

I-77 Feasibility Study (I-85 to Griffith Street)

TIP Project No. FS-0810B

**Task Order No. 1 – I-77 HOV Extension
Sub-task 1.C.2: Evaluation of Operational Impacts**

TECHNICAL MEMORANDUM
(FINAL)

November 18, 2009

1.0 INTRODUCTION

This memorandum summarizes the results of traffic simulation conducted along I-77 for the proposed extension of the high-occupancy vehicle (HOV) lanes from the current terminus at I-485 (Exit 19) near Huntersville to Griffith Street in Davidson (Exit 30). The corridor's existing HOV facility extends from about Hambright Road to Oaklawn Avenue in the southbound direction and from Cindy Lane to I-485 in the northbound direction.

The traffic simulation and analysis package used in Task Order No. 1, CORSIM, was developed for the Federal Highway Administration (FHWA). CORSIM has the capability to analyze traffic flows on surface street systems as well as freeways, and can consider the effects of additional lanes, on-street parking, bus traffic, and accidents.

There were two HOV extension options analyzed as part of this task order:

- Extend the existing HOV lane in both directions north to Griffith Street (Exit 30) and keep the existing general purpose lane cross section.
- Implement the above improvements plus add another general purpose lane in each direction between Exits 19 and 30. This will provide a cross section north of I-485 matching the section where the HOV lane currently exists south of I-485.

For Task Order No. 1, CORSIM was used to:

- Assess the impact of the extension of the current HOV lanes through Griffith Street (Exit 30) on freeway operations
- Assess the system impacts on a comprehensive scale
- Determine freeway residual impacts, if any, resulting from the proposed freeway modifications

1.1 CORSIM MODEL CALIBRATION

The default values of the CORSIM model have not been changed. The calibration for the existing No-Build conditions was not necessary as the speeds, volumes and observed queuing were reasonably close (within 10 percent) to observed existing conditions.

The CORSIM output file was created from the average of three internal CORSIM runs. The output results are the average of three random runs.

1.2 CORSIM NETWORK AND TRAFFIC ANALYSIS

The CORSIM network for Task Order No. 1 was prepared from the base existing conditions network. Using the existing network, a HOV lane by itself or a HOV lane plus another general purpose lane were added through Griffith Street (Exit 30) in the northbound and southbound directions. The volumes for the two build options came from the Metrolina Regional Travel Demand Model. Traffic analysis was performed for the planning years of 2013 and 2030 for AM and PM peak hour conditions.

2.0 RESULTS OF TRAFFIC SIMULATION

The following sections summarize the results of CORSIM traffic analysis for the two build options.

2.1 EXTENSION OF HOV LANE ONLY

2.1.1 2013 AM Peak Hour (Southbound)

When compared to No-Build conditions, the level of service would improve by two grades for southbound operations along the I-77 segment between LaSalle Street (Exit 12) and Griffith Street (Exit 30). The level of service will improve from a level of service "F" to a level of service "D" not only at on and off ramp locations but also for mainline southbound freeway operations.

The average speed for motorists traveling along I-77 in the AM peak hour would improve by six miles per hour (mph), from 42 mph to 48 mph. Overall vehicular delay time would decrease from 47 minutes to 37 minutes, a reduction of over 10 minutes (21 percent improvement).

2.1.2 2013 PM Peak Hour (Northbound)

The level of service for I-77 northbound operations will also improve by two levels when compared to No-Build conditions. Once again, the level of service will improve from a level of service "F" to a level of service "D" not only at on and off ramp locations but also for mainline northbound operations.

Average speeds in the PM peak hour will improve by seven mph, from 44 mph to 51 mph. Overall vehicular delay time along I-77 would decrease from 51 minutes to 35 minutes, a drop of nearly 16 minutes (31 percent reduction).

2.1.3 2030 AM Peak Hour (Southbound)

When compared to No-Build conditions, the level of service would improve by a single level for southbound operations along I-77 from LaSalle Street to Griffith Street. The level of service will improve from a level of service "F" to a level of service "E" at both ramp locations and for mainline operations.

To travel between Exit 30 and Exit 12, the average speed will improve by 13 mph, from 35 mph to 48 mph. Overall I-77 delay time would drop from 80 minutes to 41 minutes, a reduction of 39 minutes.

2.1.4 2030 PM Peak Hour (Northbound)

The level of service for I-77 northbound operations will improve by two levels when compared to No-Build conditions. The level of service improves from a level of service

“F” to a level of service “E” at on and off ramp locations and from level of service “F” to level of service “D” for mainline freeway operations.

The average speed will improve by four mph, from 44 mph to 48 mph. Overall vehicular delay time is projected to decrease from 58 minutes to 42 minutes, about 16 minutes less representing a 28 percent reduction for I-77 travelers.

2.1.5 Northbound Lane Termini

Based on CORSIM analysis results, designation of the proposed HOV lane extension would end about ½-mile south of Exit 28. Traffic in the northbound general purpose lanes would merge to the leftmost lane ensuring that HOV lane users have priority when three northbound lanes are reduced to two lanes. The outside general purpose lane would drop at the exit ramp at Catawba Avenue (Exit 28).

The southbound HOV lane would begin south of the causeway between Exits 28 and 30.

2.2 ADDITION OF HOV AND GENERAL PURPOSE LANES

2.2.1 2013 AM Peak Hour (Southbound)

When compared to No-Build conditions, the level of service would improve by three levels for southbound operations in the I-77 segment between LaSalle Street (Exit 12) and Griffith Street (Exit 30). The level of service will improve from a level of service “F” to a level of service “C” at on and off ramp locations and from level of service “F” to level of service “C/D” for mainline freeway operations.

Overall average travel speed will improve by four mph, from 42 mph to 46 mph. Overall vehicular delay time is expected to decrease from 47 minutes to 45 minutes, a reduction of three minutes for all vehicles traveling along I-77. The amount of traffic using I-77 under this build option is significantly higher than the volumes traveling along the freeway under No-Build conditions.

2.2.2 2013 PM Peak Hour (Northbound)

The level of service for I-77 northbound operations would also improve by three levels when compared to No-Build conditions. The level of service will improve from a level of service “F” to a level of service “C” not only at ramp locations but also for mainline northbound operations.

The average travel speed is projected to improve by 12 mph, from 44mph to 56 mph. This improvement in travel speeds means that overall vehicular delay will decrease from 51 minutes to 22 minutes, a drop of over 29 minutes (57 percent improvement) for vehicles using I-77.

2.2.3 2030 AM Peak Hour (Southbound)

When compared to No-Build conditions, the level of service would improve by two grades for southbound operations along the I-77 segment between Exit 12 and Exit 30.

The level of service will improve from a level of service “F” to a level of service “D” for on and off ramp locations and from level of service “F” to level of service “E” for mainline operations.

The average speed will improve by 22 mph, from 35 mph to 57 mph. Overall vehicular delay time will decrease from 80 minutes to 36 minutes, a reduction of 44 minutes (55 percent reduction) for I-77 motorists.

2.2.4 2030 PM Peak Hour (Northbound)

The level of service for I-77 northbound operations will improve by two levels when compared to 2030 No-Build conditions. The level of service would improve from a level of service “F” to a level of service “E” at ramp locations and from level of service “F” to level of service “D” for mainline operations.

The average speed will increase by 12 mph, from 44 mph to 56 mph. Overall vehicular delay time will drop from 58 minutes to 33 minutes, 23 minutes less representing a 40 percent reduction for I-77 travelers.

2.2.5 Northbound Lane Termini

The CORSIM analysis for adding two lanes (one HOV lane and one general purpose lane) in each direction to I-77 indicated a need to widen the I-77 causeway between Griffith Street (Exit 30) and Langtree Road (Exit 31) in order to prevent a bottleneck from merging traffic in the afternoon peak period where the northbound HOV lane ends. HOV lane designation would end just north of Exit 30 but the new lane would continue north as a general purpose lane. One general purpose lane would drop at the off ramp at Exit 28, resulting in I-77 having three northbound lanes to Langtree Road (Exit 31) where another general purpose lane would end at this recently-completed interchange.

2.3 TRAFFIC OPERATIONS ANALYSIS LANE DIAGRAMS

- The appendix, *I-77 CORSIM Traffic Simulation Results, Task Order No. 1 Alternatives*, includes a series of lane diagrams that depict the results of the CORSIM simulation analyses along the corridor. The lane diagrams show forecasted peak hour volumes, projected density and speed for mainline sections and modeled peak hour volumes for entrance and exit ramps. It also shows the expected operational levels of services for the various segments.

APPENDIX

I-77 CORSIM Traffic Simulation Results

Task Order No. 1 – I-77 Widening and HOV Facility Extension Alternatives

Figures	Year	Peak	Cross-section
Figure A-1	2013	AM	NoBuild
Figure A-2	2013	PM	NoBuild
Figure A-3	2030	AM	NoBuild
Figure A-4	2030	PM	NoBuild
Figure A-5	2013	AM	3 Lanes (1 HOV & 2 GP)
Figure A-6	2013	PM	3 Lanes (1 HOV & 2 GP)
Figure A-7	2030	AM	3 Lanes (1 HOV & 2 GP)
Figure A-8	2030	PM	3 Lanes (1 HOV & 2 GP)
Figure A-9	2013	AM	4 Lanes (1 HOV & 3 GP)
Figure A-10	2013	PM	4 Lanes (1 HOV & 3 GP) (missing)
Figure A-11	2030	AM	4 Lanes (1 HOV & 3 GP)
Figure A-12	2030	PM	4 Lanes (1 HOV & 3 GP)



I-77 HOV Study: CORISIM Model Volume Density and Speed Results

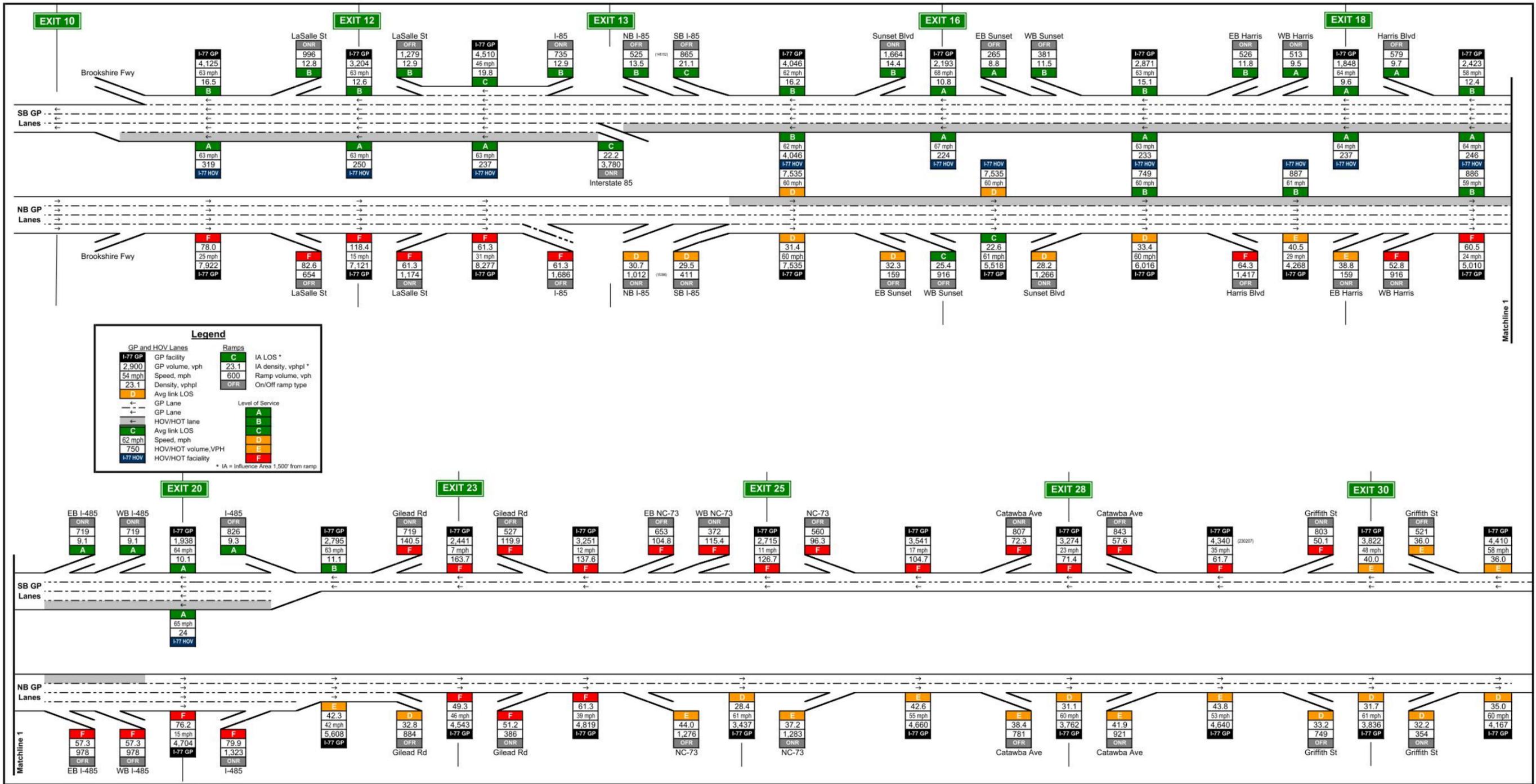
2013 AM No-Build

Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
 AM Peak Period (7:00 a.m. to 8:00 a.m.)

Date: October 20, 2009

Created by: Dhiraj Goverdhanam
 Approved by: Jonathan Reid

Figure A-1



Legend

GP and HOV Lanes	Ramps	IA LOS *
I-77 GP	GP facility	IA density, vphpl *
2,900	GP volume, vph	Ramp volume, vph
54 mph	Speed, mph	On/Off ramp type
23.1	Density, vphpl	
D	Avg link LOS	
GP Lane	GP Lane	
HOV/HOT lane	HOV/HOT lane	
C	Avg link LOS	Level of Service
62 mph	Speed, mph	A
750	HOV/HOT volume, VPH	B
I-77 HOV	HOV/HOT facility	C
		D
		E
		F

* IA = Influence Area 1,500' from ramp

I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2013 PM No-Build

Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
 PM Peak Period (5:00 p.m. to 6:00 p.m.)

Date: October 20, 2009

Created by: Dhiraj Goverdhanam
 Approved by: Jonathan Reid

Figure A-2





I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2030 AM No-Build

Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
AM Peak Period (7:00 a.m. to 8:00 a.m.)

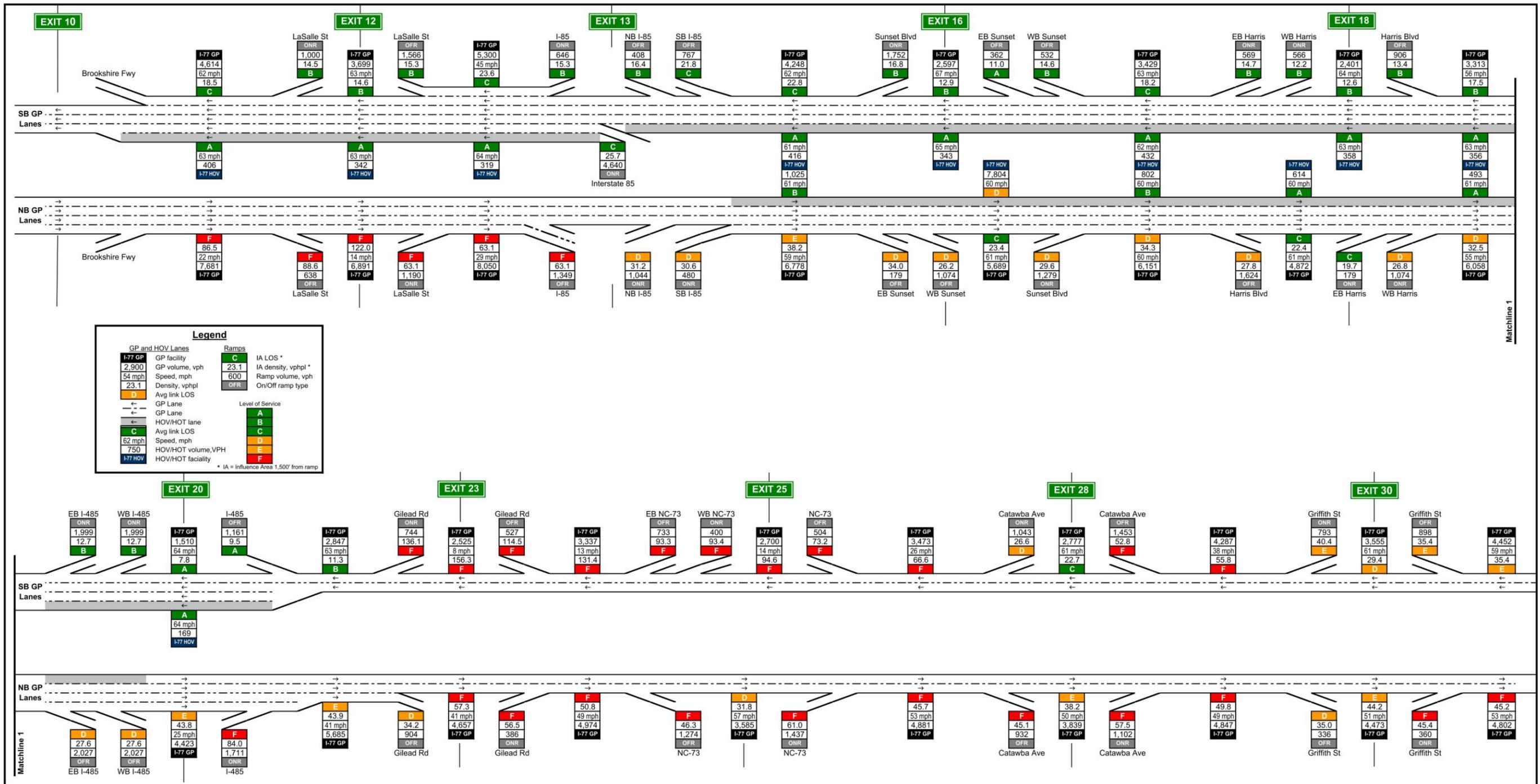
Date: October 20, 2009

Created by: Dhiraj Goverdhanam

Approved by: Jonathan Reid

Figure A-3





I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2030 PM No-Build

Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
 PM Peak Period (5:00 p.m. to 6:00 p.m.)

Date: October 20, 2009

Created by: Dhiraj Goverdhanam
 Approved by: Jonathan Reid

Figure A-4





I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2013 AM (Alt # 2)

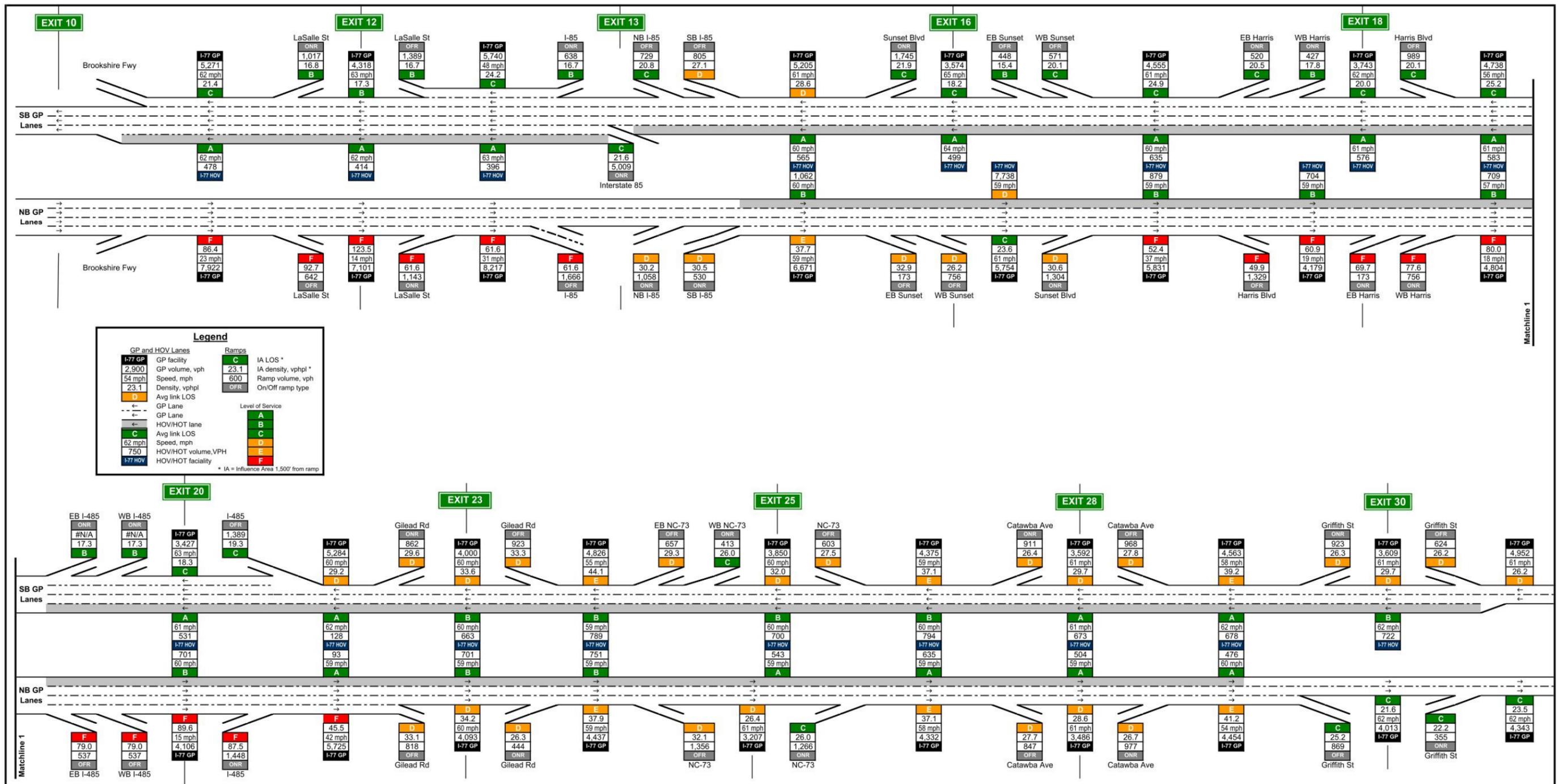
Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
AM Peak Period (7:00 a.m. to 8:00 a.m.)

Date: October 21, 2009

Created by: Dhiraj Goverdhanam
Approved by: Jonathan Reid

Figure A-5





I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2013 PM (Alt # 2)

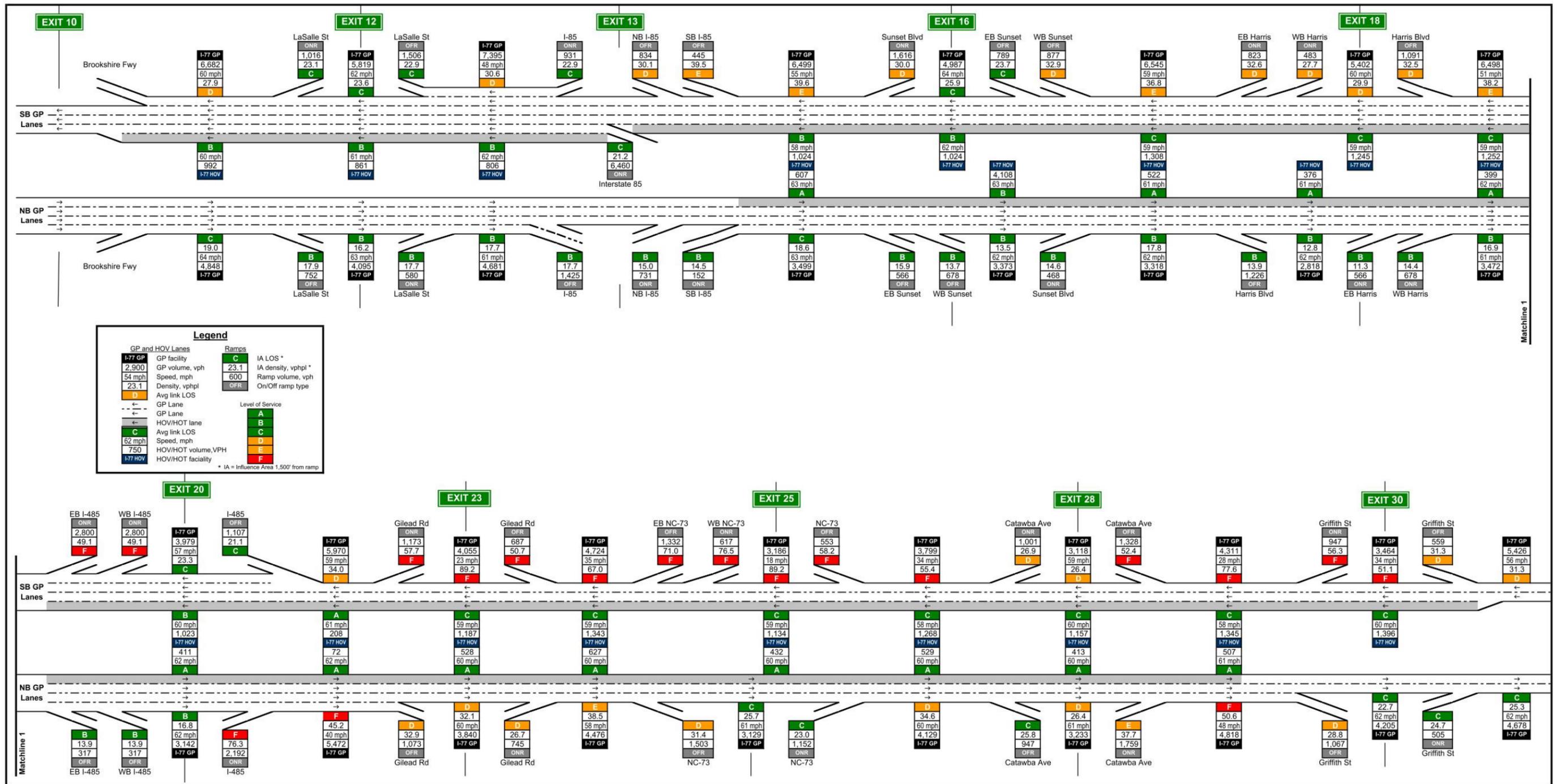
Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
 PM Peak Period (5:00 p.m. to 6:00 p.m.)

Date: October 21, 2009

Created by: Dhiraj Goverdhanam
 Approved by: Jonathan Reid

Figure A-6





I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2030 AM (Alt # 2)

Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)

AM Peak Period (7:00 a.m. to 8:00 a.m.)

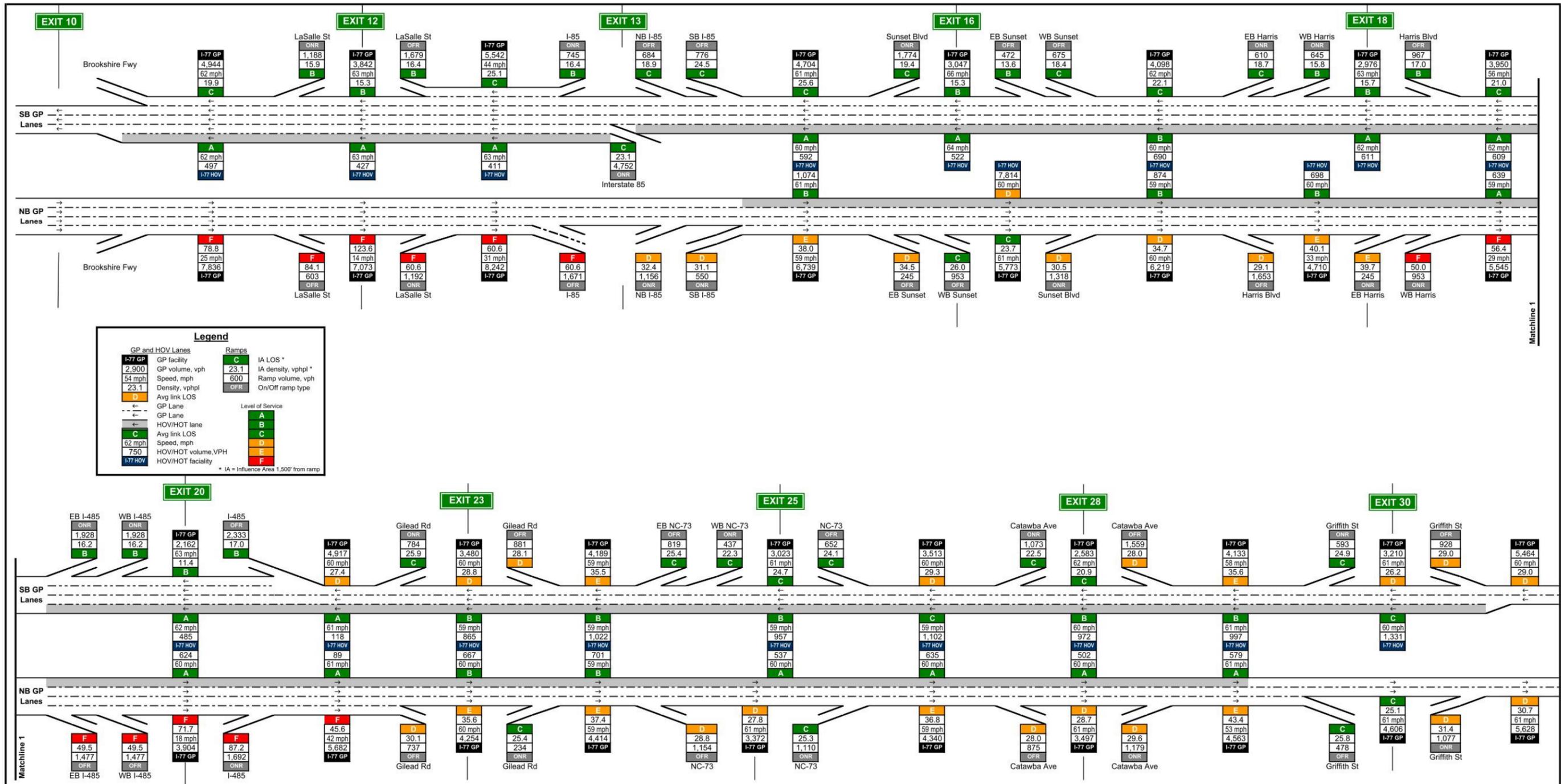
Date: October 21, 2009

Created by: Dhiraj Goverdhanam

Approved by: Jonathan Reid

Figure A-7





I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2030 PM (Alt # 2)

Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
 PM Peak Period (5:00 p.m. to 6:00 p.m.)

Date: October 21, 2009

Created by: Dhiraj Goverdhanam
 Approved by: Jonathan Reid

Figure A-8





I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2013 AM (Alt # 3)

Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
 AM Peak Period (7:00 a.m. to 8:00 a.m.)

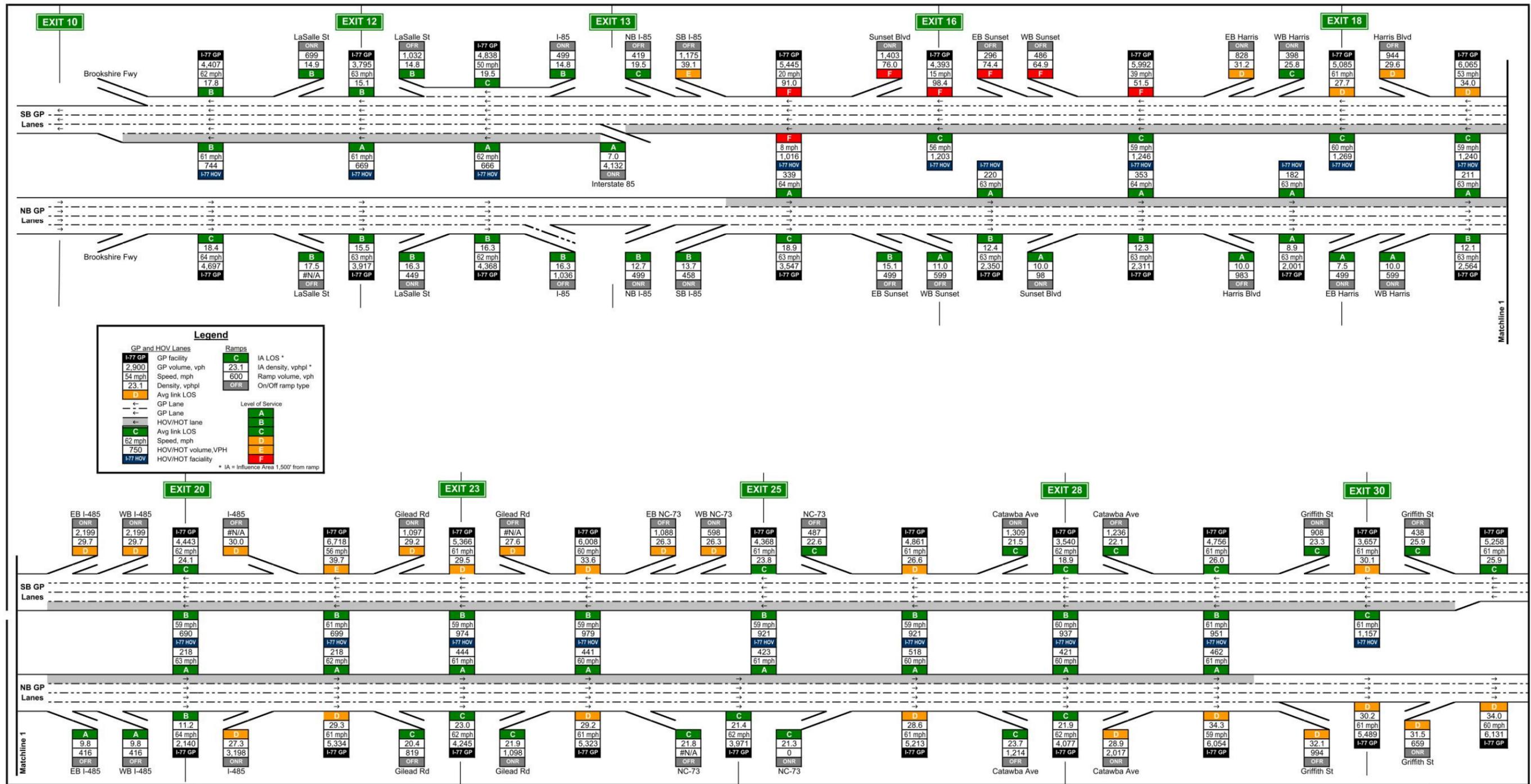
Date: October 21, 2009

Created by: Dhiraj Goverdhanam
 Approved by: Jonathan Reid

Figure A-9



Figure 10 is missing



I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2030 AM (Alt # 3)

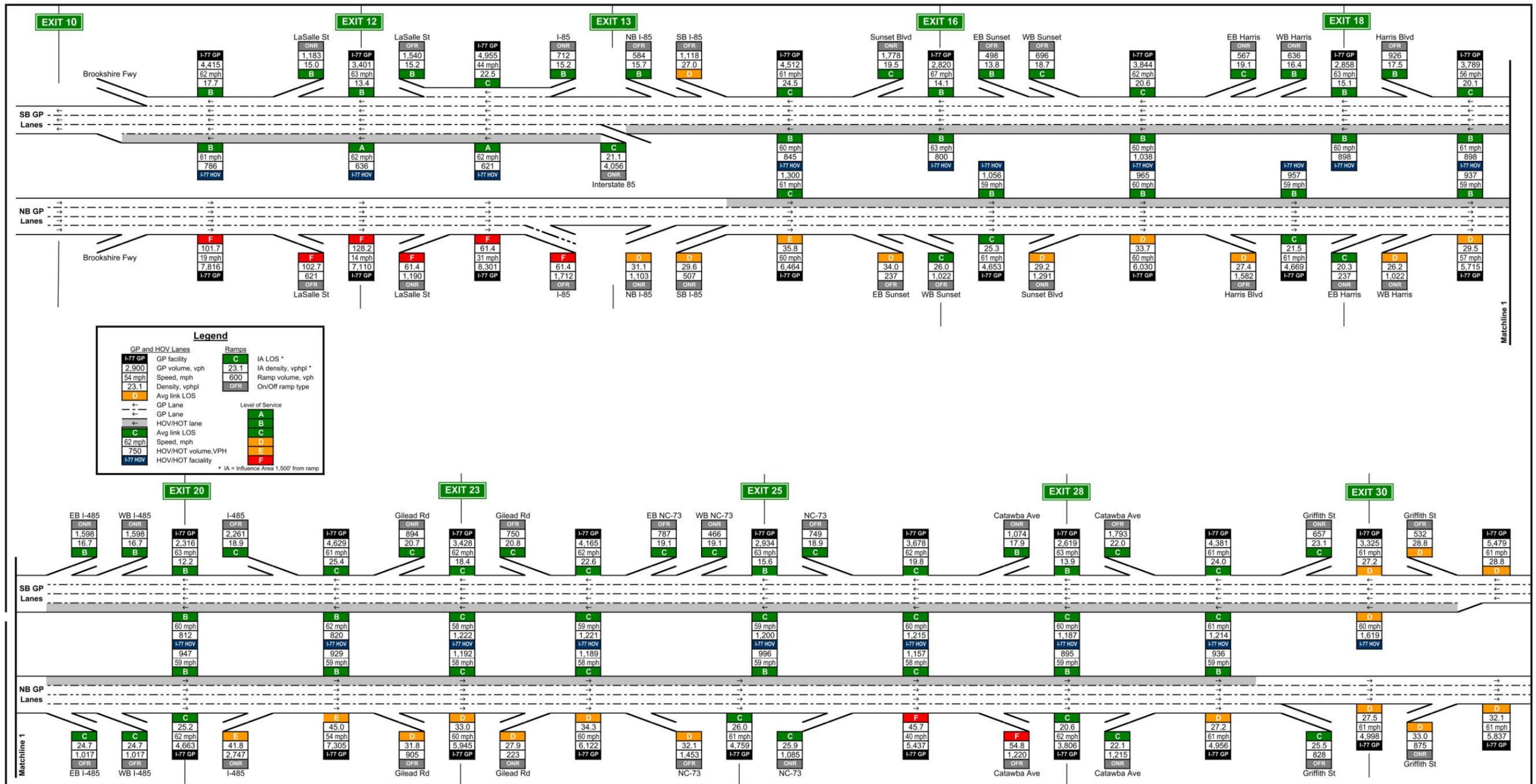
Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
AM Peak Period (7:00 a.m. to 8:00 a.m.)

Date: October 21, 2009

Created by: Dhiraj Goverdhanam
Approved by: Jonathan Reid

Figure A-11





I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2030 PM (Alt # 3)

Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
PM Peak Period (5:00 p.m. to 6:00 p.m.)

Date: October 21, 2009

Created by: Dhiraj Goverdhanam
Approved by: Jonathan Reid

Figure A-12

