

Ref: 6202

October 7, 2013

Mr. Jon D. Schneider, Chairman
Zoning Board of Appeals
Public Service Administration Building
500 Dedham Avenue
Needham, MA 02492

Re: Response to Traffic Review Comments – Addendum
Needham Mews Residential Community
692 and 744 Greendale Avenue, Needham, Massachusetts

Dear Mr. Schneider:

Vanasse & Associates, Inc. (VAI) is providing supplemental information and analyses in response to comments received via electronic mail from Mr. Brian Beisel of BETA Group, Inc., (BETA) concerning his review of the October 2, 2013 *Response to Traffic Review Comments* letter prepared by VAI in support of the proposed Needham Mews residential community to be located at 692 and 744 Greendale Avenue in Needham, Massachusetts (hereafter referred to as the “Project”). Specifically, BETA requested that VAI revise the future condition traffic-volume networks and analyses to reflect the current MassDOT design of the Kendrick Street interchange, which will now provide access to Kendrick Street westbound from the Route 128/I-95 southbound frontage road, a change from the MassDOT preliminary/25 Percent Design submission. This modification impacts two intersections within the study area: Highland Avenue/Gould Street/Hunting Road and Kendrick Street/Hunting Road. The revised 2018 No-Build and Build condition peak-hour traffic volume networks with the Kendrick Street interchange improvements and the associated analyses are attached, with the revised analyses results summarized in Table 9R.

A review of the results presented in Table 9R in relation to those summarized in Table 9 of the October 2, 2013 *Response to Traffic Review Comments* letter indicates that the modification to the design of the Kendrick Street interchange did not result in a change in the overall level-of-service at the two (2) impacted study intersections, with noted improvements for specific movements at both intersections. The addition of Project-related traffic to the subject intersections did not result in a change in the overall level-of-service at either intersection over the No-Build condition, consistent with the findings presented in the October 2, 2013 *Response to Traffic Review Comments* letter.

Mr. Jon D. Schneider
October 7, 2013
Page 2 of 2

We trust that this information is responsive to the subject comment received from BETA concerning the Kendrick Street interchange project. If you should have any questions regarding our response or would like to discuss the information in more detail, please feel free to contact me.

Sincerely,

VANASSE & ASSOCIATES, INC.

A handwritten signature in black ink, appearing to read "Jeffrey S. Dirk", with a stylized flourish at the end.

Jeffrey S. Dirk, P.E., PTOE, FITE
Principal

JSD/las

Attachments

cc: K. Ho, P.E., PTOE – BETA Group, Inc. (via email)
B. Beisel, P.E., - BETA Group, Inc. (via email)
R. Hewitt – Mill Creek Residential Trust, LLC (via email)
LAS, File



Table 9R
SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Signalized Intersection/Peak Hour/Movement	2013 Existing				2018 No-Build Without Kendrick Street Interchange				2018 Build Without Kendrick Street Interchange				2018 No-Build With Kendrick Street Interchange				2018 Build With Kendrick Street Interchange			
	V/C ^a	Delay ^b	LOS ^c	Queue ^d 50 th /95 th	V/C	Delay	LOS	Queue 50 th /95 th	V/C	Delay	LOS	Queue 50 th /95 th	V/C	Delay	LOS	Queue 50 th /95 th	V/C	Delay	LOS	Queue 50 th /95 th
Highland Avenue at Hunting Road and Gould Street																				
<i>Weekday Morning:</i>																				
Highland Avenue EB LT	0.68	73.1	E	3/7	0.73	79.2	E	3/8	0.73	80.0	F	3/8	0.71	77.0	E	3/6	0.71	77.1	E	3/6
Highland Avenue EB TH/RT	1.03	79.1	E	16/23	1.18	>80.0	F	20/27	1.19	>80.0	F	20/27	1.01	63.5	E	20/25	1.01	64.3	E	20/25
Highland Avenue WB LT	0.86	62.9	E	9/17	0.89	66.9	E	10/18	0.90	68.7	E	10/19	0.34	54.6	D	2/3	0.35	54.9	D	2/3
Highland Avenue WB TH/RT	0.66	28.5	C	10/14	0.71	30.6	C	12/16	0.71	30.6	C	12/16	0.65	31.1	C	10/12	0.65	31.2	C	10/12
Hunting Road NB LT/TH	0.82	67.0	E	7/13	0.87	72.3	E	8/14	0.88	74.7	E	8/15	0.95	73.4	E	12/19	0.96	75.2	E	12/19
Hunting Road NB RT	0.48	13.7	B	4/8	0.51	16.3	B	5/9	0.57	18.4	B	6/11	0.87	44.0	D	13/20	0.95	55.4	E	15/23
Gould Street SB LT	0.69	59.5	E	5/8	0.73	62.0	E	6/9	0.73	62.5	E	6/9	0.81	76.5	E	5/9	0.81	76.5	E	5/9
Gould Street SB LT/TH/RT	0.62	51.9	D	5/8	0.66	53.9	D	5/8	0.66	54.5	D	5/9	0.73	63.5	E	5/8	0.73	64.0	E	5/8
Overall	--	52.3	D	--	--	70.1	E	--	--	71.6	E	--	--	55.1	E	--	--	57.4	E	--
<i>Weekday Evening:</i>																				
Highland Avenue EB LT	0.41	58.8	E	2/4	0.44	60.9	E	2/4	0.45	62.1	E	2/4	0.88	>80.0	F	4/9	0.88	>80.0	F	4/9
Highland Avenue EB TH/RT	0.84	50.7	D	10/16	0.92	59.0	E	11/18	0.94	64.0	E	12/18	0.91	63.9	E	18/23	0.91	64.8	E	18/23
Highland Avenue WB LT	0.80	58.8	E	8/12	0.83	61.1	E	9/14	0.89	67.7	E	10/17	0.90	>80.0	F	10/16	0.91	>80.0	F	11/16
Highland Avenue WB TH/RT	0.62	29.5	C	10/14	0.71	32.2	C	12/16	0.69	31.6	C	12/16	0.93	54.4	E	25/28	0.93	54.5	D	25/28
Hunting Road NB LT/TH	0.57	57.3	E	3/6	0.59	58.2	E	4/6	0.61	59.5	E	4/6	0.99	>80.0	F	6/11	1.01	>80.0	F	6/11
Hunting Road NB RT	0.72	30.7	C	9/13	0.75	33.5	C	10/14	0.76	34.1	C	11/15	0.28	7.2	A	0/2	0.32	7.7	A	0/3
Gould Street SB LT	0.80	56.0	E	9/17	0.89	66.5	E	11/19	0.91	71.6	E	11/19	0.58	45.8	D	11/15	0.58	45.7	D	11/15
Gould Street SB LT/TH/RT	0.91	66.6	E	11/21	0.99	>80.0	F	13/23	1.03	>80.0	F	14/23	0.94	73.1	E	20/29	0.95	74.7	E	21/30
Overall	--	45.8	D	--	--	51.9	D	--	--	55.4	E	--	--	64.5	E	--	--	65.2	E	--
Kendrick Street at Hunting Road																				
<i>Weekday Morning:</i>																				
Kendrick Street EB LT/TH/RT	0.99	73.7	E	14/16	1.13	>80.0	F	17/19	1.13	>80.0	F	17/19	0.95	67.3	E	14/15	0.95	67.3	E	14/15
Kendrick Street WB LT	0.60	55.0	E	3/6	0.72	66.8	E	3/8	0.76	69.8	E	3/9	0.50	50.2	D	2/5	0.59	55.8	E	3/6
Kendrick Street WB TH/RT	0.45	29.4	C	7/13	0.48	30.1	C	8/14	0.48	30.1	C	8/14	0.42	32.5	C	7/13	0.42	32.5	C	7/13
Hunting Road NB LT/TH	1.06	>80.0	F	17/31	1.13	>80.0	F	18/33	1.25	>80.0	F	22/37	0.94	59.1	E	24/43	1.01	73.9	E	27/47
Hunting Road NB RT	0.46	1.0	A	0/0	0.53	1.3	A	0/0	0.55	1.4	A	0/0	0.35	0.6	A	0/0	0.37	0.7	A	0/0
Hunting Road SB LT	0.89	67.8	E	9/20	0.94	75.6	E	10/22	0.94	75.8	E	10/22	0.70	71.7	E	2/6	0.70	71.7	E	2/6
Hunting Road SB TH/RT	0.13	17.6	B	2/4	0.14	17.8	B	2/5	0.15	18.4	B	2/5	0.06	18.2	B	1/3	0.06	18.5	B	1/3
Overall	--	52.2	D	--	--	67.6	E	--	--	75.1	E	--	--	45.3	D	--	--	49.6	D	--
<i>Weekday Evening:</i>																				
Kendrick Street EB LT/TH/RT	0.82	68.3	E	4/10	0.90	79.2	E	5/11	0.93	>80.0	F	5/11	0.55	65.6	E	2/4	0.56	66.7	E	2/4
Kendrick Street WB LT	0.88	39.9	D	14/43	1.02	65.3	E	18/45	1.09	>80.0	F	26/48	0.40	32.8	C	6/12	0.52	36.6	D	8/14
Kendrick Street WB TH/RT	0.93	38.0	D	22/53	1.01	54.3	D	26/60	1.03	64.2	E	35/60	0.82	44.2	D	16/37	0.84	46.0	D	17/37
Hunting Road NB LT/TH	0.83	>80.0	F	4/10	0.91	>80.0	F	5/11	1.14	>80.0	F	7/13	0.37	47.4	D	4/7	0.42	46.3	D	5/9
Hunting Road NB RT	0.07	0.1	A	0/0	0.09	0.1	A	0/0	0.10	0.1	A	0/0	0.05	0.1	A	0/0	0.07	0.1	A	0/0
Hunting Road SB LT	0.39	39.1	D	3/6	0.41	39.8	D	4/7	0.40	40.0	D	4/7	0.05	17.6	B	1/2	0.05	17.4	B	1/2
Hunting Road SB TH/RT	0.78	50.2	D	12/18	0.82	53.0	D	13/20	0.87	56.1	E	15/24	0.91	44.3	D	21/33	0.91	44.2	D	22/34
Overall	--	44.2	D	--	--	58.6	E	--	--	73.5	E	--	--	42.0	D	--	--	42.4	D	--

^aVolume-to-capacity ratio.
^bPercentile delay per vehicle in seconds.
^cLevel-of-Service.
^dQueue length in vehicles.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.



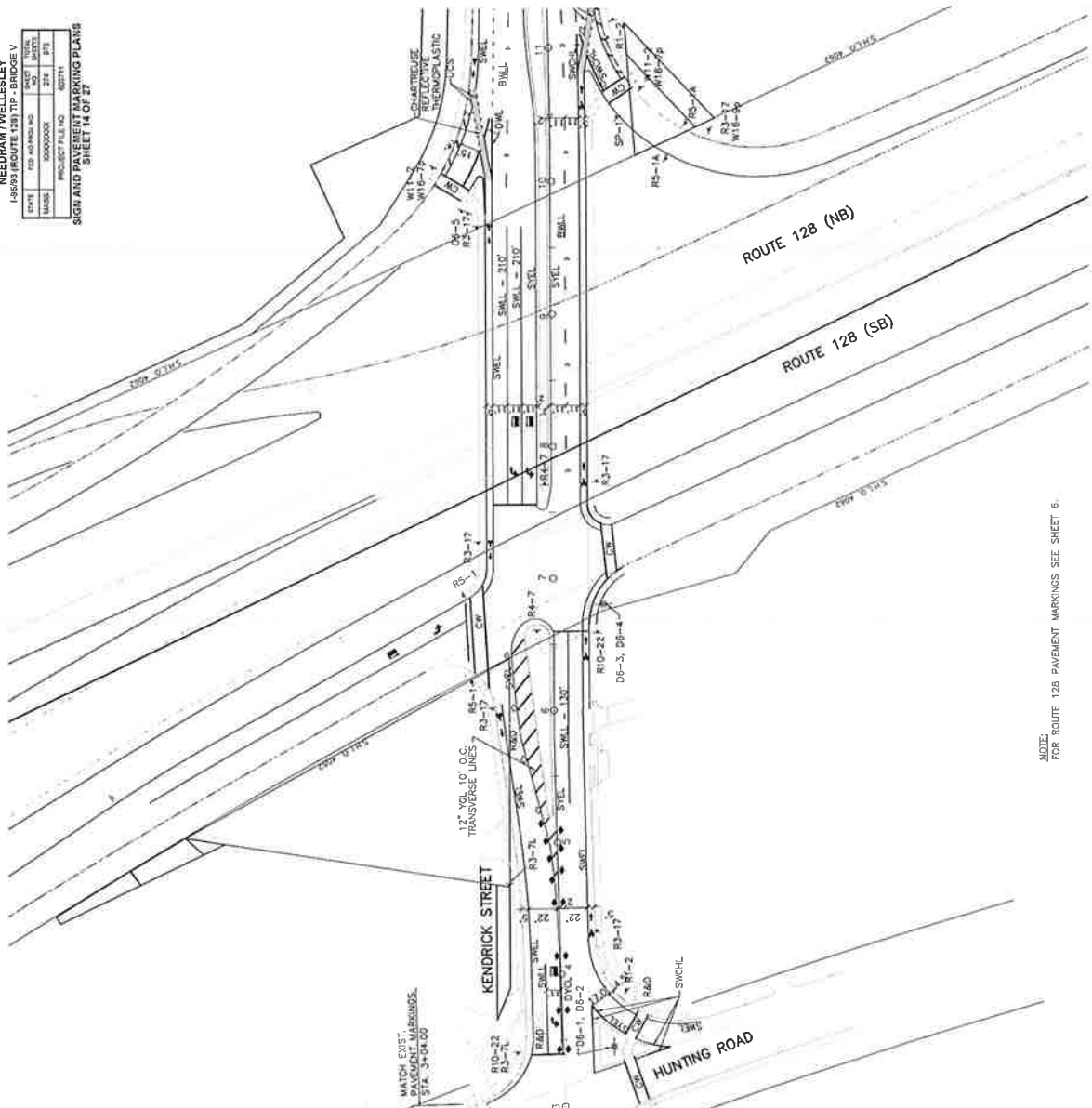
ATTACHMENTS

**MASSDOT 75 PERCENT DESIGN PLANS - I-95/I-93 (ROUTE 128) TIP – BRIDGE V
REVISED TRAFFIC-VOLUME NETWORKS
REVISED I-95/ROUTE 128 ADD-A-LANE TRAFFIC VOLUME REDISTRIBUTION
CAPACITY ANALYSIS WORKSHEETS**

MASSDOT 75 PERCENT DESIGN PLANS - I-95/I-93 (ROUTE 128) TIP – BRIDGE V

NEEDHAM / WELLESLEY
 (35893 ROUTE 128) TP - BRIDGE V
 SHEET NO. 224 OF 273
 PROJECT FILE NO. 402711
 SIGN AND PAVEMENT MARKING PLANS
 SHEET 14 OF 27

EXISTING SIGN SUMMARY



NOTE:
 FOR ROUTE 128 PAVEMENT MARKINGS SEE SHEET 6.

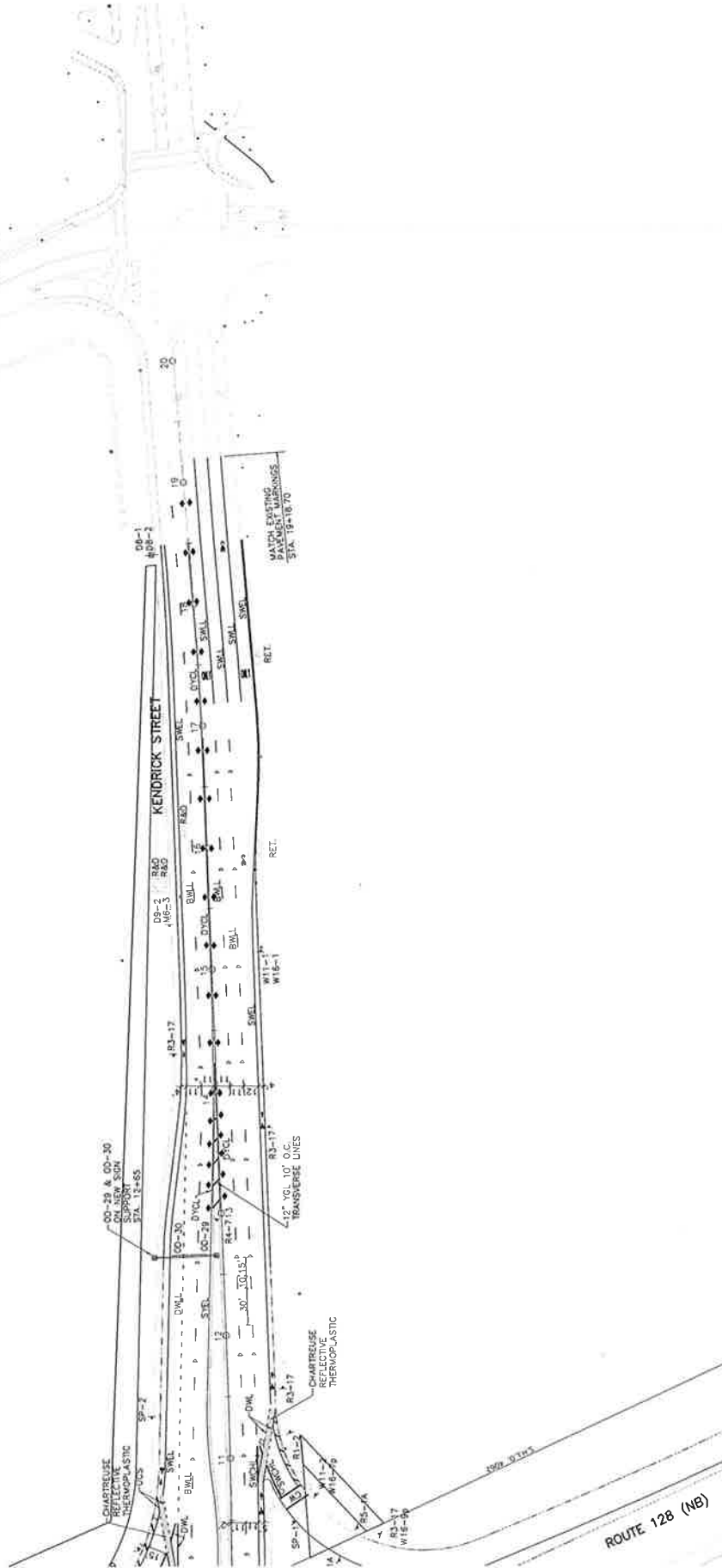


NEEDHAM / WELLESLEY
 (S&B3 ROUTE 128) TP - BRIDGE V

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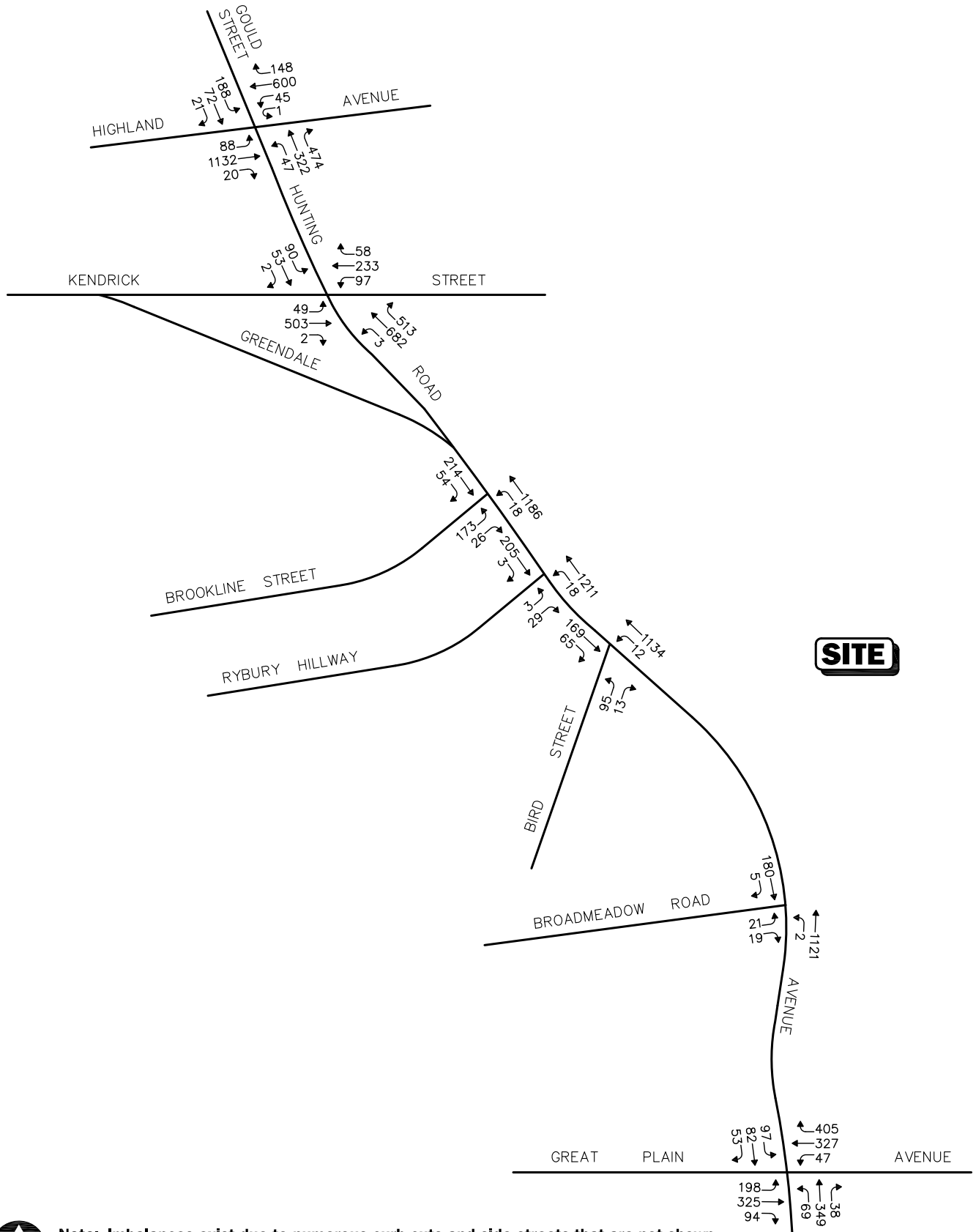
SIGN AND PAVEMENT MARKING PLANS
 SHEET 15 OF 27

EXISTING SIGN SUMMARY

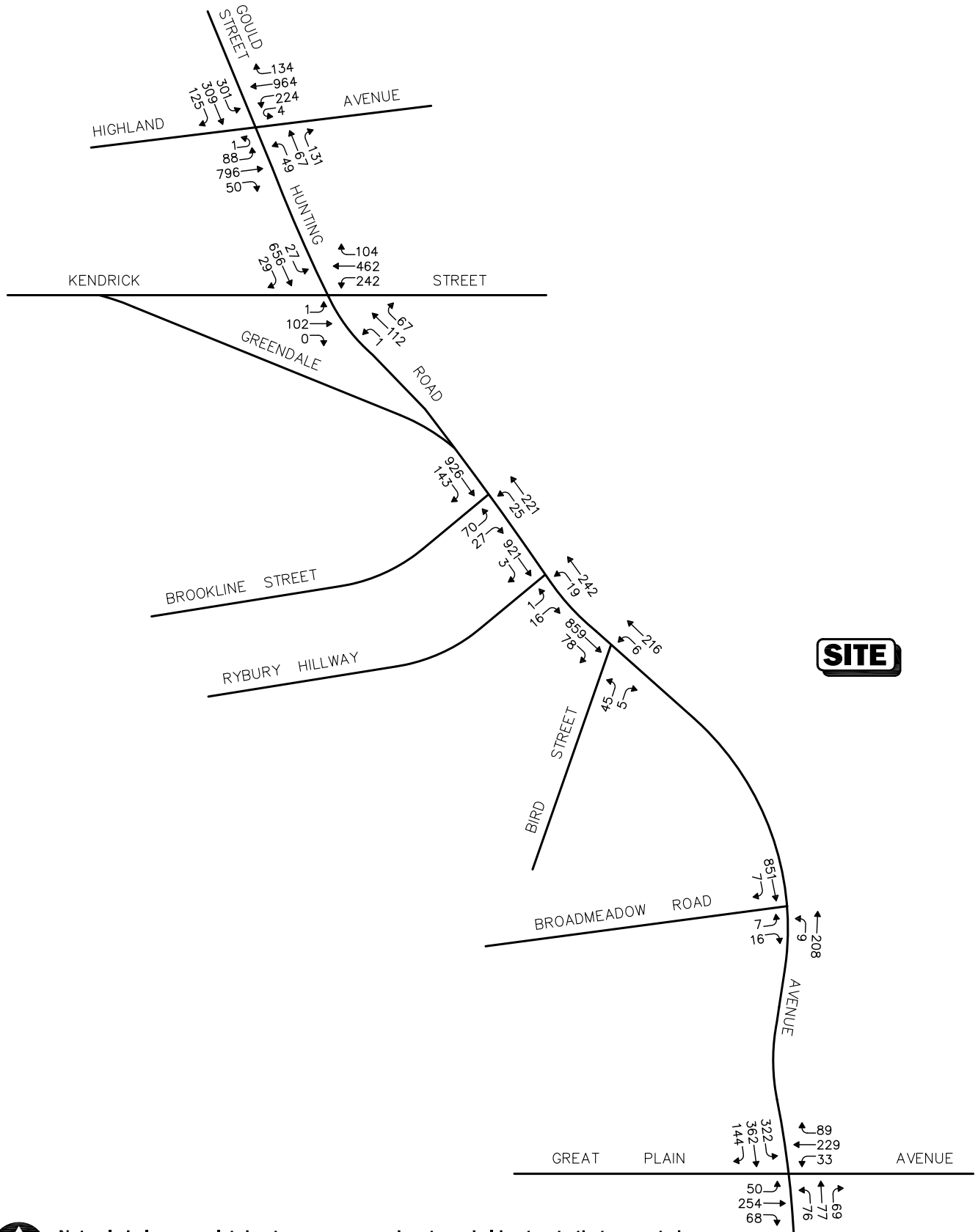


CONT. ON SHEET 224

REVISED TRAFFIC-VOLUME NETWORKS



Vanasse & Associates, Inc.
Transportation Engineers & Planners



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

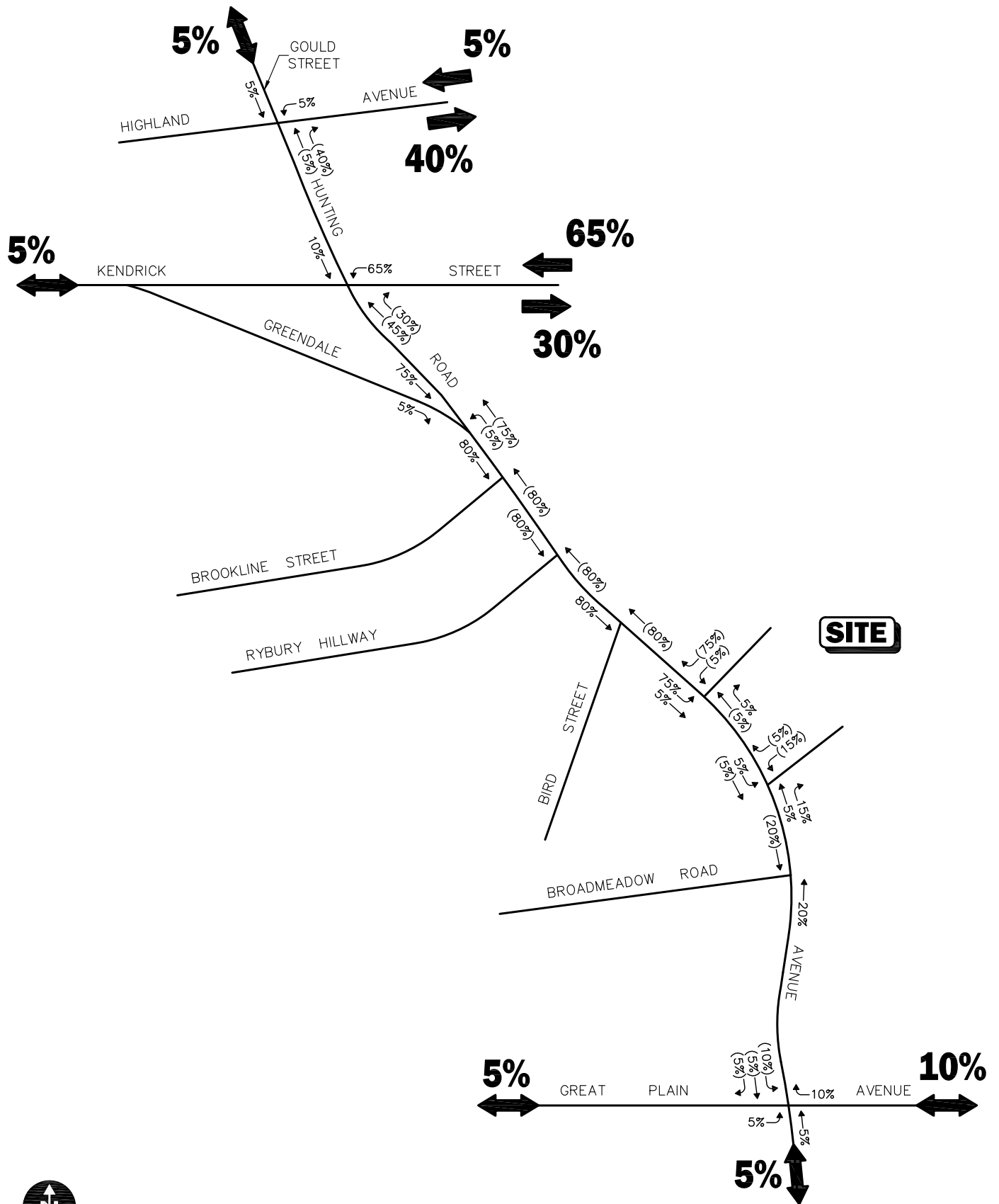
Not To Scale

Figure 6R



Vanasse & Associates, Inc.
Transportation Engineers & Planners

**2018 No-Build
Weekday Evening
Peak Hour Traffic Volumes
With Kendrick Street
Interchange Improvements**



Not To Scale



Vanasse & Associates, Inc.
Transportation Engineers & Planners

Figure 7A

**Trip Distribution Map
with Kendrick Street
Interchange Improvements**

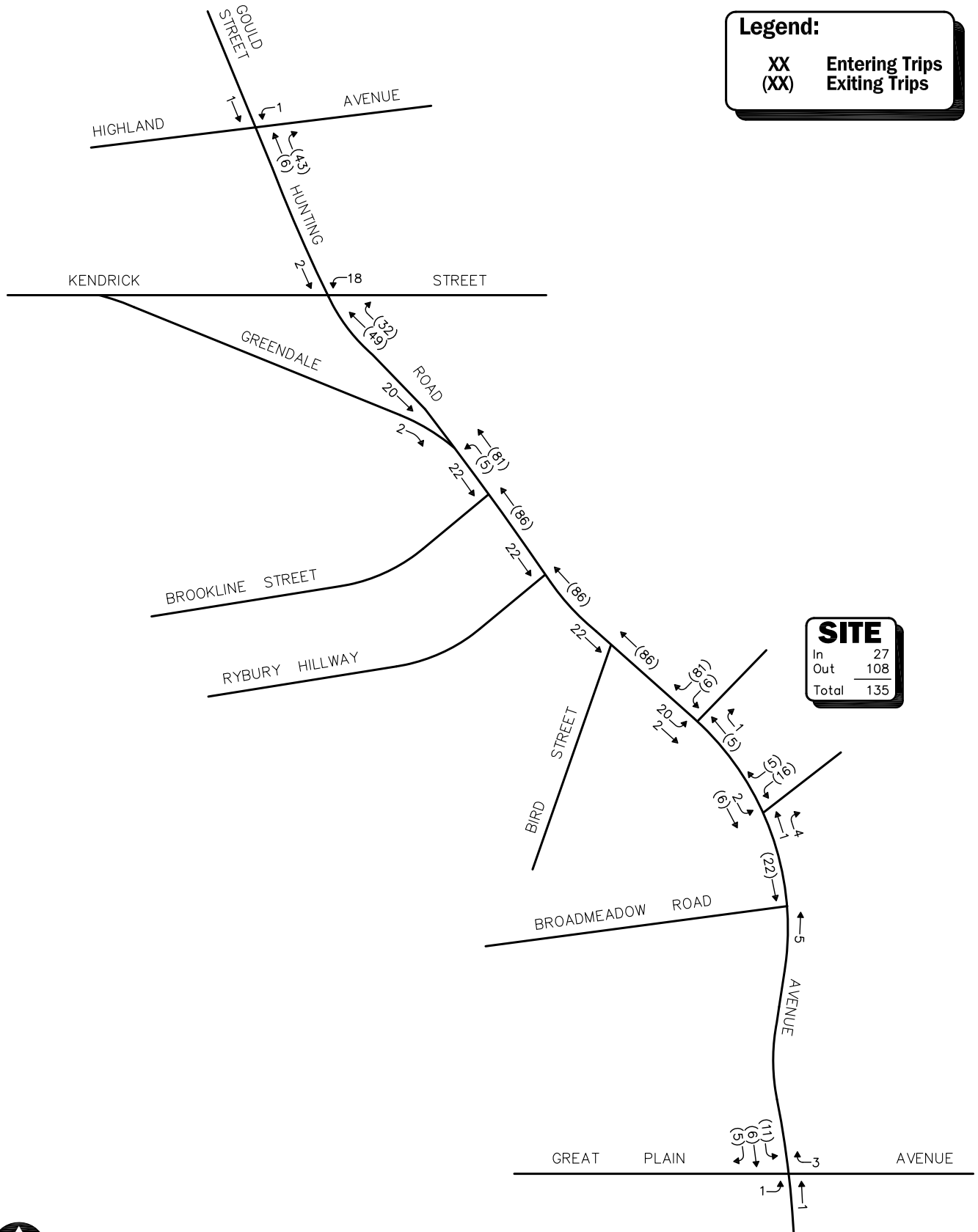


Figure 8A

Project-Generated
Weekday Morning
Peak Hour Traffic Volumes
with Kendrick Street
Interchange Improvements

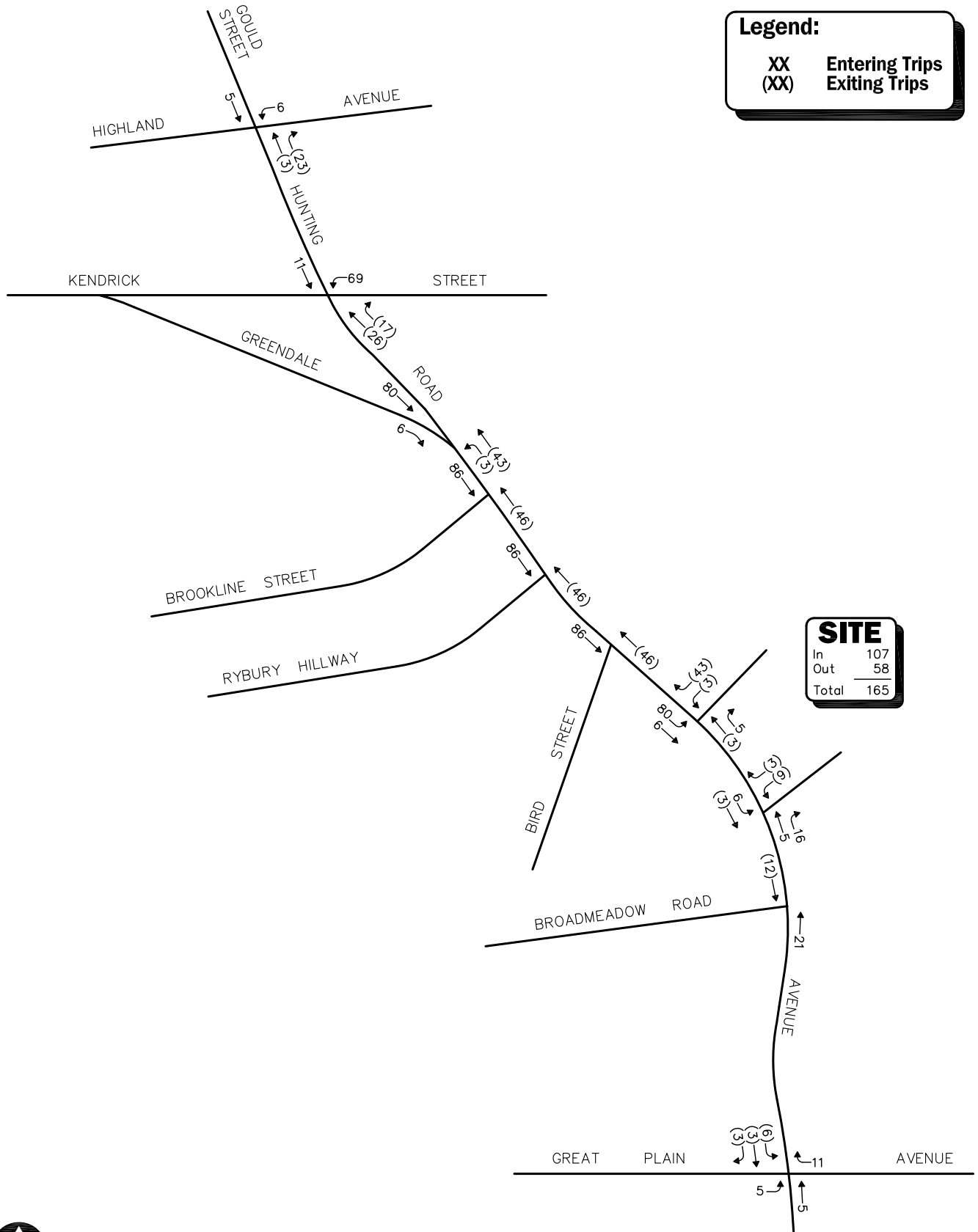
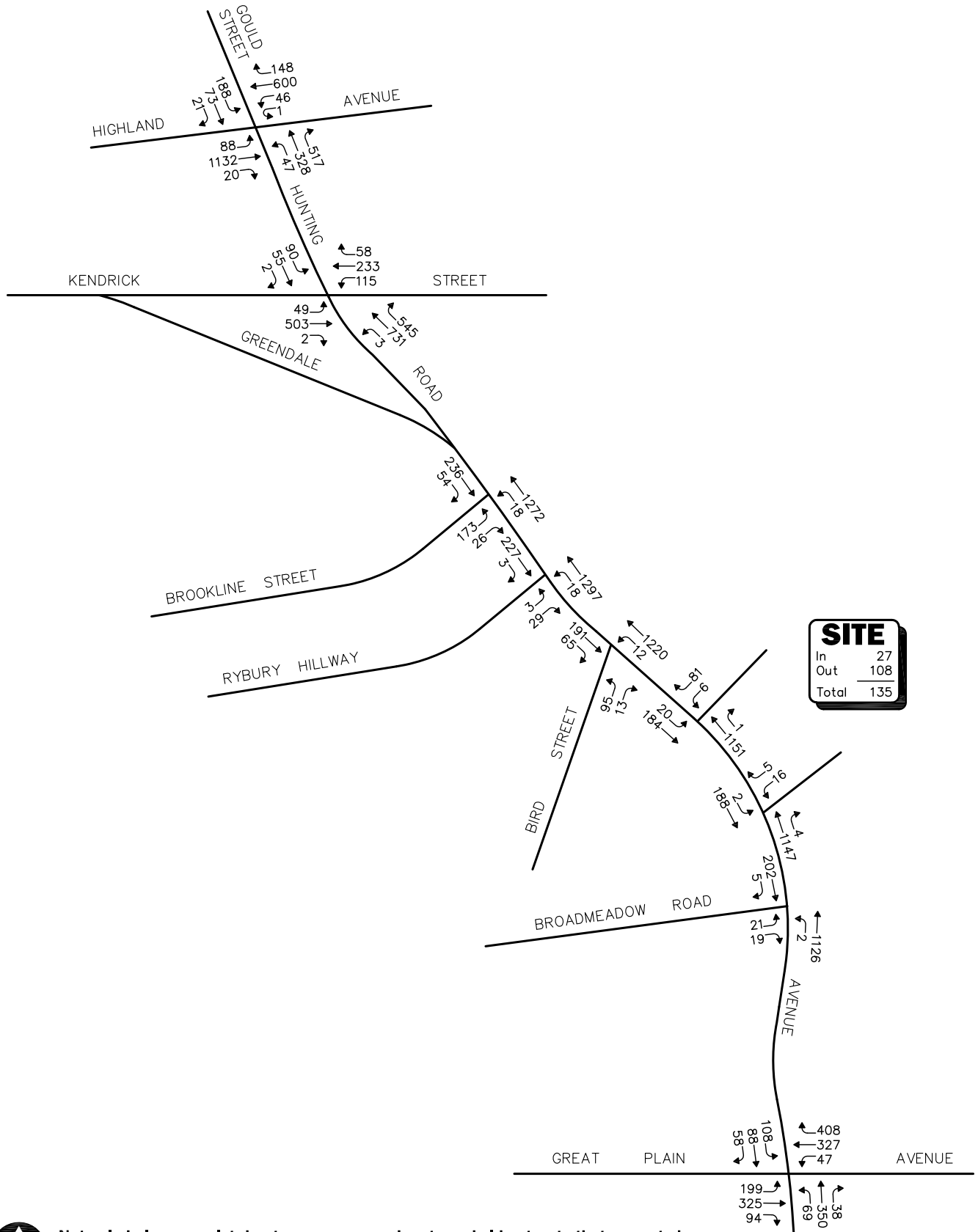


Figure 9A

Project-Generated
Weekday Evening
Peak Hour Traffic Volumes
with Kendrick Street
Interchange Improvements

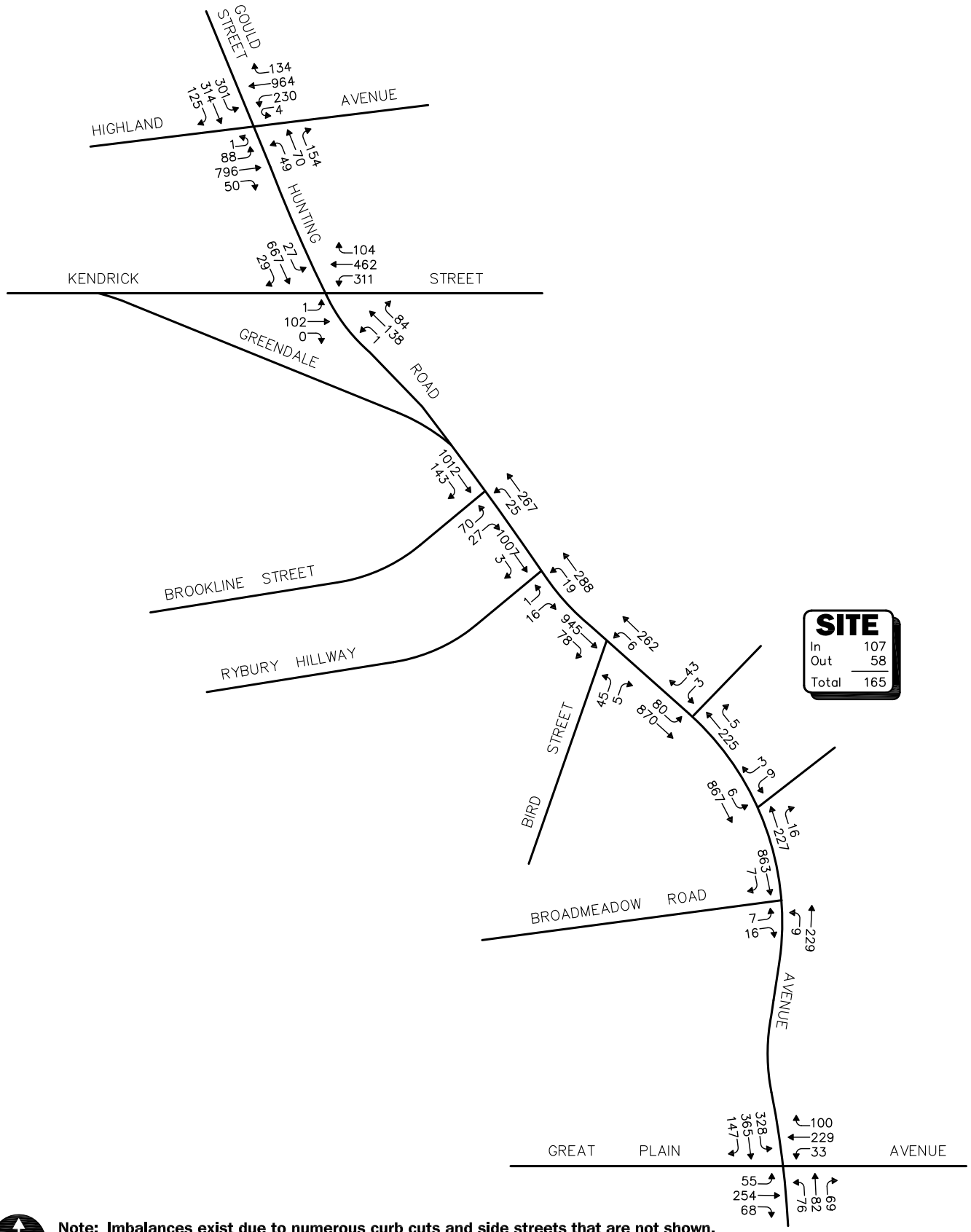


Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

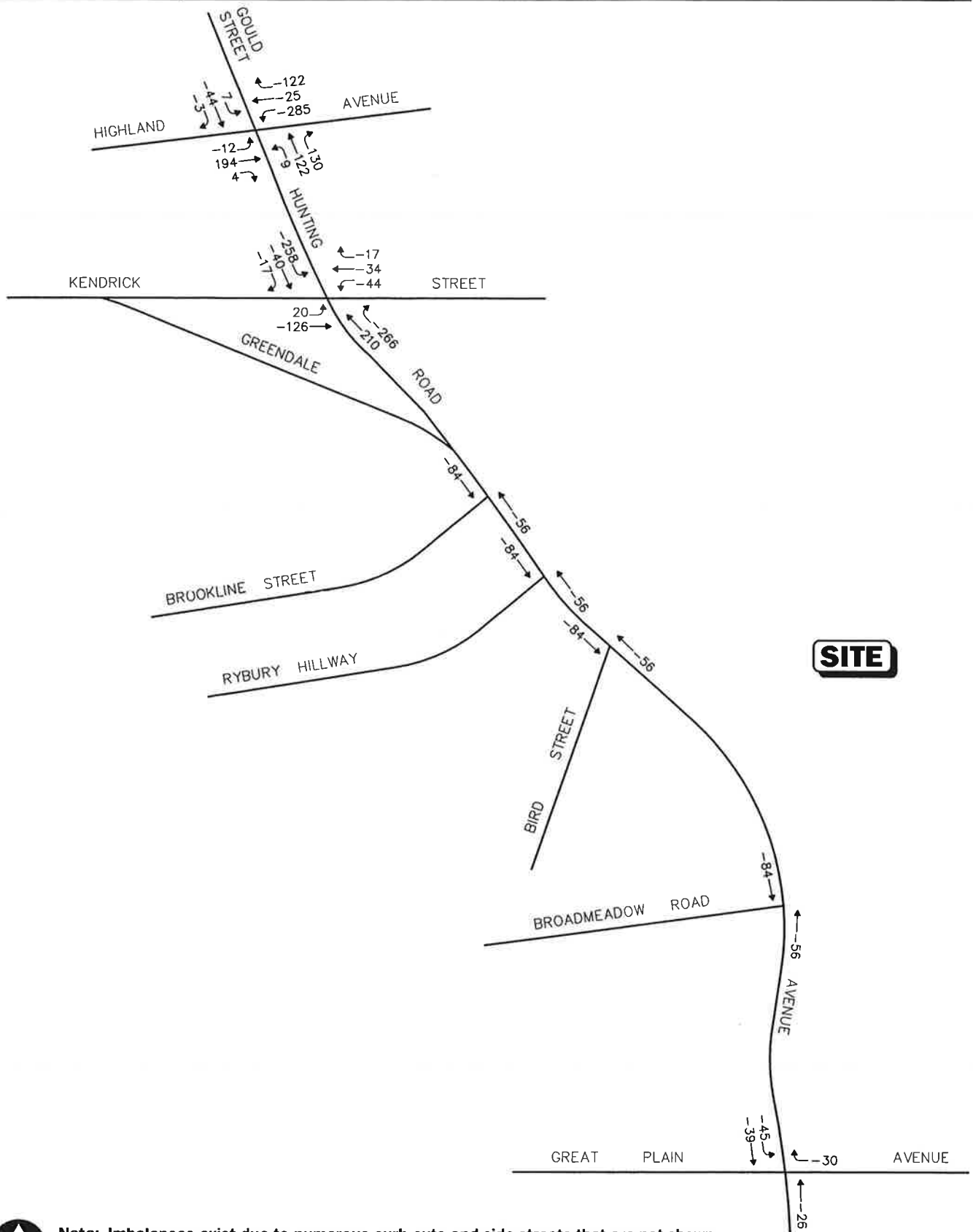


Vanasse & Associates, Inc.
 Transportation Engineers & Planners



Vanasse & Associates, Inc.
 Transportation Engineers & Planners

REVISED I-95/ROUTE 128 ADD-A-LANE TRAFFIC VOLUME REDISTRIBUTION



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

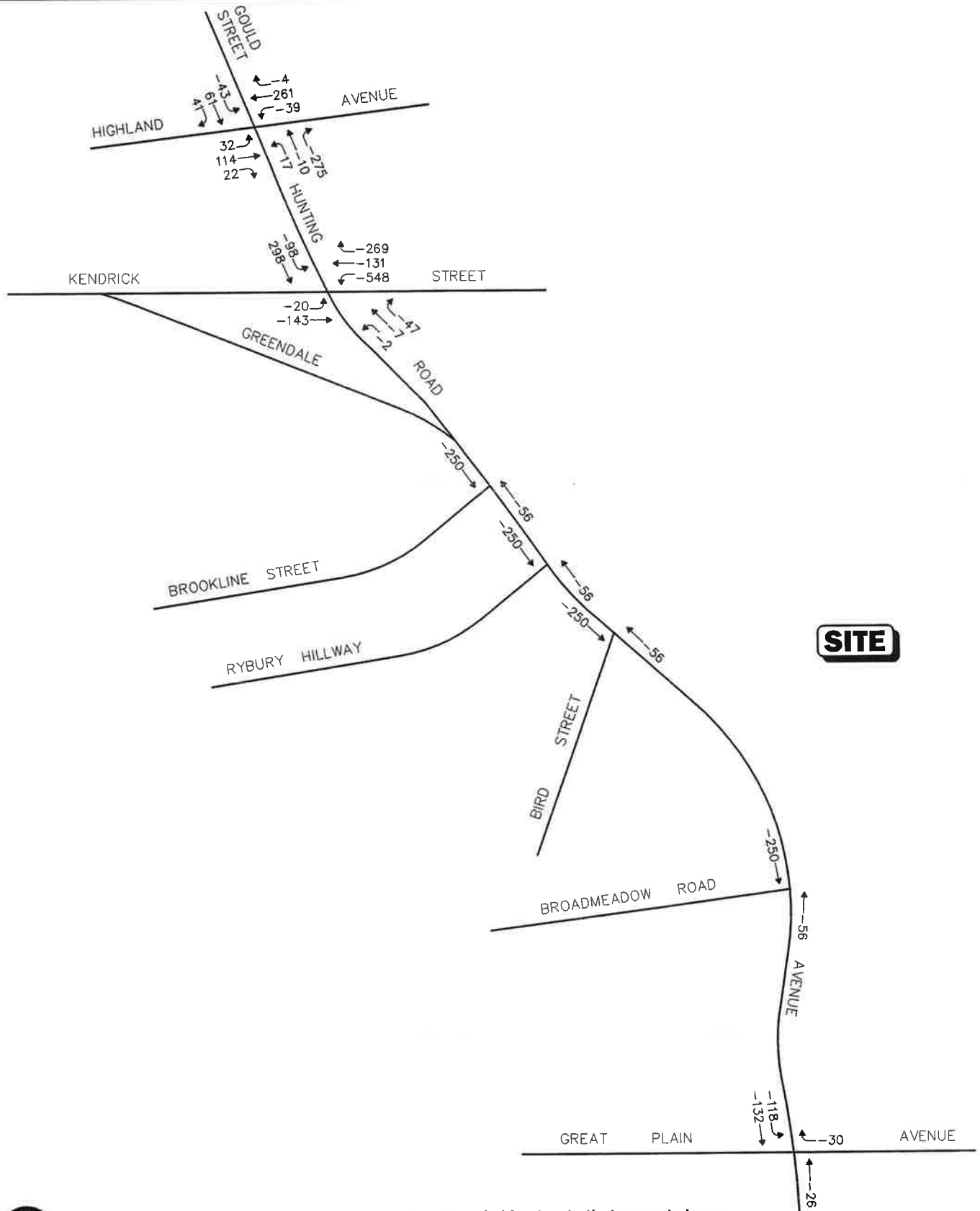
Not To Scale



Vanasse & Associates, Inc.
 Transportation Engineers & Planners

Figure A-7R

Roadway Improvement Project
I-95/Route 128 Add-A-Lane
Route 9/Highland Avenue/
Kendrick Street
Weekday Morning
Peak Hour Traffic Volumes



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure A-8R



Vanasse & Associates, Inc.

**Roadway Improvement Project
I-95/Route 128 Add-A-Lane
Route 9/Highland Avenue/
Kendrick Street
Weekday Evening
Peak Hour Traffic Volumes**

CAPACITY ANALYSIS WORKSHEETS

Highland Avenue at Gould Street and Kendrick Street
Kendrick Street at Hunting Road

Highland Avenue at Gould Street and Kendrick Street

2018 No-Build Weekday Morning Peak Hour w/Improvements
1: Hunting Rd/Gould St & Highland Ave

Lanes, Volumes, Timings
10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	88	1132	20	46	600	148	47	322	474	188	72	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	11	11	11	11	11	11	10	11	11
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.997			0.970				0.850		0.977	
Flt Protected	0.950			0.950				0.994		0.950	0.984	
Satd. Flow (prot)	1694	3412	0	1728	3293	0	0	1810	1546	1510	1628	0
Flt Permitted	0.950			0.950				0.994		0.950	0.984	
Satd. Flow (perm)	1694	3412	0	1728	3293	0	0	1810	1546	1510	1628	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			31				69		7	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		732			738			1359			383	
Travel Time (s)		16.6			16.8			30.9			8.7	
Peak Hour Factor	0.93	0.93	0.93	0.95	0.95	0.95	0.88	0.88	0.88	0.89	0.89	0.89
Heavy Vehicles (%)	3%	2%	0%	1%	3%	2%	0%	1%	1%	6%	2%	0%
Adj. Flow (vph)	95	1217	22	48	632	156	53	366	539	211	81	24
Shared Lane Traffic (%)										25%		
Lane Group Flow (vph)	95	1239	0	48	788	0	0	419	539	158	158	0
Turn Type	Prot	NA		Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	5	2		1	6		4	4	1	3	3	
Permitted Phases									4			
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	6.0	6.0	6.0	6.0	
Minimum Split (s)	11.0	21.0		11.0	21.0		21.0	21.0	11.0	11.0	11.0	
Total Split (s)	14.0	44.0		14.0	44.0		32.0	32.0	14.0	20.0	20.0	
Total Split (%)	12.7%	40.0%		12.7%	40.0%		29.1%	29.1%	12.7%	18.2%	18.2%	
Maximum Green (s)	9.0	39.0		9.0	39.0		27.0	27.0	9.0	15.0	15.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0			5.0	5.0	5.0	5.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lag	Lag	Lead	Lead	Lead	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	Max		None	None		None	None	None	None	None	
Act Effct Green (s)	8.6	39.0		9.0	39.4			26.5	40.5	14.1	14.1	
Actuated g/C Ratio	0.08	0.36		0.08	0.36			0.24	0.37	0.13	0.13	
v/c Ratio	0.71	1.01		0.34	0.65			0.95	0.87	0.81	0.73	
Control Delay	77.0	63.5		54.6	31.1			73.4	44.0	76.5	63.5	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay	77.0	63.5		54.6	31.1			73.4	44.0	76.5	63.5	
LOS	E	E		D	C			E	D	E	E	
Approach Delay		64.5			32.4			56.9			70.0	
Approach LOS		E			C			E			E	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 108.6

2018 No-Build Weekday Morning Peak Hour w/Improvements
 1: Hunting Rd/Gould St & Highland Ave

Lanes, Volumes, Timings
 10/7/2013

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.01

Intersection Signal Delay: 55.1

Intersection LOS: E

Intersection Capacity Utilization 81.5%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 1: Hunting Rd/Gould St & Highland Ave

 Ø1	 Ø2	 Ø3	 Ø4
14 s	44 s	20 s	32 s
 Ø5	 Ø6		
14 s	44 s		

2018 No-Build Weekday Morning Peak Hour w/Improvements
1: Hunting Rd/Gould St & Highland Ave

Queues
10/7/2013

								
Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	95	1239	48	788	419	539	158	158
v/c Ratio	0.71	1.01	0.34	0.65	0.95	0.87	0.81	0.73
Control Delay	77.0	63.5	54.6	31.1	73.4	44.0	76.5	63.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	77.0	63.5	54.6	31.1	73.4	44.0	76.5	63.5
Queue Length 50th (ft)	66	~491	33	235	292	311	114	108
Queue Length 95th (ft)	#145	#628	72	304	#467	#493	#222	#200
Internal Link Dist (ft)		652		658	1279			303
Turn Bay Length (ft)								
Base Capacity (vph)	140	1227	143	1213	450	619	208	231
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	1.01	0.34	0.65	0.93	0.87	0.76	0.68

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

2018 No-Build Weekday Evening Peak Hour w/Improvements
1: Hunting Rd/Gould St & Highland Ave

Lanes, Volumes, Timings

10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	89	796	50	228	964	134	49	67	131	301	309	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	11	11	11	11	11	11	10	11	11
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frnt		0.991			0.982				0.850		0.960	
Flt Protected	0.950			0.950				0.979		0.950	0.997	
Satd. Flow (prot)	1745	3394	0	1728	3397	0	0	1788	1546	1585	1645	0
Flt Permitted	0.950			0.950				0.979		0.950	0.997	
Satd. Flow (perm)	1745	3394	0	1728	3397	0	0	1788	1546	1585	1645	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4			12				151		13	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		732			738			1359			383	
Travel Time (s)		16.6			16.8			30.9			8.7	
Peak Hour Factor	0.95	0.95	0.95	0.88	0.88	0.88	0.87	0.87	0.87	0.89	0.89	0.89
Heavy Vehicles (%)	0%	2%	0%	1%	1%	0%	0%	1%	1%	1%	1%	3%
Adj. Flow (vph)	94	838	53	259	1095	152	56	77	151	338	347	140
Shared Lane Traffic (%)										10%		
Lane Group Flow (vph)	94	891	0	259	1247	0	0	133	151	304	521	0
Turn Type	Prot	NA		Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	5	2		1	6		4	4	1	3	3	
Permitted Phases									4			
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	6.0	6.0	6.0	6.0	
Minimum Split (s)	11.0	21.0		11.0	21.0		11.0	11.0	11.0	11.0	11.0	
Total Split (s)	14.0	47.0		31.0	64.0		16.0	16.0	31.0	56.0	56.0	
Total Split (%)	9.3%	31.3%		20.7%	42.7%		10.7%	10.7%	20.7%	37.3%	37.3%	
Maximum Green (s)	9.0	42.0		26.0	59.0		11.0	11.0	26.0	51.0	51.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0			5.0	5.0	5.0	5.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lag	Lag	Lead	Lead	Lead	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	Max		None	None		None	None	None	None	None	
Act Effct Green (s)	9.0	42.2		24.5	57.6			11.0	40.5	48.3	48.3	
Actuated g/C Ratio	0.06	0.29		0.17	0.39			0.08	0.28	0.33	0.33	
v/c Ratio	0.88	0.91		0.90	0.93			0.99	0.28	0.58	0.94	
Control Delay	126.1	63.9		91.9	54.4			140.6	7.2	45.8	73.1	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay	126.1	63.9		91.9	54.4			140.6	7.2	45.8	73.1	
LOS	F	E		F	D			F	A	D	E	
Approach Delay		69.8			60.9			69.7			63.1	
Approach LOS		E			E			E			E	

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 146

Baseline

LAS

Synchro 8 Report

S:\Jobs\6202\Synchro\Response to Comments\2018nbpmr w imp rev.syn

2018 No-Build Weekday Evening Peak Hour w/Improvements
 1: Hunting Rd/Gould St & Highland Ave

Lanes, Volumes, Timings
 10/7/2013

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.99

Intersection Signal Delay: 64.5

Intersection LOS: E

Intersection Capacity Utilization 79.4%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 1: Hunting Rd/Gould St & Highland Ave

 Ø1	 Ø2	 Ø3	 Ø4
31 s	47 s	56 s	16 s
 Ø5	 Ø6		
14 s	64 s		

2018 No-Build Weekday Evening Peak Hour w/Improvements
1: Hunting Rd/Gould St & Highland Ave

Queues
10/7/2013



Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	94	891	259	1247	133	151	304	521
v/c Ratio	0.88	0.91	0.90	0.93	0.99	0.28	0.58	0.94
Control Delay	126.1	63.9	91.9	54.4	140.6	7.2	45.8	73.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	126.1	63.9	91.9	54.4	140.6	7.2	45.8	73.1
Queue Length 50th (ft)	93	448	250	606	~135	0	255	504
Queue Length 95th (ft)	#208	#578	#390	#692	#267	50	358	#725
Internal Link Dist (ft)		652		658	1279			303
Turn Bay Length (ft)								
Base Capacity (vph)	107	983	308	1384	135	553	555	584
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.91	0.84	0.90	0.99	0.27	0.55	0.89

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

2018 Build Weekday Morning Peak Hour w/Improvements
1: Hunting Rd/Gould St & Highland Ave

Lanes, Volumes, Timings
10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	88	1132	20	47	600	148	47	328	517	188	73	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	11	11	11	11	11	11	10	11	11
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.997			0.970				0.850		0.977	
Flt Protected	0.950			0.950				0.994		0.950	0.984	
Satd. Flow (prot)	1694	3412	0	1728	3293	0	0	1810	1546	1510	1628	0
Flt Permitted	0.950			0.950				0.994		0.950	0.984	
Satd. Flow (perm)	1694	3412	0	1728	3293	0	0	1810	1546	1510	1628	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			31				69		7	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		732			738			1359			383	
Travel Time (s)		16.6			16.8			30.9			8.7	
Peak Hour Factor	0.93	0.93	0.93	0.95	0.95	0.95	0.88	0.88	0.88	0.89	0.89	0.89
Heavy Vehicles (%)	3%	2%	0%	1%	3%	2%	0%	1%	1%	6%	2%	0%
Adj. Flow (vph)	95	1217	22	49	632	156	53	373	588	211	82	24
Shared Lane Traffic (%)										25%		
Lane Group Flow (vph)	95	1239	0	49	788	0	0	426	588	158	159	0
Turn Type	Prot	NA		Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	5	2		1	6		4	4	1	3	3	
Permitted Phases									4			
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	6.0	6.0	6.0	6.0	
Minimum Split (s)	11.0	21.0		11.0	21.0		21.0	21.0	11.0	11.0	11.0	
Total Split (s)	14.0	44.0		14.0	44.0		32.0	32.0	14.0	20.0	20.0	
Total Split (%)	12.7%	40.0%		12.7%	40.0%		29.1%	29.1%	12.7%	18.2%	18.2%	
Maximum Green (s)	9.0	39.0		9.0	39.0		27.0	27.0	9.0	15.0	15.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0			5.0	5.0	5.0	5.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lag	Lag	Lead	Lead	Lead	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	Max		None	None		None	None	None	None	None	
Act Effct Green (s)	8.7	39.0		9.0	39.4			26.8	40.8	14.1	14.1	
Actuated g/C Ratio	0.08	0.36		0.08	0.36			0.25	0.37	0.13	0.13	
v/c Ratio	0.71	1.01		0.35	0.65			0.96	0.95	0.81	0.73	
Control Delay	77.1	64.3		54.9	31.2			75.2	55.4	76.5	64.0	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay	77.1	64.3		54.9	31.2			75.2	55.4	76.5	64.0	
LOS	E	E		D	C			E	E	E	E	
Approach Delay		65.2			32.6			63.7			70.2	
Approach LOS		E			C			E			E	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 108.9

2018 Build Weekday Morning Peak Hour w/Improvements
 1: Hunting Rd/Gould St & Highland Ave

Lanes, Volumes, Timings
 10/7/2013

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.01

Intersection Signal Delay: 57.4

Intersection LOS: E

Intersection Capacity Utilization 84.2%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 1: Hunting Rd/Gould St & Highland Ave

 Ø1	 Ø2	 Ø3	 Ø4
14 s	44 s	20 s	32 s
 Ø5	 Ø6		
14 s	44 s		

2018 Build Weekday Morning Peak Hour w/Improvements
 1: Hunting Rd/Gould St & Highland Ave

Queues
 10/7/2013

								
Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	95	1239	49	788	426	588	158	159
v/c Ratio	0.71	1.01	0.35	0.65	0.96	0.95	0.81	0.73
Control Delay	77.1	64.3	54.9	31.2	75.2	55.4	76.5	64.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	77.1	64.3	54.9	31.2	75.2	55.4	76.5	64.0
Queue Length 50th (ft)	66	~491	33	235	298	362	114	109
Queue Length 95th (ft)	#145	#628	73	304	#477	#571	#222	#202
Internal Link Dist (ft)		652		658	1279			303
Turn Bay Length (ft)								
Base Capacity (vph)	139	1224	142	1210	449	621	207	230
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	1.01	0.35	0.65	0.95	0.95	0.76	0.69

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

2018 Build Weekday Evening Peak Hour w/Improvements
1: Hunting Rd/Gould St & Highland Ave

Lanes, Volumes, Timings
10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	89	796	50	234	964	134	49	70	154	301	314	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	11	11	11	11	11	11	10	11	11
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.991			0.982				0.850		0.960	
Flt Protected	0.950			0.950				0.980		0.950	0.997	
Satd. Flow (prot)	1745	3394	0	1728	3397	0	0	1789	1546	1585	1645	0
Flt Permitted	0.950			0.950				0.980		0.950	0.997	
Satd. Flow (perm)	1745	3394	0	1728	3397	0	0	1789	1546	1585	1645	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4			12				172		13	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		732			738			1359			383	
Travel Time (s)		16.6			16.8			30.9			8.7	
Peak Hour Factor	0.95	0.95	0.95	0.88	0.88	0.88	0.87	0.87	0.87	0.89	0.89	0.89
Heavy Vehicles (%)	0%	2%	0%	1%	1%	0%	0%	1%	1%	1%	1%	3%
Adj. Flow (vph)	94	838	53	266	1095	152	56	80	177	338	353	140
Shared Lane Traffic (%)										10%		
Lane Group Flow (vph)	94	891	0	266	1247	0	0	136	177	304	527	0
Turn Type	Prot	NA		Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	5	2		1	6		4	4	1	3	3	
Permitted Phases									4			
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	6.0	6.0	6.0	6.0	
Minimum Split (s)	11.0	21.0		11.0	21.0		11.0	11.0	11.0	11.0	11.0	
Total Split (s)	14.0	47.0		31.0	64.0		16.0	16.0	31.0	56.0	56.0	
Total Split (%)	9.3%	31.3%		20.7%	42.7%		10.7%	10.7%	20.7%	37.3%	37.3%	
Maximum Green (s)	9.0	42.0		26.0	59.0		11.0	11.0	26.0	51.0	51.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0			5.0	5.0	5.0	5.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lag	Lag	Lead	Lead	Lead	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	Max		None	None		None	None	None	None	None	
Act Effct Green (s)	9.0	42.1		24.8	57.9			11.0	40.8	48.6	48.6	
Actuated g/C Ratio	0.06	0.29		0.17	0.39			0.08	0.28	0.33	0.33	
v/c Ratio	0.88	0.91		0.91	0.93			1.01	0.32	0.58	0.95	
Control Delay	127.0	64.8		94.2	54.5			146.7	7.7	45.7	74.7	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay	127.0	64.8		94.2	54.5			146.7	7.7	45.7	74.7	
LOS	F	E		F	D			F	A	D	E	
Approach Delay		70.8			61.5			68.1			64.1	
Approach LOS		E			E			E			E	

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 146.6

2018 Build Weekday Evening Peak Hour w/Improvements
 1: Hunting Rd/Gould St & Highland Ave

Lanes, Volumes, Timings
 10/7/2013

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.01

Intersection Signal Delay: 65.2

Intersection LOS: E

Intersection Capacity Utilization 80.0%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 1: Hunting Rd/Gould St & Highland Ave

 Ø1	 Ø2	 Ø3	 Ø4
31 s	47 s	56 s	16 s
 Ø5	 Ø6		
14 s	64 s		

2018 Build Weekday Evening Peak Hour w/Improvements
1: Hunting Rd/Gould St & Highland Ave

Queues
10/7/2013

								
Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	94	891	266	1247	136	177	304	527
v/c Ratio	0.88	0.91	0.91	0.93	1.01	0.32	0.58	0.95
Control Delay	127.0	64.8	94.2	54.5	146.7	7.7	45.7	74.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	127.0	64.8	94.2	54.5	146.7	7.7	45.7	74.7
Queue Length 50th (ft)	93	448	258	606	~143	4	255	513
Queue Length 95th (ft)	#208	#578	#404	#692	#273	56	358	#740
Internal Link Dist (ft)		652		658	1279			303
Turn Bay Length (ft)								
Base Capacity (vph)	107	977	307	1377	134	566	552	581
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.91	0.87	0.91	1.01	0.31	0.55	0.91

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Kendrick Street at Hunting Road

2018 No-Build Weekday Morning Peak Hour w/Improvements

Lanes, Volumes, Timings

2: Hunting Rd & Kendrick St

10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	49	503	2	97	233	58	3	682	513	90	53	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	11	12	12
Storage Length (ft)	0		0	0		110	0		110	130		0
Storage Lanes	0		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.970				0.850		0.995	
Flt Protected		0.996		0.950						0.950		
Satd. Flow (prot)	0	3547	0	1787	1825	0	0	1881	1599	1728	1890	0
Flt Permitted		0.765		0.173				0.999		0.064		
Satd. Flow (perm)	0	2725	0	325	1825	0	0	1879	1599	116	1890	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					9				145		2	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		477			405			232			1359	
Travel Time (s)		10.8			9.2			5.3			30.9	
Peak Hour Factor	0.71	0.71	0.71	0.96	0.96	0.96	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	1%	0%	1%	1%	1%	0%	1%	1%	1%	0%	0%
Adj. Flow (vph)	69	708	3	101	243	60	3	741	558	99	58	2
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	780	0	101	303	0	0	744	558	99	60	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	pm+pt	NA	
Protected Phases		6		5	2			8		7	4	
Permitted Phases	6			2			8		Free	4		
Minimum Initial (s)	7.0	7.0		7.0	10.0		10.0	10.0		7.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	15.0		15.0	15.0		12.0	15.0	
Total Split (s)	46.0	46.0		12.0	58.0		62.0	62.0		12.0	74.0	
Total Split (%)	30.7%	30.7%		8.0%	38.7%		41.3%	41.3%		8.0%	49.3%	
Maximum Green (s)	41.0	41.0		7.0	53.0		57.0	57.0		7.0	69.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0		5.0	5.0			5.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag			Lead	Lead		Lag		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		41.1		53.2	53.2			57.2	136.0	69.2	69.2	
Actuated g/C Ratio		0.30		0.39	0.39			0.42	1.00	0.51	0.51	
v/c Ratio		0.95		0.50	0.42			0.94	0.35	0.70	0.06	
Control Delay		67.3		50.2	32.5			59.1	0.6	71.7	18.2	
Queue Delay		0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay		67.3		50.2	32.5			59.1	0.6	71.7	18.2	
LOS		E		D	C			E	A	E	B	
Approach Delay		67.3			36.9			34.0			51.5	

Baseline
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2018 No-Build Weekday Morning Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings
10/7/2013

Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Initial (s)	10.0
Minimum Split (s)	18.0
Total Split (s)	18.0
Total Split (%)	12%
Maximum Green (s)	15.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	6.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	1
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	

Baseline
LAS

Synchro 8 Report
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2018 No-Build Weekday Morning Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings
10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS	E			D			C			D		

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 136

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.95

Intersection Signal Delay: 45.3

Intersection LOS: D

Intersection Capacity Utilization 92.2%

ICU Level of Service F

Analysis Period (min) 15

Splits and Phases: 2: Hunting Rd & Kendrick St

 ø2	 ø4	 ø9
58 s	74 s	18 s
 ø6	 ø5	 ø8
46 s	12 s	62 s
		 ø7
		12 s

2018 No-Build Weekday Morning Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Queues
10/7/2013



Lane Group	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	780	101	303	744	558	99	60
v/c Ratio	0.95	0.50	0.42	0.94	0.35	0.70	0.06
Control Delay	67.3	50.2	32.5	59.1	0.6	71.7	18.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	67.3	50.2	32.5	59.1	0.6	71.7	18.2
Queue Length 50th (ft)	339	54	178	590	0	42	24
Queue Length 95th (ft)	370	116	321	#1056	0	#152	61
Internal Link Dist (ft)	397		325	152			1279
Turn Bay Length (ft)					110	130	
Base Capacity (vph)	824	202	719	790	1599	142	962
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.95	0.50	0.42	0.94	0.35	0.70	0.06

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

2018 No-Build Weekday Evening Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings
10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	102	0	242	462	104	1	112	67	27	656	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	11	12	12
Storage Length (ft)	0		0	0		110	0		110	130		0
Storage Lanes	0		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.973				0.850		0.994	
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3575	0	1787	1830	0	0	1900	1599	1745	1871	0
Flt Permitted		0.679		0.677				0.749		0.615		
Satd. Flow (perm)	0	2427	0	1274	1830	0	0	1423	1599	1130	1871	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					8				145		2	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		477			405			232			1359	
Travel Time (s)		10.8			9.2			5.3			30.9	
Peak Hour Factor	0.87	0.87	0.87	0.91	0.91	0.91	0.79	0.79	0.79	0.84	0.84	0.84
Heavy Vehicles (%)	0%	1%	0%	1%	1%	1%	0%	0%	1%	0%	1%	0%
Adj. Flow (vph)	1	117	0	266	508	114	1	142	85	32	781	35
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	118	0	266	622	0	0	143	85	32	816	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	pm+pt	NA	
Protected Phases		6		5	2			8		7	4	
Permitted Phases	6			2			8		Free	4		
Minimum Initial (s)	7.0	7.0		7.0	10.0		10.0	10.0		7.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	15.0		15.0	15.0		12.0	15.0	
Total Split (s)	35.0	35.0		18.0	53.0		67.0	67.0		12.0	79.0	
Total Split (%)	23.3%	23.3%		12.0%	35.3%		44.7%	44.7%		8.0%	52.7%	
Maximum Green (s)	30.0	30.0		13.0	48.0		62.0	62.0		7.0	74.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0		5.0	5.0			5.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag			Lead	Lead		Lag		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		10.5		49.1	49.1			32.8	119.6	57.2	57.2	
Actuated g/C Ratio		0.09		0.41	0.41			0.27	1.00	0.48	0.48	
v/c Ratio		0.55		0.40	0.82			0.37	0.05	0.05	0.91	
Control Delay		65.6		32.8	44.2			47.4	0.1	17.6	44.3	
Queue Delay		0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay		65.6		32.8	44.2			47.4	0.1	17.6	44.3	
LOS		E		C	D			D	A	B	D	
Approach Delay		65.6			40.8			29.8			43.3	

Baseline
LAS

Synchro 8 Report
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2018 No-Build Weekday Evening Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings
10/7/2013

Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Initial (s)	10.0
Minimum Split (s)	18.0
Total Split (s)	18.0
Total Split (%)	12%
Maximum Green (s)	15.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	6.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	1
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	

Baseline
LAS

Synchro 8 Report
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2018 No-Build Weekday Evening Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings
10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS	E			D			C			D		

Intersection Summary

Area Type: Other
 Cycle Length: 150
 Actuated Cycle Length: 119.6
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.91
 Intersection Signal Delay: 42.0
 Intersection Capacity Utilization 75.3%
 Analysis Period (min) 15

Intersection LOS: D
 ICU Level of Service D

Splits and Phases: 2: Hunting Rd & Kendrick St

 ø2	 ø4	 ø9
53 s	79 s	18 s
 ø6	 ø5	 ø8
35 s	18 s	67 s
		 ø7
		12 s

2018 No-Build Weekday Evening Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Queues
10/7/2013

	→	↖	←	↑	↗	↘	↓
Lane Group	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	118	266	622	143	85	32	816
v/c Ratio	0.55	0.40	0.82	0.37	0.05	0.05	0.91
Control Delay	65.6	32.8	44.2	47.4	0.1	17.6	44.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.6	32.8	44.2	47.4	0.1	17.6	44.3
Queue Length 50th (ft)	44	134	398	102	0	12	521
Queue Length 95th (ft)	92	304	#920	179	0	34	826
Internal Link Dist (ft)	397		325	152			1279
Turn Bay Length (ft)					110	130	
Base Capacity (vph)	622	665	755	753	1599	667	1183
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.40	0.82	0.19	0.05	0.05	0.69

Intersection Summary

- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

2018 Build Weekday Morning Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings

10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	49	503	2	115	233	58	3	731	545	90	55	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	11	12	12
Storage Length (ft)	0		0	0		110	0		110	130		0
Storage Lanes	0		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.970				0.850		0.995	
Flt Protected		0.996		0.950						0.950		
Satd. Flow (prot)	0	3547	0	1787	1825	0	0	1881	1599	1728	1890	0
Flt Permitted		0.765		0.173				0.999		0.064		
Satd. Flow (perm)	0	2725	0	325	1825	0	0	1879	1599	116	1890	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					9				145		1	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		477			405			232			1359	
Travel Time (s)		10.8			9.2			5.3			30.9	
Peak Hour Factor	0.71	0.71	0.71	0.96	0.96	0.96	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	1%	0%	1%	1%	1%	0%	1%	1%	1%	0%	0%
Adj. Flow (vph)	69	708	3	120	243	60	3	795	592	99	60	2
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	780	0	120	303	0	0	798	592	99	62	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	pm+pt	NA	
Protected Phases		6		5	2			8		7	4	
Permitted Phases	6			2			8		Free	4		
Minimum Initial (s)	7.0	7.0		7.0	10.0		10.0	10.0		7.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	15.0		15.0	15.0		12.0	15.0	
Total Split (s)	46.0	46.0		12.0	58.0		62.0	62.0		12.0	74.0	
Total Split (%)	30.7%	30.7%		8.0%	38.7%		41.3%	41.3%		8.0%	49.3%	
Maximum Green (s)	41.0	41.0		7.0	53.0		57.0	57.0		7.0	69.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0		5.0	5.0			5.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag			Lead	Lead		Lag		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		41.1		53.2	53.2			57.2	136.0	69.2	69.2	
Actuated g/C Ratio		0.30		0.39	0.39			0.42	1.00	0.51	0.51	
v/c Ratio		0.95		0.59	0.42			1.01	0.37	0.70	0.06	
Control Delay		67.3		55.8	32.5			73.9	0.7	71.7	18.5	
Queue Delay		0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay		67.3		55.8	32.5			73.9	0.7	71.7	18.5	
LOS		E		E	C			E	A	E	B	
Approach Delay		67.3			39.1			42.7			51.2	

Baseline
LAS

Synchro 8 Report
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2018 Build Weekday Morning Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings
10/7/2013

Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Initial (s)	10.0
Minimum Split (s)	18.0
Total Split (s)	18.0
Total Split (%)	12%
Maximum Green (s)	15.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	6.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	1
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	

Baseline
LAS

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2018 Build Weekday Morning Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings
10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS	E			D			D			D		

Intersection Summary

Area Type: Other
 Cycle Length: 150
 Actuated Cycle Length: 136
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.01
 Intersection Signal Delay: 49.6
 Intersection Capacity Utilization 94.8%
 Analysis Period (min) 15

Intersection LOS: D
 ICU Level of Service F

Splits and Phases: 2: Hunting Rd & Kendrick St

 ø2	 ø4	 ø9
58 s	74 s	18 s
 ø6	 ø5	 ø8
46 s	12 s	62 s
		 ø7
		12 s

2018 Build Weekday Morning Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Queues
10/7/2013

	→	↘	←	↑	↗	↙	↓
Lane Group	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	780	120	303	798	592	99	62
v/c Ratio	0.95	0.59	0.42	1.01	0.37	0.70	0.06
Control Delay	67.3	55.8	32.5	73.9	0.7	71.7	18.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	67.3	55.8	32.5	73.9	0.7	71.7	18.5
Queue Length 50th (ft)	339	65	178	665	0	42	25
Queue Length 95th (ft)	370	#142	321	#1171	0	#152	64
Internal Link Dist (ft)	397		325	152			1279
Turn Bay Length (ft)					110	130	
Base Capacity (vph)	824	202	719	790	1599	142	962
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.95	0.59	0.42	1.01	0.37	0.70	0.06

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

2018 Build Weekday Evening Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings

10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	102	0	311	462	104	1	138	84	27	667	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	11	12	12
Storage Length (ft)	0		0	0		110	0		110	130		0
Storage Lanes	0		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.973				0.850		0.994	
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3575	0	1787	1830	0	0	1900	1599	1745	1871	0
Flt Permitted		0.681		0.677				0.760		0.570		
Satd. Flow (perm)	0	2434	0	1274	1830	0	0	1444	1599	1047	1871	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					8				145		2	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		477			405			232			1359	
Travel Time (s)		10.8			9.2			5.3			30.9	
Peak Hour Factor	0.87	0.87	0.87	0.91	0.91	0.91	0.79	0.79	0.79	0.84	0.84	0.84
Heavy Vehicles (%)	0%	1%	0%	1%	1%	1%	0%	0%	1%	0%	1%	0%
Adj. Flow (vph)	1	117	0	342	508	114	1	175	106	32	794	35
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	118	0	342	622	0	0	176	106	32	829	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	pm+pt	NA	
Protected Phases		6		5	2			8		7	4	
Permitted Phases	6			2			8		Free	4		
Minimum Initial (s)	7.0	7.0		7.0	10.0		10.0	10.0		7.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	15.0		15.0	15.0		12.0	15.0	
Total Split (s)	35.0	35.0		18.0	53.0		67.0	67.0		12.0	79.0	
Total Split (%)	23.3%	23.3%		12.0%	35.3%		44.7%	44.7%		8.0%	52.7%	
Maximum Green (s)	30.0	30.0		13.0	48.0		62.0	62.0		7.0	74.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0		5.0	5.0			5.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag			Lead	Lead		Lag		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		10.6		49.0	49.0			35.4	121.2	58.8	58.8	
Actuated g/C Ratio		0.09		0.40	0.40			0.29	1.00	0.49	0.49	
v/c Ratio		0.56		0.52	0.84			0.42	0.07	0.05	0.91	
Control Delay		66.7		36.6	46.0			46.3	0.1	17.4	44.2	
Queue Delay		0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay		66.7		36.6	46.0			46.3	0.1	17.4	44.2	
LOS		E		D	D			D	A	B	D	
Approach Delay		66.7			42.7			28.9			43.2	

Baseline

LAS

Synchro 8 Report

S:\Jobs\6202\Synchro\Response to Comments\2018bpmr w imp rev.syn

2018 Build Weekday Evening Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings
10/7/2013

Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Initial (s)	10.0
Minimum Split (s)	18.0
Total Split (s)	18.0
Total Split (%)	12%
Maximum Green (s)	15.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	6.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	1
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	

Baseline
LAS

Synchro 8 Report
S:\Jobs\6202\Synchro\Response to Comments\2018bpmr w imp rev.syn

2018 Build Weekday Evening Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Lanes, Volumes, Timings
10/7/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS	E			D			C			D		

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 121.2

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.91

Intersection Signal Delay: 42.4

Intersection LOS: D

Intersection Capacity Utilization 75.8%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 2: Hunting Rd & Kendrick St

 ø2	 ø4	 ø9
53 s	79 s	18 s
 ø6	 ø5	 ø8
35 s	18 s	67 s
		 ø7
		12 s

2018 Build Weekday Evening Peak Hour w/Improvements
2: Hunting Rd & Kendrick St

Queues
10/7/2013

	→	↖	←	↑	↗	↘	↓
Lane Group	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	118	342	622	176	106	32	829
v/c Ratio	0.56	0.52	0.84	0.42	0.07	0.05	0.91
Control Delay	66.7	36.6	46.0	46.3	0.1	17.4	44.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.7	36.6	46.0	46.3	0.1	17.4	44.2
Queue Length 50th (ft)	45	187	410	127	0	12	537
Queue Length 95th (ft)	92	398	#920	209	0	34	847
Internal Link Dist (ft)	397		325	152			1279
Turn Bay Length (ft)					110	130	
Base Capacity (vph)	614	656	744	753	1599	645	1166
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.52	0.84	0.23	0.07	0.05	0.71

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.