INTERCHANGE MODIFICATION STUDY

INTERCHANGE OF INTERSTATE 40 WITH McCRORY LANE

NASHVILLE, DAVIDSON COUNTY, TENNESSEE

Prepared By:

RAGAN-SMITH-ASSOCIATES, INC.

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INTERSTATE 40 at McCRORY LANE
INTERCHANGE MODIFICATION STUDY

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CHAPTER 1 - INTRODUCTION

A. Purpose of Study

The purpose of this study is to evaluate the operational impacts of a modification to the interchange of Interstate 40 (I-40) with McCrory Lane in west Nashville, Davidson County, Tennessee. This study was initiated due to the need to increase the capacity of McCrory Lane and this interchange to accommodate future developments along the McCrory Lane corridor. Several geometric deficiencies related to intersection skews and interstate ramp junctions will also be improved by modifying the existing interchange. The interchange of I-40 with McCrory Lane is located near mile marker 192 on I-40 in Davidson County, Tennessee. This diamond configured interchange provides full access to/from all directions on I-40 and McCrory Lane. See Figure 1 for a vicinity map of the project.

Several developments along McCrory Lane will generate traffic along McCrory Lane and at the McCrory Lane/I-40 interchange. The largest development, the Biltmore PUD, will be located at the I-40/McCrory Lane interchange. The Biltmore PUD will include 1,400 residential units, 228,000 gross square feet (GSF) of office space, and 800,000 GSF of commercial and retail space. The Riverwalk, Lexington Pointe, Boone Trace, Avondale, and Branstetter property developments within the vicinity of the I-40/McCrory Lane interchange will include 1,412 residential units and 115,000 GSF of commercial and retail space.

The proposed interchange modification would correct several existing geometric deficiencies by providing new or reconstructed entrance/exit ramps and improving McCrory Lane. Existing ramps that intersect McCrory Lane at undesirable skews will be replaced by new ramps or reconstructed to improve intersection geometries. The existing eastbound ramps on the south side of I-40 will be replaced to correct the undesirable geometry that exists at the intersection of these ramps and McCrory Lane. To provide adequate capacity for anticipated future traffic volumes, a loop ramp will be added in the northwest quadrant of the interchange to allow westbound traffic on I-40 to exit onto McCrory Lane southbound in a free-flow movement. The existing westbound entrance ramp will be modified to allow for the loop ramp. The existing westbound exit ramp in the northeast quadrant will provide a right turn only movement from I-40 west to McCrory Lane northbound. The result would be a more effective interchange that would improve existing geometric deficiencies and future operational service of both Interstate 40 and McCrory Lane.

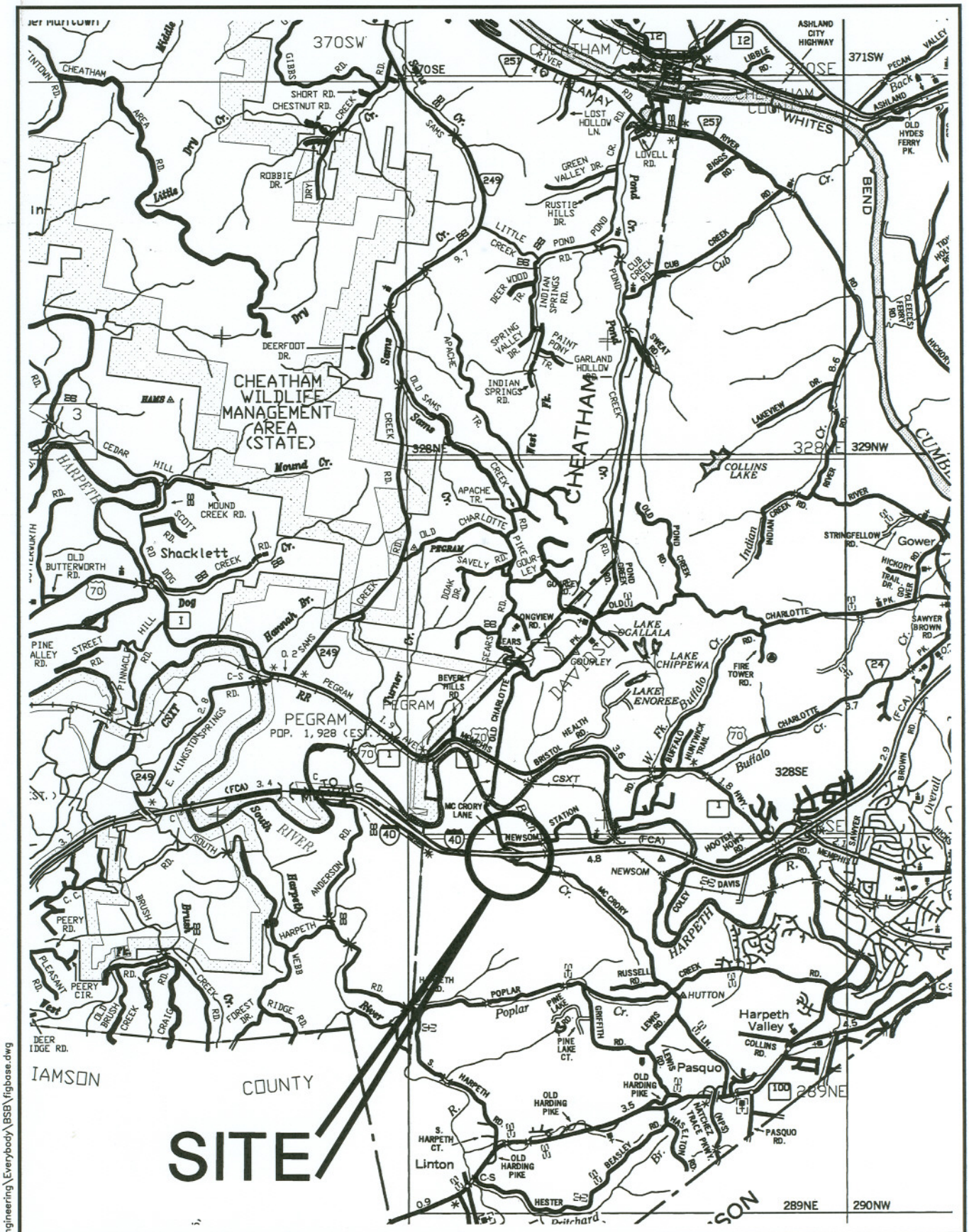
In order to evaluate and quantify the need for and impacts of this interchange modification, an inventory of the existing transportation system was carried out, along with an assessment of its adequacy. Future year traffic volumes were developed and applied to the existing system to document the need for interchange improvements. Possible improvement alternatives were evaluated and future year traffic volumes were applied to the preferred alternative to determine the adequacy of the proposed improvements.

This study addresses the policy requirements for new or modified interchanges on the existing Interstate system published in the Federal Register Volume 63 Number 28 February 11, 1998.

B. Relationship to Other Highway Improvement Plans

At the time of this study, survey and design work is underway to relocate and widen McCrory Lane to a new alignment for approximately 7,000 feet south of the interchange with I-40. The new section of McCrory Lane will contain two basic travel lanes in each direction with a raised median. Median cuts on McCrory Lane will be spaced to promote efficient access to/from this arterial roadway. The improvements recommended in this Interchange Modification Study have been coordinated with the improvements planned on McCrory Lane outside of the interchange. Currently, the portion of McCrory Lane south of I-40 is scheduled to be let for construction in September 2006 and should be completed by August 2007. This schedule may overlap with some of the Phase One interchange modifications. Coordination between this project and the Phase One interchange modifications may be needed if the interchange modifications will begin prior to August 2007.

TDOT is currently planning improvements to the intersection of U.S. Highway 70 and McCrory Lane north of I-40. This project is currently in the preliminary planning stages. The impact of developments along McCrory Lane and the improvements to the I-40/McCrory Lane interchange have been coordinated with TDOT Planning Staff developing the specific capacity needs for the U.S. Highway 70 and McCrory Lane intersection. This project is separated from the I-40 interchange by more than a mile and should not require any direct coordination with the I-40/McCrory Lane interchange modification project.



INTERSTATE 40 AT McCRORY LANE
VICINITY MAP

FIG. 1

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CHAPTER 2 - EXISTING CONDITIONS

A. Study Area Land Uses and Developments

The area south of interchange is an approved Planned Unit Development (PUD) that will contain a mix of shopping center and office uses. South of the interchange, McCrory Lane serves residential areas via connections with Poplar Creek Road and State Route 100. North of the interchange, the State of Tennessee owns property adjacent to the National Cemetery which is to the north along McCrory Lane. Newsom Station Road provides access to residential areas located northeast of the interchange. McCrory Lane also provides access to the City of Pegram via U.S. Highway 70 (State Route 1) north of the interchange.

B. Existing Transportation Network

The existing transportation system in the area is made up of freeways, arterials, and collector roadways which provide regional and local access to the area. The following roadways will comprise the study area for consideration of the I-40/McCrory Lane interchange modification proposal.

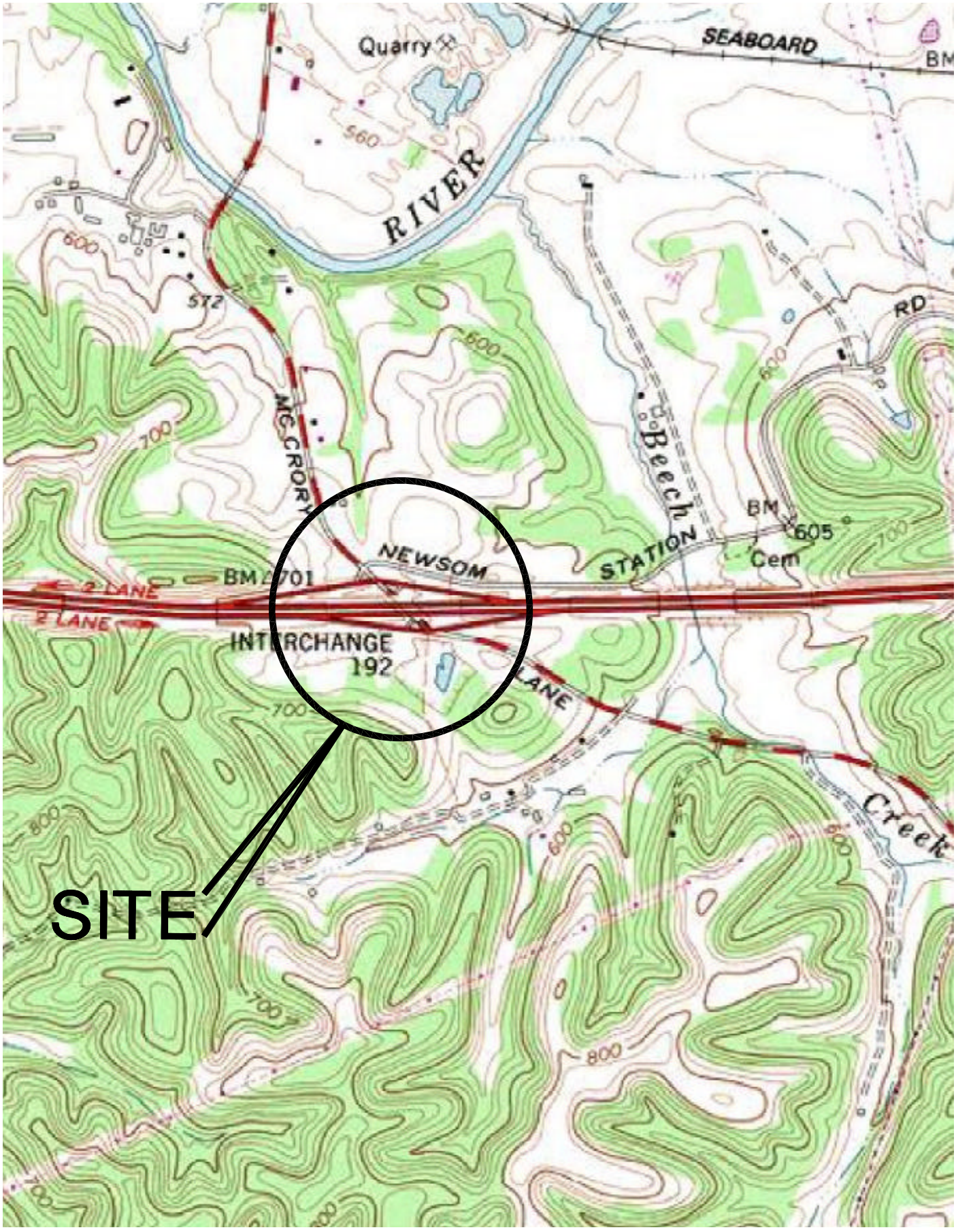
- **Interstate 40** in the study area is a four-lane freeway facility generally traveling in an east-west direction. Interstate 40 provides an inter-city connection between Nashville and Memphis, Tennessee. At McCrory Lane, access is provided to and from Interstate 40 via a diamond interchange. The existing ramp junctions for exit from I-40 to McCrory Lane are of a tapered design with divergence angles between 2 and 4 degrees. These divergence angles are within applicable design standards for a freeway facility. For entrance onto I-40 from McCrory Lane, acceleration lanes approximately 475 feet in length are provided. The length of these acceleration lanes may not meet the minimum acceleration length for entrance terminals. Within the general study area, the existing Average Daily Traffic (ADT) on Interstate 40 west of McCrory Lane is approximately 72,053 vehicles per day. The posted speed limit on Interstate 40 in the vicinity of McCrory Lane is 70 mph.

- **McCrory Lane** in the study area is a two-lane roadway generally traveling in a north-south direction in southwestern Davidson County. McCrory Lane provides a direct connection from U.S. Highway 70 in the north to State Route 100 in the south. Within the general study area, the existing ADT on McCrory Lane south of Interstate 40 is approximately 4,959 vehicles per day. A diamond interchange also allows access to Interstate 40. The intersection skew at the intersections of McCrory Lane with the I-40 ramps is in excess of 65 degrees. Current roadway design guidelines recommend that intersection skews be limited to no more than 10 or 15 degrees from a perpendicular intersection. McCrory Lane is currently classified as a four-lane scenic arterial roadway by the Metro Nashville and Davidson County 2010 Major Street Plan.

- **Newsom Station Road** in the study area is a two-lane roadway located just north of Interstate 40 to the east of McCrory Lane. Within the general study area, the existing

ADT on Newsom Station Road is approximately 4,396 vehicles per day. Several new residential developments are located along Newsom Station Road in the general study area. As a result of these residential developments, the intersection of Newsom Station Road and McCrory Lane has recently been relocated and improved to provide higher capacity and more desirable spacing with the I-40 interchange. The realignment of Newsom Station Road as part of this project corrected a poor intersection skew problem at McCrory Lane and added turn lanes to enhance operations. Newsom Station Road is currently classified as a collector roadway by the Metro Nashville and Davidson County 2010 Major Street Plan.

The location of these facilities in the immediate study area is shown in Figure 2.



INTERSTATE 40 AT McCRORY LANE
LOCATION MAP

FIG. 2

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C. Existing Operational Performance

1. Interstate 40 Mainline Operations

Interstate 40 extends from McCrory Lane towards Nashville in the east and Memphis in the west. The year 2004 ADT on Interstate 40 was 77,309 vehicles per day (vpd) east of the interchange, and 72,053 vpd west of the interchange.

A complete summary of the existing mainline interstate capacity is shown in Table 1 below. The analysis was performed for the base year (2004) in the morning and afternoon peaks. This summary shows that, currently, I-40 will experience unacceptable levels of service during peak travel periods. Operations during off-peak periods are characterized by Level of Service "B".

TABLE 1

I-40 MAINLINE CAPACITY ANALYSIS SUMMARY

I-40 Mainline Segment	Direction	Measures of Effectiveness	2004 A.M.	2004 P.M.
From Exit 188 to Exit 192 (I-40 West of McCrory Ln)	EB	Speed (mph)	61.2	65.5
		Density (pc/mi/ln)	33.2	16.9
		LOS	D	B
	WB	Speed (mph)	65.5	63.6
		Density (pc/mi/ln)	11.4	29.4
		LOS	B	D
From Exit 192 to Exit 196 (I-40 East of McCrory Ln)	EB	Speed (mph)	55.0	65.5
		Density (pc/mi/ln)	41.5	17.9
		LOS	E	B
	WB	Speed (mph)	65.5	60.0
		Density (pc/mi/ln)	11.7	34.9
		LOS	B	D

2. Interstate Ramp Junctions

The interchange of I-40 with McCrory Lane is diamond-configured and contains entrance and exit ramps that allow for full access to/from I-40 and McCrory Lane.

All ramps merge/diverge from the existing lanes on I-40. No lane drops or additions are present at the subject interchange.

Existing traffic volumes on the ramps are generally moderate and do not negatively impact operations on I-40 during non-peak periods. During peak periods, operations at the ramp junctions in the peak directions do experience poor levels of service.

Table 2 below shows the ramp junction analysis results.

TABLE 2

INTERSTATE 40 RAMP ANALYSIS RESULTS

Ramp	Measure of Effectiveness	2004	
		A.M.	P.M.
I-40 EB Exit Ramp to McCrory Lane	Speed (mph)	57.5	57.9
	Density (pc/mi/ln)	34.7	18.8
	LOS	D	B
I-40 EB Entrance Ramp from McCrory Lane	Speed (mph)	52.3	60.9
	Density (pc/mi/ln)	37.0	20.4
	LOS	E	C
I-40 WB Exit Ramp to McCrory Lane	Speed (mph)	57.7	56.7
	Density (pc/mi/ln)	17.4	40.2
	LOS	B	E
I-40 WB Entrance Ramp from McCrory Lane	Speed (mph)	62.0	58.0
	Density (pc/mi/ln)	10.7	28.2
	LOS	B	D

3. McCrory Lane Corridor

In the area of the I-40 with McCrory Lane interchange, critical intersections were analyzed for capacity deficiencies under existing traffic conditions in the a.m. and p.m. peak periods. The following intersections were analyzed:

- McCrory Lane at Newsom Station Road
- McCrory Lane at I-40 Westbound Ramps
- McCrory Lane at I-40 Eastbound Ramps

Intersection capacity analysis results are shown below in Table 3.

TABLE 3					
INTERSECTION CAPACITY ANALYSIS RESULTS					
Location	**Year**	**Control**	**Intersection Approach or Movement**	**Level-of-Service (Delay - sec./veh.)**	
				2004	
				A.M.	**P.M.**
McCrory Lane at Newsom Station Road	2004	Signal	N/A	A (8.3)	A (5.8)
McCrory Lane at I-40 Westbound Ramps	2004	Unsig	WB Left Turn	C (21.7)	C (17.4)
			WB Right Turn	A (9.1)	B (12.2)
			NB Left Turn	A (3.7)	A (3.5)
McCrory Lane at I-40 Eastbound Ramps	2004	Unsig	EB Left Turn	F (78.7)	C (16.9)
			EB Right Turn	A (9.8)	A (9.2)
			SB Left Turn	A (7.7)	A (4.4)

CHAPTER 3 - PLANNING DATA

A. Future Forecasted Traffic Volumes

In order to gauge the effectiveness of any interchange improvements, forecasts of future year traffic volumes were generated for analysis purposes. Traffic data was provided by the Tennessee Department of Transportation and manual traffic counts were collected by Ragan-Smith-Associates. Average daily traffic (ADT) and design hourly volumes (DHV) were projected for the years 2012, 2017, and 2030. Annual growth rates based upon historical count data and the transportation model maintained by the Nashville Metropolitan Planning Organization (MPO) were used to establish base year traffic volumes in 2012, 2017, and 2030. Trips were generated and distributed onto the study area roadway network for the following specific developments:

- Biltmore PUD - The Biltmore PUD is located on the east and west sides of McCrory Lane south of I-40. Construction of the Biltmore PUD will be completed in two phases. Phase One will begin in August 2007 and will include 114,000 square feet of office floor space, 240,750 square feet of commercial and retail uses, and 700 residential units. Phase One should be completed no later than January 2010. At full build-out of Phase Two, the Biltmore PUD will include 1,400 residential units, 228,000 gross square feet (GSF) of office space, and 800,000 GSF of commercial and retail space. The construction of Phase Two should begin no later than January 2012 and should be complete no later than January 2017. The Biltmore PUD Preliminary Master Plan is shown on Figure 3.

- Avondale - The Avondale development is located east of McCrory Lane and south of the Biltmore PUD Avondale will include 571 residential units. Construction at the Avondale PUD should begin in June 2006 and should be complete by June 2010.

- Riverwalk, Lexington Pointe, and Boone Trace - These developments are all being constructed on Newsom Station Road approximately 4,000 feet east of McCrory Lane. Within these three developments, there are 247 residential units that have not yet been built. These developments are currently under construction with full build-out anticipated in the years 2008 or 2009.

- Branstetter Property - The Branstetter property is located on Newsom Station Road east of McCrory Lane and north of I-40. Commercial retail and convenience market land uses are planned for this property. The Branstetter property will include approximately 115,000 GSF at full build-out. At the time of this study, there is no anticipated development schedule for the Branstetter Property. Due to other developments in the area, it has been assumed that this development will be initiated and completed prior to 2017.

COMMERCIAL P.U.D.

Commercial Acreage: 99.11 ac.
Commercial Floor Area: 908,000
Commercial FAR: 0.22

	Use	S.F.	Acreage	Maximum FAR	Proposed FAR	Maximum ISR	Proposed ISR	Building Height (Stories)	Parking Required	Parking Provided
A.	1. Hotel	80,000	19	1.80	0.270	0.85	0.16	1	208	221
	2. Office	180,000						2	600	
B.	Retail	22,000	5.32	1.80	0.101	0.85	0.42	1	110	112
C.	1. Hotel	112,400	14.89	1.80	0.231	0.85	0.17	1 & 2	368	194
	2. Office	36,100							120	(162+32)
D.	Retail	249,000	27.84	0.40	0.206	0.80	0.72	1	1229	1272
E.	1. Retail	32,000	4.7	0.80	0.156	0.80	0.51	2	106	167
	2. Office	75,000							87	
F.	Retail	79,000	9.24	0.40	0.170	0.80	0.67	1	353	393
G.	Restaurant	5,000	1.31	0.40	0.029	0.80	0.10	1	50	58
H.	Restaurant	5,500	2.27	0.40	0.053	0.80	0.48	1	55	63
I.	Hotel (175 rooms)	77,000	3.8	0.80	0.465	0.80	0.70	4	175	179
J.	Hotel (150 rooms)	55,000	5.84	0.40	0.201	0.80	0.62	2	109	130
Total Commercial		379,000								
Total Retail		521,000								
Total Commercial/Retail		900,000	95.11	0.22						

RESIDENTIAL P.U.D.

Residential Acreage: 1058.91 ac.
Total Units: Single Family 441
Townhomes 876
Multi-family 364

		Units	Acreage	Density	Maximum FAR	Maximum ISR	Proposed ISR	Building Height (Stories)	Average Lot Size	Parking Req'd	Parking Prop.
K.	Multi-Family	200	42.75	4.7	0.40	0.80	0.19	3/4 split	---	400	547
L.	Multi-Family	180	23.32	7.8	1.80	0.80	0.26	3/4 split	---	360	426
M.	Townhomes	466	302.44	1.5	0.40	0.80	0.11	2	1'16" x 28' (2,235 s.f.)	---	---
M.	Single Family	441	872.15	0.77				2	80' x 140' (11,200 s.f.)	---	---
O.	Townhomes	110	115.36	1	0.40	0.80	0.09	2	1'16" x 28' (2,235 s.f.)	---	---

Note: Townhomes consist of 60% 2 bedroom and 40% 3 bedroom
Note: Multi-Family consists of 15% 1 bedroom, 75% 2 bedroom and 20% 3 bedroom

VICINITY MAP
(N.T.S.)

Prelimanary Master Plan

At Interstate 40 and Mc Corey Lane

RAGAN·SMITH
Land Planners • Civil Engineers
Landscape Architects • Surveyors

The selection of the years 2012, 2017, and 2030 as analysis years was based on the anticipated construction schedule of the previously discussed developments. Specifically, the construction schedule of the Biltmore PUD was a significant determining factor of the analysis years due to the large number of trips that will be generated by this development. The importance of each of the analysis years as they relate to the Biltmore PUD and the proposed I-40/McCrory Lane interchange improvements is shown below:

- 2012 - This is the latest year at which completion of Phase One of the Biltmore PUD is expected. The Avondale, Riverwalk, Boone Trace, and Lexington Pointe developments should reach full build-out prior to this horizon year.

- 2017 - This is the latest year at which full build-out of the Biltmore PUD is expected. The Branstetter property may also be developed prior to this horizon year.

- 2030 - The interchange improvements may be completed by the year 2010 which would result in a 20-year design horizon year of 2030. Based upon a possible opening year of 2010, the year 2030 is established as the overall design year for this project.

Table 4 below summarizes the average daily traffic on I-40 and on McCrory Lane in the years 2004, 2012, 2017, and 2030.

TABLE 4

AVERAGE DAILY TRAFFIC SUMMARY

Location	Average Daily Traffic			
	2004	2012	2017	2030
Interstate 40 (east of McCrory Lane)	77,309	94,247	106,940	126,976
Interstate 40 (west of McCrory Lane)	72,053	85,714	95,964	114,638
McCrory Lane (north of Interstate 40)	4,607	7,833	10,223	11,417
McCrory Lane (south of Interstate 40)	4,959	21,282	33,928	35,213
Newsom Station Road	4,396	8,540	14,315	15,454

Average daily traffic (ADT) and design hourly volume (DHV) traffic data is contained in Appendix A.

B. Discussion of Improvement Alternatives

Several alternative interchange configurations were developed and evaluated during this study. The following is a discussion of alternatives considered in evaluating potential interchange modifications at I-40 and McCrory Lane:

1. Alternate A

Alternative A utilizes the existing McCrory Lane alignment and overpass structure on I-40. Three of the four existing ramps would be reconstructed on new alignments to improve intersection skews and spacing on McCrory Lane.

The eastbound access ramps, located on the south side of I-40, would be reconstructed so that they intersect McCrory Lane at a location approximately 350 feet south of I-40. This will allow for greater storage capacity on McCrory Lane southbound. A new traffic signal would be installed at this intersection.

To the north of I-40 at this interchange, a new loop ramp would be constructed to carry westbound traffic on I-40 to McCrory Lane southbound. The existing I-40 westbound entrance ramp in this quadrant would be relocated north of the new loop ramp. The entrance ramp would intersect McCrory Lane at a location that aligns with Newsom Station Road to the east. The addition of the loop ramp would allow the existing westbound exit ramp to be modified so that only right turns onto McCrory Lane northbound are allowed. A collector-distributor (C-D) road would be necessary on I-40 westbound to accommodate the addition of the new loop ramp. This improvement eliminates several conflict points on McCrory Lane. Also, the distance between major signalized intersections on McCrory Lane would be increased to approximately 1,250 feet, which is a desirable separation distance for traffic signals on arterial roadways.

As part of the reconstruction of McCrory Lane, existing grades can be lowered under I-40, which would provide acceptable clearance for vehicles on McCrory Lane. This bridge was widened as part of maintenance work performed during the 1990's. This structure has been rehabilitated and widened for additional lanes on I-40, and it would be a significant benefit of this alternative to use the existing structure. The Tennessee Department of Transportation Structures Division estimates this bridge's life span to be 20 to 30 years.

In order to increase the capacity on McCrory Lane as it passes under I-40, two spans of the existing three-span bridge will be utilized. McCrory Lane will include a three-lane cross section under the center span of this bridge. There will be one northbound lane and two southbound lanes. One of the southbound lanes will be a left turn lane at the I-40 eastbound entrance ramp, located just south of this bridge. The new loop ramp constructed in the northwest quadrant of the interchange will not merge into McCrory Lane until passing through the westernmost span of the existing bridge. Once south of the bridge, the new loop ramp will merge into McCrory Lane. This feature will provide capacity for the projected design year traffic volumes on McCrory Lane.

This alternative should be constructed in two phases. The first phase will include the improvements that will provide additional capacity with minimal disruption to existing traffic flows. These Phase One improvements will relieve the congestion

that is expected within the next four to five years and will permanently correct some geometric deficiencies related to intersection skews. The relief of this congestion for the short-term will allow for the process of planning, studying, designing, and constructing the Phase Two improvements which will have environmental and operational impacts. A description of each of these phases is below:

- Phase One - This phase would consist of the reconstruction of the eastbound entrance/exit ramps located south of I-40. McCrory Lane would also be widened to three lanes between the eastbound and westbound ramps during this phase. Additional storage capacity would be provided on the existing westbound exit ramp by extending the existing turning lanes to accommodate future queues. Traffic signals would be installed on McCrory Lane at both eastbound and westbound ramp intersections. This work would be coordinated with and completed within the same time frame that McCrory Lane south of I-40 is widened to a four lane section. Construction of this phase will begin in late 2006 and should be complete by August 2007. The estimated cost of this phase is $3,890,500.

- Phase Two - This phase would complete the interchange improvement project by reconstructing the westbound ramps north of I-40. This work would include a C-D road for the additional westbound exit ramp, the new loop ramp for I-40 westbound traffic exiting to McCrory Lane southbound, and the relocated westbound entrance ramp at the Newsom Station Road intersection. Construction of this phase will begin after Phase One is open and could be completed as soon as the year 2010 but no later the year 2012. The estimated cost of this phase is $6,598,211.

2. Alternate B

Alternate B would relocate McCrory Lane west of the existing interchange. McCrory Lane would have to be relocated from a point approximately 1,500 feet north of I-40 to a point approximately 3,800 feet south of I-40 and create a new location for McCrory Lane to cross I-40. This new interchange would be located approximately 700 feet west of the existing McCrory Lane overpass. New access ramps to I-40 would be constructed in all four quadrants, creating a diamond configured interchange. A new overpass would allow greater than a three-lane cross section on McCrory Lane over I-40.

This alternative would improve the skew that currently exists on McCrory Lane as it travels under I-40. Also, by building a new bridge over McCrory Lane on I-40, capacity for vehicular movement on McCrory Lane could be increased. However, the closely spaced signalized ramp intersections north and south of I-40 on McCrory Lane may restrict capacity due to undesirable coordinated signal spacing and limited storage capacity. Also, due to the nature of the topography and presence of several streams in this area, significant earthwork and environmental impacts will exist with alternatives that feature new interchange locations. This alternative impacts the

existing PUD south of the interchange and the cemetery on the north side of I-40 by relocating McCrory Lane. The cost of this alternative could be greater than $20 million. Further study would be needed to determine feasibility and appropriateness of this alternative.

3. Alternate C (No-Build Option)

Due to the amount of development approved for this area and the forecasted traffic volumes that will be generated by these developments, operations would quickly deteriorate to unacceptable levels after the year 2012. Based upon the need to provide adequate capacity on both I-40 and surface streets, the "no-build" alternative is not a feasible, long-term option. Other items that are not addressed in this alternative are the existing clearance issues on McCrory Lane under I-40, the bad skew and grades on McCrory Lane, and the unavailability of land in the future when improvements are necessary.

C. Environmental Concerns

Preliminary review indicates possible environmental concerns related to earthwork in the northwest quadrant of the interchange. If the interchange is relocated, the effects would be more severe. The purpose of this Interchange Modification Study is to evaluate the operational characteristics of this interchange and of the proposed interchange modifications. No environmental investigations were made in conjunction with this Interchange Modification Study.

CHAPTER 4 - PROPOSED CONDITIONS - ALTERNATE "A"

A. Proposed Operational Performance

1. Interstate 40 Mainline Operations

Anticipated mainline freeway operations during peak travel periods will degrade as traffic on I-40 increases during the period from 2004 to 2030. Heavy traffic volumes oriented to the Nashville central business district (CBD) in the a.m. peak period and away from the Nashville CBD in the p.m. peak period contribute to this operational degradation. During off-peak hours, the level of service on the I-40 mainline will remain at an acceptable level.

In order to mitigate the anticipated congestion that will increase on I-40, the portion of I-40 between exit 196 (U.S. 70/S.R. 1) and the Davidson County/Cheatham County boundary should be widened to include six lanes prior to 2030. Existing bridge structures along this segment of I-40 were modified in the late 1990's to accommodate additional travel lanes on I-40. However, the construction of additional lanes on I-40 is currently not included in any long range planning documents.

Table 5 below shows the summary of I-40 mainline capacity analysis for the design years 2012, 2017, and 2030.

TABLE 5

ALTERNATE "A"

I-40 MAINLINE CAPACITY ANALYSIS SUMMARY

I-40 Mainline Segment	Direction	Measures of Effectiveness	2012 A.M.	2012 P.M.	2017 A.M.	2017 P.M.	2030 A.M.	2030 P.M.
From Exit 188 to Exit 192 (I-40 West of McCrory Ln)	EB	Speed (mph)	- [1]	65.5	- [1]	65.4	- [1]	63.6
		Density (veh/ln-mi)	- [1]	21.3	- [1]	24.2	- [1]	29.4
		LOS	F	C	F	C	F	D
	WB	Speed (mph)	65.5	56.4	65.5	- [1]	65.5	- [1]
		Density (veh/ln-mi)	14.4	39.6	16.3	- [1]	19.3	- [1]
		LOS	B	E	B	F	C	F
From Exit 192 to Exit 196 (I-40 East of McCrory Ln)	EB	Speed (mph)	- [1]	65.5	- [1]	64.7	- [1]	60.8
		Density (veh/ln-mi)	- [1]	23.2	- [1]	27.1	- [1]	33.8
		LOS	F	C	F	D	F	D
	WB	Speed (mph)	65.5	- [1]	65.5	- [1]	65.5	- [1]
		Density (veh/ln-mi)	14.8	- [1]	17.1	- [1]	20.1	- [1]
		LOS	B	F	B	F	C	F

[1] - Indicates that the value is beyond the range of calibration of the procedure

2. Interstate Ramp Junctions

Modifications to the ramp junctions with McCrory Lane at Interstate 40 are scheduled to occur in two phases.

Proposed Phase I improvements to the eastbound ramps include a reconstruction and widening of the ramps to intersect McCrory Lane at a location approximately 250 feet south of I-40. Both ramps are to remain one lane at the I-40 merge and diverge locations, but are proposed to be widened to two lanes at the intersection with McCrory Lane. These improvements will necessitate an additional 530 feet and 330 feet of ramp run-out space along the eastbound mainline for the off-ramp and on-ramp, respectively. No improvements are necessary for Phase II construction.

Phase I improvements to the westbound ramp junctions proposes a widening of the existing off-ramp from Interstate 40 to accommodate separate left and right turn lanes onto McCrory Lane with no modifications necessary at the diverge location from the mainline. No change for the westbound on-ramp to Interstate 40 is scheduled in this phase of construction. In order to accommodate the Biltmore PUD development at full build-out for Phase II, significant modifications will be necessary at the westbound Interstate 40 ramp junctions. A loop ramp is proposed to be constructed in the northwest corner of the interchange that will allow the heavy inbound traffic from Interstate 40 to move freely onto southbound McCrory Lane. This work would include a C-D road for the additional westbound exit ramp with the off-ramp exit gore relocated upstream by approximately 550 feet. The C-D road will continue for approximately 300 more feet to a diverge location with a left lane for southbound McCrory Lane and a right lane for northbound McCrory Lane. Changes to the existing westbound on-ramp include a relocation to the McCrory Lane at Newsom Station Road intersection with an additional 920 feet of ramp run-out space at the merge point with the mainline. The existing Interstate 40 westbound off-ramp should be modified so that only a right turn onto McCrory Lane can be made.

Table 6 provides the ramp capacity analysis at the merge and diverge locations for both directions on Interstate 40 in three design years.

TABLE 6							
ALTERNATE "A"							
INTERSTATE 40 RAMP CAPACITY ANALYSIS RESULTS							
Ramp	**Measure of Effectiveness**	**2012**		**2017**		**2030**	
		A.M.	**P.M.**	**A.M.**	**P.M.**	**A.M.**	**P.M.**
I-40 EB Exit Ramp to McCrory Lane	Speed (mph)	57.2	57.2	56.9	23.0	56.8	56.7
	Density (pc/mi/ln)	40.3	23.7	44.3	45.3	53.4	31.9
	LOS	F	C	F	F	F	D
I-40 EB Entrance Ramp from McCrory Lane	Speed (mph)	40.0	61.0	56.8	59.0	49.0	57.0
	Density (pc/mi/ln)	41.2	22.8	27.0	26.1	36.7	30.7
	LOS	F	C	C	C	F	D
I-40 WB Exit Ramp to McCrory Lane	Speed (mph)	57.2	55.6	56.8	54.9	56.8	54.5
	Density (pc/mi/ln)	16.4	44.4	-13.4	17.5	-10.0	26.9
	LOS	B	F	A	F	A	F
I-40 WB Entrance Ramp from McCrory Lane	Speed (mph)	62.0	54.0	63.0	49.0	62.0	25.0
	Density (pc/mi/ln)	13.6	33.5	13.4	35.3	16.4	42.8
	LOS	B	D	B	F	B	F

The proposed modifications to the westbound exit ramp in Phase Two will create a weave situation south of Newsom Station Road by terminating the ramp into a right turn only lane. The distance between the ramp junction with McCrory Lane and Newsom Station Road will be approximately 400 feet. At the request of TDOT and FHWA staff, we have modeled this weave situation and developed/evaluated two alternative designs for this location. A brief discussion of each of these alternative design is included below:

- Alternative Design 1: This alternative would include modifying the right turn only lane at Newsom Station Road into a through-right lane. This lane would be extended along McCrory Lane north of Newsom Station for an appropriate lane drop distance. The cost of adding this alternative to Phase Two would be approximately $140,000.

- Alternative Design 2: This alternative would include the removal of the westbound exit ramp to northbound McCrory Lane. All westbound exiting traffic would use the new loop ramp to access either McCrory Lane or

Newsom Station Road. The cost of adding this alternative to Phase Two would likely exceed $1,000,000.

This situation and possible alternative designs were modeled using traffic simulation software. The results of the simulations in year 2030 conditions, including the average delay, speed, and maximum queues on the portion of McCrory Lane northbound between the westbound exit ramp and Newsom Station Road, are shown in table 7 below.

TABLE 7

ALTERNATIVE "A"

McCRORY LANE WEAVE ANALYSIS

Condition	Location	Measure of Effectiveness	Year 2030	
			A.M.	P.M.
As Proposed	Northbound on McCrory Lane between WB I-40 Exit Ramp and Newsom Station Road	Avg. Delay (sec./veh.)	13.4	13.5
		Avg. Speed (mph)	14	14
		Max. Queue (ft.)	150	536
Alternative Design 1	Northbound on McCrory Lane between WB I-40 Exit Ramp and Newsom Station Road	Avg. Delay (sec./veh.)	14.1	11.2
		Avg. Speed (mph)	14	15
		Max. Queue (ft.)	144	353
Alternative Design 2	All McCrory Lane traffic exiting to Loop Ramp	Avg. Delay (sec./veh.)	21.6	504.5
		Avg. Speed (mph)	17	13
		Max. Queue (ft.)	114	1,212

Based upon the model results from above, the proposed design and the Alternative Design 1 will experience comparable delays on McCrory Lane and the I-40 westbound exit ramp. However, the maximum queues expected with Alternative Design 1 are less than those expected with the proposed design. Alternative Design 2 could add significant cost to the project and would increase delays and queue lengths, particularly in the p.m. design hour. For this location, the preferred option for construction is Alternative Design 1.

3. McCrory Lane Corridor

Operations on McCrory Lane are expected to degrade with the build-out of the Biltmore development. Proposed changes to the westbound off ramp to McCrory Lane southbound are to relocate it to loop around and pass under the western span of the Interstate 40 bridge before merging into the existing southbound lane on

McCrory Lane. This would convert the movement that now occurs as a westbound left turn at the ramp terminal intersection to a westbound right merge south of the bridge. This feature will provide capacity for the projected design year traffic volumes on McCrory Lane as well as increase the distance between major signalized intersections on McCrory Lane to approximately 1,250 feet, which is a desirable separation distance for traffic signals on arterial roadways. The existing I-40 westbound entrance ramp would be relocated north of the new loop to intersect McCrory Lane at a location that aligns with Newsom Station Road to the east.

Due to the changes in interchange configuration, operations on McCrory Lane are expected to remain at satisfactory levels in the 2012, 2017, and 2030 design years. Table 8 displays the expected capacity analysis for signalized intersections along McCrory Lane.

TABLE 8

ALTERNATE "A"

INTERSECTION CAPACITY ANALYSIS RESULTS

Location	Control	Level-of-Service (Delay - sec./veh.)					
		2012		2017		2030	
		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
McCrory Lane at Newsom Station Road	Signal	C (32.2)	B (11.9)	B (16.9)	B (12.6)	C (21.3)	B (19.6)
McCrory Lane at I-40 Westbound Ramps	Signal	B (14.5)	B (14.7)	- (1)	- (1)	- (1)	- (1)
McCrory Lane at I-40 Eastbound Ramps	Signal	B (14.1)	B (11.8)	B (17.6)	C (26.7)	B (19.7)	C (33.6)

(1) - Ramps relocated in Phase Two

B. Proposed Design Controls and Safety Conditions

The proposed interchange modifications will correct several substandard design and safety features that have previously been identified within this document. Specifically, the following items will be addressed:

- Intersection skews on the I-40 entrance/exit ramps and McCrory Lane will be improved. The I-40 eastbound ramps will intersect McCrory Lane at 90 degrees. The westbound entrance ramp will be relocated to the existing intersection of McCrory Lane and Newsom Station Road. The proposed skew at this intersection will meet current design guidelines.

- Acceleration lane and taper lengths will be increased to meet AASHTO Interstate Design guidelines. The length of existing acceleration lanes may not meet current accepted design guidelines.

In addition to correcting the substandard design features mentioned above, the future access control needs on McCrory Lane south of the I-40 eastbound ramps should be studied. Critical design elements necessary to provide safe and acceptable operation on this roadway segment should be identified. The following access control guidelines will be implemented on McCrory Lane:

- Minimum distance between intersections will be 600 feet.

- Signal spacing will be between 1,250 feet and 1,500 feet.

Based upon these guidelines, drivers will have a minimum of 600 feet to select their lane after passing south of the I-40 eastbound ramps. The first traffic signal will be located no closer than 1,250 feet to the intersection of McCrory Lane and the I-40 eastbound ramps. This control of access and spacing of traffic signals should allow vehicles adequate opportunity to select appropriate lanes for their route of travel. The location of McCrory Lane and spacing of intersections in relationship to Interstate 40 and the Biltmore PUD can be seen in Figure 3, shown previously in this study.

C. Cost

1. Phase One

   Phase One consists of the relocation and widening of the eastbound exit ramp, the widening and minor relocation of the eastbound entrance ramp, the widening of McCrory Lane, and the widening of the westbound exit ramp. The total estimated cost for Phase One, including construction, right-of-way, and utility relocation costs, is $3,890,500.

2. Phase Two

   Phase Two consists of the reconstruction of the westbound exit ramp in the northeast quadrant of the interchange, the new construction of the loop ramp and westbound entrance ramp in the northwest quadrant of the interchange, and improvements to the intersection of McCrory Lane and Newsom Station Road. The total estimated cost for Phase Two, including construction, right-of-way, and utility relocation costs, is $6,598,211.

Cost data sheets are included in Appendix E.

D. Access Point Policy Investigation

This analysis was undertaken in accordance with the Federal Highway Administration's (FHWA) policy for granting new or revised interstate access. The FHWA policy is described in FHWA Docket No. 98-3460, "Additional Interchanges to the Interstate System," (Federal Register 63, No. 28, February 11, 1998). This analysis was conducted to demonstrate the impacts of a revised access point as opposed to providing a new access point to the interstate system. The FHWA requirements are provided in italics along with responses to those identified items.

It is in the national interest to maintain the Interstate System to provide the highest level of service in terms of safety and mobility. Adequate control of access is critical to providing such service. Therefore, new or revised access points to the existing Interstate System should meet the following requirements:

1. *The existing interchanges and/or local roads and streets in the corridor can neither provide the necessary access nor be improved to satisfactorily accommodate the design-year traffic demands while at the same time providing the access intended by the proposal.*

The proposed improvements are to the existing interchange. No additional access points to the interstate system are proposed. The proposed modifications consist of changes to ramps and ramp terminals. The only relevant change to have any effect on I-40 mainline traffic would be the changes for the westbound off-ramp. It is proposed to relocate this ramp gore upstream to the east in order to accommodate a single new off-ramp terminal onto McCrory Lane. Improvements to other ramp gores would be limited to reconstruction and will comply with current design standards.

Without the proposed modifications, the interchange at Interstate 40 and McCrory Lane will not provide a satisfactory level-of-service in future years. Significant queues and long delays are expected without the proposed improvements.

2. *All reasonable alternatives for design options, location and transportation system management type improvements (such as ramp metering, mass transit, and HOV facilities) have been assessed and provided for if currently justified, or provisions are included for accommodating such facilities if a future need is identified.*

Interchange modifications are necessary to accommodate projected traffic demands. The deficiencies associated with the existing ramp terminals cannot be adequately addressed through transportation demand management (TDM) strategies such as ramp metering and improved mass transit. Transit service does not exist in the area. A park-and-ride lot is currently located at exit 196 (U.S. 70/S.R. 1). These TDM measures could reduce the traffic congestion in the area, although not to the extent that would preclude the need for the proposed improvements. The construction of additional lanes on I-40 is currently not included in any long range planning documents; however, expansion of the interstate in the

focus area could provide the added laneage necessary to expand HOV lanes through the interchange. Expansion of the HOV lane system to the west could potentially reduce the rate of increase in the number of single occupant vehicles entering and exiting I-40 at McCrory Lane. However, the introduction of HOV lanes, other congestion management systems, or ITS applications on I-40 will not prevent the anticipated congestion on the mainline and will not offset the need to upgrade the ramp terminals on McCrory Lane.

3. *The proposed access point does not have a significant adverse impact on the safety and operation of the Interstate facility based on an analysis of current and future traffic. The operational analysis for existing conditions shall, particularly in urbanized areas, include an analysis of sections of Interstate to and including at least the first adjacent existing or proposed interchange on either side. Crossroads and other roads and streets shall be included in the analysis to the extent necessary to assure their ability to collect and distribute traffic to and from the interchange with new or revised access points.*

McCrory Lane is the crossroad of the proposed interchange modifications. Operations on McCrory Lane are expected to deteriorate as growth in the area continues. The operational issues associated with congestion at the ramp terminals and the proposals to address it have been reviewed and are reported in this study.

4. *The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" for special purpose access for transit vehicles, for HOV's, or into park and ride lots may be considered on a case-by-case basis. The proposed access will be designed to meet or exceed current standards for Federal-aid projects on the Interstate System.*

The proposed modifications to the interchange will continue to provide for all traffic movements. Phase I modifications will maintain the existing configuration of ramps with respect to the mainline. Phase II will introduce the implementation of a C-D ramp for the westbound exit and a loop in the northwest quadrant of the interchange. The intent is to improve traffic operations for intersections along McCrory Lane. The proposed modifications will continue the “full interchange” status of the location by providing access for all directional movements.

5. *The proposal considers and is consistent with local and regional land use and transportation plans. Prior to final approval, all requests for new or revised access must be consistent with the metropolitan and/or statewide transportation plan, as appropriate, the applicable provisions of 23 CFR part 450 and the transportation conformity requirements of 40 CFR parts 51 and 93.*

This study addresses modifications to the interchange of I-40 with McCrory Lane and is consistent with the local and state transportation plans. Efforts to update the Nashville MPO’s Long Range Transportation Plan with the proposed improvements are being coordinated with MPO planning staff. The proposed improvements to nearby local streets

will also be consistent with the Major Road Plan of Metro Nashville. As such, the proposal is consistent with the most recent conformity determination for the Nashville region.

6. *In areas where the potential exists for future multiple interchange additions, all requests for new or revised access are supported by a comprehensive Interstate network study with recommendations that address all proposed and desired access within the context of a long-term plan.*

At this time, there are no plans for additional access points to Interstate 40 in or near the study area.

7. *The request for a new or revised access generated by new or expanded development demonstrates appropriate coordination between the development and related or otherwise required transportation system improvements.*

The request for modification of the interchange was generated by the future development in the area and is being coordinated with improvements to McCrory Lane to the south of the interstate. The Metro Nashville Department of Public Works and TDOT have been included in the planning process for this interchange modification.

8. *The request for new or revised access contains information relative to the planning requirements and the status of the environmental processing of the proposal.*

Traffic projections for years 2012, 2017, and 2030 were the basis of the traffic analyses performed as part of this study. This traffic data is included in Appendix A. Since this study seeks operational approval only, no environmental investigations were included. If necessary, the environmental impacts of this modification will be assessed later in the project development process.

CHAPTER 5 - SUMMARY AND CONCLUSIONS

The analyses and recommendations contained in this report support the proposed modifications to the interchange at Interstate 40 and McCrory Lane. Without these modifications, this facility will not function at an acceptable level of service as traffic demands increase due to growth and development in the area.

Based upon the analysis included within this study, Alternative "A" provides improved operational performance without significant cost and impact to I-40 or McCrory Lane. Alternative "A" is the preferred interchange modification plan.

A brief summary of the benefits that Alternative "A" provides to existing geometric conditions and future operational performance is included below.

- The relocation of the intersection of McCrory Lane at the eastbound ramps along with the reconstruction of the existing ramps will serve to improve the geometric deficiency at the intersection while improving traffic flow from and onto the ramp terminals.

- Adding a loop ramp in the northwest quadrant of the interchange while utilizing a second span of the interstate overpass will provide a solution to the McCrory Lane deficiencies in the area of interest. This feature will result in the elimination of the expected heavy westbound left turn movements onto McCrory Lane and provide capacity for the projected design year traffic volumes on McCrory Lane by providing for the necessary capacity beneath the existing I-40 overpass structure. The result provides acceptable levels of service for the movements without the construction of a new bridge.

- The new loop ramp and the relocated entrance ramp to align with the intersection of McCrory Lane at Newsom Station Road will serve to increase the distance between major signalized intersections on McCrory Lane to approximately 1,250 feet, which is a desirable separation distance for traffic signals on arterial roadways.

- The existing bridge structure has been rehabilitated to allow for three lanes in each direction on I-40. The bridge currently has an acceptable sufficiency rating, and TDOT has estimated its useful life to be at least 20 to 30 years. By utilizing the existing structure, significant cost and impact can be avoided.

- As shown on Pages 18 and 19, Alternative Design 1 should be implemented to provide acceptable operations on McCrory Lane north of I-40.

APPENDIX

A. FORECASTED TRAFFIC VOLUMES

B. INTERSTATE 40 MAINLINE ANALYSIS

C. INTERSTATE 40 RAMP ANALYSIS

D. INTERSECTION CAPACITY ANALYSIS

E. McCRORY LANE WEAVE MODEL ANALYSIS

F. COST DATA SHEETS

G. FUNCTIONAL PLANS

APPENDIX A

FORECASTED TRAFFIC VOLUMES

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
SHORT RANGE PLANNING AND DATA OFFICE
SUITE 1000, JAMES K. POLK BUILDING
NASHVILLE, TENNESSEE 37243-0344

October 13, 2005

Mr. Joe Griffin
Ragan-Smith Associates, Inc.
315 Woodland Street, P.O. Box 60070
Nashville, TN 37206-0070

Subject: I-40/McCrory Lane Interchange
Traffic Projections
Nashville, Davidson County

Dear Joe:

We have reviewed the revised traffic schematics you submitted on October 7, 2005 for the subject project. The figures have our approval for your use in the study.

Further coordination should be directed to Mr. Hart's office. If I can be of further assistance, please advise.

Sincerely,

Steve Allen
Transportation Manager 2
Short Range Planning and Data Office

Cc: Ms. Jeanne Stevens
Mr. Bill Hart

RAGAN•SMITH
Land Planners • Civil Engineers
Landscape Architects • Surveyors

TECHNICAL PROJECT MEMO

HAND DELIVERED

TO: **Bill Hart, Tennessee Department of Transportation**

FROM: **Joseph F. Griffin, P.E., Ragan-Smith-Associates, Inc.**

SUBJECT: **Interstate 40 at Mccrory Lane**
Interchange Improvements to Serve Biltmore Planned Unit Development

DATE: **October 13, 2005**

COPY: **Mike Updike, Tennessee Department of Transportation**

Introduction

McCrory Lane generally runs in a north-south direction from U.S. 70/S.R. 1 to S.R. 100 in Davidson County, Tennessee. A full diamond interchange with I-40 is located on the northern section of McCrory Lane. Specifically, the Biltmore Planned Unit Development (P.U.D.) contains over 1,000 acres of land and will include 800,000 square feet of commercial uses and 1,400 residential uses. With existing traffic volumes on McCrory Lane in excess of 7,000 vehicles daily, the need for improvements along McCrory Lane and at the I-40 interchange is expected as growth in the area continues. As part of our work with the Biltmore P.U.D., Ragan-Smith has generated traffic volumes and analysis for two future horizons.

Existing Traffic Volumes

Existing traffic in the a.m. and p.m. peak hours of a weekday was counted by Ragan-Smith during November 2004. TDOT annual traffic count stations on McCrory Lane were used to establish existing daily traffic conditions. The daily traffic on McCrory Lane and peak hour traffic at the I-40 interchange on McCrory Lane are shown in the attached figures. As can be seen from the figures, average daily traffic volumes (ADT) are as follows:

TABLE 1		
EXISTING TRAFFIC VOLUMES		
Roadway	**Limits**	**ADT**
McCrory Lane	North of Newsom Station Road	4,607
	Between I-40 WB and I-40 EB	7,008
	South of I-40 EB Ramps	4,959
Newsom Station Road	East of McCrory Lane	4,396
I-40 WB Exit Ramp	East of McCrory Lane	3,127
I-40 WB Entrance Ramp	West of McCrory Lane	1,054
I-40 EB Exit Ramp	West of McCrory Lane	934
I-40 EB Entrance Ramp	East of McCrory Lane	4,117

Traffic Generation

Specific Development Growth

The majority of new traffic generated near the I-40/McCrory Lane interchange will come from several specific developments located on McCrory Lane and Newsom Station Road. Based upon the Biltmore P.U.D. development schedule, traffic volumes and analysis have been generated for two distinct horizons. The first horizon includes 50 percent of the Biltmore P.U.D. and other developments in the area. This horizon is anticipated to occur in the year 2012. The second horizon includes 100 percent of the Biltmore P.U.D. and other developments in the area. This horizon is anticipated to occur in the year 2017. The following specific developments have been considered in the generation of traffic volumes for this area.

- Biltmore P.U.D. - The Biltmore P.U.D. is located on the east and west sides of McCrory Lane south of I-40. The Biltmore P.U.D. will, at full build-out, include 1,400 residential units, 228,000 gross square feet (GSF) of office space, and 800,000 GSF of commercial and retail space. The 2012 analysis horizon includes 50 percent of the Biltmore P.U.D. The 2017 analysis horizon includes the full build-out of the Biltmore P.U.D. Table 2 below shows the 2012 and 2017 trip generation for the Biltmore P.U.D..

TABLE 2							
BILTMORE P.U.D.							
TRIP GENERATION							
Year	**Daily**	**A.M. Peak Hour**			**P.M. Peak Hour**		
		Enter	**Exit**	**Total**	**Enter**	**Exit**	**Total**
2012	16,452	404	423	827	733	740	1,473
2017	32,076	771	815	1,586	1,308	1,260	2,568

- Avondale - The Avondale development is located east of McCrory Lane and south of the Biltmore P.U.D. Avondale will include 571 residential units. The Avondale development was assumed to be at full build-out in both the 2012 and 2017 horizon years.

TABLE 3							
AVONDALE							
TRIP GENERATION							
Year	Daily	A.M. Peak Hour			P.M. Peak Hour		
		Enter	Exit	Total	Enter	Exit	Total
2012	5,166	102	307	409	324	190	514
2017	5,166	102	307	409	324	190	514

- Riverwalk, Lexington Pointe, and Boone Trace - These developments are all being constructed on Newsom Station Road approximately 4,000 feet east of McCrory Lane. Within these three developments, there are 247 residential units that have not yet been built. The completion of the remaining units was assumed to be completed in both the 2012 and 2017 horizon years.

TABLE 4							
RIVERWALK, LEXINGTON POINTE, & BOONE TRACE							
TRIP GENERATION							
Year	Daily	A.M. Peak Hour			P.M. Peak Hour		
		Enter	Exit	Total	Enter	Exit	Total
2012	2,246	40	133	173	144	82	226
2017	2,246	40	133	173	144	82	226

- Branstetter Property - The Branstetter property is located on Newsom Station Road east of McCrory Lane and north of I-40. Commercial retail and convenience market land uses are planned for this property. The Branstetter property will include approximately 115,000 GSF at full build-out. The 2012 horizon year does not include any development on the Branstetter property. The 2017 horizon year includes the full build-out of the Branstetter property.

TABLE 5							
BRANSTETTER PROPERTY							
TRIP GENERATION							
Year	Daily	A.M. Peak Hour			P.M. Peak Hour		
		Enter	Exit	Total	Enter	Exit	Total
2012	-	-	-	-	-	-	-
2017	4,254	38	38	76	142	141	283

A figure showing the location of the developments is attached to this memo. Table 6 below shows the total trips generated by the specific developments considered in the generation of traffic volumes at the interchange of Interstate 40 and McCrory Lane.

TABLE 6							
TOTAL STUDY AREA							
TRIP GENERATION							
Year	Daily	A.M. Peak Hour			P.M. Peak Hour		
		Enter	Exit	Total	Enter	Exit	Total
2012	23,864	546	863	1,409	1,201	1,012	2,213
2017	43,742	951	1,293	2,244	1,918	1,673	3,591

Annual Growth

TDOT historical ADT traffic counts and information from the Nashville Area Metropolitan Planning Organization's (MPO) transportation model was used to calculate an annual growth rate to be used. The purpose of the annual growth rate is to account for unexpected growth due to small scale development and/or general population growth. Historical traffic count data for two TDOT count stations located on McCrory Lane is shown below in Table 7.

TABLE 7		
TDOT HISTORICAL TRAFFIC COUNT DATA		
Year	Davidson County Station 121 (1)	Davidson County Station 125 (2)
1995	2,839	1,583
1996	3,069	1,872
1997	3,779	2,036
1998	3,803	2,066
1999	4,241	2,947
2000	3,379	2,519
2001	4,189	2,998
2002	4,441	3,347
2003	4,565	2,956
2004	4,606	3,043
2005	4,662	3,388
(1) - Located on McCrory Lane north of Newsom Station Road (2) - Located on McCrory Lane south of Poplar Creek Road		

The data presented above shows that traffic on McCrory Lane increased approximately 3.5 percent per year between 1995 and 2005.

The Nashville Area MPO's transportation model indicates that traffic on McCrory Lane will increase from 6,673 vehicles per day (vpd) in 2002 to 10,103 vpd in 2016 and eventually 15,802 vpd in 2025. These growth projections translate into an annual growth of 3.75 percent per year between 2002 and 2025.

Based on the TDOT historical traffic counts and Nashville Area MPO projections, an annual growth rate of 3.5 percent would be appropriate for the McCrory Lane area. However, the specific developments previously discussed are significant components of the future growth in this area. These developments alone contribute the equivalent of 11.1 percent growth per year to the roadways in the area.

Therefore, based upon the above, we will include additional unexpected growth due to small scale development and/or general population growth by increasing existing traffic by ***1.5 percent annually*** for the period from 2004 to 2017.

Projected traffic volumes for the year 2030 were calculated by increasing 2017 base traffic volumes by ***1.5 percent annually*** for the period from 2017 to 2030. Traffic generated by the specific developments mentioned previously was applied to the 2030 base volumes to develop traffic volumes for the year 2030 horizon.

Traffic Distribution and Assignment

Traffic volumes for the specific developments in the area were distributed throughout the roadway network. Generally, these distribution percentages were derived from existing traffic flows and the location of work and residential attractions in the region.

The attached figures show ADT's and DHV's for the existing traffic, the 2012 horizon year, the 2017 horizon year, and the 2030 horizon year.

Traffic Analysis

Intersection Capacity Analysis

Capacity analyses were run on the following intersections for the existing traffic, the 2012 horizon year, the 2017 horizon year, and the 2030 horizon year.

- McCrory Lane at Newsom Station Road
- McCrory Lane at I-40 Westbound Ramps
- McCrory Lane at I-40 Eastbound Ramps

The results of the capacity analyses are shown below in Table 8.

TABLE 8				
INTERSECTION CAPACITY ANALYSIS RESULTS				
Intersection	**Horizon Year**	**Control**	**Level-of-Service**	
			A.M.	**P.M.**
McCrory Lane at Newsom Station Road	2004	Signal	A	A
	2012	Signal	C	B
	2017	Signal	B	B
	2030	Signal	C	B
McCrory Lane at I-40 Westbound Ramps	2004	Unsignalized	C / A / A [(1)]	C / B / A [(1)]
	2012	Signal	B	B
	2017	- [(2)]	- [(2)]	- [(2)]
	2030	- [(2)]	- [(2)]	- [(2)]
McCrory Lane at I-40 Eastbound Ramps	2004	Unsignalized	F / A / A [(3)]	C / A / A [(3)]
	2012	Signal	B	B
	2017	Signal	B	C
	2030	Signal	B	C

[(1)] - WB L / WB TR / NB LT
[(2)] - Phase II interchange modifications result in removal of this intersection
[(3)] - EB L / EB TR / SB LT

As part of the intersection capacity analysis process, 95 percentile queue lengths were calculated at intersections along McCrory Lane. Several significant locations were checked to determine the adequacy of available storage capacity. Specifically, the queue lengths on I-40 exit ramps and on McCrory Lane between I-40 access ramp intersections were evaluated.

A summary of 95 percentile queue lengths and available storage for the I-40 exit ramps is shown below in Table 9A.

TABLE 9A				
I-40 EXIT RAMP 95% QUEUES				
Location	**Horizon Year**	**95% Queue Length (ft.)**		**Available Storage (ft.)**
		A.M. Peak Hour	**P.M. Peak Hour**	
I-40 Eastbound Exit Ramp	2004	53 / 13 (1)	3 / 3 (1)	-
	2012	44 / 54 (1)	29 / 60 (1)	500
	2017	61 / 114 (1)	64 / 340 (1)	500
	2030	69 / 172 (1)	84 / 441 (1)	500
I-40 Westbound Exit Ramp	2004	5 / 9 (1)	27 / 56 (1)	-
	2012	229 / 55 (1)	313 / 95 (1)	500
	2017	- (2)	- (2)	- (2)
	2030	- (2)	- (2)	- (2)
(1) - Left Turn / Right Turn (2) - Interchange modification creates additional lanes and free-flow operation				

A summary of 95 percentile queue lengths and available storage for McCrory Lane within the limits of the I-40 interchange is shown below in Table 9B.

TABLE 9B				
McCRORY LANE 95% QUEUES				
Location	**Horizon Year**	**95% Queue Length (ft.)**		**Available Storage (ft.)**
		A.M. Peak Hour	**P.M. Peak Hour**	
McCrory Lane SB at I-40 EB Ramps	2004	44	10	-
	2012	136 / 83 (1)	55 / 92 (1)	250 / 750
	2017	240 / 54 (1)	144 / 113 (1)	250 (3) / 1353
	2030	261 / 67 (1)	200 / 182 (1)	250 (3) / 1353
McCrory Lane NB at I-40 WB Ramps	2004	5	6	-
	2012	184 / 1 (1)	178 / 11 (1)	200 / 750
	2017	- (1)	- (1)	- (1)
	2030	- (1)	- (1)	- (1)

TABLE 9B				
McCRORY LANE 95% QUEUES				
Location	**Horizon Year**	**95% Queue Length (ft.)**		**Available Storage (ft.)**
		A.M. Peak Hour	**P.M. Peak Hour**	
McCrory Lane NB at Newsom Station Road	2004	36	51	-
	2012	127	205	575
	2017	47 / 32	41 / 144	200 / 575
	2030	83 / 18	152 / 244	200 / 575

(1) - Left Turn / Through Movement
(2) - Interchange modification creates additional lanes and free-flow operation
(3) - Double left turn lanes: one lane with 250' storage, one lane with >400' storage

Interstate Capacity Analysis

Capacity analyses were run on segments of Interstate 40 near McCrory Lane to determine the existing operational level of service and to assess the impact of future growth to operations on Interstate 40. The results of the capacity analyses are shown below in Table 10.

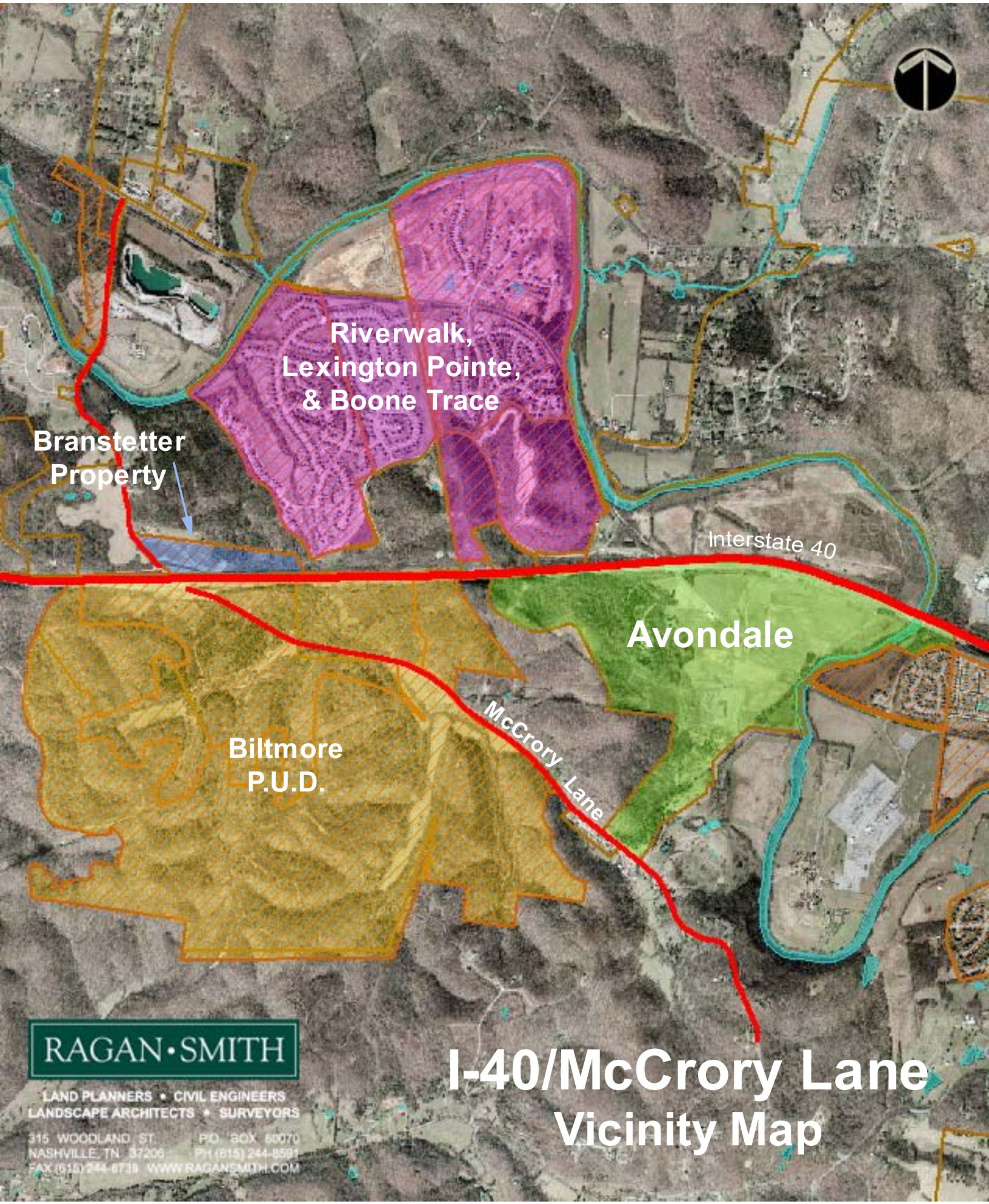
TABLE 10			
INTERSTATE CAPACITY ANALYSIS			
Segment	**Horizon Year**	**Level-of-Service**	
		A.M.	**P.M.**
I-40 WB East of McCrory Lane	2004	B	D
	2012	B	F
	2017	B	F
	2030	C	F
I-40 WB at McCrory Lane	2004	A	D
	2012	B	D
	2017	B	E
	2030	B	F

TABLE 10			
INTERSTATE CAPACITY ANALYSIS			
Segment	**Horizon Year**	**Level-of-Service**	
		A.M.	**P.M.**
I-40 WB West of McCrory Lane	2004	B	D
	2012	B	E
	2017	B	F
	2030	C	F
I-40 EB Wwest of McCrory Lane	2004	D	B
	2012	F	C
	2017	F	C
	2030	F	D
I-40 EB at McCrory Lane	2004	D	B
	2012	E	C
	2017	E	C
	2030	F	C
I-40 EB East of McCrory Lane	2004	E	B
	2012	F	C
	2017	F	D
	2030	F	D

Interstate Ramp Analysis

An evaluation of the ramp-freeway junction influence area with capacity checks for major merge and diverge situations was performed for existing ramp junction conditions and future horizon year ramp junctions. The methodology for analysis of ramp-freeway junctions is found in Chapter 25 of the Highway Capacity Manual. Ramp capacity and level of service results are shown in Table 11 below.

TABLE 11			
INTERSTATE RAMP ANALYSIS			
Ramp	**Horizon Year**	**Level-of-Service**	
		A.M.	**P.M.**
I-40 WB Exit Ramp	2004	B	D
	2012	B	F
	2017	A	F
	2030	A	F
I-40 WB Entrance Ramp	2004	B	E
	2012	B	F
	2017	B	F
	2030	B	F
I-40 EB Exit Ramp	2004	D	B
	2012	F	C
	2017	F	C
	2030	F	C
I-40 EB Entrance Ramp	2004	F	C
	2012	F	C
	2017	F	C
	2030	F	D



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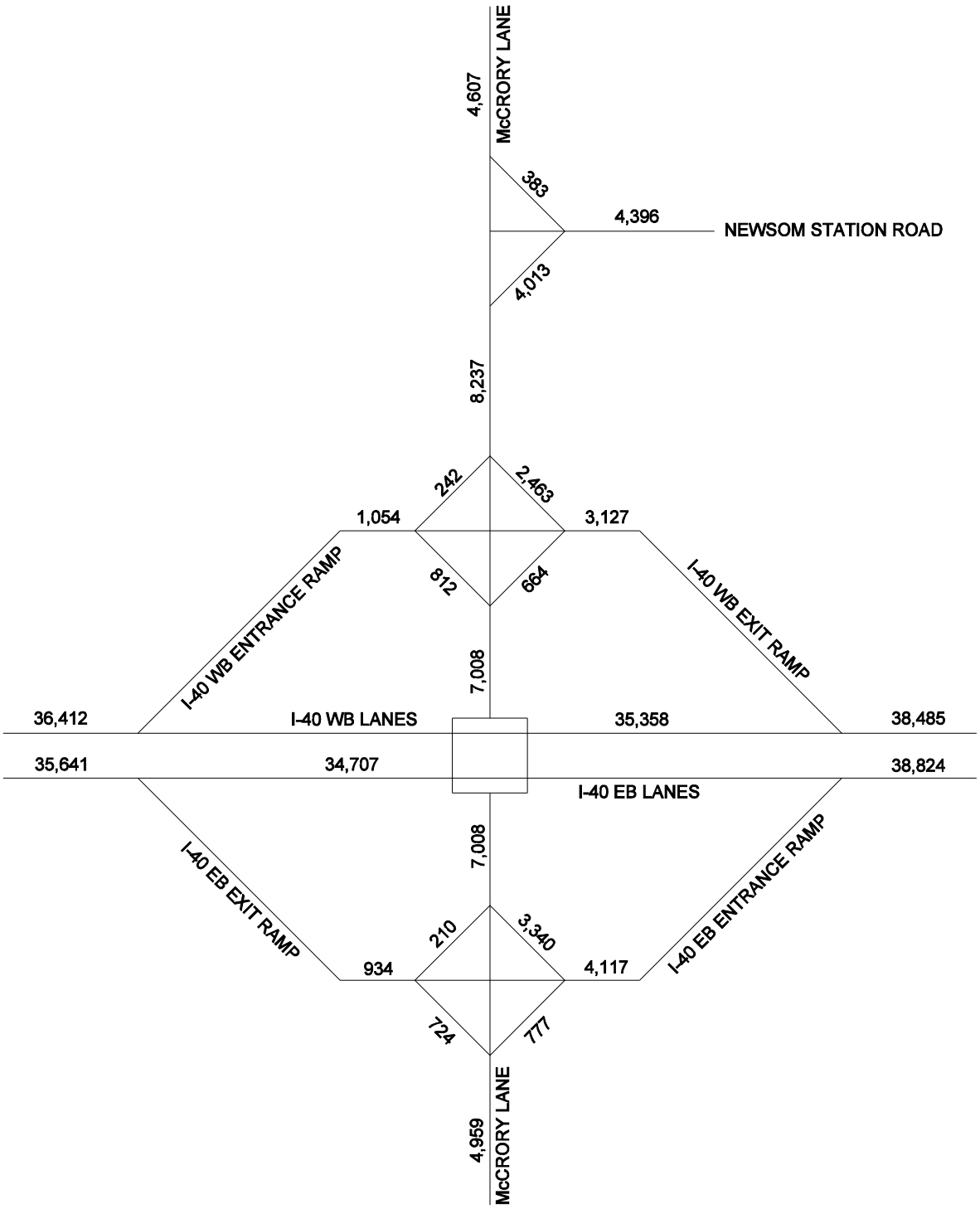
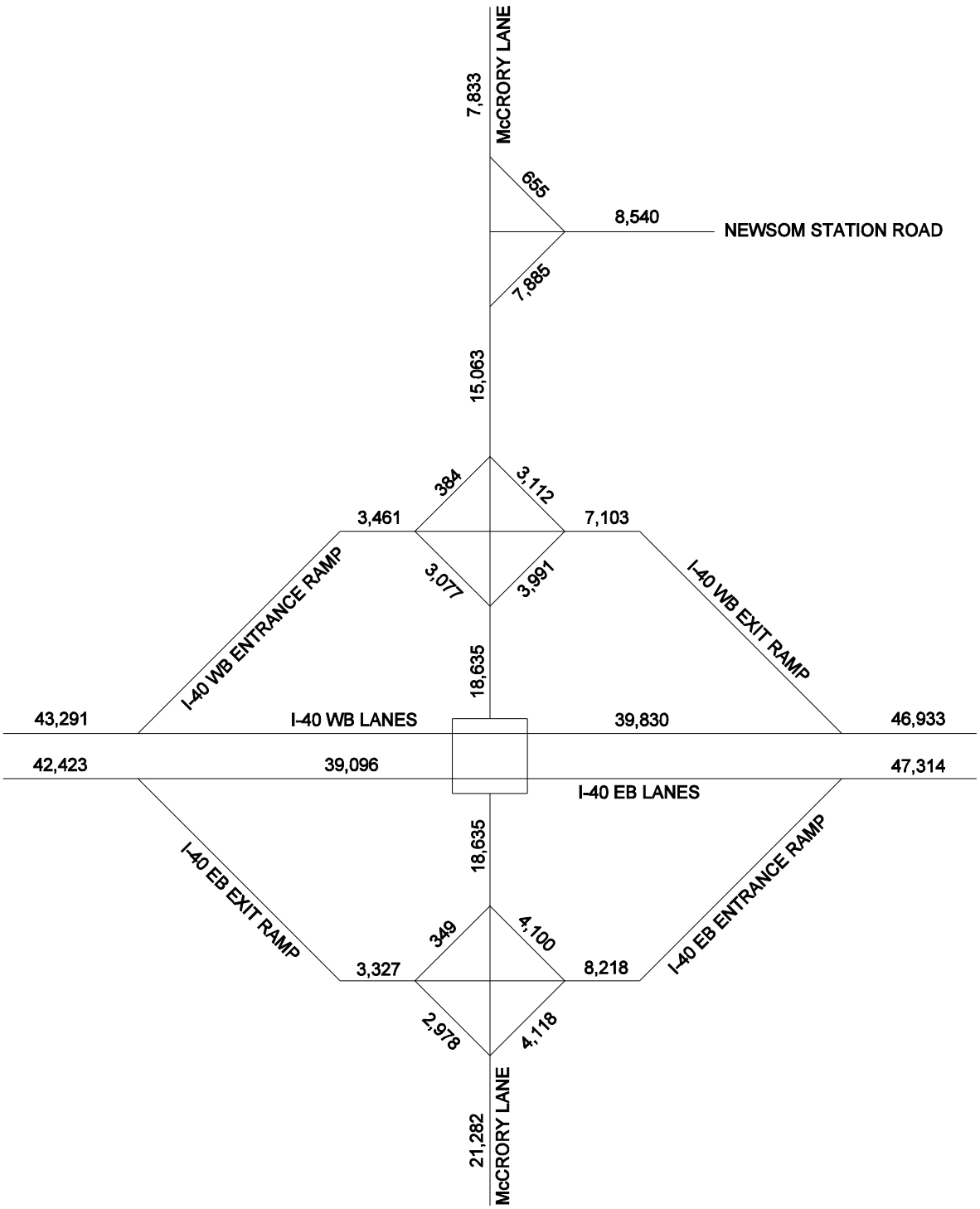
FAX (615) 244-8739 WWW.RAGANSMITH.COM

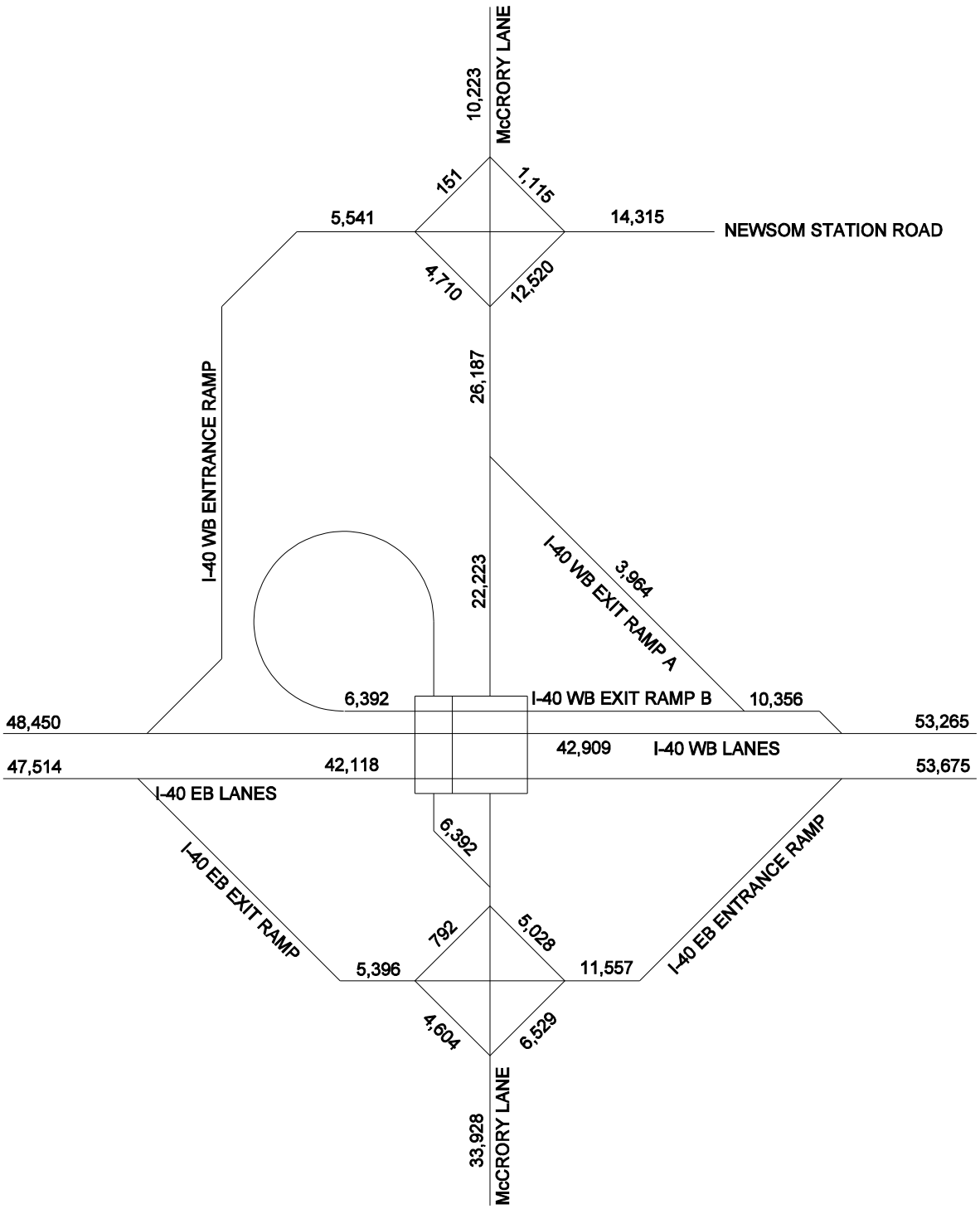
I-40/McCrory Lane
Vicinity Map



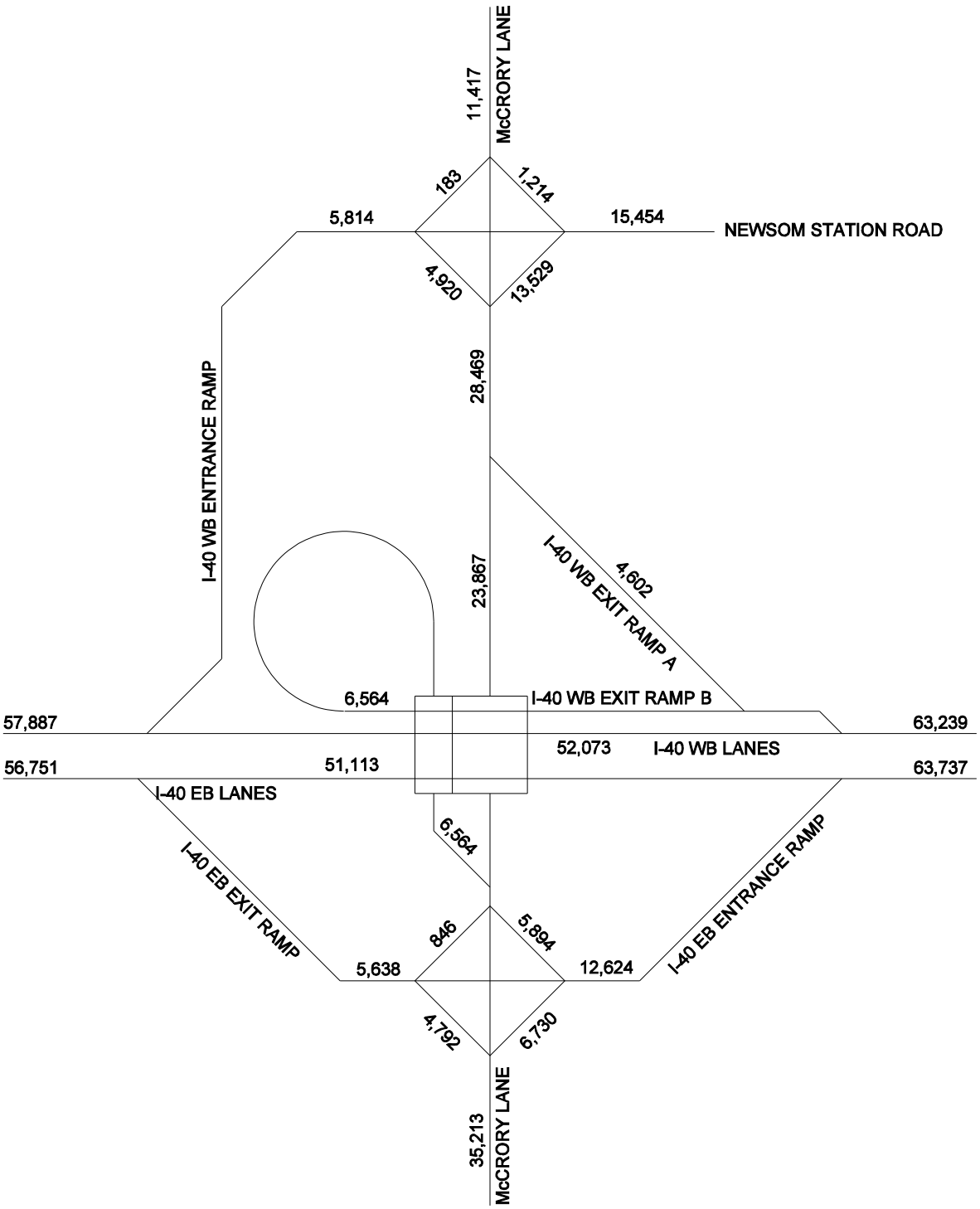
BILTMORE P.U.D.
2004 EXISTING ADT VOLUMES



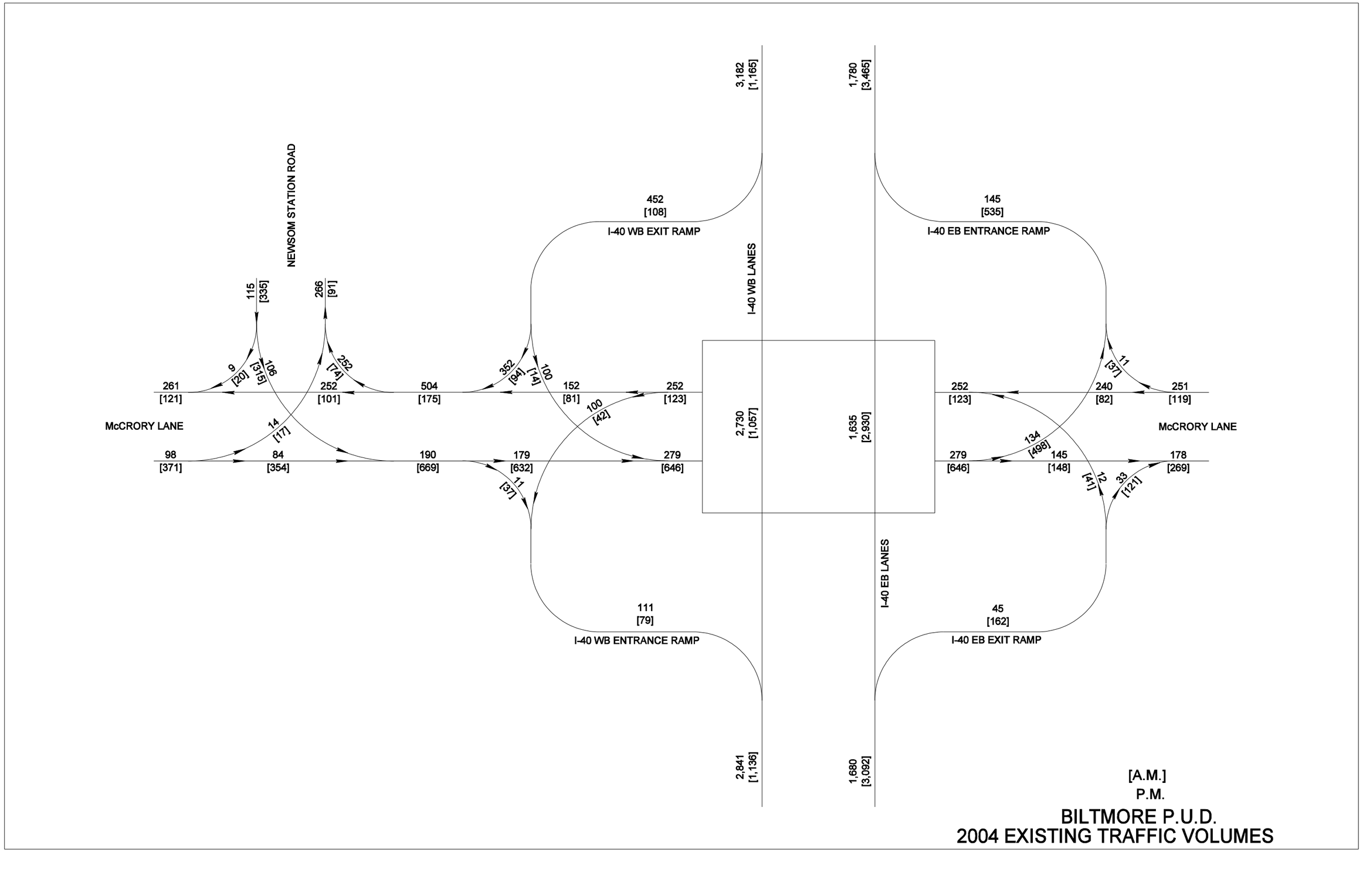
BILTMORE P.U.D.
PHASE I ADT VOLUMES
(APPROX. HORIZON YEAR - 2012)



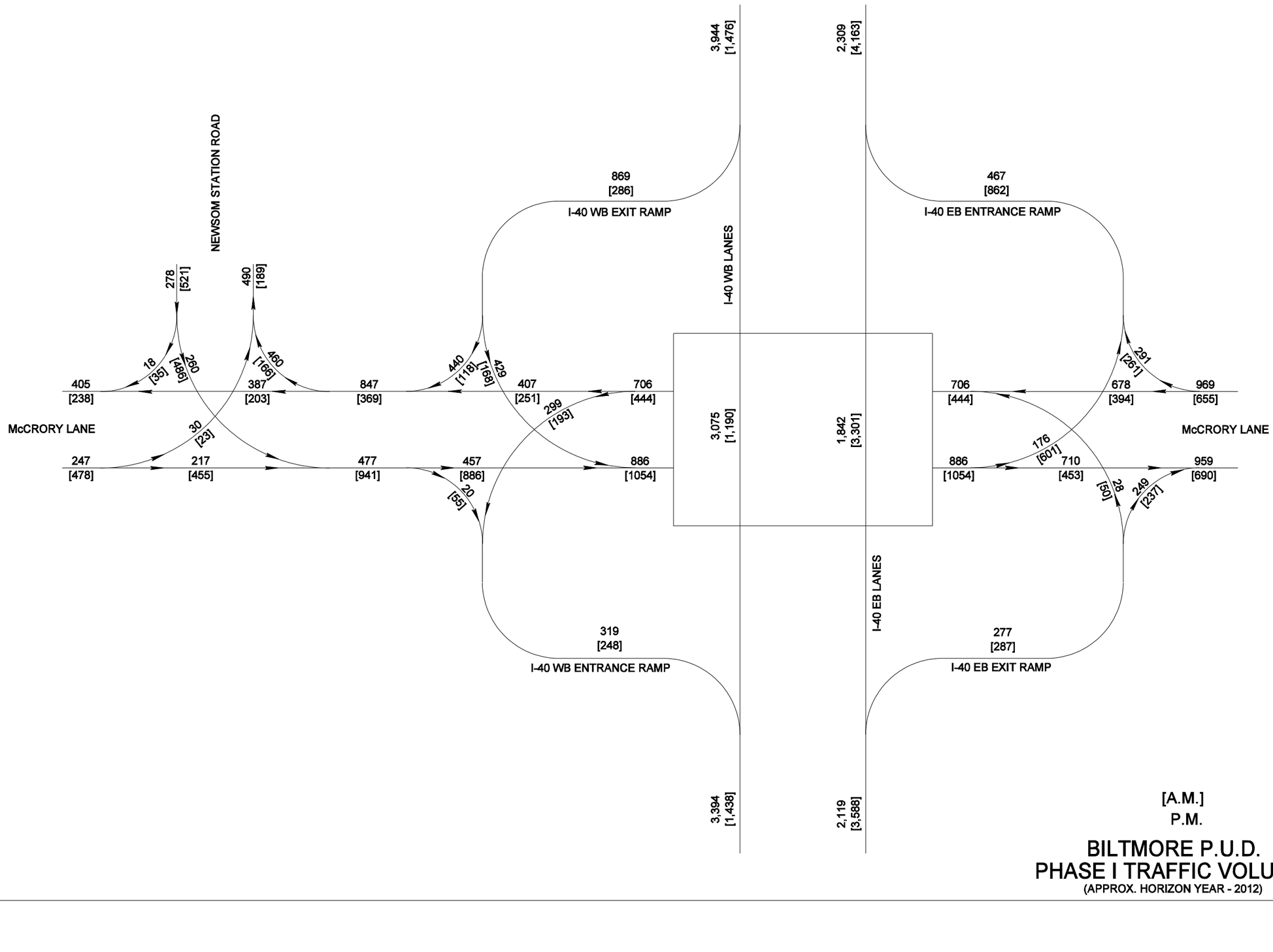
BILTMORE P.U.D.
PHASE II ADT VOLUMES
(APPROX. HORIZON YEAR - 2017)



BILTMORE
YEAR 2030 TRAFFIC VOLUMES



BILTMORE P.U.D.
2004 EXISTING TRAFFIC VOLUMES


NEWSOM STATION ROAD
I-40 WB LANES
I-40 EB LANES
3,944
[1,476]
2,309
[4,163]
869
[286]
I-40 WB EXIT RAMP
467
[862]
I-40 EB ENTRANCE RAMP
278
[521]
490
[189]
18
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260
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440
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429
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291
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678
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McCRORY LANE
McCRORY LANE
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217
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477
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886
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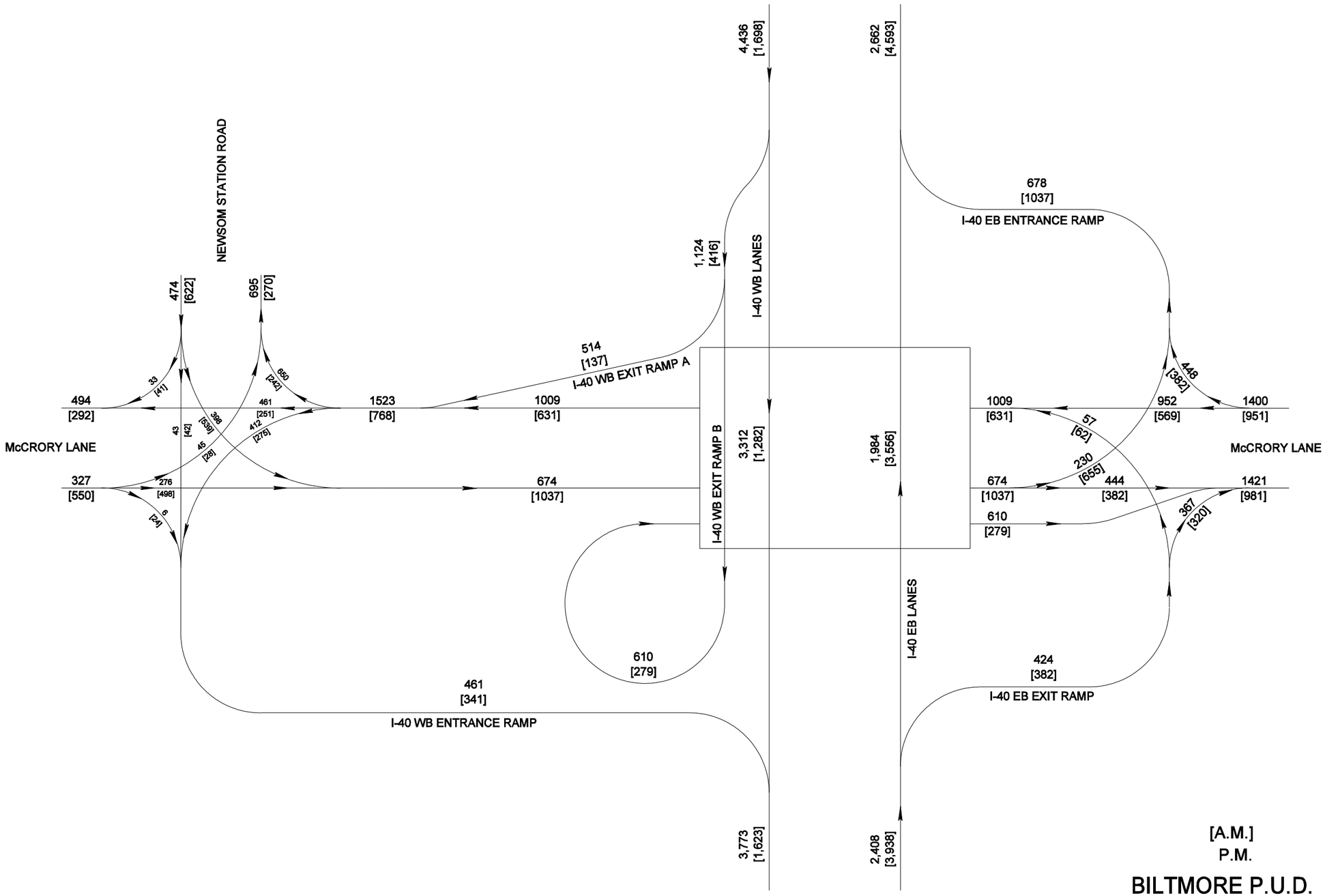
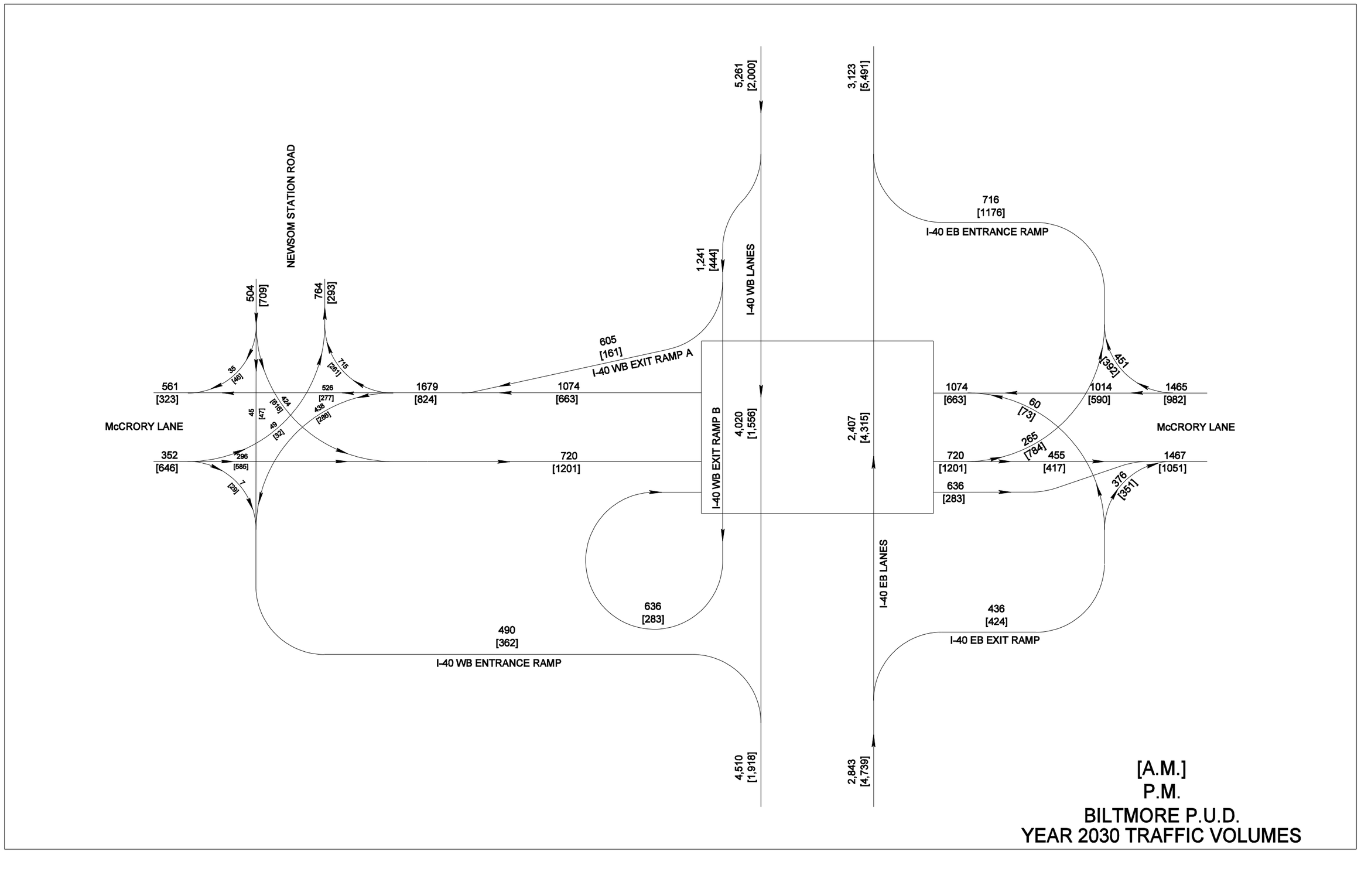
886
[1054]
710
[453]
959
[690]
20
[55]
28
[50]
249
[237]
319
[248]
I-40 WB ENTRANCE RAMP
277
[287]
I-40 EB EXIT RAMP
3,394
[1,438]
2,119
[3,588]
[A.M.]
P.M.
BILTMORE P.U.D.
PHASE I TRAFFIC VOLUMES
(APPROX. HORIZON YEAR - 2012)



[A.M.]
P.M.

BILTMORE P.U.D.
PHASE II TRAFFIC VOLUMES
(APPROX. HORIZON YEAR - 2017)


NEWSOM STATION ROAD
I-40 WB LANES
I-40 EB LANES
I-40 WB EXIT RAMP A
I-40 WB EXIT RAMP B
I-40 WB ENTRANCE RAMP
I-40 EB ENTRANCE RAMP
I-40 EB EXIT RAMP
McCRORY LANE
McCRORY LANE
5,261 [2,000]
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2,843 [4,739]
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715 [261]
1679 [824]
1074 [663]
1074 [663]
1014 [590]
1465 [982]
45 [47]
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49 [32]
438 [286]
60 [73]
352 [646]
296 [585]
7 [29]
720 [1201]
720 [1201]
265 [784]
455 [417]
1467 [1051]
636 [283]
376 [351]
636 [283]
490 [362]
436 [424]
[A.M.]
P.M.
BILTMORE P.U.D.
YEAR 2030 TRAFFIC VOLUMES

APPENDIX B

INTERSTATE 40 MAINLINE ANALYSIS

B.1 2004 INTERSTATE 40 MAINLINE ANALYSIS

B.2 2012 INTERSTATE 40 MAINLINE ANALYSIS

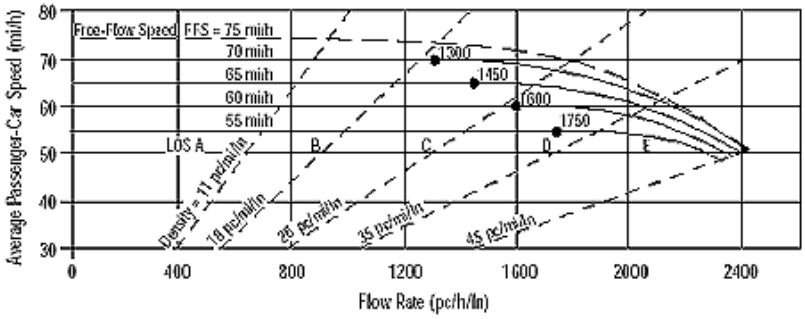
B.3 2017 INTERSTATE 40 MAINLINE ANALYSIS

B.4 2030 INTERSTATE 40 MAINLINE ANALYSIS

APPENDIX B.1

2004 INTERSTATE 40
MAINLINE 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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Exit Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1165 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	766	pc/h/ln
S	65.5	mi/h
D = v_p / S	11.7	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	

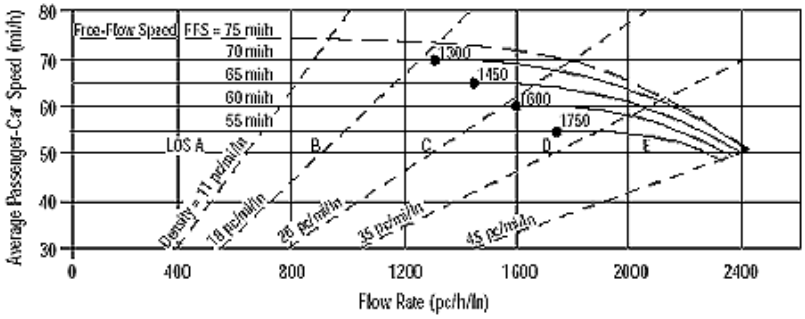
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Westbound
Agency or Company	RSA	From/To	I-40 @ McCrory Exit Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3182 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2093	pc/h/ln
S	60.0	mi/h
D = v_p / S	34.9	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	

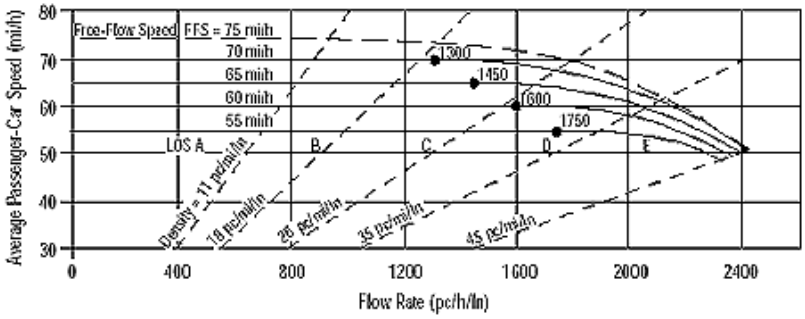
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1057 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	695	pc/h/ln
S	65.5	mi/h
D = v_p / S	10.6	pc/mi/ln
LOS	A	

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	

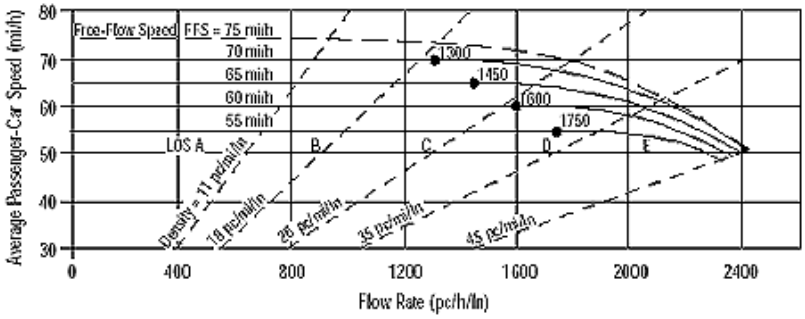
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	2730 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1795	pc/h/ln
S	64.4	mi/h
D = v_p / S	27.9	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	

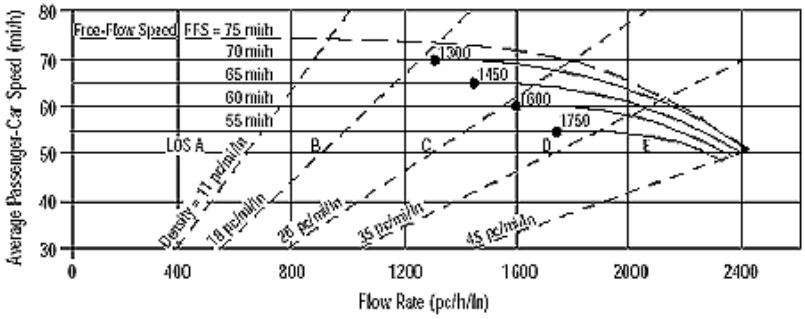
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Entrance Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1136 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	747	pc/h/ln
S	65.5	mi/h
D = v_p / S	11.4	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	

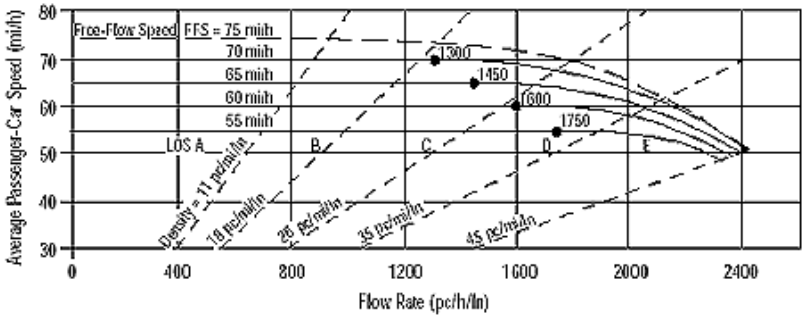
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Entrance Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	2841 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1868	pc/h/ln
S	63.6	mi/h
D = v_p / S	29.4	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	

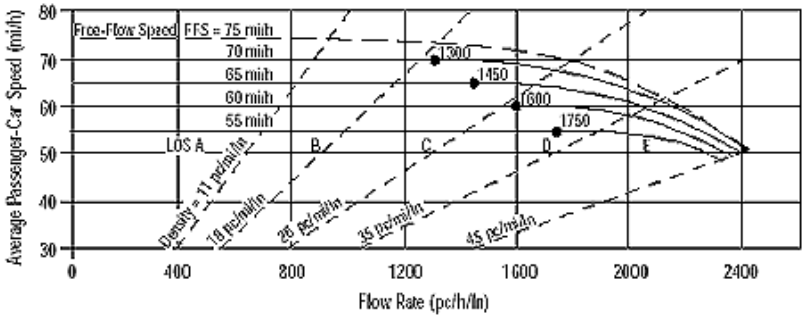
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Entrance Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3465 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2279	pc/h/ln
S	55.0	mi/h
D = v_p / S	41.5	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	

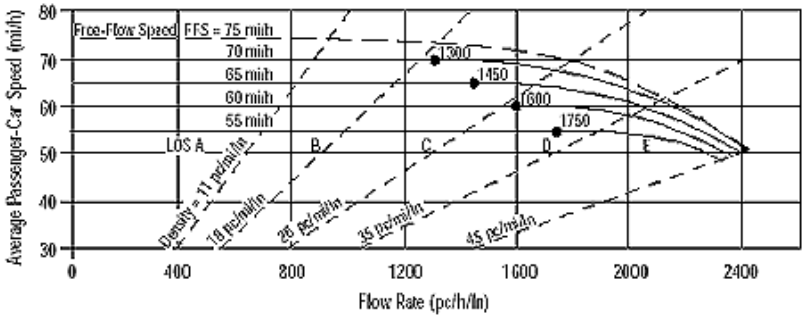
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Entrance Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1780 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1171	pc/h/ln
S	65.5	mi/h
D = v_p / S	17.9	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	

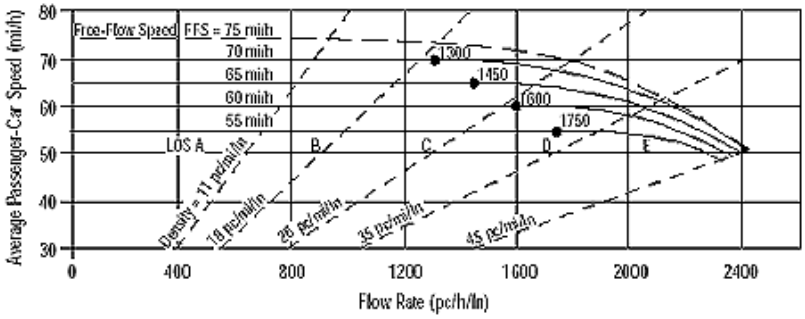
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	2930 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1927	pc/h/ln
S	62.9	mi/h
D = v_p / S	30.6	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	

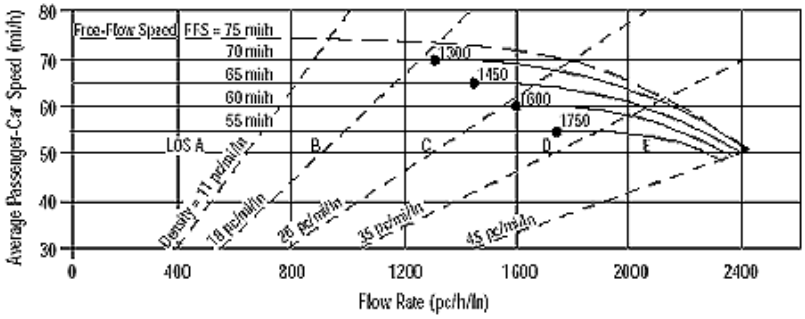
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Eastbound
Agency or Company	RSA	From/To	I-40 @ McCrory Bridge
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1635 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1075	pc/h/ln
S	65.5	mi/h
D = v_p / S	16.4	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	

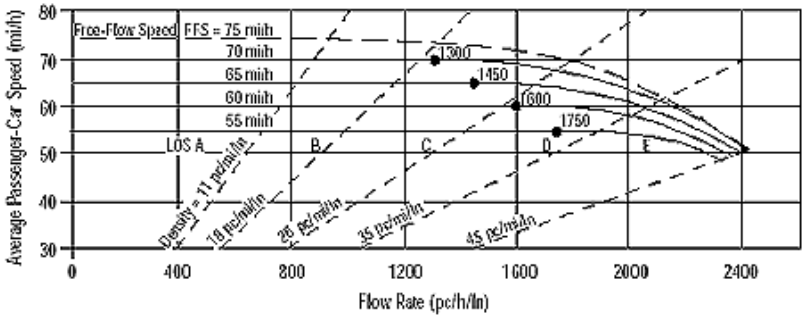
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Exit Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3092 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2033	pc/h/ln
S	61.2	mi/h
D = v_p / S	33.2	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	

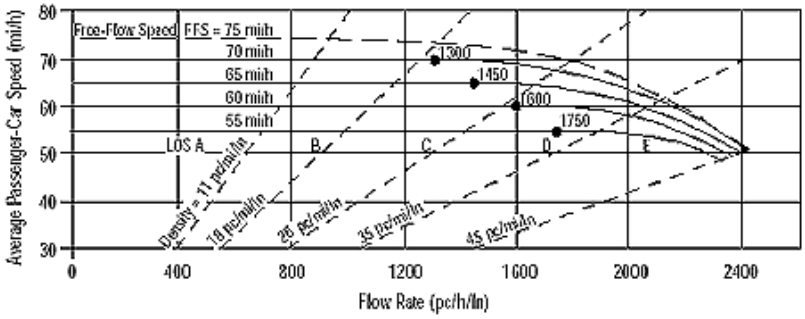
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Exit Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2004 Existing Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1680 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1105	pc/h/ln
S	65.5	mi/h
D = v_p / S	16.9	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	

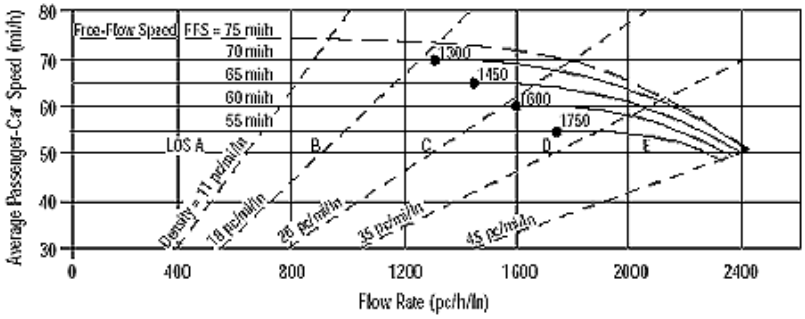
Factor Location

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

APPENDIX B.2

2012 INTERSTATE 40 MAINLINE 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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Exit Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1476 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	971	pc/h/ln
S	65.5	mi/h
D = v_p / S	14.8	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	

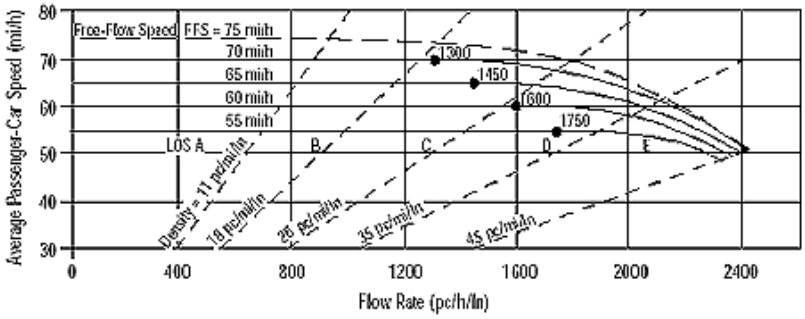
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Westbound
Agency or Company	RSA	From/To	I-40 @ McCrory Exit Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3944 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2594	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		

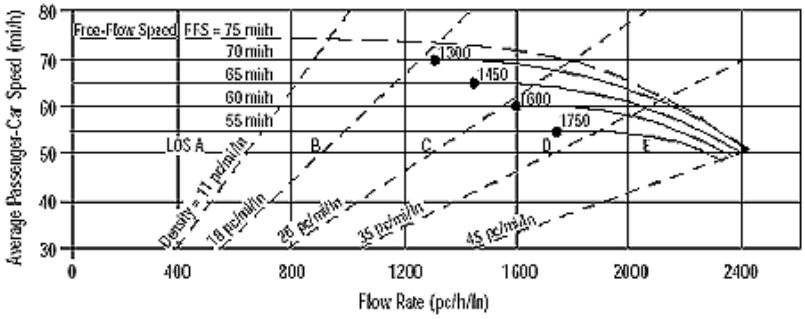
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1190 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	783	pc/h/ln
S	65.5	mi/h
D = v_p / S	12.0	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	

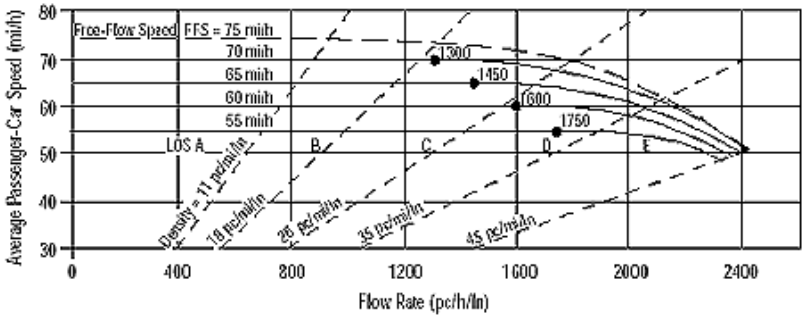
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Westbound
Agency or Company	RSA	From/To	I-40 @ McCrory Bridge
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3075 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2022	pc/h/ln
S	61.4	mi/h
D = v_p / S	32.9	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	

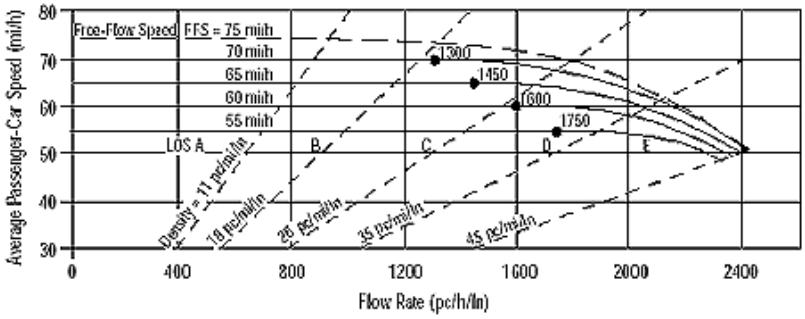
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Entrance Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1438 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	946	pc/h/ln
S	65.5	mi/h
D = v_p / S	14.4	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	

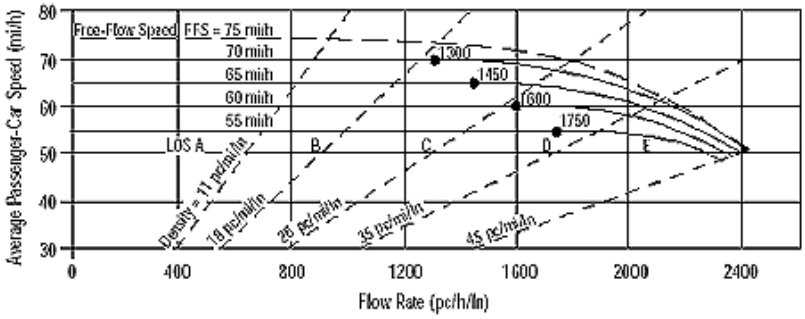
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Westbound
Agency or Company	RSA	From/To	I-40 @ McCrory Entrance Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3394 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2232	pc/h/ln
S	56.4	mi/h
D = v_p / S	39.6	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	

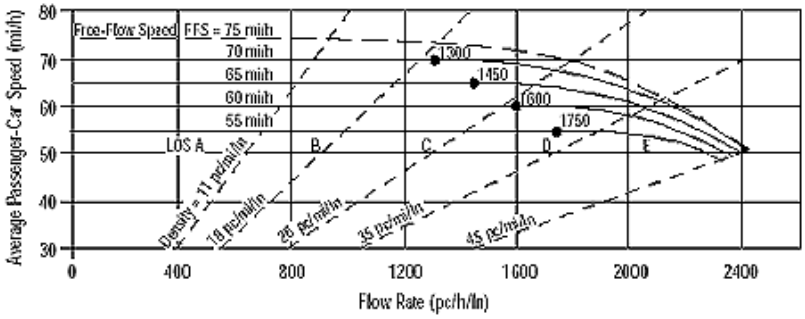
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Eastbound
Agency or Company	RSA	From/To	I-40 @ McCrory Entrance Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	4163 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2738	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	

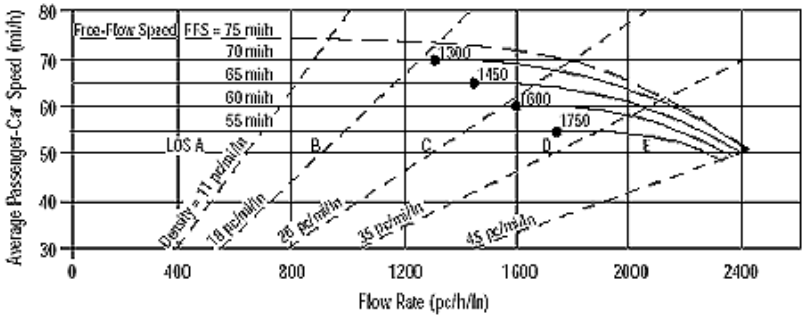
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Eastbound
Agency or Company	RSA	From/To	I-40 @ McCrory Entrance Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	2309 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1518	pc/h/ln
S	65.5	mi/h
D = v_p / S	23.2	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	

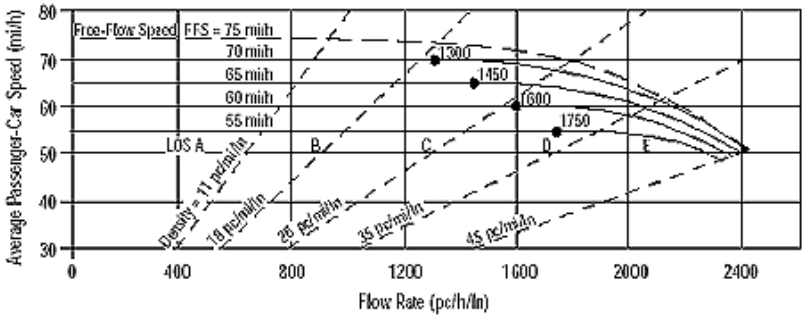
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3301 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2171	pc/h/ln
S	58.1	mi/h
D = v_p / S	37.3	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	

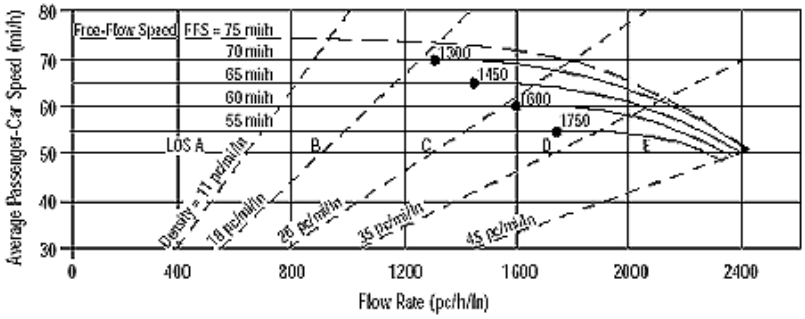
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1842 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1211	pc/h/ln
S	65.5	mi/h
D = v_p / S	18.5	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	

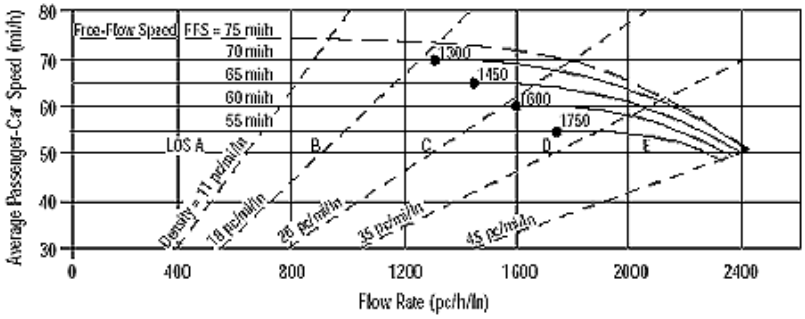
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Eastbound
Agency or Company	RSA	From/To	I-40 @ McCrory Exit Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3588 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2359	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	

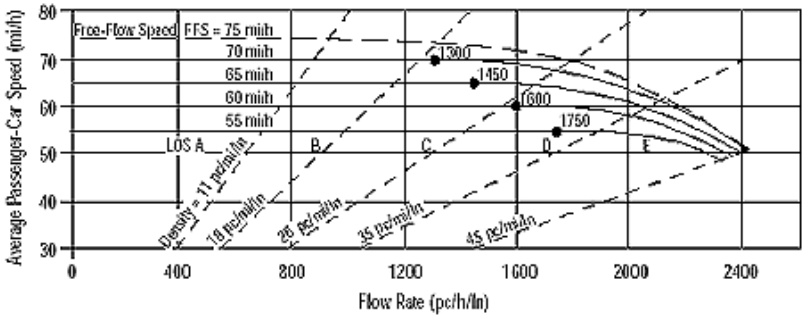
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Exit Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2012 Phase I Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	2119 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1393	pc/h/ln
S	65.5	mi/h
D = v_p / S	21.3	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	

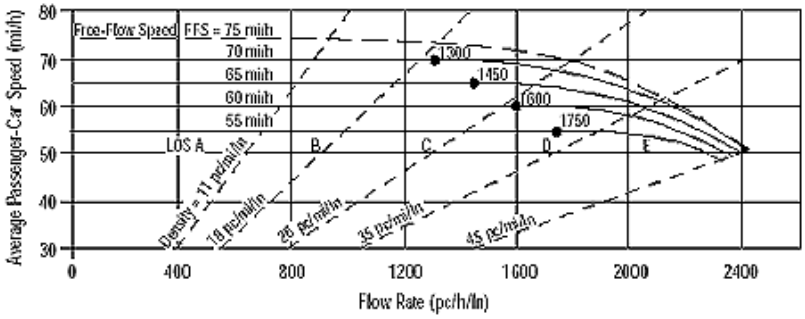
Factor Location

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

APPENDIX B.3

2017 INTERSTATE 40 MAINLINE 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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Exit Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1698 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1117	pc/h/ln
S	65.5	mi/h
D = v_p / S	17.1	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	

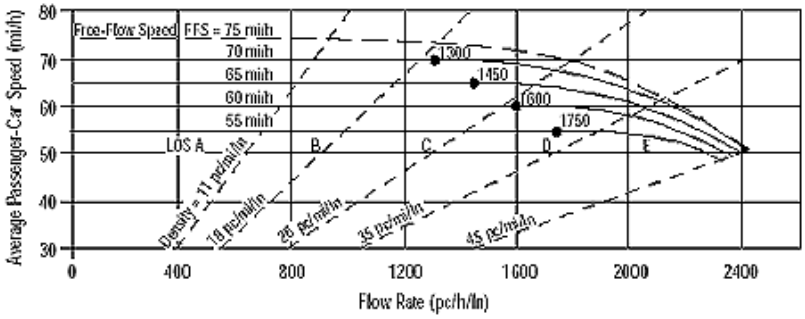
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Exit Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	4436 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2917	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	

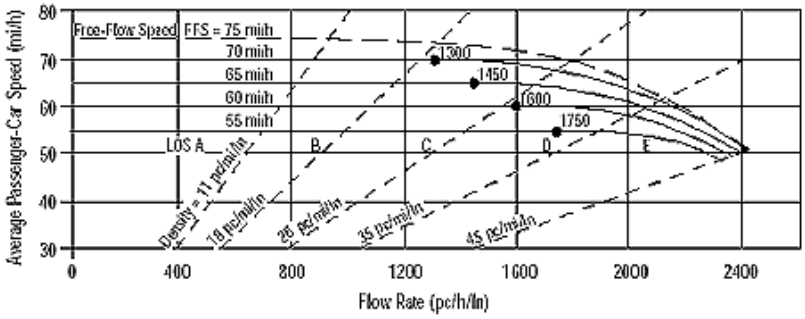
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1282 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	843	pc/h/ln
S	65.5	mi/h
D = v_p / S	12.9	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	

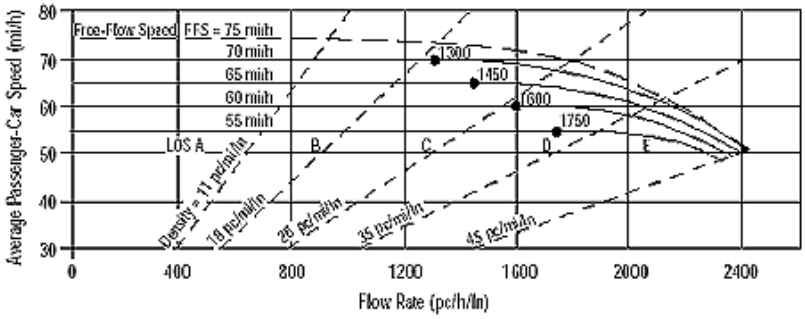
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Westbound
Agency or Company	RSA	From/To	I-40 @ McCrory Bridge
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3312 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2178	pc/h/ln
S	57.9	mi/h
D = v_p / S	37.6	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	

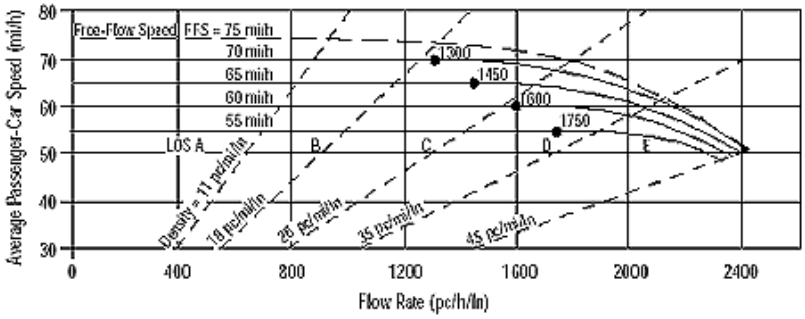
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40Westbound
Agency or Company	RSA	From/To	I-40 @ McCrory Entrance Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1623 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1067	pc/h/ln
S	65.5	mi/h
D = v_p / S	16.3	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	

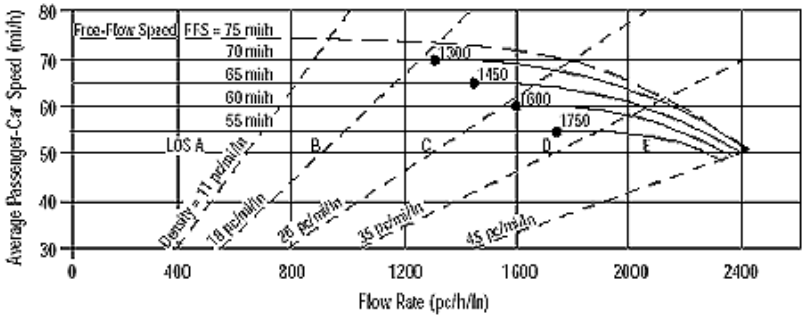
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Westbound
Agency or Company	RSA	From/To	I-40 @ McCrory Entrance Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3773 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2481	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	

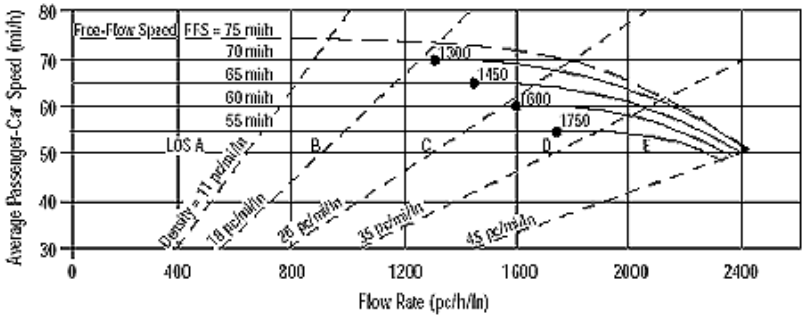
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Eastbound
Agency or Company	RSA	From/To	I-40 @ McCrory Entrance Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	4593 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	3020	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	

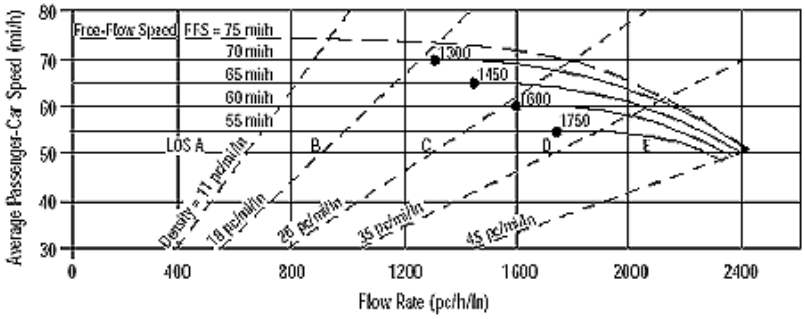
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Entrance Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	2662 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1751	pc/h/ln
S	64.7	mi/h
D = v_p / S	27.1	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	

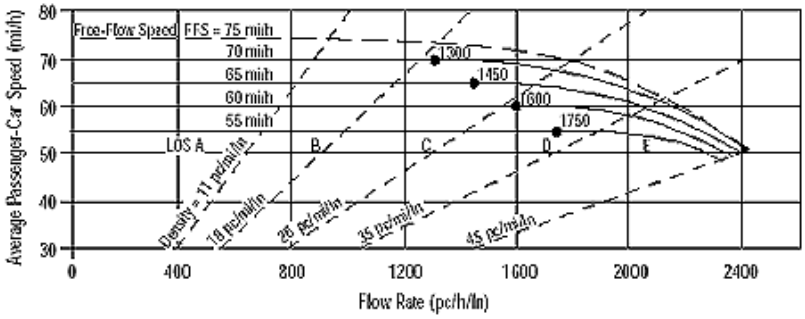
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3556 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2338	pc/h/ln
S	53.0	mi/h
D = v_p / S	44.1	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	

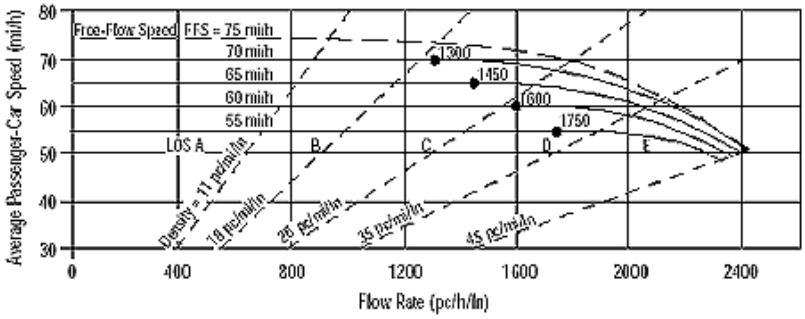
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Eastbound
Agency or Company	RSA	From/To	I-40 @ McCrory Bridge
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1984 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1305	pc/h/ln
S	65.5	mi/h
D = v_p / S	19.9	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	

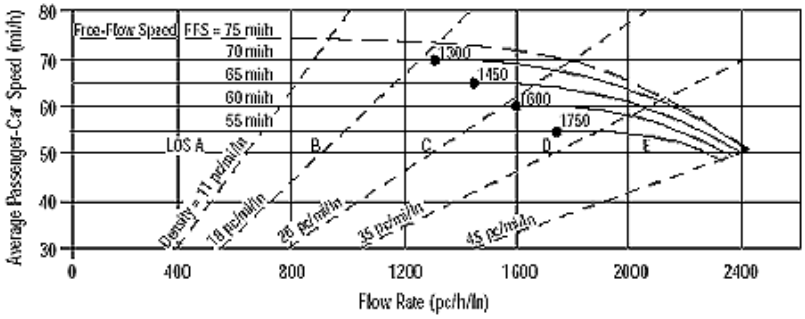
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Eastbound
Agency or Company	RSA	From/To	I-40 @ McCrory Exit Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3938 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2590	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	

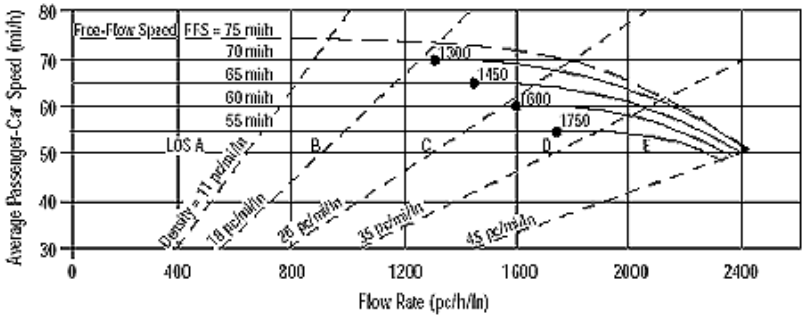
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Eastbound
Agency or Company	RSA	From/To	I-40 @ McCrory Exit Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	2408 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1584	pc/h/ln
S	65.4	mi/h
D = v_p / S	24.2	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	

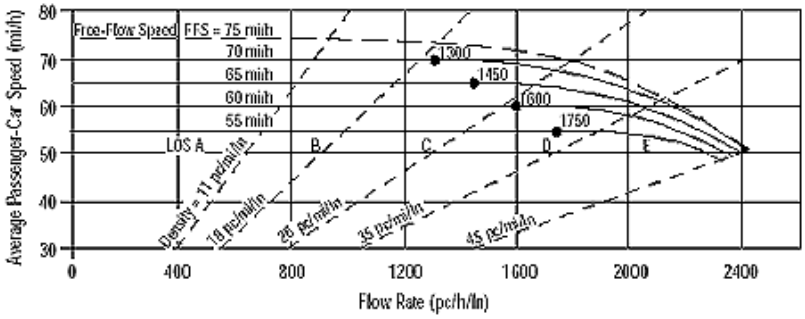
Factor Location

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

APPENDIX B.4

2030 INTERSTATE 40 MAINLINE 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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Exit Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	2000 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1315	pc/h/ln
S	65.5	mi/h
D = v_p / S	20.1	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	

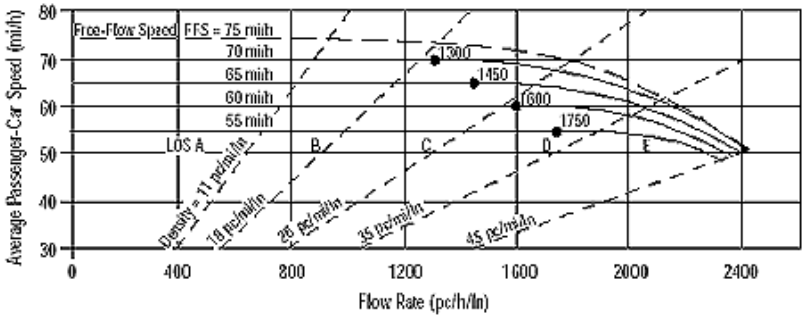
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Westbound
Agency or Company	RSA	From/To	I-40 @ McCrory Exit Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	5261 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	3460	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	

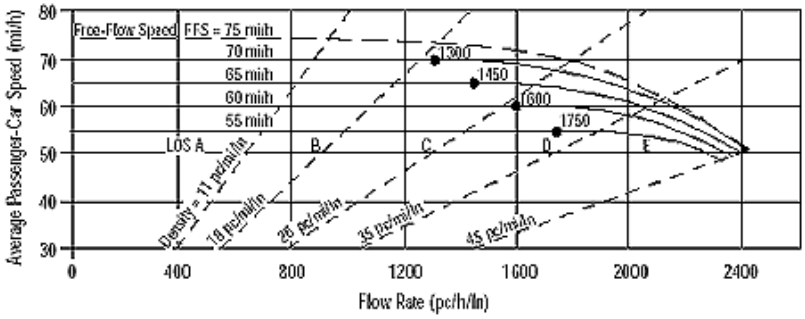
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1556 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1023	pc/h/ln
S	65.5	mi/h
D = v_p / S	15.6	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	

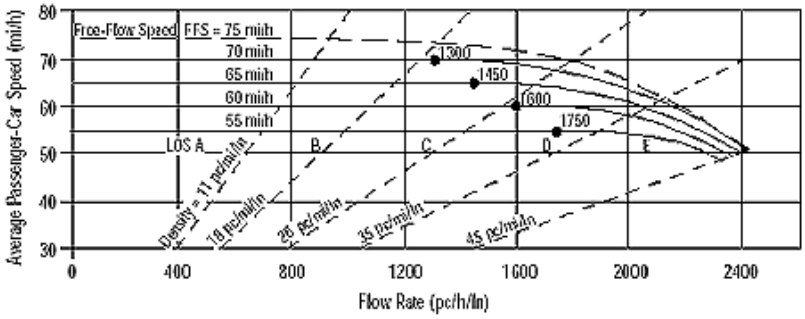
Glossary

N - Number of lanes	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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Westbound
Agency or Company	RSA	From/To	I-40 @ McCrory Bridge
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	4020 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2644	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		

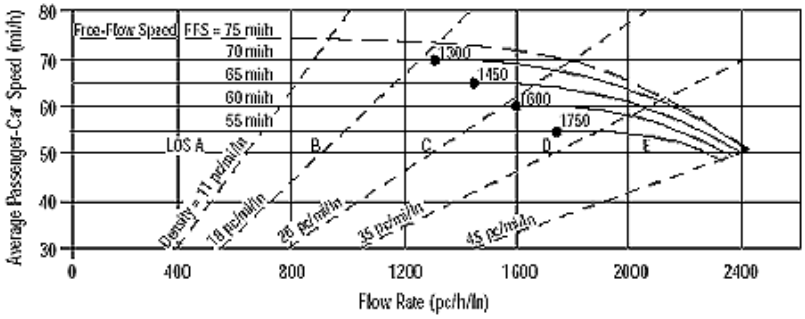
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Westbound
From/To	I-40 @ McCrory Entrance Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	1918 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1261	pc/h/ln
S	65.5	mi/h
D = v_p / S	19.3	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	

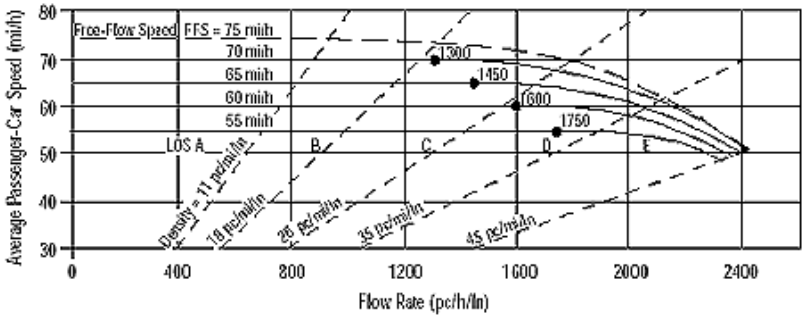
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Westbound
Agency or Company	RSA	From/To	I-40 @ McCrory Entrance Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	4510 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2966	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	

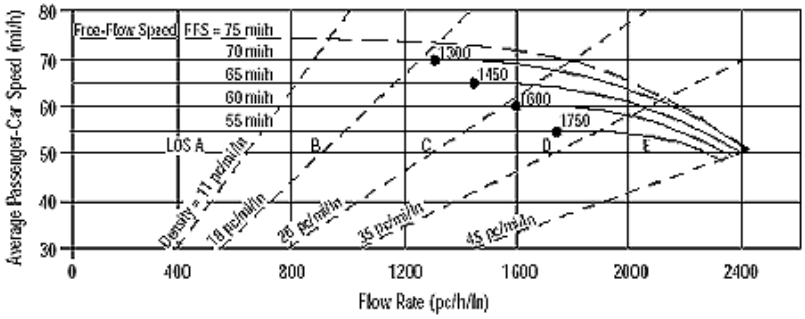
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Entrance Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	5491 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	3611	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	

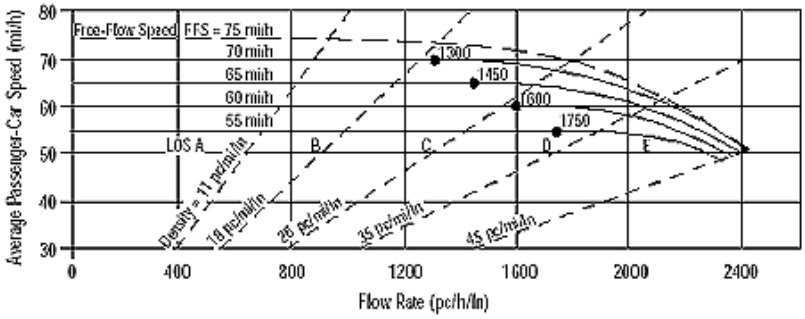
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Entrance Ramp
Jurisdiction	Davidson County, TN
Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	3123 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2054	pc/h/ln
S	60.8	mi/h
D = v_p / S	33.8	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	

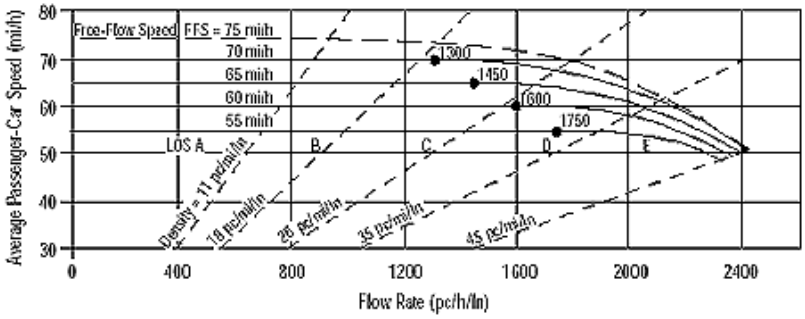
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	AM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	4315 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	2838	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	

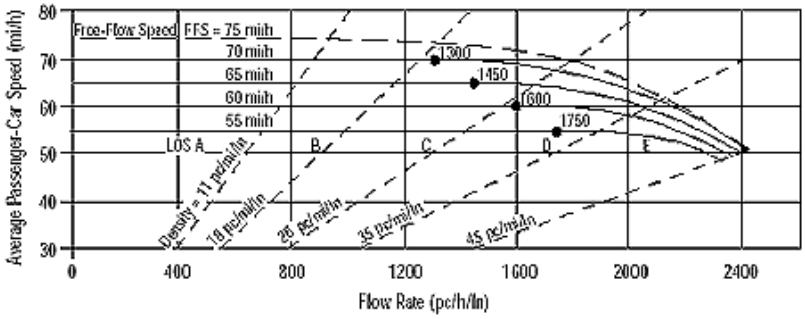
Glossary

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

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	AJB
Agency or Company	RSA
Date Performed	10/5/2005
Analysis Time Period	PM Peak Hour

Site Information

Highway/Direction of Travel	I-40 Eastbound
From/To	I-40 @ McCrory Bridge
Jurisdiction	Davidson County, TN
Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	2407 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1583	pc/h/ln
S	65.4	mi/h
D = v_p / S	24.2	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	

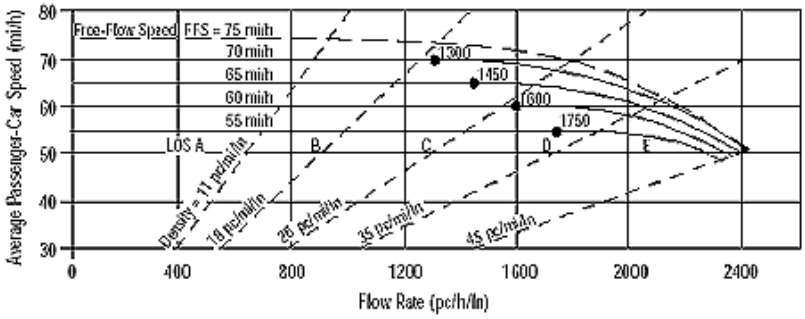
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Eastbound
Agency or Company	RSA	From/To	I-40 @ McCrory Exit Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	4739 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	3116	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	

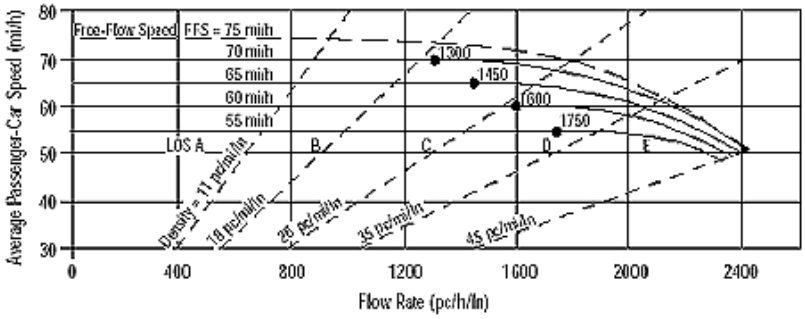
Glossary

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

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***	
Analyst	AJB	Highway/Direction of Travel	I-40 Eastbound
Agency or Company	RSA	From/To	I-40 @ McCrory Exit Ramp
Date Performed	10/5/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

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

Flow Inputs

Volume, V	2843 veh/h	Peak-Hour Factor, PHF	0.92
AADT	veh/day	%Trucks and Buses, P_T	12
Peak-Hr Prop. of AADT, K		%RVs, P_R	3
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	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.826

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)	1870	pc/h/ln
S	63.6	mi/h
D = v_p / S	29.4	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

APPENDIX C

INTERSTATE 40 RAMP ANALYSIS

C.1 2004 INTERSTATE 40 RAMP ANALYSIS

C.2 2012 INTERSTATE 40 RAMP ANALYSIS

C.3 2017 INTERSTATE 40 RAMP ANALYSIS

C.4 2030 INTERSTATE 40 RAMP ANALYSIS

APPENDIX C.1

2004 INTERSTATE 40 RAMP ANALYSIS

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 EB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2004 Existing Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = 2000 ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = 535 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3092	0.92	Composite	12	3	0.938	1.00	3583
Ramp	162	0.92	Composite	5	1	0.974	1.00	181
UpStream								
DownStream	535	0.92	Composite	5	1	0.974	1.00	597

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 3583 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	3583	4800	No
V_{12}	3583	4400:All	No
$V_{FO} = V_F - V_R$	3402	4800	No
V_R	181	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 30.6 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.444 (Exhibit 25-19)

S_R= 57.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 57.6 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 EB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2004 Existing Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = 2000 ft
Vu = veh/h	Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = 145 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1680	0.92	Composite	12	3	0.938	1.00	1947
Ramp	45	0.92	Composite	5	1	0.974	1.00	50
UpStream								
DownStream	145	0.92	Composite	5	1	0.974	1.00	162

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 1947 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	1947	4800	No
V_{12}	1947	4400:All	No
$V_{FO} = V_F - V_R$	1897	4800	No
V_R	50	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 16.5 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

D_s = 0.433 (Exhibit 25-19)

S_R= 57.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 57.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 EB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2004 Existing traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 162 veh/h

Terrain Grade

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2930	0.92	Grade	12	3	0.938	1.00	3395
Ramp	535	0.92	Composite	5	1	0.974	1.00	597
UpStream	162	0.92	Composite	5	1	0.974	1.00	181
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3395 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3992	See Exhibit 25-7	No
V_{R12}	3992	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 33.2 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.497 (Exibit 25-19)

S_R= 56.1 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 56.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 EB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2004 Existing traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 45 veh/h

Terrain Grade

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1635	0.92	Grade	12	3	0.938	1.00	1894
Ramp	145	0.92	Composite	5	1	0.974	1.00	162
UpStream	45	0.92	Composite	5	1	0.974	1.00	50
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 1894 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	2056	See Exhibit 25-7	No
V_{R12}	2056	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 18.3 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.316 (Exibit 25-19)

S_R= 61.1 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 61.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 WB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/3/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2004 Existing

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = 2000 ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	VD = 79 veh/h
	Sketch (show lanes, L_A, L_D,V_R,V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1165	0.92	Grade	12	3	0.938	1.00	1350
Ramp	108	0.92	Composite	5	1	0.974	1.00	121
UpStream								
DownStream	79	0.92	Composite	5	1	0.939	1.00	91

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 1350 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		$V_{FI}=V_F$	1350	4800	No
				V_{12}	1350	4400:All	No
V_{R12}		4600:All		$V_{FO} = V_F - V_R$	1229	4800	No
				V_R	121	2000	No

Level of Service Determination (if not F)	Level of Service Determination (if not F)
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/ mi /ln)	D_R = 15.9 (pc/ mi /ln)
LOS = (Exhibit 25-4)	LOS= B (Exhibit 25-4)
Speed Estimation	**Speed Estimation**
M_S = (Exibit 25-19)	D_s = 0.439 (Exhibit 25-19)
S_R= mph (Exhibit 25-19)	S_R= 57.7 mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)	S_0= N/A mph (Exhibit 25-19)
S= mph (Exhibit 25-14)	S = 57.7 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 WB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/3/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2004 Existing Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☑ Yes ☑ On		☐ Yes ☐ On
☐ No ☐ Off		☑ No ☐ Off
L_{up} = 2000 ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = 111 veh/h	Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3182	0.92	Grade	12	3	0.938	1.00	3687
Ramp	452	0.92	Composite	5	1	0.974	1.00	505
UpStream	111	0.92	Composite	5	1	0.939	1.00	128
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 3687 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	3687	4800	No
V_{12}	3687	4400:All	No
$V_{FO} = V_F - V_R$	3182	4800	No
V_R	505	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 36.0 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.473 (Exhibit 25-19)

S_R= 56.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 56.7 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 WB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2004 Existing Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 108 veh/h

Terrain Composite

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1057	0.92	Composite	12	3	0.938	1.00	1225
Ramp	79	0.92	Composite	1	0	0.990	1.00	87
UpStream	108	0.92	Composite	0	0	1.000	1.00	117
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 1225 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	1312	See Exhibit 25-7	No
V_{R12}	1312	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 9.4 (pc/ m/ln)

LOS = A (Exhibit 25-4)

Speed Estimation

M_S = 0.265 (Exibit 25-19)

S_R= 62.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 62.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 WB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2004 Existing Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 452 veh/h

Terrain Composite

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2730	0.92	Composite	12	3	0.938	1.00	3163
Ramp	111	0.92	Composite	5	1	0.939	1.00	128
UpStream	452	0.92	Composite	5	1	0.974	1.00	505
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3163 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3291	See Exhibit 25-7	No
V_{R12}	3291	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 24.8 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.356 (Exibit 25-19)

S_R= 60.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 60.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

APPENDIX C.2

2012 INTERSTATE 40 RAMP ANALYSIS

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 EB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = 2000 ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = 862 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3588	0.92	Composite	12	3	0.938	1.00	4157
Ramp	287	0.92	Composite	5	1	0.974	1.00	320
UpStream								
DownStream	862	0.92	Composite	5	1	0.974	1.00	962

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4157 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4157	4800	No
V_{12}	4157	4400:All	No
$V_{FO} = V_F - V_R$	3837	4800	No
V_R	320	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 35.5 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.457 (Exhibit 25-19)

S_R= 57.2 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 57.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 EB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2004 Existing Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = 2000 ft
Vu = veh/h	Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = 145 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1680	0.92	Composite	12	3	0.938	1.00	1947
Ramp	45	0.92	Composite	5	1	0.974	1.00	50
UpStream								
DownStream	145	0.92	Composite	5	1	0.974	1.00	162

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 1947 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	1947	4800	No
V_{12}	1947	4400:All	No
$V_{FO} = V_F - V_R$	1897	4800	No
V_R	50	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 16.5 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

D_s = 0.433 (Exhibit 25-19)

S_R= 57.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 57.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 EB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2012 Phase I traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 287 veh/h

Terrain Grade

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3301	0.92	Grade	12	3	0.938	1.00	3825
Ramp	862	0.92	Composite	5	1	0.974	1.00	962
UpStream	287	0.92	Composite	5	1	0.974	1.00	320
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3825 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4787	See Exhibit 25-7	No
V_{R12}	4787	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 36.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.726 (Exibit 25-19)

S_R= 49.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 49.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 EB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2012 Phase I traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 277 veh/h

Terrain Grade

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	1842	0.92	Grade	12	3	0.938	1.00	2134
Ramp	467	0.92	Composite	5	1	0.974	1.00	521
UpStream	277	0.92	Composite	5	1	0.974	1.00	309
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2134 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	2655	See Exhibit 25-7	No
V_{R12}	2655	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 20.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.313 (Exibit 25-19)

S_R= 61.2 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 61.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 WB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/3/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = 2000 ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = 248 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1476	0.92	Grade	12	3	0.938	1.00	1710
Ramp	286	0.92	Composite	5	1	0.974	1.00	319
UpStream								
DownStream	248	0.92	Composite	5	1	0.939	1.00	287

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 1710 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		$V_{FI}=V_F$	1710	4800	No
				V_{12}	1710	4400:All	No
V_{R12}		4600:All		$V_{FO} = V_F - V_R$	1391	4800	No
				V_R	319	2000	No

Level of Service Determination (if not F)	Level of Service Determination (if not F)
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/ mi /ln)	D_R = 14.5 (pc/ mi /ln)
LOS = (Exhibit 25-4)	LOS= B (Exhibit 25-4)
Speed Estimation	**Speed Estimation**
M_S = (Exibit 25-19)	D_s = 0.457 (Exhibit 25-19)
S_R= mph (Exhibit 25-19)	S_R= 57.2 mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)	S_0= N/A mph (Exhibit 25-19)
S= mph (Exhibit 25-14)	S = 57.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 WB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/3/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☑ Yes ☑ On		☐ Yes ☐ On
☐ No ☐ Off		☑ No ☐ Off
L_{up} = 2000 ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = 319 veh/h	Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3944	0.92	Grade	12	3	0.938	1.00	4570
Ramp	869	0.92	Composite	5	1	0.974	1.00	970
UpStream	319	0.92	Composite	5	1	0.939	1.00	369
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4570 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4570	4800	No
V_{12}	4570	4400:All	Yes
$V_{FO} = V_F - V_R$	3600	4800	No
V_R	970	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 39.1 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.515 (Exhibit 25-19)

S_R= 55.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 55.6 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 WB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 286 veh/h

Terrain Composite

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1190	0.92	Composite	12	3	0.938	1.00	1379
Ramp	248	0.92	Composite	5	1	0.939	1.00	287
UpStream	286	0.92	Composite	5	1	0.974	1.00	319
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 1379 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	1666	See Exhibit 25-7	No
V_{R12}	1666	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 12.1 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.272 (Exibit 25-19)

S_R= 62.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 62.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 WB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2012 Phase I Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 869 veh/h

Terrain Composite

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3075	0.92	Composite	12	3	0.938	1.00	3563
Ramp	319	0.92	Composite	5	1	0.939	1.00	369
UpStream	869	0.92	Composite	5	1	0.974	1.00	970
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3563 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3932	See Exhibit 25-7	No
V_{R12}	3932	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 29.7 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.450 (Exibit 25-19)

S_R= 57.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 57.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

APPENDIX C.3

2017 INTERSTATE 40 RAMP ANALYSIS

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 EB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = 2000 ft
Vu = veh/h	Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = 1037 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3938	0.92	Composite	12	3	0.938	1.00	4563
Ramp	382	0.92	Composite	5	1	0.974	1.00	426
UpStream								
DownStream	1037	0.92	Composite	5	1	0.974	1.00	1158

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4563 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4563	4800	No
V_{12}	4563	4400:All	Yes
$V_{FO} = V_F - V_R$	4137	4800	No
V_R	426	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 39.0 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.466 (Exhibit 25-19)

S_R= 56.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 56.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 EB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = 2000 ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = 678 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2408	0.92	Composite	12	3	0.938	1.00	2790
Ramp	424	0.92	Composite	5	1	0.974	1.00	473
UpStream								
DownStream	678	0.92	Composite	5	1	0.974	1.00	757

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 2790 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		$V_{FI}=V_F$	2790	4800	No
				V_{12}	2790	4400:All	No
V_{R12}		4600:All		$V_{FO} = V_F - V_R$	2317	4800	No
				V_R	473	2000	No

Level of Service Determination (if not F)	Level of Service Determination (if not F)
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/ mi /ln)	D_R = 23.7 (pc/ mi /ln)
LOS = (Exhibit 25-4)	LOS= C (Exhibit 25-4)
Speed Estimation	**Speed Estimation**
M_S = (Exibit 25-19)	D_s = 0.471 (Exhibit 25-19)
S_R= mph (Exhibit 25-19)	S_R= 56.8 mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)	S_0= N/A mph (Exhibit 25-19)
S= mph (Exhibit 25-14)	S = 56.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 EB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2017 Phase II traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 382 veh/h

Terrain Grade

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3556	0.92	Grade	12	3	0.938	1.00	4120
Ramp	1037	0.92	Composite	5	1	0.974	1.00	1158
UpStream	382	0.92	Composite	5	1	0.974	1.00	426
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 4120 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5278	See Exhibit 25-7	Yes
V_{R12}	5278	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 40.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.022 (Exibit 25-19)

S_R= 41.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 41.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 EB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2017 Phase II traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 424 veh/h

Terrain Grade

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1984	0.92	Grade	12	3	0.938	1.00	2299
Ramp	678	0.92	Composite	5	1	0.974	1.00	757
UpStream	424	0.92	Composite	5	1	0.974	1.00	473
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2299 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3056	See Exhibit 25-7	No
V_{R12}	3056	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 23.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.341 (Exibit 25-19)

S_R= 60.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 60.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 WB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/3/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = 2000 ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = 341 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1698	0.92	Grade	12	3	0.938	1.00	1967
Ramp	416	0.92	Composite	5	1	0.974	1.00	464
UpStream								
DownStream	341	0.92	Composite	5	1	0.939	1.00	395

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 1967 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		$V_{FI}=V_F$	1967	4800	No
				V_{12}	1967	4400:All	No
V_{R12}		4600:All		$V_{FO} = V_F - V_R$	1503	4800	No
				V_R	464	3800	No

Level of Service Determination (if not F)	Level of Service Determination (if not F)
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/ mi /ln)	D_R = -15.7 (pc/ mi /ln)
LOS = (Exhibit 25-4)	LOS= A (Exhibit 25-4)
Speed Estimation	**Speed Estimation**
M_S = (Exibit 25-19)	D_s = 0.470 (Exhibit 25-19)
S_R= mph (Exhibit 25-19)	S_R= 56.8 mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)	S_0= N/A mph (Exhibit 25-19)
S= mph (Exhibit 25-14)	S = 56.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 WB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/3/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☑ Yes ☑ On		☐ Yes ☐ On
☐ No ☐ Off		☑ No ☐ Off
L_{up} = 2000 ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = 461 veh/h	Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4436	0.92	Grade	12	3	0.938	1.00	5140
Ramp	1124	0.92	Composite	5	1	0.974	1.00	1255
UpStream	461	0.92	Composite	5	1	0.939	1.00	534
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 5140 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5140	4800	Yes
V_{12}	5140	4400:All	Yes
$V_{FO} = V_F - V_R$	3885	4800	No
V_R	1255	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 11.6 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.541 (Exhibit 25-19)

S_R= 54.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 54.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 WB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 416 veh/h

Terrain Composite

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1282	0.92	Composite	12	3	0.938	1.00	1485
Ramp	341	0.92	Composite	5	1	0.939	1.00	395
UpStream	416	0.92	Composite	5	1	0.974	1.00	464
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 1485 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	1880	See Exhibit 25-7	No
V_{R12}	1880	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 11.8 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.256 (Exibit 25-19)

S_R= 62.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 62.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 WB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2017 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☑ Yes ☐ On		☐ Yes ☐ On
☐ No ☑ Off		☑ No ☐ Off
L_{up} = 2000 ft		L_{down} = ft
V_u = 1124 veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D,V_R,V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3312	0.92	Composite	12	3	0.938	1.00	3838
Ramp	461	0.92	Composite	5	1	0.939	1.00	534
UpStream	1124	0.92	Composite	5	1	0.974	1.00	1255
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3838 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4372	See Exhibit 25-7	No
V_{R12}	4372	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 31.2 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.539 (Exibit 25-19)

S_R= 54.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 54.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

APPENDIX C.4

2030 INTERSTATE 40 RAMP ANALYSIS

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 EB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = 2000 ft
Vu = veh/h	Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = 1176 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4739	0.92	Composite	12	3	0.938	1.00	5491
Ramp	424	0.92	Composite	5	1	0.974	1.00	473
UpStream								
DownStream	1176	0.92	Composite	5	1	0.974	1.00	1313

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 5491 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5491	4800	Yes
V_{12}	5491	4400:All	Yes
$V_{FO} = V_F - V_R$	5018	4800	Yes
V_R	473	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 47.0 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.471 (Exhibit 25-19)

S_R= 56.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 56.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 EB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = 2000 ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	VD = 716 veh/h
	Sketch (show lanes, L_A, L_D,V_R,V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2843	0.92	Composite	12	3	0.938	1.00	3294
Ramp	436	0.92	Composite	5	1	0.974	1.00	487
UpStream								
DownStream	716	0.92	Composite	5	1	0.974	1.00	799

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 3294 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	3294	4800	No
V_{12}	3294	4400:All	No
$V_{FO} = V_F - V_R$	2807	4800	No
V_R	487	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 28.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.472 (Exhibit 25-19)

S_R= 56.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 56.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 EB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2030 Phase II traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 424 veh/h

Terrain Grade

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4315	0.92	Grade	12	3	0.938	1.00	5000
Ramp	1176	0.92	Composite	5	1	0.974	1.00	1313
UpStream	424	0.92	Composite	5	1	0.974	1.00	473
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 5000 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6313	See Exhibit 25-7	Yes
V_{R12}	6313	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 48.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 2.410 (Exibit 25-19)

S_R= 2.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 2.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 EB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2030 Phase II traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 436 veh/h

Terrain Grade

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2407	0.92	Grade	12	3	0.938	1.00	2789
Ramp	716	0.92	Composite	5	1	0.974	1.00	799
UpStream	436	0.92	Composite	5	1	0.974	1.00	487
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2789 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3588	See Exhibit 25-7	No
V_{R12}	3588	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 27.5 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.399 (Exibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 58.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 WB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/3/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = 2000 ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = 362 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2000	0.92	Grade	12	3	0.938	1.00	2317
Ramp	444	0.92	Composite	5	1	0.974	1.00	496
UpStream								
DownStream	362	0.92	Composite	5	1	0.939	1.00	419

Merge Areas	Diverge Areas
Estimation of v_{12}	***Estimation of v_{12}***
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 2317 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		$V_{FI}=V_F$	2317	4800	No
				V_{12}	2317	4400:All	No
V_{R12}		4600:All		$V_{FO} = V_F - V_R$	1821	4800	No
				V_R	496	3800	No

Level of Service Determination (if not F)	Level of Service Determination (if not F)
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/ mi /ln)	D_R = -12.7 (pc/ mi /ln)
LOS = (Exhibit 25-4)	LOS= A (Exhibit 25-4)
Speed Estimation	***Speed Estimation***
M_S = (Exibit 25-19)	D_s = 0.473 (Exhibit 25-19)
S_R= mph (Exhibit 25-19)	S_R= 56.8 mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)	S_0= N/A mph (Exhibit 25-19)
S= mph (Exhibit 25-14)	S = 56.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	AJB	Freeway/Dir of Travel	I-40 WB Exit Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/3/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☑ Yes ☑ On		☐ Yes ☐ On
☐ No ☐ Off		☑ No ☐ Off
L_{up} = 2000 ft	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = 490 veh/h	Sketch (show lanes, L_A, L_D,V_R,V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5261	0.92	Grade	12	3	0.938	1.00	6096
Ramp	1241	0.92	Composite	5	1	0.974	1.00	1385
UpStream	490	0.92	Composite	5	1	0.939	1.00	567
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 6096 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6096	4800	Yes
V_{12}	6096	4400:All	Yes
$V_{FO} = V_F - V_R$	4711	4800	No
V_R	1385	3800	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 19.8 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.553 (Exhibit 25-19)

S_R= 54.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 54.5 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 WB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	AM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 444 veh/h

Terrain Composite

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1556	0.92	Composite	12	3	0.938	1.00	1803
Ramp	362	0.92	Composite	5	1	0.939	1.00	419
UpStream	444	0.92	Composite	5	1	0.974	1.00	496
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 1803 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	2222	See Exhibit 25-7	No
V_{R12}	2222	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 14.5 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.266 (Exibit 25-19)

S_R= 62.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 62.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	AJB	Freeway/Dir of Travel	I-40 WB Entrance Ramp
Agency or Company	RSA	Junction	McCrory Lane
Date Performed	10/4/2005	Jurisdiction	Davidson County, TN
Analysis Time Period	PM Peak Hour	Analysis Year	2030 Phase II Traffic

Project Description Biltmore

Inputs

Upstream Adj Ramp	Terrain Composite	Downstream Adj Ramp
☑ Yes ☐ On		☐ Yes ☐ On
☐ No ☑ Off		☑ No ☐ Off
L_{up} = 1000 ft		L_{down} = ft
V_u = 1241 veh/h	S_{FF} = 70.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D,V_R,V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4020	0.92	Composite	12	3	0.938	1.00	4658
Ramp	490	0.92	Composite	5	1	0.939	1.00	567
UpStream	1241	0.92	Composite	5	1	0.974	1.00	1385
DownStream								

Merge Areas | Diverge Areas

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 4658 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

Merge Areas

	Actual	Maximum	LOS F?
V_{FO}	5225	See Exhibit 25-7	Yes
V_{R12}	5225	4600:All	Yes

Diverge Areas

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

Merge Areas

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 37.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Diverge Areas

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

Merge Areas

M_S = 0.955 (Exibit 25-19)

S_R= 43.3 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 43.3 mph (Exhibit 25-14)

Diverge Areas

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

APPENDIX D

INTERSECTION CAPACITY ANALYSIS

D.1 2004 INTERSECTION CAPACITY ANALYSIS

D.2 2012 INTERSECTION CAPACITY ANALYSIS

D.3 2017 INTERSECTION CAPACITY ANALYSIS

D.4 2030 INTERSECTION CAPACITY ANALYSIS

APPENDIX D.1

2004 INTERSECTION CAPACITY ANALYSIS

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00		1.00
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	1770	1583	1863	1583		1859
Flt Permitted	0.95	1.00	1.00	1.00		0.99
Satd. Flow (perm)	1770	1583	1863	1583		1839
Volume (vph)	315	20	101	74	17	354
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	342	22	110	80	18	385
RTOR Reduction (vph)	0	15	0	46	0	0
Lane Group Flow (vph)	342	7	110	34	0	403
Turn Type		Perm		Perm	Perm	
Protected Phases	8		2			6
Permitted Phases		8		2	6	
Actuated Green, G (s)	11.4	11.4	14.3	14.3		14.3
Effective Green, g (s)	11.4	11.4	14.3	14.3		14.3
Actuated g/C Ratio	0.34	0.34	0.42	0.42		0.42
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	599	535	791	672		780
v/s Ratio Prot	c0.19		0.06			
v/s Ratio Perm		0.00		0.02		c0.22
v/c Ratio	0.57	0.01	0.14	0.05		0.52
Uniform Delay, d1	9.1	7.4	5.9	5.7		7.2
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	1.3	0.0	0.1	0.0		0.6
Delay (s)	10.5	7.4	6.0	5.7		7.7
Level of Service	B	A	A	A		A
Approach Delay (s)	10.3		5.9			7.7
Approach LOS	B		A			A

Intersection Summary			
HCM Average Control Delay	8.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	33.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	342	22	110	80	403
v/c Ratio	0.57	0.04	0.14	0.11	0.52
Control Delay	12.8	4.2	7.6	3.0	11.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	12.8	4.2	7.6	3.0	11.0
Queue Length 50th (ft)	40	0	10	0	46
Queue Length 95th (ft)	105	8	36	16	124
Internal Link Dist (ft)	1274		507		675
Turn Bay Length (ft)		175		100	
Base Capacity (vph)	744	678	865	778	854
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.46	0.03	0.13	0.10	0.47

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00		1.00
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.99
Satd. Flow (prot)	1770	1583	1863	1583		1850
Flt Permitted	0.95	1.00	1.00	1.00		0.96
Satd. Flow (perm)	1770	1583	1863	1583		1786
Volume (vph)	106	9	252	252	14	84
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	115	10	274	274	15	91
RTOR Reduction (vph)	0	8	0	86	0	0
Lane Group Flow (vph)	115	2	274	188	0	106
Turn Type		Perm		Perm	Perm	
Protected Phases	8		2			6
Permitted Phases		8		2	6	
Actuated Green, G (s)	8.2	8.2	35.7	35.7		35.7
Effective Green, g (s)	8.2	8.2	35.7	35.7		35.7
Actuated g/C Ratio	0.16	0.16	0.69	0.69		0.69
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	280	250	1281	1089		1229
v/s Ratio Prot	c0.06		c0.15			
v/s Ratio Perm		0.00		0.12		0.06
v/c Ratio	0.41	0.01	0.21	0.17		0.09
Uniform Delay, d1	19.7	18.4	3.0	2.9		2.7
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	1.0	0.0	0.1	0.1		0.0
Delay (s)	20.7	18.4	3.0	2.9		2.7
Level of Service	C	B	A	A		A
Approach Delay (s)	20.5		3.0			2.7
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	5.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	51.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	28.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	115	10	274	274	106
v/c Ratio	0.35	0.03	0.21	0.23	0.09
Control Delay	10.4	5.1	4.5	1.5	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	10.4	5.1	4.5	1.5	4.2
Queue Length 50th (ft)	18	0	21	0	7
Queue Length 95th (ft)	34	5	51	19	22
Internal Link Dist (ft)	1274		507		675
Turn Bay Length (ft)		175		100	
Base Capacity (vph)	549	498	1316	1199	1247
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.21	0.02	0.21	0.23	0.09

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	0	0	14	0	94	42	81	0	0	632	37
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	0	15	0	102	46	88	0	0	687	40
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											587	
pX, platoon unblocked	0.89	0.89	0.89	0.89	0.89		0.89					
vC, conflicting volume	989	886	707	886	907	88	727			88		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	987	873	671	873	895	88	694			88		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	93	100	89	94			100		
cM capacity (veh/h)	173	243	407	231	235	970	803			1508		

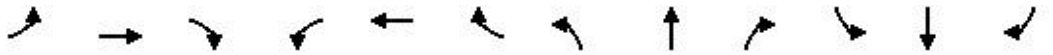
Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	15	102	134	727
Volume Left	15	0	46	0
Volume Right	0	102	0	40
cSH	231	970	803	1700
Volume to Capacity	0.07	0.11	0.06	0.43
Queue Length 95th (ft)	5	9	5	0
Control Delay (s)	21.7	9.1	3.7	0.0
Lane LOS	C	A	A	
Approach Delay (s)	10.8		3.7	0.0
Approach LOS	B			

Intersection Summary				
Average Delay	1.8			
Intersection Capacity Utilization	54.0%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	0	0	100	0	352	100	152	0	0	179	11
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	0	109	0	383	109	165	0	0	195	12
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											587	
pX, platoon unblocked												
vC, conflicting volume	966	583	201	583	589	165	207			165		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	966	583	201	583	589	165	207			165		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	73	100	56	92			100		
cM capacity (veh/h)	124	390	840	398	387	879	1365			1413		

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	109	383	274	207
Volume Left	109	0	109	0
Volume Right	0	383	0	12
cSH	398	879	1365	1700
Volume to Capacity	0.27	0.44	0.08	0.12
Queue Length 95th (ft)	27	56	6	0
Control Delay (s)	17.4	12.2	3.5	0.0
Lane LOS	C	B	A	
Approach Delay (s)	13.4		3.5	0.0
Approach LOS	B			

Intersection Summary				
Average Delay	7.8			
Intersection Capacity Utilization	55.4%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	41	0	121	0	0	0	0	82	37	498	148	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	45	0	132	0	0	0	0	89	40	541	161	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1201	
pX, platoon unblocked												
vC, conflicting volume	1353	1373	161	1484	1353	109	161			129		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1353	1373	161	1484	1353	109	161			129		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	51	100	85	100	100	100	100			63		
cM capacity (veh/h)	90	92	884	62	94	944	1418			1456		

Direction, Lane #	EB 1	EB 2	NB 1	SB 1
Volume Total	45	132	129	702
Volume Left	45	0	0	541
Volume Right	0	132	40	0
cSH	90	884	1700	1456
Volume to Capacity	0.49	0.15	0.08	0.37
Queue Length 95th (ft)	53	13	0	44
Control Delay (s)	78.7	9.8	0.0	7.7
Lane LOS	F	A		A
Approach Delay (s)	27.2		0.0	7.7
Approach LOS	D			

Intersection Summary				
Average Delay	10.1			
Intersection Capacity Utilization	56.2%	ICU Level of Service	B	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	12	0	33	0	0	0	0	240	11	134	145	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	0	36	0	0	0	0	261	12	146	158	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)											1201	
pX, platoon unblocked												
vC, conflicting volume	716	722	158	752	716	267	158			273		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	716	722	158	752	716	267	158			273		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	100	96	100	100	100	100			89		
cM capacity (veh/h)	316	313	888	286	316	772	1422			1290		

Direction, Lane #	EB 1	EB 2	NB 1	SB 1
Volume Total	13	36	273	303
Volume Left	13	0	0	146
Volume Right	0	36	12	0
cSH	316	888	1700	1290
Volume to Capacity	0.04	0.04	0.16	0.11
Queue Length 95th (ft)	3	3	0	10
Control Delay (s)	16.9	9.2	0.0	4.4
Lane LOS	C	A		A
Approach Delay (s)	11.3		0.0	4.4
Approach LOS	B			

Intersection Summary				
Average Delay	3.0			
Intersection Capacity Utilization	41.7%	ICU Level of Service	A	
Analysis Period (min)	15			

APPENDIX D.2

2012 INTERSECTION CAPACITY ANALYSIS

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.55	1.00
Satd. Flow (perm)	1770	1583	1863	1583	1022	1863
Volume (vph)	486	35	203	166	23	455
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	528	38	221	180	25	495
RTOR Reduction (vph)	0	24	0	84	0	0
Lane Group Flow (vph)	528	14	221	96	25	495
Turn Type		pm+ov		Perm	pm+pt	
Protected Phases	8	1	2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	38.8	44.0	64.0	64.0	73.2	73.2
Effective Green, g (s)	38.8	44.0	64.0	64.0	73.2	73.2
Actuated g/C Ratio	0.32	0.37	0.53	0.53	0.61	0.61
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	572	633	994	844	656	1136
v/s Ratio Prot	c0.30	0.00	0.12		0.00	c0.27
v/s Ratio Perm		0.01		0.06	0.02	
v/c Ratio	0.92	0.02	0.22	0.11	0.04	0.44
Uniform Delay, d1	39.2	24.3	14.8	13.9	9.5	12.4
Progression Factor	1.00	1.00	1.02	1.94	1.00	1.00
Incremental Delay, d2	20.6	0.0	0.5	0.3	0.0	1.2
Delay (s)	59.8	24.3	15.6	27.3	9.5	13.6
Level of Service	E	C	B	C	A	B
Approach Delay (s)	57.4		20.8			13.5
Approach LOS	E		C			B

Intersection Summary			
HCM Average Control Delay	32.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	57.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	528	38	221	180	25	495
v/c Ratio	0.92	0.06	0.22	0.19	0.04	0.44
Control Delay	61.1	5.0	18.2	6.3	12.3	15.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.1	5.0	18.2	6.3	12.3	15.6
Queue Length 50th (ft)	395	0	104	17	7	190
Queue Length 95th (ft)	462	17	127	49	24	348
Internal Link Dist (ft)	1274		507			675
Turn Bay Length (ft)		175			150	
Base Capacity (vph)	826	717	1007	938	612	1137
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	0.64	0.05	0.22	0.19	0.04	0.44

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.38	1.00
Satd. Flow (perm)	1770	1583	1863	1583	708	1863
Volume (vph)	260	18	387	460	30	217
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	283	20	421	500	33	236
RTOR Reduction (vph)	0	14	0	248	0	0
Lane Group Flow (vph)	283	6	421	253	33	236
Turn Type		pm+ov		Perm	pm+pt	
Protected Phases	8	1	2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	14.1	17.7	30.3	30.3	37.9	37.9
Effective Green, g (s)	14.1	17.7	30.3	30.3	37.9	37.9
Actuated g/C Ratio	0.23	0.29	0.51	0.51	0.63	0.63
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	416	573	941	799	511	1177
v/s Ratio Prot	c0.16	0.00	c0.23		0.00	c0.13
v/s Ratio Perm		0.00		0.16	0.04	
v/c Ratio	0.68	0.01	0.45	0.32	0.06	0.20
Uniform Delay, d1	20.9	15.0	9.5	8.7	4.9	4.7
Progression Factor	1.00	1.00	0.90	0.98	1.00	1.00
Incremental Delay, d2	4.5	0.0	1.3	0.9	0.1	0.4
Delay (s)	25.4	15.0	9.9	9.5	4.9	5.0
Level of Service	C	B	A	A	A	A
Approach Delay (s)	24.7		9.6			5.0
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	11.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	46.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	283	20	421	500	33	236
v/c Ratio	0.68	0.03	0.42	0.46	0.07	0.20
Control Delay	29.1	4.4	11.5	2.9	5.7	6.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.1	4.4	11.5	2.9	5.7	6.0
Queue Length 50th (ft)	93	0	86	3	4	30
Queue Length 95th (ft)	145	9	205	45	15	72
Internal Link Dist (ft)	1274		507			675
Turn Bay Length (ft)		175			150	
Base Capacity (vph)	561	648	991	1076	476	1178
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	0.50	0.03	0.42	0.46	0.07	0.20

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor					1.00	1.00	1.00	1.00			1.00	
Frt					1.00	0.85	1.00	1.00			0.99	
Flt Protected					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (prot)					1770	1583	1770	1863			1848	
Flt Permitted					0.95	1.00	0.21	1.00			1.00	
Satd. Flow (perm)					1770	1583	391	1863			1848	
Volume (vph)	0	0	0	168	0	118	193	251	0	0	886	55
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	183	0	128	210	273	0	0	963	60
RTOR Reduction (vph)	0	0	0	0	0	111	0	0	0	0	2	0
Lane Group Flow (vph)	0	0	0	0	183	17	210	273	0	0	1021	0
Turn Type				Split		Perm	Perm					
Protected Phases				8	8			2			6	
Permitted Phases						8	2					
Actuated Green, G (s)					16.0	16.0	96.0	96.0			96.0	
Effective Green, g (s)					16.0	16.0	96.0	96.0			96.0	
Actuated g/C Ratio					0.13	0.13	0.80	0.80			0.80	
Clearance Time (s)					4.0	4.0	4.0	4.0			4.0	
Vehicle Extension (s)					3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)					236	211	313	1490			1478	
v/s Ratio Prot					c0.10			0.15			c0.55	
v/s Ratio Perm						0.01	0.54					
v/c Ratio					0.78	0.08	0.67	0.18			0.69	
Uniform Delay, d1					50.3	45.6	5.2	2.8			5.4	
Progression Factor					1.00	1.00	2.00	0.62			0.37	
Incremental Delay, d2					14.7	0.2	9.2	0.2			1.9	
Delay (s)					64.9	45.7	19.6	2.0			3.9	
Level of Service					E	D	B	A			A	
Approach Delay (s)		0.0			57.0			9.6			3.9	
Approach LOS		A			E			A			A	

Intersection Summary			
HCM Average Control Delay	14.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	80.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	183	128	210	273	1023
v/c Ratio	0.78	0.40	0.70	0.18	0.69
Control Delay	71.9	11.6	27.8	2.1	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.5
Total Delay	71.9	11.6	27.8	2.1	4.6
Queue Length 50th (ft)	136	0	48	23	90
Queue Length 95th (ft)	#229	55	#184	1	m115
Internal Link Dist (ft)	1008			213	507
Turn Bay Length (ft)		500	200		
Base Capacity (vph)	266	346	298	1490	1481
Starvation Cap Reductn	0	0	0	0	137
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.69	0.37	0.70	0.18	0.76

Intersection Summary

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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor					1.00	1.00	1.00	1.00			1.00	
Frt					1.00	0.85	1.00	1.00			0.99	
Flt Protected					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (prot)					1770	1583	1770	1863			1852	
Flt Permitted					0.95	1.00	0.38	1.00			1.00	
Satd. Flow (perm)					1770	1583	710	1863			1852	
Volume (vph)	0	0	0	429	0	440	299	407	0	0	457	20
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	466	0	478	325	442	0	0	497	22
RTOR Reduction (vph)	0	0	0	0	0	279	0	0	0	0	3	0
Lane Group Flow (vph)	0	0	0	0	466	199	325	442	0	0	516	0
Turn Type				Split		Perm	Perm					
Protected Phases				8	8			2			6	
Permitted Phases						8	2					
Actuated Green, G (s)					18.0	18.0	34.0	34.0			34.0	
Effective Green, g (s)					18.0	18.0	34.0	34.0			34.0	
Actuated g/C Ratio					0.30	0.30	0.57	0.57			0.57	
Clearance Time (s)					4.0	4.0	4.0	4.0			4.0	
Vehicle Extension (s)					3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)					531	475	402	1056			1049	
v/s Ratio Prot					c0.26			0.24			0.28	
v/s Ratio Perm						0.13	c0.46					
v/c Ratio					0.88	0.42	0.81	0.42			0.49	
Uniform Delay, d1					20.0	16.8	10.4	7.4			7.8	
Progression Factor					1.00	1.00	0.24	0.21			0.43	
Incremental Delay, d2					15.1	0.6	11.4	0.8			1.5	
Delay (s)					35.1	17.4	13.9	2.4			4.8	
Level of Service					D	B	B	A			A	
Approach Delay (s)		0.0			26.1			7.2			4.8	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM Average Control Delay	14.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	98.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	466	478	325	442	519
v/c Ratio	0.88	0.63	0.81	0.42	0.49
Control Delay	40.8	8.2	17.7	2.5	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	40.8	8.2	17.7	2.5	5.0
Queue Length 50th (ft)	158	21	8	7	31
Queue Length 95th (ft)	#313	95	m#178	m11	67
Internal Link Dist (ft)	1008			213	507
Turn Bay Length (ft)		500	150		
Base Capacity (vph)	549	766	409	1074	1070
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.85	0.62	0.79	0.41	0.49

Intersection Summary

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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00					1.00	1.00	0.97	1.00	
Frt		1.00	0.85					1.00	0.85	1.00	1.00	
Flt Protected		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1770	1583					1863	1583	3433	1863	
Flt Permitted		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1770	1583					1863	1583	3433	1863	
Volume (vph)	50	0	237	0	0	0	0	394	261	601	453	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	0	258	0	0	0	0	428	284	653	492	0
RTOR Reduction (vph)	0	0	218	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	54	40	0	0	0	0	428	284	653	492	0
Turn Type	Split		Perm						Free	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						Free			
Actuated Green, G (s)		7.4	7.4					20.7	60.0	13.9	40.6	
Effective Green, g (s)		9.4	9.4					22.7	60.0	15.9	42.6	
Actuated g/C Ratio		0.16	0.16					0.38	1.00	0.27	0.71	
Clearance Time (s)		6.0	6.0					6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		277	248					705	1583	910	1323	
v/s Ratio Prot		0.03						c0.23		c0.19	0.26	
v/s Ratio Perm			0.03						c0.18			
v/c Ratio		0.19	0.16					0.61	0.18	0.72	0.37	
Uniform Delay, d1		22.0	21.9					15.1	0.0	20.0	3.4	
Progression Factor		1.00	1.00					1.00	1.00	0.92	1.15	
Incremental Delay, d2		0.3	0.3					3.9	0.2	1.9	0.6	
Delay (s)		22.4	22.2					18.9	0.2	20.3	4.5	
Level of Service		C	C					B	A	C	A	
Approach Delay (s)		22.2			0.0			11.5			13.5	
Approach LOS		C			A			B			B	

Intersection Summary			
HCM Average Control Delay	14.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	80.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	54	258	428	284	653	492
v/c Ratio	0.19	0.55	0.61	0.18	0.72	0.37
Control Delay	23.7	8.7	19.9	0.2	21.9	4.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.7	8.7	19.9	0.2	21.9	4.7
Queue Length 50th (ft)	17	0	124	0	113	91
Queue Length 95th (ft)	44	54	208	0	136	83
Internal Link Dist (ft)	1163		843			393
Turn Bay Length (ft)		500			250	
Base Capacity (vph)	295	479	704	1583	936	1321
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	0.18	0.54	0.61	0.18	0.70	0.37

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00					1.00	1.00	0.97	1.00	
Frt		1.00	0.85					1.00	0.85	1.00	1.00	
Flt Protected		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1770	1583					1863	1583	3433	1863	
Flt Permitted		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1770	1583					1863	1583	3433	1863	
Volume (vph)	28	0	249	0	0	0	0	678	291	176	710	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	30	0	271	0	0	0	0	737	316	191	772	0
RTOR Reduction (vph)	0	0	218	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	30	53	0	0	0	0	737	316	191	772	0
Turn Type	Split		Perm						Free	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						Free			
Actuated Green, G (s)		7.4	7.4					30.0	60.0	4.6	40.6	
Effective Green, g (s)		9.4	9.4					32.0	60.0	6.6	42.6	
Actuated g/C Ratio		0.16	0.16					0.53	1.00	0.11	0.71	
Clearance Time (s)		6.0	6.0					6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		277	248					994	1583	378	1323	
v/s Ratio Prot		0.02						c0.40		0.06	c0.41	
v/s Ratio Perm			0.03						c0.20			
v/c Ratio		0.11	0.21					0.74	0.20	0.51	0.58	
Uniform Delay, d1		21.7	22.1					10.8	0.0	25.2	4.3	
Progression Factor		1.00	1.00					1.00	1.00	1.12	0.67	
Incremental Delay, d2		0.2	0.4					5.0	0.3	0.8	1.4	
Delay (s)		21.9	22.5					15.8	0.3	29.0	4.2	
Level of Service		C	C					B	A	C	A	
Approach Delay (s)		22.4			0.0			11.1			9.1	
Approach LOS		C			A			B			A	

Intersection Summary			
HCM Average Control Delay	11.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	98.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	30	271	737	316	191	772
v/c Ratio	0.11	0.58	0.74	0.20	0.51	0.58
Control Delay	22.5	9.8	16.7	0.3	32.3	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.5	9.8	16.7	0.3	32.3	4.5
Queue Length 50th (ft)	10	4	187	0	39	75
Queue Length 95th (ft)	29	60	313	0	m55	m92
Internal Link Dist (ft)	1163		843			393
Turn Bay Length (ft)		200			250	
Base Capacity (vph)	295	480	994	1583	378	1323
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	0.10	0.56	0.74	0.20	0.51	0.58

Intersection Summary

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

APPENDIX D.3

2017 INTERSECTION CAPACITY ANALYSIS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor				0.97	1.00		1.00	1.00	1.00	1.00	1.00	
Frt				1.00	0.93		1.00	1.00	0.85	1.00	0.99	
Flt Protected				0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)				3433	1725		1770	1863	1583	1770	1850	
Flt Permitted				0.95	1.00		0.32	1.00	1.00	0.48	1.00	
Satd. Flow (perm)				3433	1725		594	1863	1583	901	1850	
Volume (vph)	0	0	0	539	42	41	275	251	242	28	498	24
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	586	46	45	299	273	263	30	541	26
RTOR Reduction (vph)	0	0	0	0	35	0	0	0	111	0	2	0
Lane Group Flow (vph)	0	0	0	586	56	0	299	273	152	30	565	0
Turn Type				Split			pm+pt		Perm	pm+pt		
Protected Phases				8	8		5	2		1	6	
Permitted Phases							2		2	6		
Actuated Green, G (s)				15.9	15.9		40.5	40.5	40.5	30.6	30.6	
Effective Green, g (s)				15.9	15.9		40.5	40.5	40.5	30.6	30.6	
Actuated g/C Ratio				0.23	0.23		0.58	0.58	0.58	0.44	0.44	
Clearance Time (s)				4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)				780	392		537	1078	916	414	809	
v/s Ratio Prot				c0.17	0.03		c0.09	0.15		0.00	c0.31	
v/s Ratio Perm							0.23		0.10	0.03		
v/c Ratio				0.75	0.14		0.56	0.25	0.17	0.07	0.70	
Uniform Delay, d1				25.2	21.6		16.0	7.3	6.9	11.5	16.0	
Progression Factor				1.00	1.00		0.57	0.48	0.06	1.00	1.00	
Incremental Delay, d2				4.1	0.2		1.1	0.5	0.3	0.1	5.0	
Delay (s)				29.3	21.8		10.2	4.0	0.8	11.6	20.9	
Level of Service				C	C		B	A	A	B	C	
Approach Delay (s)		0.0			28.3			5.2			20.5	
Approach LOS		A			C			A			C	

Intersection Summary			
HCM Average Control Delay	16.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	586	91	299	273	263	30	567
v/c Ratio	0.75	0.21	0.55	0.24	0.25	0.06	0.65
Control Delay	31.8	13.8	10.9	4.1	0.6	11.8	19.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.8	13.8	10.9	4.1	0.6	11.8	19.3
Queue Length 50th (ft)	117	15	24	22	0	7	189
Queue Length 95th (ft)	171	49	m47	m32	m0	21	296
Internal Link Dist (ft)		1274		507			675
Turn Bay Length (ft)	250		200			150	
Base Capacity (vph)	848	460	576	1145	1074	471	886
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	0.69	0.20	0.52	0.24	0.24	0.06	0.64

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor				0.97	1.00		1.00	1.00	1.00	1.00	1.00	
Frt				1.00	0.93		1.00	1.00	0.85	1.00	1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)				3433	1742		1770	1863	1583	1770	1856	
Flt Permitted				0.95	1.00		0.49	1.00	1.00	0.46	1.00	
Satd. Flow (perm)				3433	1742		913	1863	1583	861	1856	
Volume (vph)	0	0	0	398	43	33	412	461	650	45	276	6
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	433	47	36	448	501	707	49	300	7
RTOR Reduction (vph)	0	0	0	0	29	0	0	0	254	0	0	0
Lane Group Flow (vph)	0	0	0	433	54	0	448	501	453	49	307	0
Turn Type				Split			pm+pt		Perm	pm+pt		
Protected Phases				8	8		5	2		1	6	
Permitted Phases							2		2	6		
Actuated Green, G (s)				16.3	16.3		65.7	57.7	57.7	55.1	51.1	
Effective Green, g (s)				16.3	16.3		65.7	57.7	57.7	55.1	51.1	
Actuated g/C Ratio				0.18	0.18		0.73	0.64	0.64	0.61	0.57	
Clearance Time (s)				4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)				622	315		767	1194	1015	568	1054	
v/s Ratio Prot				c0.13	0.03		c0.07	0.27		0.00	0.17	
v/s Ratio Perm							c0.36		0.29	0.05		
v/c Ratio				0.70	0.17		0.58	0.42	0.45	0.09	0.29	
Uniform Delay, d1				34.5	31.1		5.0	7.9	8.1	7.0	10.1	
Progression Factor				1.00	1.00		1.11	0.49	0.54	1.00	1.00	
Incremental Delay, d2				3.4	0.3		0.9	0.9	1.1	0.1	0.7	
Delay (s)				37.9	31.4		6.5	4.7	5.5	7.0	10.8	
Level of Service				D	C		A	A	A	A	B	
Approach Delay (s)		0.0			36.9			5.6			10.3	
Approach LOS		A			D			A			B	

Intersection Summary			
HCM Average Control Delay	12.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	59.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	433	83	448	501	707	49	307
v/c Ratio	0.70	0.24	0.76	0.41	0.55	0.08	0.29
Control Delay	40.3	20.2	13.2	5.3	1.9	5.3	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.3	20.2	13.2	5.3	1.9	5.3	12.9
Queue Length 50th (ft)	120	23	32	49	0	6	78
Queue Length 95th (ft)	157	58	m41	m144	m28	19	187
Internal Link Dist (ft)		1274		507			675
Turn Bay Length (ft)	250		200			150	
Base Capacity (vph)	806	437	836	1227	1284	664	1054
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	0.54	0.19	0.54	0.41	0.55	0.07	0.29

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00					1.00	1.00	0.97	0.95	
Frt		1.00	0.85					1.00	0.85	1.00	1.00	
Flt Protected		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1770	1583					1863	1583	3433	3539	
Flt Permitted		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1770	1583					1863	1583	3433	3539	
Volume (vph)	62	0	320	0	0	0	0	569	382	655	661	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	67	0	348	0	0	0	0	618	415	712	718	0
RTOR Reduction (vph)	0	0	268	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	67	80	0	0	0	0	618	415	712	718	0
Turn Type	Split		Perm						Free	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						Free			
Actuated Green, G (s)		7.6	7.6					29.1	70.0	15.3	50.4	
Effective Green, g (s)		9.6	9.6					31.1	70.0	17.3	52.4	
Actuated g/C Ratio		0.14	0.14					0.44	1.00	0.25	0.75	
Clearance Time (s)		6.0	6.0					6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		243	217					828	1583	848	2649	
v/s Ratio Prot		0.04						c0.33		c0.21	0.20	
v/s Ratio Perm			0.05						c0.26			
v/c Ratio		0.28	0.37					0.75	0.26	0.84	0.27	
Uniform Delay, d1		27.1	27.4					16.2	0.0	25.0	2.8	
Progression Factor		1.00	1.00					1.00	1.00	1.03	0.99	
Incremental Delay, d2		0.6	1.1					6.1	0.4	6.3	0.2	
Delay (s)		27.7	28.5					22.2	0.4	32.0	3.0	
Level of Service		C	C					C	A	C	A	
Approach Delay (s)		28.4			0.0			13.5			17.4	
Approach LOS		C			A			B			B	

Intersection Summary			
HCM Average Control Delay	17.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	67	348	618	415	712	718
v/c Ratio	0.28	0.72	0.75	0.26	0.84	0.27
Control Delay	30.2	15.1	23.3	0.4	35.3	3.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.2	15.1	23.3	0.4	35.3	3.0
Queue Length 50th (ft)	26	14	212	0	167	55
Queue Length 95th (ft)	61	#114	336	0	#240	54
Internal Link Dist (ft)	1163		843			271
Turn Bay Length (ft)		200			250	
Base Capacity (vph)	253	493	827	1583	850	2649
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	0.26	0.71	0.75	0.26	0.84	0.27

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00					1.00	1.00	0.97	0.95	
Frt		1.00	0.85					1.00	0.85	1.00	1.00	
Flt Protected		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1770	1583					1863	1583	3433	3539	
Flt Permitted		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1770	1583					1863	1583	3433	3539	
Volume (vph)	57	0	367	0	0	0	0	952	448	230	1054	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	62	0	399	0	0	0	0	1035	487	250	1146	0
RTOR Reduction (vph)	0	0	104	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	62	295	0	0	0	0	1035	487	250	1146	0
Turn Type	Split		Perm						Free	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						Free			
Actuated Green, G (s)		16.0	16.0					51.0	90.0	5.0	62.0	
Effective Green, g (s)		18.0	18.0					53.0	90.0	7.0	64.0	
Actuated g/C Ratio		0.20	0.20					0.59	1.00	0.08	0.71	
Clearance Time (s)		6.0	6.0					6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		354	317					1097	1583	267	2517	
v/s Ratio Prot		0.04						c0.56		c0.07	0.32	
v/s Ratio Perm			c0.19						0.31			
v/c Ratio		0.18	0.93					0.94	0.31	0.94	0.46	
Uniform Delay, d1		29.8	35.4					17.1	0.0	41.3	5.6	
Progression Factor		1.00	1.00					1.00	1.00	1.09	0.75	
Incremental Delay, d2		0.2	32.9					16.6	0.5	37.3	0.6	
Delay (s)		30.1	68.3					33.7	0.5	82.2	4.7	
Level of Service		C	E					C	A	F	A	
Approach Delay (s)		63.2			0.0			23.1			18.6	
Approach LOS		E			A			C			B	

Intersection Summary			
HCM Average Control Delay	26.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	62	399	1035	487	250	1146
v/c Ratio	0.18	0.95	0.94	0.31	0.94	0.46
Control Delay	31.5	58.4	35.3	0.5	86.6	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.5	58.4	35.3	0.5	86.6	4.8
Queue Length 50th (ft)	29	158	502	0	76	87
Queue Length 95th (ft)	64	#340	#818	0	m#144	113
Internal Link Dist (ft)	1163		843			271
Turn Bay Length (ft)		200			250	
Base Capacity (vph)	354	421	1097	1583	267	2517
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	0.18	0.95	0.94	0.31	0.94	0.46

Intersection Summary

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.

APPENDIX D.4

2030 INTERSECTION CAPACITY ANALYSIS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor				0.97	1.00		1.00	1.00	1.00	1.00	0.95	
Frt				1.00	0.93		1.00	1.00	0.85	1.00	0.99	
Flt Protected				0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)				3433	1724		1770	1863	1583	1770	3514	
Flt Permitted				0.95	1.00		0.38	1.00	1.00	0.41	1.00	
Satd. Flow (perm)				3433	1724		703	1863	1583	762	3514	
Volume (vph)	0	0	0	616	47	46	286	277	261	32	585	29
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	670	51	50	311	301	284	35	636	32
RTOR Reduction (vph)	0	0	0	0	36	0	0	0	135	0	6	0
Lane Group Flow (vph)	0	0	0	670	65	0	311	301	149	35	662	0
Turn Type				Split			pm+pt		Perm	pm+pt		
Protected Phases				8	8		5	2		1	6	
Permitted Phases							2		2	6		
Actuated Green, G (s)				19.5	19.5		36.7	36.7	36.7	24.8	24.8	
Effective Green, g (s)				19.5	19.5		36.7	36.7	36.7	24.8	24.8	
Actuated g/C Ratio				0.28	0.28		0.52	0.52	0.52	0.35	0.35	
Clearance Time (s)				4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)				956	480		577	977	830	296	1245	
v/s Ratio Prot				c0.20	0.04		c0.11	0.16		0.00	c0.19	
v/s Ratio Perm							0.18		0.09	0.04		
v/c Ratio				0.70	0.14		0.54	0.31	0.18	0.12	0.53	
Uniform Delay, d1				22.6	18.9		14.0	9.4	8.7	15.2	18.0	
Progression Factor				1.00	1.00		0.48	0.46	0.09	1.00	1.00	
Incremental Delay, d2				2.3	0.1		0.8	0.6	0.4	0.2	1.6	
Delay (s)				25.0	19.1		7.5	5.0	1.2	15.4	19.6	
Level of Service				C	B		A	A	A	B	B	
Approach Delay (s)		0.0			24.2			4.6			19.4	
Approach LOS		A			C			A			B	

Intersection Summary			
HCM Average Control Delay	15.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	670	101	311	301	284	35	668
v/c Ratio	0.70	0.20	0.54	0.29	0.28	0.09	0.49
Control Delay	26.9	11.7	9.6	5.1	0.7	16.5	18.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.9	11.7	9.6	5.1	0.7	16.5	18.7
Queue Length 50th (ft)	128	16	31	30	0	9	112
Queue Length 95th (ft)	190	51	m28	m27	m0	28	171
Internal Link Dist (ft)		1274		507			675
Turn Bay Length (ft)	250		200			150	
Base Capacity (vph)	970	523	605	1107	1056	390	1615
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	0.69	0.19	0.51	0.27	0.27	0.09	0.41

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor				0.97	1.00		1.00	1.00	1.00	1.00	1.00	
Frt				1.00	0.93		1.00	1.00	0.85	1.00	1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)				3433	1741		1770	1863	1583	1770	1856	
Flt Permitted				0.95	1.00		0.38	1.00	1.00	0.45	1.00	
Satd. Flow (perm)				3433	1741		700	1863	1583	832	1856	
Volume (vph)	0	0	0	424	45	35	438	526	715	49	296	7
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	461	49	38	476	572	777	53	322	8
RTOR Reduction (vph)	0	0	0	0	29	0	0	0	192	0	1	0
Lane Group Flow (vph)	0	0	0	461	58	0	476	572	585	53	329	0
Turn Type				Split			pm+pt		pm+ov	pm+pt		
Protected Phases				8	8		5	2	8	1	6	
Permitted Phases							2		2	6		
Actuated Green, G (s)				14.0	14.0		38.0	31.2	45.2	24.7	21.9	
Effective Green, g (s)				14.0	14.0		38.0	31.2	45.2	24.7	21.9	
Actuated g/C Ratio				0.23	0.23		0.63	0.52	0.75	0.41	0.36	
Clearance Time (s)				4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)				801	406		659	969	1298	386	677	
v/s Ratio Prot				c0.13	0.03		c0.15	0.31	0.11	0.01	0.18	
v/s Ratio Perm							c0.31		0.26	0.05		
v/c Ratio				0.58	0.14		0.72	0.59	0.45	0.14	0.49	
Uniform Delay, d1				20.4	18.2		6.6	10.0	2.8	10.7	14.7	
Progression Factor				1.00	1.00		1.94	1.00	4.08	1.00	1.00	
Incremental Delay, d2				1.0	0.2		3.2	2.2	0.2	0.2	2.5	
Delay (s)				21.4	18.4		16.1	12.2	11.5	10.9	17.2	
Level of Service				C	B		B	B	B	B	B	
Approach Delay (s)		0.0			20.9			12.9			16.3	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM Average Control Delay	15.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	62.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	461	87	476	572	777	53	330
v/c Ratio	0.58	0.20	0.79	0.56	0.53	0.12	0.49
Control Delay	23.1	12.5	21.0	12.4	1.5	7.1	19.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.1	12.5	21.0	12.4	1.5	7.1	19.2
Queue Length 50th (ft)	75	14	146	249	21	6	88
Queue Length 95th (ft)	111	42	m193	m288	m20	18	178
Internal Link Dist (ft)		1274		467			675
Turn Bay Length (ft)	250		200			150	
Base Capacity (vph)	915	492	659	1023	1481	455	678
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	0.50	0.18	0.72	0.56	0.52	0.12	0.49

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00					1.00	1.00	0.97	0.95	
Frt		1.00	0.85					1.00	0.85	1.00	1.00	
Flt Protected		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1770	1583					1863	1583	3433	3539	
Flt Permitted		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1770	1583					1863	1583	3433	3539	
Volume (vph)	73	0	351	0	0	0	0	590	392	784	700	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	79	0	382	0	0	0	0	641	426	852	761	0
RTOR Reduction (vph)	0	0	248	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	79	134	0	0	0	0	641	426	852	761	0
Turn Type	Split		Perm						Free	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						Free			
Actuated Green, G (s)		7.8	7.8					26.6	70.0	19.6	50.2	
Effective Green, g (s)		9.8	9.8					28.6	70.0	19.6	52.2	
Actuated g/C Ratio		0.14	0.14					0.41	1.00	0.28	0.75	
Clearance Time (s)		6.0	6.0					6.0		4.0	6.0	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		248	222					761	1583	961	2639	
v/s Ratio Prot		0.04						c0.34		c0.25	0.22	
v/s Ratio Perm			c0.08						0.27			
v/c Ratio		0.32	0.61					0.84	0.27	0.89	0.29	
Uniform Delay, d1		27.1	28.3					18.7	0.0	24.1	2.9	
Progression Factor		1.00	1.00					1.00	1.00	1.19	1.35	
Incremental Delay, d2		0.7	4.6					10.9	0.4	9.0	0.2	
Delay (s)		27.8	32.9					29.6	0.4	37.6	4.1	
Level of Service		C	C					C	A	D	A	
Approach Delay (s)		32.0			0.0			18.0			21.8	
Approach LOS		C			A			B			C	

Intersection Summary			
HCM Average Control Delay	22.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	79	382	641	426	852	761
v/c Ratio	0.32	0.81	0.84	0.27	0.88	0.29
Control Delay	31.0	24.4	31.7	0.4	40.1	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.0	24.4	31.7	0.4	40.1	4.2
Queue Length 50th (ft)	31	38	245	0	208	75
Queue Length 95th (ft)	69	#172	#434	0	#290	97
Internal Link Dist (ft)	1163		843			271
Turn Bay Length (ft)		200			250	
Base Capacity (vph)	253	473	761	1583	983	2641
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	0.31	0.81	0.84	0.27	0.87	0.29

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00					1.00	1.00	0.97	0.95	
Frt		1.00	0.85					1.00	0.85	1.00	1.00	
Flt Protected		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1770	1583					1863	1583	3433	3539	
Flt Permitted		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1770	1583					1863	1583	3433	3539	
Volume (vph)	60	0	376	0	0	0	0	1014	451	265	1091	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	65	0	409	0	0	0	0	1102	490	288	1186	0
RTOR Reduction (vph)	0	0	107	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	65	302	0	0	0	0	1102	490	288	1186	0
Turn Type	Split		Perm						Free	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						Free			
Actuated Green, G (s)		21.0	21.0					72.0	120.0	9.0	87.0	
Effective Green, g (s)		23.0	23.0					74.0	120.0	11.0	89.0	
Actuated g/C Ratio		0.19	0.19					0.62	1.00	0.09	0.74	
Clearance Time (s)		6.0	6.0					6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		339	303					1149	1583	315	2625	
v/s Ratio Prot		0.04						c0.59		c0.08	0.34	
v/s Ratio Perm			c0.19						0.31			
v/c Ratio		0.19	1.00					0.96	0.31	0.91	0.45	
Uniform Delay, d1		40.7	48.5					21.6	0.0	54.0	6.0	
Progression Factor		1.00	1.00					1.00	1.00	1.05	1.16	
Incremental Delay, d2		0.3	50.7					18.4	0.5	29.0	0.5	
Delay (s)		41.0	99.2					40.0	0.5	85.6	7.5	
Level of Service		D	F					D	A	F	A	
Approach Delay (s)		91.2			0.0			27.8			22.8	
Approach LOS		F			A			C			C	

Intersection Summary			
HCM Average Control Delay	34.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	65	409	1102	490	288	1186
v/c Ratio	0.19	1.00	0.96	0.31	0.91	0.45
Control Delay	42.5	77.2	41.0	0.5	89.0	7.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.5	77.2	41.0	0.5	89.0	7.6
Queue Length 50th (ft)	43	229	750	0	110	190
Queue Length 95th (ft)	84	#441	#1107	0	#200	182
Internal Link Dist (ft)	1163		843			271
Turn Bay Length (ft)		200			250	
Base Capacity (vph)	339	410	1149	1583	315	2625
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	0.19	1.00	0.96	0.31	0.91	0.45

Intersection Summary

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

APPENDIX E

McCRORY LANE WEAVE MODEL ANALYSIS

1: Newsom Station Road & McCrory Lane Performance by approach

Approach	WB	NB	SB	All
Delay / Veh (s)	33.6	13.4	18.5	21.2
Avg Speed (mph)	16	14	15	15

2: I-40 WB Off-Ramp & McCrory Lane Performance by approach

Approach	WB	NB	SB	All
Delay / Veh (s)	1.6	1.4	2.7	2.2
Avg Speed (mph)	31	33	28	29

3: I-40 EB Off-Ramp & McCrory Lane Performance by approach

Approach	EB	NB	SB	All
Delay / Veh (s)	15.6	18.4	15.6	16.5
Avg Speed (mph)	24	17	11	15

10: McCrory Lane & Performance by approach

Approach	EB	NB	SB	All
Delay / Veh (s)	1.1	2.8	1.7	2.0
Avg Speed (mph)	28	26	30	28

Total Network Performance

Delay / Veh (s)	35.5
Avg Speed (mph)	21

Intersection: 1: Newsom Station Road & McCrory Lane

Movement	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	L	TR	L	T	R	L	T	TR
Maximum Queue (ft)	250	223	70	204	150	94	53	224	199
Average Queue (ft)	129	109	17	116	55	37	25	134	89
95th Queue (ft)	207	190	50	173	115	69	53	202	165
Link Distance (ft)			1282		520	520		716	716
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	250	250		200			150		
Storage Blk Time (%)	0			0				3	
Queuing Penalty (veh)	0			1				1	

Intersection: 2: I-40 WB Off-Ramp & McCrory Lane

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 3: I-40 EB Off-Ramp & McCrory Lane

Movement	EB	NB	NB	SB	SB	SB	SB
Directions Served	LT	T	R	L	L	T	T
Maximum Queue (ft)	133	429	427	263	271	271	269
Average Queue (ft)	59	227	20	162	170	99	75
95th Queue (ft)	109	408	153	235	254	222	186
Link Distance (ft)	1187	870	870		274	274	274
Upstream Blk Time (%)				0	0	0	0
Queuing Penalty (veh)				0	1	0	0
Storage Bay Dist (ft)				250			
Storage Blk Time (%)				0	0		
Queuing Penalty (veh)				1	2		

1: Newsom Station Road & McCrory Lane Performance by approach

Approach	WB	NB	SB	All
Delay / Veh (s)	23.5	13.5	23.7	16.9
Avg Speed (mph)	19	14	13	15

2: I-40 WB Off-Ramp & McCrory Lane Performance by approach

Approach	WB	NB	SB	All
Delay / Veh (s)	2.7	5.6	1.8	3.7
Avg Speed (mph)	34	23	28	28

3: I-40 EB Off-Ramp & McCrory Lane Performance by approach

Approach	EB	NB	SB	All
Delay / Veh (s)	17.2	19.0	15.2	17.2
Avg Speed (mph)	24	17	11	16

10: McCrory Lane & Performance by approach

Approach	EB	NB	SB	All
Delay / Veh (s)	1.8	3.5	1.3	2.4
Avg Speed (mph)	27	25	33	28

Total Network Performance

Delay / Veh (s)	32.2
Avg Speed (mph)	22

Intersection: 1: Newsom Station Road & McCrory Lane

Movement	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	L	TR	L	T	R	L	TR
Maximum Queue (ft)	127	117	84	236	536	532	175	264
Average Queue (ft)	74	64	18	138	194	101	33	122
95th Queue (ft)	117	108	51	224	427	365	85	198
Link Distance (ft)			1282		479	479		715
Upstream Blk Time (%)					1	0		
Queuing Penalty (veh)					11	2		
Storage Bay Dist (ft)	250	250		200			150	
Storage Blk Time (%)				1	2			3
Queuing Penalty (veh)				6	9			1

Intersection: 2: I-40 WB Off-Ramp & McCrory Lane

Movement	WB	NB
Directions Served	R	T
Maximum Queue (ft)	85	133
Average Queue (ft)	4	15
95th Queue (ft)	33	76
Link Distance (ft)	994	356
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 3: I-40 EB Off-Ramp & McCrory Lane

Movement	EB	NB	NB	SB	SB	SB	SB
Directions Served	LT	T	R	L	L	T	T
Maximum Queue (ft)	113	885	629	192	253	269	311
Average Queue (ft)	46	443	79	93	84	92	78
95th Queue (ft)	89	722	390	161	160	203	182
Link Distance (ft)	1187	870	870		274	274	274
Upstream Blk Time (%)		1				0	0
Queuing Penalty (veh)		0				1	1
Storage Bay Dist (ft)				250			
Storage Blk Time (%)					0		
Queuing Penalty (veh)					0		

1: Newsom Station Road & McCrory Lane Performance by approach

Approach	WB	NB	SB	All
Delay / Veh (s)	26.0	14.1	19.4	19.6
Avg Speed (mph)	19	14	10	15

2: I-40 WB Off-Ramp & McCrory Lane Performance by approach

Approach	WB	NB	SB	All
Delay / Veh (s)	1.6	1.3	2.5	2.0
Avg Speed (mph)	32	33	28	29

3: I-40 EB Off-Ramp & McCrory Lane Performance by approach

Approach	EB	NB	SB	All
Delay / Veh (s)	15.5	19.1	15.5	16.8
Avg Speed (mph)	25	16	11	15

10: McCrory Lane & Performance by approach

Approach	EB	NB	SB	All
Delay / Veh (s)	0.8	2.9	1.5	1.8
Avg Speed (mph)	28	26	32	29

Total Network Performance

Delay / Veh (s)	34.4
Avg Speed (mph)	21

Intersection: 1: Newsom Station Road & McCrory Lane

Movement	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	L	TR	L	T	TR	L	T	TR
Maximum Queue (ft)	167	166	72	161	144	102	175	237	215
Average Queue (ft)	119	93	20	102	69	46	29	129	100
95th Queue (ft)	165	149	53	163	128	74	84	204	164
Link Distance (ft)			1283		520	520		347	347
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	250	250		200			150		
Storage Blk Time (%)								2	
Queuing Penalty (veh)								1	

Intersection: 2: I-40 WB Off-Ramp & McCrory Lane

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 3: I-40 EB Off-Ramp & McCrory Lane

Movement	EB	NB	NB	SB	SB	SB	SB
Directions Served	LT	T	R	L	L	T	T
Maximum Queue (ft)	115	505	252	220	237	237	222
Average Queue (ft)	50	246	15	141	146	46	37
95th Queue (ft)	94	440	105	205	217	151	120
Link Distance (ft)	1187	870	870		274	274	274
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)				250			
Storage Blk Time (%)					0		
Queuing Penalty (veh)					0		

1: Newsom Station Road & McCrory Lane Performance by approach

Approach	WB	NB	SB	All
Delay / Veh (s)	30.9	11.2	17.8	16.1
Avg Speed (mph)	16	15	16	16

2: I-40 WB Off-Ramp & McCrory Lane Performance by approach

Approach	WB	NB	SB	All
Delay / Veh (s)	2.2	3.9	1.8	2.9
Avg Speed (mph)	35	26	28	30

3: I-40 EB Off-Ramp & McCrory Lane Performance by approach

Approach	EB	NB	SB	All
Delay / Veh (s)	17.2	19.2	15.0	17.2
Avg Speed (mph)	24	17	12	16

10: McCrory Lane & Performance by approach

Approach	EB	NB	SB	All
Delay / Veh (s)	1.8	3.2	1.5	2.3
Avg Speed (mph)	27	26	32	28

Total Network Performance

Delay / Veh (s)	31.0
Avg Speed (mph)	22

Intersection: 1: Newsom Station Road & McCrory Lane

Movement	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	L	TR	L	T	TR	L	TR
Maximum Queue (ft)	165	180	88	225	240	353	175	220
Average Queue (ft)	93	90	19	107	70	135	30	103
95th Queue (ft)	143	144	53	182	150	263	81	173
Link Distance (ft)			1283		479	479		715
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	250	250		200			150	
Storage Blk Time (%)				0				2
Queuing Penalty (veh)				1				1

Intersection: 2: I-40 WB Off-Ramp & McCrory Lane

Movement	WB	NB
Directions Served	R	T
Maximum Queue (ft)	50	85
Average Queue (ft)	2	5
95th Queue (ft)	16	33
Link Distance (ft)	994	356
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 3: I-40 EB Off-Ramp & McCrory Lane

Movement	EB	NB	NB	SB	SB	SB	SB
Directions Served	LT	T	R	L	L	T	T
Maximum Queue (ft)	113	885	885	171	177	280	270
Average Queue (ft)	46	447	110	91	81	93	77
95th Queue (ft)	89	728	505	156	144	214	178
Link Distance (ft)	1187	870	870		274	274	274
Upstream Blk Time (%)		1	0			0	0
Queuing Penalty (veh)		0	0			0	1
Storage Bay Dist (ft)				250			
Storage Blk Time (%)							
Queuing Penalty (veh)							

1: Newsom Station Road & McCrory Lane Performance by approach

Approach	EB	WB	NB	SB	All
Delay / Veh (s)	21.6	55.1	34.9	31.2	37.0
Avg Speed (mph)	17	12	15	11	13

3: I-40 EB Off-Ramp & McCrory Lane Performance by approach

Approach	EB	NB	SB	All
Delay / Veh (s)	13.1	19.5	20.7	19.2
Avg Speed (mph)	27	16	19	19

Total Network Performance

Delay / Veh (s)	49.8
Avg Speed (mph)	19

Intersection: 1: Newsom Station Road & McCrory Lane

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	R	L	L	TR	L	T	R	L	T	TR
Maximum Queue (ft)	113	114	87	275	285	699	225	661	215	175	269	232
Average Queue (ft)	63	45	18	191	180	109	160	139	46	32	185	117
95th Queue (ft)	105	89	61	277	299	431	245	428	106	85	269	193
Link Distance (ft)		1192				1269		1247			716	716
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	150		150	250	250		200		190	150		
Storage Blk Time (%)				2	7		11	0	0		17	
Queuing Penalty (veh)				2	6		42	1	0		6	

Intersection: 3: I-40 EB Off-Ramp & McCrory Lane

Movement	EB	NB	SB	SB	SB	SB
Directions Served	LT	T	L	L	T	T
Maximum Queue (ft)	69	462	242	257	1382	112
Average Queue (ft)	42	269	153	155	83	45
95th Queue (ft)	68	439	213	227	484	96
Link Distance (ft)	1185	870			1247	1247
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)			250	250		
Storage Blk Time (%)			0	0		
Queuing Penalty (veh)			0	1		

Nework Summary

Network wide Queuing Penalty: 58

1: Newsom Station Road & McCrory Lane Performance by approach

Approach	EB	WB	NB	SB	All
Delay / Veh (s)	504.5	46.7	39.4	267.0	233.1
Avg Speed (mph)	13	13	14	2	10

3: I-40 EB Off-Ramp & McCrory Lane Performance by approach

Approach	EB	NB	SB	All
Delay / Veh (s)	17.1	20.0	17.6	18.6
Avg Speed (mph)	24	16	20	19

Total Network Performance

Delay / Veh (s)	199.1
Avg Speed (mph)	16

Intersection: 1: Newsom Station Road & McCrory Lane

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	L	TR	L	T	R	L	TR
Maximum Queue (ft)	175	1212	195	171	203	147	225	1121	234	175	730
Average Queue (ft)	122	408	144	115	95	29	209	389	71	51	623
95th Queue (ft)	197	960	226	166	151	91	252	935	162	127	854
Link Distance (ft)		1198				1271		1248			715
Upstream Blk Time (%)		0									40
Queuing Penalty (veh)		0									0
Storage Bay Dist (ft)	150		150	250	250		200		190	150	
Storage Blk Time (%)	1	18	2				16	0	0	0	77
Queuing Penalty (veh)	12	176	11				100	4	0	0	38

Intersection: 3: I-40 EB Off-Ramp & McCrory Lane

Movement	EB	NB	NB	SB	SB	SB	SB
Directions Served	LT	T	R	L	L	T	T
Maximum Queue (ft)	157	750	661	127	149	192	214
Average Queue (ft)	56	450	40	78	72	95	113
95th Queue (ft)	101	749	291	124	116	167	188
Link Distance (ft)	1185	870	870			1248	1248
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)				250	250		
Storage Blk Time (%)							
Queuing Penalty (veh)							

Nework Summary

Network wide Queuing Penalty: 340

APPENDIX F

COST DATA SHEETS

COST DATA SHEET

Project: I-40 at McCrory Lane Interchange, Phase 1
Length: N/A

Right-of-Way

Land (3.55 Acres)	$ 390,500	
Improvements	$ -	
Damages	$ -	
Incidentals	$ -	
Relocation Payments	$ -	
Total Right-of-Way Cost:		**$ 390,500**

Utility Relocation

Reimbursable	$ -	
Non-reimbursable	$ 76,000	
Total Utility Cost:		**$ 76,000**

Construction

Clearing and Grubbing	$ 66,100	
Earthwork	$ 452,300	
Pavement Removal	$ 76,500	
Drainage (includes Erosion Control)	$ 210,400	
Structures	$ -	
Railroad Crossing or Separation	$ -	
Paving	$ 1,183,000	
Retaining Walls	$ 25,200	
Maintenance of Traffic	$ 66,900	
Topsoil	$ 13,200	
Seeding	$ 4,000	
Sodding	$ -	
Signing	$ 28,600	
Lighting	$ -	
Signalization	$ 200,000	
Fence	$ 27,400	
Guardrail	$ 26,200	
Rip Rap or Slope Protection	$ -	
Other Construction Items (8.5%)	$ 223,533	
Mobilization	$ 250,000	
Construction Cost:	$ 2,853,333	
10% Engineering and Contingencies	$ 285,333	
Total Construction Cost:		**$ 3,138,666**

Preliminary Engineering (10% Const.)	$ 285,333	
TOTAL PHASE ONE COST:		**$ 3,890,500**

COST DATA SHEET

Project: I-40 at McCrory Lane Interchange, Phase 2
Length: N/A

Right-of-Way

Land (Commercial Zoning - 0.60 Acres)	$ 100,000	
Land (State Land, no zoning - 4.94 Acres)	$ 49,400	
Improvements	$ -	
Damages	$ -	
Incidentals	$ -	
Relocation Payments	$ -	
Total Right-of-Way Cost:		**$ 149,400**

Utility Relocation

Reimbursable	$ -	
Non-reimbursable	$ 75,000	
Total Utility Cost:		**$ 75,000**

Construction

Clearing and Grubbing	$ 97,100	
Earthwork	$ 813,560	
Pavement Removal	$ 107,100	
Drainage (includes Erosion Control)	$ 212,300	
Structures	$ 935,800	
Railroad Crossing or Separation	$ -	
Paving	$ 1,734,140	
Retaining Walls	$ 329,400	
Maintenance of Traffic	$ 77,300	
Topsoil	$ 19,500	
Seeding	$ 6,000	
Sodding	$ -	
Signing	$ 145,600	
Lighting	$ 125,000	
Signalization	$ 18,000	
Fence	$ 24,600	
Guardrail	$ -	
Rip Rap or Slope Protection	$ -	
Other Construction Items (8.5%)	$ 416,109	
Mobilization	$ 250,000	
Construction Cost:	$ 5,311,509	
10% Engineering and Contingencies	$ 531,151	
Total Construction Cost:		**$ 5,842,660**

Preliminary Engineering (10% Const.)	$ 531,151	
TOTAL PHASE TWO COST:		**$ 6,598,211**

APPENDIX G

FUNCTIONAL PLANS

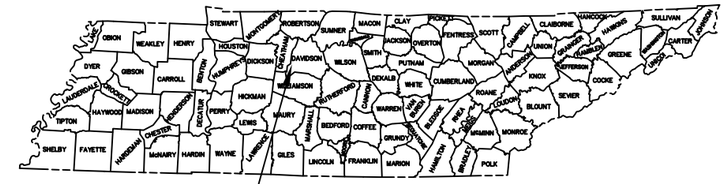
TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO. ---

Index Of Sheets

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING

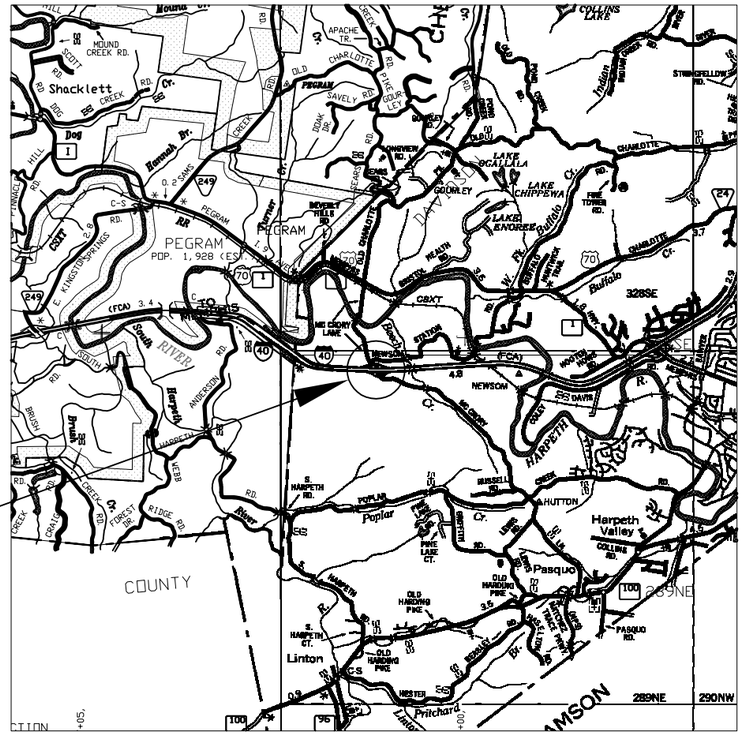
DAVIDSON COUNTY

TENN.	YEAR	SHEET NO.
	2005	1
FED. AID PROJ. NO.	.	
STATE PROJ. NO.	.	



INTERSTATE 40 AT McCRORY LANE

STATE HIGHWAY NO. 40 F.A.H.S. NO. 40



MAP NOT TO SCALE

SPECIAL NOTES

PROPOSALS MAY BE REJECTED BY THE COMMISSIONER IF ANY OF THE UNIT PRICES CONTAINED THEREIN ARE OBVIOUSLY UNBALANCED, EITHER EXCESSIVE OR BELOW THE REASONABLE COST ANALYSIS VALUE.

THIS PROJECT TO BE CONSTRUCTED UNDER THE STANDARD SPECIFICATIONS OF THE TENNESSEE DEPARTMENT OF TRANSPORTATION DATED MARCH 1, 1995 AND ADDITIONAL SPECIFICATIONS AND SPECIAL PROVISIONS CONTAINED IN THE PLANS AND IN THE PROPOSAL CONTRACT

TDOT ROAD SP. SV. 2 _____

DESIGNER JOSEPH F. GRIFFIN, P.E. CHECKED BY _____

P.E. NO. _____

APPROVED: _____
CHIEF ENGINEER

DATE: _____

APPROVED: _____
COMMISSIONER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED: _____ _____
DIVISION ADMINISTRATOR DATE

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO. ---

TYPE	YEAR	PROJECT NO.	SHEET NO.
-	2005	-	2
.	.	.	.
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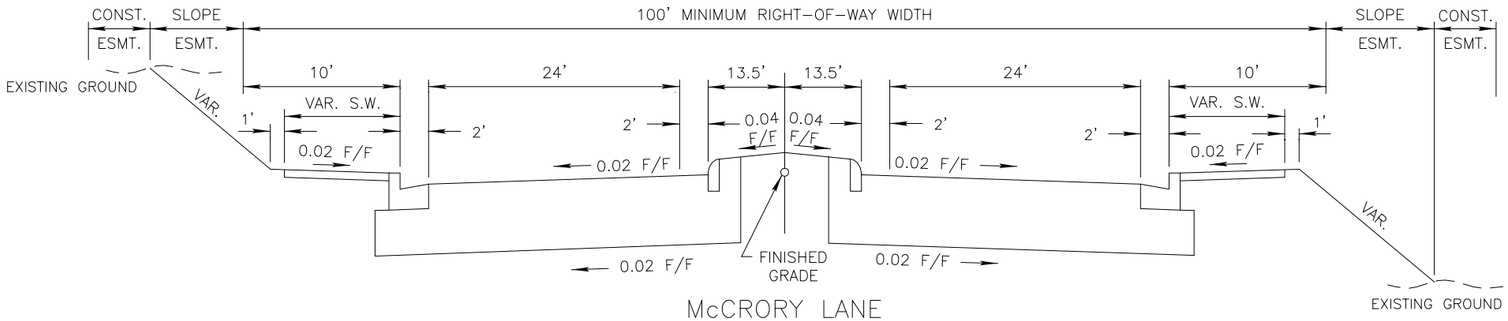
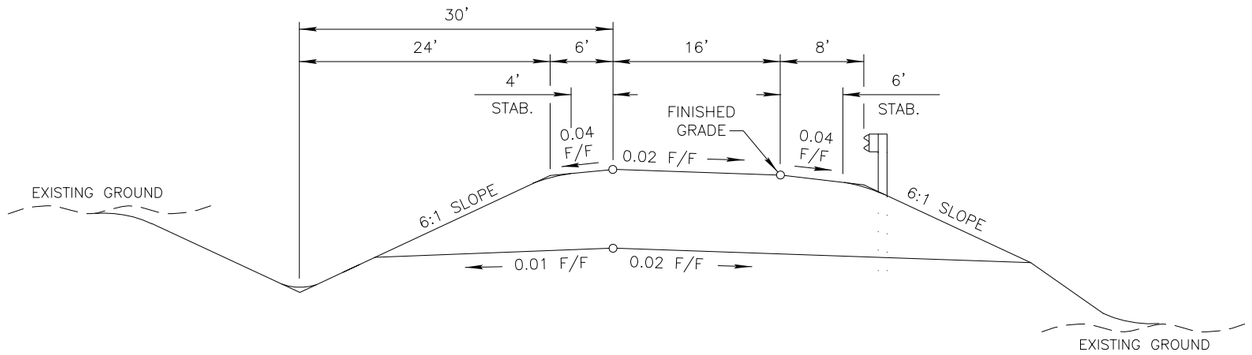
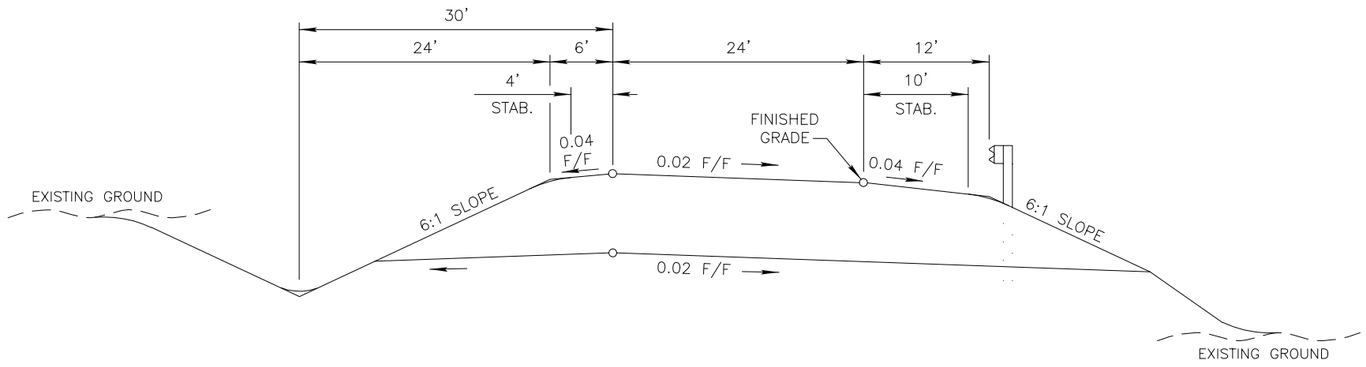
.	.	.	.



McCRORY LANE
SOUTH OF INTERSTATE 40



ONE LANE RAMPS



TWO LANE RAMPS

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

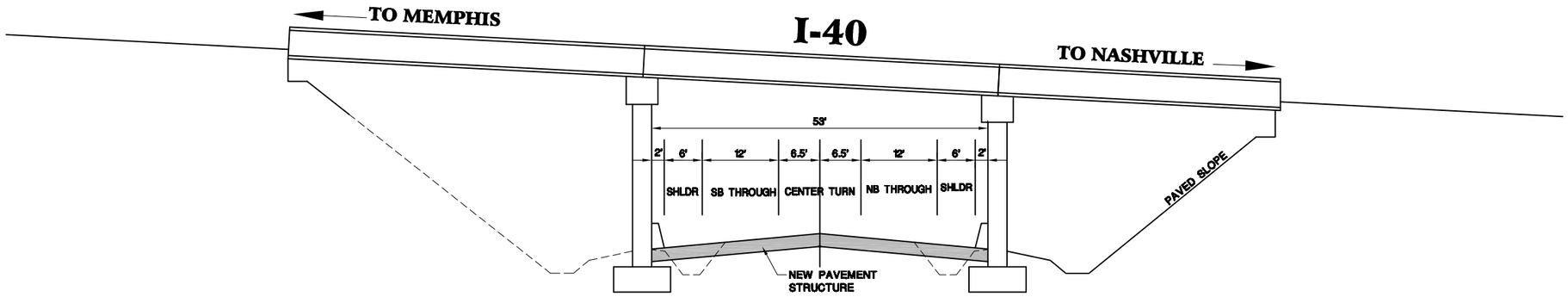
INTERSTATE 40 &
McCRORY LANE

INTERCHANGE
MODIFICATION STUDY

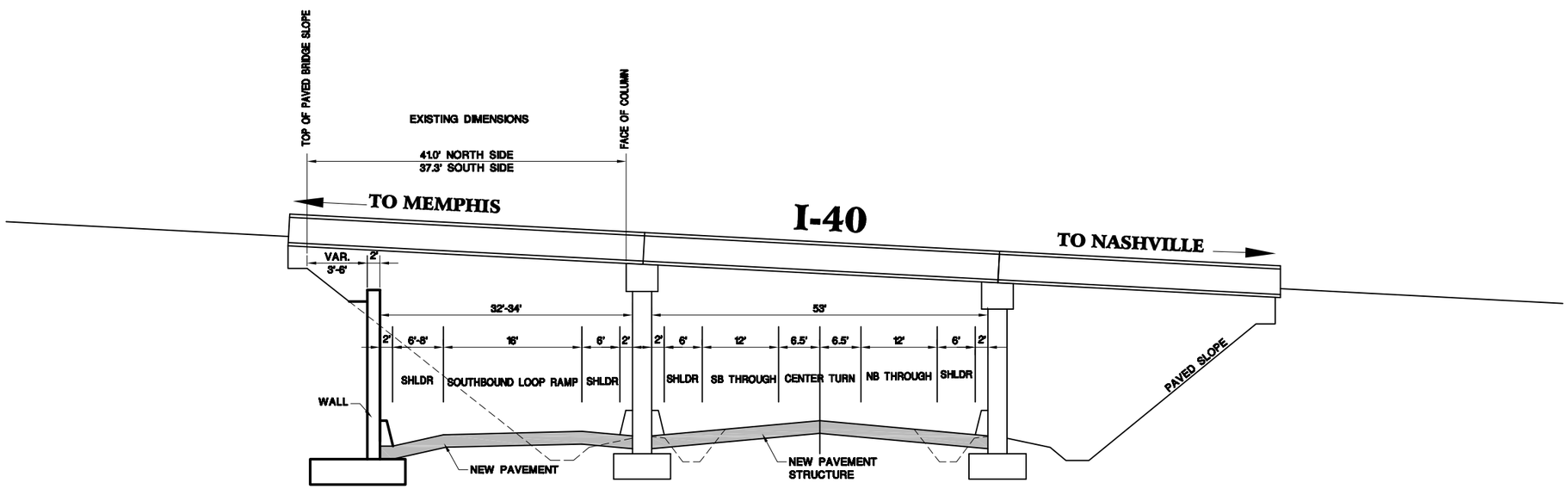
TYPICAL SECTIONS

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO. ---

TYPE	YEAR	PROJECT NO.	SHEET NO.
-	2005	-	3
.	.	.	.
.	.	.	.
.	.	.	.



McCRORY LANE – PHASE I
LOOKING NORTH



McCRORY LANE – PHASE II
LOOKING NORTH

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

INTERSTATE 40 &
McCRORY LANE

INTERCHANGE
MODIFICATION STUDY

TYPICAL SECTIONS

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO. ___

TYPE	YEAR	PROJECT NO.	SHEET NO.
-	2005	-	4
.	.	.	.
.	.	.	.
.	.	.	.

SEE SHEET NO. 5

0 100 200 300

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

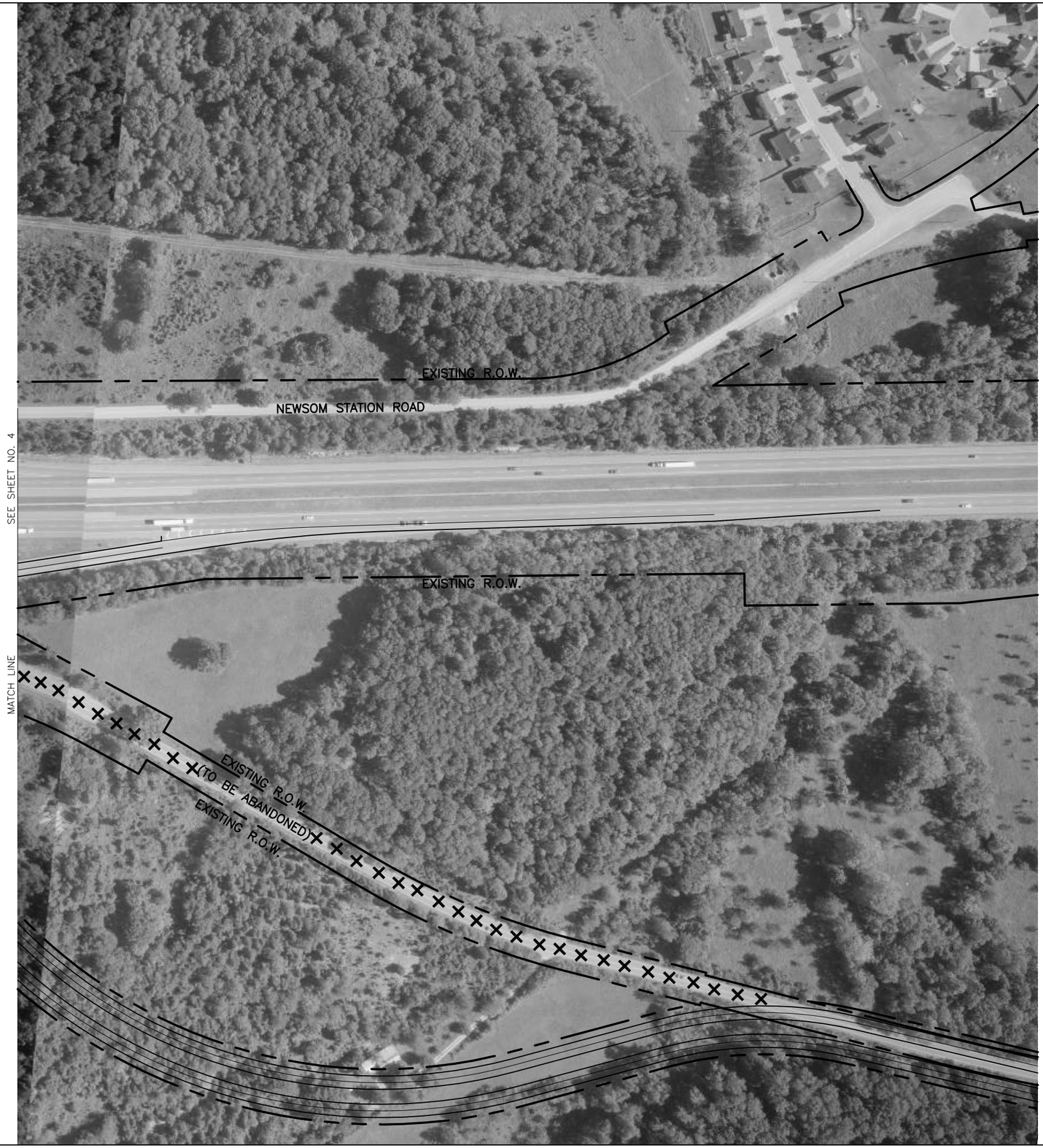
INTERSTATE 40 & McCRORY LANE

INTERCHANGE MODIFICATION STUDY

PHASE I IMPROVEMENTS

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO. ___

TYPE	YEAR	PROJECT NO.	SHEET NO.
-	2005	-	5
.	.	.	.
.	.	.	.
.	.	.	.



0 100 200 300

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

INTERSTATE 40 & McCRORY LANE

INTERCHANGE MODIFICATION STUDY

PHASE I IMPROVEMENTS

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO. ---

TYPE	YEAR	PROJECT NO.	SHEET NO.
-	2005	-	6
.	.	.	.
.	.	.	.
.	.	.	.

SEE SHEET NO. 7

MATCH LINE

0 100 200 300

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

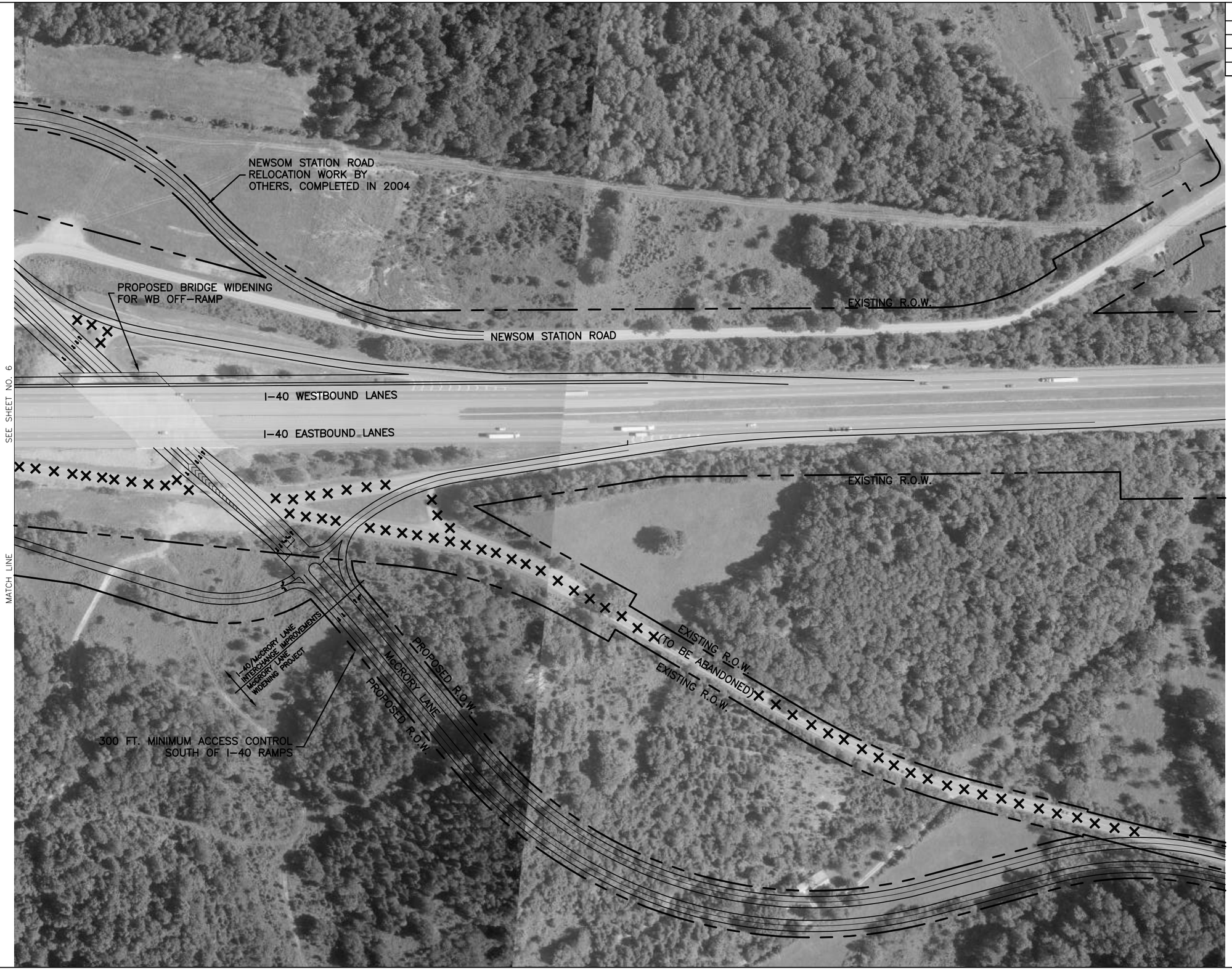
INTERSTATE 40 & McCRORY LANE

INTERCHANGE MODIFICATION STUDY

PHASE II IMPROVEMENTS

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO. ---

TYPE	YEAR	PROJECT NO.	SHEET NO.
-	2005	-	7
.	.	.	.
.	.	.	.
.	.	.	.



STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

INTERSTATE 40 & McCRORY LANE

INTERCHANGE MODIFICATION STUDY

PHASE II IMPROVEMENTS