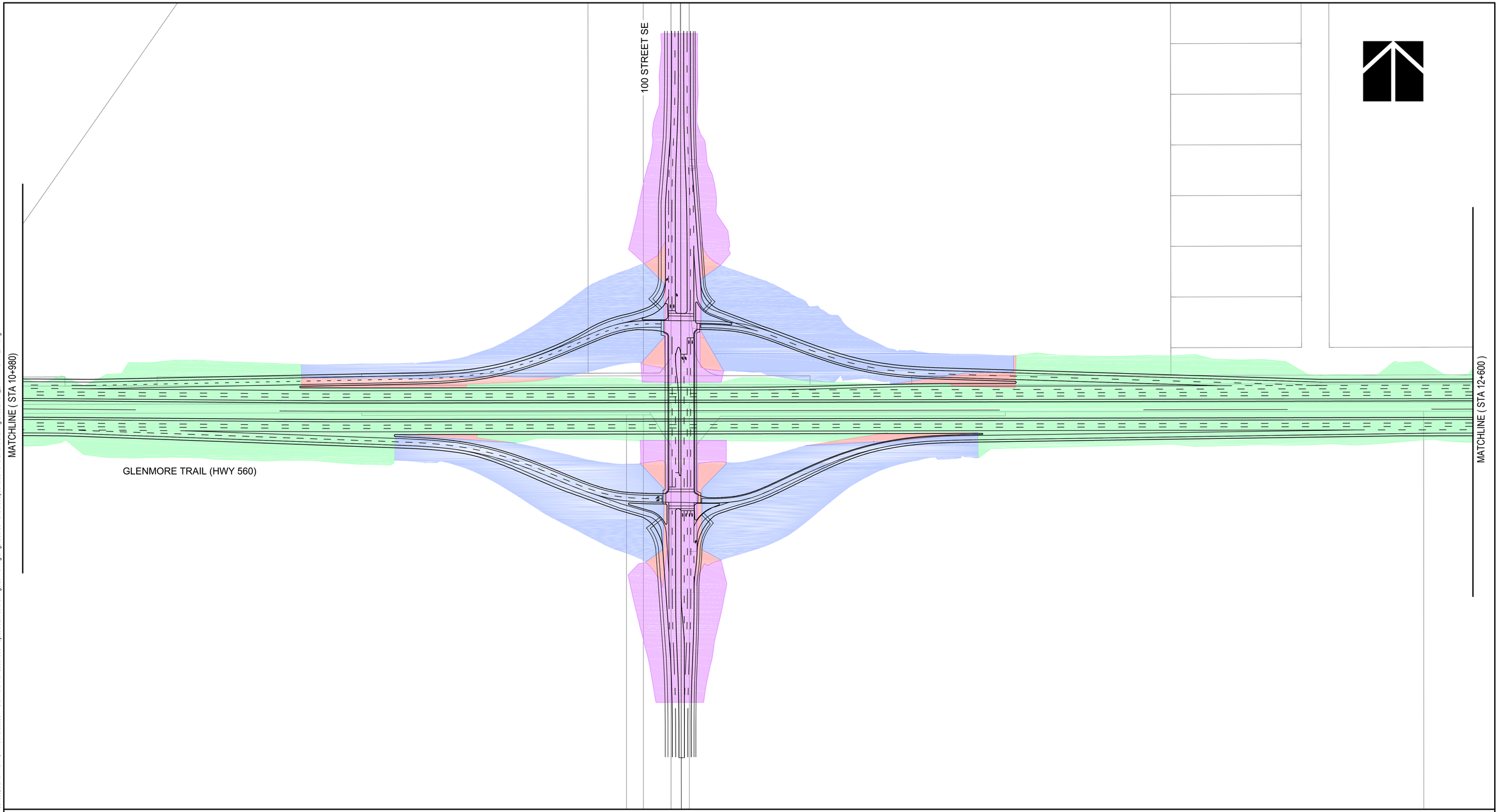
GLENMORE TRAIL EAST STUDY - 100 STREET S.E. TO CONRICH ROAD

ORDER OF MAGNITUDE COST COMPARISON
GLENMORE TRAIL / CONRICH ROAD INTERCHNAGE

ITEMS #	DESCRIPTION	UNIT	UNIT RATE	DIAMOND @ CONRICH ROAD		DDI @ CONRICH ROAD	
				ESTIMATED QUANTITY	ESTIMATED AMOUNT	ESTIMATED QUANTITY	ESTIMATED AMOUNT
Glenmore Trail Widening (From Existing 2 Lanes to 6 Lanes Section)							
1	Asphalt	m^2	$ 125.00	65088	$ 8,136,000.00	64182	$ 8,022,750.00
2	Fill	m^3	$ 15.00	87955	$ 1,319,325.00	87955	$ 1,319,325.00
					Sub-Total: $ 9,455,325.00		$ 9,342,075.00
Ramps							
1	NW Ramp - Asphalt	m^2	$ 125.00	6497	$ 812,125.00	6315	$ 789,375.00
2	NW Ramp - Fill	m^3	$ 15.00	49280	$ 739,200.00	33476	$ 502,140.00
3	NE Ramp - Asphalt	m^2	$ 125.00	4972	$ 621,500.00	6915	$ 864,375.00
4	NE Ramp - Fill	m^3	$ 15.00	58363	$ 875,445.00	42498	$ 637,470.00
5	SW Ramp - Asphalt	m^2	$ 125.00	6887	$ 860,875.00	7841	$ 980,125.00
6	SW Ramp - Fill	m^3	$ 15.00	50711	$ 760,665.00	48059	$ 720,885.00
7	SE Ramp - Asphalt	m^2	$ 125.00	5662	$ 707,750.00	5649	$ 706,125.00
8	SE Ramp - Fill	m^3	$ 15.00	27097	$ 406,455.00	12158	$ 182,370.00
					Sub-Total: $ 5,784,015.00		$ 5,382,865.00
North-South Connector Widening (From Existing 2 Lanes to 4 Lanes Section)							
1	Asphalt	m^2	$ 125.00	18293	$ 2,286,625.00	18694	$ 2,336,750.00
2	Fill	m^3	$ 15.00	177470	$ 2,662,050.00	289269	$ 4,339,035.00
					Sub-Total: $ 4,948,675.00		$ 6,675,785.00
Bridge Structure							
1	Bridge	m^2	$ 4,000.00	2807	$ 11,228,000.00	2545	$10,180,000.00
					Sub-Total: $ 11,228,000.00		$10,180,000.00
					Construction Items Sub-Total: $ 31,416,015.00		**$ 31,580,725.00**
					Construction Items Sub-Total (Rounded): $ 31,500,000.00		**$ 31,600,000.00**
					Contingency (30%): $ 9,450,000.00		$ 9,480,000.00
					Total Incl. Contingency: $ 40,950,000.00		**$ 41,080,000.00**
					Engineering & Testing (15%): $ 6,142,500.00		$ 6,162,000.00
Property Acquisition							
1	NW Ramp	Arce	$ 750,000.00	8.89	$ 6,667,016.45	10.62	$ 7,962,464.42
2	NE Ramp	Arce	$ 750,000.00	8.93	$ 6,696,669.05	11.73	$ 8,798,111.75
3	SW Ramp	Arce	$ 750,000.00	17.02	$ 12,766,185.62	18.41	$ 13,808,474.51
4	SE Ramp	Arce	$ 750,000.00	15.47	$ 11,602,877.05	16.27	$ 12,200,191.61
					Property Acquisition Sub-Total: $ 37,732,748.17		$ 42,769,242.28
					Construction Items Total + Property Acquisition Total Class 4 Estimate: $ 84,825,248.17		$ 90,011,242.28
					Total Class 4 Estimate Rounded (2017 Dollars): $84.9 M		**$90.1 M**
					- 40% Budgeting Variance: **$50.9 M**		**$54.1 M**
					+ 75% Budgeting Variance: **$148.5 M**		**$157.6 M**

Assumption:

1 This estimate is solely comparing items different for Conventional Diamond and Diverging Diamond Interchange that may significantly vary
2 Property for stormwater ponds not included in this estimate
3 Conrich Road is assumed to be going over Glenmore Trail



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ISL Engineering and Land Services

Calgary

NOTE: ALL DRAWINGS ARE PRINTED AT HALF SCALE WHEN IN 11" x 17" FORMAT

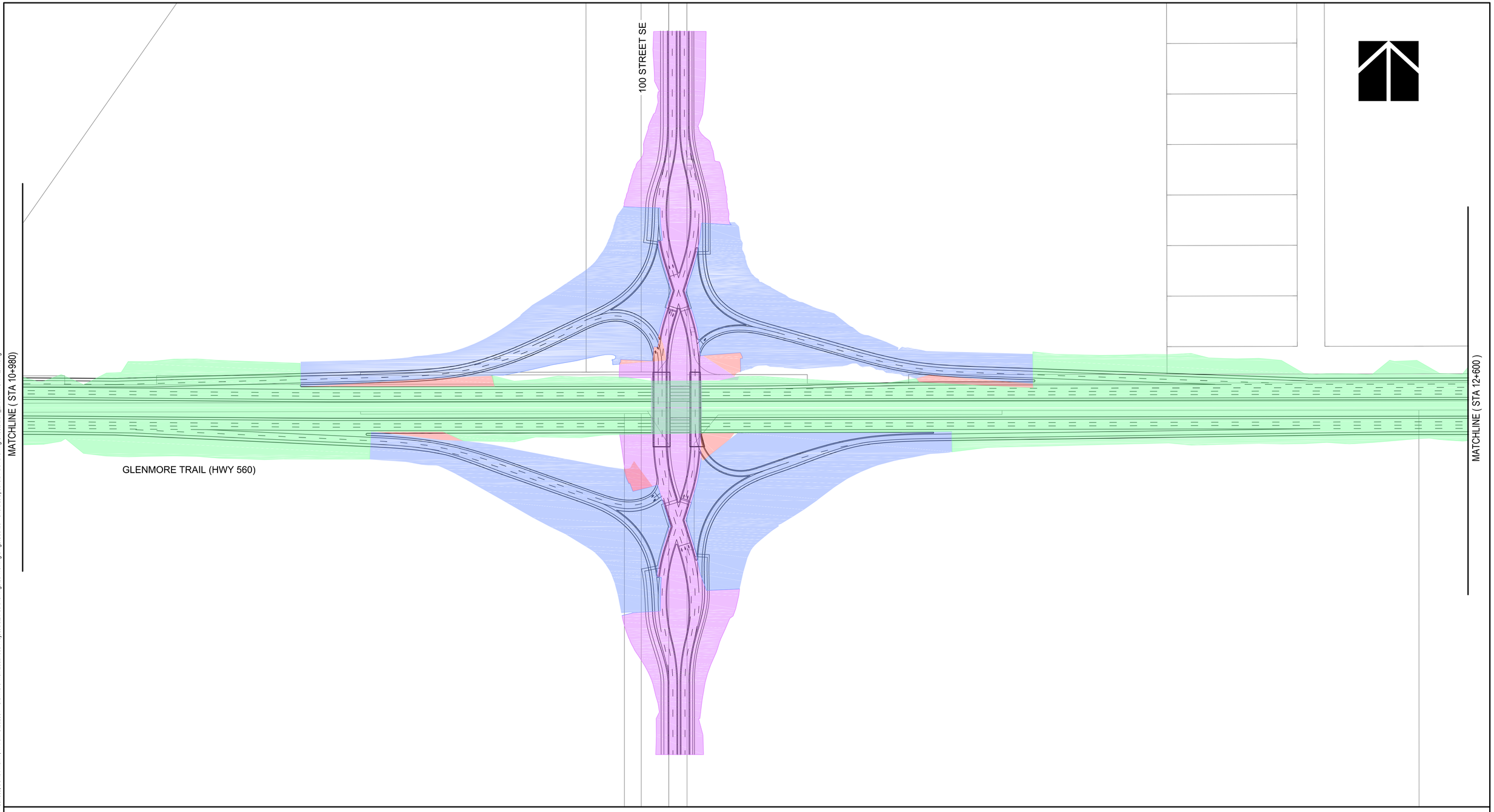
PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION

LEGEND:

- GLENMORE TRAIL EAST
- RAMPS
- 100 STREET
- DUPLICATE AREA (4.15 % OF TOTAL AREA)

1:2000 0 40 120m

GLENMORE TRAIL EAST STUDY
100 STREET SE TO CONRICH ROAD
100 STREET INTERCHANGE
FULL DIAMOND INTERCHANGE
EARTHWORKS QUANTITY ESTIMATE
EXHIBIT 1.0



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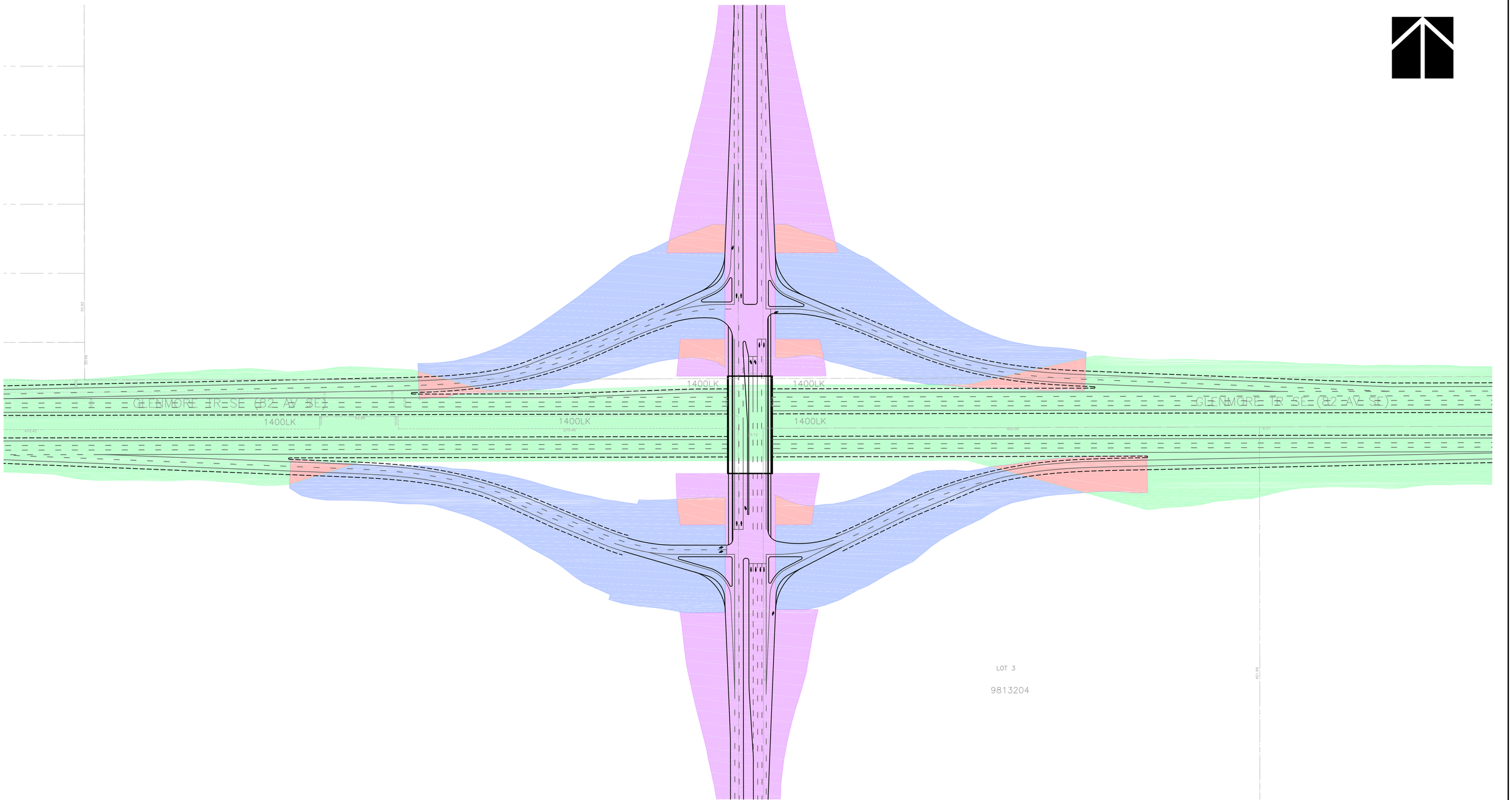
SUBJECT TO REVISION

LEGEND:

- GLENMORE TRAIL EAST
- RAMPS
- 100 STREET
- DUPLICATE AREA (1.78 % OF TOTAL AREA)

1:2000 0 40 120m

GLENMORE TRAIL EAST STUDY
100 STREET SE TO CONRICH ROAD
100 STREET INTERCHANGE
DIVERGING DIAMOND INTERCHANGE
EARTHWORKS QUANTITY ESTIMATE
EXHIBIT 2.0



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SUBJECT TO REVISION

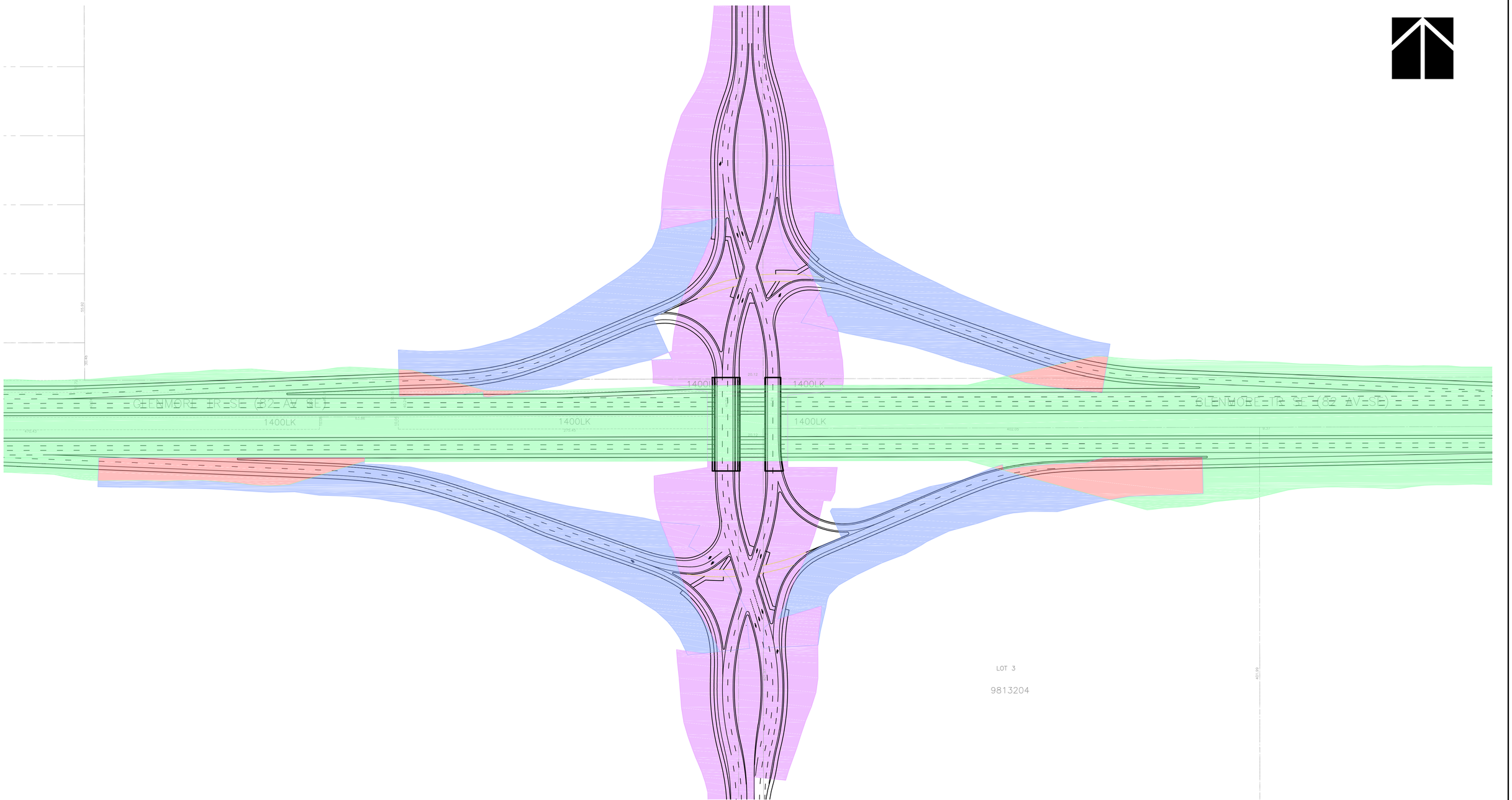
EARTHWORKS

- GLENMORE DRIVE
- RAMPS
- CONRICH ROAD
- *DUPLICATE AREA 2.6% OF TOTAL AREA

1:1500 0 15 30 45 60 75

GLENMORE TRAIL EAST STUDY
100 STREET SE TO CONRICH ROAD

CONRICH INTERCHANGE
STANDARD DIAMOND INTERCHANGE
EARTHWORKS QUANTITY ESTIMATE
EXHIBIT 3.0



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NOTE: ALL DRAWINGS ARE PRINTED AT HALF SCALE WHEN IN 11" x 17" FORMAT

PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION

EARTHWORKS

- GLENMORE DRIVE
- RAMPS
- CONRICH ROAD
- *DUPLICATE AREA 3.3% OF TOTAL AREA

1:1500 0 15 30 45 60 75

GLENMORE TRAIL EAST STUDY
100 STREET SE TO CONRICH ROAD

CONRICH INTERCHANGE
DDI INTERCHANGE
EARTHWORKS QUANTITY ESTIMATE
EXHIBIT 4.0

MATCHLINE (STA 10+980)

GLENMORE TRAIL (HWY 560)

MATCHLINE (STA 12+600)

100 STREET SE

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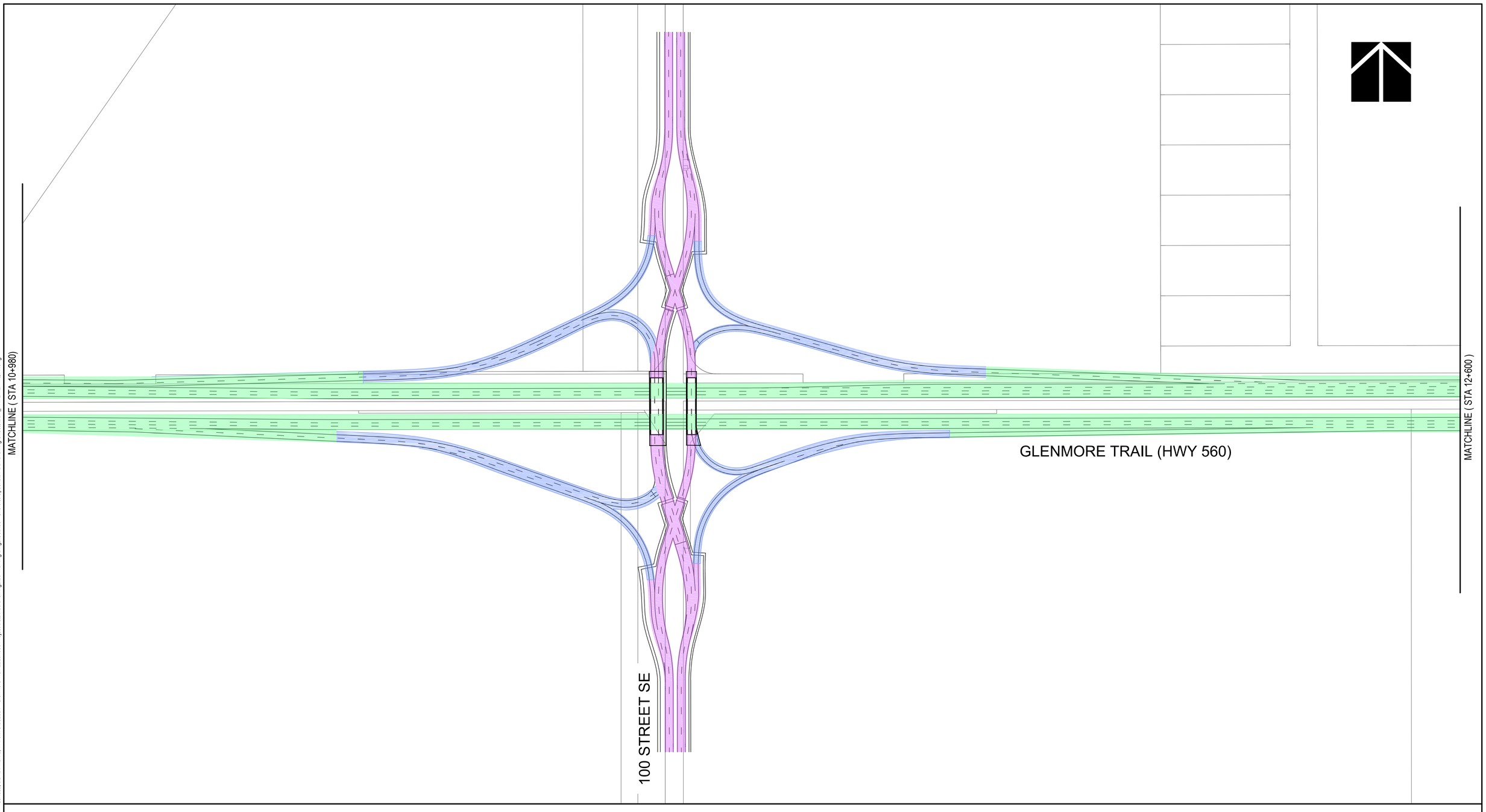
PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION

LEGEND:

- GLENMORE TRAIL EAST
- RAMPS
- 100 STREET

1:2000 0 40 120m

GLENMORE TRAIL EAST STUDY
100 STREET SE TO CONRICH ROAD
100 STREET INTERCHANGE
FULL DIAMOND INTERCHANGE
PAVEMENT QUANTITY ESTIMATE
EXHIBIT 5.0



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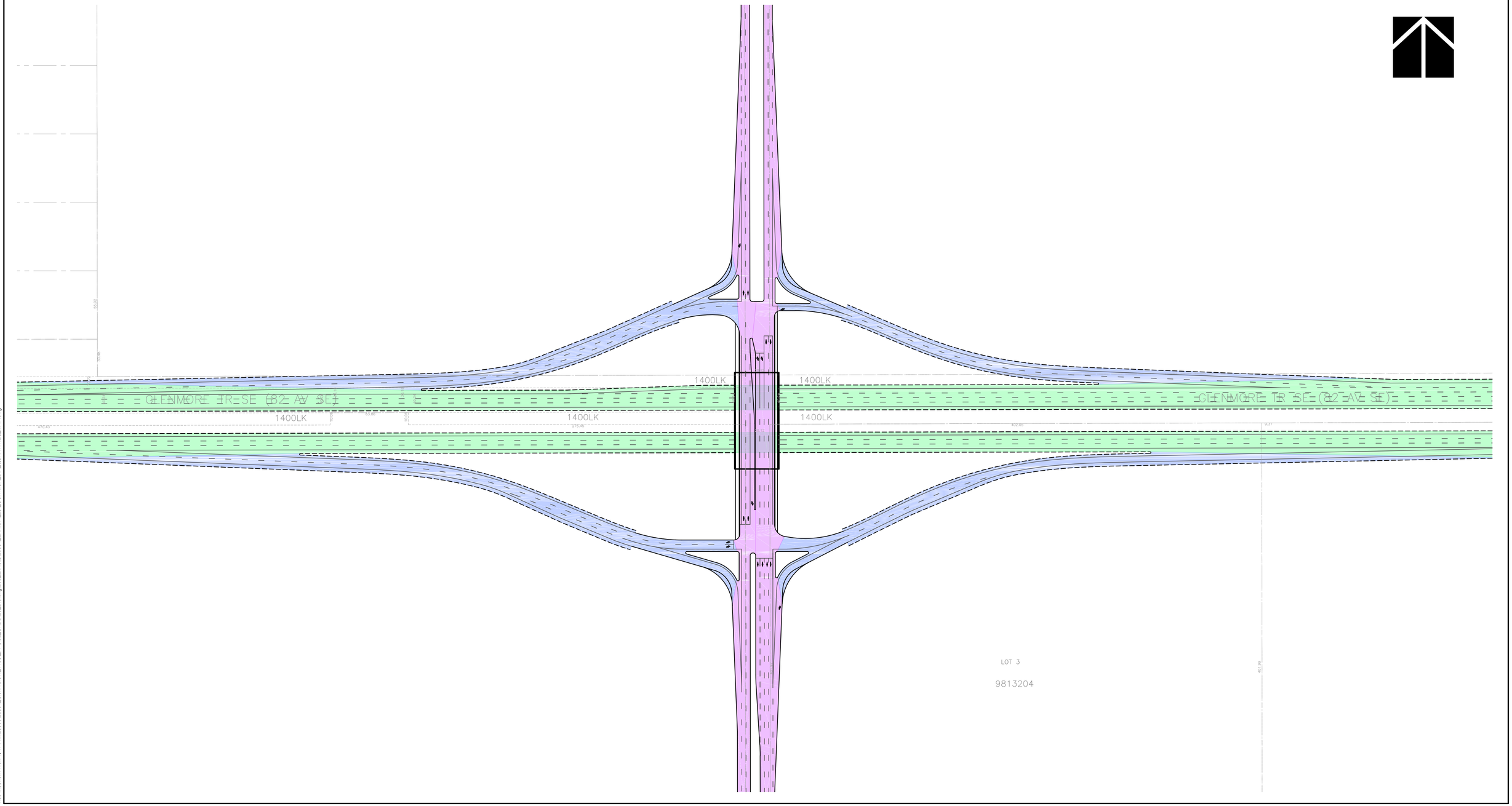
PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION

LEGEND:

- GLENMORE TRAIL EAST
- RAMPS
- 100 STREET

1:2000 0 40 120m

GLENMORE TRAIL EAST STUDY
100 STREET SE TO CONRICH ROAD
100 STREET INTERCHANGE
DIVERGING DIAMOND INTERCHANGE
PAVEMENT QUANTITY ESTIMATE
EXHIBIT 6.0



NOTE: ALL DRAWINGS ARE PRINTED AT HALF SCALE WHEN IN 11" x 17" FORMAT

PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION

PAVEMENT
- GLENMORE DRIVE
- RAMPS
- CONRICH ROAD

1:1500 0 15 30 45 60 75

GLENMORE TRAIL EAST STUDY
100 STREET SE TO CONRICH ROAD
CONRICH INTERCHANGE
STANDARD DIAMOND INTERCHANGE
PAVEMENT QUANTITY ESTIMATE
EXHIBIT 7.0

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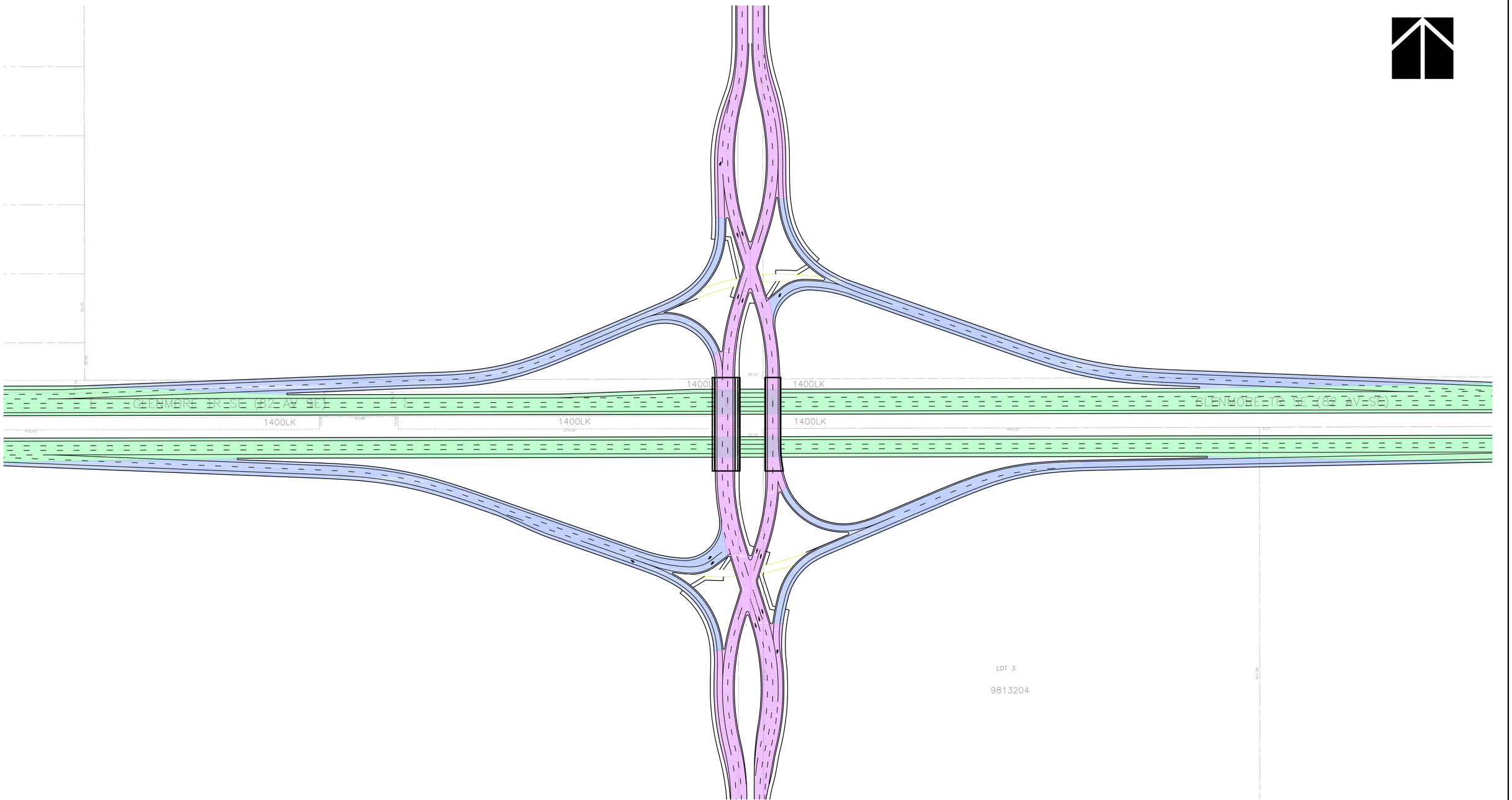

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PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION

PAVEMENT

- GLENMORE DRIVE
- RAMPS
- CONRICH ROAD

1:1500 0 15 30 45 60 75

GLENMORE TRAIL EAST STUDY
100 STREET SE TO CONRICH ROAD

CONRICH INTERCHANGE
DDI INTERCHANGE
PAVEMENT QUANTITY ESTIMATE
EXHIBIT 8.0

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Synchro Results Comparison Diveraging Diamond Interchange vs Diamond Interchange

	AM Peak											
	Diamond North Junction @ 100 St						Diamond South Junction @ 100 St					
Cycle Length 70s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTTT	NBR	SBL	SBTT
Volumes	200	100	400	930	120	400	900	1000	430	30	20	300
Control Delay (s)	38.6	Free Flow	28.6	14.6	20.9	Free Flow	30.1	Free Flow	15.9	Free Flow	14.3	16.9
v/c ratio	0.74		0.66	0.59	0.14		0.88		0.2		0.06	0.3
LOS	D		C	B	C		C		B		B	B
Queue Length 95th (m)	44.2		40.2	67	15.5		92.9		20.4		4.6	36.8
Sim Traffic Queue Length 95th (m)	69.6	-	44.9	41.9	24.9	-	344.9	-	27.9		10.9	29.7

	AM Peak											
	DDI North Junction @ 100 St						DDI South Junction @ 100 St					
Cycle Length 60s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTT	NBR	SBL	SBTT
Volumes	200	100	400	930	120	400	900	1000	430	30	20	300
Control Delay (s)	Yield Condition	Free Flow	Free Flow	9.8	16.5	Free Flow	7.2	Free Flow	8.5	Free Flow	Free Flow	12.9
v/c ratio				0.52	0.13		0.6		0.18			0.28
LOS				A	B		A		A			B
Queue Length 95th (m)				42.7	11.4		29.5		14.7			25.5
Sim Traffic Queue Length 95th (m)	-	-	-	47.8	22	-	44.7	-	34.7	-	-	21.3

	PM Peak											
	Diamond North Junction @ 100 St						Diamond South Junction @ 100 St					
Cycle Length 90s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTTT	NBR	SBL	SBTT
Volumes	70	100	1000	1200	300	1300	1100	700	1100	100	200	170
Control Delay (s)	46.3	Free Flow	29.7	5.3	27.7	Free Flow	32.2	Free Flow	41	Free Flow	54.2	23.2
v/c ratio	0.48		0.84	0.57	0.35		0.9		0.86		0.82	0.18
LOS	D		C	A	C		C		D		D	C
Queue Length 95th (m)	25.5		66.3	48	41.5		126.8		81.1		66.4	28.6
Sim Traffic Queue Length 95th (m)	46.5		94.4	42.7	327.4	-	57.3	-	79.4	-	63.4	47.2

	PM Peak											
	DDI North Junction @ 100 St						DDI South Junction @ 100 St					
Cycle Length 60s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTT	NBR	SBL	SBTT
Volumes	70	100	1000	1200	300	1300	1100	700	1100	100	200	170
Control Delay (s)	Yield Condition	Free Flow	Free Flow	9.3	19.1	Free Flow	13.9	Free Flow	10	Free Flow	Free Flow	10.6
v/c ratio				0.65	0.34		0.69		0.7			0.47
LOS				A	B		B		B			B
Queue Length 95th (m)				64.9	25.3		68		10			39.4
Sim Traffic Queue Length 95th (m)	-	-	-	46.4	39.6	-	45.5	-	65.4	-	-	16.5

* Turning movements which operate slightly better are being highlighted in green

*Turning Movements which opearate with v/c > 0.9 or LOS > E are being highlighted in red

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Synchro Results Comparison Diveraging Diamond Interchange vs Diamond Interchange (with 25% Growth)

	AM Peak											
	Diamond North Junction @ 100 St						Diamond South Junction @ 100 St					
Cycle Length 80s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTTT	NBR	SBL	SBTT
Volumes	250	125	500	1163	150	500	1125	1250	538	38	25	375
Control Delay (s)	47.7	Free Flow	27.8	21.8	24.2	Free Flow	31.7	Free Flow	21.3	Free Flow	13.8	18.6
v/c ratio	0.83		0.76	0.75	0.19		0.92		0.3		0.1	0.43
LOS	D		C	C	C		C		C		B	B
Queue Length 95th (m)	70		42.5	117.6	19.9		130.6		30.2		4.8	43.1
Sim Traffic Queue Length 95th (m)	106.7	-	71.8	78.6	31.5		345.1		40.4		13.6	36.7

	AM Peak											
	DDI North Junction @ 100 St						DDI South Junction @ 100 St					
Cycle Length 60s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTT	NBR	SBL	SBTT
Volumes	250	125	500	1163	150	500	1125	1250	538	38	25	375
Control Delay (s)	Yield Condition	Free Flow	Free Flow	10.2	16.7	Free Flow	15.8	Free Flow	8.8	Free Flow	Free Flow	13.6
v/c ratio				0.65	0.16		0.8		0.23			0.35
LOS				B	B		B		A			B
Queue Length 95th (m)				57.4	13.6		63.4		18.3			31.6
Sim Traffic Queue Length 95th (m)	-	-	-	46.7	26.3	-	46.1	-	37.1	-	-	27.8

	PM Peak											
	Diamond North Junction @ 100 St						Diamond South Junction @ 100 St					
Cycle Length 90s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTTT	NBR	SBL	SBTT
Volumes	88	125	1250	1500	375	1625	1375	875	1375	125	250	213
Control Delay (s)	50.2	Free Flow	17.6	5.8	48.9	Free Flow	72.6	Free Flow	70.3	Free Flow	149.4	12
v/c ratio	0.58		0.82	0.76	0.8		1.08		1.04		1.23	0.24
LOS	D		B	A	D		E		E		F	B
Queue Length 95th (m)	31		58.2	34.8	59.1		194.7		107.2		74.9	24.9
Sim Traffic Queue Length 95th (m)	54.3	-	85	64.7	741.7	-	311.3	-	242.3	-	74.1	101.5

	PM Peak											
	DDI North Junction @ 100 St						DDI South Junction @ 100 St					
Cycle Length 60s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTT	NBR	SBL	SBTT
Volumes	88	125	1250	1500	375	1625	1375	875	1375	125	250	213
Control Delay (s)	Yield Condition	Free Flow	Free Flow	11.9	20	Free Flow	20.5	Free Flow	15.1	Free Flow	Free Flow	11.8
v/c ratio				0.81	0.43		0.86		0.88			0.58
LOS				B	B		C		B			B
Queue Length 95th (m)				89.9	31.2		115.9		83.5			52.4
Sim Traffic Queue Length 95th (m)	-	-	-	49.3	39.1	-	45.4	-	51.2	-	-	39.1

* Turning movements which operate slightly better are being highlighted in green

*Turning Movements which opearate with v/c > 0.9 or LOS > E are being highlighted in red

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Synchro Results Comparison Diveraging Diamond Interchange vs Diamond Interchange

	AM Peak											
	Diamond North Junction @ Conrich Rd						Diamond South Junction @ Conrich Rd					
Cycle Length 100s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTTT	NBR	SBL	SBTT
Volumes	100	100	300	1140	110	400	1100	1000	340	30	10	200
Control Delay (s)	49.7	Free Flow	5.7	5.2	32.9	Free Flow	13.5	Free Flow	35.2	Free Flow	21.5	13.1
v/c ratio	0.52		0.27	0.61	0.18		0.68		0.32		0.06	0.34
LOS	D		A	A	A		B		D		C	B
Queue Length 95th (m)	34.6		39.4	30.6	16.6		87.6		24.6		8.2	18.3
Sim Traffic Queue Length 95th (m)	40.8	-	38	59.6	28.2	-	89.8	-	62.6		9.6	38.8

	AM Peak											
	DDI North Junction @ Conrich Rd						DDI South Junction @ Conrich Rd					
Cycle Length 110s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTT	NBR	SBL	SBTT
Volumes	100	100	300	1140	110	400	1100	1000	340	30	10	200
Control Delay (s)	Yield Condition	Free Flow	Free Flow	10.7	32.9	Free Flow	9.8	Free Flow	35	Free Flow	Free Flow	10.9
v/c ratio				0.74	0.18		0.66		0.4			0.12
LOS				B	C		A		C			B
Queue Length 95th (m)				44.3	17.2		64.3		30.9			23.3
Sim Traffic Queue Length 95th (m)	-	-	-	52.2	27.4	-	99.6	-	53.2	-	-	33.1

	PM Peak											
	Diamond North Junction @ Conrich Rd						Diamond South Junction @ Conrich Rd					
Cycle Length 100s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTTT	NBR	SBL	SBTT
Volumes	60	30	900	900	270	1100	800	700	1000	100	200	130
Control Delay (s)	47.1	Free Flow	9.8	0.5	38	Free Flow	39.5	Free Flow	40.5	Free Flow	6.8	0.2
v/c ratio	0.35		0.71	0.44	0.46		0.86		0.79		0.51	0.09
LOS	D		A	A	D		D		D		A	A
Queue Length 95th (m)	23.6		45.4	2.8	38.3		110.4		67.8		0.1	0
Sim Traffic Queue Length 95th (m)	30.1		94.5	36.5	55	-	115.4	-	110.7	-	57.5	6.2

	PM Peak											
	DDI North Junction @ Conrich Rd						DDI South Junction @ Conrich Rd					
Cycle Length 90s	WBL	WBR	NBLL	NBTT	SBTT	SBR	EBLL	EBR	NBTTT	NBR	SBL	SBTT
Volumes	60	30	900	900	270	1100	800	700	1000	100	200	130
Control Delay (s)	Yield Condition	Free Flow	Free Flow	11.9	23.3	Free Flow	22	Free Flow	29.6	Free Flow	Free Flow	15.5
v/c ratio				0.77	0.28		0.7		0.72			0.1
LOS				B	C		C		C			B
Queue Length 95th (m)				36.9	29.4		74.2		74.9			17.5
Sim Traffic Queue Length 95th (m)	-	-	-	66	54.4	-	77.5	-	115.7	-	-	25.2

* Turning movements which operate slightly better are being highlighted in green

*Turning Movements which opearate with v/c > 0.9 or LOS > E are being highlighted in red