Final Memorandum

HNTB

To: Jeff Dayton, P.E.

From: John Grant, P.E.

Subject: Gaston East-West Connector
Updated Traffic Forecast and Revised Preliminary Design Traffic Capacity Analysis for the Preferred Alternative

Date: May 10, 2010

HNTB Project: 46816

NORTH CAROLINA PROFESSIONAL SEAL 022945 ENGINEER JOHN H. GRANT

5/10/10

1.0 Introduction

The North Carolina Turnpike Authority (NCTA) proposes to improve east-west travel between I-85 west of Gastonia in Gaston County and I-485/NC 160 in Mecklenburg County through construction of the Gaston East-West Connector. This project is designated as Statewide Transportation Improvement Program (STIP) Project Number U-3321 in the North Carolina Department of Transportation's (NCDOT) *2009-2015 Statewide Transportation Improvement Program*. Through the development of practical and context sensitive designs, NCTA has identified not constructing the Bud Wilson Road interchange as a part of this project. In addition, some preliminary interchange designs of Detailed Study Alternative (DSA) 9 have been modified.

HNTB North Carolina, P.C. (HNTB) was contracted by the NCTA to complete an additional 2035 Build Toll traffic forecast scenario as a result of the Bud Wilson Road interchange removal. This scenario was not included in the previously submitted Final Traffic Forecast Memorandum on November 18, 2009. HNTB was also contracted to complete traffic capacity analysis based on the revised preliminary designs utilizing this updated traffic forecast scenario.

HNTB analyzed the following revised interchange designs:

- Robinson Road – modified westbound ramp to a compressed ramp termini,
- NC 274 – modified to a compressed "diamond" interchange,
- NC 273 – modified to "diamond" interchange with the removal of loop ramp in the northwest quadrant,
- I-485 – eliminated "flyover" for southeast quadrant (WB to SB) to an at-grade ramp intersection.

In addition to the updated traffic forecast scenario and interchange capacity analysis, a mainline freeway analysis is included to verify the level of service (LOS) of the Gaston East-West Connector as a 4-lane facility in the 2035 design year.

2.0 Traffic Forecast Volumes

For the purposes of this technical memorandum, the following 2035 Toll forecast scenario will be used:

- 2035 Toll without Bud Wilson interchange and Preferred Alternative Alignment

This updated forecast scenario was developed by utilizing the previously approved 2035 Toll with US 29/74 interchange scenario, removing the Bud Wilson interchange, and redistributing and adjusting these forecasted volumes to account for the removal of the Bud Wilson interchange. An additional Metrolina Regional Model (MRM) run of the 2035 Toll without Bud Wilson interchange was also completed for comparative purposes to validate the adjusted volumes. The updated traffic forecast scenario figures are included in **Appendix A** and peak hour breakouts are included in **Appendix B**.

3.0 Interchange Analysis

Analysis Approach

The focus of the traffic capacity analysis was on the operations of the modified ramp terminals. Traffic capacity analysis was performed utilizing Synchro 7.0 software. NCDOT's Congestion Management Section's Capacity Analysis Guidelines were used in the analysis. The following preliminary interchange designs were revised and/or modified and the capacity analysis was conducted based on these preliminary designs. All capacity analyses utilize the updated 2035 Toll without Bud Wilson interchange traffic forecast.

The results of the traffic capacity analysis are based on the level of service (LOS) and delay. Refer to **Tables 1-4** for the overall LOS and delay during the AM and PM peak hour. Synchro output, including both LOS and delay results, is included in **Appendix C**.

A. Robinson Road

This traffic capacity analysis was based on the revised preliminary design that shifts the westbound ramp terminal southward to a "compressed" ramp termini location. The capacity analysis reveals that the westbound ramp is expected to operate at LOS E during the PM peak hour. This level of service is related to the removal of the Bud Wilson interchange and not a change in the Robinson Road interchange design. With the addition of a second right turn lane on the westbound ramp, the intersection is expected to improve to an overall LOS D.

Table 1 – 2035 Build Toll Synchro Intersection Analysis Results

Intersection	Time Period	2035 Toll without Bud Wilson Interchange		2035 Toll without Bud Wilson Interchange with improvements	
		LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
Westbound Ramp	AM	D	37.4	C	29.9
	PM	E	63.2	D	36.7
Eastbound Ramp	AM	C	29.1	C	31.1
	PM	C	23.0	C	23.7

B. NC 274

This traffic capacity analysis was based on the revised preliminary design to a compressed "diamond" type interchange. The capacity analysis reveals that both ramp intersections are expected to operate at LOS C or better during the AM and PM peak hour.

Table 2 – 2035 Build Toll Synchro Intersection Analysis Results

Intersection	Time Period	2035 Toll without Bud Wilson Interchange	
		LOS	Delay (sec/veh)
Westbound Ramp	AM	B	15.5
	PM	B	19.7
Eastbound Ramp	AM	C	24.1
	PM	C	22.5

C. NC 273

This traffic capacity analysis was based on the preliminary design with the proposed diamond interchange by replacing the loop ramp in the northwest quadrant with a left turn at the westbound off ramp. To accommodate this design the westbound on ramp is shifted south to align with the westbound off ramp. The capacity analysis reveals that both ramp intersections are expected to operate at LOS C or better during the AM and PM peak hour.

Table 3 – 2035 Build Toll Synchro Intersection Analysis Results

Intersection	Time Period	2035 Toll without Bud Wilson Interchange	
		LOS	Delay (sec/veh)
Westbound Ramp	AM	C	24.8
	PM	C	30.8
Eastbound Ramp	AM	B	19.9
	PM	B	15.8

D. I-485

This traffic capacity analysis was based on the preliminary design with the removal of the "flyover" ramp for the southeast quadrant (WB to SB) to an at-grade ramp terminus. This analysis assumes dual westbound left turn lanes. The capacity analysis reveals that both ramp intersections are expected to operate at LOS A during both the AM and PM peak hour.

Table 4 – 2035 Build Toll Synchro Intersection Analysis Results

Intersection	Time Period	2035 Toll without Bud Wilson Interchange	
		LOS	Delay (sec/veh)
Southbound Ramp	AM	A	8.5
	PM	A	6.4

Gaston East-West Connector Main Line Analysis

Traffic capacity analysis was performed utilizing Highway Capacity Software (HCS) 2000. NCDOT's Congestion Management Section's Capacity Analysis Guidelines were used in the analysis.

Table 5 shows the mainline basic 4 lane freeway segment LOS for the 2035 Toll without Bud Wilson Road interchange scenario. Refer to **Appendix D** for basic freeway capacity analysis reports.

Table 5 – Mainline Freeway 4-Lane Level of Service

Segment	2035 Toll Traffic 4-Lane
I-85 to US 29/74	B
US 29/74 to Linwood Road	B
Linwood Road to US 321	B
US 321 to Robinson Road	C
Robinson Road to NC 274	C
NC 274 to NC 279	C
NC 279 to NC 273	D
NC 273 to Dixie River Road	***F***
Dixie River Road to I-485	E

The capacity analysis revealed that the 4 lane freeway segment between NC 273 and Dixie River is expected to operate a LOS F in 2035. A failure year capacity analysis indicates that the 4 lane freeway between NC 273 and Dixie River Road is expected to operate at LOS D or better until 2028. In 2029 it is expected to operate at LOS E and will reach LOS F in 2033. If the forecasted traffic volumes develop, additional travel lanes on the Gaston East-West Connector will be needed from NC 273 eastward to I-485 to achieve acceptable LOS. These additional lanes can be developed from the interchange ramp and carried to/from NC 273 to I-485 as auxiliary lanes. The distance between the interchanges allows these to be considered as a freeway lane in the HCS analysis. The mainline basic freeway analysis indicates that a 6 lane facility for the 2035 Toll without the Bud Wilson interchange scenario is expected to operate at LOS C or better during the peak hours.

4.0 Summary and Recommendations

In summary, this technical memorandum provides an updated 2035 Toll traffic forecast without the Bud Wilson Road Interchange and traffic capacity analysis associated with the revised preliminary design.

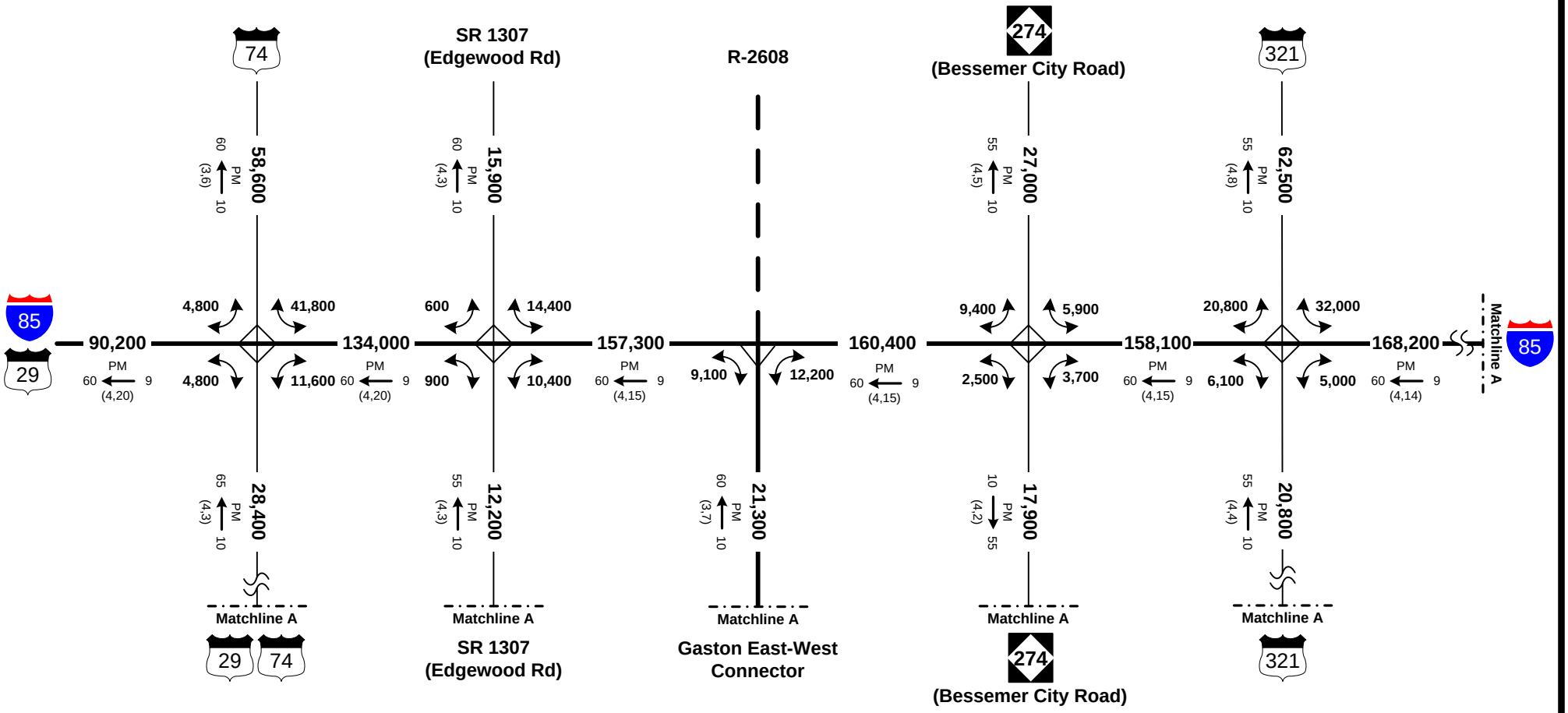
The traffic capacity analysis utilizing the updated forecast indicates that the revised designs are expected to operate at acceptable LOS with one exception. The westbound ramp at Robinson

Road is expected to operate at LOS E during the PM peak hour. With the improvement to westbound dual right turn lanes, the intersection is expected to operate at LOS D.

A mainline basic freeway analysis was completed for a 4 lane facility. The capacity analysis indicates that the section between NC 273 and Dixie River Road is expected to operate a LOS F in 2035. A freeway mainline failure year analysis indicates the 4 lane facility is expected to operate at LOS D until 2028 and will reach LOS E in 2029 and LOS F by 2033. With the addition of "auxiliary lanes" from NC 273 to I-485, the mainline basic freeway analysis of a 6 lane facility indicates that the Gaston East-West Connector is expected to operate at LOS C or better in 2035.

If you have any questions or additional information, please contact Mr. John Grant, P.E. at 919-424-0467.

Appendix A – Forecast Figures



LEGEND

- = Breakline
- = Existing Roadway
- = Future Roadway
- ### = VPD - # of Vehicles per Day
  Average Annual Daily Traffic
- DHV = Design Hourly Volume = K30
  K30 = 30th Highest Hourly Volume
- PM = PM Peak Period
- D = Directional Split (%)
- → = Indicates Direction of D
  Reverse Flow for AM Peak
- (d,t) = Duals, TT-ST's (%)
- = Daily Turn Movements

PM
DHV → D
(d,t)

N
NTS

Gaston East-West Connector

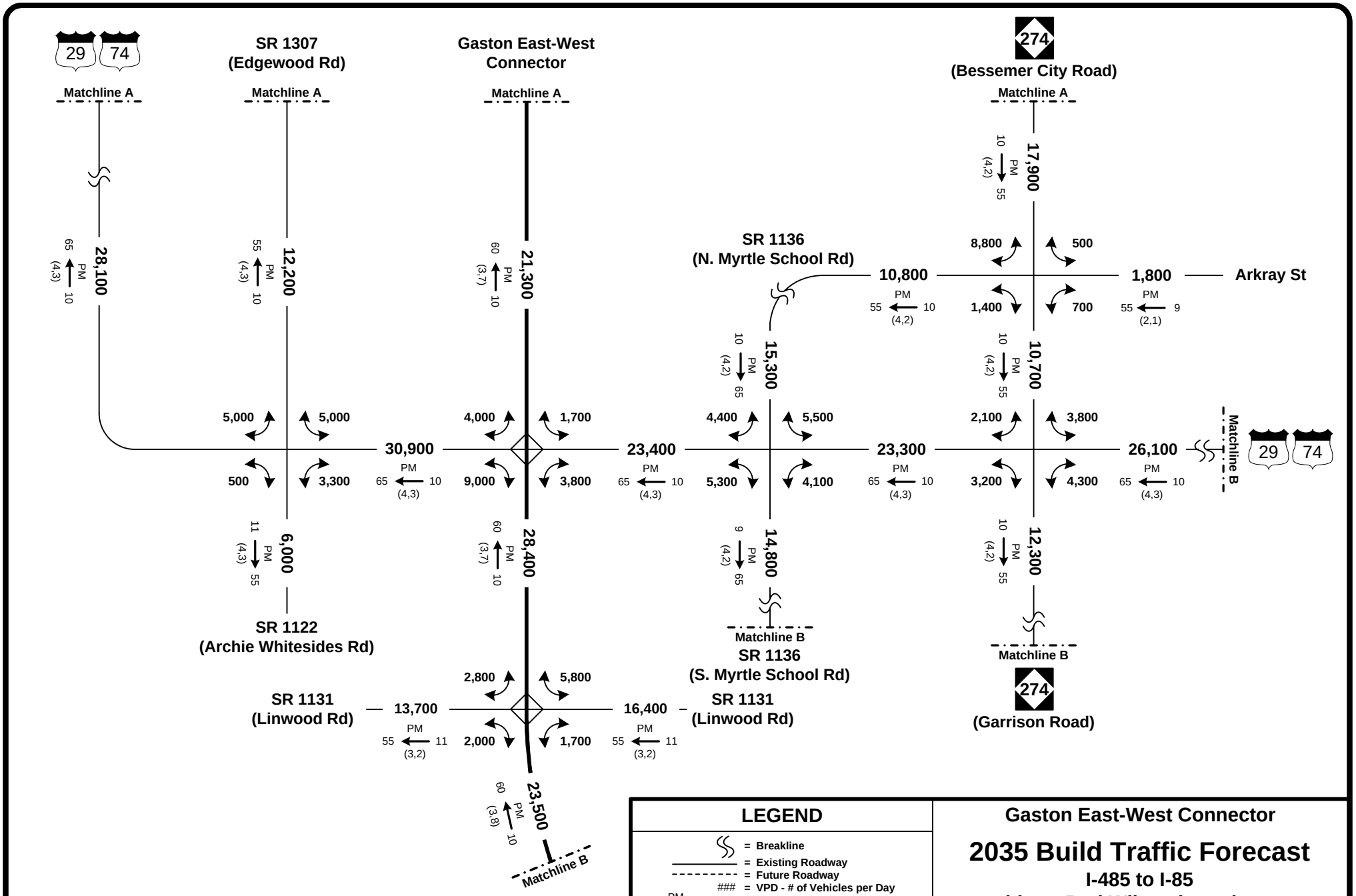
2035 Build Traffic Forecast

I-485 to I-85
without Bud Wilson interchange

STIP: U-3321	**COUNTY:** Gaston/Mecklenburg
DATE: February 2010	**DIVISION:** 12 / 10
PREPARED BY: HNTB North Carolina, P.C. 343 East Six Forks Rd Suite 200 Raleigh, North Carolina 27609	**Figure 1.1**

NORTH CAROLINA Turnpike Authority

HNTB



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DHV →(PM) D (d,t)

N

NTS

Gaston East-West Connector

2035 Build Traffic Forecast

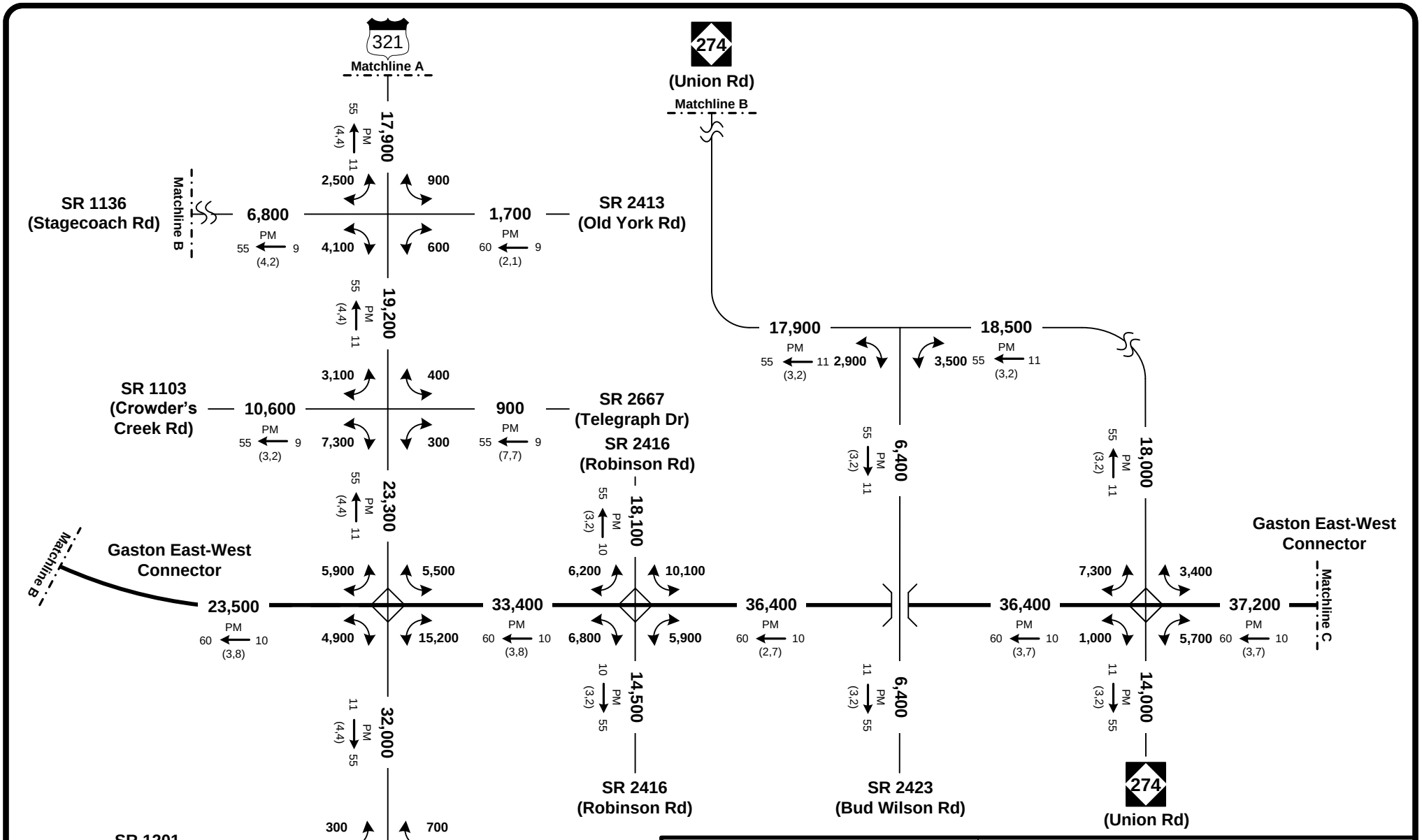
I-485 to I-85

without Bud Wilson interchange

STIP: U-3321	**COUNTY:** Gaston/Mecklenburg
DATE: February 2010	**DIVISION:** 12 / 10
PREPARED BY: HNTB North Carolina, P.C. 343 East Six Forks Rd Suite 200 Raleigh, North Carolina 27609	**Figure 1.2**

NORTH CAROLINA Turnpike Authority

HNTB


321
Matchline A
274
(Union Rd)
Matchline B
17,900
PM
55
11
(4,4)
2,500
900
4,100
600
SR 1136
(Stagecoach Rd)
Matchline B
6,800
PM
55
9
(4,2)
1,700
PM
60
9
(2,1)
SR 2413
(Old York Rd)
19,200
17,900
PM
55
11
(3,2)
2,900
3,500
18,500
PM
55
11
(3,2)
3,100
400
SR 1103
(Crowder's
Creek Rd)
10,600
PM
55
9
(3,2)
7,300
300
900
PM
55
9
(7,7)
SR 2667
(Telegraph Dr)
SR 2416
(Robinson Rd)
23,300
18,100
6,400
18,000
Gaston East-West
Connector
Matchline B
Gaston East-West
Connector
23,500
PM
60
10
(3,8)
5,900
5,500
4,900
15,200
33,400
PM
60
10
(3,8)
6,200
10,100
6,800
5,900
36,400
PM
60
10
(2,7)
36,400
PM
60
10
(3,7)
7,300
3,400
1,000
5,700
37,200
PM
60
10
(3,7)
Matchline C
32,000
14,500
6,400
14,000
SR 2416
(Robinson Rd)
SR 2423
(Bud Wilson Rd)
274
(Union Rd)
SR 1201
(Superior
Stainless Rd)
900
PM
10
55
(4,2)
300
700
300
700
1,700
PM
65
10
(5,3)
SR 2420
(Forbes Rd)
32,000
321
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(d,t) = Duals, TT-ST's (%)
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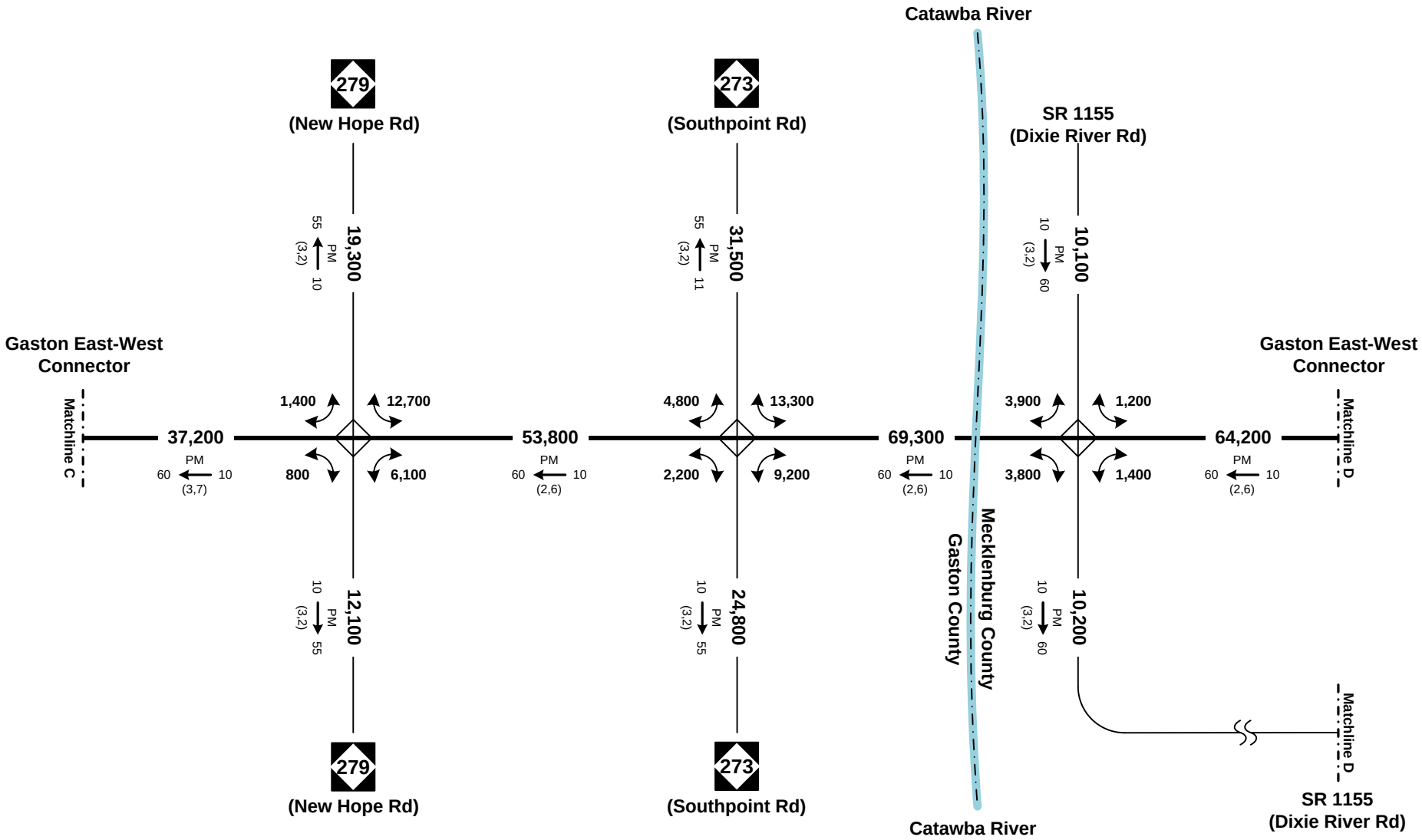
NTS
Gaston East-West Connector
2035 Build Traffic Forecast
I-485 to I-85
without Bud Wilson interchange
STIP: U-3321
COUNTY: Gaston/Mecklenburg
DATE: February 2010
DIVISION: 12 / 10
PREPARED BY: HNTB North Carolina, P.C.
343 East Six Forks Rd Suite 200
Raleigh, North Carolina 27609
Figure 1.3
NORTH CAROLINA Turnpike Authority
HNTB



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PM
DHV → D
(d,t)

N
NTS

Gaston East-West Connector

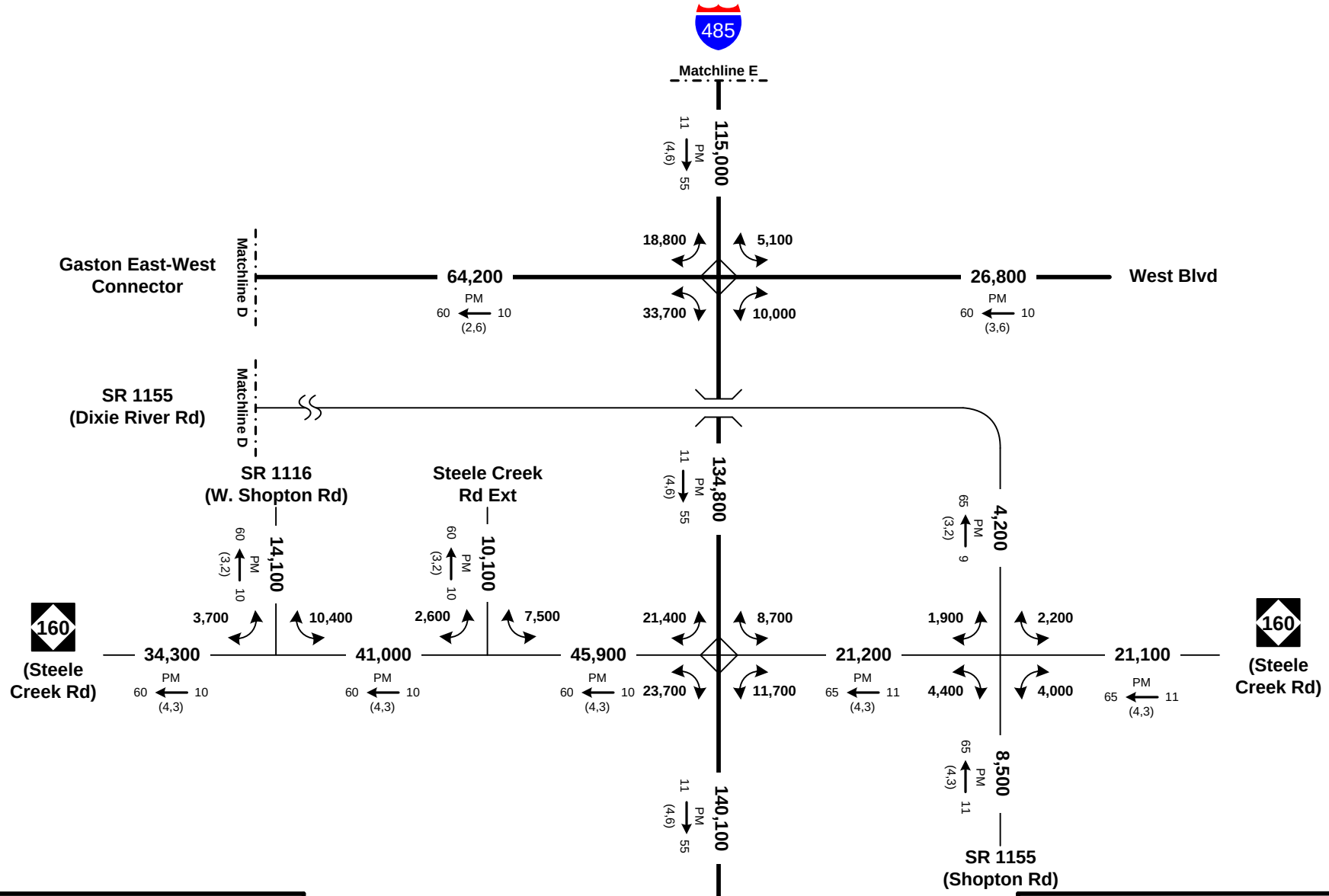
2035 Build Traffic Forecast

I-485 to I-85
without Bud Wilson interchange

STIP: U-3321	**COUNTY:** Gaston/Mecklenburg
DATE: February 2010	**DIVISION:** 12 / 10
PREPARED BY: HNTB North Carolina, P.C. 343 East Six Forks Rd Suite 200 Raleigh, North Carolina 27609	**Figure 1.4**

NORTH CAROLINA Turnpike Authority

HNTB



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- PM DHV → D (d,t)
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- (d,t) = Duals, TT-ST's (%)
- = Daily Turn Movements

N

NTS

NORTH CAROLINA Turnpike Authority

HNTB

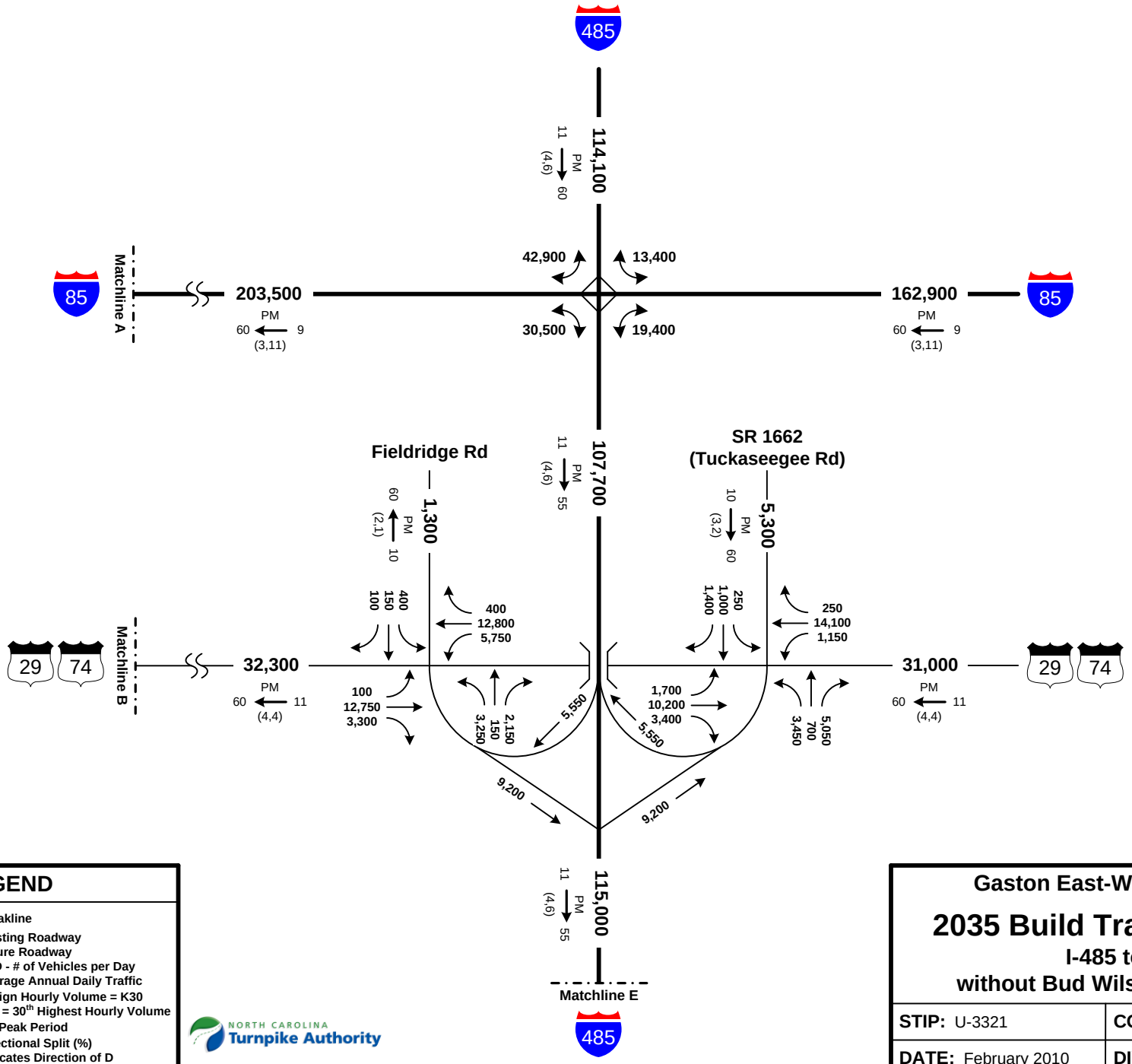
Gaston East-West Connector

2035 Build Traffic Forecast

I-485 to I-85

without Bud Wilson interchange

STIP: U-3321	**COUNTY:** Gaston/Mecklenburg
DATE: February 2010	**DIVISION:** 12 / 10
PREPARED BY: HNTB North Carolina, P.C. 343 East Six Forks Rd Suite 200 Raleigh, North Carolina 27609	**Figure 1.5**



LEGEND

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- = Existing Roadway
- = Future Roadway
- ### = VPD - # of Vehicles per Day Average Annual Daily Traffic
- PM DHV → D (d,t)
- DHV = Design Hourly Volume = K30 K30 = 30th Highest Hourly Volume
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N

NTS

NORTH CAROLINA Turnpike Authority

HNTB

Gaston East-West Connector

2035 Build Traffic Forecast

I-485 to I-85

without Bud Wilson interchange

STIP: U-3321	**COUNTY:** Gaston/Mecklenburg
DATE: February 2010	**DIVISION:** 12 / 10
PREPARED BY: HNTB North Carolina, P.C. 343 East Six Forks Rd Suite 200 Raleigh, North Carolina 27609	**Figure 1.6**

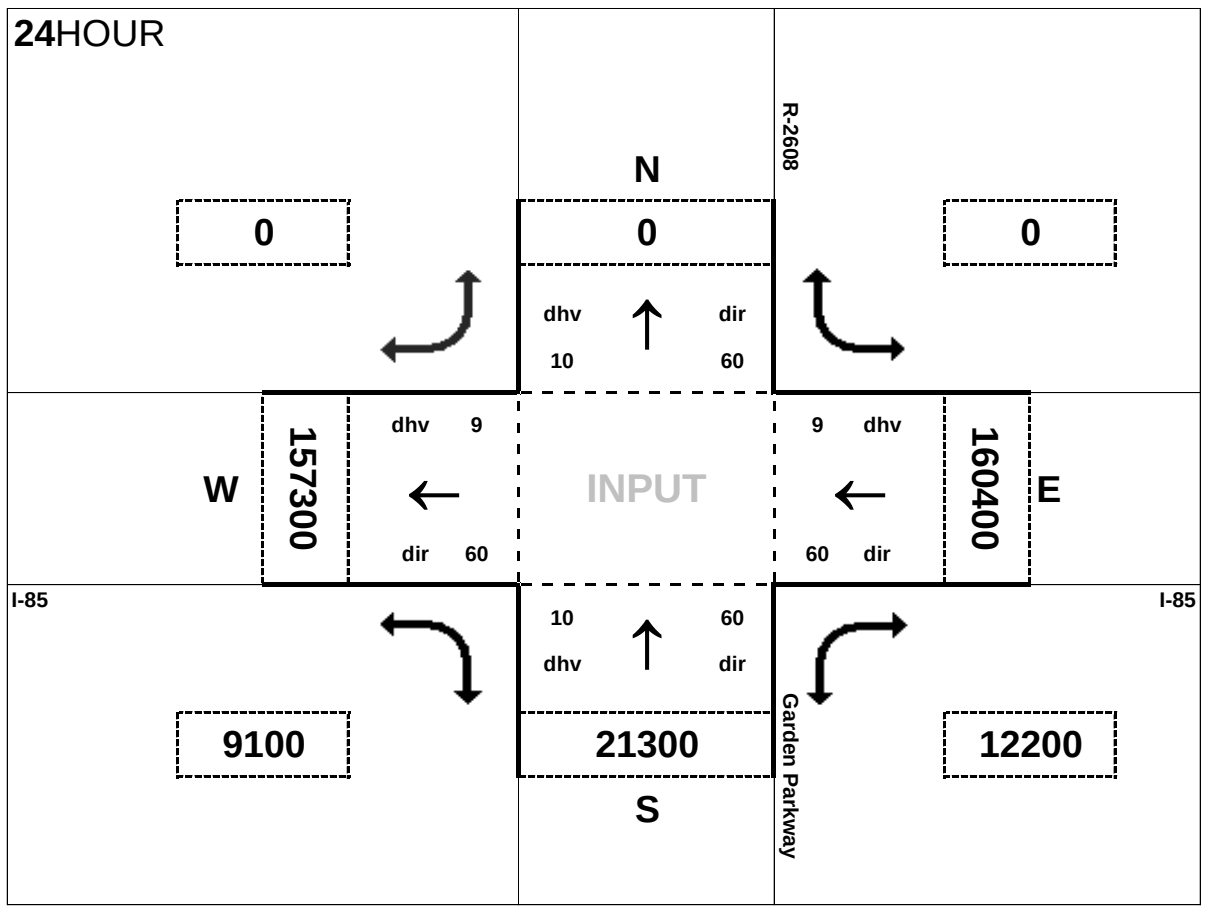
Appendix B – Peak Hour Breakouts

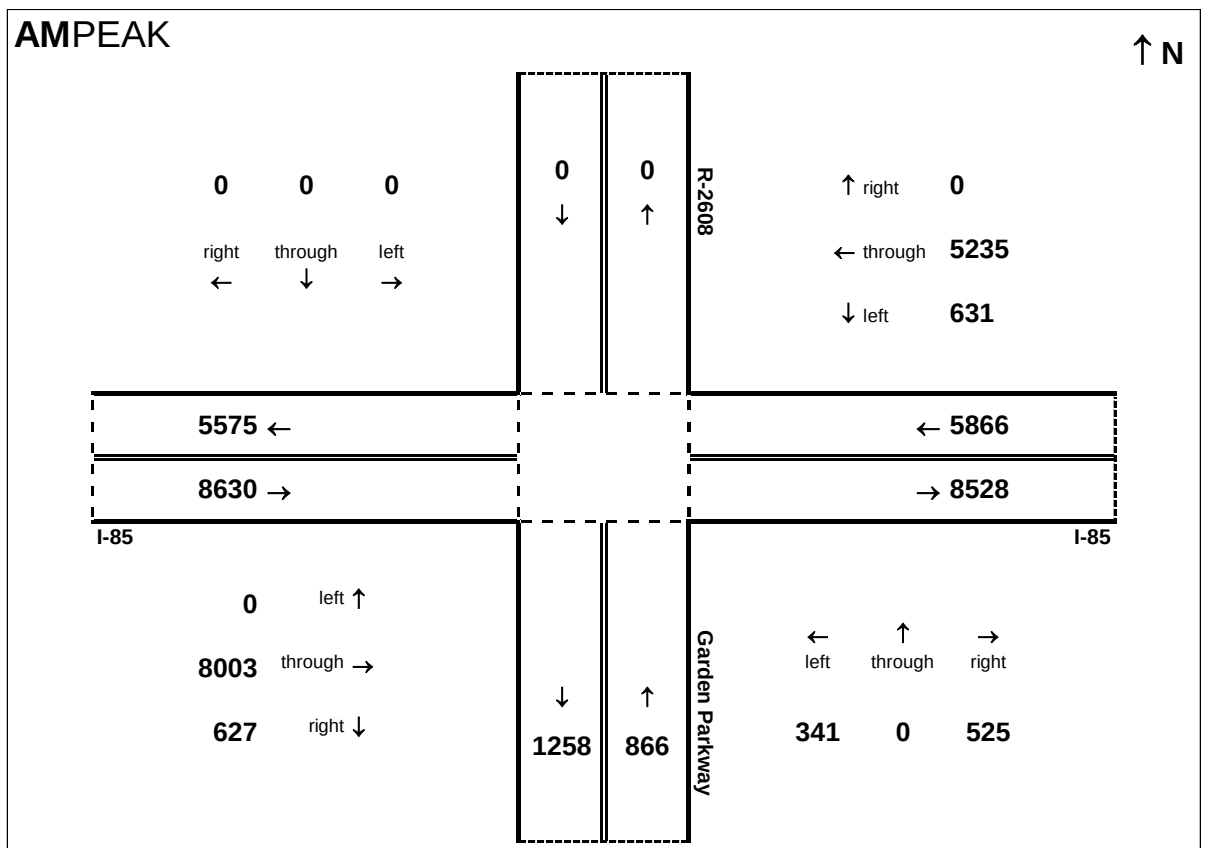
Peak Hour Volume Breakouts Report:
I-85 - Garden Parkway

Traffic Forecast Release Date:
March-10

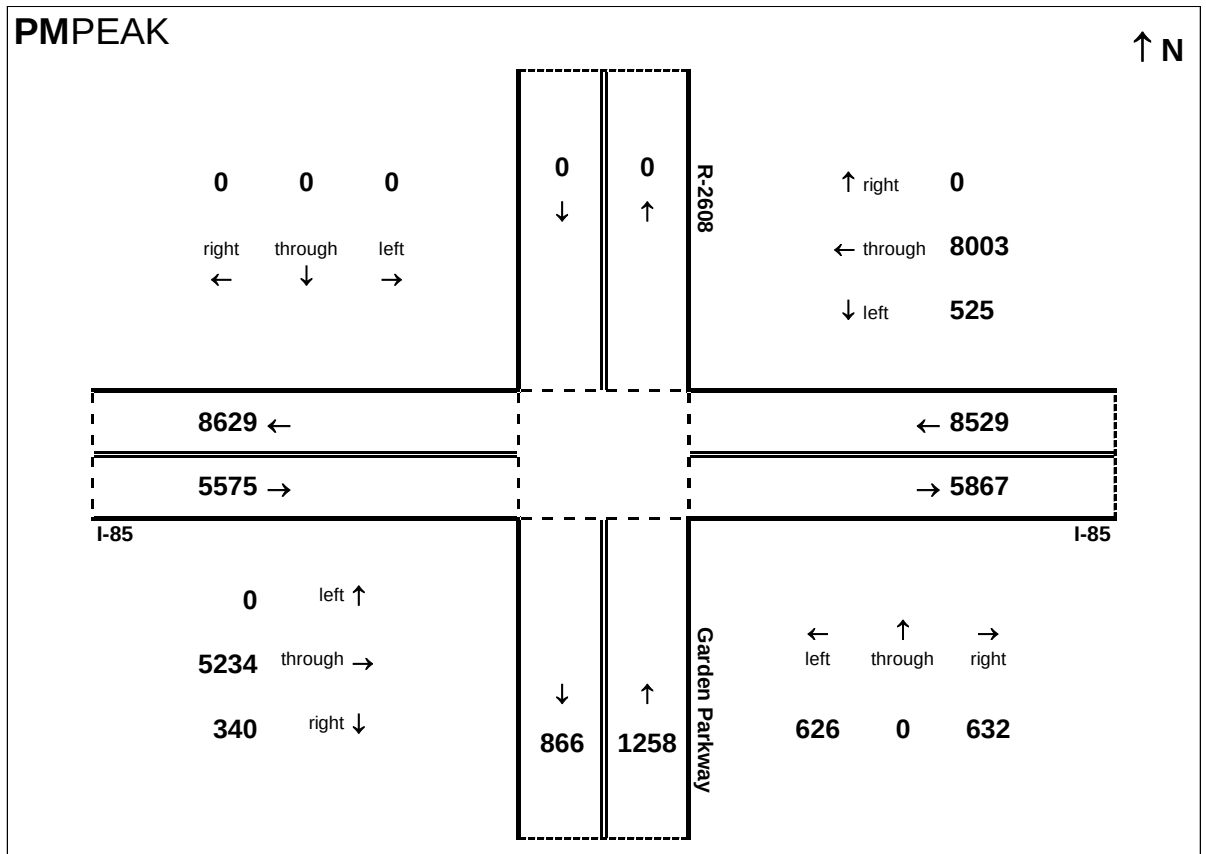
Traffic Data Year:
2035 Build w/o B.W.

Project:
Gaston E-W Connector (Garden Parkway)





AM peak hour inflow is 15362 vehicles. AM peak hour outflow is 15361 vehicles.



PM peak hour inflow is 15362 vehicles. PM peak hour outflow is 15362 vehicles.

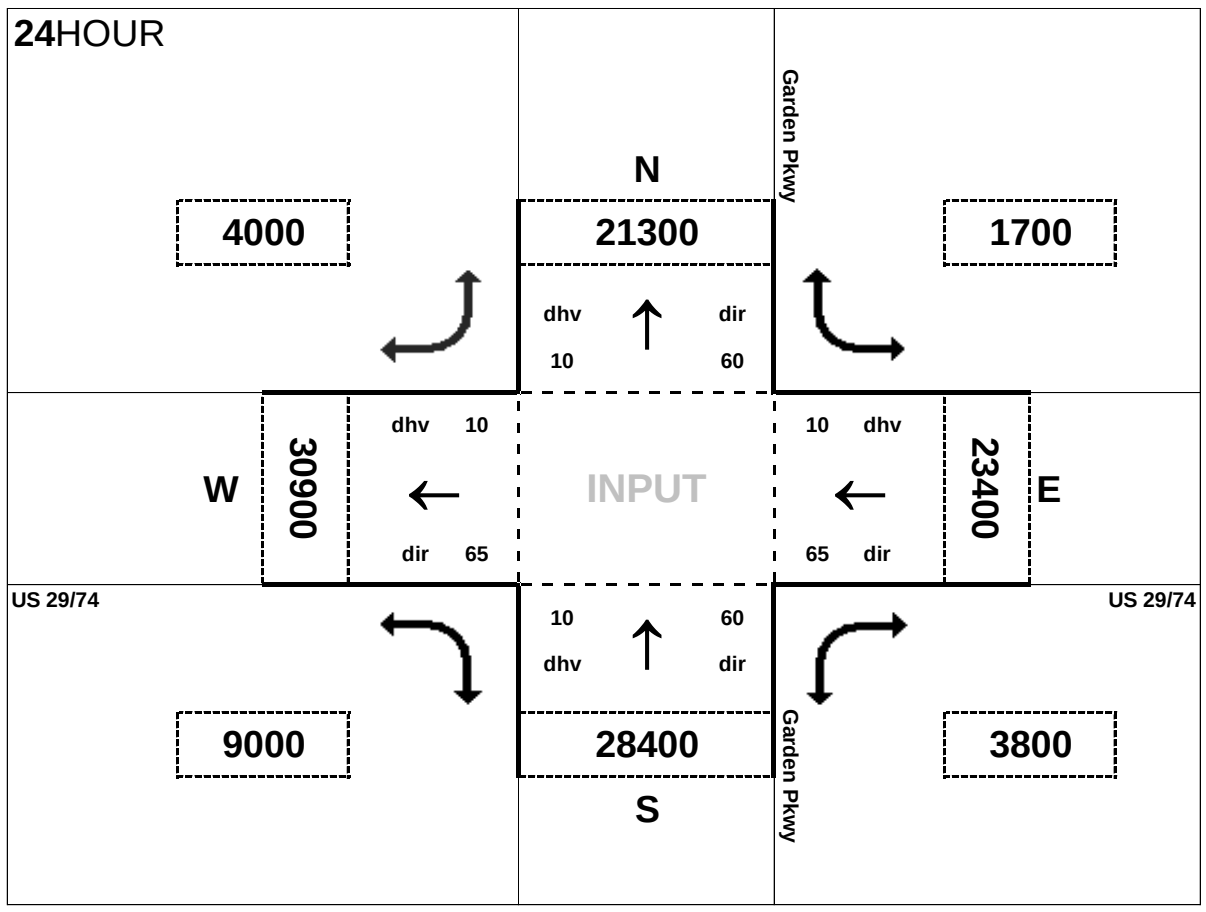
Peak Hour Volume Breakouts Report:
Garden Parkway & US 29/74

Traffic Forecast Release Date:
March-10

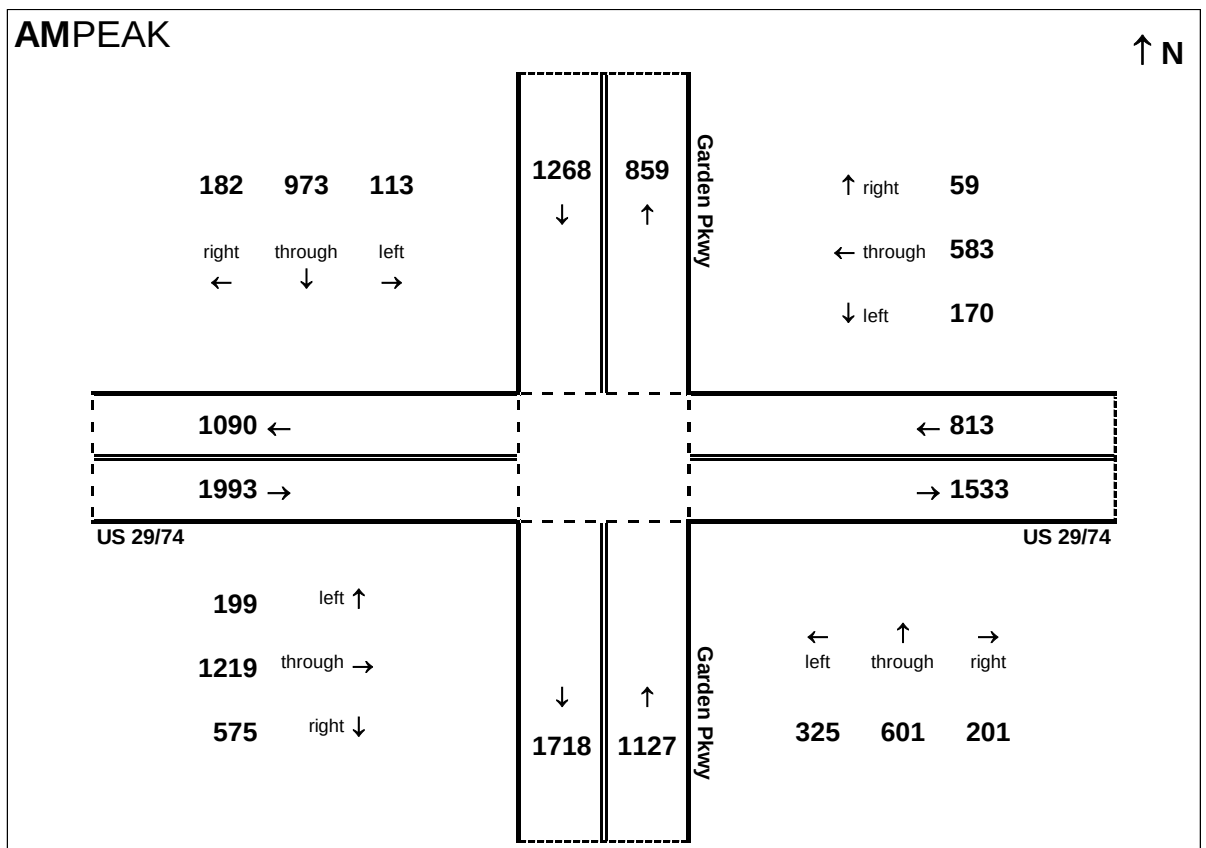
Traffic Data Year:
2035 Build w/o B.W.

Project:
Gaston E-W Connector (Garden Parkway)

24HOUR

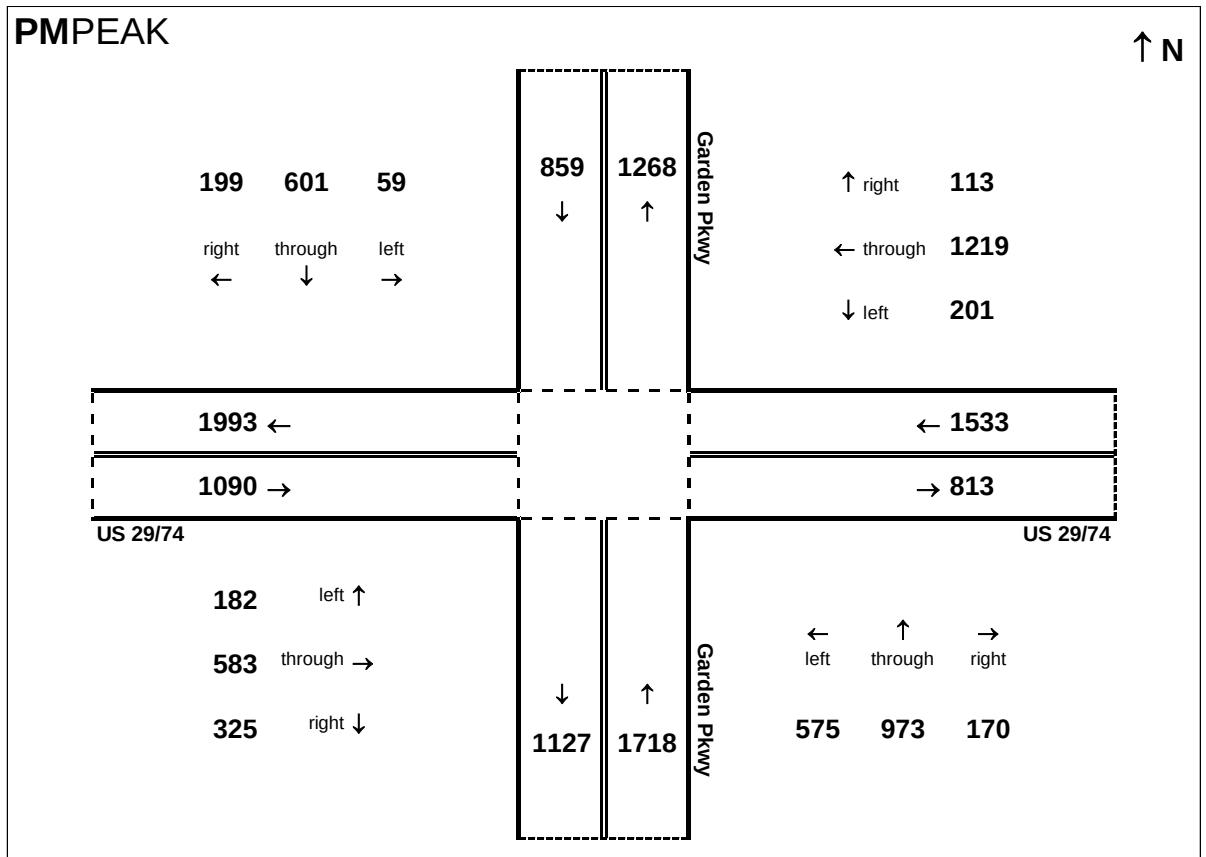


AMPEAK



AM peak hour inflow is 5201 vehicles. AM peak hour outflow is 5200 vehicles.

PMPEAK



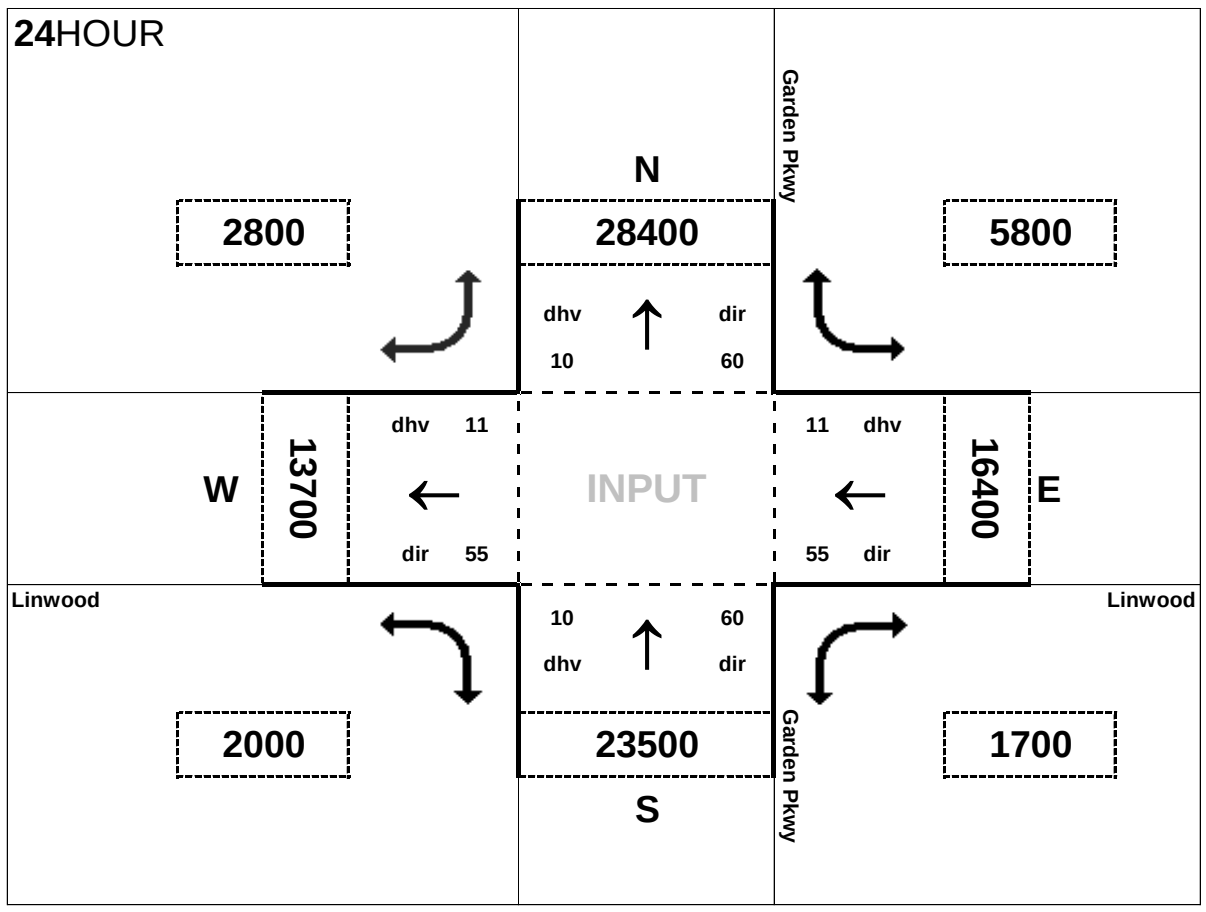
PM peak hour inflow is 5200 vehicles. PM peak hour outflow is 5201 vehicles.

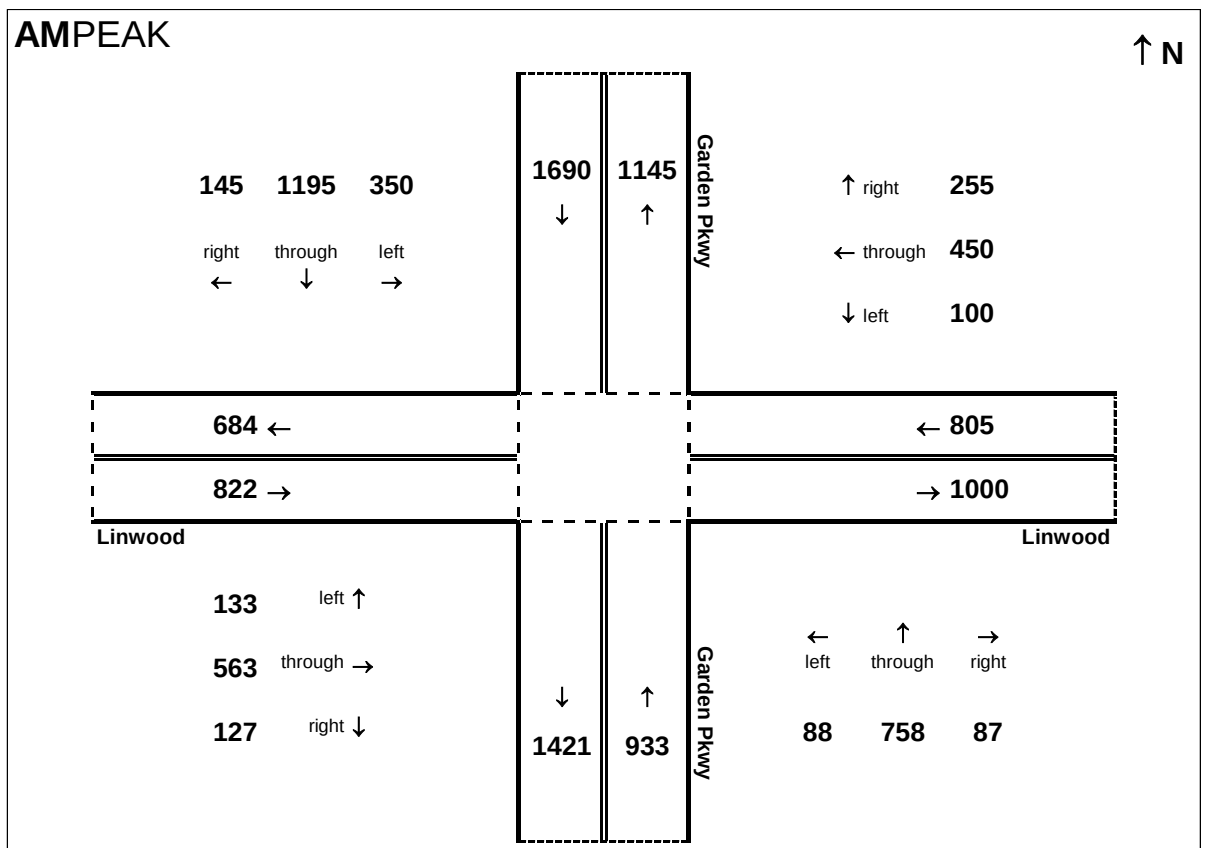
Peak Hour Volume Breakouts Report:
Garden Parkway & Linwood

Traffic Forecast Release Date:
March-10

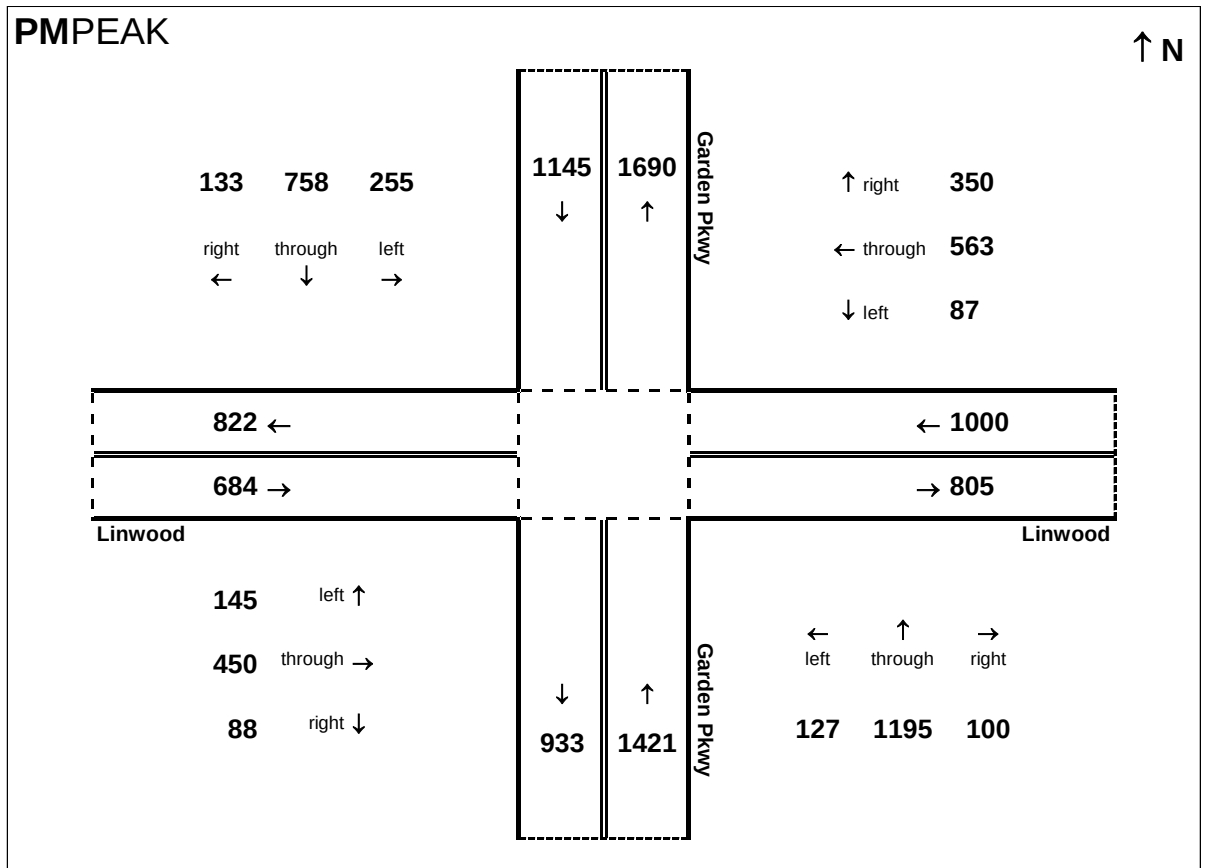
Traffic Data Year:
2035 Build w/o B.W.

Project:
Gaston E-W Connector (Garden Parkway)





AM peak hour inflow is 4250 vehicles. AM peak hour outflow is 4250 vehicles.



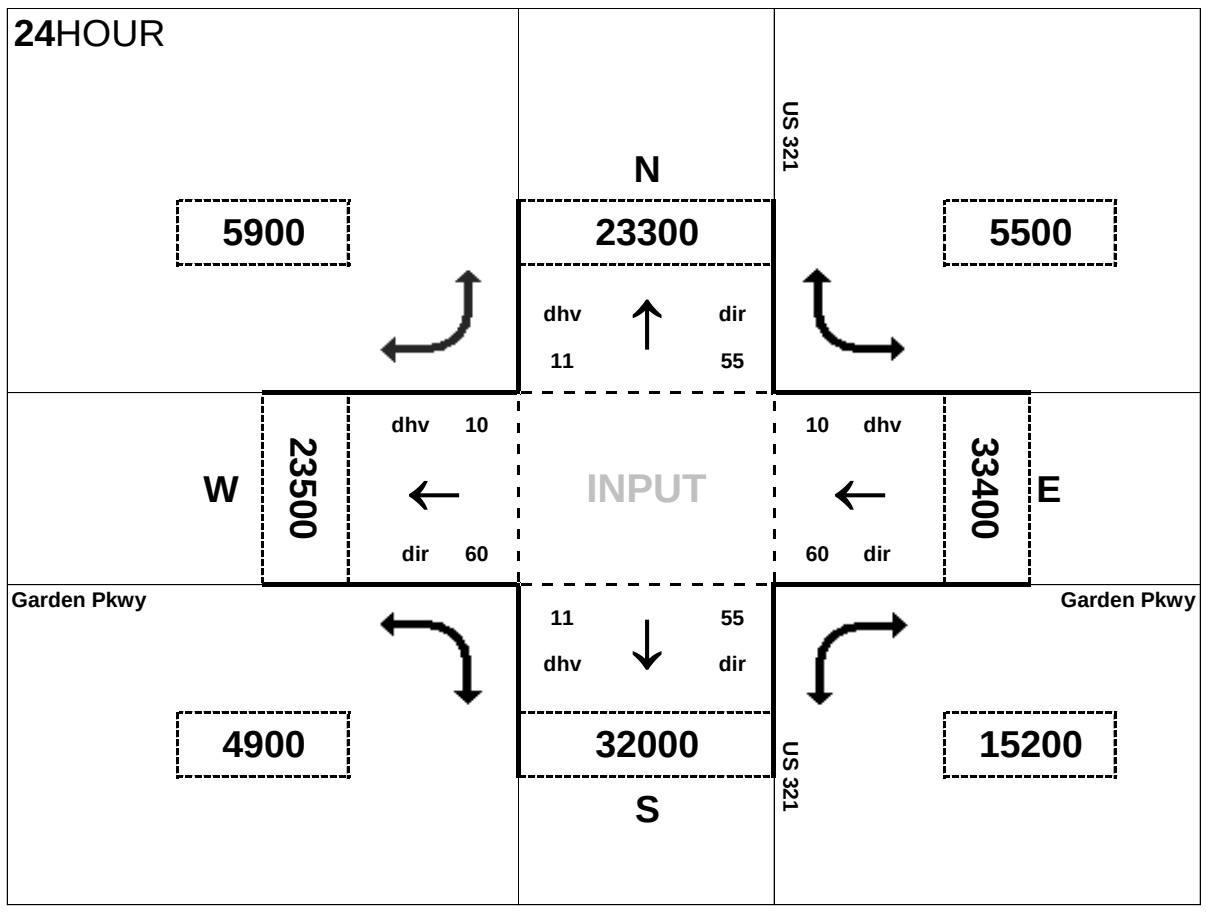
PM peak hour inflow is 4250 vehicles. PM peak hour outflow is 4250 vehicles.

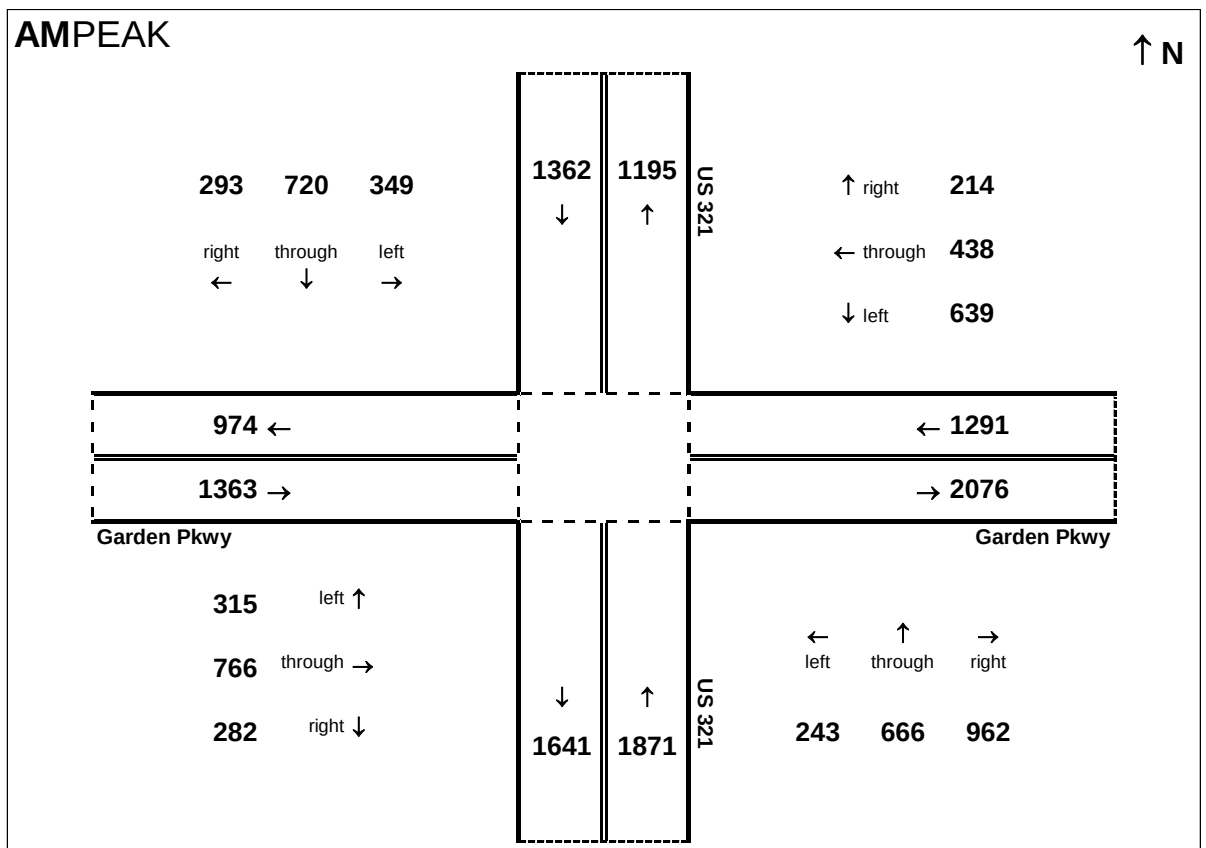
Peak Hour Volume Breakouts Report:
Garden Parkway & US 321

Traffic Forecast Release Date:
March-10

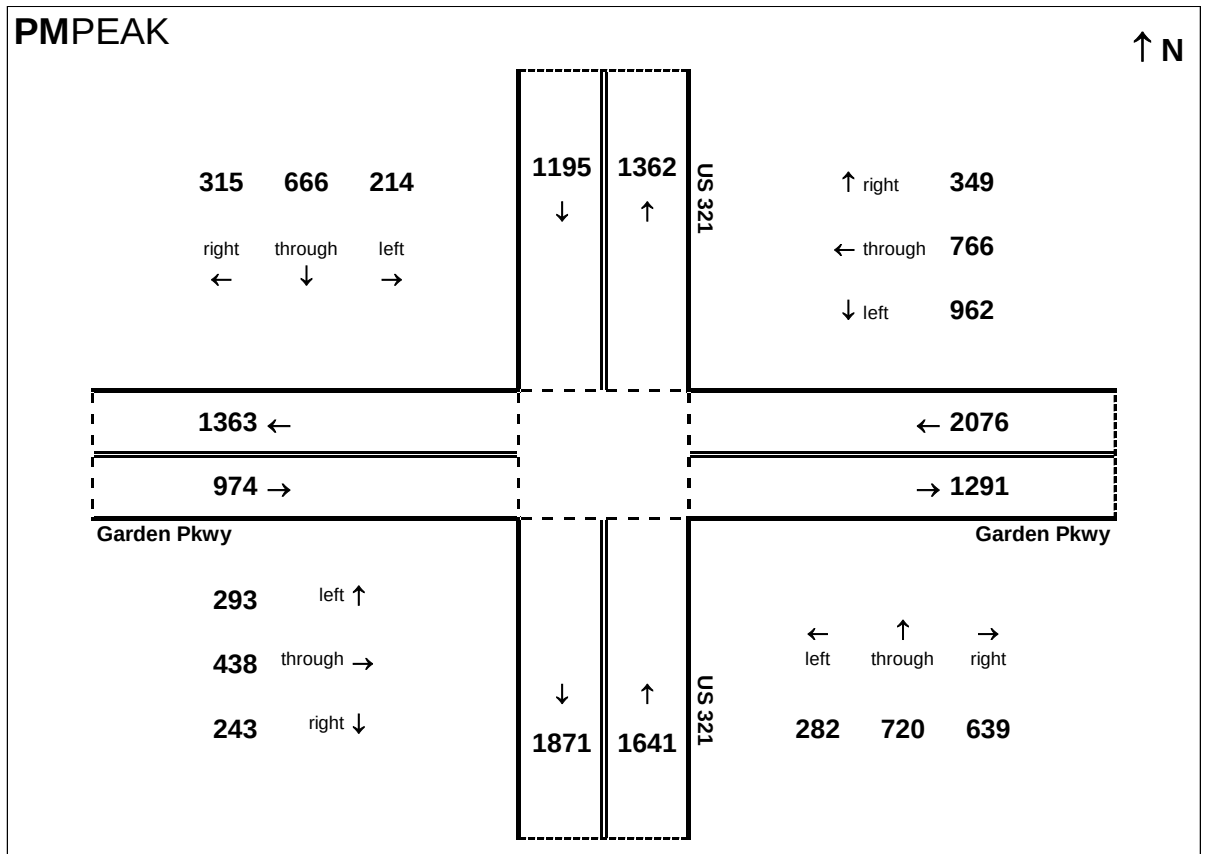
Traffic Data Year:
2035 Build w/o B.W.

Project:
Gaston E-W Connector (Garden Parkway)





AM peak hour inflow is 5887 vehicles. AM peak hour outflow is 5886 vehicles.



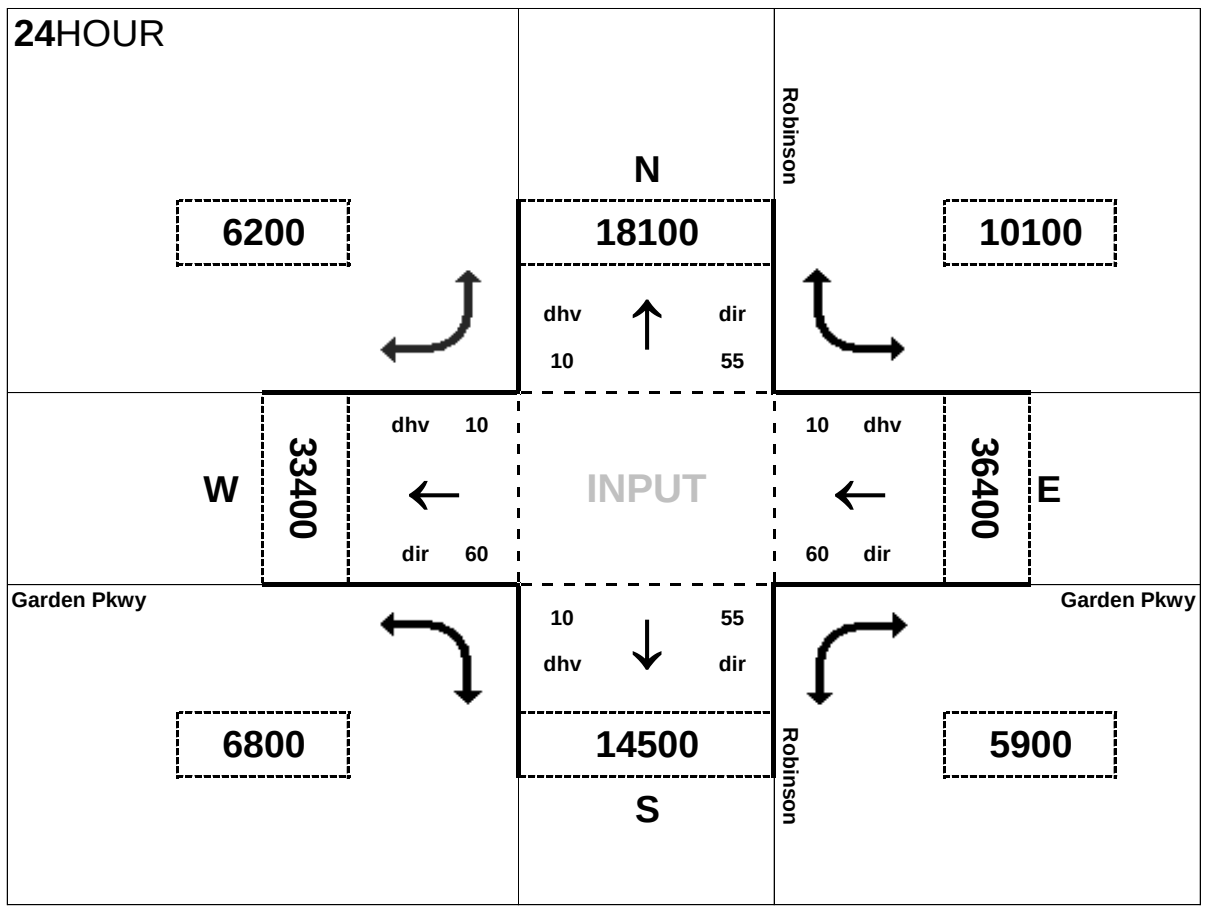
PM peak hour inflow is 5886 vehicles. PM peak hour outflow is 5887 vehicles.

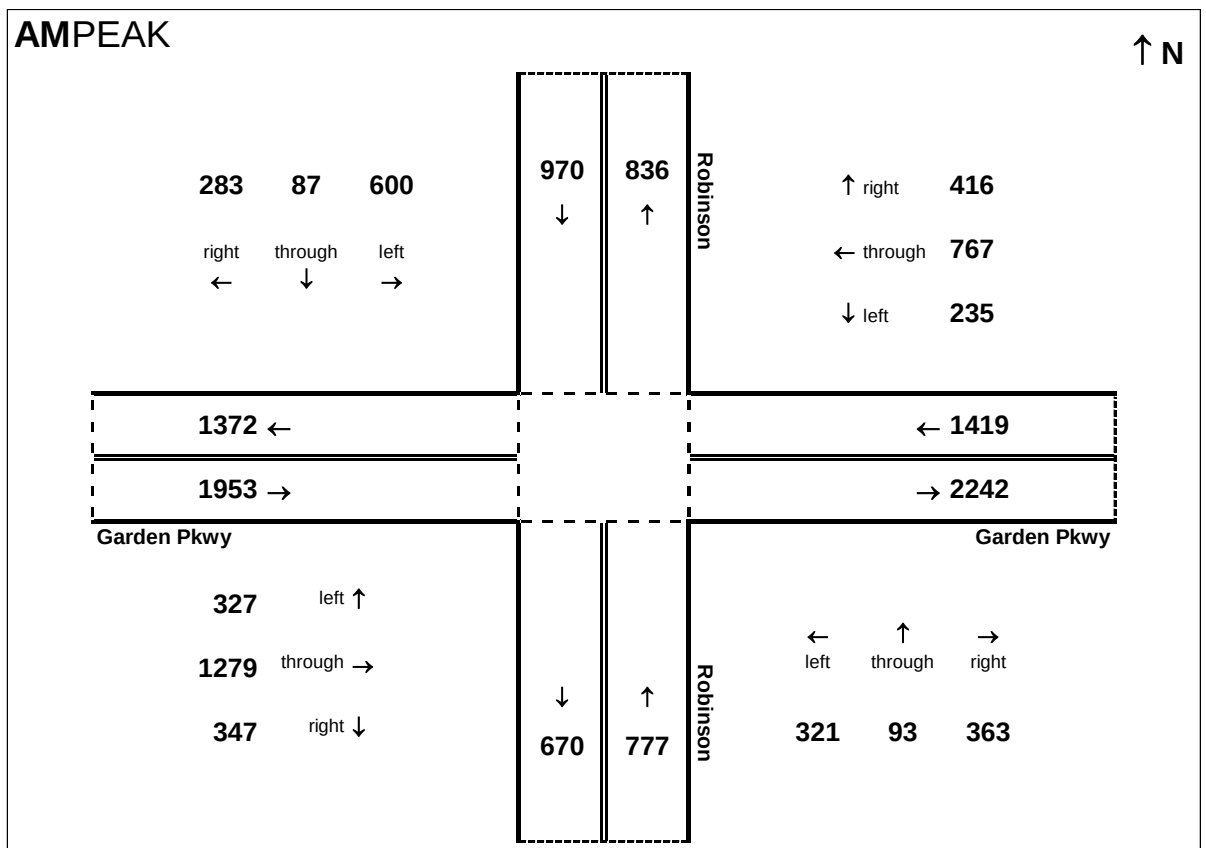
Peak Hour Volume Breakouts Report:
Garden Parkway & Robinson

Traffic Forecast Release Date:
March-10

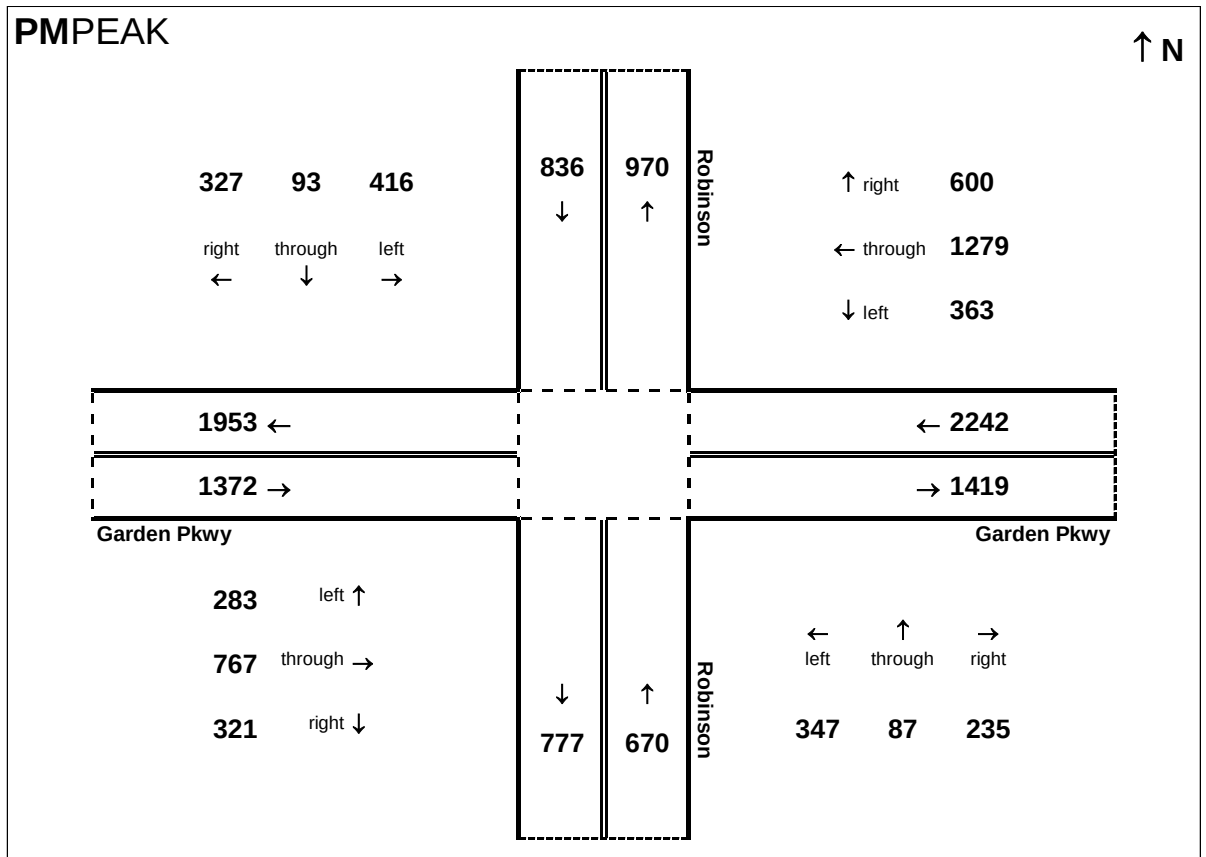
Traffic Data Year:
2035 Build w/o B.W.

Project:
Gaston E-W Connector (Garden Parkway)





AM peak hour inflow is 5119 vehicles. AM peak hour outflow is 5120 vehicles.



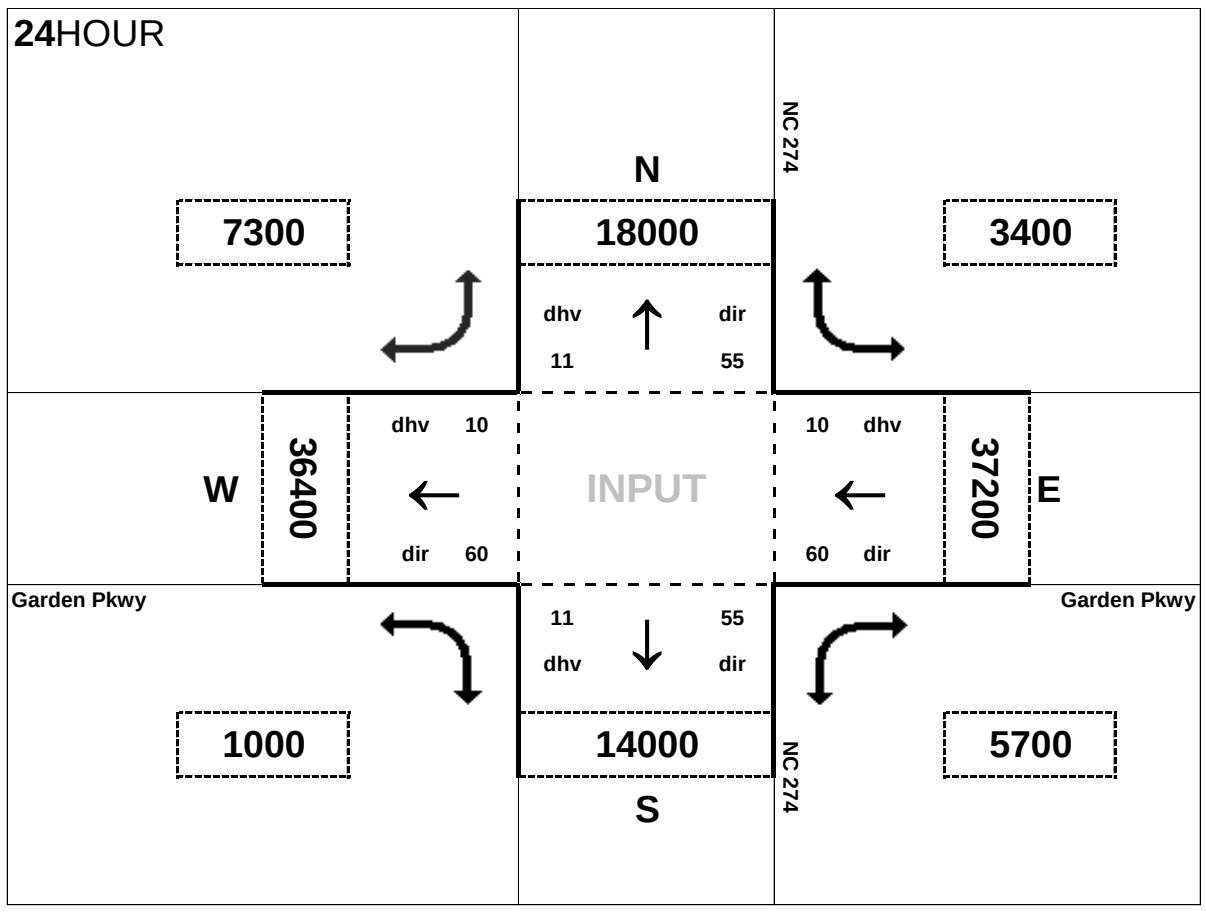
PM peak hour inflow is 5120 vehicles. PM peak hour outflow is 5119 vehicles.

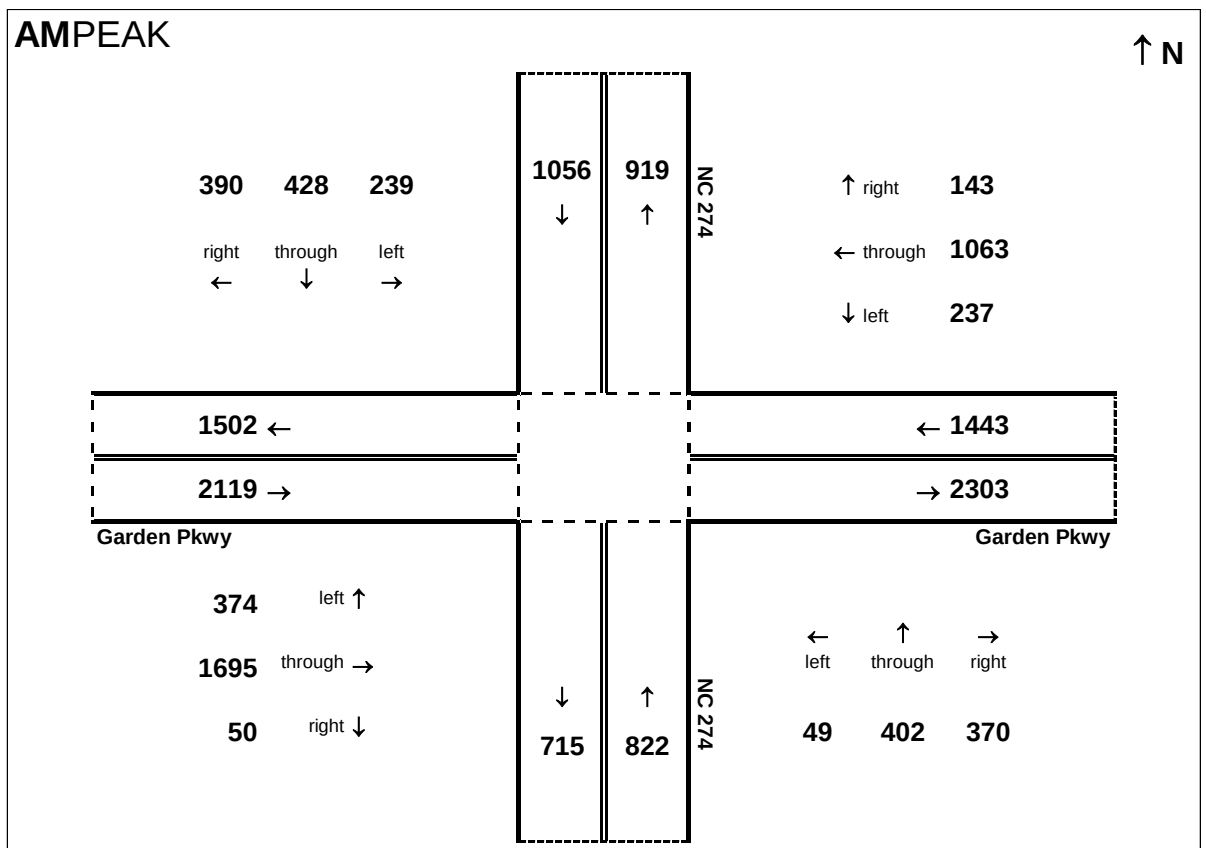
Peak Hour Volume Breakouts Report:
Garden Parkway & NC 274

Traffic Forecast Release Date:
March-10

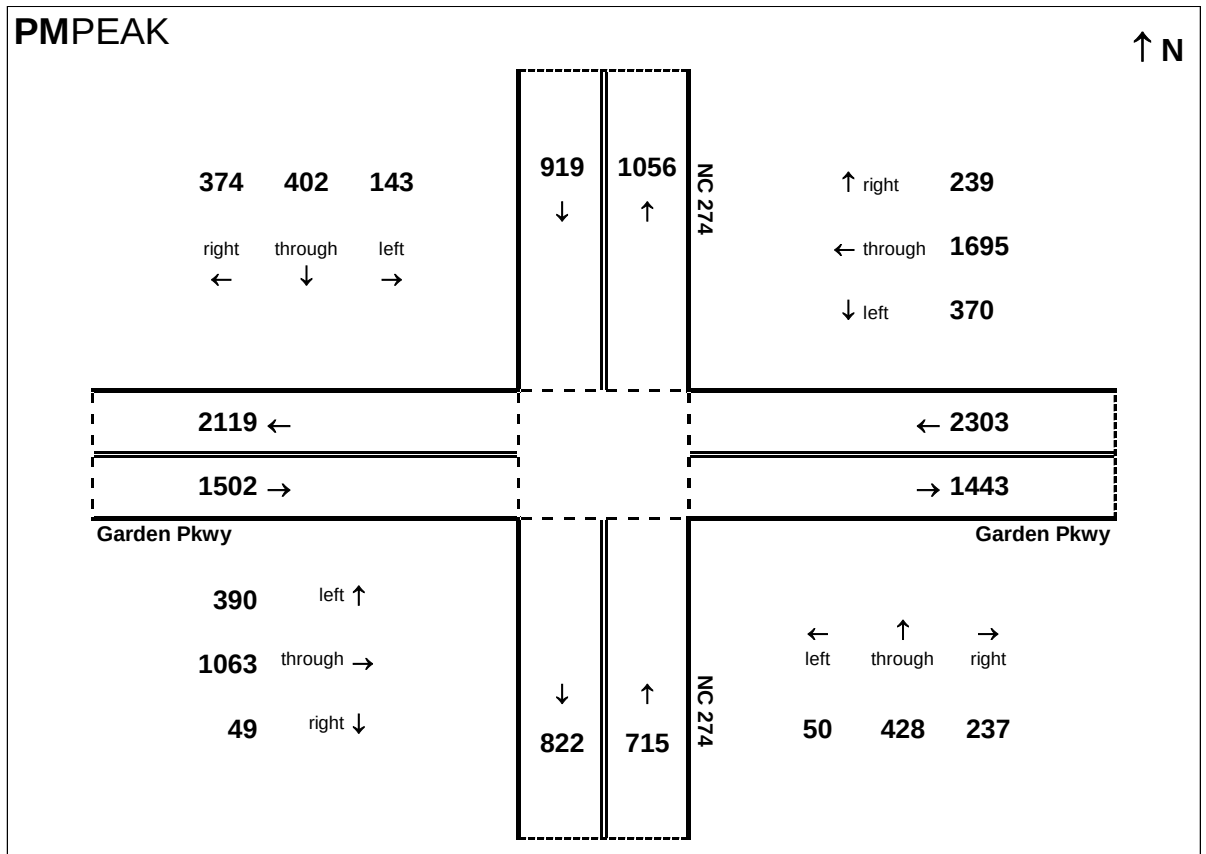
Traffic Data Year:
2035 Build w/o B.W.

Project:
Gaston E-W Connector (Garden Parkway)





AM peak hour inflow is 5440 vehicles. AM peak hour outflow is 5439 vehicles.



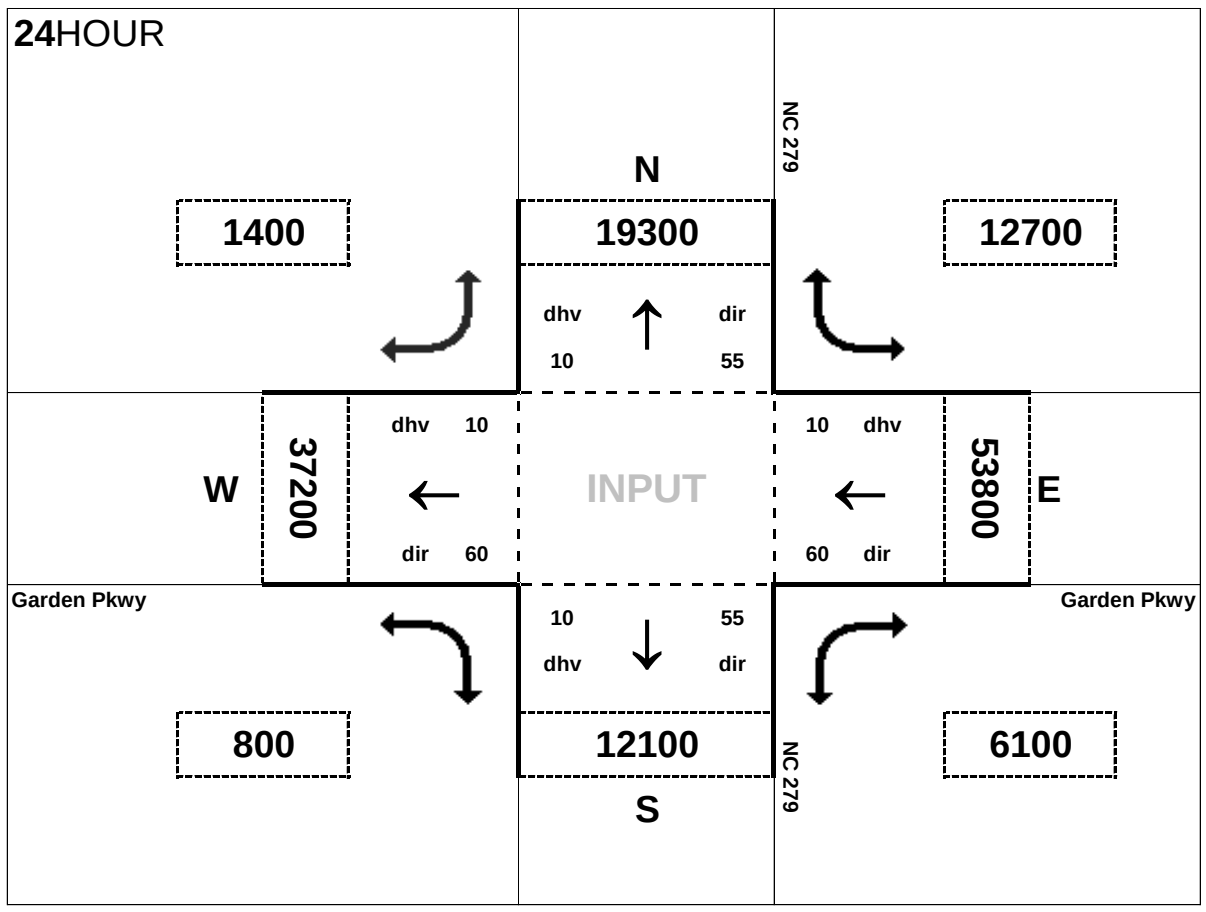
PM peak hour inflow is 5439 vehicles. PM peak hour outflow is 5440 vehicles.

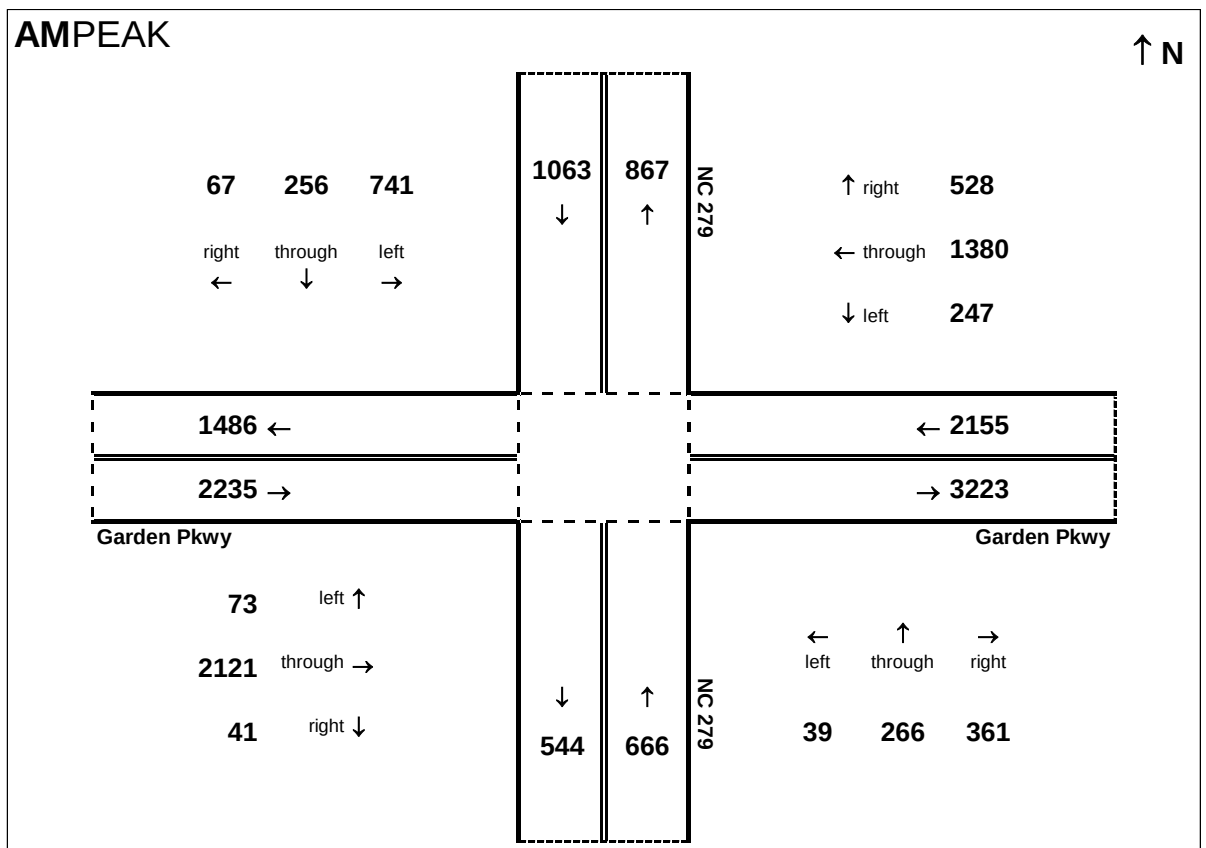
Peak Hour Volume Breakouts Report:
Garden Parkway & NC 279

Traffic Forecast Release Date:
March-10

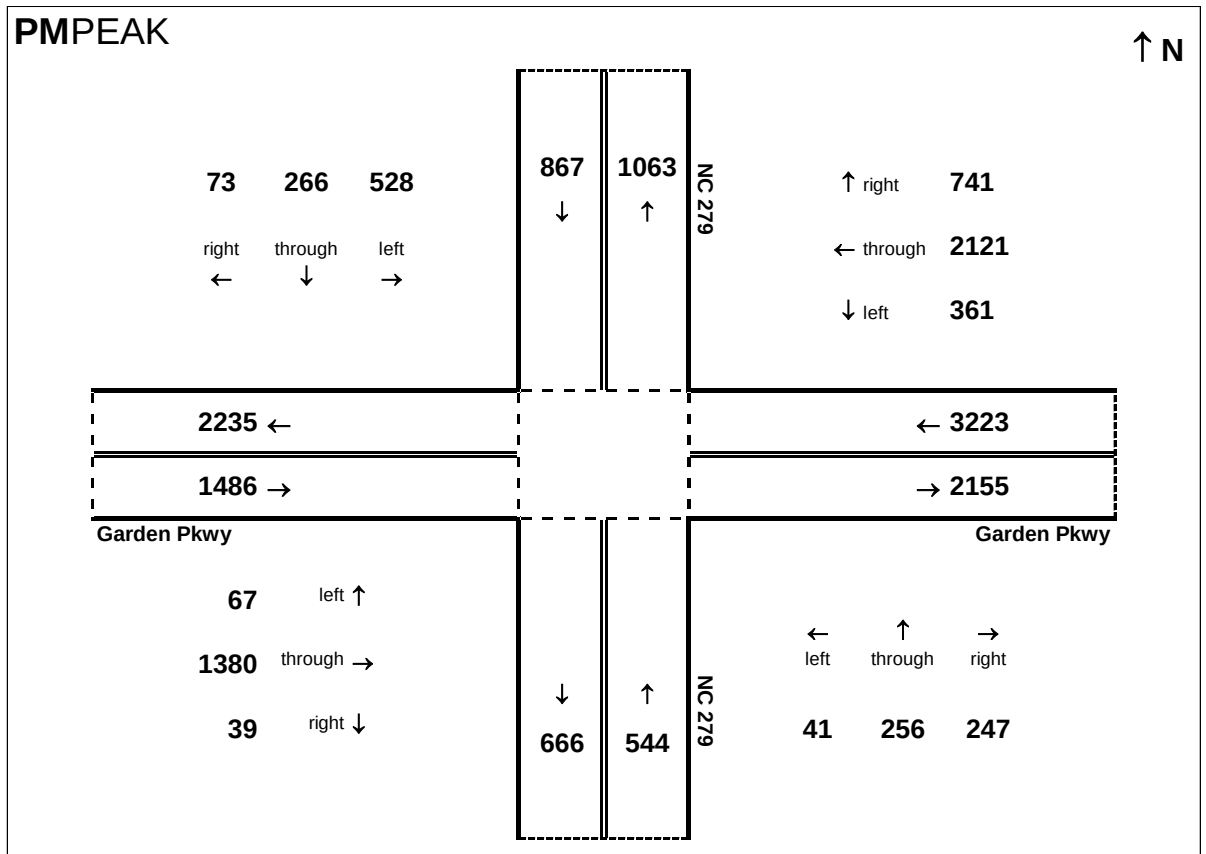
Traffic Data Year:
2035 Build w/o B.W.

Project:
Gaston E-W Connector (Garden Parkway)





AM peak hour inflow is 6119 vehicles. AM peak hour outflow is 6120 vehicles.



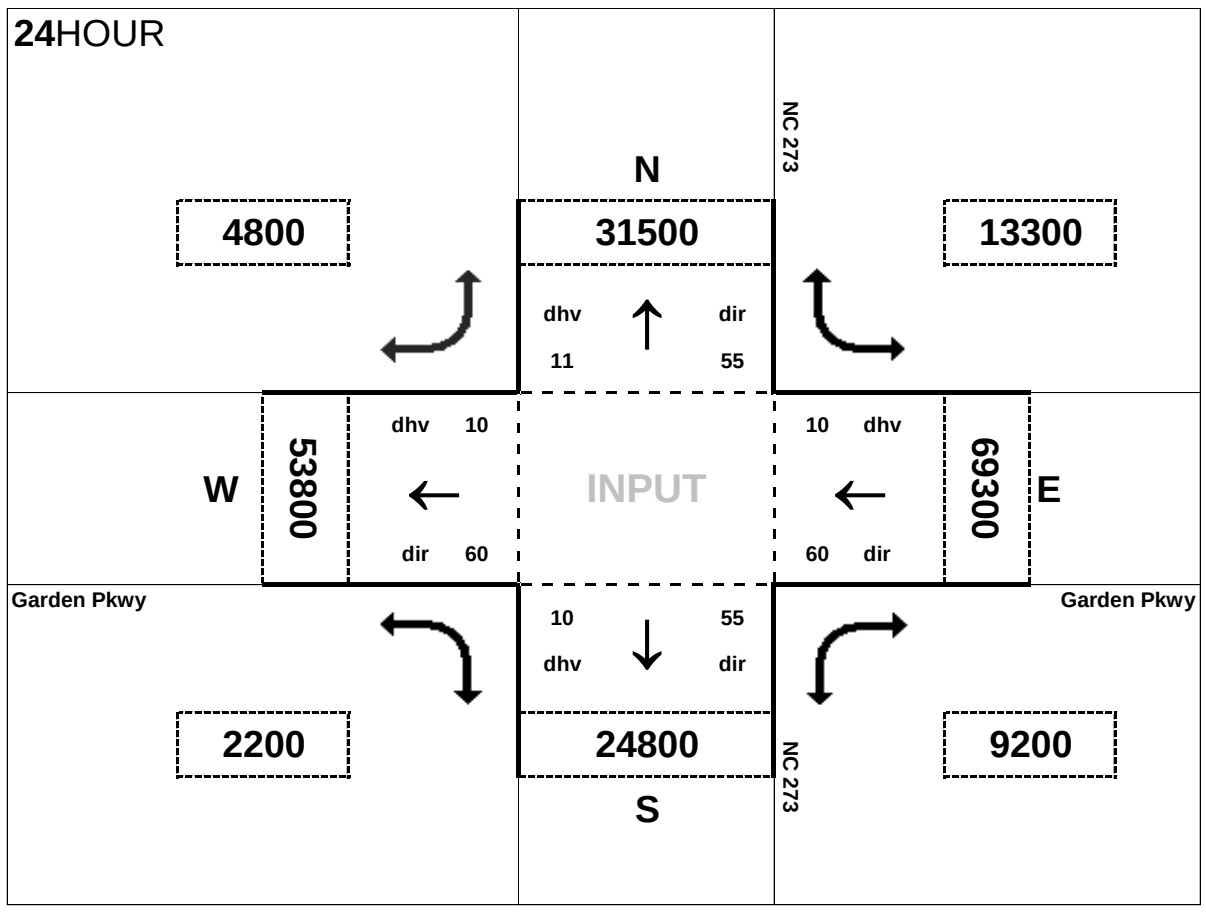
PM peak hour inflow is 6120 vehicles. PM peak hour outflow is 6119 vehicles.

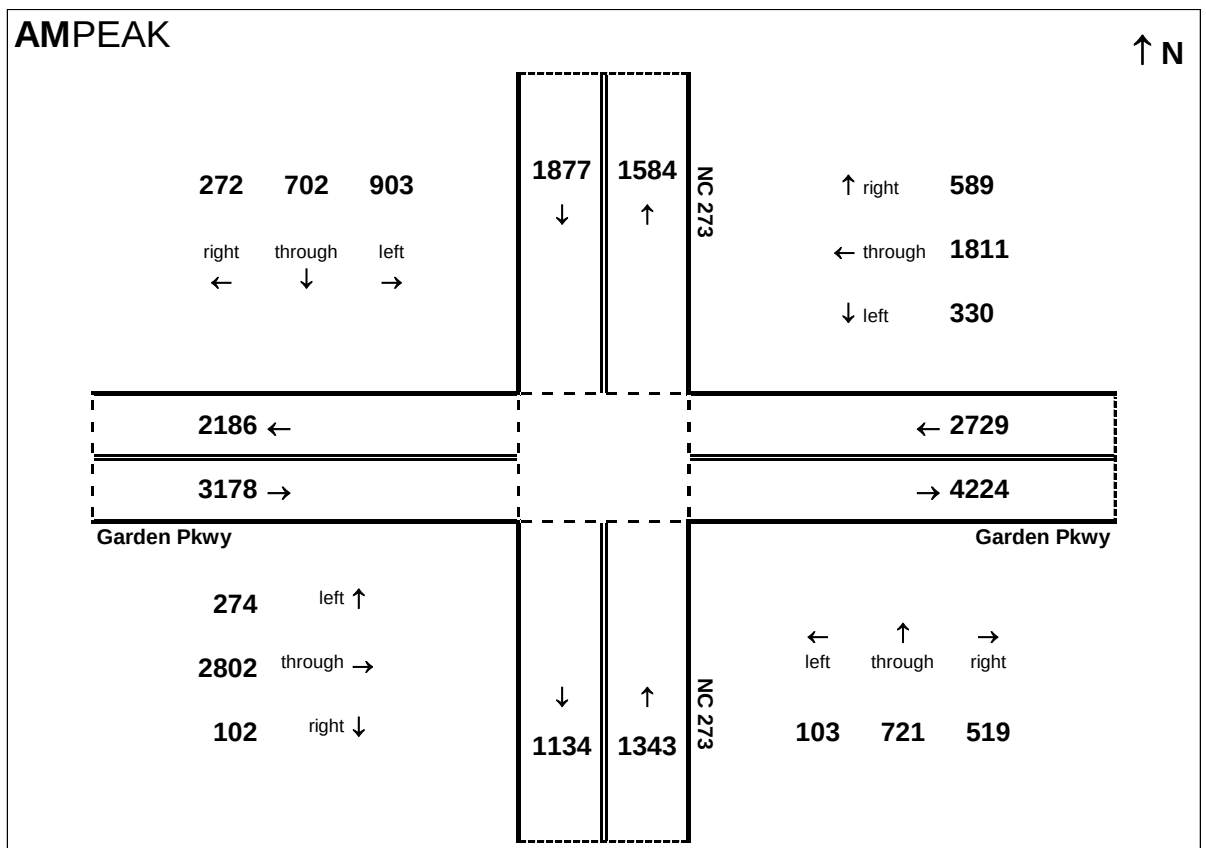
Peak Hour Volume Breakouts Report:
Garden Parkway & NC 273

Traffic Forecast Release Date:
March-10

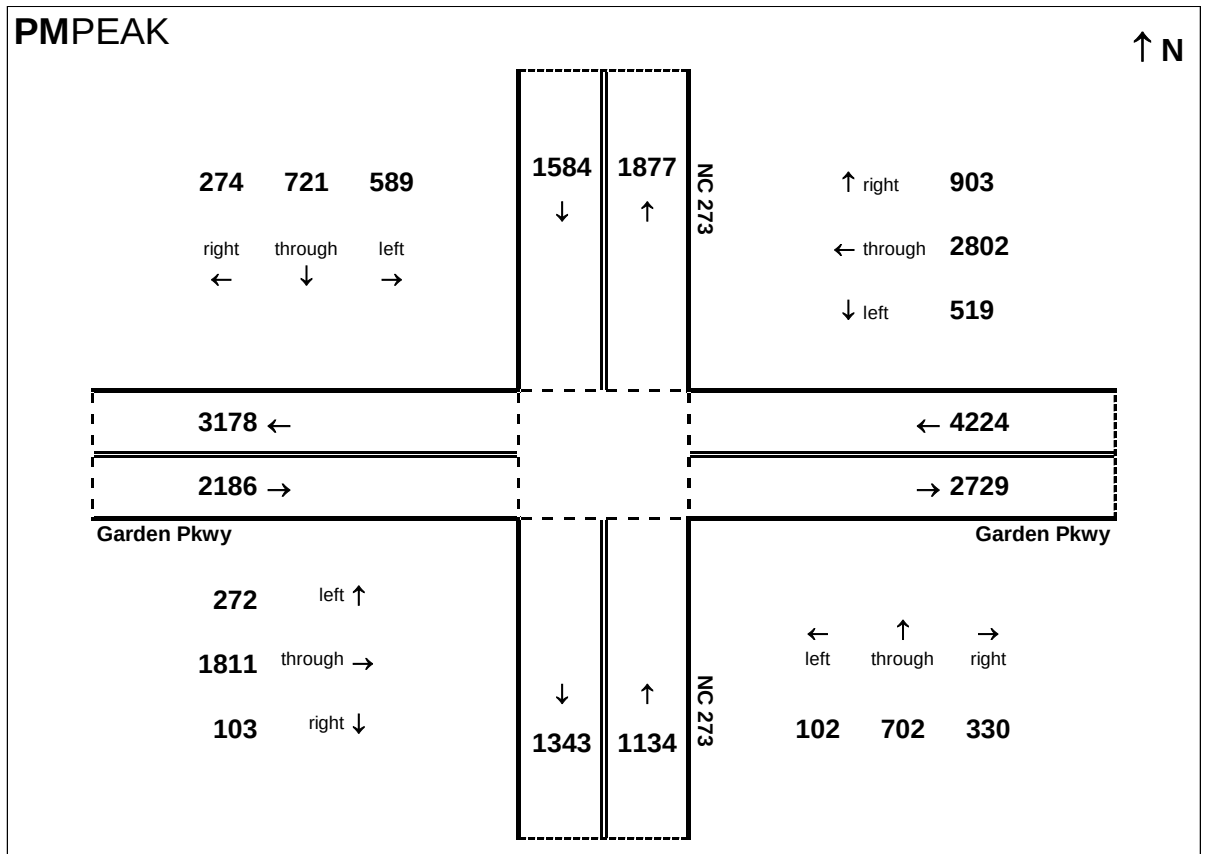
Traffic Data Year:
2035 Build w/o B.W.

Project:
Gaston E-W Connector (Garden Parkway)





AM peak hour inflow is 9127 vehicles. AM peak hour outflow is 9128 vehicles.



PM peak hour inflow is 9128 vehicles. PM peak hour outflow is 9127 vehicles.

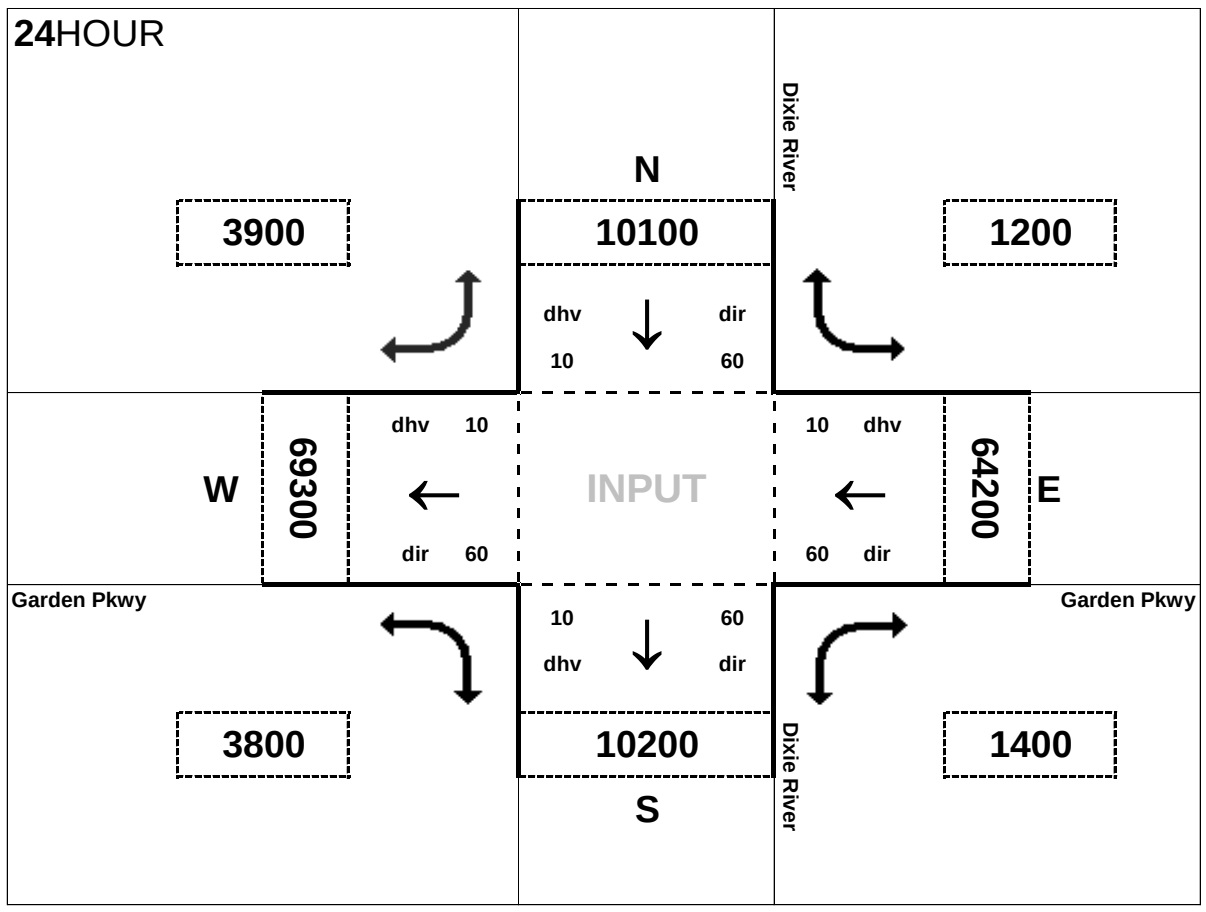
Peak Hour Volume Breakouts Report:
Garden Parkway & Dixie River

Traffic Forecast Release Date:
March-10

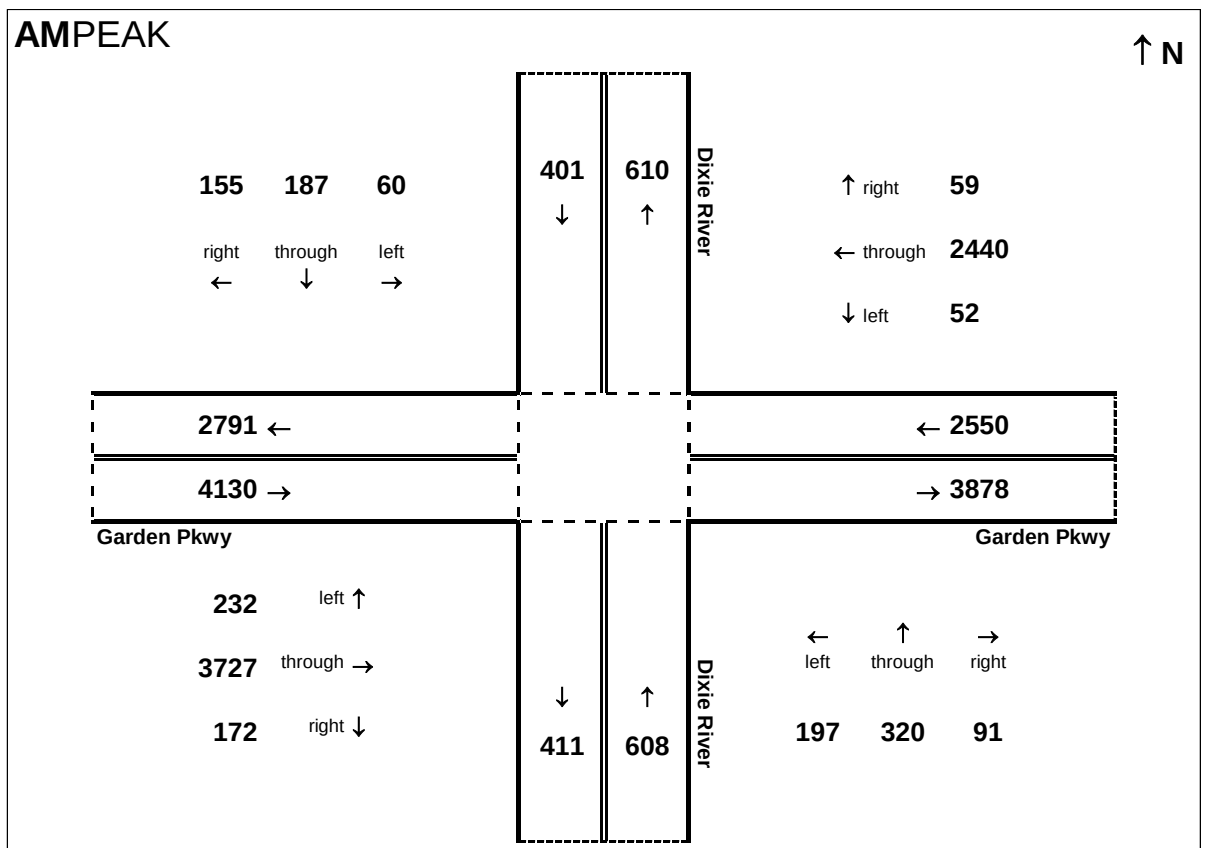
Traffic Data Year:
2035 Build w/o B.W.

Project:
Gaston E-W Connector (Garden Parkway)

24HOUR

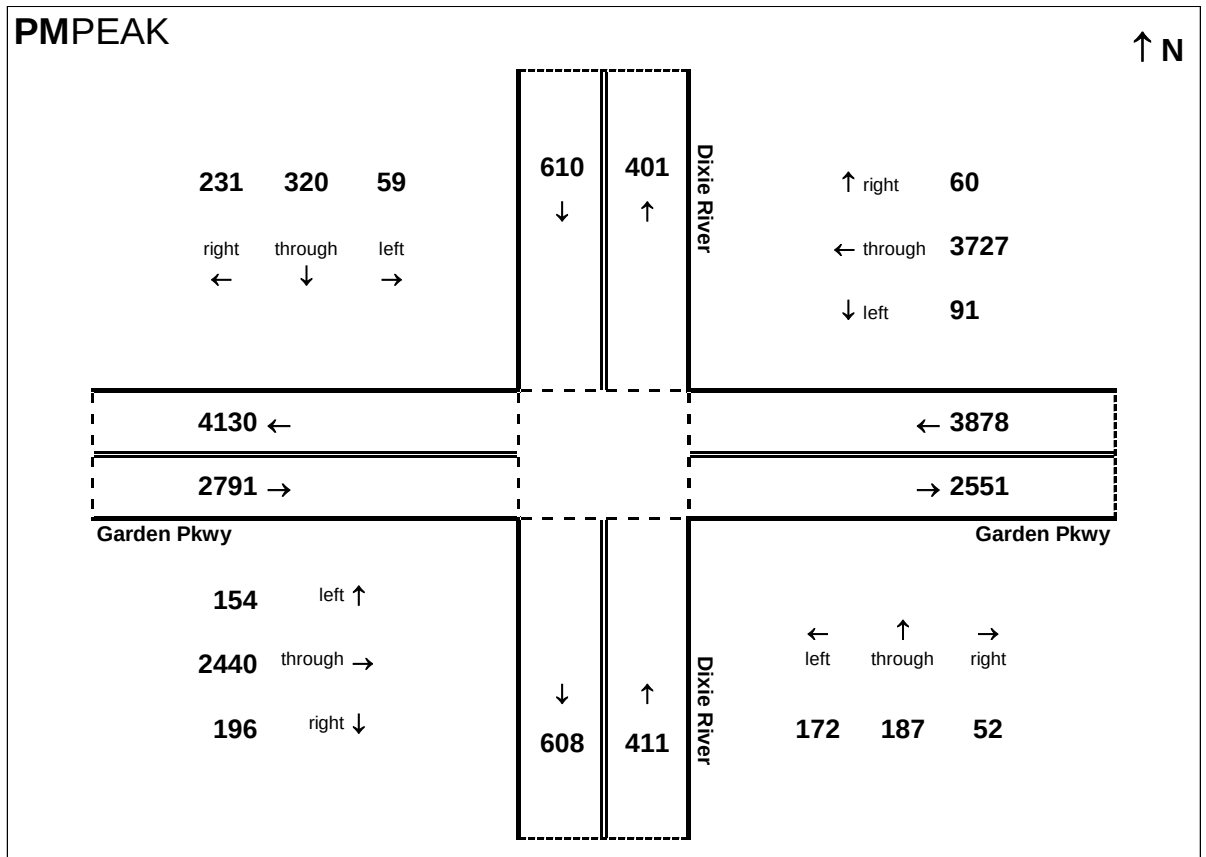


AMPEAK



AM peak hour inflow is 7689 vehicles. AM peak hour outflow is 7690 vehicles.

PMPEAK



PM peak hour inflow is 7690 vehicles. PM peak hour outflow is 7690 vehicles.

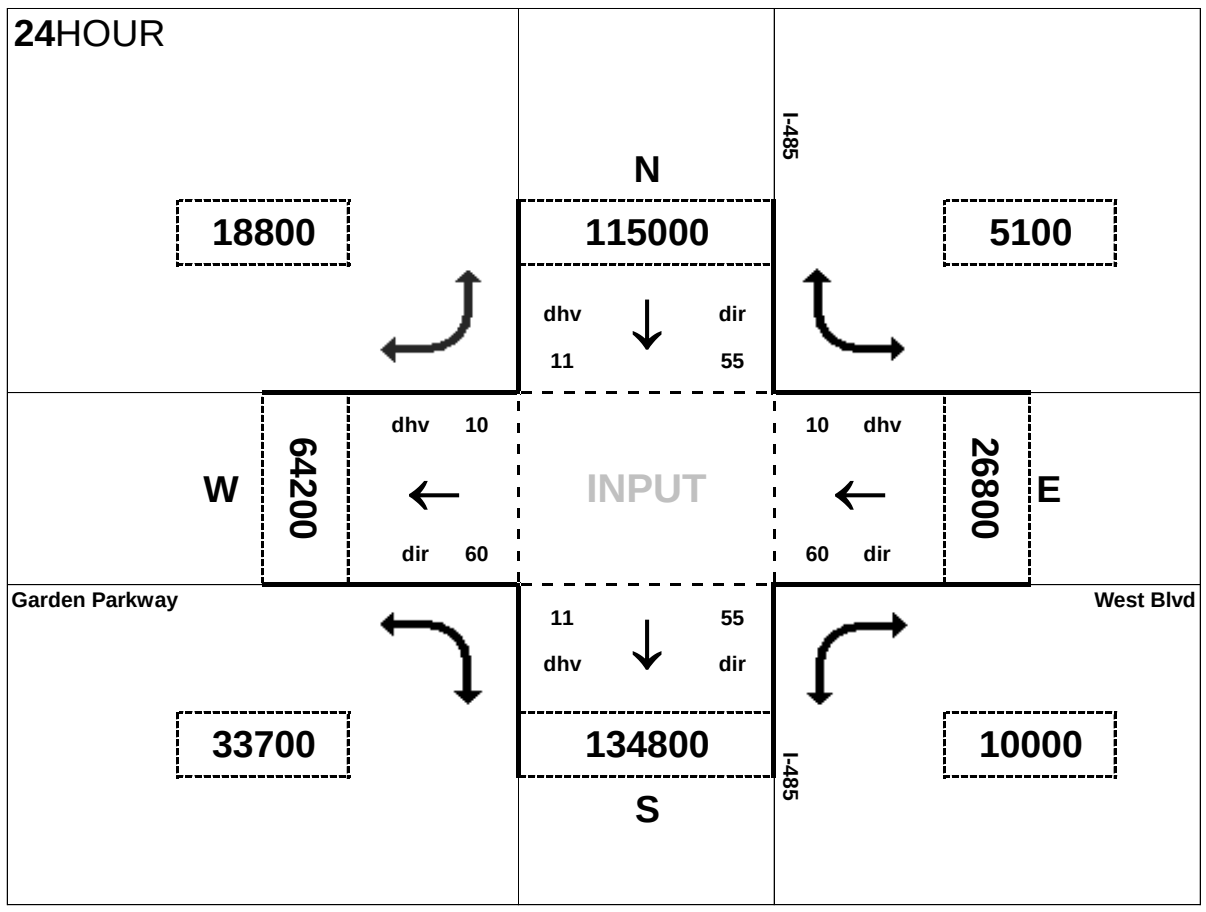
Peak Hour Volume Breakouts Report:
I-485 - Garden Parkway

Traffic Forecast Release Date:
March-10

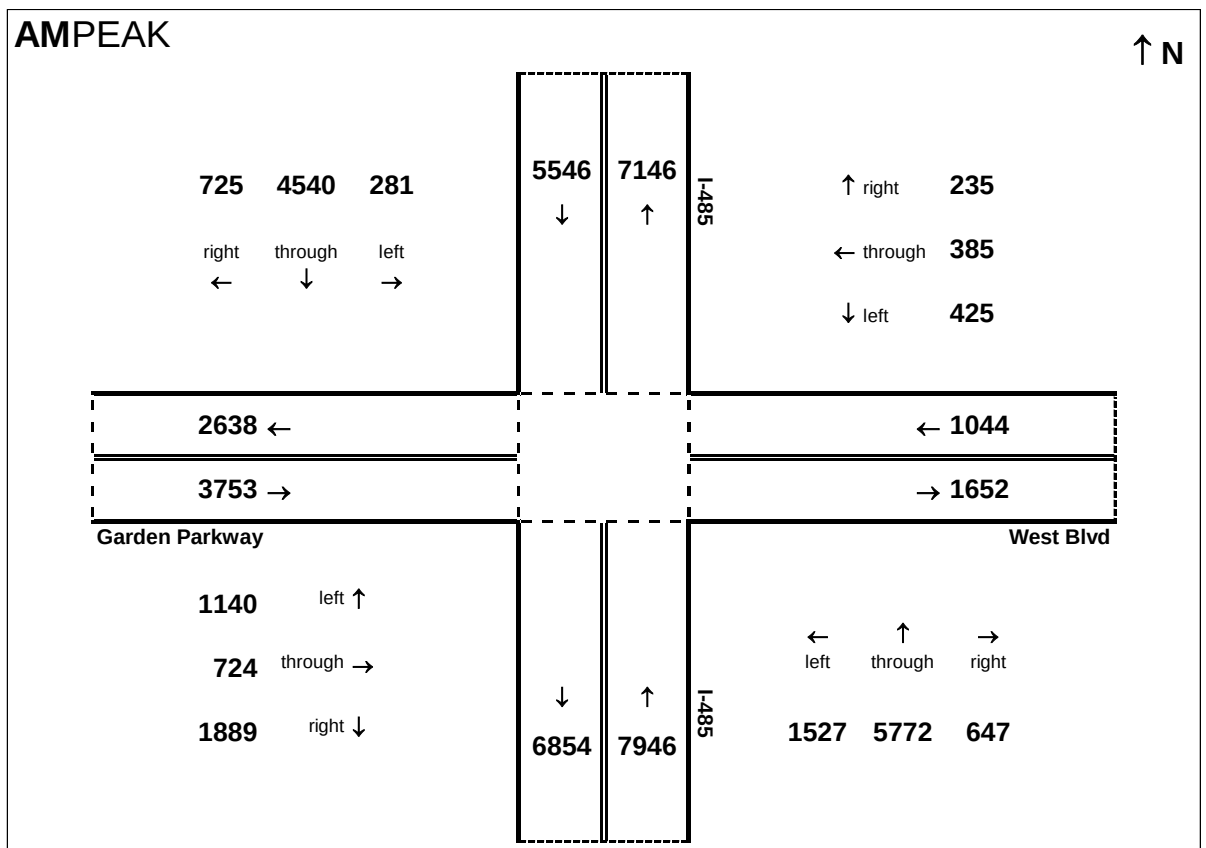
Traffic Data Year:
2035 Build w/o B.W.

Project:
Gaston E-W Connector (Garden Parkway)

24HOUR

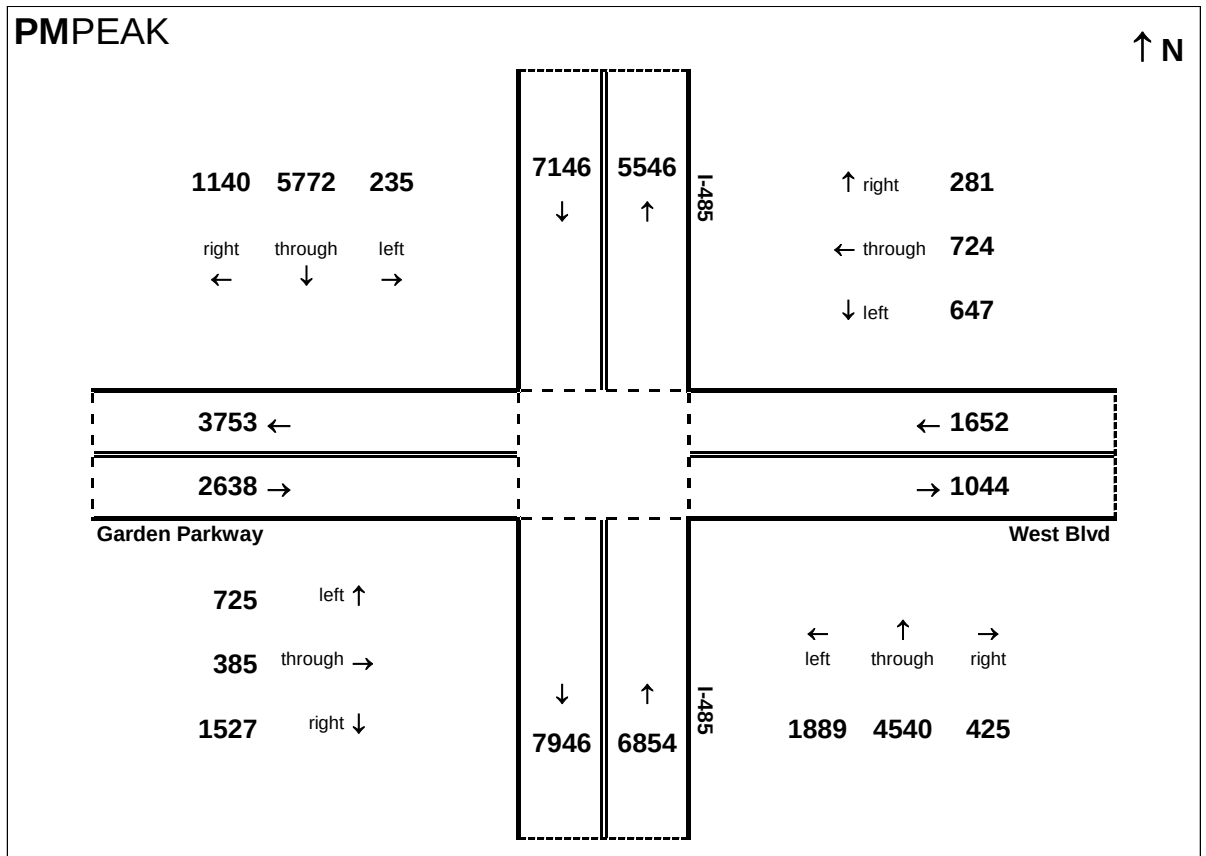


AMPEAK



AM peak hour inflow is 18289 vehicles. AM peak hour outflow is 18290 vehicles.

PMPEAK



PM peak hour inflow is 18290 vehicles. PM peak hour outflow is 18289 vehicles.

Appendix C – Synchro Analysis

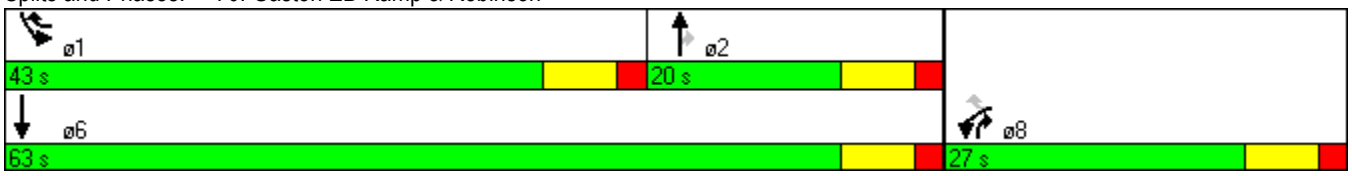
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	347	327	414	363	600	322
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250	0		275	375	
Storage Lanes	1	1		1	1	
Taper Length (ft)	100	100		100	100	
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1538	3438	1482	1656	3438
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1719	1538	3438	1482	1656	3438
Right Turn on Red		No		No		
Satd. Flow (RTOR)						
Link Speed (mph)	35		45			45
Link Distance (ft)	428		1449			982
Travel Time (s)	8.3		22.0			14.9
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	5%	5%	5%	9%	9%	5%
Adj. Flow (vph)	386	363	460	403	667	358
Shared Lane Traffic (%)						
Lane Group Flow (vph)	386	363	460	403	667	358
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		12			12
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Turn Type		pm+ov		pm+ov	Prot	
Protected Phases	8	1	2	8	1	6
Permitted Phases		8		2		
Detector Phase	8	1	2	8	1	6
Switch Phase						
Minimum Initial (s)	7.0	7.0	12.0	7.0	7.0	12.0
Minimum Split (s)	14.0	14.0	19.0	14.0	14.0	19.0
Total Split (s)	27.0	43.0	20.0	27.0	43.0	63.0
Total Split (%)	30.0%	47.8%	22.2%	30.0%	47.8%	70.0%
Maximum Green (s)	20.0	36.0	13.0	20.0	36.0	56.0
Yellow Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag		Lead	Lag		Lead	
Lead-Lag Optimize?		Yes	Yes		Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	C-Min	None	None	C-Min
Act Effct Green (s)	22.0	64.8	15.2	42.2	37.8	58.0

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Actuated g/C Ratio	0.24	0.72	0.17	0.47	0.42	0.64
v/c Ratio	0.92	0.33	0.79	0.58	0.96	0.16
Control Delay	62.6	5.5	47.4	21.7	29.9	0.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	62.6	5.5	47.4	21.7	29.9	0.4
LOS	E	A	D	C	C	A
Approach Delay	35.0		35.4			19.6
Approach LOS	C		D			B
Queue Length 50th (ft)	214	63	133	162	80	1
Queue Length 95th (ft)	#384	99	#206	256	m#521	m1
Internal Link Dist (ft)	348		1369			902
Turn Bay Length (ft)	250			275	375	
Base Capacity (vph)	420	1111	580	695	699	2216
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.92	0.33	0.79	0.58	0.95	0.16

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 37 (41%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.96
Intersection Signal Delay: 29.1 Intersection LOS: C
Intersection Capacity Utilization 82.5% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 70: Gaston EB Ramp & Robinson



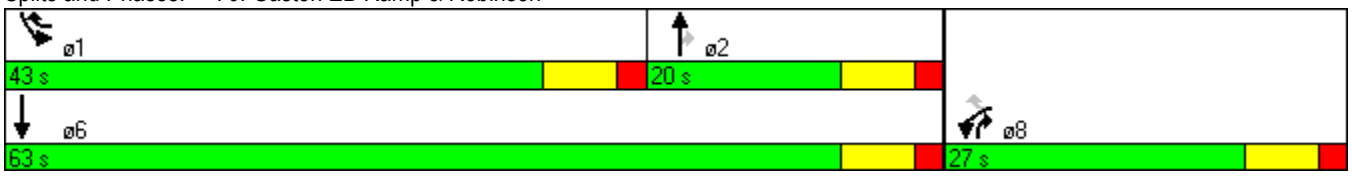
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	347	327	414	363	600	322
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250	0		275	375	
Storage Lanes	1	1		1	1	
Taper Length (ft)	100	100		100	100	
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1538	3438	1482	1656	3438
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1719	1538	3438	1482	1656	3438
Right Turn on Red		No		No		
Satd. Flow (RTOR)						
Link Speed (mph)	35		45			45
Link Distance (ft)	428		1449			982
Travel Time (s)	8.3		22.0			14.9
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	5%	5%	5%	9%	9%	5%
Adj. Flow (vph)	386	363	460	403	667	358
Shared Lane Traffic (%)						
Lane Group Flow (vph)	386	363	460	403	667	358
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		12			12
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Turn Type		pm+ov		pm+ov	Prot	
Protected Phases	8	1	2	8	1	6
Permitted Phases		8		2		
Detector Phase	8	1	2	8	1	6
Switch Phase						
Minimum Initial (s)	7.0	7.0	12.0	7.0	7.0	12.0
Minimum Split (s)	14.0	14.0	19.0	14.0	14.0	19.0
Total Split (s)	27.0	43.0	20.0	27.0	43.0	63.0
Total Split (%)	30.0%	47.8%	22.2%	30.0%	47.8%	70.0%
Maximum Green (s)	20.0	36.0	13.0	20.0	36.0	56.0
Yellow Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag		Lead	Lag		Lead	
Lead-Lag Optimize?		Yes	Yes		Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	C-Min	None	None	C-Min
Act Effct Green (s)	22.0	64.8	15.2	42.2	37.8	58.0

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Actuated g/C Ratio	0.24	0.72	0.17	0.47	0.42	0.64
v/c Ratio	0.92	0.33	0.79	0.58	0.96	0.16
Control Delay	62.6	5.5	47.4	21.7	37.0	1.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	62.6	5.5	47.4	21.7	37.0	1.8
LOS	E	A	D	C	D	A
Approach Delay	35.0		35.4			24.7
Approach LOS	C		D			C
Queue Length 50th (ft)	214	63	133	162	333	0
Queue Length 95th (ft)	#384	99	#206	256	#566	0
Internal Link Dist (ft)	348		1369			902
Turn Bay Length (ft)	250			275	375	
Base Capacity (vph)	420	1111	580	695	699	2216
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.92	0.33	0.79	0.58	0.95	0.16

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 41 (46%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.96
Intersection Signal Delay: 31.1 Intersection LOS: C
Intersection Capacity Utilization 82.5% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 70: Gaston EB Ramp & Robinson



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	235	5	416	321	420	0	0	687	283
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	225		0	300		0	0		100
Storage Lanes	0		0	2		0	1		0	0		1
Taper Length (ft)	100		100	100		100	100		100	100		100
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt					0.852							0.850
Flt Protected				0.950			0.950					
Satd. Flow (prot)	0	0	0	3335	1542	0	1626	3438	0	0	3438	1455
Flt Permitted				0.950			0.950					
Satd. Flow (perm)	0	0	0	3335	1542	0	1626	3438	0	0	3438	1455
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1365			2194			982			1113	
Travel Time (s)		26.6			42.7			14.9			16.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	11%	5%	2%	2%	5%	11%
Adj. Flow (vph)	0	0	0	261	6	462	357	467	0	0	763	314
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	261	468	0	357	467	0	0	763	314
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Prot			Prot					Perm
Protected Phases				3	8		5	2			6	
Permitted Phases												6
Detector Phase				3	8		5	2			6	6
Switch Phase												
Minimum Initial (s)				7.0	7.0		7.0	12.0			12.0	12.0
Minimum Split (s)				14.0	14.0		14.0	19.0			19.0	19.0
Total Split (s)	0.0	0.0	0.0	35.0	35.0	0.0	27.0	55.0	0.0	0.0	28.0	28.0
Total Split (%)	0.0%	0.0%	0.0%	38.9%	38.9%	0.0%	30.0%	61.1%	0.0%	0.0%	31.1%	31.1%
Maximum Green (s)				28.0	28.0		20.0	48.0			21.0	21.0
Yellow Time (s)				5.0	5.0		5.0	5.0			5.0	5.0
All-Red Time (s)				2.0	2.0		2.0	2.0			2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	2.0	2.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	2.0	5.0	5.0
Lead/Lag							Lead				Lag	Lag
Lead-Lag Optimize?							Yes				Yes	Yes
Vehicle Extension (s)				3.0	3.0		3.0	3.0			3.0	3.0
Recall Mode				None	None		None	C-Min			C-Min	C-Min
Act Effct Green (s)				29.5	29.5		21.8	50.5			23.7	23.7

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio				0.33	0.33		0.24	0.56			0.26	0.26
v/c Ratio				0.24	0.93		0.91	0.24			0.84	0.82
Control Delay				22.6	56.3		46.0	4.4			41.7	50.6
Queue Delay				0.0	0.0		0.0	0.0			0.0	0.0
Total Delay				22.6	56.3		46.0	4.4			41.7	50.6
LOS				C	E		D	A			D	D
Approach Delay					44.3			22.4			44.3	
Approach LOS					D			C			D	
Queue Length 50th (ft)				54	252		98	27			218	170
Queue Length 95th (ft)				84	#439		m#300	m36			#317	#313
Internal Link Dist (ft)		1285			2114			902			1033	
Turn Bay Length (ft)				225			300					100
Base Capacity (vph)				1112	514		397	1931			907	384
Starvation Cap Reductn				0	0		0	0			0	0
Spillback Cap Reductn				0	0		0	0			0	0
Storage Cap Reductn				0	0		0	0			0	0
Reduced v/c Ratio				0.23	0.91		0.90	0.24			0.84	0.82

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 72 (80%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.93
Intersection Signal Delay: 37.4 Intersection LOS: D
Intersection Capacity Utilization 79.5% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 71: Gaston WB Ramp & Robinson

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	235	5	416	321	420	0	0	687	283
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	225		250	300		0	0		100
Storage Lanes	0		0	2		1	1		0	0		1
Taper Length (ft)	100		100	100		100	100		100	100		100
Lane Util. Factor	1.00	1.00	1.00	0.97	0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Frt					0.854	0.850						0.850
Flt Protected				0.950			0.950					
Satd. Flow (prot)	0	0	0	3335	1468	1461	1626	3438	0	0	3438	1455
Flt Permitted				0.950			0.950					
Satd. Flow (perm)	0	0	0	3335	1468	1461	1626	3438	0	0	3438	1455
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1365			2194			982			1113	
Travel Time (s)		26.6			42.7			14.9			16.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	11%	5%	2%	2%	5%	11%
Adj. Flow (vph)	0	0	0	261	6	462	357	467	0	0	763	314
Shared Lane Traffic (%)						49%						
Lane Group Flow (vph)	0	0	0	261	232	236	357	467	0	0	763	314
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Prot		Perm	Prot					Perm
Protected Phases				3	8		5	2			6	
Permitted Phases						8						6
Detector Phase				3	8	8	5	2			6	6
Switch Phase												
Minimum Initial (s)				7.0	7.0	7.0	7.0	12.0			12.0	12.0
Minimum Split (s)				14.0	14.0	14.0	14.0	19.0			19.0	19.0
Total Split (s)	0.0	0.0	0.0	26.0	26.0	26.0	31.0	64.0	0.0	0.0	33.0	33.0
Total Split (%)	0.0%	0.0%	0.0%	28.9%	28.9%	28.9%	34.4%	71.1%	0.0%	0.0%	36.7%	36.7%
Maximum Green (s)				19.0	19.0	19.0	24.0	57.0			26.0	26.0
Yellow Time (s)				5.0	5.0	5.0	5.0	5.0			5.0	5.0
All-Red Time (s)				2.0	2.0	2.0	2.0	2.0			2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	2.0	2.0	2.0	5.0	5.0	5.0	5.0	5.0	2.0	2.0	5.0	5.0
Lead/Lag							Lead				Lag	Lag
Lead-Lag Optimize?							Yes				Yes	Yes
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Recall Mode				None	None	None	None	C-Min			C-Min	C-Min
Act Effct Green (s)				19.2	19.2	19.2	24.2	60.8			31.6	31.6

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio				0.21	0.21	0.21	0.27	0.68			0.35	0.35
v/c Ratio				0.37	0.74	0.76	0.82	0.20			0.63	0.62
Control Delay				31.3	47.7	49.2	41.9	2.5			28.4	32.1
Queue Delay				0.0	0.0	0.0	0.0	0.0			0.0	0.0
Total Delay				31.3	47.7	49.2	41.9	2.5			28.4	32.1
LOS				C	D	D	D	A			C	C
Approach Delay					42.3			19.6			29.4	
Approach LOS					D			B			C	
Queue Length 50th (ft)				63	127	129	99	20			200	156
Queue Length 95th (ft)				98	#218	#233	m#174	m26			266	252
Internal Link Dist (ft)		1285			2114			902			1033	
Turn Bay Length (ft)				225		250	300					100
Base Capacity (vph)				778	343	341	470	2321			1206	510
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				0.34	0.68	0.69	0.76	0.20			0.63	0.62

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 72 (80%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 29.9 Intersection LOS: C
Intersection Capacity Utilization 62.3% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 71: Gaston WB Ramp & Robinson

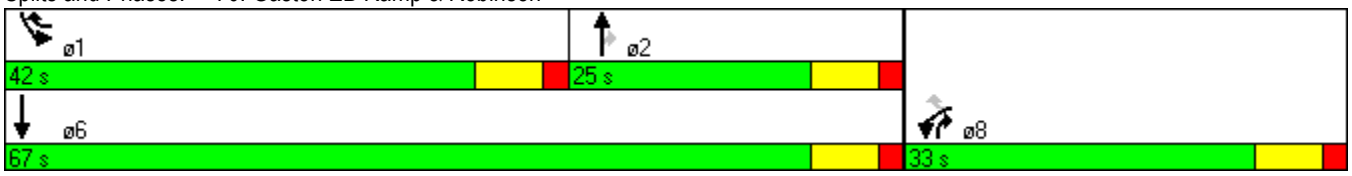
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	321	283	434	235	416	456
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250	0		275	375	
Storage Lanes	1	1		1	1	
Taper Length (ft)	100	100		100	100	
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1538	3438	1482	1656	3438
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1719	1538	3438	1482	1656	3438
Right Turn on Red		No		No		
Satd. Flow (RTOR)						
Link Speed (mph)	35		45			45
Link Distance (ft)	428		1449			982
Travel Time (s)	8.3		22.0			14.9
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	5%	5%	5%	9%	9%	5%
Adj. Flow (vph)	357	314	482	261	462	507
Shared Lane Traffic (%)						
Lane Group Flow (vph)	357	314	482	261	462	507
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		12			12
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Turn Type		pm+ov		pm+ov	Prot	
Protected Phases	8	1	2	8	1	6
Permitted Phases		8		2		
Detector Phase	8	1	2	8	1	6
Switch Phase						
Minimum Initial (s)	7.0	7.0	12.0	7.0	7.0	12.0
Minimum Split (s)	14.0	14.0	19.0	14.0	14.0	19.0
Total Split (s)	33.0	42.0	25.0	33.0	42.0	67.0
Total Split (%)	33.0%	42.0%	25.0%	33.0%	42.0%	67.0%
Maximum Green (s)	26.0	35.0	18.0	26.0	35.0	60.0
Yellow Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag		Lead	Lag		Lead	
Lead-Lag Optimize?		Yes	Yes		Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	C-Min	None	None	C-Min
Act Effct Green (s)	25.7	64.0	26.0	56.7	33.3	64.3

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Actuated g/C Ratio	0.26	0.64	0.26	0.57	0.33	0.64
v/c Ratio	0.81	0.32	0.54	0.31	0.84	0.23
Control Delay	49.6	8.4	36.4	13.6	27.8	1.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.6	8.4	36.4	13.6	27.8	1.0
LOS	D	A	D	B	C	A
Approach Delay	30.3		28.4			13.8
Approach LOS	C		C			B
Queue Length 50th (ft)	207	70	148	87	212	2
Queue Length 95th (ft)	#320	103	208	145	295	3
Internal Link Dist (ft)	348		1369			902
Turn Bay Length (ft)	250			275	375	
Base Capacity (vph)	481	1041	893	873	613	2211
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.74	0.30	0.54	0.30	0.75	0.23

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 60 (60%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 23.0 Intersection LOS: C
Intersection Capacity Utilization 70.8% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 70: Gaston EB Ramp & Robinson



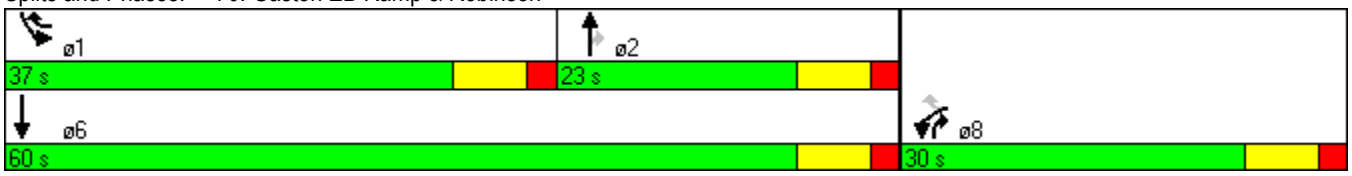
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	321	283	434	235	416	456
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250	0		275	375	
Storage Lanes	1	1		1	1	
Taper Length (ft)	100	100		100	100	
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1719	1538	3438	1482	1656	3438
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1719	1538	3438	1482	1656	3438
Right Turn on Red		No		No		
Satd. Flow (RTOR)						
Link Speed (mph)	35		45			45
Link Distance (ft)	428		1449			982
Travel Time (s)	8.3		22.0			14.9
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	5%	5%	5%	9%	9%	5%
Adj. Flow (vph)	357	314	482	261	462	507
Shared Lane Traffic (%)						
Lane Group Flow (vph)	357	314	482	261	462	507
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		12			12
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Turn Type		pm+ov		pm+ov	Prot	
Protected Phases	8	1	2	8	1	6
Permitted Phases		8		2		
Detector Phase	8	1	2	8	1	6
Switch Phase						
Minimum Initial (s)	7.0	7.0	12.0	7.0	7.0	12.0
Minimum Split (s)	14.0	14.0	19.0	14.0	14.0	19.0
Total Split (s)	30.0	37.0	23.0	30.0	37.0	60.0
Total Split (%)	33.3%	41.1%	25.6%	33.3%	41.1%	66.7%
Maximum Green (s)	23.0	30.0	16.0	23.0	30.0	53.0
Yellow Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag		Lead	Lag		Lead	
Lead-Lag Optimize?		Yes	Yes		Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	C-Min	None	None	C-Min
Act Effct Green (s)	23.2	58.0	22.0	50.3	29.7	56.8

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Actuated g/C Ratio	0.26	0.64	0.24	0.56	0.33	0.63
v/c Ratio	0.80	0.32	0.57	0.32	0.84	0.23
Control Delay	46.0	7.5	34.5	12.6	36.6	1.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.0	7.5	34.5	12.6	36.6	1.5
LOS	D	A	C	B	D	A
Approach Delay	28.0		26.8			18.3
Approach LOS	C		C			B
Queue Length 50th (ft)	185	60	135	79	204	2
Queue Length 95th (ft)	#311	97	189	130	#339	1
Internal Link Dist (ft)	348		1369			902
Turn Bay Length (ft)	250			275	375	
Base Capacity (vph)	478	1030	842	857	589	2168
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.30	0.57	0.30	0.78	0.23

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 56 (62%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 23.7 Intersection LOS: C
Intersection Capacity Utilization 70.8% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 70: Gaston EB Ramp & Robinson



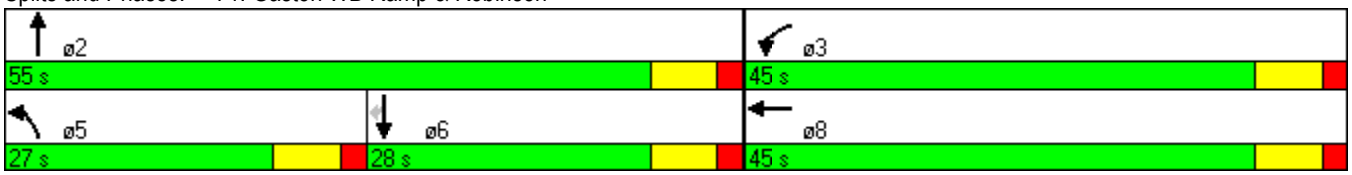
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	363	5	600	347	370	0	0	509	327
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	225		0	300		0	0		100
Storage Lanes	0		0	2		0	1		0	0		1
Taper Length (ft)	100		100	100		100	100		100	100		100
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt					0.851							0.850
Flt Protected				0.950			0.950					
Satd. Flow (prot)	0	0	0	3335	1540	0	1626	3438	0	0	3438	1455
Flt Permitted				0.950			0.950					
Satd. Flow (perm)	0	0	0	3335	1540	0	1626	3438	0	0	3438	1455
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1365			2194			982			1113	
Travel Time (s)		26.6			42.7			14.9			16.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	11%	5%	2%	2%	5%	11%
Adj. Flow (vph)	0	0	0	403	6	667	386	411	0	0	566	363
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	403	673	0	386	411	0	0	566	363
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Prot			Prot					Perm
Protected Phases				3	8		5	2			6	
Permitted Phases												6
Detector Phase				3	8		5	2			6	6
Switch Phase												
Minimum Initial (s)				7.0	7.0		7.0	12.0			12.0	12.0
Minimum Split (s)				14.0	14.0		14.0	19.0			19.0	19.0
Total Split (s)	0.0	0.0	0.0	45.0	45.0	0.0	27.0	55.0	0.0	0.0	28.0	28.0
Total Split (%)	0.0%	0.0%	0.0%	45.0%	45.0%	0.0%	27.0%	55.0%	0.0%	0.0%	28.0%	28.0%
Maximum Green (s)				38.0	38.0		20.0	48.0			21.0	21.0
Yellow Time (s)				5.0	5.0		5.0	5.0			5.0	5.0
All-Red Time (s)				2.0	2.0		2.0	2.0			2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	2.0	2.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	2.0	5.0	5.0
Lead/Lag							Lead				Lag	Lag
Lead-Lag Optimize?							Yes				Yes	Yes
Vehicle Extension (s)				3.0	3.0		3.0	3.0			3.0	3.0
Recall Mode				None	None		None	C-Min			C-Min	C-Min
Act Effct Green (s)				40.0	40.0		22.0	50.0			23.0	23.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio				0.40	0.40		0.22	0.50			0.23	0.23
v/c Ratio				0.30	1.09		1.08	0.24			0.72	1.08
Control Delay				21.3	94.6		98.2	7.2			41.4	111.5
Queue Delay				0.0	0.0		0.0	0.0			0.0	0.0
Total Delay				21.3	94.6		98.2	7.2			41.4	111.5
LOS				C	F		F	A			D	F
Approach Delay					67.1			51.3			68.8	
Approach LOS					E			D			E	
Queue Length 50th (ft)				88	~487		~282	27			175	~261
Queue Length 95th (ft)				124	#704		#446	37			236	#439
Internal Link Dist (ft)		1285			2114			902			1033	
Turn Bay Length (ft)				225			300					100
Base Capacity (vph)				1334	616		358	1719			791	335
Starvation Cap Reductn				0	0		0	0			0	0
Spillback Cap Reductn				0	0		0	0			0	0
Storage Cap Reductn				0	0		0	0			0	0
Reduced v/c Ratio				0.30	1.09		1.08	0.24			0.72	1.08

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 120
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.09
Intersection Signal Delay: 63.2 Intersection LOS: E
Intersection Capacity Utilization 93.5% ICU Level of Service F
Analysis Period (min) 15
~ 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.

Splits and Phases: 71: Gaston WB Ramp & Robinson



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	363	5	600	347	370	0	0	509	327
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	225		250	300		0	0		100
Storage Lanes	0		0	2		1	1		0	0		1
Taper Length (ft)	100		100	100		100	100		100	100		100
Lane Util. Factor	1.00	1.00	1.00	0.97	0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Frt					0.853	0.850						0.850
Flt Protected				0.950			0.950					
Satd. Flow (prot)	0	0	0	3335	1466	1461	1626	3438	0	0	3438	1455
Flt Permitted				0.950			0.950					
Satd. Flow (perm)	0	0	0	3335	1466	1461	1626	3438	0	0	3438	1455
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1365			2194			982			1113	
Travel Time (s)		26.6			42.7			14.9			16.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	11%	5%	2%	2%	5%	11%
Adj. Flow (vph)	0	0	0	403	6	667	386	411	0	0	566	363
Shared Lane Traffic (%)						50%						
Lane Group Flow (vph)	0	0	0	403	340	333	386	411	0	0	566	363
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Prot		Perm	Prot					Perm
Protected Phases				3	8		5	2			6	
Permitted Phases						8						6
Detector Phase				3	8	8	5	2			6	6
Switch Phase												
Minimum Initial (s)				7.0	7.0	7.0	7.0	12.0			12.0	12.0
Minimum Split (s)				14.0	14.0	14.0	14.0	19.0			19.0	19.0
Total Split (s)	0.0	0.0	0.0	29.0	29.0	29.0	29.0	61.0	0.0	0.0	32.0	32.0
Total Split (%)	0.0%	0.0%	0.0%	32.2%	32.2%	32.2%	32.2%	67.8%	0.0%	0.0%	35.6%	35.6%
Maximum Green (s)				22.0	22.0	22.0	22.0	54.0			25.0	25.0
Yellow Time (s)				5.0	5.0	5.0	5.0	5.0			5.0	5.0
All-Red Time (s)				2.0	2.0	2.0	2.0	2.0			2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	2.0	2.0	2.0	5.0	5.0	5.0	5.0	5.0	2.0	2.0	5.0	5.0
Lead/Lag							Lead				Lag	Lag
Lead-Lag Optimize?							Yes				Yes	Yes
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Recall Mode				None	None	None	None	C-Min			C-Min	C-Min
Act Effct Green (s)				23.4	23.4	23.4	23.6	56.6			28.0	28.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio				0.26	0.26	0.26	0.26	0.63			0.31	0.31
v/c Ratio				0.46	0.89	0.88	0.90	0.19			0.53	0.80
Control Delay				29.9	59.2	56.9	48.1	2.8			28.1	44.4
Queue Delay				0.0	0.0	0.0	0.0	0.0			0.0	0.0
Total Delay				29.9	59.2	56.9	48.1	2.8			28.1	44.4
LOS				C	E	E	D	A			C	D
Approach Delay					47.5			24.8			34.5	
Approach LOS					D			C			C	
Queue Length 50th (ft)				98	194	189	101	17			141	191
Queue Length 95th (ft)				141	#356	#347	#347	24			194	#343
Internal Link Dist (ft)		1285			2114			902			1033	
Turn Bay Length (ft)				225		250	300					100
Base Capacity (vph)				889	391	390	434	2162			1069	453
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				0.45	0.87	0.85	0.89	0.19			0.53	0.80

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 88 (98%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 36.7 Intersection LOS: D
Intersection Capacity Utilization 68.8% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 71: Gaston WB Ramp & Robinson

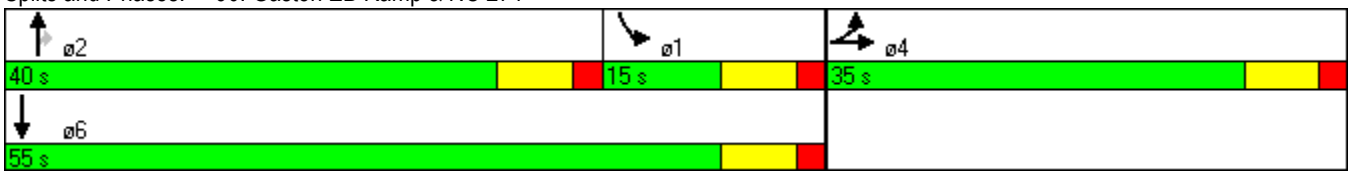
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	374	5	50	0	0	0	0	451	370	239	665	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	0		0	200		100	300		550
Storage Lanes	1		0	0		0	1		1	0		0
Taper Length (ft)	100		100	100		100	100		100	0		100
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	0.97	0.95	1.00
Frt		0.865							0.850			
Flt Protected	0.950									0.950		
Satd. Flow (prot)	1719	1570	0	0	0	0	0	4940	1583	3433	3438	0
Flt Permitted	0.950									0.950		
Satd. Flow (perm)	1719	1570	0	0	0	0	0	4940	1583	3433	3438	0
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			45			45			45	
Link Distance (ft)		888			325			823			342	
Travel Time (s)		17.3			4.9			12.5			5.2	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	5%	2%	5%	2%	2%	2%	10%	5%	2%	2%	5%	10%
Adj. Flow (vph)	416	6	56	0	0	0	0	501	411	266	739	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	416	62	0	0	0	0	0	501	411	266	739	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Split								Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases									2			
Detector Phase	4	4						2	2	1	6	
Switch Phase												
Minimum Initial (s)	7.0	7.0						12.0	12.0	7.0	12.0	
Minimum Split (s)	14.0	14.0						19.0	19.0	14.0	19.0	
Total Split (s)	35.0	35.0	0.0	0.0	0.0	0.0	0.0	40.0	40.0	15.0	55.0	0.0
Total Split (%)	38.9%	38.9%	0.0%	0.0%	0.0%	0.0%	0.0%	44.4%	44.4%	16.7%	61.1%	0.0%
Maximum Green (s)	28.0	28.0						33.0	33.0	8.0	48.0	
Yellow Time (s)	5.0	5.0						5.0	5.0	5.0	5.0	
All-Red Time (s)	2.0	2.0						2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	2.0	2.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	2.0
Lead/Lag								Lead	Lead	Lag		
Lead-Lag Optimize?								Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0						3.0	3.0	3.0	3.0	
Recall Mode	None	None						C-Min	C-Min	None	C-Min	
Act Effct Green (s)	27.0	27.0						36.5	36.5	11.5	53.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio	0.30	0.30						0.41	0.41	0.13	0.59	
v/c Ratio	0.81	0.13						0.25	0.64	0.61	0.36	
Control Delay	41.9	22.4						18.7	27.9	42.7	8.8	
Queue Delay	0.0	0.0						0.0	0.0	0.0	0.2	
Total Delay	41.9	22.4						18.7	27.9	42.7	9.0	
LOS	D	C						B	C	D	A	
Approach Delay		39.3						22.8			17.9	
Approach LOS		D						C			B	
Queue Length 50th (ft)	210	25						72	199	71	137	
Queue Length 95th (ft)	316	53						95	295	#127	79	
Internal Link Dist (ft)		808			245			743			262	
Turn Bay Length (ft)	200								100	300		
Base Capacity (vph)	573	523						2031	651	439	2025	
Starvation Cap Reductn	0	0						0	0	0	558	
Spillback Cap Reductn	0	0						0	0	0	0	
Storage Cap Reductn	0	0						0	0	0	0	
Reduced v/c Ratio	0.73	0.12						0.25	0.63	0.61	0.50	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 65 (72%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 24.1 Intersection LOS: C
Intersection Capacity Utilization 68.1% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 90: Gaston EB Ramp & NC 274



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	237	5	143	49	776	0	0	667	390
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	200		0	0		0	200		100
Storage Lanes	0		0	1		0	0		0	2		1
Taper Length (ft)	100		100	100		100	0		100	100		100
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.86	1.00
Frt					0.855							0.850
Flt Protected				0.950			0.950					
Satd. Flow (prot)	0	0	0	1770	1593	0	1641	3438	0	0	6225	1468
Flt Permitted				0.950			0.950					
Satd. Flow (perm)	0	0	0	1770	1593	0	1641	3438	0	0	6225	1468
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			45			45			45	
Link Distance (ft)		944			651			342			719	
Travel Time (s)		18.4			9.9			5.2			10.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	5%	2%	5%	2%	2%	2%	10%	5%	2%	2%	5%	10%
Adj. Flow (vph)	0	0	0	263	6	159	54	862	0	0	741	433
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	263	165	0	54	862	0	0	741	433
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Prot			Prot					Perm
Protected Phases				3	8		5	2			6	
Permitted Phases												6
Detector Phase				3	8		5	2			6	6
Switch Phase												
Minimum Initial (s)				7.0	7.0		7.0	12.0			12.0	12.0
Minimum Split (s)				14.0	19.0		14.0	19.0			19.0	19.0
Total Split (s)	0.0	0.0	0.0	27.0	27.0	0.0	14.0	63.0	0.0	0.0	49.0	49.0
Total Split (%)	0.0%	0.0%	0.0%	30.0%	30.0%	0.0%	15.6%	70.0%	0.0%	0.0%	54.4%	54.4%
Maximum Green (s)				20.0	20.0		7.0	56.0			42.0	42.0
Yellow Time (s)				5.0	5.0		5.0	5.0			5.0	5.0
All-Red Time (s)				2.0	2.0		2.0	2.0			2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	2.0	2.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	2.0	5.0	5.0
Lead/Lag							Lead				Lag	Lag
Lead-Lag Optimize?							Yes				Yes	Yes
Vehicle Extension (s)				3.0	3.0		3.0	3.0			3.0	3.0
Recall Mode				None	None		None	C-Min			C-Min	C-Min
Act Effct Green (s)				19.4	19.4		9.5	60.6			48.9	48.9

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio				0.22	0.22		0.11	0.67			0.54	0.54
v/c Ratio				0.69	0.48		0.31	0.37			0.22	0.54
Control Delay				41.9	35.1		46.9	2.8			12.1	18.7
Queue Delay				0.0	0.0		0.0	0.2			0.0	0.0
Total Delay				41.9	35.1		46.9	2.9			12.1	18.7
LOS				D	D		D	A			B	B
Approach Delay					39.3			5.5			14.5	
Approach LOS					D			A			B	
Queue Length 50th (ft)				137	81		25	8			67	170
Queue Length 95th (ft)				215	139		m52	78			87	270
Internal Link Dist (ft)		864			571			262			639	
Turn Bay Length (ft)				200								100
Base Capacity (vph)				437	393		173	2321			3410	804
Starvation Cap Reductn				0	0		0	564			0	0
Spillback Cap Reductn				0	0		0	0			0	0
Storage Cap Reductn				0	0		0	0			0	0
Reduced v/c Ratio				0.60	0.42		0.31	0.49			0.22	0.54

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 64 (71%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.69
Intersection Signal Delay: 15.5 — Intersection LOS: B
Intersection Capacity Utilization 68.1% — ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

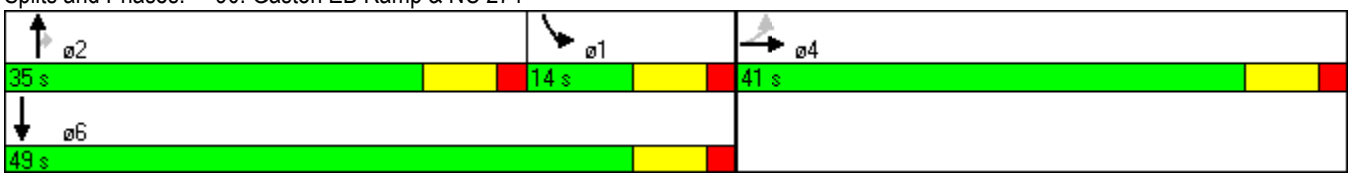
Splits and Phases: 91: Gaston WB Ramp & NC 274

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	390	5	49	0	0	0	0	478	237	143	772	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	0		0	200		100	300		550
Storage Lanes	1		0	0		0	1		1	0		0
Taper Length (ft)	100		100	100		100	100		100	0		100
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	0.97	0.95	1.00
Frt		0.865							0.850			
Flt Protected	0.950									0.950		
Satd. Flow (prot)	1719	1570	0	0	0	0	0	4940	1583	3433	3438	0
Flt Permitted	0.950									0.950		
Satd. Flow (perm)	1719	1570	0	0	0	0	0	4940	1583	3433	3438	0
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			45			45			45	
Link Distance (ft)		888			325			823			342	
Travel Time (s)		17.3			4.9			12.5			5.2	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	5%	2%	5%	2%	2%	2%	10%	5%	2%	2%	5%	10%
Adj. Flow (vph)	433	6	54	0	0	0	0	531	263	159	858	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	433	60	0	0	0	0	0	531	263	159	858	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm								Perm	Prot		
Protected Phases		4						2		1	6	
Permitted Phases	4								2			
Detector Phase	4	4						2	2	1	6	
Switch Phase												
Minimum Initial (s)	7.0	7.0						12.0	12.0	7.0	12.0	
Minimum Split (s)	14.0	14.0						19.0	19.0	14.0	19.0	
Total Split (s)	41.0	41.0	0.0	0.0	0.0	0.0	0.0	35.0	35.0	14.0	49.0	0.0
Total Split (%)	45.6%	45.6%	0.0%	0.0%	0.0%	0.0%	0.0%	38.9%	38.9%	15.6%	54.4%	0.0%
Maximum Green (s)	34.0	34.0						28.0	28.0	7.0	42.0	
Yellow Time (s)	5.0	5.0						5.0	5.0	5.0	5.0	
All-Red Time (s)	2.0	2.0						2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	5.0	2.0	2.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	2.0
Lead/Lag								Lead	Lead	Lag		
Lead-Lag Optimize?								Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0						3.0	3.0	3.0	3.0	
Recall Mode	None	None						C-Min	C-Min	None	C-Min	
Act Effct Green (s)	29.6	29.6						34.9	34.9	10.5	50.4	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio	0.33	0.33						0.39	0.39	0.12	0.56	
v/c Ratio	0.77	0.12						0.28	0.43	0.40	0.45	
Control Delay	36.0	19.5						20.6	24.7	38.3	13.0	
Queue Delay	0.0	0.0						0.0	0.0	0.0	0.5	
Total Delay	36.0	19.5						20.6	24.7	38.3	13.5	
LOS	D	B						C	C	D	B	
Approach Delay		34.0						21.9			17.3	
Approach LOS		C						C			B	
Queue Length 50th (ft)	217	23						76	111	39	167	
Queue Length 95th (ft)	295	46						110	194	m68	249	
Internal Link Dist (ft)		808			245			743			262	
Turn Bay Length (ft)	200								100	300		
Base Capacity (vph)	688	628						1933	619	399	1925	
Starvation Cap Reductn	0	0						0	0	0	575	
Spillback Cap Reductn	0	0						0	0	0	0	
Storage Cap Reductn	0	0						0	0	0	0	
Reduced v/c Ratio	0.63	0.10						0.27	0.42	0.40	0.64	

Intersection Summary	
Area Type:	Other
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 16 (18%), Referenced to phase 2:NBT and 6:SBT, Start of Green	
Natural Cycle: 60	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.77	
Intersection Signal Delay: 22.5	Intersection LOS: C
Intersection Capacity Utilization 68.1%	ICU Level of Service C
Analysis Period (min) 15	
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 90: Gaston EB Ramp & NC 274



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	370	5	239	50	818	0	0	545	374
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	200		0	0		0	200		100
Storage Lanes	0		0	1		0	0		0	2		1
Taper Length (ft)	100		100	100		100	0		100	100		100
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.86	1.00
Frt					0.853							0.850
Flt Protected				0.950			0.950					
Satd. Flow (prot)	0	0	0	1770	1589	0	1641	3438	0	0	6225	1468
Flt Permitted				0.950			0.950					
Satd. Flow (perm)	0	0	0	1770	1589	0	1641	3438	0	0	6225	1468
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			45			45			45	
Link Distance (ft)		944			651			342			727	
Travel Time (s)		18.4			9.9			5.2			11.0	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	5%	2%	5%	2%	2%	2%	10%	5%	2%	2%	5%	10%
Adj. Flow (vph)	0	0	0	411	6	266	56	909	0	0	606	416
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	411	272	0	56	909	0	0	606	416
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Prot			Prot					Perm
Protected Phases				3	8		5	2			6	
Permitted Phases												6
Detector Phase				3	8		5	2			6	6
Switch Phase												
Minimum Initial (s)				7.0	7.0		7.0	12.0			12.0	12.0
Minimum Split (s)				14.0	19.0		14.0	19.0			19.0	19.0
Total Split (s)	0.0	0.0	0.0	34.0	34.0	0.0	14.0	56.0	0.0	0.0	42.0	42.0
Total Split (%)	0.0%	0.0%	0.0%	37.8%	37.8%	0.0%	15.6%	62.2%	0.0%	0.0%	46.7%	46.7%
Maximum Green (s)				27.0	27.0		7.0	49.0			35.0	35.0
Yellow Time (s)				5.0	5.0		5.0	5.0			5.0	5.0
All-Red Time (s)				2.0	2.0		2.0	2.0			2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	2.0	2.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	2.0	5.0	5.0
Lead/Lag							Lead				Lag	Lag
Lead-Lag Optimize?							Yes				Yes	Yes
Vehicle Extension (s)				3.0	3.0		3.0	3.0			3.0	3.0
Recall Mode				None	None		None	C-Min			C-Min	C-Min
Act Effct Green (s)				26.1	26.1		9.3	53.9			42.4	42.4

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio				0.29	0.29		0.10	0.60			0.47	0.47
v/c Ratio				0.80	0.59		0.33	0.44			0.21	0.60
Control Delay				41.9	32.6		49.1	4.3			15.6	24.5
Queue Delay				0.0	0.0		0.0	0.3			0.0	0.0
Total Delay				41.9	32.6		49.1	4.5			15.6	24.5
LOS				D	C		D	A			B	C
Approach Delay					38.2			7.1			19.2	
Approach LOS					D			A			B	
Queue Length 50th (ft)				209	128		25	31			64	191
Queue Length 95th (ft)				313	204		m57	42			84	300
Internal Link Dist (ft)		864			571			262			647	
Turn Bay Length (ft)				200								100
Base Capacity (vph)				570	512		170	2059			2937	693
Starvation Cap Reductn				0	0		0	479			0	0
Spillback Cap Reductn				0	0		0	0			70	0
Storage Cap Reductn				0	0		0	0			0	0
Reduced v/c Ratio				0.72	0.53		0.33	0.58			0.21	0.60

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 88 (98%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 19.7 — Intersection LOS: B
Intersection Capacity Utilization 68.1% — ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 91: Gaston WB Ramp & NC 274

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	274	5	102	0	0	0	0	824	519	903	1032	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	400		0	0		0	0		350	400		0
Storage Lanes	1		0	0		0	0		1	2		0
Taper Length (ft)	100		100	100		100	100		100	100		100
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt		0.858							0.850			
Flt Protected	0.950									0.950		
Satd. Flow (prot)	1770	1553	0	0	0	0	0	3438	1495	3242	3438	0
Flt Permitted	0.950									0.950		
Satd. Flow (perm)	1770	1553	0	0	0	0	0	3438	1495	3242	3438	0
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1907			1478			1082			1189	
Travel Time (s)		37.1			28.8			16.4			18.0	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	5%	5%	2%	2%	2%	2%	5%	8%	8%	5%	0%
Adj. Flow (vph)	304	6	113	0	0	0	0	916	577	1003	1147	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	304	119	0	0	0	0	0	916	577	1003	1147	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm								Free	Prot		
Protected Phases		4						2		1	6	
Permitted Phases	4								Free			
Detector Phase	4	4						2		1	6	
Switch Phase												
Minimum Initial (s)	7.0	7.0						7.0		7.0	7.0	
Minimum Split (s)	19.0	19.0						19.0		14.0	19.0	
Total Split (s)	25.0	25.0	0.0	0.0	0.0	0.0	0.0	36.0	0.0	39.0	75.0	0.0
Total Split (%)	25.0%	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%	36.0%	0.0%	39.0%	75.0%	0.0%
Maximum Green (s)	18.0	18.0						29.0		32.0	68.0	
Yellow Time (s)	5.0	5.0						5.0		5.0	5.0	
All-Red Time (s)	2.0	2.0						2.0		2.0	2.0	
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	0.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	0.0
Total Lost Time (s)	5.0	5.0	2.0	2.0	4.0	2.0	4.0	5.0	4.0	5.0	5.0	4.0
Lead/Lag								Lead		Lag		
Lead-Lag Optimize?								Yes		Yes		
Vehicle Extension (s)	3.0	3.0						3.0		3.0	3.0	
Recall Mode	None	None						C-Min		None	C-Min	
Act Effct Green (s)	19.7	19.7						31.6	100.0	33.7	70.3	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio	0.20	0.20						0.32	1.00	0.34	0.70	
v/c Ratio	0.87	0.39						0.84	0.39	0.92	0.47	
Control Delay	64.7	39.1						40.7	0.8	16.4	2.1	
Queue Delay	0.0	0.0						0.0	0.0	0.0	0.0	
Total Delay	64.7	39.1						40.7	0.8	16.4	2.1	
LOS	E	D						D	A	B	A	
Approach Delay		57.5						25.3			8.8	
Approach LOS		E						C			A	
Queue Length 50th (ft)	189	66						287	0	239	61	
Queue Length 95th (ft)	#335	121						#394	0	m238	m64	
Internal Link Dist (ft)		1827			1398			1002			1109	
Turn Bay Length (ft)	400								350	400		
Base Capacity (vph)	354	311						1086	1495	1102	2417	
Starvation Cap Reductn	0	0						0	0	0	0	
Spillback Cap Reductn	0	0						0	0	0	0	
Storage Cap Reductn	0	0						0	0	0	0	
Reduced v/c Ratio	0.86	0.38						0.84	0.39	0.91	0.47	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 2 (2%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 19.9 Intersection LOS: B
Intersection Capacity Utilization 87.4% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 110: Gaston EB Ramp & NC 273

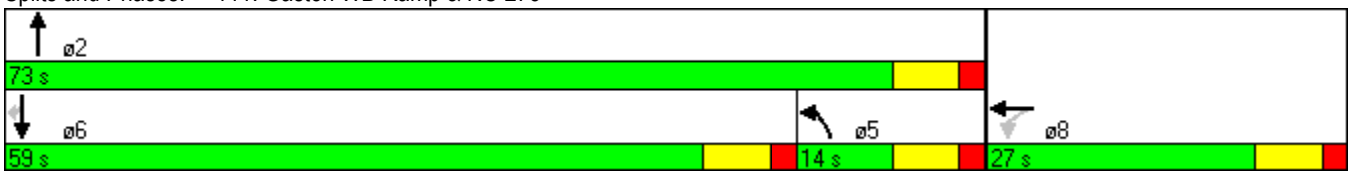
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	330	5	589	103	995	0	0	1605	272
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	325		0	200		0	0		200
Storage Lanes	0		0	2		1	1		0	0		1
Taper Length (ft)	100		100	100		100	100		100	100		100
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt						0.850						0.850
Flt Protected					0.953		0.950					
Satd. Flow (prot)	0	0	0	0	1724	1538	1671	3438	0	0	3438	1495
Flt Permitted					0.953		0.950					
Satd. Flow (perm)	0	0	0	0	1724	1538	1671	3438	0	0	3438	1495
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		2613			3142			1189			755	
Travel Time (s)		50.9			61.2			18.0			11.4	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	8%	5%	0%	0%	5%	8%
Adj. Flow (vph)	0	0	0	367	6	654	114	1106	0	0	1783	302
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	373	654	114	1106	0	0	1783	302
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Perm		Free	Prot					Perm
Protected Phases					8		5	2			6	
Permitted Phases				8		Free						6
Detector Phase				8	8		5	2			6	6
Switch Phase												
Minimum Initial (s)				7.0	7.0		7.0	7.0			7.0	7.0
Minimum Split (s)				19.0	19.0		14.0	19.0			19.0	19.0
Total Split (s)	0.0	0.0	0.0	27.0	27.0	0.0	14.0	73.0	0.0	0.0	59.0	59.0
Total Split (%)	0.0%	0.0%	0.0%	27.0%	27.0%	0.0%	14.0%	73.0%	0.0%	0.0%	59.0%	59.0%
Maximum Green (s)				20.0	20.0		7.0	66.0			52.0	52.0
Yellow Time (s)				5.0	5.0		5.0	5.0			5.0	5.0
All-Red Time (s)				2.0	2.0		2.0	2.0			2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	-2.0	-2.0	0.0	-2.0	-2.0	0.0	0.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	4.0	5.0	5.0
Lead/Lag							Lag				Lead	Lead
Lead-Lag Optimize?							Yes				Yes	Yes
Vehicle Extension (s)				3.0	3.0		3.0	3.0			3.0	3.0
Recall Mode				None	None		None	C-Min			C-Min	C-Min
Act Effct Green (s)					22.0	100.0	9.0	68.0			54.0	54.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio					0.22	1.00	0.09	0.68			0.54	0.54
v/c Ratio					0.98	0.43	0.76	0.47			0.96	0.37
Control Delay					82.8	0.9	48.3	1.1			36.2	15.0
Queue Delay					0.0	0.0	0.0	0.0			0.0	0.0
Total Delay					82.8	0.9	48.3	1.1			36.2	15.0
LOS					F	A	D	A			D	B
Approach Delay					30.6			5.5			33.1	
Approach LOS					C			A			C	
Queue Length 50th (ft)					238	0	79	0			542	105
Queue Length 95th (ft)					#425	0	m94	m0			#738	166
Internal Link Dist (ft)		2533			3062			1109			675	
Turn Bay Length (ft)							200					200
Base Capacity (vph)					379	1538	150	2338			1857	807
Starvation Cap Reductn					0	0	0	0			0	0
Spillback Cap Reductn					0	0	0	0			0	0
Storage Cap Reductn					0	0	0	0			0	0
Reduced v/c Ratio					0.98	0.43	0.76	0.47			0.96	0.37

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 24.8 Intersection LOS: C
Intersection Capacity Utilization 87.4% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 111: Gaston WB Ramp & NC 273



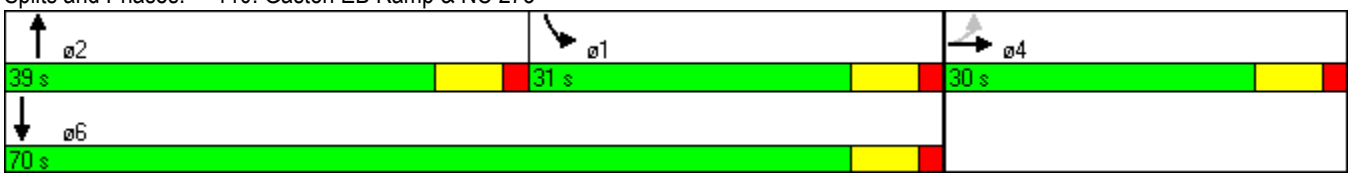
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	272	5	103	0	0	0	0	804	330	589	1240	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	400		0	0		0	0		350	400		0
Storage Lanes	1		0	0		0	0		1	2		0
Taper Length (ft)	100		100	100		100	100		100	100		100
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt		0.858							0.850			
Flt Protected	0.950									0.950		
Satd. Flow (prot)	1770	1553	0	0	0	0	0	3438	1495	3242	3438	0
Flt Permitted	0.950									0.950		
Satd. Flow (perm)	1770	1553	0	0	0	0	0	3438	1495	3242	3438	0
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1907			1478			1082			1189	
Travel Time (s)		37.1			28.8			16.4			18.0	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	5%	5%	2%	2%	2%	2%	5%	8%	8%	5%	0%
Adj. Flow (vph)	302	6	114	0	0	0	0	893	367	654	1378	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	302	120	0	0	0	0	0	893	367	654	1378	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm								Free	Prot		
Protected Phases		4						2		1	6	
Permitted Phases	4								Free			
Detector Phase	4	4						2		1	6	
Switch Phase												
Minimum Initial (s)	7.0	7.0						7.0		7.0	7.0	
Minimum Split (s)	19.0	19.0						19.0		14.0	19.0	
Total Split (s)	30.0	30.0	0.0	0.0	0.0	0.0	0.0	39.0	0.0	31.0	70.0	0.0
Total Split (%)	30.0%	30.0%	0.0%	0.0%	0.0%	0.0%	0.0%	39.0%	0.0%	31.0%	70.0%	0.0%
Maximum Green (s)	23.0	23.0						32.0		24.0	63.0	
Yellow Time (s)	5.0	5.0						5.0		5.0	5.0	
All-Red Time (s)	2.0	2.0						2.0		2.0	2.0	
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	0.0	-2.0	0.0	-2.0	0.0	-2.0	-2.0	0.0
Total Lost Time (s)	5.0	5.0	2.0	2.0	4.0	2.0	4.0	5.0	4.0	5.0	5.0	4.0
Lead/Lag								Lead		Lag		
Lead-Lag Optimize?								Yes		Yes		
Vehicle Extension (s)	3.0	3.0						3.0		3.0	3.0	
Recall Mode	None	None						C-Min		None	C-Min	
Act Effct Green (s)	22.4	22.4						37.8	100.0	24.8	67.6	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio	0.22	0.22						0.38	1.00	0.25	0.68	
v/c Ratio	0.76	0.34						0.69	0.25	0.81	0.59	
Control Delay	49.1	34.8						30.5	0.4	11.7	3.2	
Queue Delay	0.0	0.0						0.0	0.0	0.0	0.0	
Total Delay	49.1	34.8						30.5	0.4	11.7	3.2	
LOS	D	C						C	A	B	A	
Approach Delay		45.1						21.8			6.0	
Approach LOS		D						C			A	
Queue Length 50th (ft)	177	63						261	0	113	118	
Queue Length 95th (ft)	270	113						340	0	m115	m130	
Internal Link Dist (ft)		1827			1398			1002			1109	
Turn Bay Length (ft)	400								350	400		
Base Capacity (vph)	443	388						1298	1495	844	2324	
Starvation Cap Reductn	0	0						0	0	0	0	
Spillback Cap Reductn	0	0						0	0	0	0	
Storage Cap Reductn	0	0						0	0	0	0	
Reduced v/c Ratio	0.68	0.31						0.69	0.25	0.77	0.59	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 96 (96%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 15.8 Intersection LOS: B
Intersection Capacity Utilization 89.7% ICU Level of Service E
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 110: Gaston EB Ramp & NC 273



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	519	5	903	102	974	0	0	1310	274
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	325		0	200		0	0		200
Storage Lanes	0		0	2		1	1		0	0		1
Taper Length (ft)	100		100	100		100	100		100	100		100
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt						0.850						0.850
Flt Protected					0.953		0.950					
Satd. Flow (prot)	0	0	0	0	1724	1538	1671	3438	0	0	3438	1495
Flt Permitted					0.953		0.950					
Satd. Flow (perm)	0	0	0	0	1724	1538	1671	3438	0	0	3438	1495
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		2613			3142			1189			755	
Travel Time (s)		50.9			61.2			18.0			11.4	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	8%	5%	0%	0%	5%	8%
Adj. Flow (vph)	0	0	0	577	6	1003	113	1082	0	0	1456	304
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	583	1003	113	1082	0	0	1456	304
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Perm		Free	Prot					Perm
Protected Phases					8		5	2			6	
Permitted Phases				8		Free						6
Detector Phase				8	8		5	2			6	6
Switch Phase												
Minimum Initial (s)				7.0	7.0		7.0	7.0			7.0	7.0
Minimum Split (s)				19.0	19.0		14.0	19.0			19.0	19.0
Total Split (s)	0.0	0.0	0.0	38.0	38.0	0.0	14.0	62.0	0.0	0.0	48.0	48.0
Total Split (%)	0.0%	0.0%	0.0%	38.0%	38.0%	0.0%	14.0%	62.0%	0.0%	0.0%	48.0%	48.0%
Maximum Green (s)				31.0	31.0		7.0	55.0			41.0	41.0
Yellow Time (s)				5.0	5.0		5.0	5.0			5.0	5.0
All-Red Time (s)				2.0	2.0		2.0	2.0			2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	-2.0	-2.0	0.0	-2.0	-2.0	0.0	0.0	-2.0	-2.0
Total Lost Time (s)	4.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	4.0	5.0	5.0
Lead/Lag							Lag				Lead	Lead
Lead-Lag Optimize?							Yes				Yes	Yes
Vehicle Extension (s)				3.0	3.0		3.0	3.0			3.0	3.0
Recall Mode				None	None		None	C-Min			C-Min	C-Min
Act Effct Green (s)					33.0	100.0	9.0	57.0			43.0	43.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio					0.33	1.00	0.09	0.57			0.43	0.43
v/c Ratio					1.02	0.65	0.75	0.55			0.99	0.47
Control Delay					78.7	2.2	50.9	6.8			49.2	23.5
Queue Delay					0.0	0.0	0.0	0.0			0.0	0.0
Total Delay					78.7	2.2	50.9	6.8			49.2	23.5
LOS					E	A	D	A			D	C
Approach Delay					30.3			10.9			44.7	
Approach LOS					C			B			D	
Queue Length 50th (ft)					~398	0	78	103			470	135
Queue Length 95th (ft)					#606	0	m#123	89			#639	212
Internal Link Dist (ft)		2533			3062			1109			675	
Turn Bay Length (ft)							200					200
Base Capacity (vph)					569	1538	150	1960			1478	643
Starvation Cap Reductn					0	0	0	0			0	0
Spillback Cap Reductn					0	0	0	0			0	0
Storage Cap Reductn					0	0	0	0			0	0
Reduced v/c Ratio					1.02	0.65	0.75	0.55			0.99	0.47

Intersection Summary

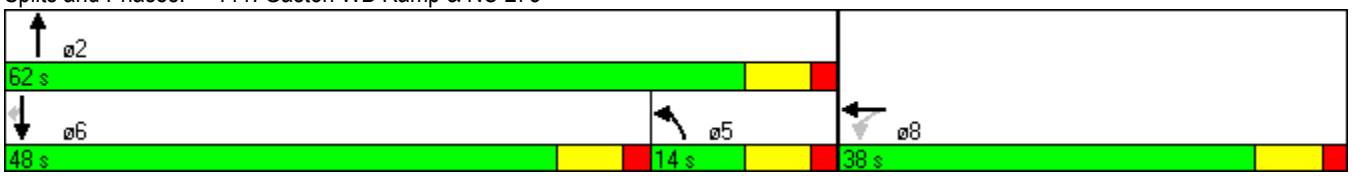
Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.02
Intersection Signal Delay: 30.8 Intersection LOS: C
Intersection Capacity Utilization 89.7% ICU Level of Service E
Analysis Period (min) 15

~ 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.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 111: Gaston WB Ramp & NC 273



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	724	0	425	385	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	250		0	0
Storage Lanes		0	2		0	0
Taper Length (ft)		100	100		100	100
Lane Util. Factor	0.95	1.00	0.97	0.95	1.00	1.00
Frt						
Flt Protected			0.950			
Satd. Flow (prot)	3539	0	3433	3539	0	0
Flt Permitted			0.950			
Satd. Flow (perm)	3539	0	3433	3539	0	0
Right Turn on Red		No				No
Satd. Flow (RTOR)						
Link Speed (mph)	55			55	45	
Link Distance (ft)	2076			1378	1002	
Travel Time (s)	25.7			17.1	15.2	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	804	0	472	428	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	804	0	472	428	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	24			24	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Turn Type			Prot			
Protected Phases	4		3	8		
Permitted Phases						
Detector Phase	4		3	8		
Switch Phase						
Minimum Initial (s)	7.0		7.0	7.0		
Minimum Split (s)	19.0		14.0	19.0		
Total Split (s)	60.0	0.0	30.0	90.0	0.0	0.0
Total Split (%)	66.7%	0.0%	33.3%	100.0%	0.0%	0.0%
Maximum Green (s)	53.0		23.0	83.0		
Yellow Time (s)	5.0		5.0	5.0		
All-Red Time (s)	2.0		2.0	2.0		
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	2.0	5.0	5.0	2.0	2.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0		
Recall Mode	None		None	None		
Act Effct Green (s)	18.8		13.3	42.3		
Actuated g/C Ratio	0.44		0.31	1.00		

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
v/c Ratio	0.51		0.44	0.12		
Control Delay	9.9		13.8	0.1		
Queue Delay	0.0		0.0	0.0		
Total Delay	9.9		13.8	0.1		
LOS	A		B	A		
Approach Delay	9.9			7.3		
Approach LOS	A			A		
Queue Length 50th (ft)	64		43	0		
Queue Length 95th (ft)	117		93	0		
Internal Link Dist (ft)	1996			1298	922	
Turn Bay Length (ft)			250			
Base Capacity (vph)	3539		2080	3539		
Starvation Cap Reductn	0		0	0		
Spillback Cap Reductn	0		0	0		
Storage Cap Reductn	0		0	0		
Reduced v/c Ratio	0.23		0.23	0.12		

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 42.3
Natural Cycle: 40
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.51
Intersection Signal Delay: 8.5 — Intersection LOS: A
Intersection Capacity Utilization 43.2% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 139: Gaston EW & I-485 SB Ramp

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	385	0	647	724	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	250		0	0
Storage Lanes		0	2		0	0
Taper Length (ft)		100	100		100	100
Lane Util. Factor	0.95	1.00	0.97	0.95	1.00	1.00
Frt						
Flt Protected			0.950			
Satd. Flow (prot)	3539	0	3433	3539	0	0
Flt Permitted			0.950			
Satd. Flow (perm)	3539	0	3433	3539	0	0
Right Turn on Red		No				No
Satd. Flow (RTOR)						
Link Speed (mph)	55			55	45	
Link Distance (ft)	2076			1378	1002	
Travel Time (s)	25.7			17.1	15.2	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	428	0	719	804	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	428	0	719	804	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	24			24	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Turn Type			Prot			
Protected Phases	4		3	8		
Permitted Phases						
Detector Phase	4		3	8		
Switch Phase						
Minimum Initial (s)	7.0		7.0	7.0		
Minimum Split (s)	19.0		14.0	19.0		
Total Split (s)	60.0	0.0	30.0	90.0	0.0	0.0
Total Split (%)	66.7%	0.0%	33.3%	100.0%	0.0%	0.0%
Maximum Green (s)	53.0		23.0	83.0		
Yellow Time (s)	5.0		5.0	5.0		
All-Red Time (s)	2.0		2.0	2.0		
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Total Lost Time (s)	5.0	2.0	5.0	5.0	2.0	2.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0		
Recall Mode	None		None	None		
Act Effct Green (s)	12.9		15.3	38.4		
Actuated g/C Ratio	0.34		0.40	1.00		

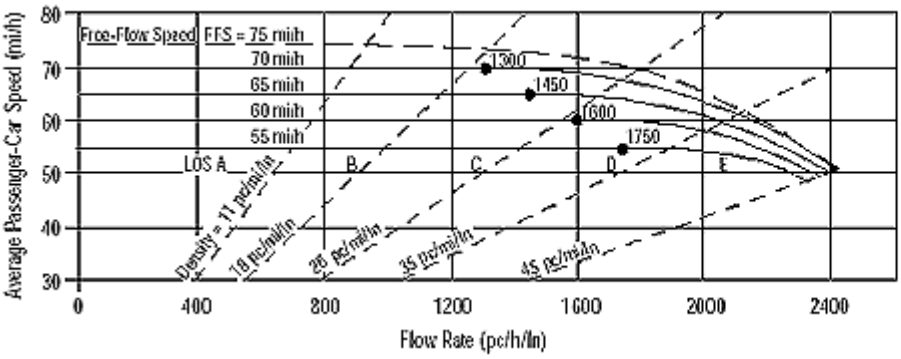
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
v/c Ratio	0.36		0.53	0.23		
Control Delay	11.0		10.6	0.1		
Queue Delay	0.0		0.0	0.0		
Total Delay	11.0		10.6	0.1		
LOS	B		B	A		
Approach Delay	11.0			5.1		
Approach LOS	B			A		
Queue Length 50th (ft)	33		55	0		
Queue Length 95th (ft)	70		103	0		
Internal Link Dist (ft)	1996			1298	922	
Turn Bay Length (ft)			250			
Base Capacity (vph)	3539		2273	3539		
Starvation Cap Reductn	0		0	0		
Spillback Cap Reductn	0		0	0		
Storage Cap Reductn	0		0	0		
Reduced v/c Ratio	0.12		0.32	0.23		

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 38.4	
Natural Cycle: 40	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.53	
Intersection Signal Delay: 6.4	Intersection LOS: A
Intersection Capacity Utilization 40.2%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 139: Gaston EW & I-485 SB Ramp

Appendix D – Highway Capacity Analysis

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*JHG*
Agency or Company	*HNTB North Carolina PC*
Date Performed	*3/2/2010*
Analysis Time Period	*Peak Hour*

Site Information

Highway/Direction of Travel	*Gaston E-W*
From/To	*West of US 29/74*
Jurisdiction	
Analysis Year	*2035 Build without Bud Wilson*

Project Description Gaston East-West Connector

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1268*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h

Calc Speed Adj and FFS

f_{LW}	*0.0*	mi/h
f_{LC}	*0.0*	mi/h
f_{ID}	*0.0*	mi/h
f_N	*4.5*	mi/h
FFS	*65.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*757*	pc/h/ln
S	*65.5*	mi/h
D = v_p / S	*11.6*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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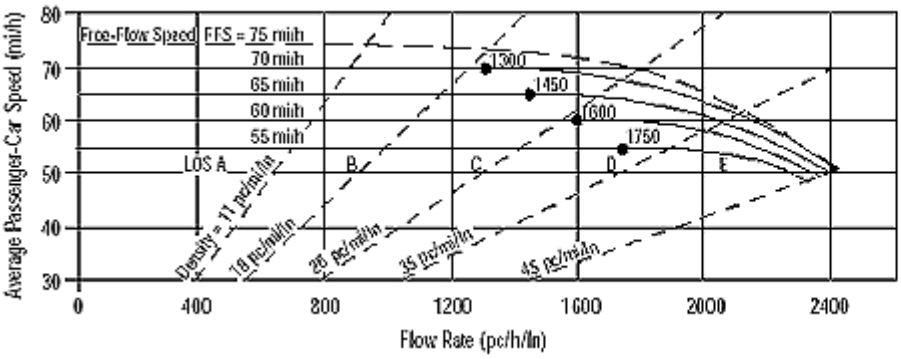
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst	*JHG*	Highway/Direction of Travel	*Gaston E-W*
Agency or Company	*HNTB North Carolina PC*	From/To	*East of US 29/74*
Date Performed	*3/2/2010*	Jurisdiction	*Gaston E-W - US 29/74*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 Build without Bud Wilson*

Project Description Gaston East-West Connector

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1718*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*65.5*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1026*	pc/h/ln	Design LOS	
S	*65.5*	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	*15.7*	pc/mi/ln	S	mi/h
LOS	*B*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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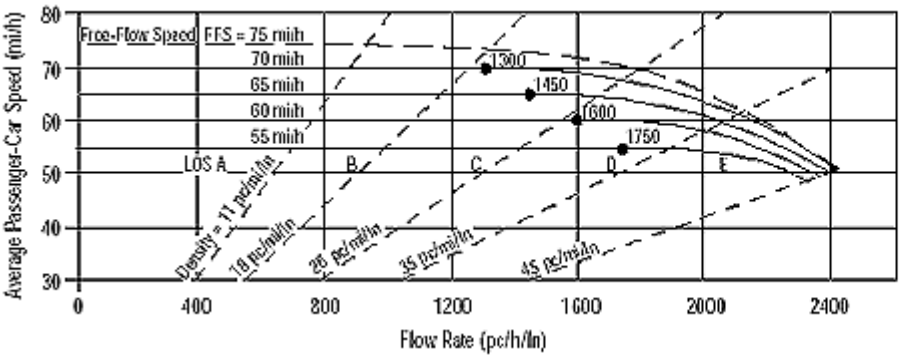

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	BAR
Agency or Company	HNTB North Carolina PC
Date Performed	12/17/2009
Analysis Time Period	Peak Hour

Site Information

Highway/Direction of Travel	Gaston E-W
From/To	East of Linwood
Jurisdiction	504 - Gaston E-W - Linwood
Analysis Year	2035 Build without Bud Wilson

Project Description Gaston East-West Connector

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	1422 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	6
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Rolling
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	2.0
E_T	2.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.917

Speed Inputs

Lane Width	12.0	ft
Rt-Shoulder Lat. Clearance	6.0	ft
Interchange Density	0.50	I/mi
Number of Lanes, N	2	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	70.0	mi/h

Calc Speed Adj and FFS

f_{LW}	0.0	mi/h
f_{LC}	0.0	mi/h
f_{ID}	0.0	mi/h
f_N	4.5	mi/h
FFS	65.5	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	861	pc/h/ln
S	65.5	mi/h
D = v_p / S	13.1	pc/mi/ln
LOS	B	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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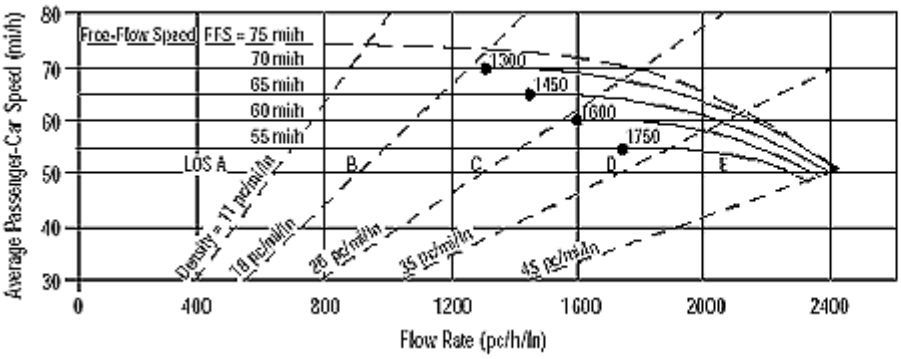

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	BAR
Agency or Company	HNTB North Carolina PC
Date Performed	12/17/2009
Analysis Time Period	Peak Hour

Site Information

Highway/Direction of Travel	Gaston E-W
From/To	East of US 321
Jurisdiction	604 - Gaston E-W - US 321
Analysis Year	2035 Build without Bud Wilson

Project Description Gaston East-West Connector

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	2077 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	6
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Rolling
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	2.0
E_T	2.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.917

Speed Inputs

Lane Width	12.0	ft
Rt-Shoulder Lat. Clearance	6.0	ft
Interchange Density	0.50	I/mi
Number of Lanes, N	2	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	70.0	mi/h

Calc Speed Adj and FFS

f_{LW}	0.0	mi/h
f_{LC}	0.0	mi/h
f_{ID}	0.0	mi/h
f_N	4.5	mi/h
FFS	65.5	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1258	pc/h/ln
S	65.5	mi/h
D = v_p / S	19.2	pc/mi/ln
LOS	C	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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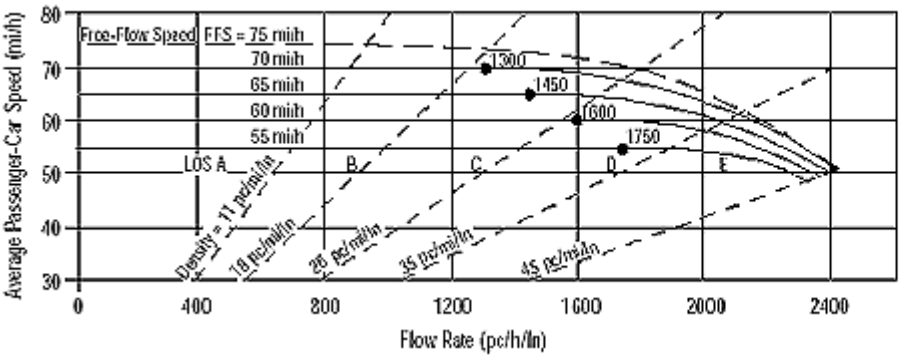

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	BAR
Agency or Company	HNTB North Carolina PC
Date Performed	12/17/2009
Analysis Time Period	Peak Hour

Site Information

Highway/Direction of Travel	Gaston E-W
From/To	East of Robinson
Jurisdiction	704 - Gaston E-W - Robinson
Analysis Year	2035 Build without Bud Wilson

Project Description Gaston East-West Connector

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	2242 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Rolling
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	2.0
E_T	2.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.930

Speed Inputs

Lane Width	12.0	ft
Rt-Shoulder Lat. Clearance	6.0	ft
Interchange Density	0.50	I/mi
Number of Lanes, N	2	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	70.0	mi/h

Calc Speed Adj and FFS

f_{LW}	0.0	mi/h
f_{LC}	0.0	mi/h
f_{ID}	0.0	mi/h
f_N	4.5	mi/h
FFS	65.5	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1339	pc/h/ln
S	65.5	mi/h
D = v_p / S	20.4	pc/mi/ln
LOS	C	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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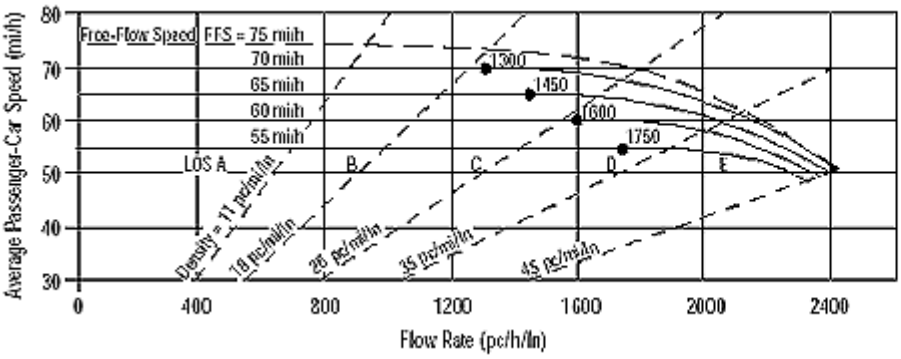

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	BAR
Agency or Company	HNTB North Carolina PC
Date Performed	12/17/2009
Analysis Time Period	Peak Hour

Site Information

Highway/Direction of Travel	Gaston E-W
From/To	East of NC 274
Jurisdiction	904 - Gaston E-W - NC 274
Analysis Year	2035 Build without Bud Wilson

Project Description Gaston East-West Connector

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	2304 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Rolling
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	2.0
E_T	2.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.930

Speed Inputs

Lane Width	12.0	ft
Rt-Shoulder Lat. Clearance	6.0	ft
Interchange Density	0.50	I/mi
Number of Lanes, N	2	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	70.0	mi/h

Calc Speed Adj and FFS

f_{LW}	0.0	mi/h
f_{LC}	0.0	mi/h
f_{ID}	0.0	mi/h
f_N	4.5	mi/h
FFS	65.5	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1376	pc/h/ln
S	65.5	mi/h
D = v_p / S	21.0	pc/mi/ln
LOS	C	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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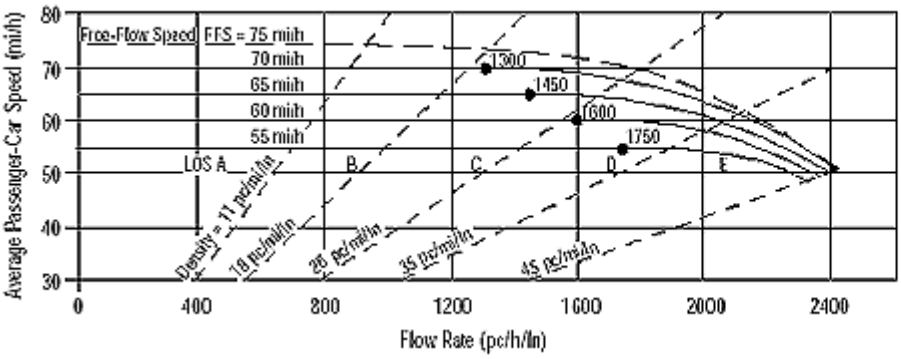

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	BAR
Agency or Company	HNTB North Carolina PC
Date Performed	12/17/2009
Analysis Time Period	Peak Hour

Site Information

Highway/Direction of Travel	Gaston E-W
From/To	East of NC 279
Jurisdiction	1005 - Gaston E-W - NC 279
Analysis Year	2035 Build without Bud Wilson

Project Description Gaston East-West Connector

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	3223 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Rolling
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	2.0
E_T	2.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.943

Speed Inputs

Lane Width	12.0	ft
Rt-Shoulder Lat. Clearance	6.0	ft
Interchange Density	0.50	I/mi
Number of Lanes, N	2	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	70.0	mi/h

Calc Speed Adj and FFS

f_{LW}	0.0	mi/h
f_{LC}	0.0	mi/h
f_{ID}	0.0	mi/h
f_N	4.5	mi/h
FFS	65.5	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1898	pc/h/ln
S	63.3	mi/h
D = v_p / S	30.0	pc/mi/ln
LOS	D	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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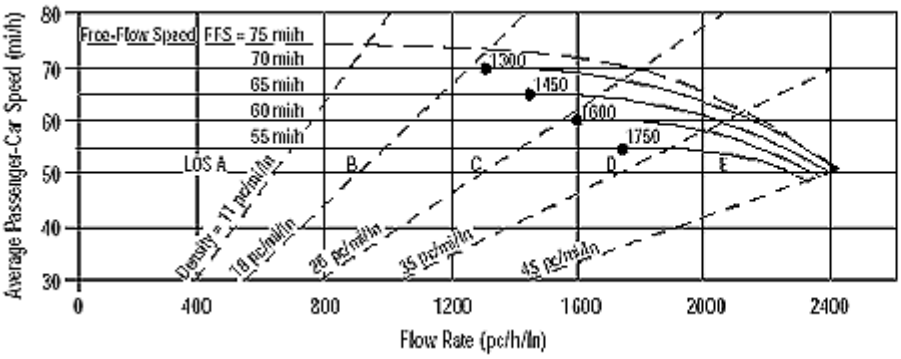

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	BAR
Agency or Company	HNTB North Carolina PC
Date Performed	12/17/2009
Analysis Time Period	Peak Hour

Site Information

Highway/Direction of Travel	Gaston E-W
From/To	East of NC 273
Jurisdiction	1104 - Gaston E-W - NC 273
Analysis Year	2035 Build without Bud Wilson

Project Description Gaston East-West Connector

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	4224 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Rolling
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	2.0
E_T	2.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.943

Speed Inputs

Lane Width	12.0	ft
Rt-Shoulder Lat. Clearance	6.0	ft
Interchange Density	0.50	I/mi
Number of Lanes, N	2	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	70.0	mi/h

Calc Speed Adj and FFS

f_{LW}	0.0	mi/h
f_{LC}	0.0	mi/h
f_{ID}	0.0	mi/h
f_N	4.5	mi/h
FFS	65.5	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2487	pc/h/ln
S		mi/h
D = v_p / S		pc/mi/ln
LOS	F	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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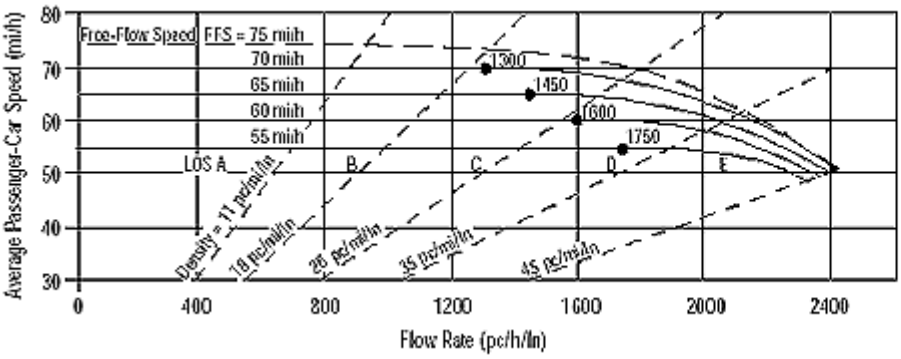

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*BAR*
Agency or Company	*HNTB North Carolina PC*
Date Performed	
Analysis Time Period	*Peak Hour*

Site Information

Highway/Direction of Travel	*Gaston E-W*
From/To	*East of Dixie River*
Jurisdiction	*Gaston E-W - Dixie River*
Analysis Year	*2035 Build without Bud Wilson*

Project Description Gaston East-West Connector

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3878*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h

Calc Speed Adj and FFS

f_{LW}	*0.0*	mi/h
f_{LC}	*0.0*	mi/h
f_{ID}	*0.0*	mi/h
f_N	*4.5*	mi/h
FFS	*65.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2284*	pc/h/ln
S	*54.8*	mi/h
D = v_p / S	*41.7*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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