INTERCHANGE JUSTIFICATION STUDY

APD-40 Proposed Interchange Between Exit 20 at I-75 and South Lee Highway (SR 2/US 11) Bradley County

PREPARED BY
LONG ENGINEERING
for the
TENNESSEE DEPARTMENT OF TRANSPORTATION
PROJECT PLANNING DIVISION

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1.0 INTRODUCTION

1.1 Study Purpose and Scope

Purpose

The purpose of this study is to investigate the need and viability of a new interchange located on APD-40 (State Route 311/US74/US 64 Bypass), approximately 0.6-mile east of the Exit 20 interchange with I-75 and 0.9 mile west of the South Lee Highway (US 11) interchange with APD-40 in Cleveland, Tennessee.

Scope

The scope of the study is to provide a detailed evaluation of potential interchange locations and configurations to better accommodate traffic anticipated with potential development in the immediate area. This study is at the request of the Tennessee Department of Transportation (TDOT) on behalf of local, state, and federal officials representing Cleveland, Tennessee.

The Cleveland Urban Area Metropolitan Planning Organization (CUAMPO) has identified this potential project as being supported by the natural characteristics of the land, existing and proposed utilities, and existing and proposed complimentary roadway system including, but not limited to, the proposed improvements to the nearby I-75 Exit 20.

Project Need

This proposed new interchange is needed to meet current passenger and freight transportation demands, to mitigate safety and congestion concerns, and to support the future logical pattern of development within the study area. According to the CUAMPO, the addition of a new interchange is justified in terms of economic necessity and support of the future regional and national transportation system. The transportation improvements outlined in this study are necessary to support the current needs of the area as well as the envisioned future land use and economic development.

The natural characteristics of the area, the existing and proposed utilities, and the existing and proposed roads supports the proposed economic development. The proposed slip ramp will provide direct access to southeast quadrant of the study interchange for the following proposed economic developments:

- The United States Forest Service (USFS) is planning to relocate their Cherokee National Forest headquarters to this site. The USFS site will also serve as a tourist destination prior to entering the Cherokee National Forest on APD-40 which will include the historical and cultural resources associated with the Trail of Tears National Trail.
- An Ocoee River Gateway site for visitors providing a natural entrance to the Ocoee River rafting and recreation area.
- A Visitor Welcome Center to draw attention to the area by promoting the many regional and recreational opportunities for the thousands of visitors who access the Cherokee National Forest and the Ocoee River area via the study interchange.
- A convention center serving the southern Cleveland/Bradley County area.
- An industrial park to support the new Volkswagen plant facility near I-75 Exit 9 interchange in Chattanooga.

At this time, there is an Interchange Modification Study (IMS) concurrently underway at the I-75 Exit 20 interchange. Although these are separate studies, they have been reviewed collectively and prepared concurrently to assure that the future implementation is a collaborated and coordinated system.

1.2 Description of Project Area

This project area, located in the City of Cleveland in Bradley County, is along APD-40 between Exit 20 on 1-75 and the South Lee Highway (US 11) interchange on APD-40. ***Figure 1.1*** depicts the study location and the surrounding area with the proximity of the adjacent interchanges. ***Figure 1.2*** highlights the immediate interchange area on an aerial photograph. APD-40 is a part of the Appalachian Regional network also known as Corridor K and connects this area to Polk County and further into North Carolina. ***Figure 1.3*** presents a photograph taken from the Humphrey Bridge Road overpass to the west. ***Figure 1.4*** depicts a view to the east from the same location. Both photographs illustrate that the horizontal alignment is fairly straight for the majority of the corridor.

APD-40 route starts at approximately the mid-point of the bridge overpass at Exit 20 (Over I-75). To the west of this location, the road is known as Pleasant Grove Road and is a two lane facility. The bridge over I-75 is also a two-lane facility. Traveling east from I-75, APD-40 widens to a four-lane facility throughout the remainder of the study corridor.

<u>Exit-20 at 1-75 Interchange Study</u>

The nearest interchange to the west is Exit 20 at I-75. An IMS is being prepared for this location and has been coordinated with this study effort to ensure the recommended modifications are compatible with this study.

<u>Population and Growth</u>

The population in Bradley County increased by 27% from the year 1990 to 2006. This is slightly ahead of the statewide pace of 26.2%. ***Table 1.1*** presents population trends for the area.

Table 1.1 – U.S. Census Population Trends

Year	City of Cleveland	Bradley County	Tennessee
1990	36,138	73,712	4.88 Mil
2000	37,192	87,965	5.69 mil
2006	38,627	93,728	6.16 mil

The land area in close proximity to this interchange has been targeted by the local jurisdiction for future development. This subarea’s growth rate will be greater than the overall rate for Cleveland and Bradley County.

Figure 1.1 – Location Map

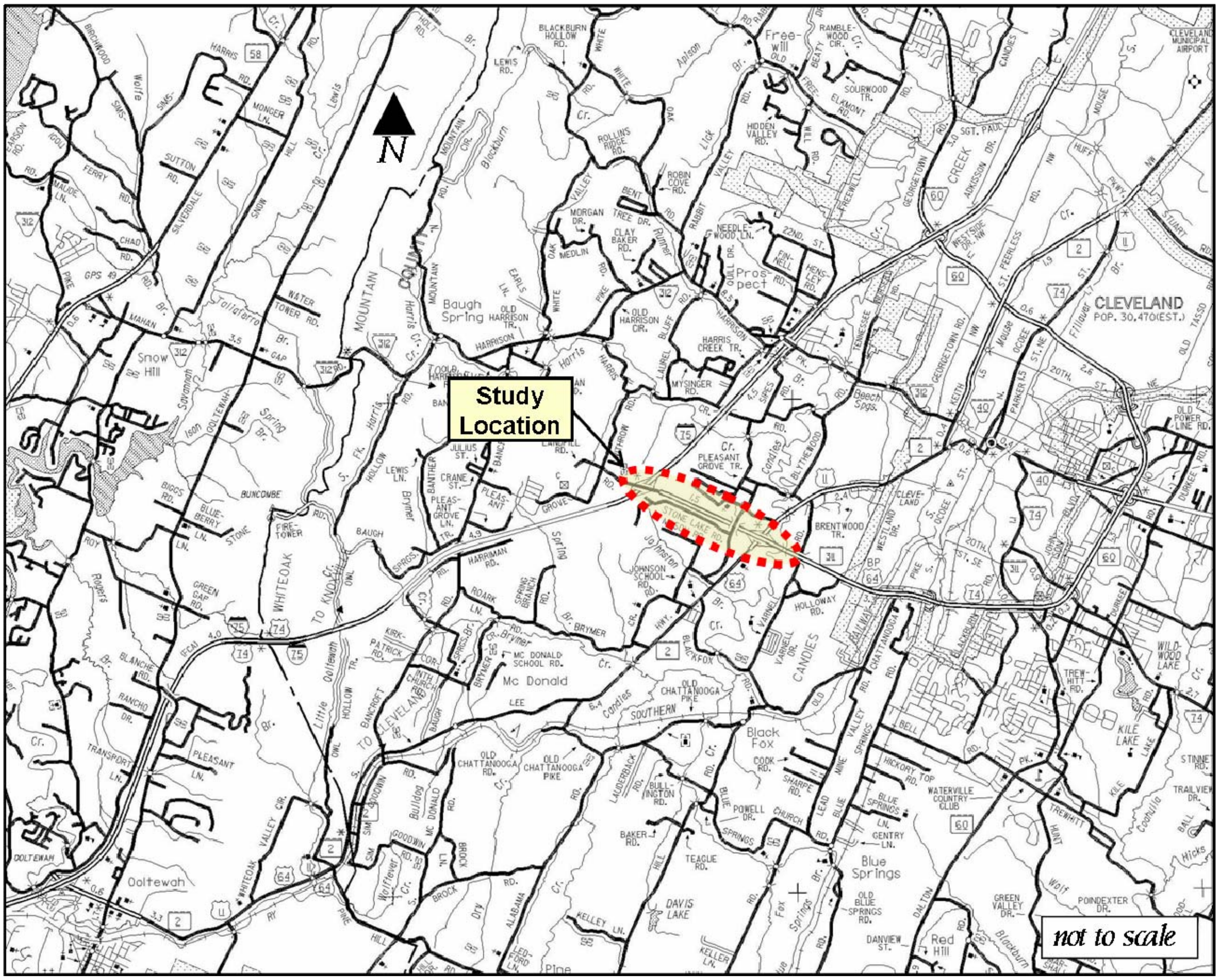


Figure 1.2 – Proposed Interchange Overview Area

South Lee Highway (US 11) at APD-40

The nearest interchange to the east is at South Lee Highway (US 11). This interchange is a traditional diamond and provides access to the southern area of Cleveland, Bradley County, and the northern reaches of Hamilton County. South Lee Highway is a multi-lane facility in this area and the ramp terminals are currently unsignalized.

Figure 1.3 – Westbound View along APD-40 from Humphrey Bridge Rd

Figure 1.4 – Eastbound View along APD-40 toward the US 11 Interchange

1.3 Relationship to Other Highway Improvement Plans and Programs

The proposed APD-40 access is included in the CUAMPO Long Range Transportation plan. The section of APD-40 just east of Exit 20 is a controlled access facility and property development has been curtailed because of the controlled access. The City of Cleveland has requested to be allowed access from APD-40 to allow for development along these areas.

This project has received funding in three Federal earmarks in the most recent SAFETEA-LU highway bill of 2005. Funding for environmental studies for Exit 20 and a new interchange on APD-40 are in the CUAMPO 2006-2008 Transportation Improvement Program (TIP). In addition, TDOT's 2010-2012 Proposed Comprehensive Multimodal Program has identified preliminary engineering for this proposed interchange.

This study is developed in cooperation with an IMS at the Exit 20 at I-75 interchange. The recommended configuration for a proposed Exit 20 interchange modification is presented in ***Appendix F***. In a later section of this study, ***Figure 2.3*** presents a depiction of how the two interchanges will be coordinated.

2.0 PRELIMINARY PLANNING DATA

2.1 Land Use

In preparation of this study effort, officials from Cleveland in conjunction with the CUAMPO prepared a detailed land use report that contains specific land use projections for the study area. As this report provides valuable information, it is provided in its entirety in ***Appendix G***. Specific areas adjacent to this proposed interchange are discussed below.

Western Area (Exit 20 Interchange)
There is a gas station/convenience store (Brewer's Exxon) located in the northwest quadrant of the interchange. This business attracts a large amount of truck traffic. There is also a fireworks discount store in the same area. A new Toyota dealership was constructed and opened for business during the first part of 2008 behind Brewer's Exxon.

In the southwest quadrant there is a multiplex movie theatre complex and another fireworks store. There is an abandoned service station in this quadrant that occupies the area between the fireworks store and Pleasant Grove Road. Just west of the movie theatre is a relatively new automobile travel center (Horizon) that includes a service station, convenience mart, and two restaurants.

The Tri-State Exhibition Center is situated approximately one mile west of the I-75 Exit 20 interchange. The Center has scheduled events almost every weekend from April through November. Most events are 3-day events, usually spanning a weekend. The Bradley County Landfill is further west.

Eastern Area (South Lee Highway (US 11) Interchange)
Automotive dealerships occupy the areas on the northwest and southeast quadrants. The area to the north is increasingly commercial. The area to the south transitions to a more rural setting.

Northern Area
The majority of the land on the north side adjacent to APD-40 is undeveloped. Further north, there are residential areas with low volume, low speed local roads.

Southern Area
The development to the south of APD-40 within the study limits is limited. There is a power station situated between the two existing interchanges along with a few businesses and some farm/pasture land.

This area has been identified by local officials as ideal for an industrial park as the future land use plans indicated that this relatively undeveloped area will become more commercial in the future. However, for development to survive, a direct connection to APD-40 is necessary to eliminate the need to travel east along substandard local roads to South Lee Highway.

Other Study Conclusions
The land in the study area is a logical location for future urban development including commercial, industrial, and residential uses. The following summarizes the local opinion of the area as extracted from the previously mentioned study provided in ***Appendix G***.

> *"These future land uses are supported by the plans of the Cleveland Urban Area MPO, Bradley County, and the City of Cleveland. The natural characteristics of the land, existing and proposed utilities, and existing and proposed roads would support such a development pattern. The proposed improvements to I-75 Exit 20 and the nearby APD-40 interchange or intersection are needed to meet current passenger and freight transportation needs, to mitigate safety and congestion concerns, and to support the aforementioned future logical pattern of development within the study area. The proposed improvements are also justified in terms of their connection to regional economic development in nearby Chattanooga, in terms of tourism and the public's access to the Cherokee National Forest and the historical and cultural resources associated with the Trail of Tears, and in terms of the future regional and national transportation systems that must make efficient use of existing facilities, provide intermodal connections, and enhance transportation security. The primary transportation improvements contemplated in this study, the improvements to I-75 Exit 20 and the nearby APD-40 interchange or intersection, are needed to support current needs of the area as well as the envisioned future land use and economic development. "*

Figure 2.1 and ***Figure 2.2*** depict Land Use Maps extracted from the CUAMPO Land Use Plan for the area. As depicted in ***Figure 2.1***, the majority of land adjacent to APD-40 between the I-75 Exit 20 and South Lee Highway Interchanges is currently zoned natural with a scattering of businesses, residential developments, and institutional resources. ***Figure 2.2*** presents the future land use plan where the entire frontage to APD-40 will be transformed to industrial and business/commercial. Note that on both figures, a proposed intersection is indicated. These figures were prepared prior to this study. At the time of the land use plan preparation, it was thought that one option may be to add an intersection between the two existing interchanges. This was not a consideration for this study.

2.2 Environmental Concerns

There is an existing lake in the southeast quadrant of the Exit 20 interchange. Several initial concepts would have directly impacted this lake. The recommended concept plan does not affect the lake area. There are several utility implications that would need to be considered with the potential new interchange location.

As this project progresses in the NEPA process, it will be necessary to conduct other studies to determine environmental and historical impact. The Tennessee Department of Transportation will perform all necessary studies including ecological and historical studies.

Figure 2.1 – Existing Land Use

(Extracted from the CAUMPO Land Use Report. See Appendix G for full Report)

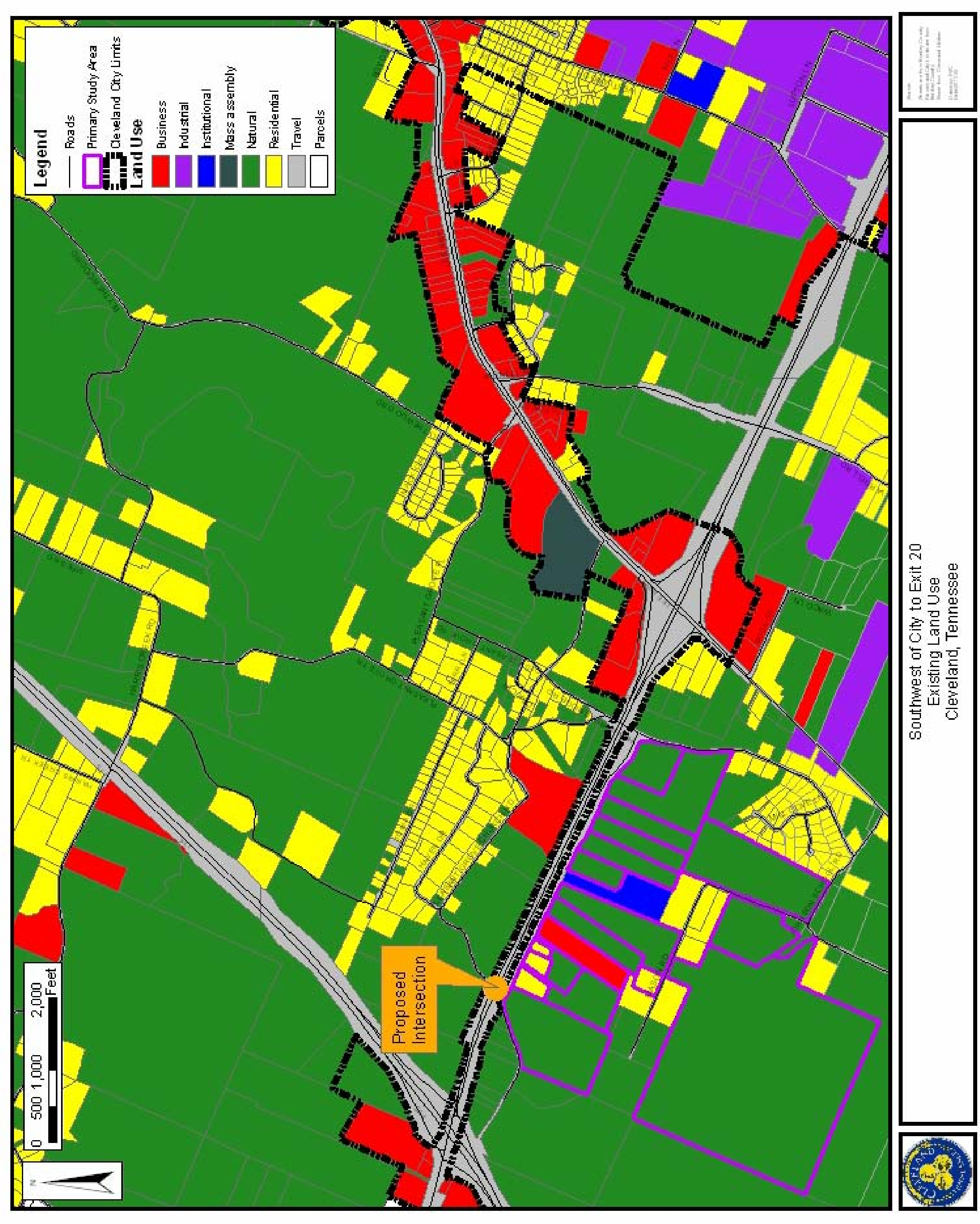
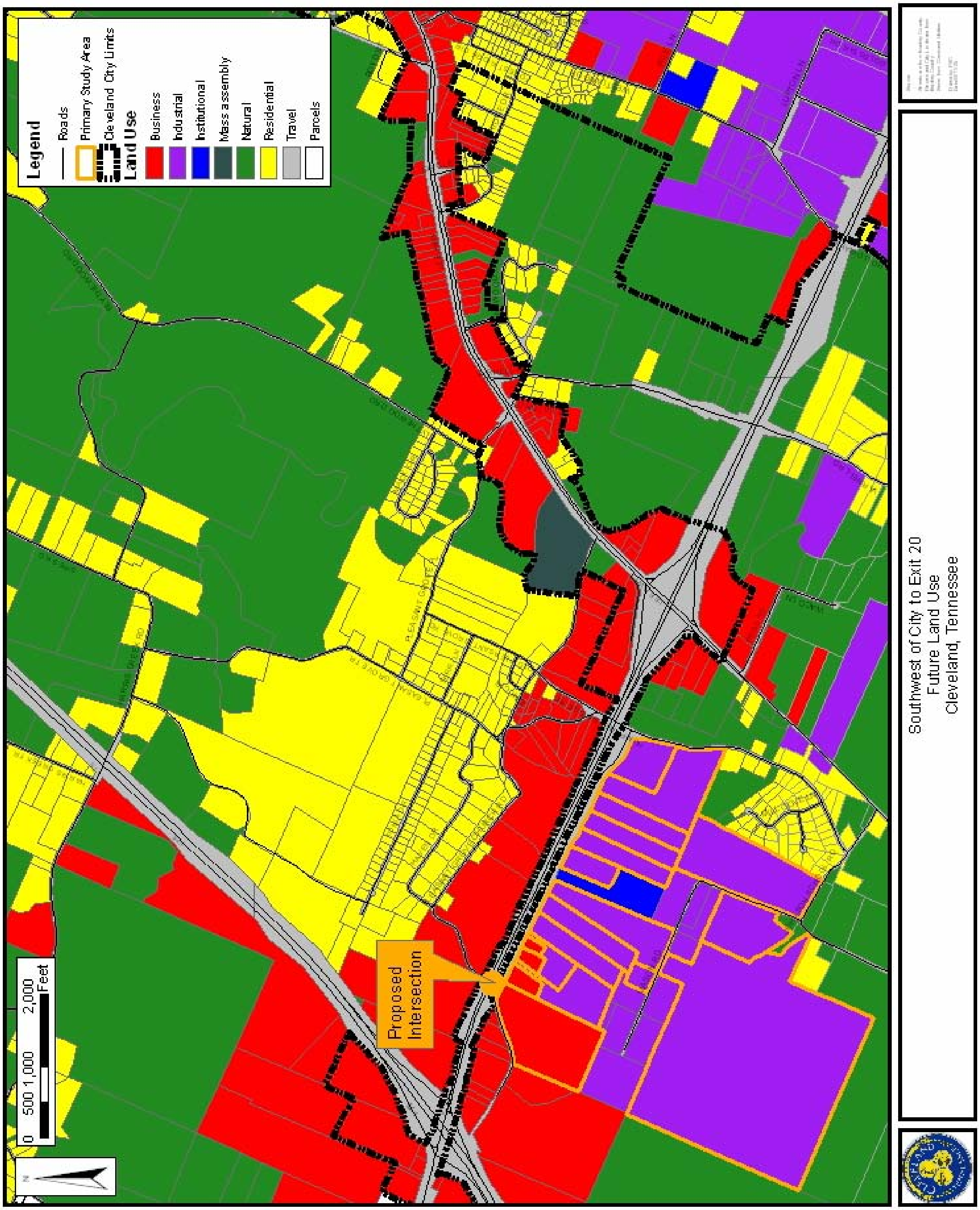


Figure 2.2 – Future Land Use

(Extracted from the CAUMPO Land Use Report. See Appendix G for full Report)



2.3 Traffic Served

The proposed study interchange is located on APD-40 between I-75 and S.R. 2 (U.S 11/South Lee Highway) in the City of Cleveland, Bradley County, Tennessee. Within the interchange study area, APD-40 is a four-lane, divided, limited access freeway.

Traffic volume estimates for I-75 and APD-40 for this study were developed from the Cleveland Urban Area Metropolitan Planning Organization (CUAMPO) Transportation Demand Model (TDM). The TDM was updated to analyze two transportation alternatives, hereinafter described as traffic condition scenarios. The first traffic condition scenario was the evaluation of the existing system on APD-40 between I-75 and S.R. 2 (U.S 11/South Lee Highway) and the second traffic condition scenario was the evaluation of the proposed system that included a proposed APD-40 interchange between I-75 and S.R. 2 (U.S 11/South Lee Highway). Two technical memorandums were prepared to document the TDM findings and results. In addition to the two traffic condition scenarios, a slip ramp to Stone Lake Road is being proposed to diverge from the I-75 northbound to APD-40 off-ramp. A discussion of the slip ramp is included in ***Section 2.3.1***.

A total of four traffic condition scenarios were subsequently developed using the combinations of with/without the proposed interchange and with/without the proposed slip ramp as described below:

- Existing System (without the Proposed Interchange) without the Slip Ramp
- Existing System with the Slip Ramp
- Proposed System (with the Proposed Interchange) without the Slip Ramp
- Proposed System with the Slip Ramp

Since the traffic impacts to the study interchange vary with each traffic condition scenario, this report contains the capacity analyses for each traffic condition scenario. A complete compilation of the traffic data and memorandums, including the Average Annual Daily Traffic (AADT) Volumes and the Design Hour Volumes (DHV) for the horizon years 2013 and 2033 can be found in ***Appendix A*** of this report.

The capacity of a facility is defined in the Highway Capacity Manual (HCM) as the maximum hourly rate at which vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic, and control conditions. Any change in these conditions will result in a change in the capacity of a facility.

The analysis of highway capacity is a set of procedures used to estimate the traffic-carrying ability of facilities over a range of defined operational conditions known as levels-of-service (LOS). LOS is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A LOS definition generally describes these operational conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety. ***Table 2.1*** presents descriptions for each LOS.

Table 2.1 – Level of Service (LOS) Description

LOS	Level of Service Description
A	Free Flow operations. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. The general level of physical and psychological comfort provided the driver is high.
B	Reasonably free flow operations. The ability to maneuver within the traffic stream is only slightly restricted and the general level of physical and psychological comfort provided to the driver is high.
C	Flow with speeds at or near free flow. Freedom to maneuver within the traffic stream is noticeably restricted and lane changes require more vigilance on the part of the driver. The driver notices an increase in tension because of additional vigilance required for safe operation.
D	Speeds decline with increasing traffic. Freedom to maneuver within the traffic stream is noticeably limited. The driver experiences reduced physical and psychological comfort levels.
E	At the lower boundary, the facility is at capacity. Operations are volatile because there are virtually no gaps in the traffic stream. There is little or no room to maneuver. The driver experiences poor levels of physical and psychological comfort.
F	Breakdowns in traffic flow. The number of vehicles entering the highway section exceeds the capacity, or ability of the highway to accommodate that number of vehicles. There is little or no room to maneuver. The driver experiences poor levels of physical and psychological comfort.

Source: Highway Capacity Manual (2000), Transportation Research Board

The Highway Capacity Software (HCS) was used to obtain the capacity analysis LOS results presented in this study for different facility types: Freeway Segments, Ramp Merges, Ramp Diverges, Weave Areas, Multi-Lane Highways, Two-Lane Highways, Signalized Intersections, and Unsignalized Intersections. It should be noted that I-75 was assumed to be widened to six-lanes in all of the 2033 capacity analyses. The HCS printouts for all of the capacity analyses can be found in ***Appendix I*** of this report.

The capacity analyses for the existing system also included the evaluation of a proposed slip ramp diverging from the I-75 northbound off-ramp to Stone Lake Road. Proposed economic development accommodating commercial, industrial, and residential uses is planned for on both sides of APD-40 between the I-75 and US 11 (South Lee Highway) interchanges. The location of this slip ramp will allow vehicles to directly enter the proposed economic development area in the southeast quadrant of the interchange without traveling on APD-40. The return for these traffic volumes will be a proposed interchange on APD-40 or a new access road extending Stone Lake Road to US 11 (South Lee Highway). Without the proposed interchange, Stone Lake Road intersects with Humphrey Bridge Road that would be re-routed to US 11 (South Lee Highway).

The proposed slip ramp capacity analysis results for both the existing and proposed systems are included in ***Section 2.3.1*** and ***Section 2.3.2***, respectively.

2.3.1 Existing System

The existing system is defined in this study interchange as the traffic condition scenarios without the proposed interchange on APD-40.

APD-40 Study Area Traffic Volumes

The existing system Average Annual Daily Traffic (AADT) Volumes and the Design Hour Volumes (DHV) for the horizon years 2013 and 2033 are shown in ***Table 2.2*** within the APD-40 study area.

Table 2.2 – APD-40 Study Area Traffic Volumes (Two-Way Volumes)
(Existing System)

Location		**Traffic Volume**	**2013**		**2033**	
			W/O Slip Ramp	**With Slip Ramp**	**W/O Slip Ramp**	**With Slip Ramp**
APD-40	Between I-75 and South Lee Highway	AADT	27,500	26,050	41,700	38,880
		DHV - AM Peak	3,190	3,023	4,882	4,630
		DHV - PM Peak	3,326	3,203	5,072	4,884
	East of South Lee Highway	AADT	26,400	26,400	38,500	38,500
		DHV - AM Peak	2,776	2,776	4,249	4,249
		DHV - PM Peak	3,031	3,031	4,504	4,504
I-75	North of APD-40	AADT	59,600	59,600	86,800	86,800
		DHV - AM Peak	4,324	4,324	6,244	6,244
		DHV - PM Peak	5,766	5,766	8,312	8,312
	South of APD-40	AADT	79,600	79,600	113,100	113,100
		DHV - AM Peak	5,987	5,987	8,747	8,747
		DHV - PM Peak	7,485	7,485	10,958	10,958
Pleasant Grove Road	West of I-75	AADT	4,800	4,800	7,200	7,200
		DHV - AM Peak	423	423	643	643
		DHV - PM Peak	481	481	722	722
South Lee Highway	North of APD-40	AADT	17,800	17,800	27,900	27,900
		DHV - AM Peak	1,607	1,607	2,497	2,497
		DHV - PM Peak	2,062	2,062	3,231	3,231
	South of APD-40	AADT	15,700	14,250	27,700	24,880
		DHV - AM Peak	1,697	1,530	2,652	2,400
		DHV - PM Peak	2,019	1,896	3,183	2,995

For the existing system capacity analyses, the truck percentages for each roadway are:

- I-75 north of APD-40: 30%
- I-75 south of APD-40: 24%
- APD-40 between I-75 and S.R. 2 (U.S. 11/South Lee Highway): 15%
- APD-40 east of S.R. 2 (U.S. 11/South Lee Highway): 14%
- Pleasant Grove Road west of I-75: 3%
- S.R. 2 (U.S. 11/South Lee Highway) north of APD-40: 3%
- S.R. 2 (U.S. 11/South Lee Highway) south of APD-40: 3%

APD-40 Study Area Mainline Capacity Analyses

The mainline capacity analyses for the existing system were conducted for each direction and leg of the interchange. The freeway segment analysis was used for I-75 and APD-40 and the two-lane highway analysis was used for Pleasant Grove Road. The mainline capacity analyses results for the existing system are summarized in ***Table 2.3***.

Table 2.3 - APD-40 Study Area Mainline Capacity Analysis Results
(Existing System)

Location		**Direction**	**Peak Period**	**2013**		**2033**[1]	
				W/O Slip Ramp	**With Slip Ramp**	**W/O Slip Ramp**	**With Slip Ramp**
APD-40	Between I-75 and South Lee Highway	EB	AM	B	B	C	C
			PM	C	B	D	C
		WB	AM	C	C	D	D
			PM	B	B	D	D
	East of South Lee Highway	EB	AM	B	B	C	C
			PM	C	C	D	D
		WB	AM	B	B	D	D
			PM	B	B	C	C
I-75	North of APD-40	NB	AM	B	B	B	B
			PM	D	D	D	D
		SB	AM	C	C	C	C
			PM	C	C	C	C
	South of APD-40	NB	AM	C	C	C	C
			PM	F (C)[2]	F (C)[2]	E	E
		SB	AM	D	D	D	D
			PM	D	D	D	D
Pleasant Grove Road	West of I-75	Two-Way	AM	C	C	C	C
			PM	C	C	C	C
South Lee Highway	North of APD-40	NB	AM	A	A	B	B
			PM	A	A	B	B
		SB	AM	B	B	B	B
			PM	B	B	C	C
	South of APD-40	NB	AM	A	A	A	A
			PM	B	B	C	C
		SB	AM	B	B	C	B
			PM	B	A	B	B

1. Indicates that I-75 is assumed widened to a six-lane facility for the 2033 results.
2. Indicates that LOS C would be achieved with I-75 widened to a six-lane facility.

APD-40 Study Area Merge and Diverge Ramp Capacity Analyses

The ramp capacity analyses for the existing system were conducted for both merge and diverge situations within the APD-40 study area. The ramp merge and diverge capacity analysis results for the existing system are summarized in ***Table 2.4***.

Table 2.4 - Capacity Analysis Results for the APD-40 Study Area Merge and Diverge Ramps
(Existing System with/without the Proposed Slip Ramp)

Location	**Direction**	**Peak Period**	**2013**		**2033[1]**	
			W/O Slip Ramp	**With Slip Ramp**	**W/O Slip Ramp**	**With Slip Ramp**
MERGE						
APD-40 at I-75	EB Entrance Ramp	AM	Free-Flow Traffic Movement			
		PM				
APD-40 at South Lee Highway	EB Entrance Ramp	AM	B	B	B	B
		PM	B	B	B	B
	WB Entrance Ramp	AM	B	B	B	B
		PM	B	B	B	B
I-75 at APD-40	NB Entrance Ramp	AM	C	C	C	C
		PM	D	D	D	D
	SB Entrance Ramp	AM	D	D	D	D
		PM	D	D	D	D
DIVERGE						
APD-40 at I-75	WB Exit Ramp	AM	B	B	B	B
		PM	B	B	B	B
APD-40 at South Lee Highway	EB Exit Ramp	AM	B	B	C	C
		PM	B	B	C	C
	WB Exit Ramp	AM	B	B	B	B
		PM	B	B	B	B
I-75 at APD-40	NB Exit Ramp[2]	AM	B	B	B	B
		PM	F (B)[3]	F (B)[3]	D	D
	NB Exit Slip Ramp	AM	A	A	B	B
		PM	B	B	C	C
	SB Exit Ramp	AM	C	C	C	C
		PM	C	C	C	C

1. Indicates that I-75 is assumed widened to a six-lane facility for the 2033 results.
2. The NB Exit Ramp is assumed widened to two lanes.
3. Indicates that LOS B would be achieved with I-75 widened to a six-lane facility.

I-75/APD-40 NB and SB Ramp Terminal Intersections

The intersection capacity analyses for the existing system were conducted for both the I-75/APD-40 NB and SB ramp terminal intersections, which are both signalized. The capacity analyses for the I-75/APD-40 NB ramp terminal intersection does not include any right turn traffic volumes to/from APD-40 because of their channelized movements being outside the influence of the traffic signal operation. The I-75/APD-40 NB and SB ramp terminal capacity analysis results for the existing system are the same with and without the proposed slip ramp, which are summarized in ***Table 2.5***.

Table 2.5 - Capacity Analysis Results for the
I-75/APD-40 NB and SB Ramp Terminal Intersections
(Existing System with/without the Proposed Slip Ramp)

Location	Approach and Movement		Peak Period	2013[1]	2013[2]	2033[1]	2033[2]
I-75/APD-40 NB Off/On-Ramp	Overall		AM	D	B (B)	F	C (C)
			PM	C	B (B)	F	C (C)
	Traffic Movement	EB Left Turn	AM	A	B (B)	A	B (B)
			PM	A	B (B)	A	B (B)
		WB Thru	AM	E	C (C)	F	D (D)
			PM	D	C (C)	F	C (C)
		NB Left Turn	AM	E	C (C)	F	D (D)
			PM	D	C (C)	F	C (C)
I-75/APD-40 SB Off/On-Ramp	Overall		AM	F	C	F	D
			PM	D	C	F	C
	Traffic Movement	EB Thru	AM	F	C	F	D
			PM	D	C	F	C
		WB Left Turn	AM	F	C	F	E
			PM	D	C	F	C
		SB Left Turn	AM	F	C	F	D
			PM	D	C	F	C

1. Indicates the capacity results with the existing geometry (i.e. no improvements).
2. Indicates the capacity results with the proposed geometry, which for the NB ramp terminal intersection includes 1 EB Left Turn Lane, 2 EB Thru Lanes, 2 WB Thru Lanes, and 1 NB Left Turn Lane (2 NB Left Turn Lanes). The proposed geometry for the SB ramp terminal intersection includes 2 EB Thru Lanes, 2 WB Left Turn Lanes, 2 WB Thru Lanes, 2 SB Left Turn Lanes, and 2 SB Right Turn Lanes.

ADP-40/South Lee Highway EB and WB Ramp Terminal Intersections

The intersection capacity analyses for the existing system were conducted for the APD-40/ South Lee Highway EB and WB ramp terminal intersections, which are both unsignalized. South Lee Highway is also known as S.R. 2 and U.S. 11. The APD-40/South Lee Highway ramp terminal capacity analysis results for the existing system are summarized in ***Table 2.6***.

Table 2.6 - Capacity Analysis Results for the ADP-40/South Lee Highway EB and WB Ramp Terminal Intersections
(Existing System)

Location	**Approach and Movement**		**Peak Period**	**Unsignalized**				**Signalized**			
				2013		**2033**		**2013**		**2033[1]**	
				W/O S.R.	**With S.R.**	**W/O S.R.**	**With S.R.**	**W/O S.R.**	**With S.R.**	**W/O S.R.**	**With S.R.**
APD-40/S. Lee Hwy. EB Off/On-Ramp	Overall		AM	N/A				B	B	C (C)	C (C)
			PM					C	C	E (D)	D (C)
	Traffic Movement	SB Left Turn	AM	A	A	B	B	B	B	D (D)	C (C)
			PM	C	C	F	F	D	C	F (E)	E (D)
		EB Left Turn	AM	F	F	F	F	B	B	C (C)	C (C)
			PM	F	F	F	F	C	C	D (D)	E (D)
		EB Right Turn	AM	C	B	F	C	C	B	D (D)	C (C)
			PM	B	B	D	C	D	C	F (E)	D (D)
APD-40/S. Lee Hwy. WB Off/On-Ramp	Overall		AM	N/A				B	B	C (C)	C (C)
			PM					B	B	D (C)	D (C)
	Traffic Movement	NB Left Turn	AM	B	B	E	E	B	B	D (D)	D (D)
			PM	D	D	F	F	C	C	E (D)	E (D)
		WB Left Turn	AM	F	F	F	F	B	B	D (D)	D (D)
			PM	F	F	F	F	C	C	E (D)	E (D)
		WB Right Turn	AM	B	B	B	B	B	B	D (D)	D (D)
			PM	B	B	C	C	C	C	E (D)	E (D)

1. The parenthesis indicates the capacity results with the proposed geometry, which for the EB ramp terminal intersection includes 2 NB Thru Lanes, 1 NB Right Turn Lane, 2 SB Left Turn Lanes, 2 SB Thru Lanes, 1 EB Left Turn Lane, and 1 EB Right Turn Lane. The proposed geometry for the WB ramp terminal intersection includes 2 NB Left Turn Lanes, 2 NB Thru Lanes, 2 SB Thru Lanes, 1 SB Right Turn Lane, 1 WB Left Turn Lane, and 1 WB Right Turn Lane.

Proposed I-75 NB to Stone Lake Road Slip Ramp Intersection

The intersection capacity analyses were conducted for the proposed I-75 NB slip ramp terminal intersection at Stone Lake Road which are the same for both the existing and proposed systems. The following assumptions were made for the intersection capacity analyses:

- Proposed I-75 NB slip ramp is one-way and terminates at Stone Lake Road.
- Stone Lake Road traffic volumes assumed based on a 500 acre Industrial Park development built in the southeast quadrant of the study interchange and 67% of the development is built south of the proposed slip ramp intersection.
- The proposed development is 60% built-out in 2013 and 100% built-out in 2033.

The proposed I-75 NB slip ramp terminal capacity analysis results are summarized in ***Table 2.7***.

Table 2.7 – Capacity Analysis Results for the
Proposed I-75 NB Slip Ramp Terminal Intersection at Stone Lake Road
(Existing and Proposed Systems)

Location	Approach and Movement		Peak Period	Unsignalized[1]		Signalized[1]	
				2013	2033	2013	2033[2]
Proposed I-75 NB Slip Ramp at Stone Lake Road	Overall		AM	N/A		D	F (D)
			PM			D	F (D)
	Traffic Movement	EB Left Turn	AM	D	F	D	F (C)
			PM	D	F	D	F (D)
		EB Right Turn	AM	F	F	E	F (D)
			PM	B	B	E	F (D)
		NB Thru	AM	A	A	A	A (A)
			PM	A	A	E	F (D)
		SB Thru	AM	A	A	D	F (D)
			PM	A	A	A	A (A)

1. The proposed geometry includes 1 NB Thru Lane, 1 SB Thru Lane, 1 EB Left Turn Lane, and 1 EB Right Turn Lane.
2. The parenthesis indicates the capacity results with Stone Lake Road widened from two lanes to four lanes.

Table 2.7 depicts the capacity results for worst case scenario. If the development density occurs similar to this analyzed development and the proposed interchange is not constructed, then Stone Lake Road would need to be widened to four lanes to handle these worst case traffic volumes. However, since the actual developments may change, this study proposes that the intersection of the proposed slip ramp with Stone Lake Road be unsignalized and consist of one approach lane on Stone Lake Road along with a two lane approach (1 Left Turn Lane and 1 Right Turn Lane) on the slip ramp.

2.3.2 Proposed System

The proposed system is defined in this study interchange as the traffic condition scenarios with the proposed interchange on APD-40.

APD-40 Study Area Traffic Volumes

The proposed system Average Annual Daily Traffic (AADT) Volumes and the Design Hour Volumes (DHV) for the horizon years 2013 and 2033 are shown in ***Table 2.8*** within the APD-40 study area.

Table 2.8 – APD-40 Study Area Traffic Volumes (Two-Way Volumes)
(Proposed System)

Location		Traffic Volume	2013		2033	
			W/O Slip Ramp	With Slip Ramp	W/O Slip Ramp	With Slip Ramp
APD-40	Between I-75 and the Proposed Interchange	AADT	29,900	28,450	47,800	44,980
		DHV - AM Peak	3,268	3,101	5,055	4,803
		DHV - PM Peak	3,518	3,395	5,428	5,240
	Between the Proposed Interchange and South Lee Highway	AADT	27,500	27,500	41,700	41,700
		DHV - AM Peak	2,887	2,887	4,429	4,429
		DHV - PM Peak	2,918	2,918	4,469	4,469
	East of South Lee Highway	AADT	29,400	29,400	46,000	46,000
		DHV - AM Peak	3,055	3,055	4,780	4,780
		DHV - PM Peak	3,130	3,130	4,880	4,880
I-75	North of APD-40	AADT	62,900	62,900	95,000	95,000
		DHV - AM Peak	4,693	4,693	6,834	6,834
		DHV - PM Peak	6,233	6,233	9,097	9,097
	South of APD-40	AADT	79,600	79,600	113,100	113,100
		DHV - AM Peak	5,987	5,987	8,747	8,747
		DHV - PM Peak	7,485	7,485	10,958	10,958
Pleasant Grove Road	West of I-75	AADT	5,100	5,100	7,800	7,800
		DHV - AM Peak	514	514	786	786
		DHV - PM Peak	522	522	799	799
Proposed Interchange Mainline	North of APD-40	AADT	6,800	6,800	10,900	10,900
		DHV - AM Peak	759	759	1,201	1,201
		DHV - PM Peak	787	787	1,269	1,269
	South of APD-40	AADT	7,900	6,450	12,500	9,680
		DHV - AM Peak	812	645	1,285	1,033
		DHV - PM Peak	735	612	1,164	976
South Lee Highway	North of APD-40	AADT	18,300	18,300	29,100	29,100
		DHV - AM Peak	1,628	1,628	2,596	2,596
		DHV - PM Peak	2,348	2,348	3,734	3,734
	South of APD-40	AADT	13,700	13,700	22,500	22,500
		DHV - AM Peak	1,224	1,224	1,955	1,955
		DHV - PM Peak	1,898	1,898	3,031	3,031

For the proposed system capacity analyses, the truck percentages for each roadway are:

- I-75 north of APD-40: 30%
- I-75 south of APD-40: 24%
- APD-40 between I-75 and Proposed Interchange Mainline: 15%
- APD-40 between Prop. Interchange Mainline and S.R. 2 (U.S. 11/South Lee Hwy.): 14%
- APD-40 east of S.R. 2 (U.S. 11/South Lee Highway): 14%
- Pleasant Grove Road west of I-75: 3%
- Proposed Interchange Mainline north of APD-40: 5%
- Proposed Interchange Mainline south of APD-40: 5%
- S.R. 2 (U.S. 11/South Lee Highway) north of APD-40: 3%
- S.R. 2 (U.S. 11/South Lee Highway) south of APD-40: 3%

APD-40 Study Area Mainline Capacity Analyses

The mainline capacity analyses for the proposed system were conducted for each direction and leg of the interchange. The freeway segment analysis was used for I-75 and APD-40 and the two-lane highway analysis was used for Pleasant Grove Road. The mainline capacity analyses results for the proposed system are summarized in ***Table 2.9***.

Table 2.9 - Mainline Capacity Analysis Results
(Proposed System)

Location		**Direction**	**Peak Period**	**2013**		**2033**[1]	
				W/O Slip Ramp	**With Slip Ramp**	**W/O Slip Ramp**	**With Slip Ramp**
APD-40	Between I-75 and the Proposed Interchange	EB	AM	B	B	C	C
			PM	C	B	D	D
		WB	AM	C	C	D	D
			PM	C	C	D	D
	Between the Proposed Interchange and South Lee Hwy.	EB	AM	B	B	C	C
			PM	B	B	D	D
		WB	AM	C	C	D	D
			PM	B	B	C	C
	East of South Lee Highway	EB	AM	B	B	C	C
			PM	C	C	D	D
		WB	AM	C	C	D	D
			PM	B	B	C	C
I-75	North of APD-40	NB	AM	B	B	B	B
			PM	D	D	D	D
		SB	AM	C	C	C	C
			PM	C	C	C	C
	South of APD-40	NB	AM	C	C	C	C
			PM	F (C)[2]	F (C)[2]	E	E
		SB	AM	D	D	D	D
			PM	D	D	D	D
Pleasant Grove Road	West of I-75	Two-Way	AM	C	C	C	C
			PM	C	C	C	C
Proposed Interchange Mainline	North of APD-40	NB	AM	A	A	A	A
			PM	A	A	A	A
		SB	AM	A	A	A	A
			PM	A	A	A	A
	South of APD-40	NB	AM	A	A	A	A
			PM	A	A	A	A
		SB	AM	A	A	A	A
			PM	A	A	A	A
South Lee Highway	North of APD-40	NB	AM	A	A	B	B
			PM	B	B	C	C
		SB	AM	A	A	B	B
			PM	B	B	C	C
	South of APD-40	NB	AM	A	A	A	A
			PM	B	B	C	C
		SB	AM	A	A	B	B
			PM	A	A	B	B

1. Indicates that I-75 is assumed widened to a six-lane facility for the 2033 results.
2. Indicates that LOS C would be achieved with I-75 widened to a six-lane facility.

APD-40 Study Area Merge and Diverge Ramp Capacity Analyses

The ramp capacity analyses for the proposed system were conducted for both merge and diverge situations within the APD-40 study area. The ramp merge and diverge capacity analysis results for the existing system are summarized in ***Table 2.10***.

Table 2.10 - Capacity Analysis Results for the APD-40 Study Area Merge and Diverge Ramps
(Proposed System with/without the Proposed Slip Ramp)

Location	Direction	Peak Period	2013		2033[1]	
			W/O Slip Ramp	With Slip Ramp	W/O Slip Ramp	With Slip Ramp
MERGE						
APD-40 at I-75	EB Entrance Ramp	AM	Free-Flow Traffic Movement			
		PM				
APD-40 at the Proposed Interchange	EB Entrance Ramp	AM	B	B	B	B
		PM	B	B	C	C
	WB Entrance Ramp	AM	B	B	D	D
		PM	B	B	D	D
APD-40 at South Lee Highway	EB Entrance Ramp	AM	B	B	B	B
		PM	C	C	D	D
	WB Entrance Ramp	AM	B	B	D	D
		PM	B	B	B	B
I-75 at APD-40	NB Entrance Ramp	AM	C	C	C	C
		PM	D	D	D	D
	SB Entrance Ramp	AM	D	D	D	D
		PM	D	D	D	D
DIVERGE						
APD-40 at I-75	WB Exit Ramp	AM	B	B	D	D
		PM	B	B	D	D
APD-40 at the Proposed Interchange	EB Exit Ramp	AM	B	B	C	C
		PM	B	B	D	C
	WB Exit Ramp	AM	B	B	D	D
		PM	B	B	B	B
APD-40 at South Lee Highway	EB Exit Ramp	AM	B	B	B	B
		PM	B	B	D	D
	WB Exit Ramp	AM	C	C	D	D
		PM	B	B	C	C
I-75 at APD-40	NB Exit Ramp[2]	AM	B	B	B	B
		PM	F (B)[3]	F (B)[3]	D	D
	NB Exit Slip Ramp	AM	A	A	B	B
		PM	B	B	C	C
	SB Exit Ramp	AM	C	C	C	C
		PM	C	C	C	C

1. Indicates that I-75 is assumed widened to a six-lane facility for the 2033 results.
2. The NB Exit Ramp is assumed widened to two lanes.
3. Indicates that LOS B would be achieved with I-75 widened to a six-lane facility.

APD-40 Weave Areas

A weave area does not currently exist on APD-40 because the distance between I-75 and South Lee Highway entrance/exit ramps is greater than 2500 feet. The proposed interchange will establish weave areas on APD-40 as the distance between entrance/exit ramps will be reduced to less than 2500 feet on both sides of the proposed interchange. The weave area capacity analysis results for the APD-40 EB and WB directions are summarized in ***Table 2.11***.

Table 2.11 - Capacity Analysis Results for the APD-40 Weave Areas

Location		**Peak Period**	**2013**		**2033**	
			W/O Slip Ramp	**With Slip Ramp**	**W/O Slip Ramp**	**With Slip Ramp**
APD-40 EB	Between I-75 and the Proposed Interchange	AM	B	B	E	C
		PM	D	C	F	F
	Between the Proposed Interchange and South Lee Highway	AM	B	B	B	B
		PM	B	B	D	D
APD-40 WB	Between South Lee Highway and the Proposed Interchange	AM	B	B	D	D
		PM	B	B	B	B
	Between the Proposed Interchange and I-75	AM	C	C	E	E
		PM	C	C	F	F

Auxiliary Lanes

Since LOS E and LOS F were present within the APD-40 mainline, ramp, and weave area analyses, auxiliary lanes were analyzed between the APD-40 entrance and exit ramps. The APD-40 mainline EB and WB capacity analysis results comparison with and without the auxiliary lane are shown in ***Table 2.12***.

Table 2.12 – APD-40 Auxiliary Lanes Capacity Analysis Comparison

Location		Facility Type	Peak Period	2013		2033	
				No Auxiliary Lanes	Auxiliary Lanes	No Auxiliary Lanes	Auxiliary Lanes
APD-40 EB	Between I-75 and the Proposed Interchange[1]	Freeway Segment	AM	B (B)	A (A)	C (C)	B (B)
			PM	C (B)	B (B)	D (D)	C (B)
		Weave Area	AM	B (B)	B (B)	E (C)	C (B)
			PM	D (C)	B (B)	F (F)	D (C)
		Ramp Merge (From I-75)	AM	Free-Flow Traffic Movement			
			PM				
		Ramp Diverge (To Prop. Interchange)	AM	B (B)	B (B)	C (C)	C (C)
			PM	B (B)	B (B)	D (C)	D (C)
	Between the Proposed Interchange and South Lee Hwy.[2]	Freeway Segment	AM	B	A	C	B
			PM	B	B	D	C
		Weave Area	AM	B	A	B	B
			PM	B	B	D	B
		Ramp Merge (From Prop Interchange)	AM	B	A	B	B
			PM	B	B	C	B
		Ramp Diverge (To South Lee Highway)	AM	B	A	B	B
			PM	B	B	D	C
APD-40 WB	Between South Lee Highway and the Proposed Interchange[2]	Freeway Segment	AM	C	B	D	C
			PM	B	A	C	B
		Weave Area	AM	B	B	D	B
			PM	B	A	B	B
		Ramp Merge (From South Lee Highway)	AM	B	B	D	B
			PM	B	B	B	B
		Ramp Diverge (To Prop. Interchange)	AM	B	B	D	C
			PM	B	B	B	B
	Between the Proposed Interchange and I-75[2]	Freeway Segment	AM	C	B	D	C
			PM	C	B	D	C
		Weave Area	AM	C	B	E	C
			PM	C	B	F	C
		Ramp Merge (From Prop Interchange)	AM	B	B	D	C
			PM	B	B	D	C
		Ramp Diverge (To I-75)	AM	B	B	D	C
			PM	B	B	D	D

1. The parenthesis indicates the capacity results with the slip ramp.
2. Indicates the capacity results with/without the slip ramp.

I-75/APD-40 NB and SB Ramp Terminal Intersections

The intersection capacity analyses for the proposed system were conducted for both the I-75/APD-40 NB and SB ramp terminal intersections, which are both signalized. The capacity analyses for the I-75/APD-40 NB ramp terminal intersection does not include any right turn traffic volumes to/from APD-40 because of their channelized movements being outside the influence of the traffic signal operation. The I-75/APD-40 NB and SB ramp terminal capacity analysis results for the proposed system are the same with and without the proposed slip ramp, which are summarized in ***Table 2.13***.

Table 2.13 - Capacity Analysis Results for the
I-75/APD-40 NB and SB Ramp Terminal Intersections
(Proposed System with/without the Proposed Slip Ramp)

Location	Approach and Movement		Peak Period	2013[1]	2013[2]	2033[1]	2033[2]
I-75/APD-40 NB Off/On-Ramp	Overall		AM	D	B (B)	F	C (C)
			PM	C	B (B)	F	C (C)
	Traffic Movement	EB Left Turn	AM	A	B (B)	A	C (C)
			PM	A	B (B)	A	B (B)
		WB Thru	AM	E	C (C)	F	D (D)
			PM	D	C (C)	F	C (C)
		NB Left Turn	AM	E	C (C)	F	D (D)
			PM	D	C (C)	F	C (C)
I-75/APD-40 SB Off/On-Ramp	Overall		AM	F	C	F	E
			PM	D	C	F	C
	Traffic Movement	EB Thru	AM	F	C	F	E
			PM	D	C	F	C
		WB Left Turn	AM	F	C	F	E
			PM	D	C	F	C
		SB Left Turn	AM	F	C	F	E
			PM	D	C	F	C

1. Indicates the capacity results with the existing geometry (i.e. no improvements).
2. Indicates the capacity results with the proposed geometry, which for the NB ramp terminal intersection includes 1 EB Left Turn Lane, 2 EB Thru Lanes, 2 WB Thru Lanes, and 1 NB Left Turn Lane (2 NB Left Turn Lanes). The proposed geometry for the SB ramp terminal intersection includes 2 EB Thru Lanes, 2 WB Left Turn Lanes, 2 WB Thru Lanes, 2 SB Left Turn Lanes, and 2 SB Right Turn Lanes.

ADP-40/Proposed Interchange EB and WB Ramp Terminal Intersections

The intersection capacity analyses for the proposed system were conducted for the APD-40/ Proposed Interchange EB and WB ramp terminal intersections. The APD-40/Proposed Interchange ramp terminal capacity analysis results for the proposed system are summarized in ***Table 2.14***.

Table 2.14 - Capacity Analysis Results for the ADP-40/Proposed Interchange EB and WB Ramp Terminal Intersections
(Proposed System)

Location	**Approach and Movement**		**Peak Period**	**Unsignalized**				**Signalized**			
				2013		**2033**		**2013**		**2033**[1]	
				W/O S.R.	**With S.R.**	**W/O S.R.**	**With S.R.**	**W/O S.R.**	**With S.R.**	**W/O S.R.**	**With S.R.**
APD-40/Proposed Interchange EB Off/On-Ramp	Overall		AM	N/A				B	B	C	C
			PM					C	C	C	C
	Traffic Movement	SB Left Turn	AM	A	A	A	A	C	C	C	C
			PM	A	A	B	B	C	C	C	C
		EB Left Turn	AM	C	C	F	F	C	C	C	C
			PM	B	B	E	E	C	C	C	C
		EB Right Turn	AM	B	A	B	B	C	B	C	C
			PM	A	A	B	A	C	C	C	C
APD-40/Proposed Interchange WB Off/On-Ramp	Overall		AM	N/A				B	B	B	B
			PM					C	C	C	C
	Traffic Movement	NB Left Turn	AM	A	A	A	A	C	C	C	C
			PM	A	A	D	D	C	C	C	C
		WB Left Turn	AM	C	C	F	F	C	C	C	C
			PM	D	D	F	F	C	C	C	C
		WB Right Turn	AM	B	B	B	B	C	C	C	C
			PM	A	A	A	A	C	C	C	C

[1] The parenthesis indicates the capacity results with the proposed geometry, which for the EB ramp terminal intersection includes 2 NB Thru Lanes, 1 NB Right Turn Lane, 2 SB Left Turn Lanes, 2 SB Thru Lanes, 1 EB Left Turn Lane, and 1 EB Right Turn Lane. The proposed geometry for the WB ramp terminal intersection includes 2 NB Left Turn Lanes, 2 NB Thru Lanes, 2 SB Thru Lanes, 1 SB Right Turn Lane, 2 WB Left Turn Lanes, and 1 WB Right Turn Lane.

ADP-40/South Lee Highway EB and WB Ramp Terminal Intersections

The intersection capacity analyses for the proposed system were conducted for the APD-40/ South Lee Highway EB and WB ramp terminal intersections, which are both unsignalized. South Lee Highway is also known as S.R. 2 and U.S. 11. The APD-40/ South Lee Highway ramp terminal capacity analysis results for the existing system are the same with and without the proposed slip ramp, which are summarized in ***Table 2.15***.

Table 2.15 - Capacity Analysis Results for the
ADP-40/South Lee Highway EB and WB Ramp Terminal Intersections
(Proposed System with/without the Proposed Slip Ramp)

Location	**Approach and Movement**		**Peak Period**	**Unsignalized**		**Signalized**	
				2013	**2033**	**2013**	**2033[1]**
APD-40/S. Lee Hwy. EB Off/On-Ramp	Overall		AM	N/A		B	C (C)
			PM			C	E (D)
	Traffic Movement	SB Left Turn	AM	A	B	B	C (C)
			PM	D	F	C	F (E)
		EB Left Turn	AM	F	F	B	C (C)
			PM	F	F	C	F (E)
		EB Right Turn	AM	B	C	B	C (C)
			PM	B	C	C	D (D)
APD-40/S. Lee Hwy. WB Off/On-Ramp	Overall		AM	N/A		B	C (C)
			PM			B	C (C)
	Traffic Movement	NB Left Turn	AM	B	C	B	C (D)
			PM	B	F	B	D (D)
		WB Left Turn	AM	C	F	B	C (C)
			PM	F	F	B	C (C)
		WB Right Turn	AM	B	C	B	C (D)
			PM	C	F	C	D (D)

1. The parenthesis indicates the capacity results with the proposed geometry, which for the EB ramp terminal intersection includes 2 NB Thru Lanes, 1 NB Right Turn Lane, 2 SB Left Turn Lanes, 2 SB Thru Lanes, 1 EB Left Turn Lane, and 1 EB Right Turn Lane. The proposed geometry for the WB ramp terminal intersection includes 2 NB Left Turn Lanes, 2 NB Thru Lanes, 2 SB Thru Lanes, 1 SB Right Turn Lane, 1 WB Left Turn Lane, and 1 WB Right Turn Lane.

Proposed I-75 NB to Stone Lake Road Slip Ramp Intersection

The intersection capacity analyses for the proposed I-75 NB slip ramp terminal intersection at Stone Lake Road is contained in the ***Section 2.3.2***.

2.4 Crash Analysis

The crash data used in this analysis was provided by TDOT and included reports from 2003-2005. A collision diagram and summary can be found in ***Appendix E*** of this study. A total of 10 crashes were reported along APD-40 between the Exit 20 interchange area and the South Lee Highway Interchange area. ***Table 2.16*** summarizes the crash data for the given period. This data does not include crashes associated with the Exit 20 interchange. The companion I-75 Exit 20 Interchange Modification Study includes an analysis of that area. Along this stretch of study corridor, access is fully controlled, therefore, crashes are limited to those typical of interstate type facilities (i.e, rear end, sideswipe, and run off the road).

Table 2.16– APD-40 Crash Data Summary

DESCRIPTION	2003	2004	2005	Total	PCT. OF TOTAL
Rear-end		1		1	10.0%
Left-turn					-
Head-on					-
Right-angle					-
Sideswipe	1	3		4	40.0%
Pedestrian/cyclist					-
Struck fixed object/Animal in Road					-
Run off the road	4			4	40.0%
Overturn			1	1	10.0%
INVOLVEMENT					
All Vehicles	6	9	1	16	100.0%
ROAD SURFACE					
Dry (No Adverse Conditions)	2	4	1	7	70.0%
Wet (Rain)	3			3	30.0%
DAMAGE					
Property Damage only	3	3	1	7	70.0%
Injury Crashes (No Fatalities)	2	1		3	30.0%
Fatality Crashes					-
Number of Injuries	2	2		4	-
Number of Fatalities					-
CRASH SUMMARY					
Total Crashes	5	4	1	10	-
Percentage of Total	50.0%	40.0%	10.0%	-	-

2.5 Proposed Improvements

This study recommends the construction of a new interchange along APD-40 between the existing interchanges of Exit 20 on I-75 and South Lee Highway (US 11). The proposed interchange will need auxiliary lanes connecting the two adjoining interchanges. ***Appendix B*** presents the functional plans for the proposed interchange. ***Figure 2.3*** and ***Figure 2.4*** present a schematic of the proposed work. ***Figure 2.3*** also shows the relationship to the I-75 Exit 20 proposed interchange modification (dashed) and how the two projects interconnect.

The scope of work for the proposed interchange includes the following work items:

- Construction of a new bridge, approximately 320 linear feet, over APD-40. This bridge would consist of six (6) travel lanes with shoulders for a total width of 96 feet measured out-to-out.
- A minimum of 300 feet access control in each direction from ramp terminals.
    - A new intersection with Stone Lake Road to the south.
    - To the north, the TDOT controlled section will be stubbed and it will be a local government responsibility to tie future improvements to this location.
- Eastbound Ramp Terminal Intersection:
    - Construct a single lane off ramp that develops a dual right-turn and a separate left-turn lane at the intersection.
    - Construct two northbound and southbound thru lanes for the mainline.
    - Construct a separate northbound right-turn lane.
    - Construct two separate southbound left-turn lanes.
    - Construct a dual lane on-ramp that tapers to a single lane prior to merging with APD-40 eastbound.
    - Install traffic signalization.
- Westbound Ramp Terminal Intersection:
    - Construct a single lane off ramp that develops a dual left-turn and a separate right-turn lane at the intersection.
    - Construct two northbound and southbound thru lanes for the mainline.
    - Construct two separate northbound left-turn lanes.
    - Construct a separate southbound right-turn lane.
    - Construct a dual lane on-ramp that tapers to a single lane prior to merging with APD-40 westbound.
    - Install traffic signalization.
- Relocate Stone Lake Road for the area impacted by the interchange location. Approximately 1800 linear feet will be obliterated and replaced with 2,200 feet on new location.
- Add auxiliary lanes along APD-40 connecting ramp movement to adjoining interchanges
    - 2,600 linear feet of westbound auxiliary lane between the new interchange and South Lee Highway.

  - 2,400 linear feet of eastbound auxiliary lane between the new interchange and South Lee Highway.
  - 1,300 linear feet of eastbound auxiliary lane between the new interchange and I-75 Exit 20.
  - 1,300 linear feet of westbound auxiliary lane between the new interchange and I-75 Exit 20 northbound on-ramp (assuming I-75 Exit 20 modifications are completed).
- A Commitment from local government to build necessary infrastructure on the north side of the proposed interchange. Currently, the concept plan shows an estimated alignment location. The exact location is to be determined by local officials except for the location at which it connects to the TDOT controlled portion of the interchange (300 ft north of the ramp terminal).

Other recommended improvements for the area include:

APD-40/South Lee Highway Interchange

Construct two northbound left turn lanes at the westbound ramp terminal intersection on the north side of APD-40. Construct a separate northbound right-turn lane and two separate southbound left-turn lanes at the eastbound ramp terminal intersection on the south side of APD-40. Install traffic signalization at both ramp terminal intersections.

APD-40/I-75 Interchange (Discussed in detail in separate Interchange Modification Study)

As detailed in a companion Interchange Modification Study, it is proposed to widen the APD-40 bridge over I-75 to accommodate two eastbound and two westbound thru lanes, two westbound left turn lanes (traffic heading south on I-75), and one eastbound left turn lane (traffic heading north on I-75). Ramp improvements will be included to improve overall operations at the ramp terminals. The proposed slip ramp to Stone Lake Road is discussed further in this IMS.

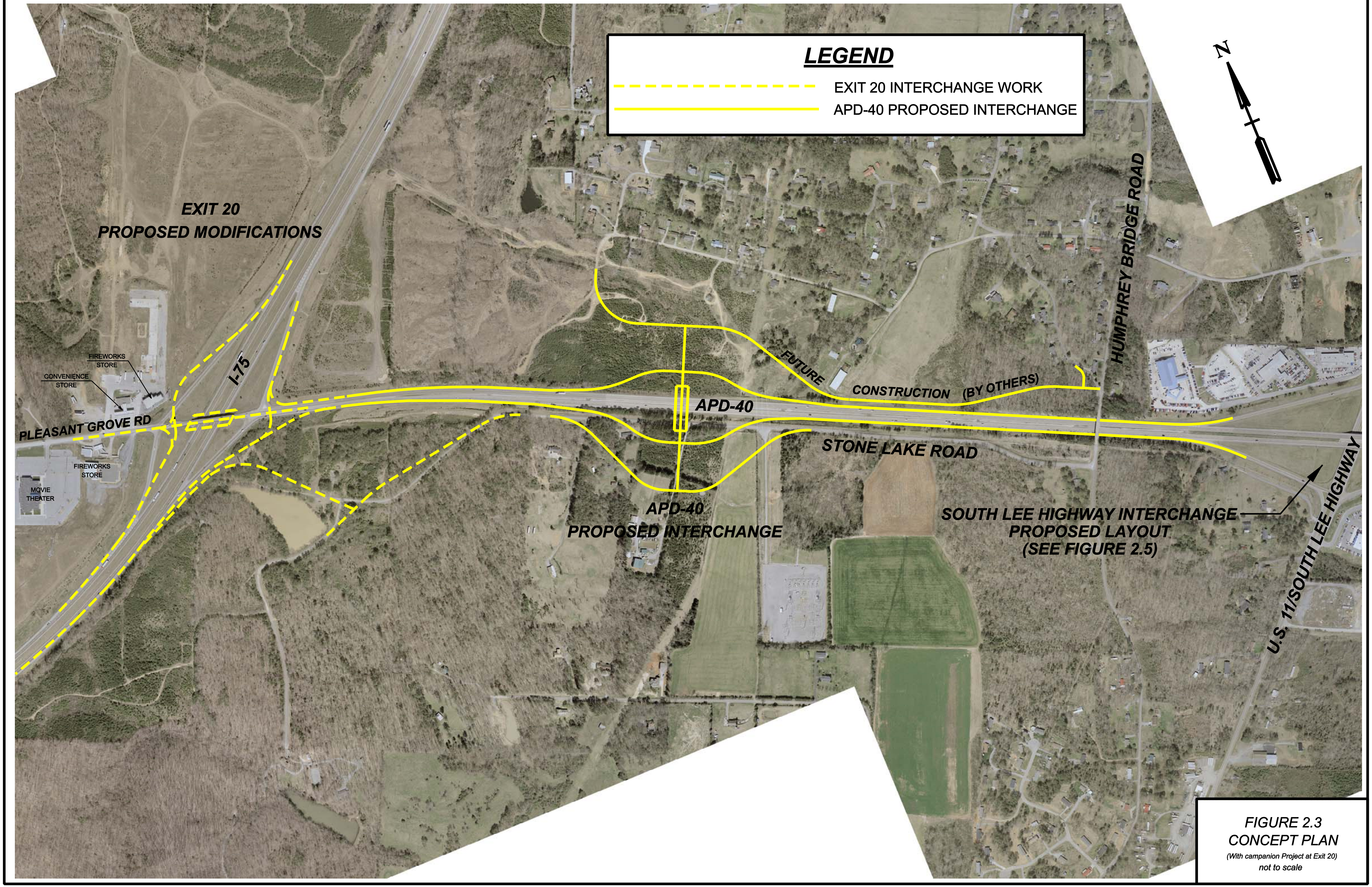


FIGURE 2.3
CONCEPT PLAN
(With campanion Project at Exit 20)
not to scale

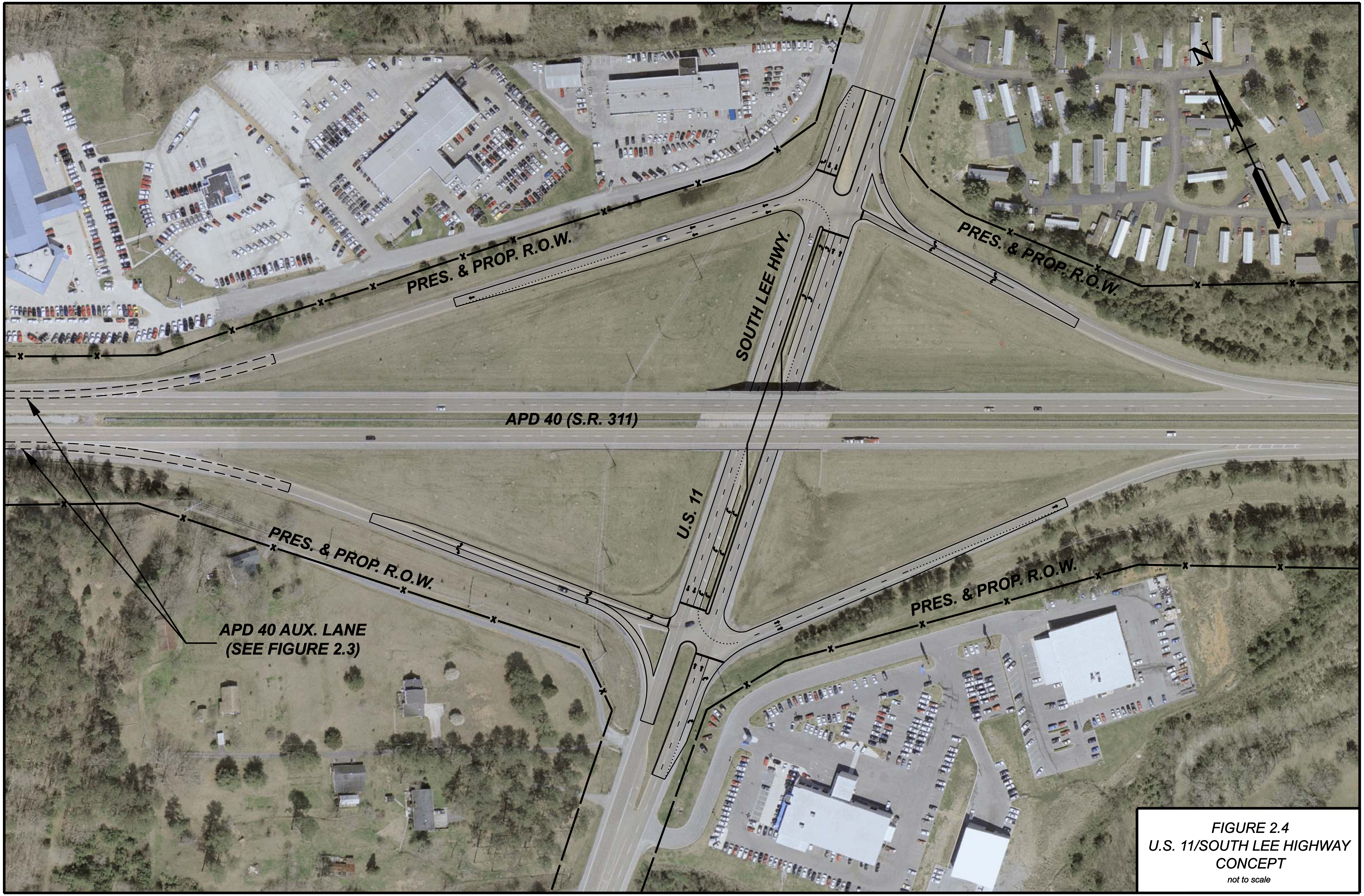


FIGURE 2.4
U.S. 11/SOUTH LEE HIGHWAY
CONCEPT
not to scale

2.6 Discussion of Options

During the course of the study, a number of options were discussed, conceptualized and removed from further consideration for a variety of reasons. The process included a number of coordination meetings and events that served to reduce this list of potential options to the recommended configuration. The following list identifies the various coordination meetings since study inception and ***Appendix H*** contains the meeting summaries for each.

Schedule of Meetings & Coordination Activities and key dates:

- Cleveland Coordination Meeting on October 17, 2007
- TDOT Coordination Meeting on October 29, 2007
- TDOT Initial Concepts Meeting on November 21, 2007
- Cleveland Area Stakeholder Meeting on December 20, 2007
- Traffic Operations Review meeting on January 14, 2008
- Coordination meeting with the FHWA on April 2, 2008
- Concurrence with Concept 1 from TDOT Design Division in April 2008

In October of 2007, the initial list of concepts totaled approximately six variations of interchanges, slip ramps, flyover, and frontage roads. This list was refined to the four most viable concepts and advanced for presentation to area stakeholders at a meeting on December 20, 2007.

Gathering input from the stakeholder meeting, two concepts were identified as preferred by local stakeholders (Concept 1 and Concept 4). After the December 20, 2007 Cleveland area stakeholder meeting, traffic data was obtained and analysis was conducted on the four (4) concepts carried through the Cleveland area stakeholder meeting.

It was determined at this time that Concepts 2 and 3 could be dropped from further consideration due to lack of support from local stakeholders and TDOT, and the finding of the traffic operations analysis which indicated that Concepts 1 and 4 were superior. The local preference was to maximize use of the developable land adjacent to the interchange area. Concepts 2 and 3 had complex movements that were contrary to driver expectancy and large footprints that would require significant right-of-way. This is counterproductive to what the local stakeholders envision for the area.

On April 2, 2008, a coordination meeting was held with the Federal Highway Administration (FHWA) Nashville, Tennessee office. The purpose of this meeting was to present a status report of the studies prior to making submittal of the actual reports and to present Concepts 1 and 4 to FWHA for comment. It was confirmed at the meeting that Concept 1 was preferred to Concept 4.

Recommended - Concept 1
From the previously mentioned process, Concept 1 emerged as the preferred and recommended concept. Several of the key criteria for it selection included the fact:

- That it would be the least expensive concept to build;
- Require local participation to build a connecting road to the north only;

- Minimizes the footprint when compared to other concepts thereby minimizing required right-of-way; and
- It would be typical of driver expectancy, unlike some of the other concepts.

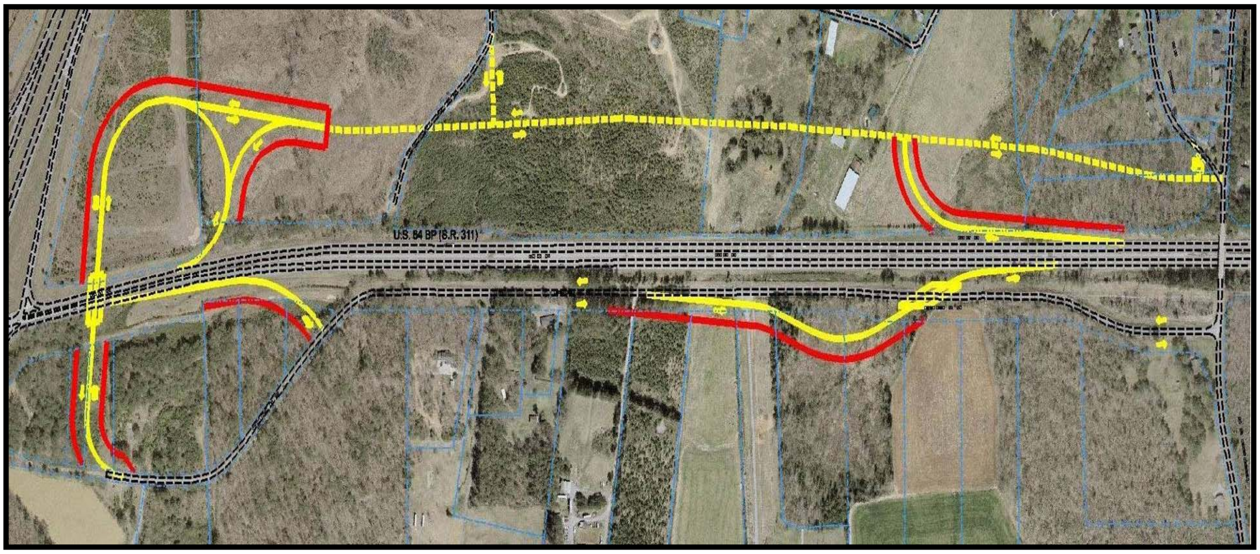
Other Concepts

The following discussion pertains to other considered concepts. ***Appendix C*** presents enlarged schematics of the concepts, along with bullets highlighting advantages and disadvantages of each, as presented at the December 20, 2007 stakeholder meeting in Cleveland, Tennessee.

Concept 2

Concept 2, shown in ***Figure 2.5***, created a new interchange with separated ramps that are connected via a frontage road system located between the existing I-75 and South Lee Highway interchanges. This concept attempts to satisfy one of the earlier requests by local stakeholders to keep a new interchange close to and visible from I-75 Exit 20. The main issue inherent with this configuration is the short weave distances created between new ramps and the adjoining existing ramps at I-75 Exit 20 and South Lee Highway.

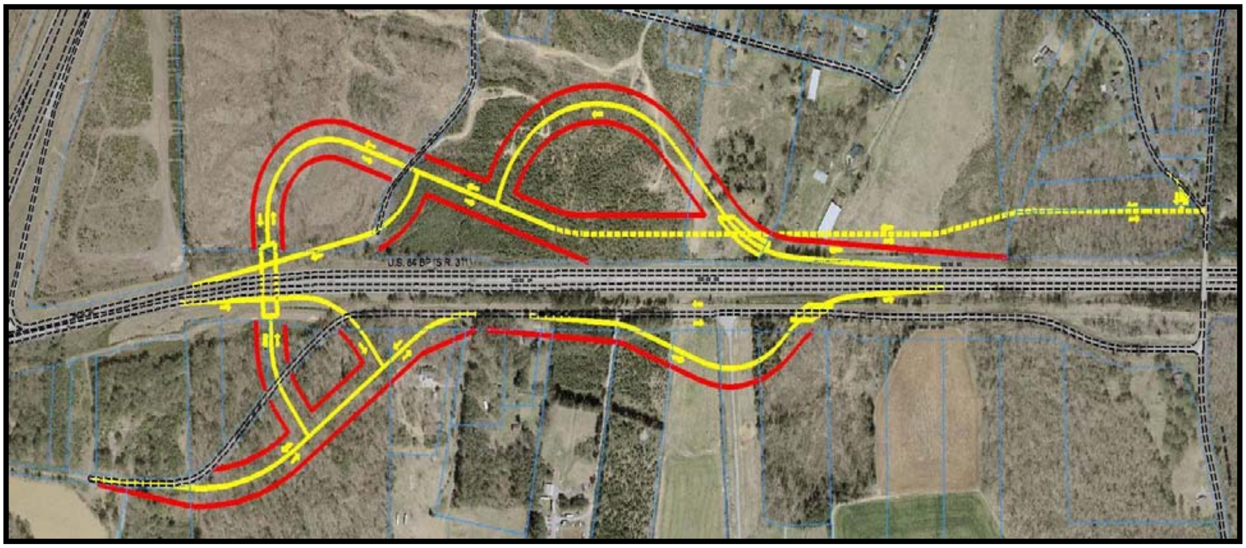
Figure 2.5 – Concept 2



Concept 3

Concept 3, shown in ***Figure 2.6***, is similar to Concept 2 along APD-40, but with a different frontage road system. Once the right-of-way requirements were estimated it became clear that the overall impact of the footprint was greater than what was anticipated by local stakeholders. In addition, the requirement to basket weave ramps increased the initial cost estimates for structures and left this concept less attractive than other options.

Figure 2.6 – Concept 3

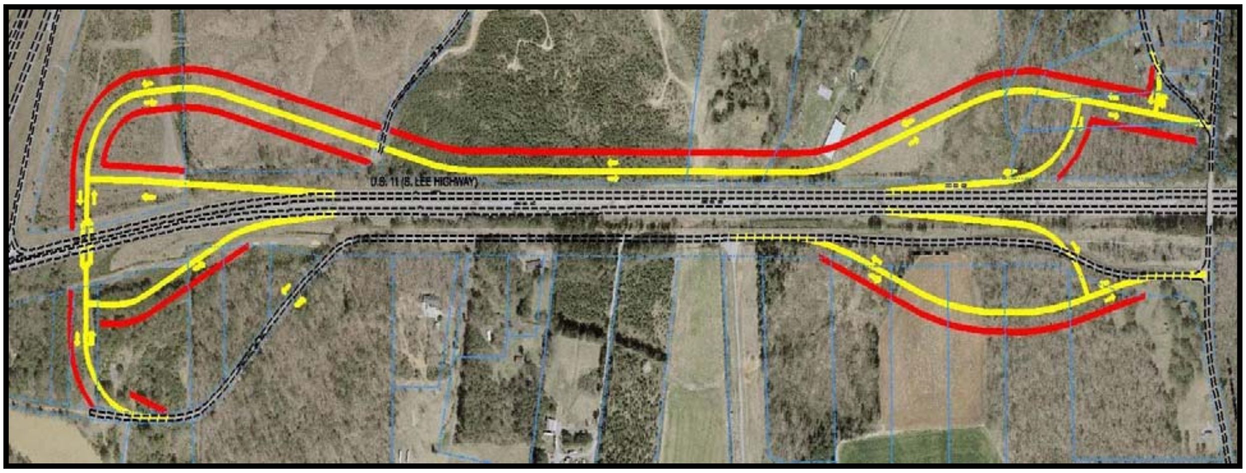


Concept 4

Concept 4, shown in ***Figure 2.7***, entails a new system of separated on-ramps and off-ramps that are connected via a frontage road system located between the existing I-75 and South Lee Highway interchanges. The two-way frontage road connecting the ramp areas would be a local road and development would be allowed to have direct access to it. ***Figure 2.7*** shows a proposed right-of-way limit to the north of the frontage road that was later determined as not necessary.

The major concern for Concept 4 is meeting driver expectations with the non-traditional ramp locations and the challenge to effectively sign and provide positive guidance for the configuration. As a result, Concept 1 was advanced in lieu of Concept 4.

Figure 2.7 – Concept 4



3.0 ENGINEERING INVESTIGATION

Analysis was made to determine the potential impacts of a proposed interchange and the effect these changes may have on APD-40 and the adjacent interchanges. ***Section 2.3*** summarized the expected LOS for the recommended concept plan.

3.1 Traffic Operations

An initial capacity analysis summarized in ***Section 2.3*** was made within the APD-40 study area for two scenarios, one scenario without the proposed interchange and one scenario with the proposed interchange. Based on these capacity analysis results, the following recommended improvements are summarized below.

New Interchange

The scope of work for the proposed interchange consists of constructing a new bridge (approximately 320 linear feet) over APD-40. This bridge would consist of six (6) travel lanes with shoulders for a total width of 96 feet measured out-to-out. There would be a minimum of 300 feet access control in each direction from the ramp terminals. Location of the new interchange would require approximately 1800 linear feet of relocation for Stone Lake Road.

The scope of work for the proposed interchange includes the following work items:

- Construction of a new bridge, approximately 320 linear feet, over APD-40. This bridge would consist of six (6) travel lanes with shoulders for a total width of 96 feet measured out-to-out.
- A minimum of 300 feet access control in each direction from ramp terminals.
    - A new intersection with Stone Lake Road to the south.
    - To the north, the TDOT controlled section will be stubbed and it will be a local government responsibility to tie future improvements to this location.
- Eastbound Ramp Terminal Intersection:
    - Construct a single lane off ramp that develops a dual right-turn and a separate left-turn lane at the intersection.
    - Construct two northbound and southbound thru lanes for the mainline.
    - Construct a separate northbound right-turn lane.
    - Construct two separate southbound left-turn lanes.
    - Construct a dual lane on-ramp that tapers to a single lane prior to merging with APD-40 eastbound.
    - Install traffic signalization.
- Westbound Ramp Terminal Intersection:
    - Construct a single lane off ramp that develops a dual left-turn and a separate right-turn lane at the intersection.
    - Construct two northbound and southbound thru lanes for the mainline.
    - Construct two separate northbound left-turn lanes.
    - Construct a separate southbound right-turn lane.

  - Construct a dual lane on-ramp that tapers to a single lane prior to merging with APD-40 westbound.
  - Install traffic signalization.
- Relocate Stone Lake Road for the area impacted by the interchange location. Approximately 1800 linear feet will be obliterated and replaced with 2,200 feet on new location.
- Add auxiliary lanes along APD-40 connecting ramp movement to adjoining interchanges
  - 2,600 linear feet of westbound auxiliary lane between the new interchange and South Lee Highway.
  - 2,400 linear feet of eastbound auxiliary lane between the new interchange and South Lee Highway.
  - 1,300 linear feet of eastbound auxiliary lane between the new interchange and I-75 Exit 20.
  - 1,300 linear feet of westbound auxiliary lane between the new interchange and I-75 Exit 20 northbound on-ramp (assuming I-75 Exit 20 modifications are completed).
- A Commitment from local government to build necessary infrastructure on the north side of the proposed interchange. Currently, the concept plan shows an estimated alignment location. The exact location is to be determined by local officials except for the location at which it connects to the TDOT controlled portion of the interchange (300 ft north of the ramp terminal).

Other recommended improvements that will improve the overall system include:

<u>APD-40/South Lee Highway Interchange</u>

Construct two northbound left turn lanes at the westbound ramp terminal intersection on the north side of APD-40. Construct a separate northbound right-turn lane and two separate southbound left-turn lanes at the eastbound ramp terminal intersection on the south side of APD-40. Install traffic signalization at both ramp terminal intersections.

<u>Proposed I-75 NB Slip Ramp at Stone Lake Road</u>

Construct a one-lane slip ramp diverging from the I-75 NB to APD-40 exit ramp connecting to Stone Lake Road. At the ramp terminal intersection, Stone Lake Road should consist of a four-lane roadway section and the slip ramp should consist of a separate left-turn lane and right-turn lane. Traffic signalization should be installed at the ramp terminal intersection.

<u>APD-40/I-75 Interchange (Discussed in detail in separate Interchange Modification Study)</u>

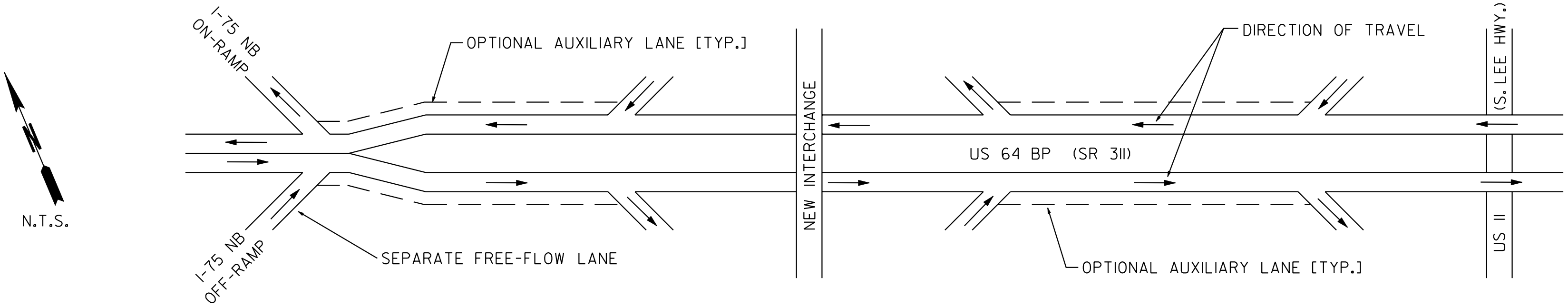
As detailed in a companion Interchange Modification Study, it is proposed to widen the APD-40 bridge over I-75 to accommodate two eastbound and two westbound thru lanes, two westbound left turn lanes (traffic heading south on I-75), and one eastbound left turn lane (traffic heading north on I-75). Ramp improvements will be included to improve overall operations at the ramp terminals.

Figure 3.1 to 3.4 further depict the anticipated 2013 and 2033 LOS for the recommended configuration. ***Appendix I*** presents the detailed HCS output for the recommended concept.

APD-40 WESTBOUND TRAVEL LANES - FROM SOUTH LEE HIGHWAY TO EXIT 20

FREEWAY SEGMENTS	SEGMENT LENGTH	N/A		1900 FEET		2000 FEET		1975 FEET		N/A
	DESIGN HOUR VOLUME	1220		1758		1543		1776		1558
	NUMBER OF LANES	2		2 (3)		2		2 (3)		2
	LEVEL OF SERVICE	B		C (B)		B		C (B)		B
RAMP JUNCTIONS	OPERATION TYPE		DIVERGE		MERGE		DIVERGE		MERGE	
	RAMP TYPE		OFF-RAMP		ON-RAMP		OFF-RAMP		ON-RAMP	
	DESIGN HOUR VOLUME		538		215		233		218	
	NUMBER OF LANES		1		1		1		1	
	LEVEL OF SERVICE*		B (B)		B (B)		B (B)		B (B)	
WEAVE AREAS	DESIGN HOUR VOLUME			621				393		
	WEAVE AREA TYPE			TYPE A				TYPE A		
	LEVEL OF SERVICE			C (B)				B (B)		

*LOWEST LOS BETWEEN UPSTREAM/DOWNSTREAM RAMP INFLUENCE



FREEWAY SEGMENTS	SEGMENT LENGTH	N/A		1900 FEET		2000 FEET		1975 FEET		N/A
	DESIGN HOUR VOLUME	337		1510		961		1101		847
	NUMBER OF LANES	2		2 (3)		2		2 (3)		2
	LEVEL OF SERVICE	A		B (A)		A		B (A)		A
RAMP JUNCTIONS	OPERATION TYPE		FREE-FLOW		DIVERGE		MERGE		DIVERGE	
	RAMP TYPE		ON-RAMP		OFF-RAMP		ON-RAMP		OFF-RAMP	
	DESIGN HOUR VOLUME		961		549		140		254	
	NUMBER OF LANES		1		1		1		1	
	LEVEL OF SERVICE*		A (A)		B (B)		B (A)		B (A)	
WEAVE AREAS	DESIGN HOUR VOLUME			812				330		
	WEAVE AREA TYPE			TYPE A				TYPE A		
	LEVEL OF SERVICE			B (B)				B (A)		

*LOWEST LOS BETWEEN UPSTREAM/DOWNSTREAM RAMP INFLUENCE

APD-40 EASTBOUND TRAVEL LANES - FROM EXIT 20 TO SOUTH LEE HIGHWAY

AADT TRUCK PERCENTAGE = 15%

(A) = INDICATES LOS WITH AUXILIARY LANE INCLUDED

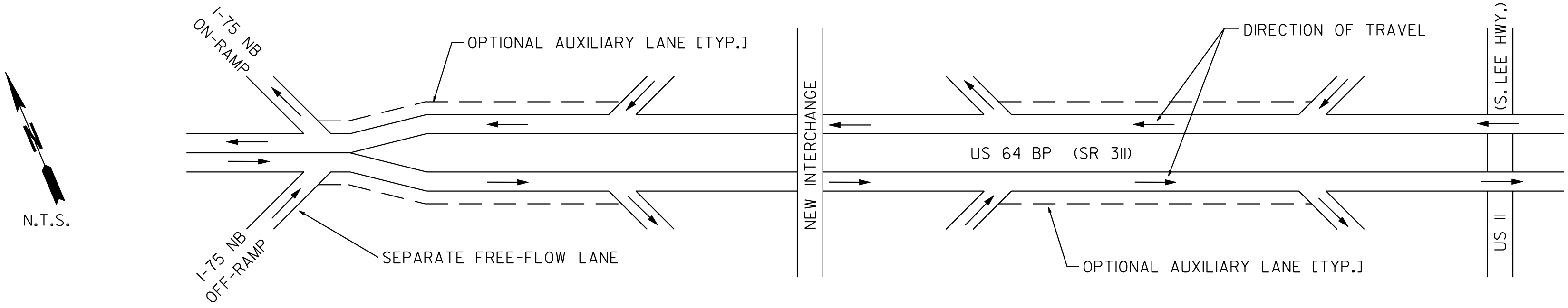
APD-40
MAINLINE LEVEL OF SERVICE SUMMARY
2013 AM PEAK HOUR

FIGURE 3.1
CONCEPT 1

APD-40 WESTBOUND TRAVEL LANES - FROM SOUTH LEE HIGHWAY TO EXIT 20

FREEWAY SEGMENTS	SEGMENT LENGTH	N/A		1900 FEET		2000 FEET		1975 FEET		N/A
	DESIGN HOUR VOLUME	1008		1772		1125		1203		805
	NUMBER OF LANES	2		2 (3)		2		2 (3)		2
	LEVEL OF SERVICE	A		C (B)		B		B (A)		A
RAMP JUNCTIONS	OPERATION TYPE		DIVERGE		MERGE		DIVERGE		MERGE	
	RAMP TYPE		OFF-RAMP		ON-RAMP		OFF-RAMP		ON-RAMP	
	DESIGN HOUR VOLUME		764		647		78		385	
	NUMBER OF LANES		1		1		1		1	
	LEVEL OF SERVICE*		B (B)		B (B)		B (B)		B (B)	
WEAVE AREAS	DESIGN HOUR VOLUME			853				424		
	WEAVE AREA TYPE			TYPE A				TYPE A		
	LEVEL OF SERVICE			C (B)				B (A)		

*LOWEST LOS BETWEEN UPSTREAM/DOWNSTREAM RAMP INFLUENCE



FREEWAY SEGMENTS	SEGMENT LENGTH	N/A		1900 FEET		2000 FEET		1975 FEET		N/A
	DESIGN HOUR VOLUME	337		1746		1482		1715		1405
	NUMBER OF LANES	2		2 (3)		2		2 (3)		2
	LEVEL OF SERVICE	A		C (B)		B		C (B)		B
RAMP JUNCTIONS	OPERATION TYPE		FREE-FLOW		DIVERGE		MERGE		DIVERGE	
	RAMP TYPE		ON-RAMP		OFF-RAMP		ON-RAMP		OFF-RAMP	
	DESIGN HOUR VOLUME		1409		264		233		310	
	NUMBER OF LANES		1		1		1		1	
	LEVEL OF SERVICE*		A (A)		B (B)		B (B)		B (B)	
WEAVE AREAS	DESIGN HOUR VOLUME			1247				459		
	WEAVE AREA TYPE			TYPE A				TYPE A		
	LEVEL OF SERVICE			D (B)				B (B)		

*LOWEST LOS BETWEEN UPSTREAM/DOWNSTREAM RAMP INFLUENCE

APD-40 EASTBOUND TRAVEL LANES - FROM EXIT 20 TO SOUTH LEE HIGHWAY

AADT TRUCK PERCENTAGE = 15%

(A) = INDICATES LOS WITH AUXILIARY LANE INCLUDED

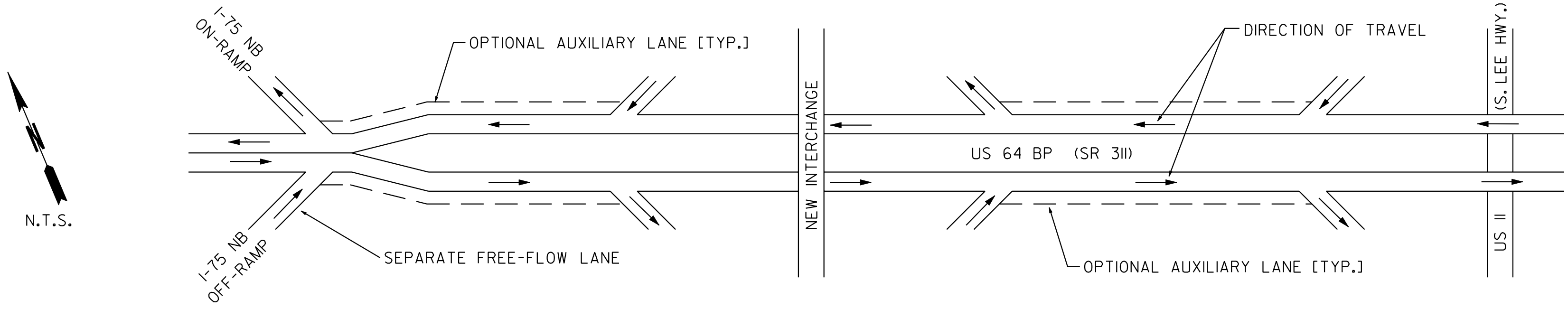
APD-40
MAINLINE LEVEL OF SERVICE SUMMARY
2013 PM PEAK HOUR

FIGURE 3.2
CONCEPT 1

APD-40 WESTBOUND TRAVEL LANES - FROM SOUTH LEE HIGHWAY TO EXIT 20

FREEWAY SEGMENTS	SEGMENT LENGTH	N/A		1900 FEET		2000 FEET		1975 FEET		N/A
	DESIGN HOUR VOLUME	1827		2718		2375		2731		2413
	NUMBER OF LANES	2		2 (3)		2		2 (3)		2
	LEVEL OF SERVICE	C		D (C)		C		D (C)		C
RAMP JUNCTIONS	OPERATION TYPE		DIVERGE		MERGE		DIVERGE		MERGE	
	RAMP TYPE		OFF-RAMP		ON-RAMP		OFF-RAMP		ON-RAMP	
	DESIGN HOUR VOLUME		891		343		356		318	
	NUMBER OF LANES		1		1		1		1	
	LEVEL OF SERVICE*		D (C)		D (C)		D (C)		D (B)	
WEAVE AREAS	DESIGN HOUR VOLUME			1010				592		
	WEAVE AREA TYPE			TYPE A				TYPE A		
	LEVEL OF SERVICE			E (C)				D (B)		

*LOWEST LOS BETWEEN UPSTREAM/DOWNSTREAM RAMP INFLUENCE



FREEWAY SEGMENTS	SEGMENT LENGTH	N/A		1900 FEET		2000 FEET		1975 FEET		N/A
	DESIGN HOUR VOLUME	832		2337		1479		1698		1309
	NUMBER OF LANES	2		2 (3)		2		2 (3)		2
	LEVEL OF SERVICE	A		C (B)		B		C (B)		B
RAMP JUNCTIONS	OPERATION TYPE		FREE-FLOW		DIVERGE		MERGE		DIVERGE	
	RAMP TYPE		ON-RAMP		OFF-RAMP		ON-RAMP		OFF-RAMP	
	DESIGN HOUR VOLUME		1505		858		219		389	
	NUMBER OF LANES		1		1		1		1	
	LEVEL OF SERVICE*		A (A)		C (C)		B (B)		B (B)	
WEAVE AREAS	DESIGN HOUR VOLUME			1257				508		
	WEAVE AREA TYPE			TYPE A				TYPE A		
	LEVEL OF SERVICE			E (C)				B (B)		

*LOWEST LOS BETWEEN UPSTREAM/DOWNSTREAM RAMP INFLUENCE

APD-40 EASTBOUND TRAVEL LANES - FROM EXIT 20 TO SOUTH LEE HIGHWAY

AADT TRUCK PERCENTAGE = 15%

(A) = INDICATES LOS WITH AUXILIARY LANE INCLUDED

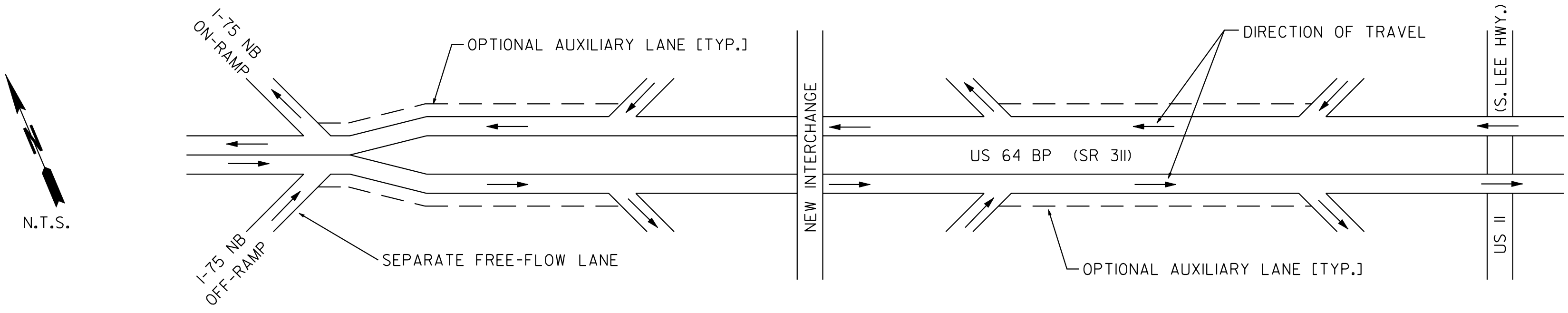
APD-40
MAINLINE LEVEL OF SERVICE SUMMARY
2033 AM PEAK HOUR

FIGURE 3.3
CONCEPT 1

APD-40 WESTBOUND TRAVEL LANES - FROM SOUTH LEE HIGHWAY TO EXIT 20

FREEWAY SEGMENTS	SEGMENT LENGTH	N/A		1900 FEET		2000 FEET		1975 FEET		N/A
	DESIGN HOUR VOLUME	1512		2736		1703		1824		1222
	NUMBER OF LANES	2		2 (3)		2		2 (3)		2
	LEVEL OF SERVICE	B		D (C)		C		C (B)		B
RAMP JUNCTIONS	OPERATION TYPE		DIVERGE		MERGE		DIVERGE		MERGE	
	RAMP TYPE		OFF-RAMP		ON-RAMP		OFF-RAMP		ON-RAMP	
	DESIGN HOUR VOLUME		1224		1033		121		602	
	NUMBER OF LANES		1		1		1		1	
	LEVEL OF SERVICE*		D (D)		D (C)		B (B)		B (B)	
WEAVE AREAS	DESIGN HOUR VOLUME			1333				643		
	WEAVE AREA TYPE			TYPE A				TYPE A		
	LEVEL OF SERVICE			F (C)				B (B)		

*LOWEST LOS BETWEEN UPSTREAM/DOWNSTREAM RAMP INFLUENCE



FREEWAY SEGMENTS	SEGMENT LENGTH	N/A		1900 FEET		2000 FEET		1975 FEET		N/A
	DESIGN HOUR VOLUME	510		2692		2280		2645		2178
	NUMBER OF LANES	2		2 (3)		2		2 (3)		2
	LEVEL OF SERVICE	A		D (C)		C		D (C)		C
RAMP JUNCTIONS	OPERATION TYPE		FREE-FLOW		DIVERGE		MERGE		DIVERGE	
	RAMP TYPE		ON-RAMP		OFF-RAMP		ON-RAMP		OFF-RAMP	
	DESIGN HOUR VOLUME		2182		412		365		467	
	NUMBER OF LANES		1		1		1		1	
	LEVEL OF SERVICE*		A (A)		D (C)		C (B)		D (C)	
WEAVE AREAS	DESIGN HOUR VOLUME			1926				704		
	WEAVE AREA TYPE			TYPE A				TYPE A		
	LEVEL OF SERVICE			F (D)				D (B)		

*LOWEST LOS BETWEEN UPSTREAM/DOWNSTREAM RAMP INFLUENCE

APD-40 EASTBOUND TRAVEL LANES - FROM EXIT 20 TO SOUTH LEE HIGHWAY

AADT TRUCK PERCENTAGE = 15%

(A) = INDICATES LOS WITH AUXILIARY LANE INCLUDED

APD-40
MAINLINE LEVEL OF SERVICE SUMMARY
2033 PM PEAK HOUR

FIGURE 3.4
CONCEPT 1

3.2 Access Analysis (FHWA Policy Analysis)

This study is undertaken in accordance with the Federal Highway Administration's (FHWA) policy regarding requests for additional or revised access points to the Interstate System. The FWHA policy is described in the Federal Register Notice Volume 63, No. 28, dated February 11, 1998. This analysis demonstrates the impacts of modifications to the studied interchange. The FHWA requires evaluation of eight policy statements. These are listed below in *bulleted italics*, followed by the response as analyzed for this location.

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.*

This proposed interchange, as identified by the Cleveland Area Urban Metropolitan Planning Organization (CAUMPO), is significant for regional mobility. The primary transportation improvements outlined in this study are needed to support current needs of the area as well as the envisioned future land use and economic development.

The area in which the recommended interchange is proposed is targeted for significant future development. The natural characteristics of the land, existing and proposed utilities, and existing and proposed roads would support such a development pattern. The proposed APD-40 interchange is necessary to satisfy the needs of the region and to support the previously mentioned logical pattern of development within the study area.

Currently, there are no suitable parallel routes to APD-40 that could accommodate the targeted development traffic anticipated for the area that could be used to connect to existing interchange ramps at I-75 Exit 20 and South Lee Highway. For I-75 Exit 20, the closest interchanges are five and nine miles respectively, and with the APD-40 route bisecting from the east, no opportunities are presented to accommodate development traffic to the I-75 Exit 20 Interchange without providing new access to APD-40 via a new interchange. The closest connection to APD-40 is via the South Lee Highway Interchange (US 11). Without a new interchange on APD-40, development traffic would be forced to navigate a constrained local road system to get to APD-40.

The natural characteristics of the area, the existing and proposed utilities, and the existing and proposed roads supports the proposed economic development. The proposed slip ramp will provide direct access to southeast quadrant of the study interchange for the following proposed economic developments:

- The United States Forest Service (USFS) is planning to relocate their Cherokee National Forest headquarters to this site. The USFS site will also serve as a tourist destination prior to entering the Cherokee National Forest on APD-40 which will include the historical and cultural resources associated with the Trail of Tears National Trail.
- An Ocoee River Gateway site for visitors providing a natural entrance to the Ocoee River rafting and recreation area.
- A Visitor Welcome Center to draw attention to the area by promoting the many regional and recreational opportunities for the thousands of visitors who access the Cherokee National Forest and the Ocoee River area via the study interchange.
- A convention center serving the southern Cleveland/Bradley County area.
- An industrial park to support the new Volkswagen plant facility near I-75 Exit 9

interchange in Chattanooga.

2. *Transportation System Management: FHWA policy states: "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.*

The proposed interchange is necessary to improve access to the area and support economic development and regional growth projections. A local road system is needed to connect the interchange to APD-40, however a local road system improvement by itself would not meet the needs of the area.

This area has been aggressively targeted by the local and regional stakeholders for significant development. A majority of the development is contingent upon the ability to access APD-40 and I-75. A new interchange at this location is critical to the planning effort. Without the interchange, the connection back to I-75 would result in significant indirect travel through residential areas in order to access South Lee Highway, then APD-40.

Currently, there are no HOV options for APD-40 or I-75 in the project area. Transit service is limited and park and ride lots are non-existent. With the development of a new interchange, there may be potential to add a park-and-ride facility for Chattanooga commuters or even a rapid transit bus stop if Chattanooga transit options extended further northeast along I-75.

Consideration was made for frontage road improvements only but those would require access to APD-40 at either the I-75 interchange area or at South Lee Highway through residential areas. The interchange option combined with auxiliary lanes provides direct access to APD-40 and minimizes the weave impacts between the adjacent interchanges. The interchange location also keeps development traffic close to APD-40 and I-75 and out of the local road system and residential area.

Consideration was made for an at-grade intersection on APD-40 between two existing interchanges. It was determined that introducing a traffic signal less than one mile from the new signals at the I-75 Exit 20 ramp may queue traffic along the mainline of APD-40 and be detrimental for through traffic. An interchange with auxiliary lanes would provide better traffic operations

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 each 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 the new or revised access points.*

An operational analysis of current and future traffic was made for sections of the Interstate and all ramps and ramp termini within the limits of the study area. This includes analysis for Exit-20 at I-75 and South Lee Highway at APD-40. Technically, the existing adjacent interchanges related to the subject interchange are outside the influence of weaving. However, it is recommended that auxiliary lanes be constructed along APD-40.

The proposed slip ramp provides many benefits for regional traffic whose destination will be this proposed economic development, especially the development planned for in the study interchange’s southeast quadrant. The highway capacity and safety benefits include the reduction in APD-40 eastbound traffic volumes heading eastbound away from I-75 which in turn, will also reduce the weaving traffic volumes for the same APD-40 segment with the construction of the proposed Interchange.

Under Chapter 3 of this study, summary tables are presented which highlight future levels of service for the existing and proposed interchange locations in addition to mainline APD-40 operations. ***Appendix I*** presents details Highway Capacity Summary output files for the recommended concept. Results of the capacity analyses presented in ***Section 2.3*** indicate that no significant traffic operational issues are expected with construction of the improvements identified in ***Section 2.5***.

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 recommended proposal is for a full interchange and will provide for all traffic movements. On the South side of APD-40, the interchange connector will tie to a relocated Stone Lake Road. This will provide access east and west along Stone Lake Road and the Humphreys Bridge Road to the east. On the north side, local officials will be responsible for providing the connection to a public facility. The recommended concept plan depicts a sample connection that may change based on development patterns. However, the intent is to provide for an improved local facility to safely and efficiently connect to the interchange.

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 transportation conformity requirements of 40 CFR parts 51 and 93.*

This study was initiated at the request of the local government and is included in their long-range planning efforts. This study was coordinated with both TDOT and Cleveland area stakeholders. The proposed interchange is consistent with all local, regional, and statewide land use and transportation plans.

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.*

The proposed APR-40 interchange has received funding in three earmarks in the most recent SAFETEA-LU highway bill. Currently, there are no long-range plans for an additional interchange along APD-40. There is a companion study underway that is proposing modifications to the existing Exit 20 Interchange on I-75. This is also the starting point for APD-40. The two studies have been coordinated with the improvements for each projected blended together as an integrated system (***Figure 2.4***).

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.*

This study originated at the request of local representatives from the City of Cleveland, Bradley County and the CUAMPO with the support of state and federal officials. This study has been coordinated with these stakeholders through prior planning efforts and this report. The City and County planning efforts have identified the area to the east as potential for development. The addition of this interchange is integral to adequately accommodate existing traffic and operations and for the planning of future development.

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.*

This study's recommendation was developed in conjunction and cooperation with TDOT, Cleveland area stakeholders and FHWA. As this study's findings are approved it will then be necessary to begin conducting additional environmental studies as outlined in the NEPA planning process.

3.3 Cost Estimate

The total estimated project cost for the recommended plans is $12.7 million. This estimate includes costs to construct a new interchange on APD-40. The estimate includes a portion of the auxiliary lanes connecting existing ramp terminals at I-75 and the South Lee highway Interchanges to the ramps for the proposed interchange. This estimate does not include costs associated with a local commitment for enhanced roadway connections on the north side of the interchange.

Right-of-Way					
Land + Improvements	x	acres (18.953)		$ 551,000	
Incidentals ($3,000)	x	tracts (14)		$ 42,000	
Relocation (Moving + Housing)	x	residences (1)		$ 37,000	
		businesses			
		non-profits			
Total Right-of-Way Cost					**$ 630,000**
Utility Relocation					
Reimbursable				$	
Non-Reimbursable				$	
Total Utility Cost					**$ 573,000**
Construction					
Clear and Grubbing				$ 124,000	
Earthwork				$ 2,970,000	
Pavement Removal				$ 17,000	
Drainage				$ 30,000	
Structures				$ 3,125,000	
Railroad Crossing or Separation				$ -	
Paving				$ 906,000	
Retaining Walls				$ -	
Maintenance of Traffic				$ 200,000	
Topsoil				$ 241,000	
Seeding				$ 32,000	
Sodding				$ 100,000	
Signing				$ 50,000	
Lighting				$ -	
Signalization				$ 300,000	
Fence				$ 219,000	
Guardrail				$ 69,000	
Rip Rap or Slope Protection				$ 50,000	
Construction Items Subtotal			$ 8,433,000		
Other Construction Items				$ 551,000	
Erosion Control				$ 250,000	
Mobilization				$ 435,000	
10% Engineering & Cont.				$ 923,000	
Total Construction Cost					$ **10,592,000**
Preliminary Engineering					$ **923,000**
					$
TOTAL COST					**12,718,000**

In addition to the new interchange costs, the following costs are provided based on the other improvements discussed in this report:

APD-40/South Lee Highway Interchange

A conceptual cost estimate was also prepared for the identified improvements at the South Lee Highway Interchange. The proposed modifications included ramp work, adding turn lanes, and installation of two traffic signals. The estimate for this work is $731,000.

APD-40/I-75 Interchange (Discussed in detail in separate Interchange Modification Study)

The proposed modification to the APD-40 at I-75 interchange (Exit 20) is estimated at $13.3 million with the proposed slip ramp and $12.1 million without the proposed slip ramp.

4.0 SUMMARY AND CONCLUSIONS

The purpose of this study is to investigate the need and viability of a new interchange located on APD-40, approximately 0.6-mile east of I-75 at Exit 20 and 0.9-mile west of the South Lee Highway interchange with APD-40 in Cleveland, Tennessee.

This study provides a detailed evaluation of potential interchange locations and configurations in order to better accommodate traffic anticipated with potential development in the immediate area. This study is at the request of the Tennessee Department of Transportation (TDOT) on behalf of the local government in Cleveland, Tennessee.

The recommended plan from this study proposes constructing a new interchange approximately mid-way between the two existing interchanges on APD-40. The proposed interchange configuration is a traditional diamond with a bridge over existing APD-40. Due to the close proximity of the adjoining interchanges, auxiliary lanes should be constructed connecting the adjoining interchanges ramps to this new location.

The recommended concept consists of:

- Construction of a new bridge, approximately 320 linear feet, over APD-40. This bridge would consist of six (6) travel lanes with shoulders for a total width of 96 feet measured out-to-out.
- A minimum of 300 feet access control in each direction from ramp terminals.
    - A new intersection with Stone Lake Road to the south.
    - To the north, the TDOT controlled section will be stubbed and it will be a local government responsibility to tie future improvements to this location.
- Eastbound Ramp Terminal Intersection:
    - Construct a single lane off ramp that develops a dual right-turn and a separate left-turn lane at the intersection.
    - Construct two northbound and southbound thru lanes for the mainline.
    - Construct a separate northbound right-turn lane.
    - Construct two separate southbound left-turn lanes.
    - Construct a dual lane on-ramp that tapers to a single lane prior to merging with APD-40 eastbound.
    - Install traffic signalization.
- Westbound Ramp Terminal Intersection:
    - Construct a single lane off ramp that develops a dual left-turn and a separate right-turn lane at the intersection.
    - Construct two northbound and southbound thru lanes for the mainline.
    - Construct two separate northbound left-turn lanes.
    - Construct a separate southbound right-turn lane.
    - Construct a dual lane on-ramp that tapers to a single lane prior to merging with APD-40 westbound.

    - Install traffic signalization.

- Relocate Stone Lake Road for the area impacted by the interchange location. Approximately 1800 linear feet will be obliterated and replaced with 2,200 feet on new location.
- Add auxiliary lanes along APD-40 connecting ramp movement to adjoining interchanges
    - 2,600 linear feet of westbound auxiliary lane between the new interchange and South Lee Highway.
    - 2,400 linear feet of eastbound auxiliary lane between the new interchange and South Lee Highway.
    - 1,300 linear feet of eastbound auxiliary lane between the new interchange and I-75 Exit 20.
    - 1,300 linear feet of westbound auxiliary lane between the new interchange and I-75 Exit 20 northbound on-ramp (assuming I-75 Exit 20 modifications are completed).

Other recommended improvements for the area include:

APD-40/South Lee Highway Interchange

Construct two northbound left turn lanes at the westbound ramp terminal intersection on the north side of APD-40. Construct a separate northbound right-turn lane and two separate southbound left-turn lanes at the eastbound ramp terminal intersection on the south side of APD-40. Install traffic signalization at both ramp terminal intersections.

Proposed I-75 NB Slip Ramp at Stone Lake Road

Construct a one-lane slip ramp diverging from the I-75 NB to APD-40 exit ramp connecting to Stone Lake Road. At the ramp terminal intersection, Stone Lake Road should consist of a four-lane roadway section and the slip ramp should consist of a separate left-turn lane and right-turn lane. Traffic signalization should be installed at the ramp terminal intersection.

The service life of the proposed interchange will exceed the 2033 planning horizon. This proposed new interchange is needed to meet current passenger and freight transportation needs and to support the future logical pattern of development within the study area. These improvements are estimated to cost $12.7 million.

4.1 TDOT Design Division Concurrence

The following page presents a memorandum detailing the TDOT Design Division's concurrence in support of Concept 1.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
DESIGN DIVISION
505 DEADERICK STREET
SUITE 1300, JAMES K. POLK BUILDING
NASHVILLE, TENNESSEE 37243-0348
PHONE NO. (615)741-0450 FAX NO. (615)532-2799

MEMORANDUM

TO: Ron Baker, Roadway Specialist 3
Project Planning Division

FROM: Jim Waters, Assistant Director
Design Division

DATE: May 1, 2008

SUBJECT: **PIN: 107386.00, 06007-1237-14, HPP-NHE-311(26)**
SR-311 (US-74, US-64 BP) Interchange between I-75(Exit 20)
and SR-2 (US-11) in Cleveland
Bradley County

PIN: 110079.00, Project No. 99107-7086-04,
APD-40 Proposed Interchange between Exit 20 at I-75 and South Lee Highway
(SR-2/US-11), Bradley County

Per your request, we have reviewed the meeting summary and the presentation from the meeting held with the FHWA, and TDOT representatives from your office on April 2, 2008.

Exit 20 Interchange

We prefer **Concept 1**, the Diamond interchange, at exit 20. It should be the most economical intersection to build and is a type of intersection drivers are comfortable using.

The traffic is expected to more than double by 2033, 61,000 vpd to 132000 vpd. Careful attention should be paid to the number of lanes across the bridge and the addition of lanes as traffic develops. Consideration should be given to proposed turning movements, so that potential long term modifications to these turning movements would be easily incorporated as the traffic grows both on I-75 and the ramps.

The length of the proposed bridge should be carefully studied, so that future widening of I-75 could be performed without any additional work on the bridge.

APD Interchange

We prefer **Concept 1** for the APD interchange. The other options seem overly complicated and likely to cause driver confusion. One key benefit of Concept 1 is that this concept is located the farthest away from the exit 20 interchange. Proposed designs for the APD interchange should take into account the close proximity of the exit 20 interchange.

If you have any questions, or need additional information, please do not hesitate to call me at (615) 741-0450.

cc: Jeff Jones

APPENDIX A

TRAFFIC DATA

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
PROJECT PLANNING OFFICE
SUITE 1000, JAMES K. POLK BUILDING
NASHVILLE, TENNESSEE 37243-0344

May 12, 2009

Mr. Steve Bryan
Long Engineering Inc.
5550 Franklin Road
Suite 202
Nashville Tn. 37220

Subject: Traffic Figures for Proposed Interchange on APD-40
between I-75 & S.R. 2.
Cleveland Tennessee. Bradley County

Dear Steve:

We have reviewed the traffic schematics you submitted on May 12, 2009 for the subject project. These traffic schematics have our approval for your use in this study.

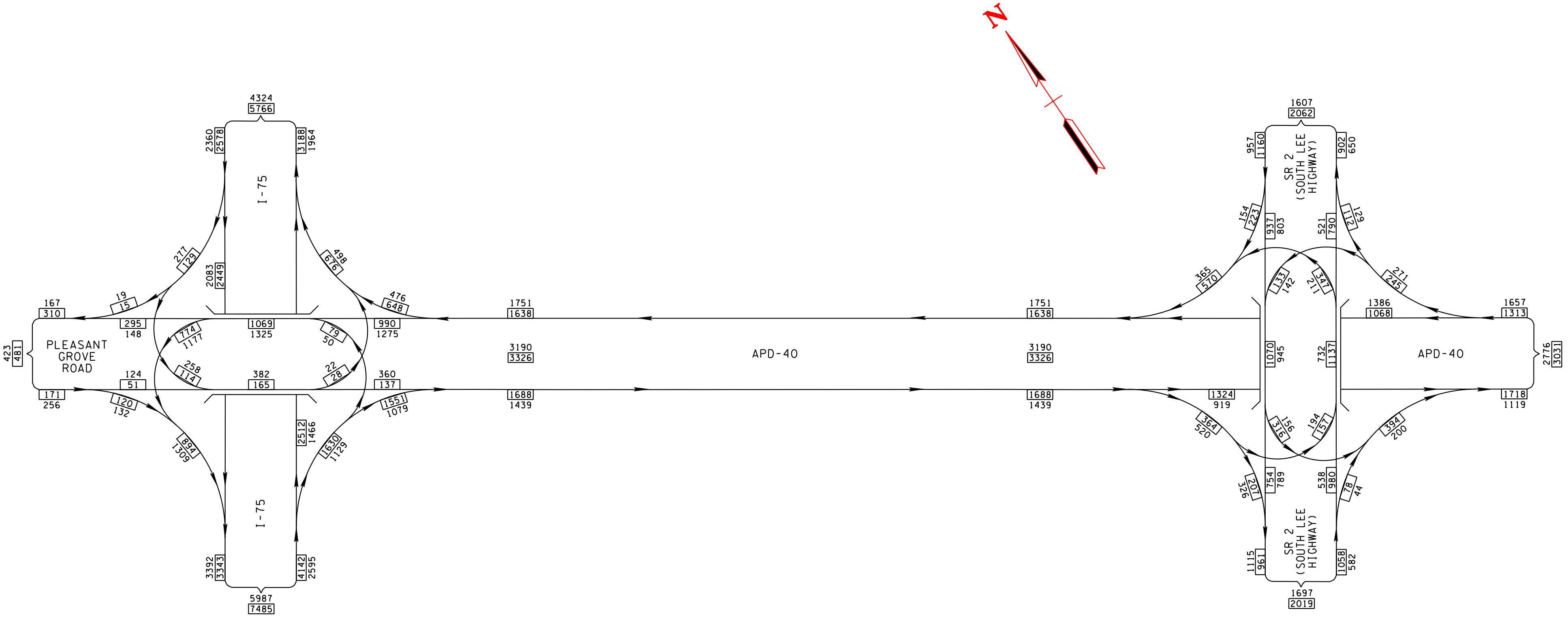
Further coordination should be directed to Mr. Bill Hart's office. If I can be of further assistance, please advice.

Sincerely,

Tony Armstrong

Tony Armstrong
Transportation Manager 1

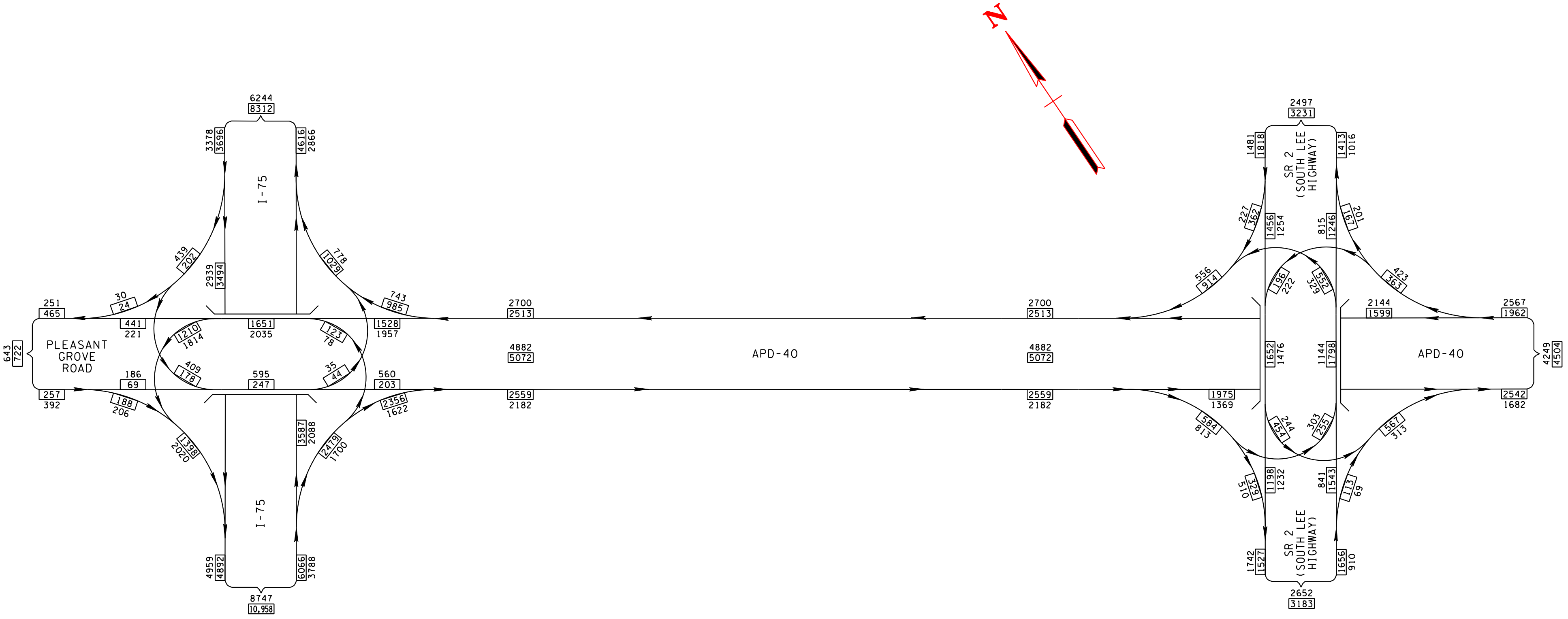
Cc: Mr. Bill Hart



AM PEAK - 000
PM PEAK - 000

CLEVELAND, BRADLEY COUNTY
EXISTING SYSTEM WITHOUT SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

2013 DESIGN HOUR VOLUMES



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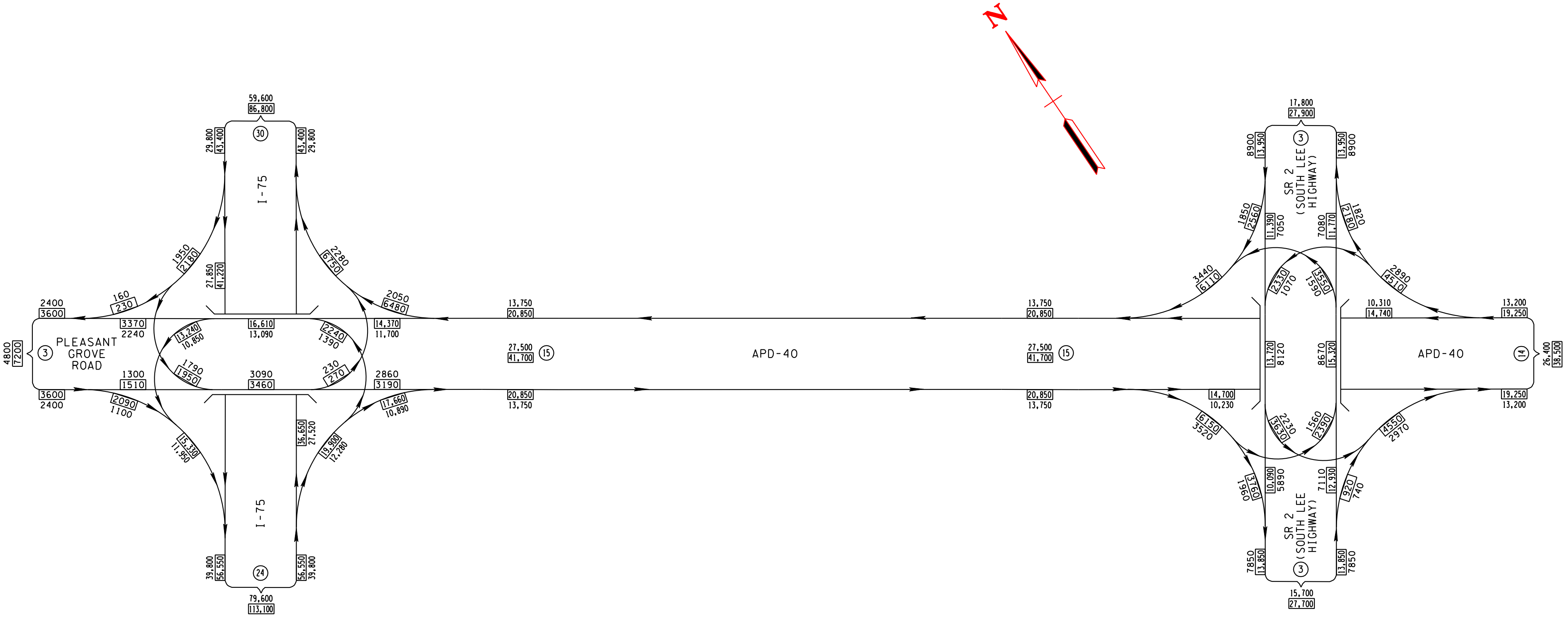
TDOT

CLEVELAND, BRADLEY COUNTY
EXISTING SYSTEM WITHOUT SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

2033 DESIGN HOUR VOLUMES

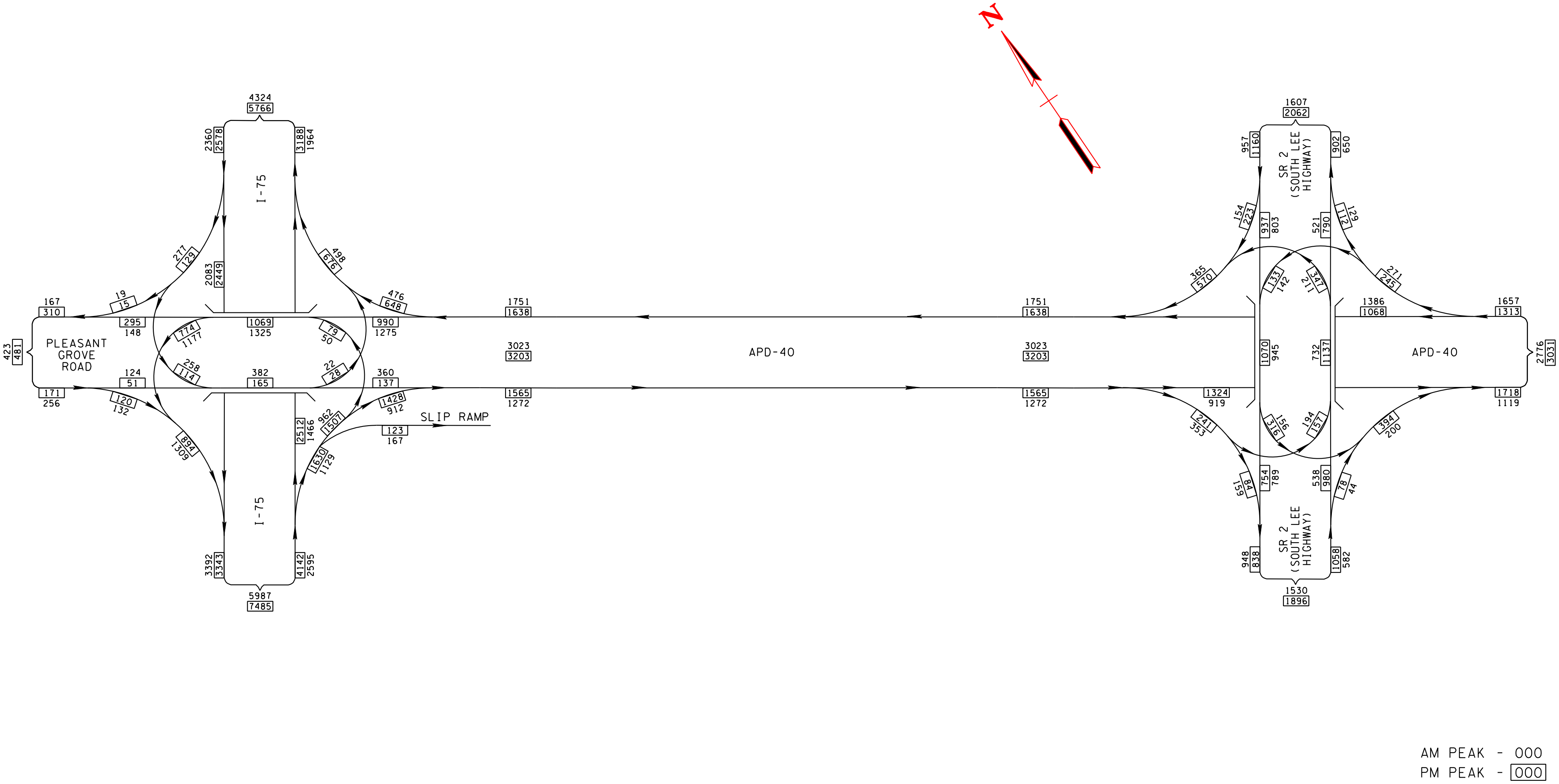


2013 AADT - 000
2033 AADT - [000]
AADT TRUCK % - ⓪

TDOT

CLEVELAND, BRADLEY COUNTY
EXISTING SYSTEM WITHOUT SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

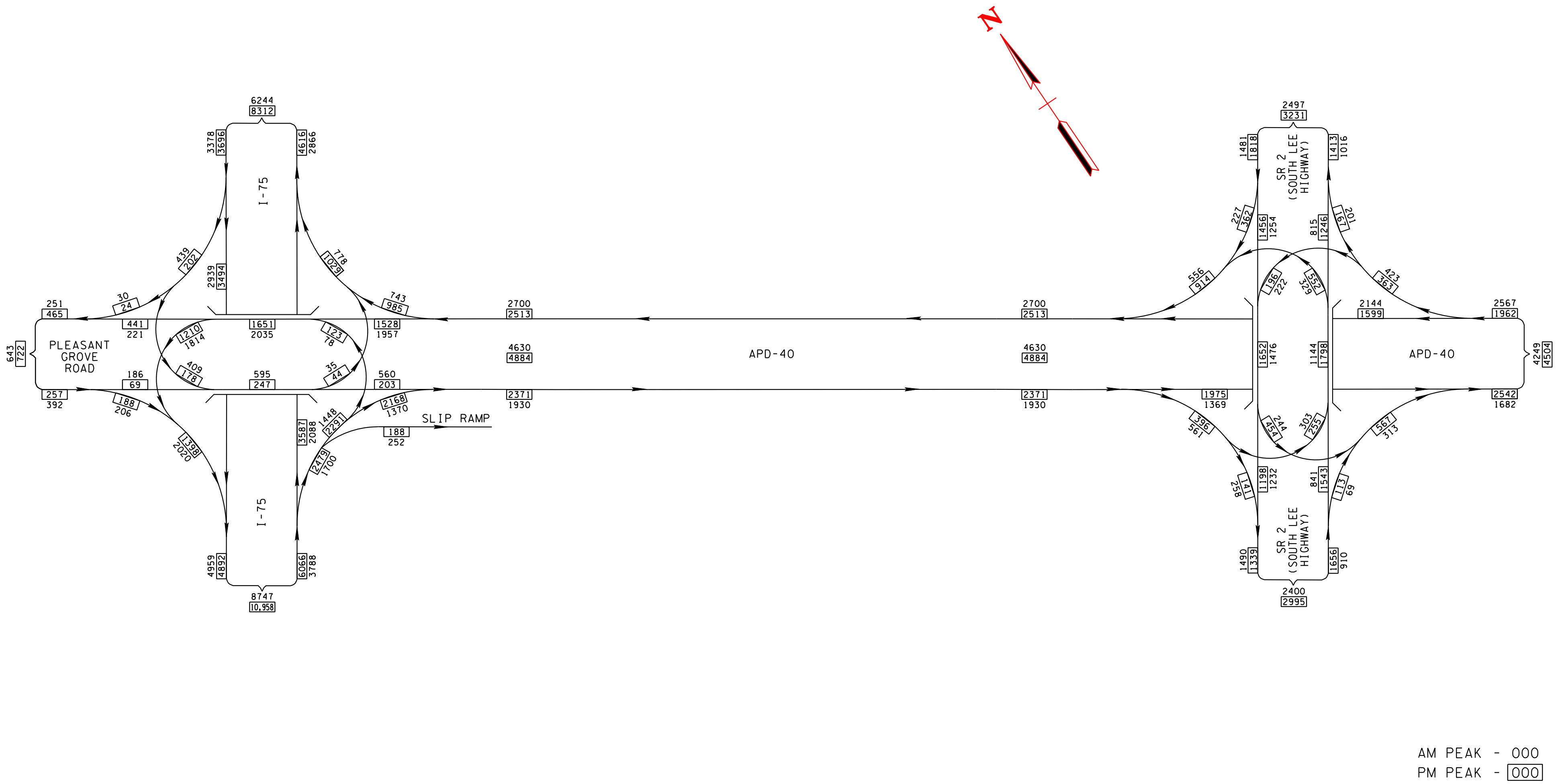
2013/2033 AADT



TDOT

CLEVELAND, BRADLEY COUNTY
EXISTING SYSTEM WITH SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

2013 DESIGN HOUR VOLUMES



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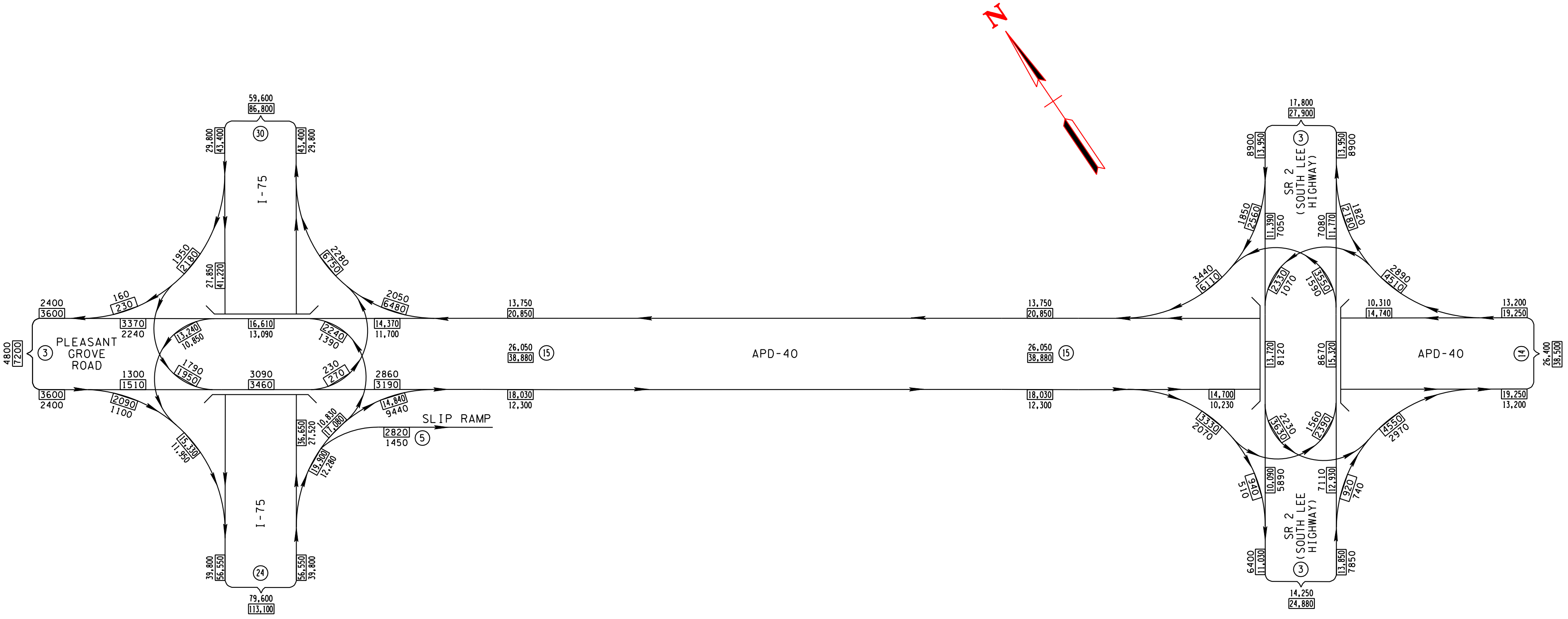
CLEVELAND, BRADLEY COUNTY
EXISTING SYSTEM WITH SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

2033 DESIGN HOUR VOLUMES



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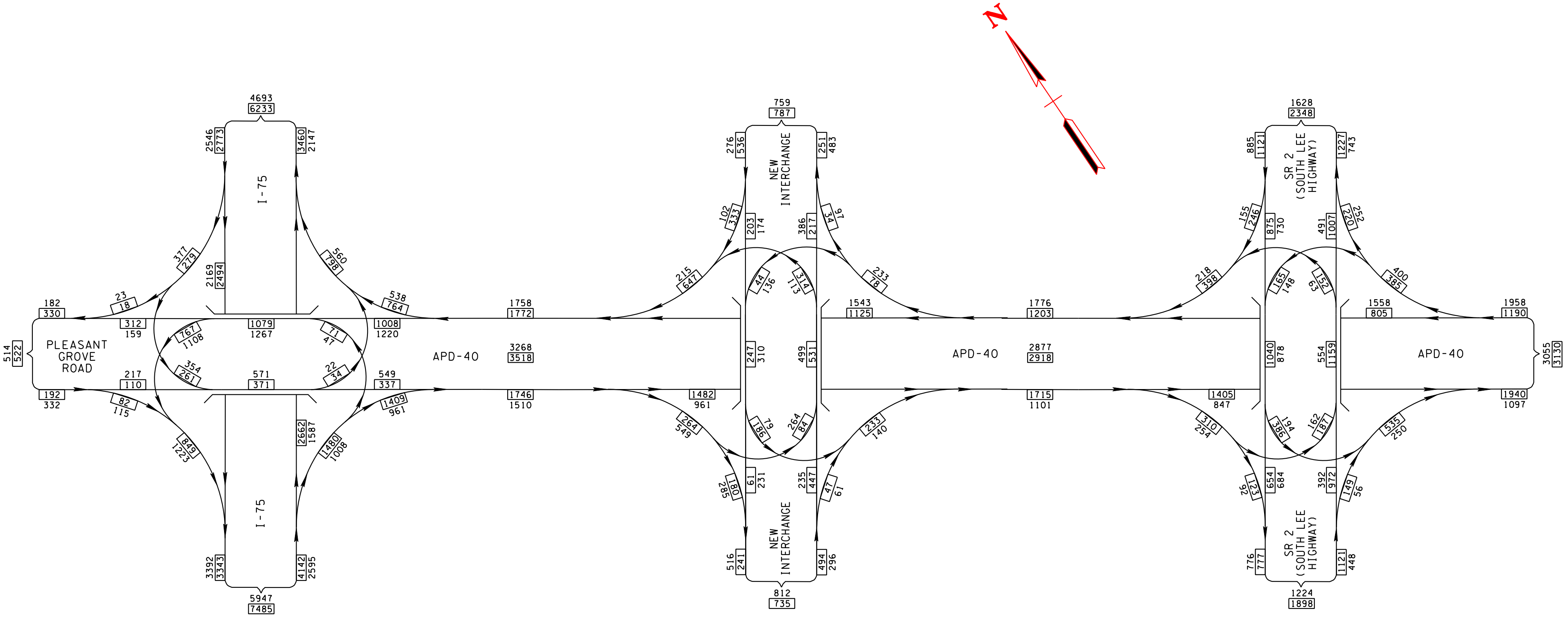
2033 AADT - $\boxed{000}$
AADT TRUCK % - ⓪

CLEVELAND, BRADLEY COUNTY
EXISTING SYSTEM WITH SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

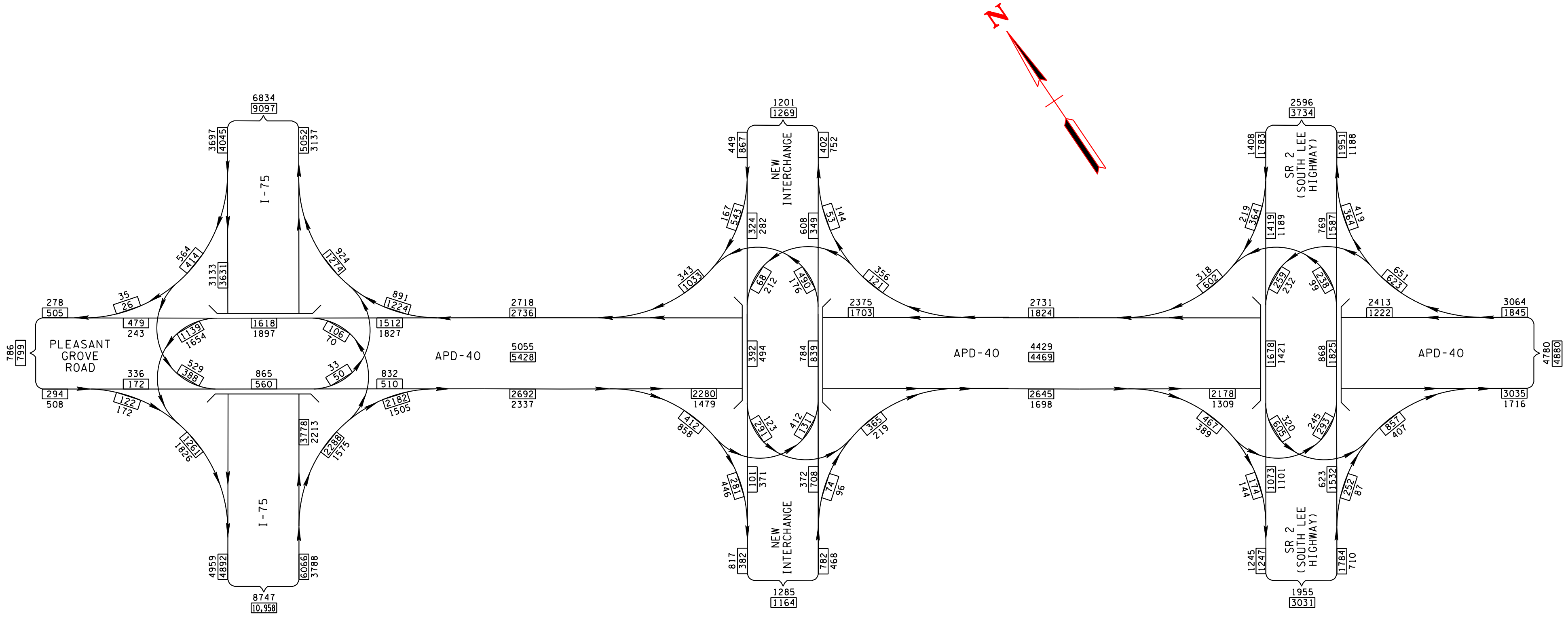
2013/2033 AADT



TDOT

CLEVELAND, BRADLEY COUNTY
PROPOSED SYSTEM WITHOUT SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

2013 DESIGN HOUR VOLUMES



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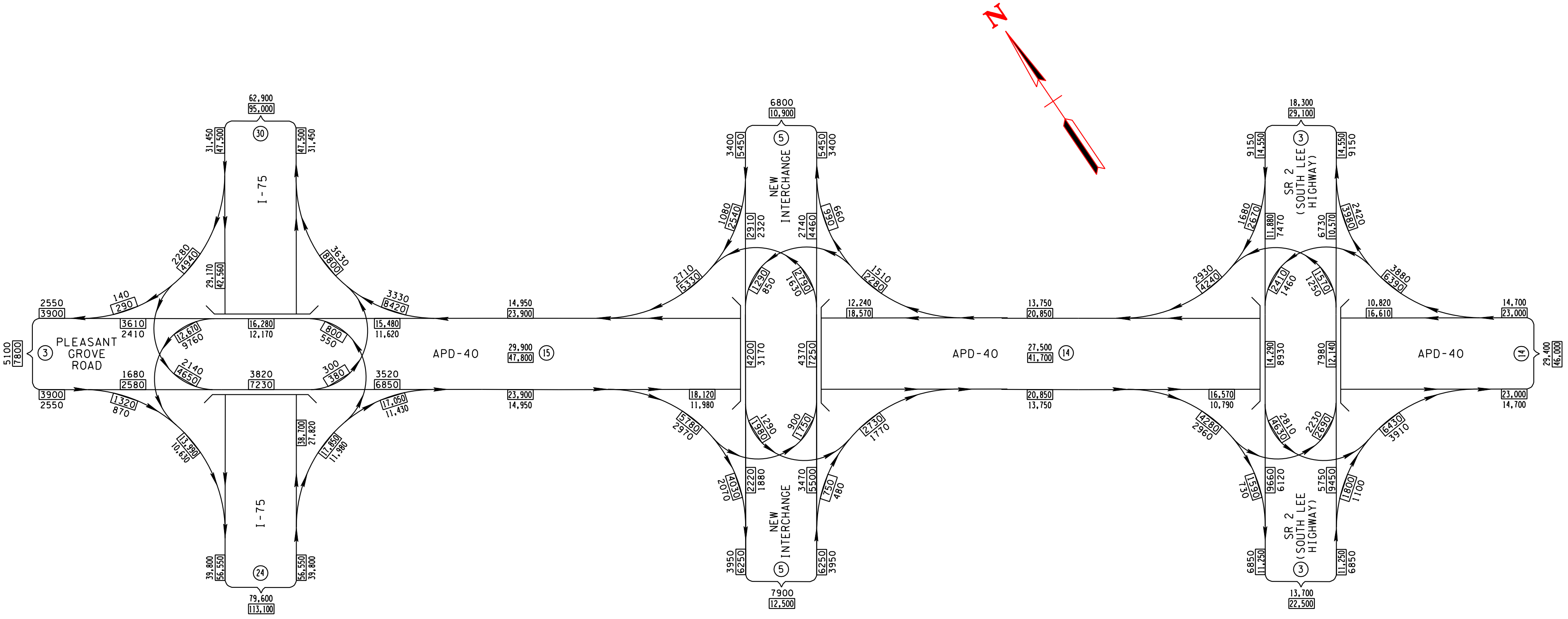
CLEVELAND, BRADLEY COUNTY
PROPOSED SYSTEM WITHOUT SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

2033 DESIGN HOUR VOLUMES



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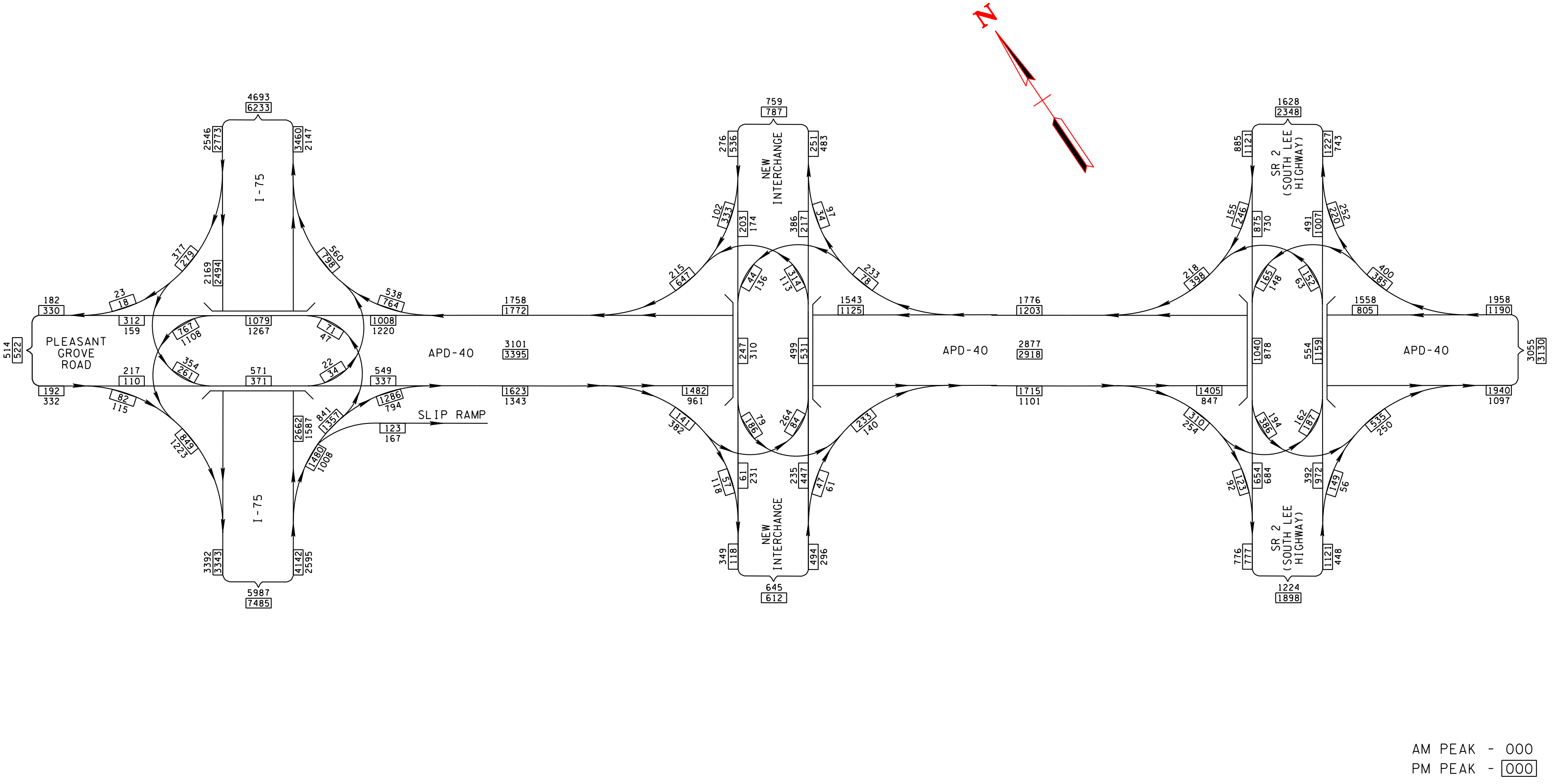
2033 AADT - $\boxed{000}$
AADT TRUCK % - ⓪

TDOT

CLEVELAND, BRADLEY COUNTY
PROPOSED SYSTEM WITHOUT SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

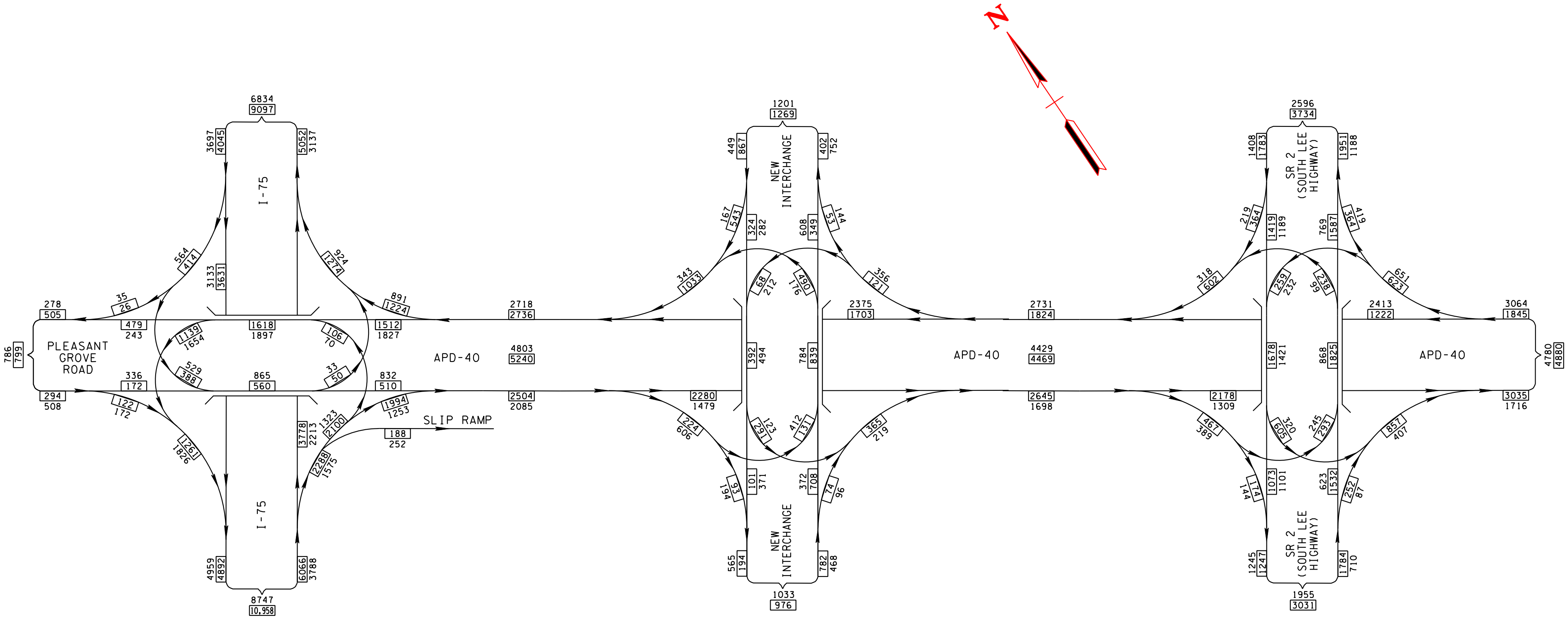
2013/2033 AADT



TDOT

CLEVELAND, BRADLEY COUNTY
PROPOSED SYSTEM WITH SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

2013 DESIGN HOUR VOLUMES



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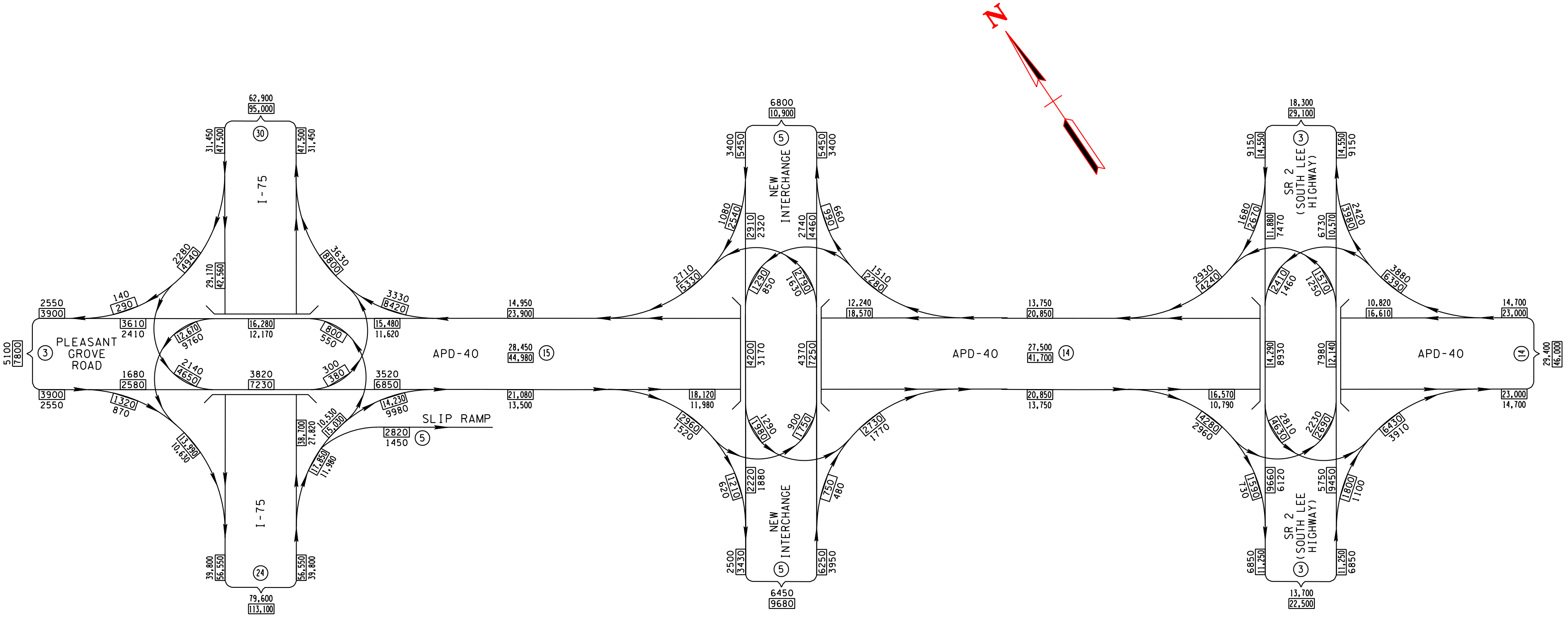
CLEVELAND, BRADLEY COUNTY
PROPOSED SYSTEM WITH SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

2033 DESIGN HOUR VOLUMES



2013 AADT - 000
2033 AADT - $\boxed{000}$
AADT TRUCK % - ⓪

TDOT

CLEVELAND, BRADLEY COUNTY
PROPOSED SYSTEM WITH SLIP RAMP
APD-40 BETWEEN I-75 AND S.R. 2

2013/2033 AADT

I-75 / APD 40 Interchange Analysis – May 4, 2009

Executive Summary

Two technical memorandums were developed to discuss the use of the Cleveland Urban Area Metropolitan Planning Organization (MPO) Transportation Demand Model (TDM) which was used to analyze transportation alternatives along I-75 and APD 40. The first memorandum discussed the parameters in the version of the Cleveland model used to develop the MPO's Long Range Plan (LRP). This included a summary of traffic analysis zone data as well as traffic assignment results. The second memorandum summarized updates to the model after its use on the LRP. The results provided in the technical memorandums will be used as part of an Interchange Modification Study (IMS) for the APD 40 interchange with I-75 at Exit 20 as well as an Interchange Justification Study (IJS) for a proposed interchange along APD 40 between I-75 and US 11.

As noted, the Cleveland MPO TDM was used in this study. The model is a traditional four-step travel demand model developed in TransCAD. The most recent version of the model was approved in 2008. The model does not have a mode split component, and therefore, consists of trip generation, trip distribution, and traffic assignment components. The model includes two geographic files for the transportation network and traffic analysis zones. The study area consists of eight Traffic Analysis Zones (TAZs) located approximately halfway between Cleveland and Chattanooga, Tennessee along I-75. Major roads in the study area are I-75 and APD 40, an east-west route which intersects with I-75 at Exit 20.

A review of the calibration of the base year (Year 2000 model) indicated that the model performs very well on I-75. However, the other links including APD 40 between I-75 and US 11 as well as both US 11 links have a high percent difference. Further investigation into the model indicated that the discrepancies in the study area were due to the following issues:

- The network detail in the study area is fairly light since there aren't many major roads. That forces more vehicles onto the roads that do exist in the model.
- The Cleveland area is very close to Chattanooga and this appears to have an impact on the external trips in the model.

Major land use changes are anticipated in and around the area of the I-75 / APD 40 interchange. This includes a proposed interchange along APD 40 that is located approximately 0.625 miles east of I-75, and growth in the zones in the southeast quadrant of the I-75 /APD 40 interchange. To account for this growth, the targeted traffic analysis zone was split into two zones and the land use data was split. Two network scenarios were tested in the model including one with the proposed interchange and one without.

For purposes of the current IMS, minor adjustments were made to the model in order to reduce some of the calibration discrepancies. Using the calibrated model volumes versus the known traffic volume in the study area, factors were developed for key study area segments. These factors were then applied to the future year (Year 2030) traffic volumes from the model to derive volumes needed for the IMS. Values for the scenario with the proposed interchange along APD are shown in **Table ES-1** while values for the scenario without the proposed interchange along APD 40 are shown in **Table ES-2**.

Once the model scenarios were finalized, the final step involved developing traffic forecasts for a mid-year (Year 2013) and the design year (Year 2033). This was accomplished using an interpolation process for Year 2013 and an extrapolation process for Year 2033.

Table ES-1: Year 2030 Traffic Volumes with Interchange (Factored)

Segment	Segment Description	Factor (rounded)	2030 Model (AADT)	2030 Factored (AADT)
1	I-75 South of APD 40	1.00	108,060	108,100
2	I-75 North of APD 40	1.05	85,938	90,200
3a	APD 40 between I-75 and Int.	0.73	61,741	45,100
3b	APD 40 between Int. and US 11	1.00	39,621	39,600
4	APD 40 East of US 11	1.09	39,936	43,500
5	US 11 North of APD 40	0.77	35,654	27,500
6	US 11 South of APD 40	0.41	51,675	21,200
7	Pleasant Grove Rd West of I-75	1.00	2,537	2,500
8	Link North of APD 40 Interchange	1.00	10,264	10,300
9	Link South of APD 40 Interchange	1.00	11,856	11,900

Table ES-2: Year 2030 Traffic Volumes without Interchange (Factored)

Segment	Segment Description	Factor (rounded)	2030 Model (AADT)	2030 Factored (AADT)
1	I-75 South of APD 40	1.00	108,060	108,100
2	I-75 North of APD 40	1.05	78,718	82,700
3	APD 40 between I-75 and US 11	0.73	54,239	39,600
4	APD 40 East of US 11	1.09	33,627	36,700
5	US 11 North of APD 40	0.77	34,338	26,400
6	US 11 South of APD 40	0.41	63,073	25,900
7	Pleasant Grove Rd West of I-75	1.00	2,255	2,300

I-75 / APD 40 Interchange Analysis

Cleveland MPO Model

May 4, 2009

Task 1 Technical Memorandum: Existing Model Data

The purpose of this memorandum is to summarize the existing model data in the Cleveland Urban Area Metropolitan Planning Organization (MPO) Transportation Demand Model (TDM). This is the first of two memorandums discussing the use of the model to analyze transportation alternatives along I-75 and APD 40. The data presented in this memorandum is as it appeared in the approved Long Range Plan (LRP). The results provided in the technical memorandums will be used as part of an Interchange Modification Study (IMS) for the APD 40 interchange with I-75 at Exit 20 as well as an Interchange Justification Study (IJS) for a proposed interchange along APD 40 between I-75 and US 11.

1. Study Area Description

The study area consists of eight Traffic Analysis Zones (TAZs) located approximately halfway between Cleveland and Chattanooga, Tennessee along I-75. Major roads in the study area are I-75 and APD 40, an east-west route which intersects with I-75 at Exit 20.

The blue shaded area in **Figure 1** represents TAZ 70 in the TDM. This TAZ has been identified as an area of proposed growth in the Cleveland area. The transportation alternatives considered in this study are intended to provide better access to this TAZ. **Figure 1** displays the study area.

2. Transportation Demand Model Description

The Cleveland MPO TDM is a traditional four-step travel demand model developed in TransCAD. The most recent version of the model was approved in 2008. The model does not have a mode split component, and therefore, consists of trip generation, trip distribution, and traffic assignment components. The model includes two geographic files for the transportation network and traffic analysis zones.

3. Base Model Inputs

Figures 2 and **3** provide the population, household, retail employment, and non-retail employment data for the TAZs in the study area for Year 2000 and Year 2030, respectively. **Table 1** provides a summary of this data.

Also, the MPO provided current year land use information for comparison. This can be found in **Appendix A**. This information was used to validate population and employment numbers for 2000. The MPO's map shows a large percentage of the land use in the study area as residential, commercial, or undeveloped.

Figure 1: Study Area

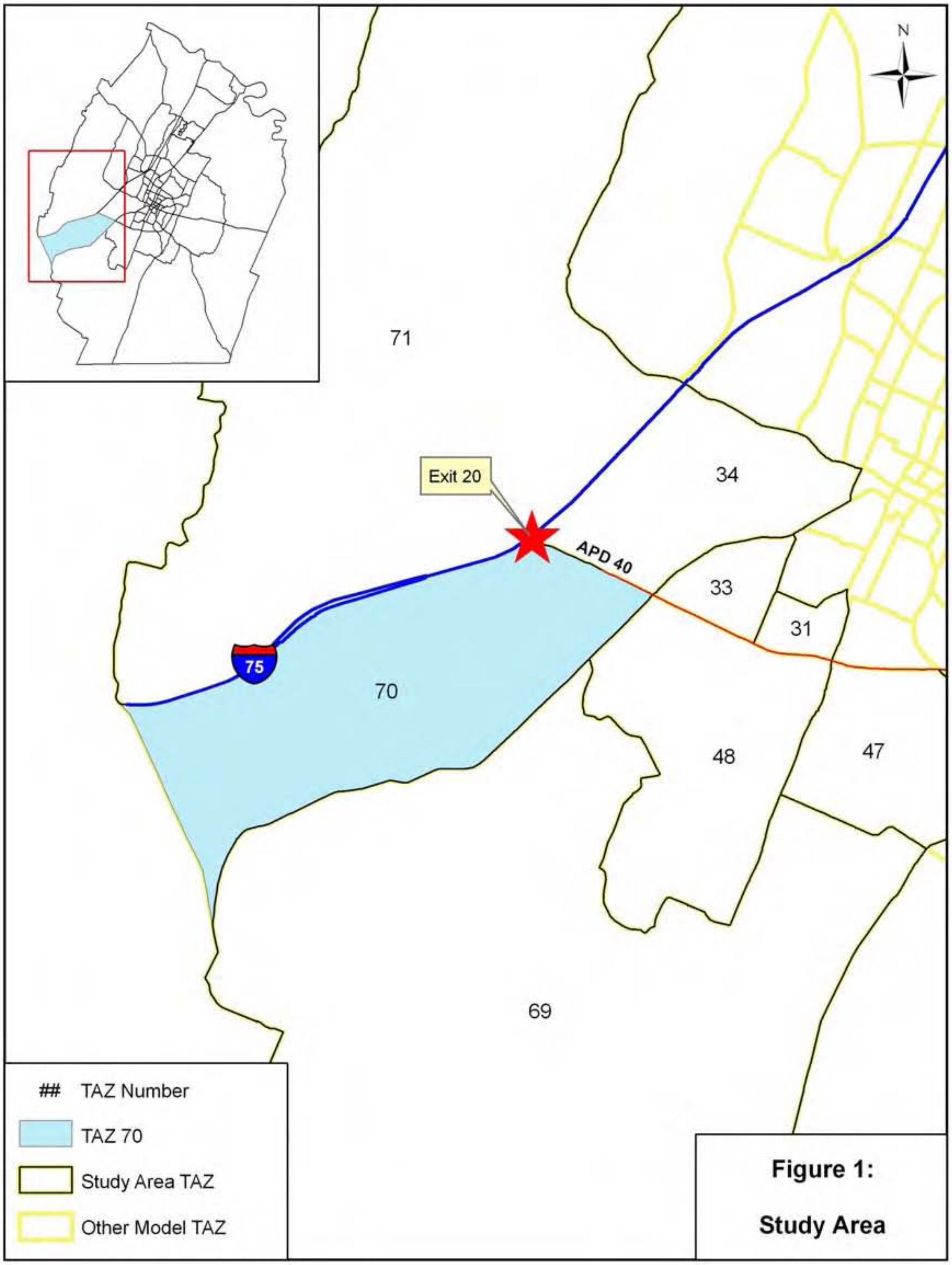


Figure 2: Year 2000 Traffic Analysis Zone Data

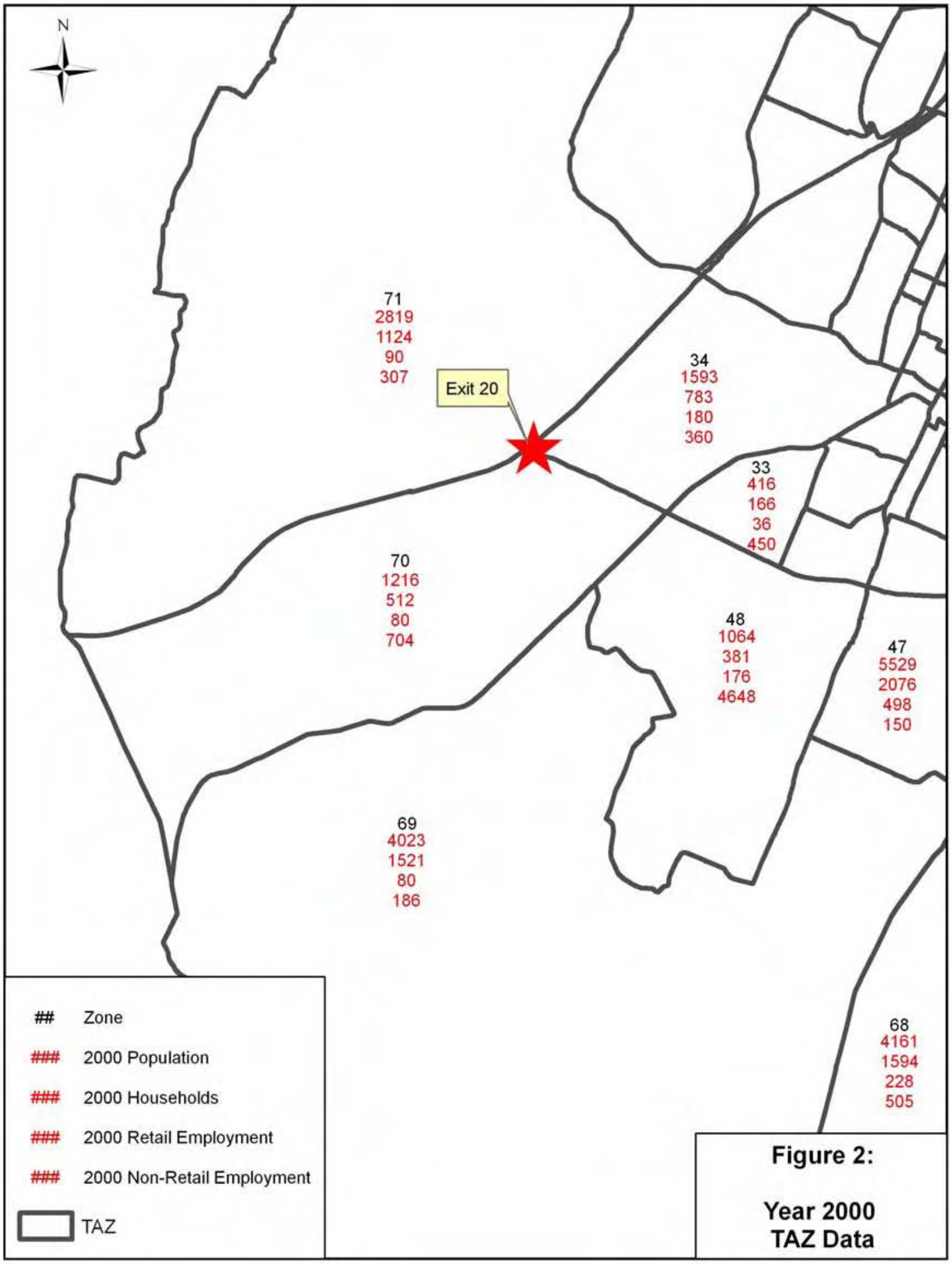


Figure 3: Year 2030 Traffic Analysis Zone Data

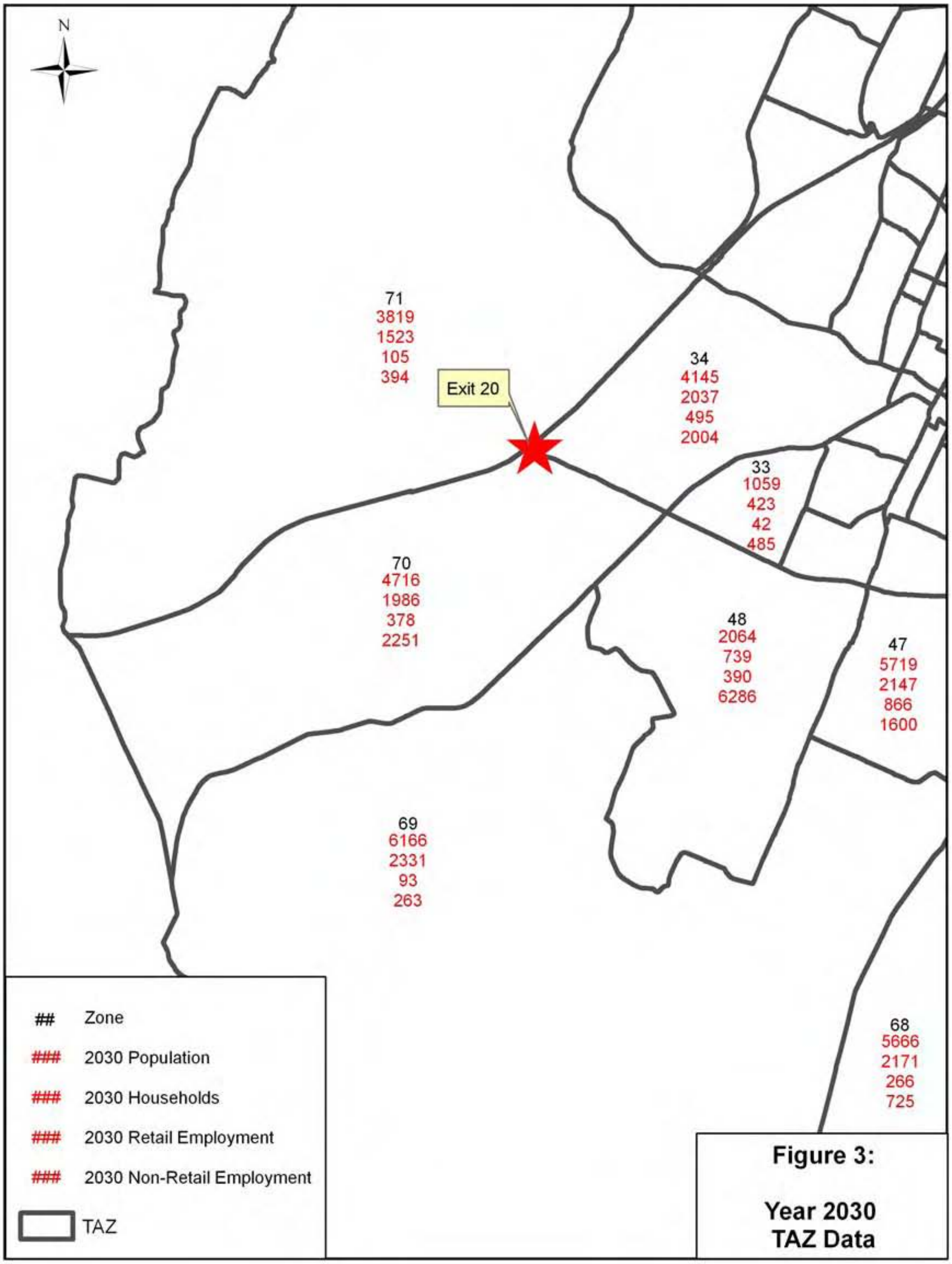


Table 1: Traffic Analysis Zone Comparison

TAZ	Population		Households		Pop/ HH% Change	Retail Employment		% Change	Non-Retail Employment		% Change
	2000	2030	2000	2030		2000	2030		2000	2030	
33	416	1059	166	423	155%	36	42	17%	450	485	8%
34	1593	4145	783	2037	160%	180	495	175%	360	2004	457%
47	5529	5719	2076	2147	3%	498	866	74%	150	1600	967%
48	1064	2064	381	739	94%	176	390	122%	4648	6286	35%
68	4161	5666	1594	2171	36%	228	266	17%	505	725	44%
69	4023	6166	1521	2331	53%	80	93	16%	186	263	41%
70	1216	4716	512	1986	288%	80	378	373%	704	2251	220%
71	2819	3819	1124	1523	35%	90	105	17%	307	394	28%

4. Traffic Assignments

Figures 4 and **5** provide the traffic volumes for the Year 2000 and Year 2030 base models, respectively. The traffic volumes are shown as directional average daily traffic (ADT) volumes. The “AB / BA” shown in the figures refers to this directional volume output from the model. AB represents the volume in one direction while BA refers to the opposite direction.

Figure 4: Year 2000 Traffic Assignment

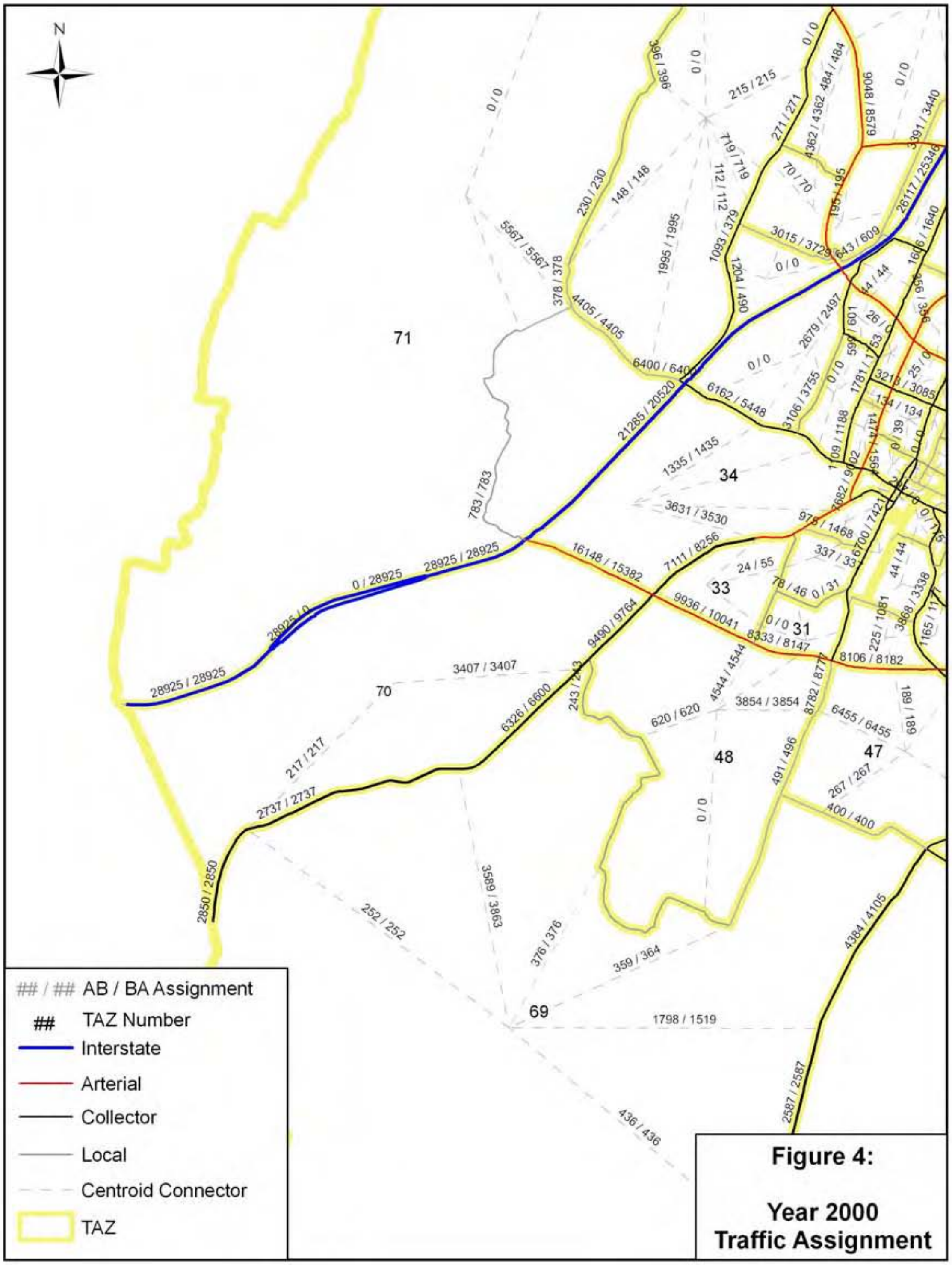
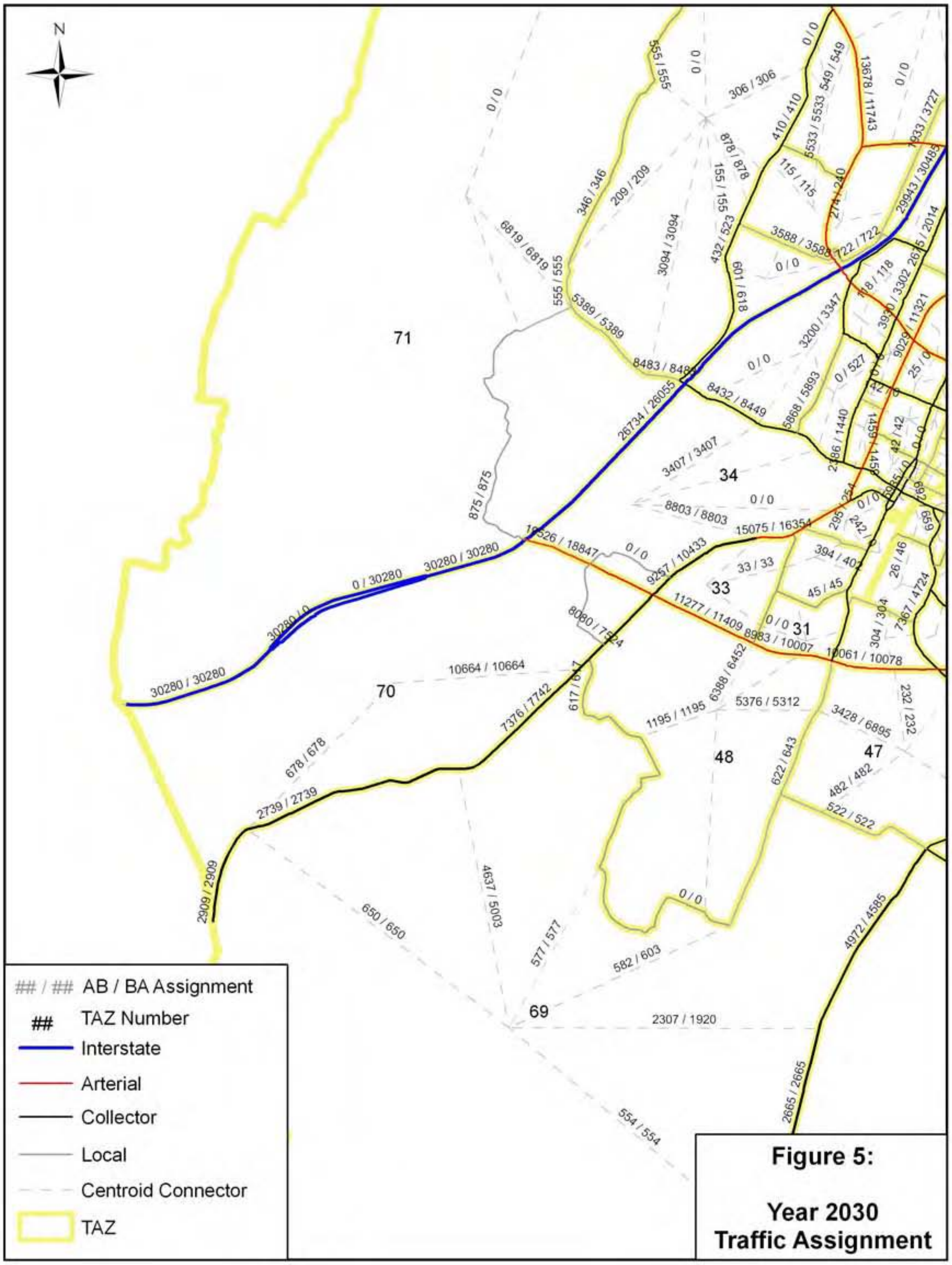
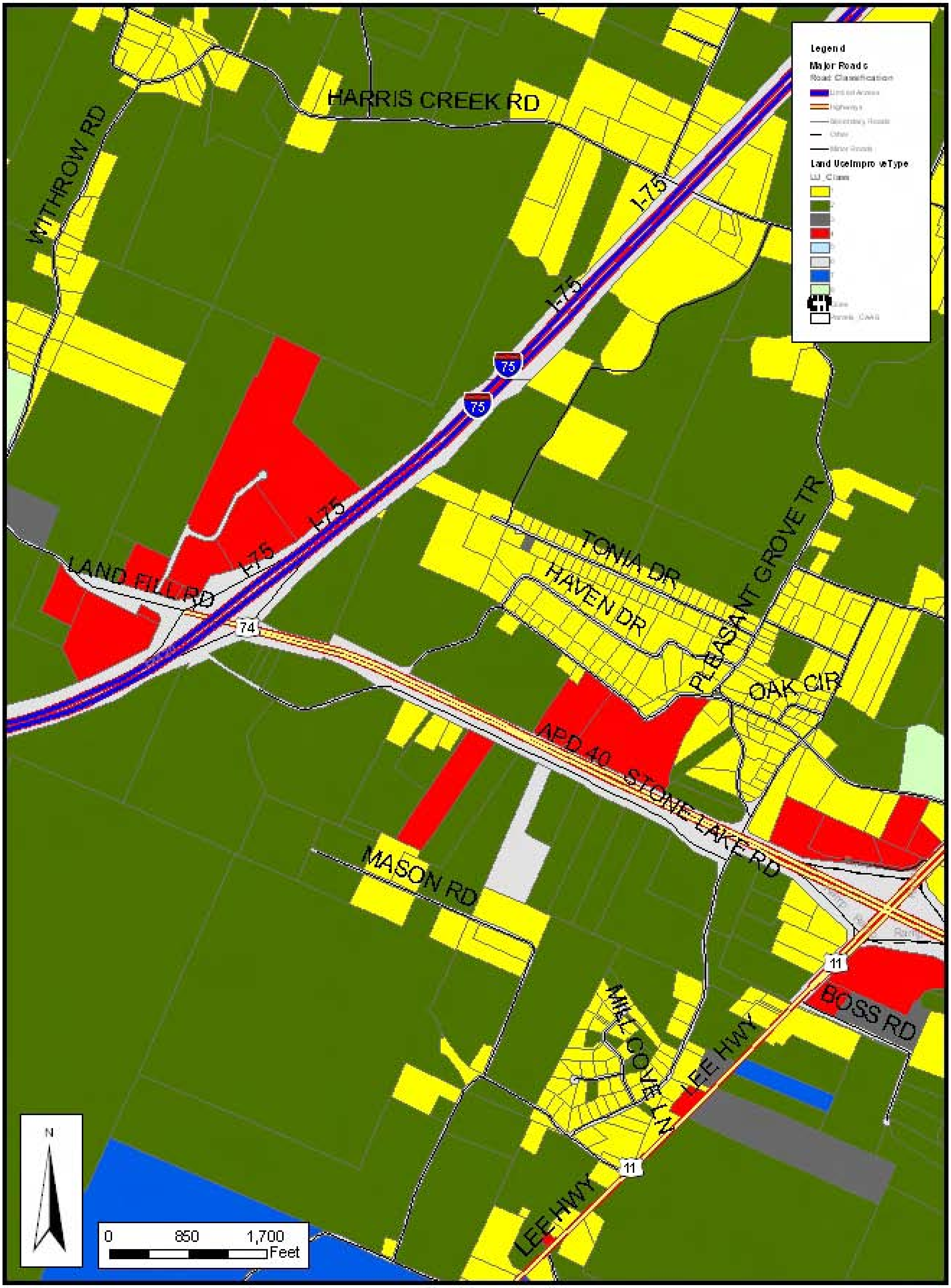


Figure 5: Year 2030 Traffic Assignment



Appendix A

Land Use Data



Exit 20 and APD 40 Current Land Use

Source: Land Use Data provided by Cleveland, MPO on April 7, 2009

I-75 / APD 40 Interchange Analysis

Cleveland MPO Model

May 4, 2009

Task 2 Technical Memorandum: Model Update

The purpose of this memorandum is to summarize the updates made to the Cleveland Urban Area Metropolitan Planning Organization (MPO) Transportation Demand Model (TDM). This is the second of two memorandums discussing the use of the model to analyze transportation alternatives along I-75 and APD 40. The first memorandum summarized existing model data as it appeared in the approved Long Range Plan (LRP). This second memorandum focuses on updates to the model after its use for the LRP. The results provided in the technical memorandums will be used as part of an Interchange Modification Study (IMS) for the APD 40 interchange with I-75 at Exit 20 as well as an Interchange Justification Study (IJS) for a proposed interchange along APD 40 between I-75 and US 11.

1. Study Area Description

The study area consists of eight Traffic Analysis Zones (TAZs) located approximately halfway between Cleveland and Chattanooga, Tennessee along I-75. Major roads in the study area are I-75 and APD 40, an east-west route which intersects with I-75 at Exit 20.

The blue shaded area in **Figure 1** represents TAZ 70 in the TDM. This TAZ has been identified as an area of proposed growth in the Cleveland area. The transportation alternatives considered in this study are intended to provide better access to this TAZ. **Figure 1** displays the study area.

2. Transportation Demand Model Description (Original 2006 TransCAD model)

The Cleveland MPO TDM is a traditional four-step travel demand model developed in TransCAD. The model does not have a mode split component, and therefore, consists of trip generation, trip distribution, and traffic assignment components. The model includes two geographic files for the transportation network and traffic analysis zones. Models were developed for a base year of 2000 as well as Year 2030, the year of the LRP.

Travel demand model calibration typically involves a series of reports and statistics which match the model output against acceptable model standards established by reviewing agencies. This can include overall model statistics as well as categorical statistics (i.e., VMT by functional classification, etc.). While attempts are made to minimize error within the models during calibration, the degree of error varies by volume groups, classification, and other criteria. For instance, lower classified roads such as collectors typically have a larger range of acceptable error when compared to higher classified roads such as interstates. Often, the error on individual links may be higher than the average for the volume group or classification of that particular link. Post-processing of these values is often necessary to account for this error.

Table 1 provides a summary of the model calibration in the study area, specifically along APD 40. As shown, the model performs very well on I-75. However, the other links including APD 40 between I-75 and US 11 as well as both US 11 links have a high percent difference.

Figure 1: Study Area

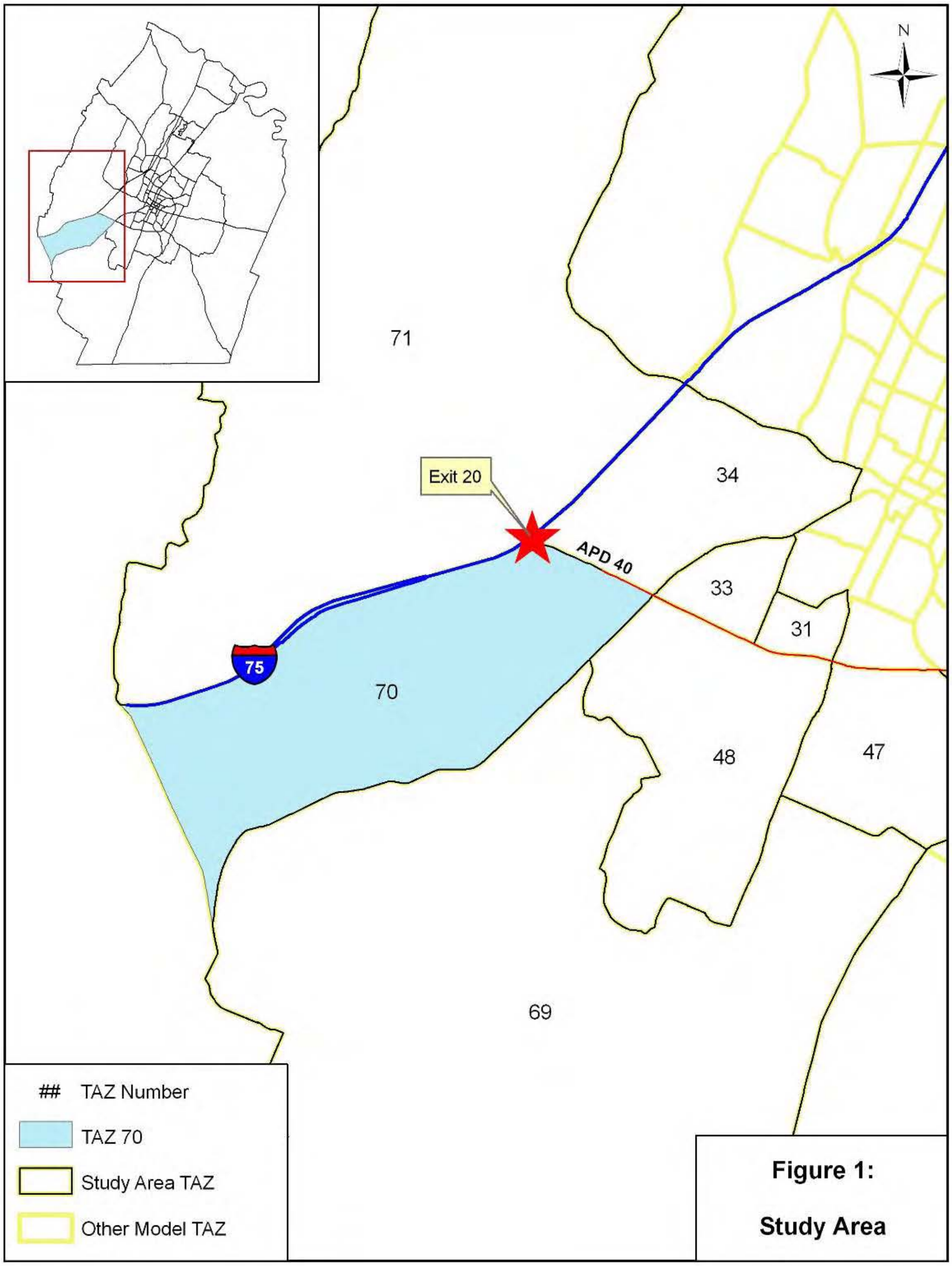


Table 1: Study Area Calibration Results (Year 2000)

Segment	Segment Description	2000 Model Assignment (AADT)	2004 Model (AADT)	2008 TRIMS (AADT)	% Diff (2000 vs 2004)	% Diff (2000 vs 2008)
1	I-75 South of APD 40	57,850	57,850	56,782	0.0%	1.8%
2	I-75 North of APD 40	41,804	41,940	46,648	-0.3%	-11.5%
3	APD 40 between I-75 and US 11	31,529	18,230	17,210	42.2%	78.5%
4	APD 40 East of US 11	19,377	18,580	18,400	4.1%	5.3%
5	US 11 North of APD 40	15,367	11,290	10,425	26.5%	43.8%
6	US 11 South of APD 40	19,253	7,920	7,112	58.9%	153.3%
7	Pleasant Grove Rd West of I-75	1,567	N / A	N / A	-	-

Further investigation into the model indicated that the discrepancies in the study area were due to the following issues:

- The network detail in the study area is fairly light since there are few major roads. That forces more vehicles onto the roads that do exist in the model.
- The Cleveland area is very close to Chattanooga and this appears to have an impact on the model. Typically, the ADT on a route in a model decreases as it approaches the edge of the model. This is because the urban area transitions into rural areas where there are fewer vehicles. Therefore, trips in a border TAZ are typically attracted internally toward the center of the gravity in the model (i.e., Central Business District, etc). In the south part of the Cleveland model, this is not the case since Chattanooga is close by. A look at the volumes on US 11 south of the county line indicated another interchange along I-75. The volume on US 11 increases as it gets closer to the interchange to the south. It is believed that the trips in Zone 70 (and other nearby zones such as TAZ 69) are more attracted to the south but the model is not able to reflect this trip interaction.

As future model enhancements are made, additional detail should be paid to the role of external stations and networks at the edges of the model, particularly in the south closer to Chattanooga. For purposes of the current IMS, minor adjustments were made to the model in order to reduce some of the calibration discrepancies. This includes adjustments of the travel speeds along APD 40 to reduce trips from using this interchange as a cut-through to other destinations. **Table 2** displays the updated volume comparisons.

Table 2: Study Area Calibration Results (Year 2000) – With Adjustments

Segment	Segment Description	2000 Model Assignment (AADT)	2004 Model (AADT)	2008 TRIMS (AADT)	% Diff (2000 vs 2004)	% Diff (2000 vs 2008)
1	I-75 South of APD 40	57,850	57,850	56,782	0.0%	1.8%
2	I-75 North of APD 40	39,961	41,940	46,648	-5.0%	-15.9%
3	APD 40 between I-75 and US 11	25,099	18,230	17,210	27.4%	43.3%
4	APD 40 East of US 11	17,106	18,580	18,400	-8.6%	-7.0%
5	US 11 North of APD 40	14,736	11,290	10,425	23.4%	38.2%
6	US 11 South of APD 40	19,196	7,920	7,112	58.7%	152.6%
7	Pleasant Grove Rd West of I-75	1,100	N / A	N / A	-	-

As shown, the adjustments made to the model still do not account for the high percent differences between the model assignment and the known traffic volume. Often in model analysis, a factor is created to account for variations between calibrated model volumes and actual traffic volumes. Due to the discrepancies along these key model links, such a factor should be used and will be discussed later in this document.

For reference, **Figure 2** displays the 2030 traffic assignment for the model. The traffic volumes are shown as directional average daily traffic (ADT) volumes. The "AB / BA" shown in the figures refers to this directional volume output from the model. AB represents the volume in one direction while BA refers to the opposite direction. **Appendix A** also provides screenshots of the model output.

3. Model Updates for I-75 Coordination (2008)

The Cleveland MPO TDM was updated in 2008 in order to make the model more consistent with the Chattanooga model. This involved using a more aggressive growth rate on I-75. The result was much higher traffic volumes along I-75 as shown in **Figure 3**.

4. Base Model Inputs

Table 3 provides the population, household, and employment information for TAZ 70 as provided by the MPO. The values shown in **Table 3** are consistent with all versions of the model described to this point in the document, including the original model files used for the LRP as well as the updated model for the I-75 coordination.

Table 3: Zone 70 Attributes

	2000	2030	Difference
Population	1,216	4,716	3,500
Households	512	1,986	1,474
Retail Employment	80	378	298
Non-Retail Employment	704	2,251	1,547

As shown, all inputs are expected to significantly grow between Year 2000 and Year 2030. The total households in Zone 70 for Year 2030 were originally forecasted as 1,986 households and the total employment for the zone was forecasted at 2,629 employees (retail and non-retail employment).

5. Land Use Changes / Model Input Changes (2009 Model Update)

Major changes are anticipated in the area in and around Zone 70. This includes:

- A proposed interchange along APD 40 located approximately 0.625 miles east of I-75; and
- A high number of retail and non-retail employment including a high concentration of parcels adjacent to either I-75 or APD 40 (i.e., north and west portions of Zone 70).

A decision was made to split Zone 70 to reflect this concentration of development. **Figure 4** displays this split.

Figure 2: Year 2030 Traffic Analysis Zone Data (LRP)

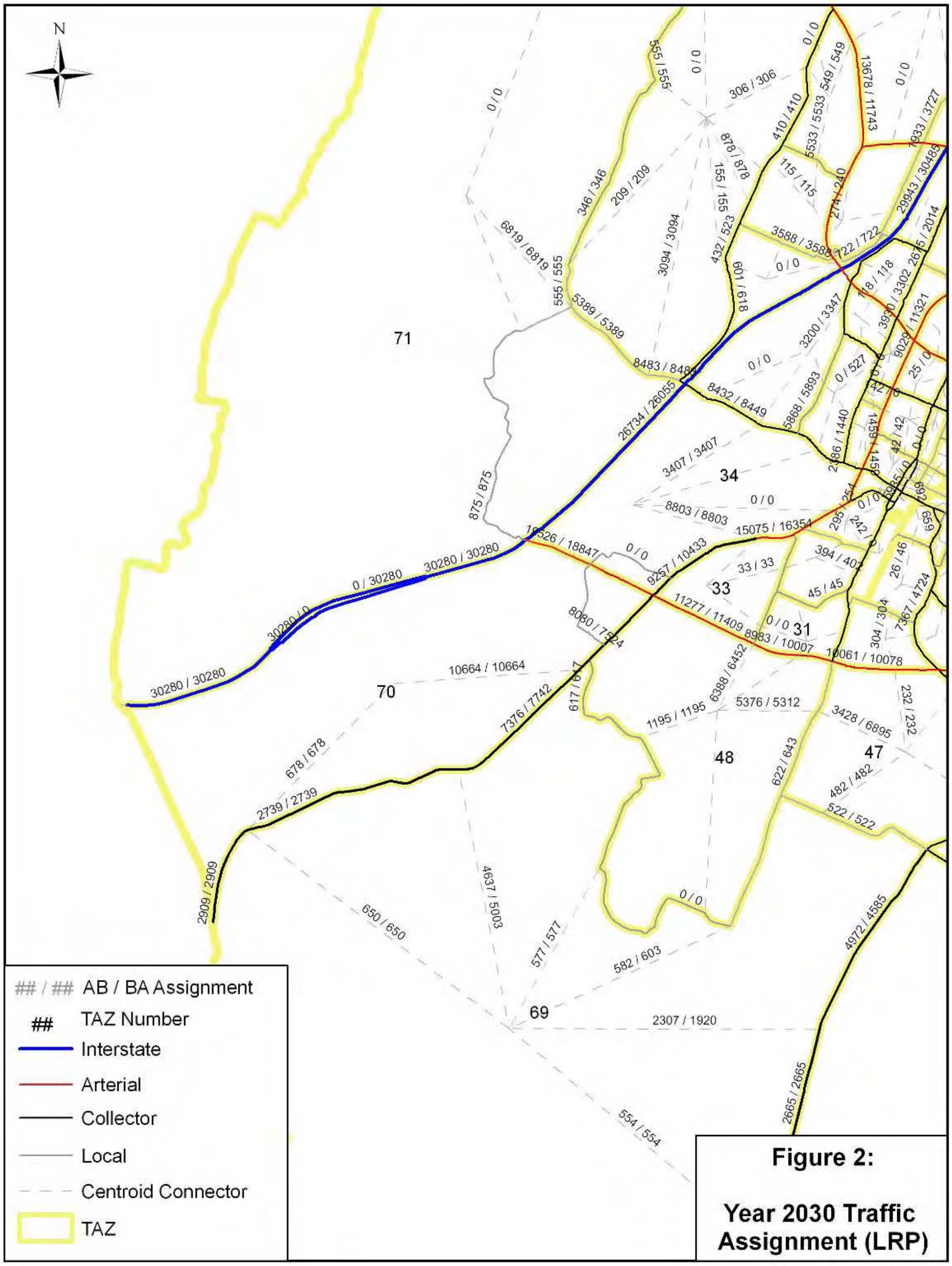


Figure 3: Year 2030 Traffic Analysis Zone Data (I-75 Adjustment)

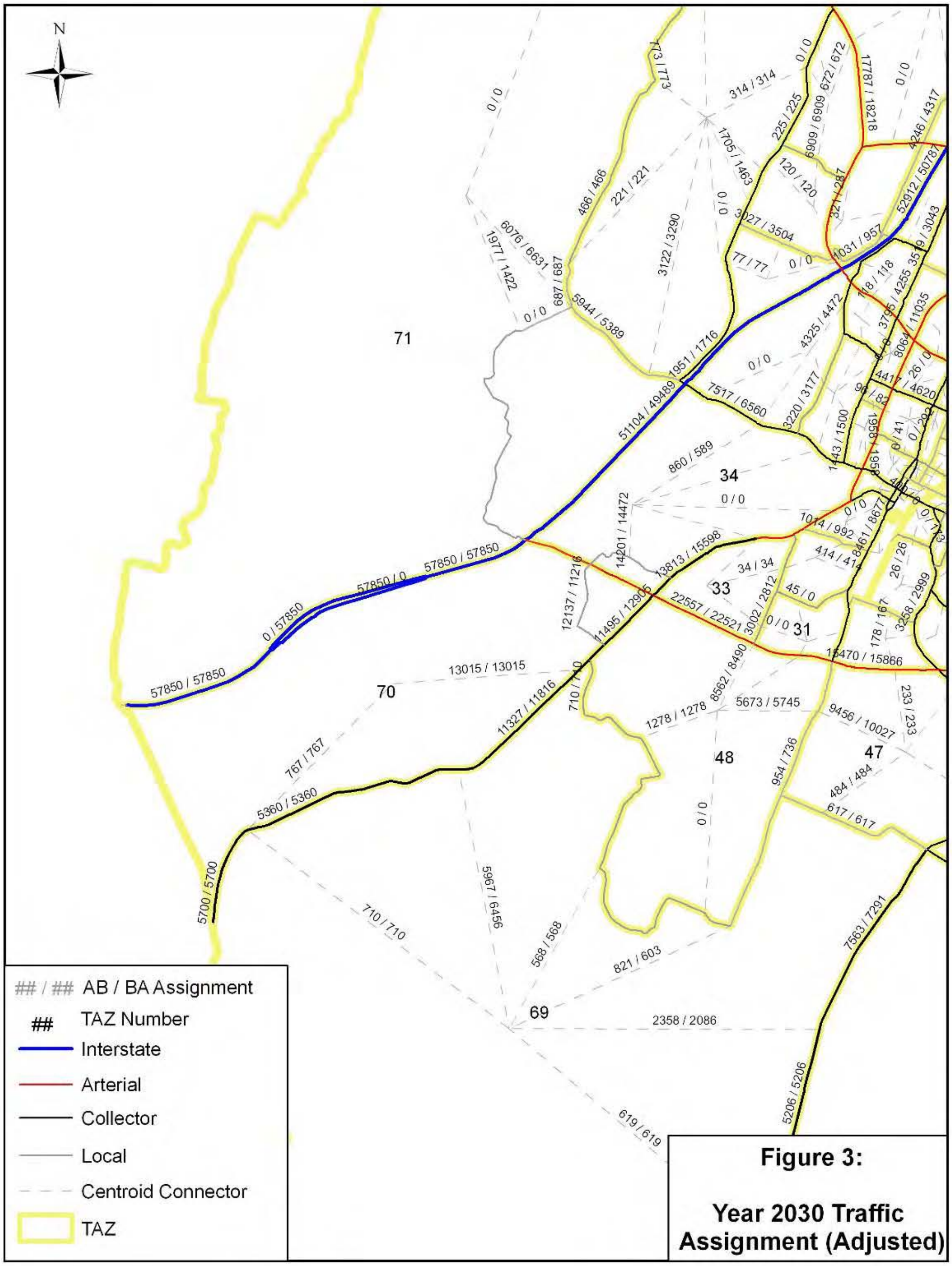
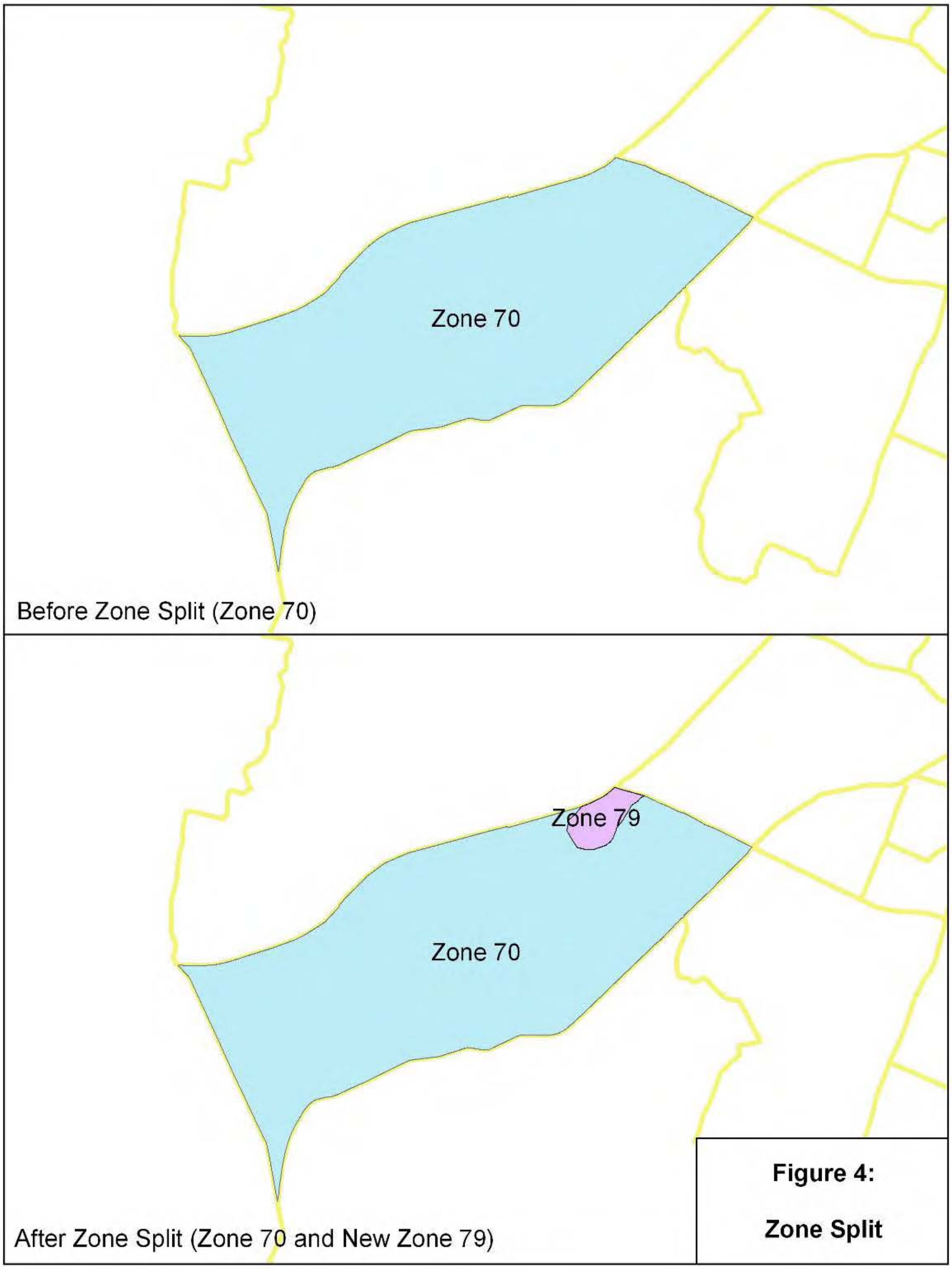


Figure 4: Zone Split



Zonal Attribute Changes

The next step involved reallocating the population, households, and employment to the split zones. In traditional modeling applications, the summation of each category remains the same when splitting. In addition, if changes are made to the totals of the two zones, adjustments are typically made to ensure the modeled area control totals are kept in balance. However, in cases of major changes to the land use in an area, exceptions can apply as in this analysis.

In order to estimate future land use data for the new industrial park TAZ, the Institute of Transportation Engineers (ITE) *Trip Generation Manual* was consulted and research was performed to identify other studies relating to similar projects. From the ITE manual, two trip generation equations, one for trips per employee and one for trips per acre, were combined to create a new estimate of approximately 19 employees per acre.

As an independent check, a report entitled *Employment Density Study* written for the Southern California Association of Governments (SCAG) was reviewed. In this report, various land use types were studied in six California counties to develop approximations of median / average employment density for square feet of building space and for acres of land.

Based on discussions with Project Team members, it is expected that this land use in new Zone 79 will most likely serve as a support site for a future planned automobile plant. From the SCAG report, several land use types and their densities were reviewed as those possible for this study's industrial park property. **Table 4** summarizes these rates.

Table 4: Trip Rates by Land Use Types

Land use	Average Employee / Acre	Median Employees / Acre
Low-rise Office	43.95	22.91
R&D/Flex Space	20.53	18.13
Light Manufacturing	17.83	11.63
Warehouse	11.40	10.63
Average	**23.43**	**15.83**

As shown, the average employee per acre is 23.43 and the median employee per acre is 15.83. An average of these two values yields a value of 19.50 employees per acre. However, before applying this rate to the total property area of approximately 516 acres, consideration may need to be given to adjustments which may be needed to account for “other uses” required within the zone, such as parking, utilities, landscaping and possibly staging areas for truck operations.

Multiple development scenarios were tested since it is currently uncertain how much of the acreage will be developed as a result of other land needs such as parking lots, etc. **Table 5** summarizes potential employment for the zone.

Table 5: Land Use Scenarios

Acreage for Other Uses	Remaining Acreage (%)	Remaining Acres	Trip Rate / Acre	Total Employment	Retail Employment	Non-Retail Employment
0.0%	100.0%	516	19.5	10,000	1,000	9,000
10.0%	90.0%	464	19.5	9,000	900	8,100
20.0%	80.0%	413	19.5	8,000	800	7,200
30.0%	70.0%	361	19.5	7,000	700	6,300
40.0%	60.0%	310	19.5	6,000	600	5,400

Next, adjustments were necessary for the projections of original Zone 70 to account for the zone split. It was assumed that:

1. The original Zone 70 was already identified as a zone of high growth potential, and therefore, the high forecasts for retail and non-retail employment in the zone should not be duplicated with the new land use scenarios.
2. All of the original forecasted population and households would be assigned to Zone 70.
3. The majority of the employment growth originally assigned to this zone would be transferred to Zone 79.
4. There was a small amount of existing employment in the area of the new zone.
5. A small amount of the employment will be assigned to Zone 70.

Table 6 presents the land use values used for this analysis.

Table 6: Revised Zone Attributes (Year 2030)

	Before Split	After Split	
	Zone 70	Zone 70	Zone 79
Population	4,716	4,587	0
Households	1,986	1,932	0
Retail Employment	378	100	500
Non-Retail Employment	2,251	400	5,000

The new land use data was used to populate the two TAZs.

Model User Interface Changes

The splitting of the zones also had an impact on the user interface used to run the model. The changes included:

- Adjustment of the *.rsc files to replace any mention of 78 zones to reflect 79 zones, which included the calculation of the skim matrix. As a result, a new user interface (*.dbd) file was created which should be used anytime the new zone system is used.
- Expand of the ixxx_imp.mtx file to include the new zone.

External / Internal Trips and Trip Distribution Impacts

Changes to the model External–Internal (E-I) trips were necessary to increase the amount of trips from External Station 185 to Zone 79. This was done by adjusting the impedance matrix (ixxi_imp.mtx). In the original model, all E-I trip pairs were assigned a value of 1. Changing this value changes the attraction of the specific E-I pair.

An assumption was necessary to determine the distribution of trips to Zone 79. The following distribution was assumed:

- 25% from I-75 to the South (to / from Chattanooga)
- 25% from I-75 to the North (to / from Knoxville)
- 25% from the east along APD 40
- 15% from the west along APD 40
- 10% from the south along US 11 and other internal routes

These assumptions were based on an assessment of the characteristics of the trips attracted to this zone including both freight and employee access to the site.

Therefore, a target of 25% of the total trips to Zone 79 was assumed to originate and terminate at External Station 185. As a result, the value in the impedance matrix was adjusted for each model run to meet this assumption.

6. Traffic Assignment

As noted and shown in **Table 5**, the amount of acreage available for development is unknown. This is a result of parking, internal roads and other related infrastructure that will be necessary. In addition, the terrain of the site may further limit the amount of construction. For this analysis, it was assumed that 40% of the site will not be developed

Two scenarios were tested in this memorandum:

- Scenario 1 – Year 2030 with APD 40 interchange between I-75 and US 11
- Scenario 2 – Year 2030 without APD 40 interchange between I-75 and US 11

Scenario 1

Scenario 1 considers the split TAZs 70 and 79 along with the network used in the Cleveland MPO LRP which included the APD 40 interchange. This interchange was originally coded in the LRP along with internal network links representing links that would tie into the interchange. Upon further analysis, the original travel speeds (and resulting travel times) on these links were too high and resulted in cut-through traffic. Traffic was using the new interchange to avoid the APD 40 / US 11 intersection. As expected, an adjustment of these speeds resulted in less traffic on these internal network links than scenarios tested earlier in this project.

Figure 5 displays the model output. As shown, approximately 61,700 vehicles per day are expected to use APD 40 between I-75 and the new interchange in Year 2030. Screenshots of the model output is also shown in **Appendix A**. Using the calibrated model volumes versus the known traffic volume in the study area, factors were developed for key study area segments as shown in **Table 7**. These values were then applied directly to the model output for these key segments.

Figure 5: Scenario 1 (Existing Geometric Conditions with APD 40 Interchange)

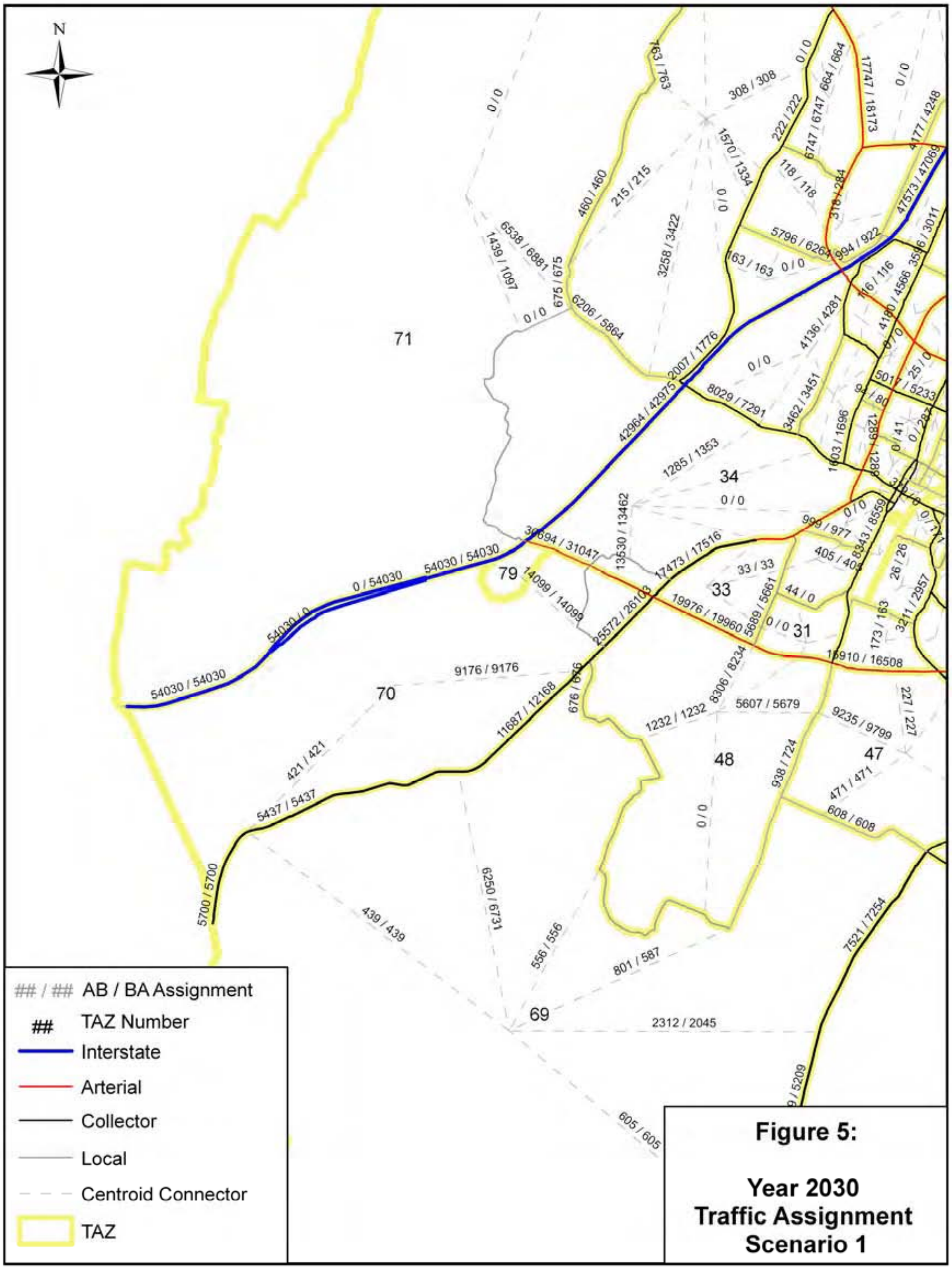


Table 7: Year 2030 Traffic Volumes With Interchange (Factored)

Segment	Segment Description	Factor (rounded)	2030 Model (AADT)	2030 Factored (AADT)
1	I-75 South of APD 40	1.00	108,060	108,100
2	I-75 North of APD 40	1.05	85,938	90,200
3a	APD 40 between I-75 and Int.	0.73	61,741	45,100
3b	APD 40 between Int. and US 11	1.00	39,621	39,600
4	APD 40 East of US 11	1.09	39,936	43,500
5	US 11 North of APD 40	0.77	35,654	27,500
6	US 11 South of APD 40	0.41	51,675	21,200
7	Pleasant Grove Rd West of I-75	1.00	2,537	2,500
8	Link North of APD 40 Interchange	1.00	10,264	10,300
9	Link South of APD 40 Interchange	1.00	11,856	11,900

Using a factor of 0.73 which is based on the difference between the base year calibrated volume and the actual base year AADT, 45,100 vehicles per day are expected along APD 40 between I-75 and US 11. It should be noted that Segments 8 and 9 do not exist in the base model, and therefore, do not have a factor that can be derived.

Scenario 2

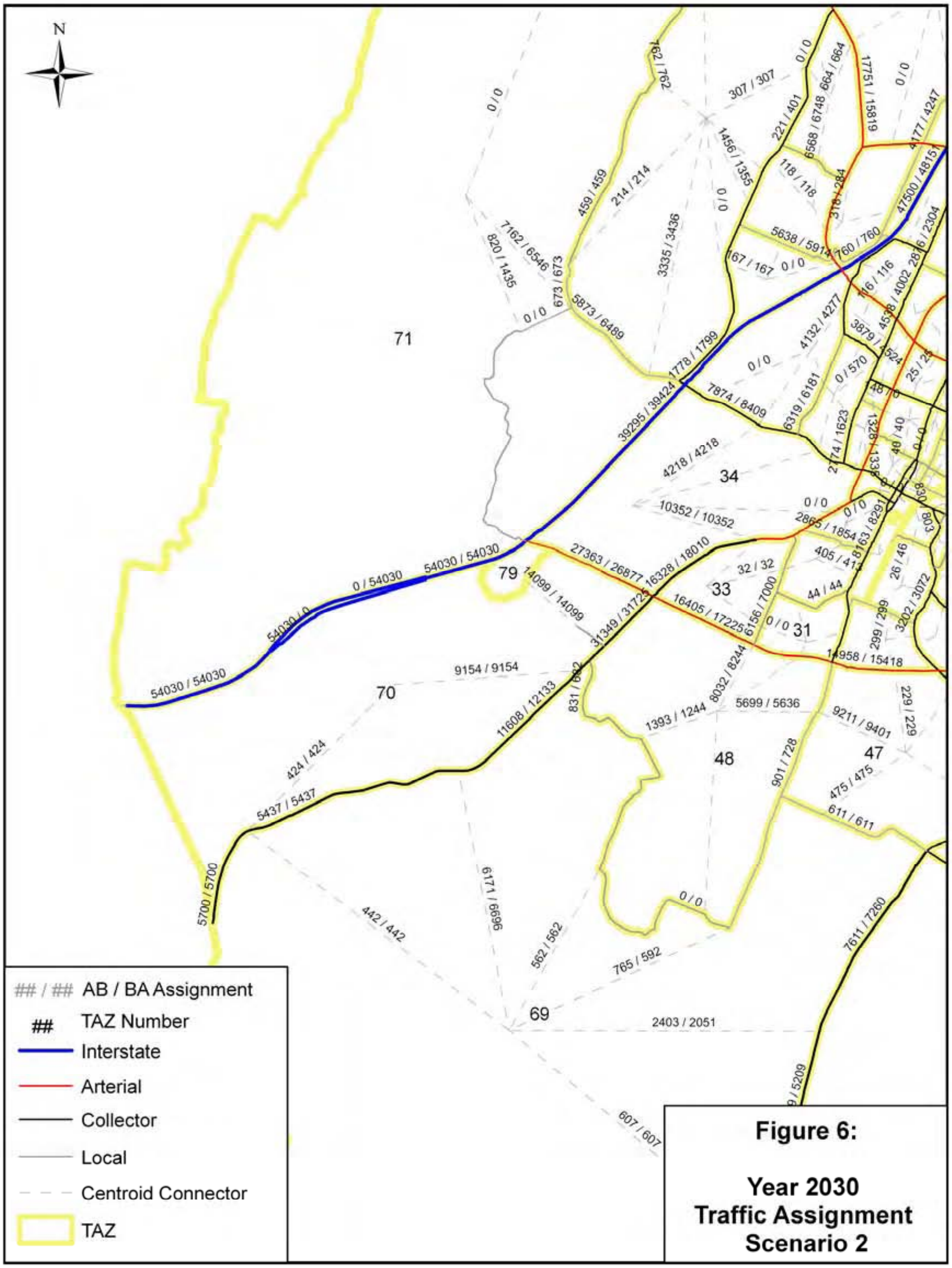
Scenario 2 considers the split TAZs 70 and 79; however, the APD 40 interchange between I-75 and US 11 is not included in the model network. **Figure 6** displays the model output. Screenshots of the model output are also shown in **Appendix A**. As shown, approximately 54,200 vehicles per day are expected to use APD 40 between I-75 and the new interchange in Year 2030.

Using the same factors used in **Table 7**, factors were developed for key study area segments as shown in **Table 8**. These values were then applied directly to the model output for these key segments.

Table 8: Year 2030 Traffic Volumes Without Interchange (Factored)

Segment	Segment Description	Factor (rounded)	2030 Model (AADT)	2030 Factored (AADT)
1	I-75 South of APD 40	1.00	108,060	108,100
2	I-75 North of APD 40	1.05	78,718	82,700
3	APD 40 between I-75 and US 11	0.73	54,239	39,600
4	APD 40 East of US 11	1.09	33,627	36,700
5	US 11 North of APD 40	0.77	34,338	26,400
6	US 11 South of APD 40	0.41	63,073	25,900
7	Pleasant Grove Rd West of I-75	1.00	2,255	2,300

Figure 6: Scenario 2 (Without APD 40 Interchange)



7. Interpolation / Extrapolation of Traffic Volumes

Once the model scenarios were finalized, the next step involved developing traffic forecasts for a mid-year (Year 2013) and the design year (Year 2033). The mid-year forecasts were derived by interpolating the base year (Year 2000) and future year (Year 2030) traffic volumes. The base year (Year 2000) volumes were based on traffic counts and the future year (Year 2030) volumes were based on the factored volumes derived from the model. Similarly, the design year forecasts were derived by extrapolating the Year 2030 factored volumes using the growth trends based on the Year 2000 and Year 2030 volumes. These values are shown in **Appendix B**.

8. Summary

This document summarizes the steps undertaken to develop traffic forecasts along I-75 and APD 40 using the Cleveland MPO travel demand model. This included an analysis of how well the model calibrates along these key segments. The model calibrates well as a whole, but as with most models, discrepancies exist on individual links. Based upon a review of the base year model assignments and known traffic counts in the study area, the calibration along I-75 was acceptable. However, there were some discrepancies along APD 40 and US 11. Using this information, adjustments were made to the model which included changes to high travel speeds along key links. Post-processing adjustments were needed to account for calibration discrepancies.

In addition to the model adjustments, Year 2030 scenarios were run. This included making physical adjustments to the traffic analysis zones and changing the inputs into the zones to account for proposed land use changes near the I-75 interchange. Two scenarios were tested including a scenario with a proposed interchange along APD 40 between I-75 and US 11 and a second scenario without the interchange. Once complete, the model volumes were factored for the calibration discrepancies. In addition, the factored volumes were interpolated to get Year 2013 volumes and extrapolated to get Year 2033 volumes.

Appendix A

TransCAD Output from Cleveland MPO TDM

Figure A-1: Year 2000 Model AADT (After Recalibration)

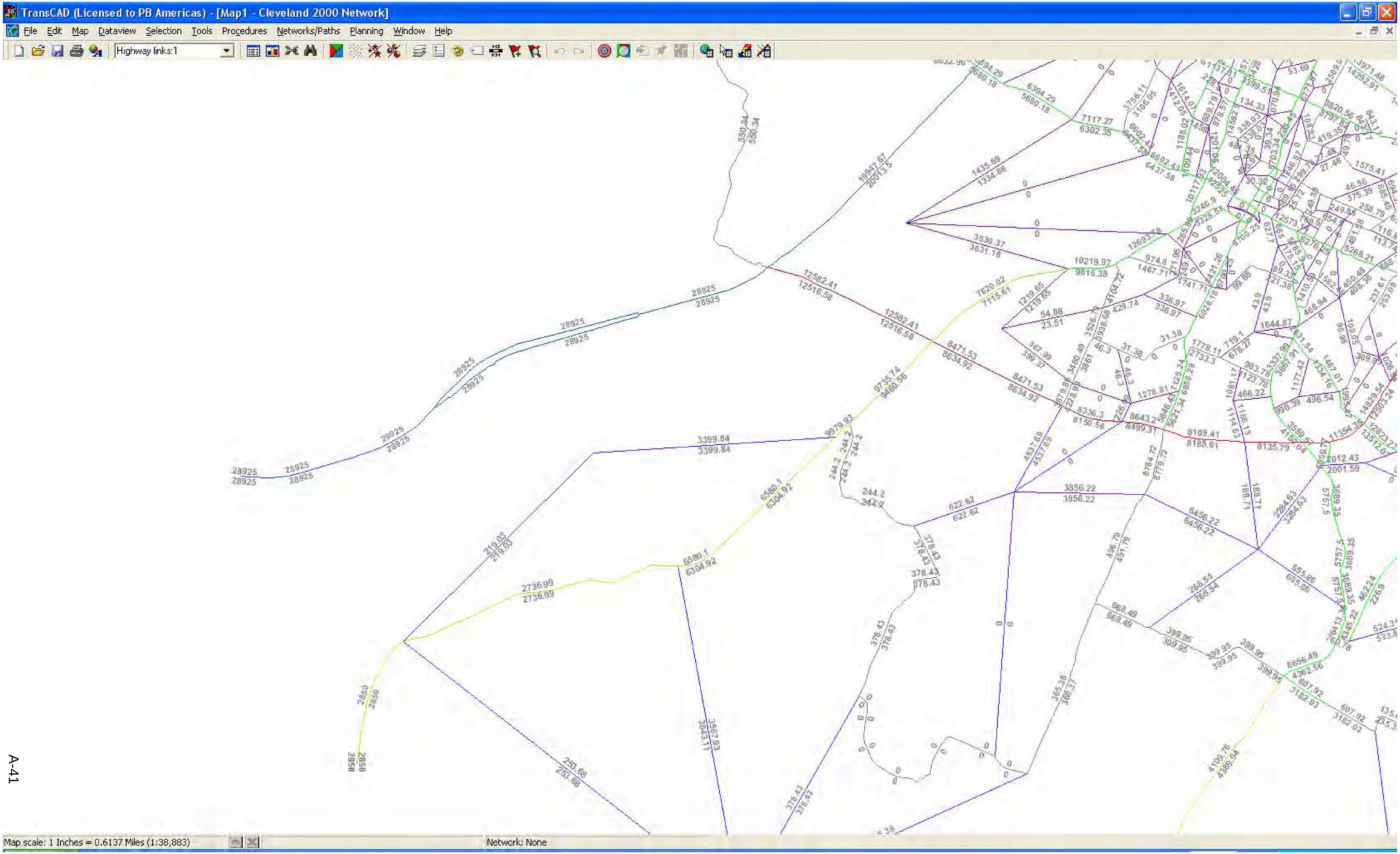


Figure A-2: Year 2030 Model AADT (With Interchange / Non-Factored)

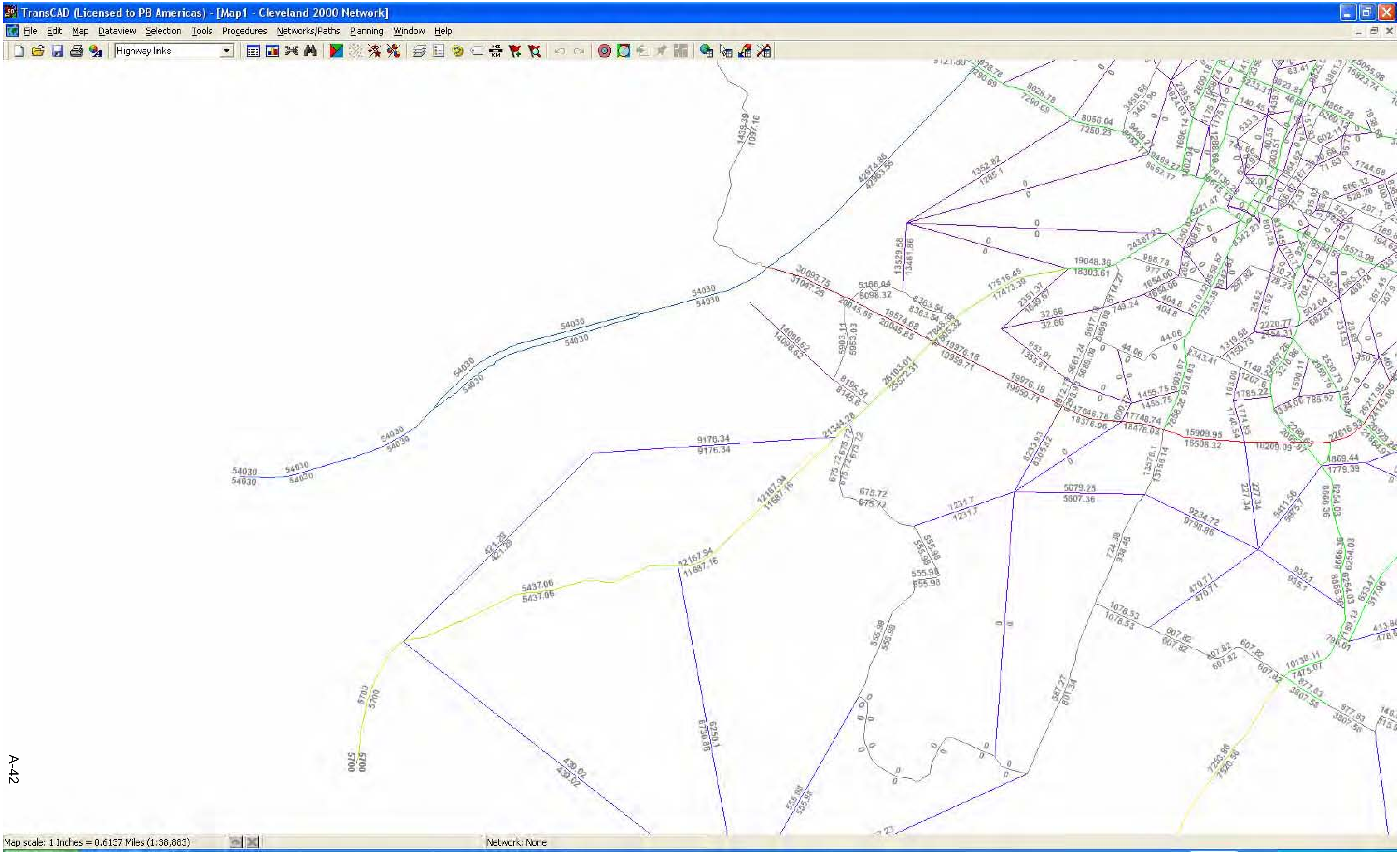
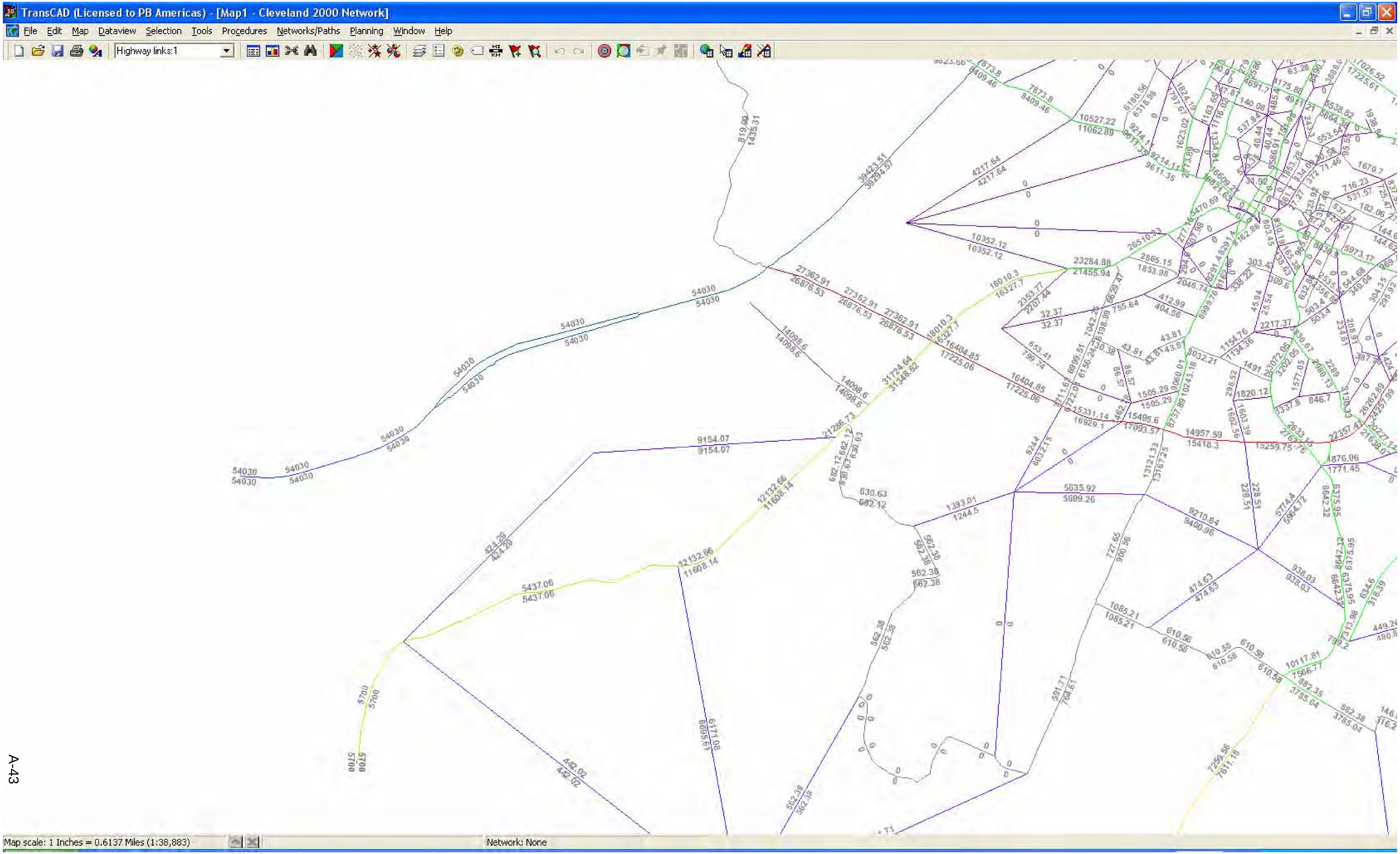


Figure A-3: Year 2030 Model AADT (Without Interchange / Non-Factored)



Appendix B

2013 and 2033 Segment Traffic Forecasts

Table B-1: 2013 (Interpolated) and 2033 (Extrapolated) Traffic Volumes

Segment	Segment Description	2000 AADT	2030 AADT (Factored)		2013 AADT (Interpolated)		2033 AADT (Extrapolated)	
			With Interchange	Without Interchange	With Interchange	Without Interchange	With Interchange	Without Interchange
1	I 75 South of APD 40	57,850	108,100	108,100	79,600	79,600	113,100	113,100
2	I 75 North of APD 40	41,940	90,200	82,700	62,900	59,600	95,000	86,800
3a	APD 40 between I 75 and Interchange	18,230	45,100	39,600	29,900	27,500	47,800	41,700
3b	APD 40 between Interchange and US 11	18,230	39,600	39,600	27,500	27,500	41,700	41,700
4	APD 40 East of US 11	18,580	43,500	36,700	29,400	26,400	46,000	38,500
5	US 11 North of APD 40	11,290	27,500	26,400	18,300	17,800	29,100	27,900
6	US 11 South of APD 40	7,920	21,200	25,900	13,700	15,700	22,500	27,700
7	APD 40 West of US 11	1,100	2,500	2,300	1,700	1,600	2,600	2,400
8	Link North of APD 40 Interchange	-	10,300	-	6,800	-	10,900	-
9	Link South of APD 40 Interchange	-	11,900	-	7,900	-	12,500	-

I-75 / APD 40 Interchange Analysis

Cleveland MPO Model

May 5, 2009

Task 3 Technical Memorandum: Design Traffic Volumes

Two technical memorandums (Task 1 and Task 2) were developed by PB Americas, Inc. to discuss the use of the Cleveland Urban Area Metropolitan Planning Organization (MPO) Transportation Demand Model (TDM). These memorandums, dated May 4, 2009, were described in the Memorandum of Understanding document dated March 27, 2009.

The TDM was updated to analyze two transportation alternatives along I-75 and APD 40, hereafter described as traffic condition scenarios. These traffic condition scenarios included one without the proposed APD-40 interchange and one with the proposed APD-40 interchange. When completed, study link Average Annual Daily Traffic (AADT) volumes were provided to Long Engineering for the horizon years 2013 and 2033. These AADT volumes are shown in **Table 1**.

Table 1 – 2013 and 2013 Study Link AADT Volumes

Study Links	2013 AADT		2033 AADT	
	Without Proposed Interchange	With Proposed Interchange	Without Proposed Interchange	With Proposed Interchange
I-75 North of APD-40	59,600	62,900	86,800	95,000
I-75 South of APD-40	79,600	79,600	113,100	113,100
Pleasant Grove Road	1,600	1,700	2,400	2,600
APD-40 between I-75 and Proposed Interchange	27,500	29,900	41,700	47,800
APD-40 between Proposed Interchange and US 11		27,500		41,700
APD-40 East of US 11	26,400	29,400	38,500	46,000
Proposed Interchange North of APD-40	-	6,800	-	10,900
Proposed Interchange South of APD-40	-	7,900	-	12,500
US 11 North of APD-40	17,800	18,300	27,900	29,100
US 11 South of APD-40	15,700	13,700	27,700	22,500

After reviewing the traffic volumes in **Table 1**, it was determined that the study link volumes for Pleasant Grove Road were low especially being adjacent to I-75 and near the perimeter of the TDM. To account for additional growth near the I-75 interchange, the traffic volumes on Pleasant Grove Road were tripled as shown in **Table 2**.

Table 2 – Pleasant Grove Road AADT Volume Adjustment

Pleasant Grove Road		AADT (From TDM)	AADT (Adjusted)
2013	Without Proposed Interchange	1,600	4,800
	With Proposed Interchange	1,700	5,100
2033	Without Proposed Interchange	2,400	7,200
	With Proposed Interchange	2,600	7,800

From the previously discussed traffic condition scenarios, a slip ramp to Stone Lake Road is being proposed to diverge from the I-75 northbound off-ramp to APD-40. This slip ramp will allow vehicles to directly enter the proposed development in the southeast quadrant of the interchange without traveling on APD-40. The return for these traffic volumes will be the proposed interchange on APD-40 or a new access road extending Stone Lake Road to US 11.

A total of four traffic condition scenarios were subsequently developed using the combinations of with/without the proposed interchange and with/without the proposed slip ramp as described below:

- Existing System (without the Proposed Interchange) without the Slip Ramp
- Existing System with the Slip Ramp
- Proposed System (with the Proposed Interchange) without the Slip Ramp
- Proposed System with the Slip Ramp

The AADT volumes were initially applied to each study link with the assumption of a 50/50 directional split. Using available turning movement count (TMC) percentages, AADT volumes were developed for each traffic condition scenario. The traffic volumes for the AM and PM design hour volumes (DHV) were developed from the AADT volumes based on available TMC percentages for each peak period. In the development of the traffic volumes, lane balancing was used so that the traffic volumes within and between each interchange were equal.

APPENDIX B

FUNCTIONAL PLANS

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.

Index Of Sheets

SHEET NO.	DESCRIPTION
1	TITLE SHEET
2-3	TYPICAL SECTIONS
4-7	LAYOUT SHEETS

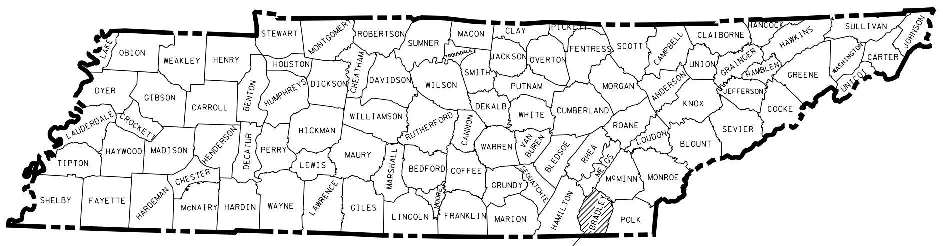
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING

BRADLEY COUNTY

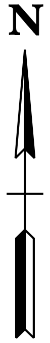
INTERCHANGE JUSTIFICATION STUDY
APD 40 (S.R. 311)

FUNCTIONAL PLANS

TENN.	YEAR	SHEET NO.
	2009	1
FED. AID PROJ. NO.		
STATE PROJ. NO.		



PROJECT LOCATION



PROJECT LOCATION

SCALE: 1"= 1 MILE

APPROVED: ______________________
CHIEF ENGINEER

DATE: ______________________

APPROVED: ______________________
COMMISSIONER

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 LONG ENGINEERING ______________ CHECKED BY ______________________

P.E. NO. ______________________

TRAFFIC DATA	
ADT ( )	
ADT (20)	
DHV (20)	
D	-
T (ADT)	%
T (DHV)	%
V	MPH

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED:

______________________ ______________
DIVISION ADMINISTRATOR DATE

2/24/2009 10:25:34 AM
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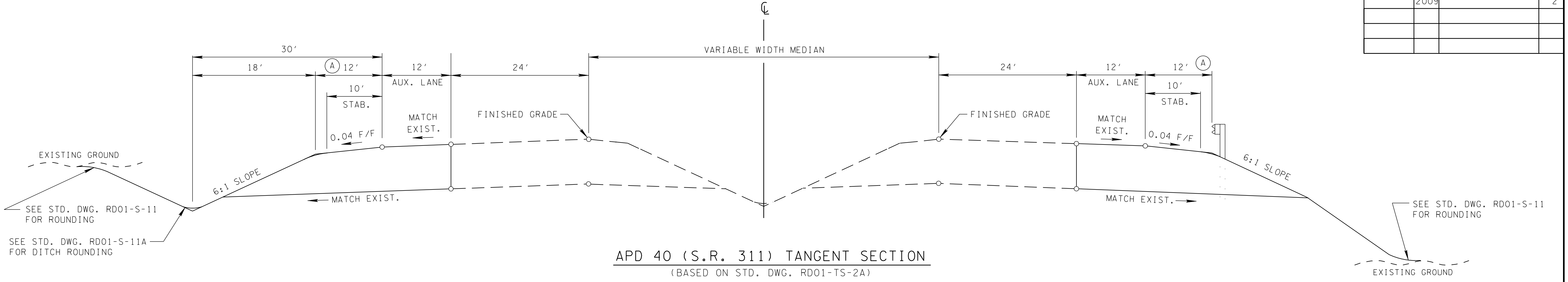
TENNESSEE D.O.T.
DESIGN DIVISION

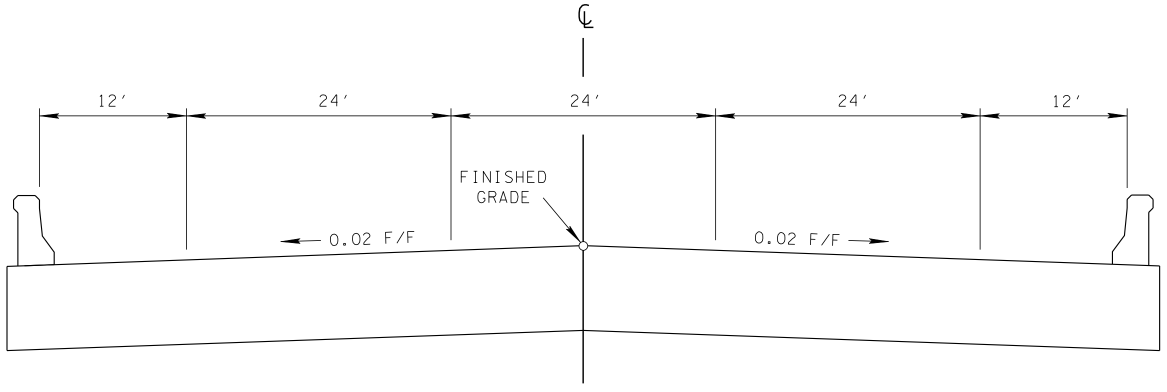
FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		2

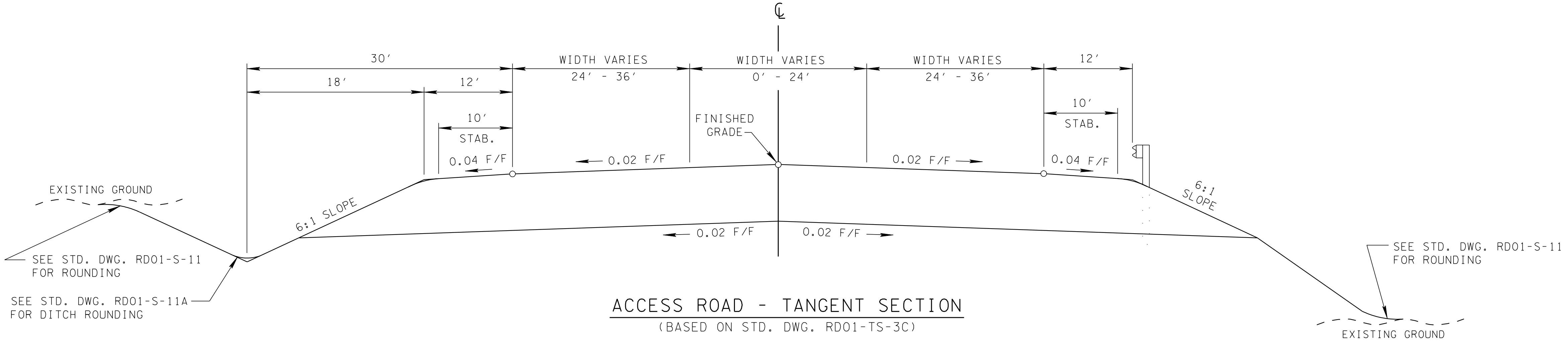


APD 40 (S.R. 311) TANGENT SECTION
(BASED ON STD. DWG. RD01-TS-2A)

Ⓐ SHOULDER WIDTH WILL BE REDUCED AT HUMPHREY BRIDGE ROAD.



ACCESS ROAD - TANGENT SECTION
(BASED ON STD. DWG. RD01-TS-6)



ACCESS ROAD - TANGENT SECTION
(BASED ON STD. DWG. RD01-TS-3C)

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STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

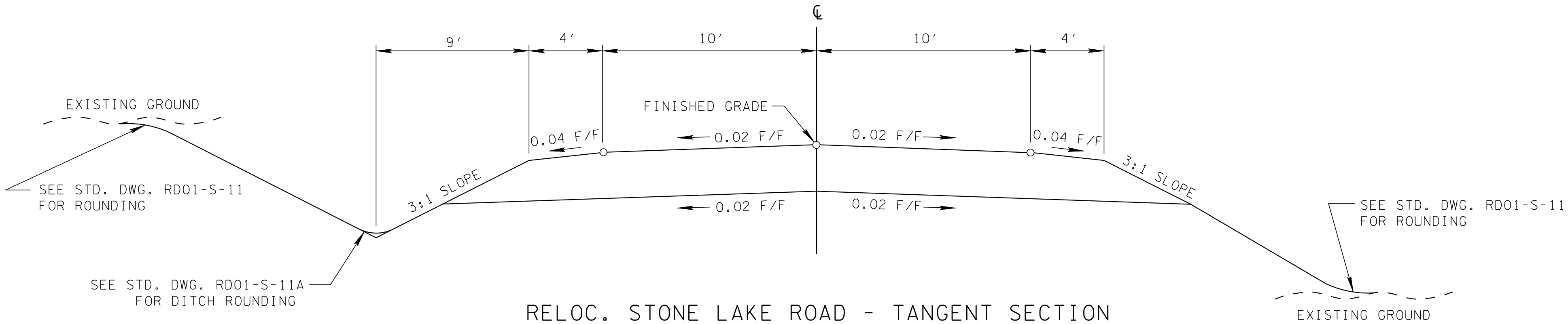
BRADLEY COUNTY
APD 40 (S.R. 311)
TYPICAL SECTIONS

NOT TO SCALE

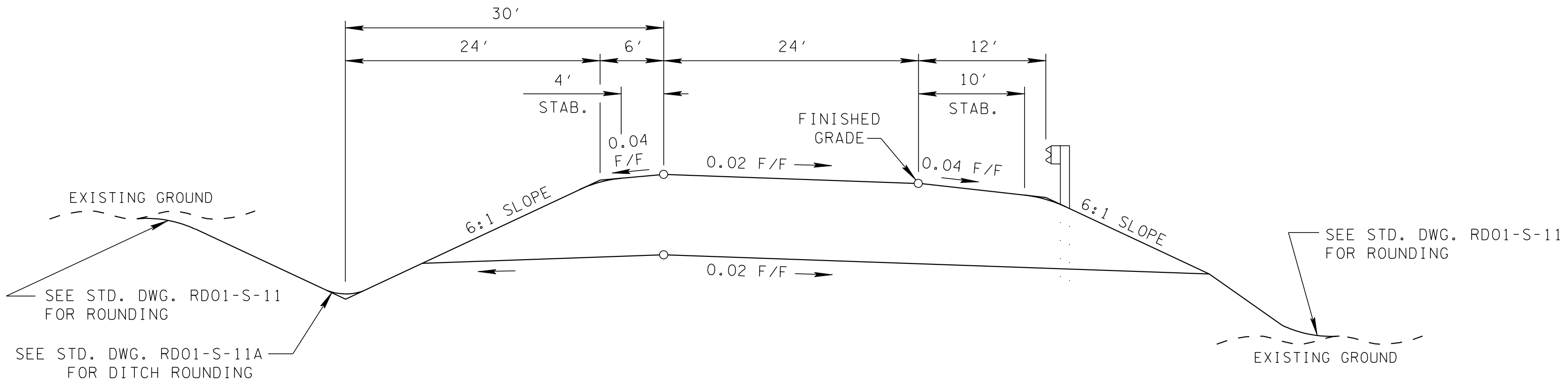
TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

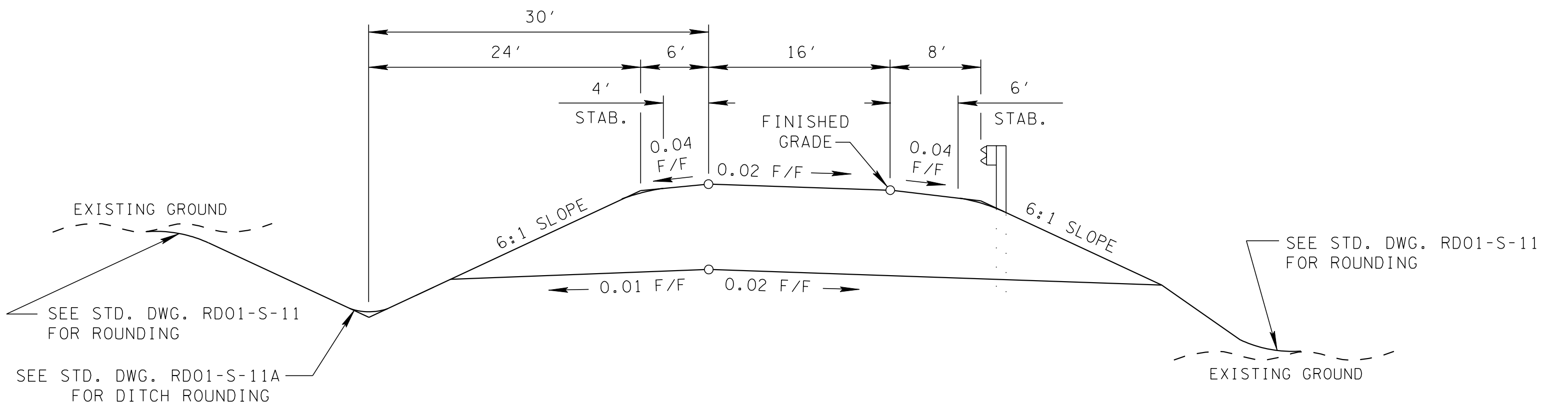
TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		3



RELOC. STONE LAKE ROAD - TANGENT SECTION
(BASED ON STD. DWG. RD01-TS-1)



TWO LANE RAMPS - TANGENT SECTION
(BASED ON STD. DWG. RD01-TS-4)



ONE LANE RAMPS - TANGENT SECTION
(BASED ON STD. DWG. RD01-TS-4)

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BRADLEY COUNTY
APD 40 (S.R. 311)
TYPICAL SECTIONS

NOT TO SCALE

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TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		4

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BRADLEY COUNTY
APD 40 (S.R. 311)
FUNCTIONAL
LAYOUT

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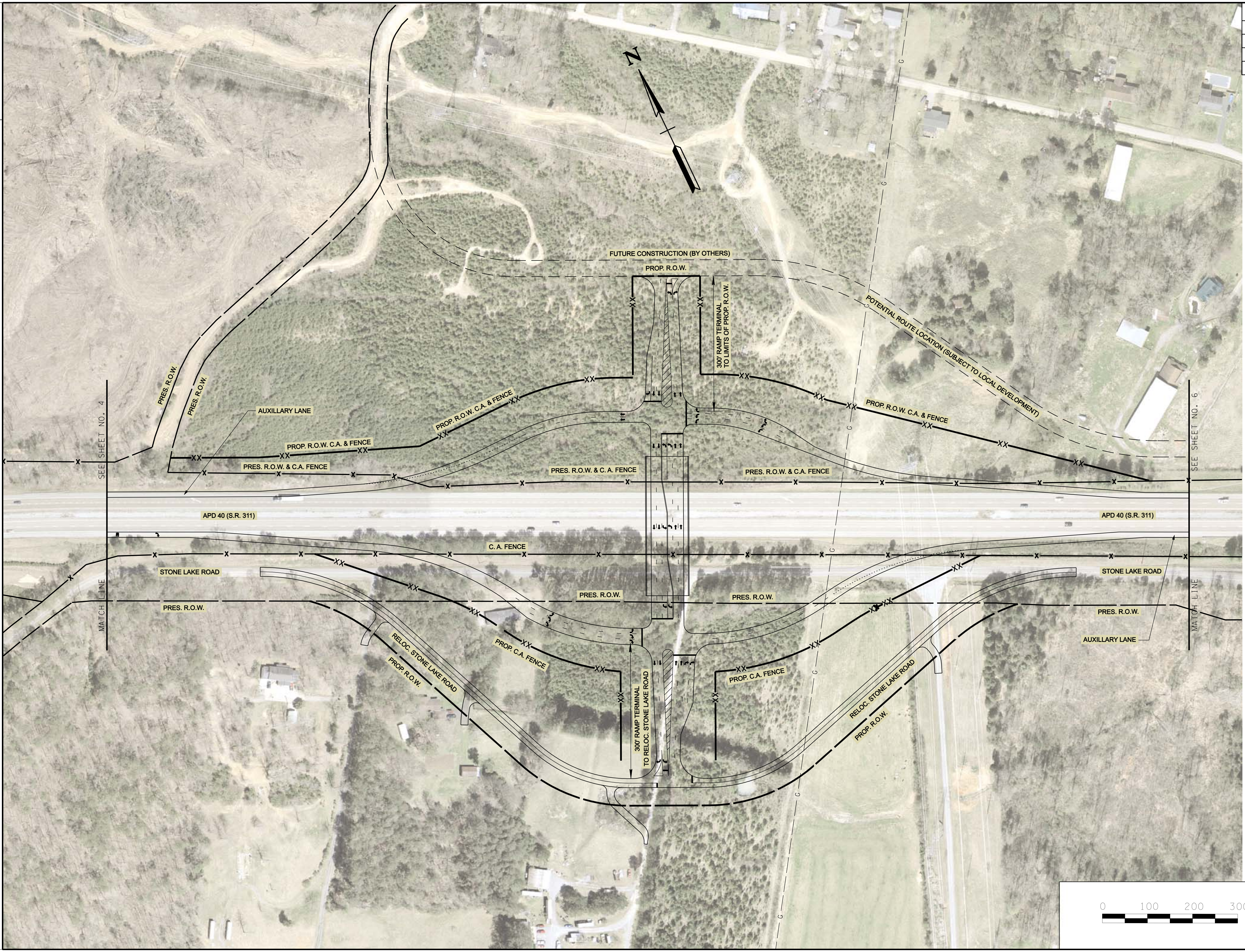
TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		5



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STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BRADLEY COUNTY
APD 40 (S.R. 311)
FUNCTIONAL
LAYOUT

TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		6

0 100 200 300

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BRADLEY COUNTY
APD 40 (S.R. 311)
FUNCTIONAL
LAYOUT

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TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		7

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BRADLEY COUNTY
APD 40 (S.R. 311)
FUNCTIONAL
LAYOUT

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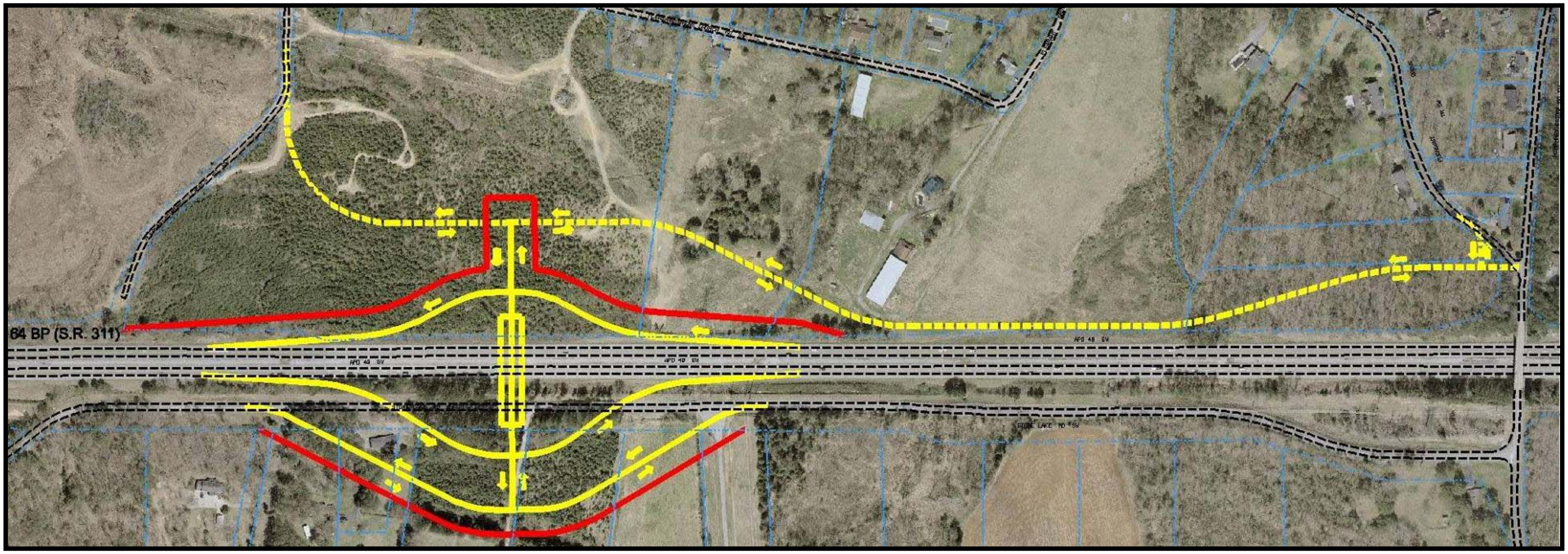
APPENDIX C

OTHER OPTIONS CONSIDERED

APD CONCEPT 1 (RECOMMENDED)

- New diamond-shape interchange located approximately midway between the existing I-75 and South Lee Highway interchanges
- Advantages:
  - ✓ Potential connections to local roads and Humphrey Bridge Road on the north and south sides of US 64 BP
  - ✓ Least expensive APD Concept
- Disadvantage:
  - ✓ Overhead power lines may prevent the new interchange layout from being located eastward from its shown location
  - ✓ Weave distances between interchanges may be undesirable. Consideration for additional auxiliary lanes on US 64 BP may be necessary.

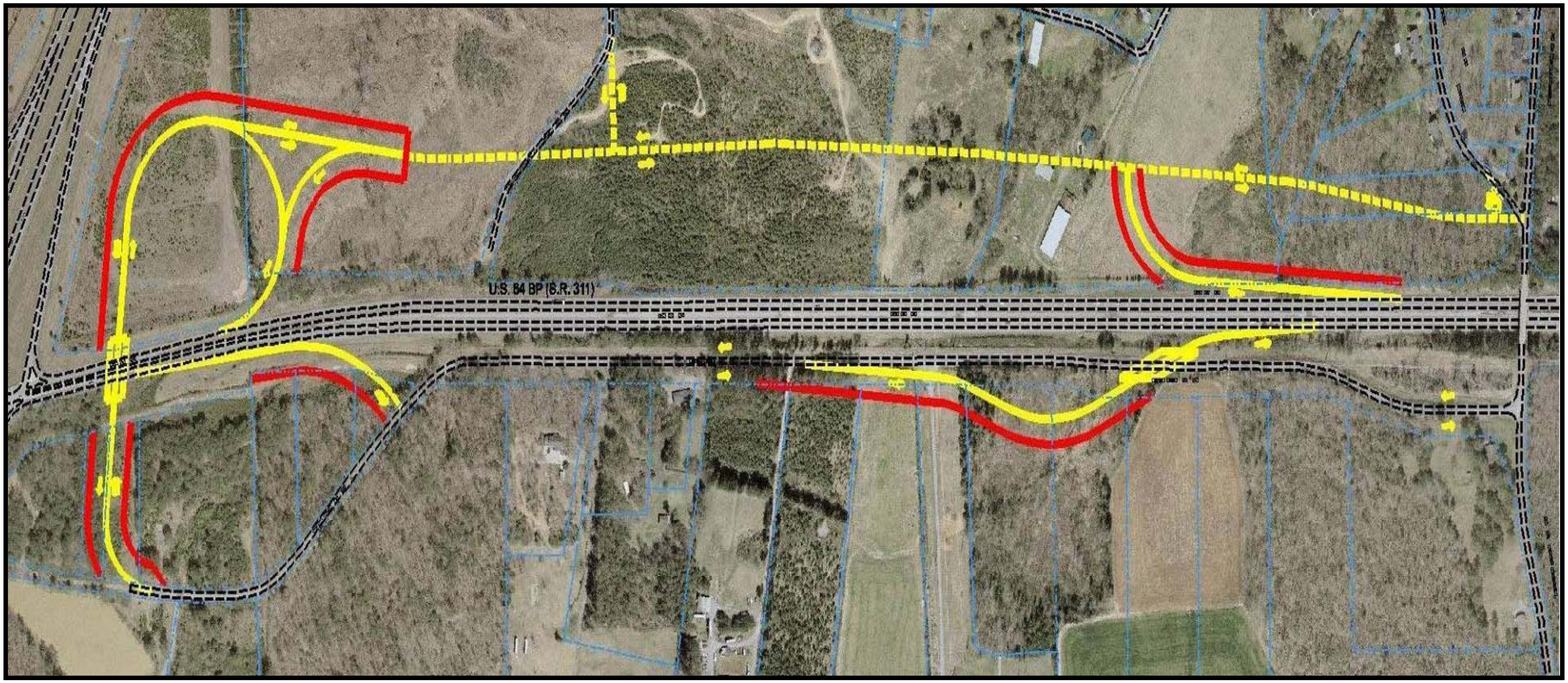
APD CONCEPT 1 (RECOMMENDED)



APD CONCEPT 2

- New interchange with separated ramps that are connected via a frontage road system located between the existing I-75 and South Lee Highway interchanges
- <u>Advantages:</u>
  - ✓ Potential connections to local roads and Humphrey Bridge Road on the north side of US 64 BP
- <u>Disadvantages:</u>
  - ✓ Overhead power lines may prevent the western on-ramps and off-ramps from being located westward from their shown location
  - ✓ Weave distances between interchanges may be undesirable. Consideration for additional auxiliary lanes on US 64 BP may be necessary.

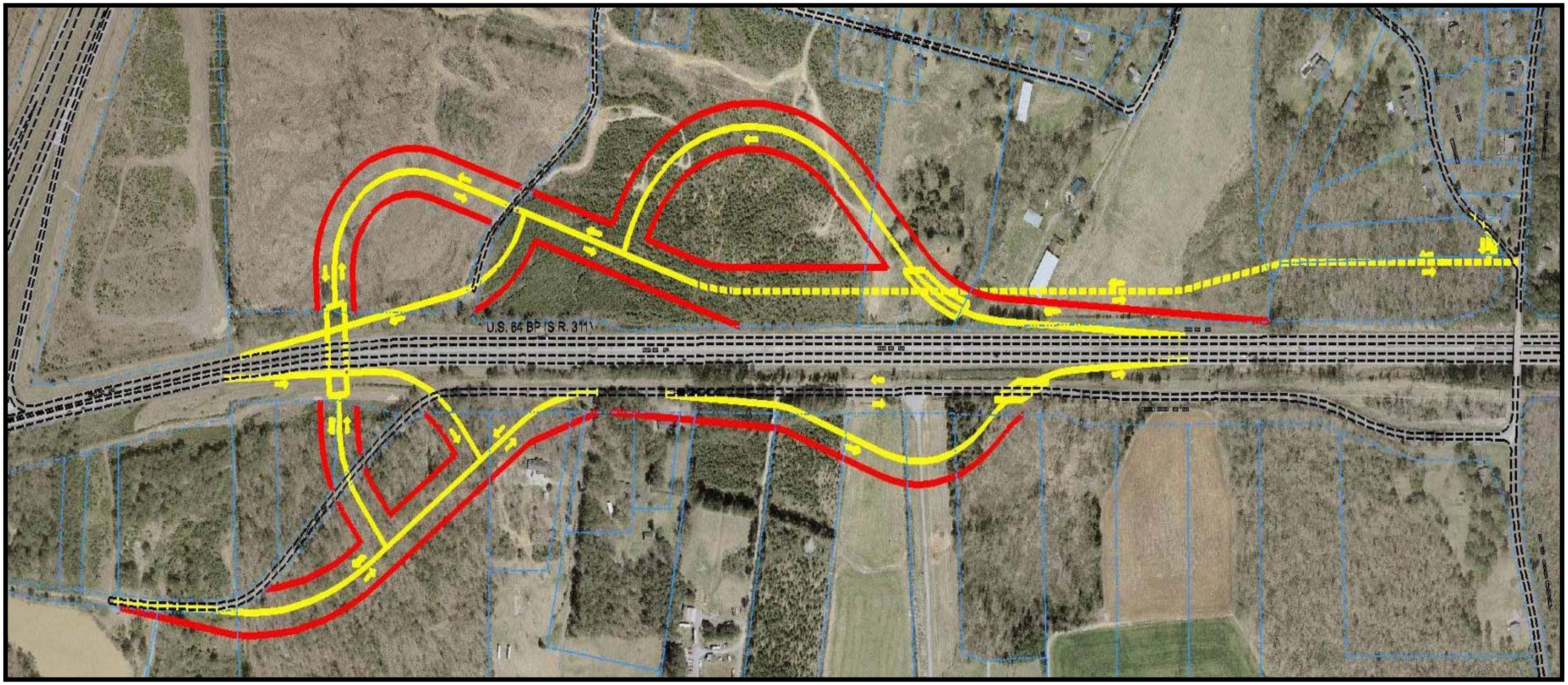
APD CONCEPT 2



APD CONCEPT 3

- Similar to APD Concept 2 along US 64 BP, but with a different frontage road system
- Advantages:
  - ✓ Potential connections to local roads and Humphrey Bridge Road on the north side of US 64 BP
  - ✓ Most expensive APD Concept
- Disadvantages:
  - ✓ Overhead power lines may prevent the western on-ramps and off-ramps from being located westward from their shown location
  - ✓ Weave distances between interchanges may be undesirable. Consideration for additional auxiliary lanes on US 64 BP may be necessary.

APD CONCEPT 3

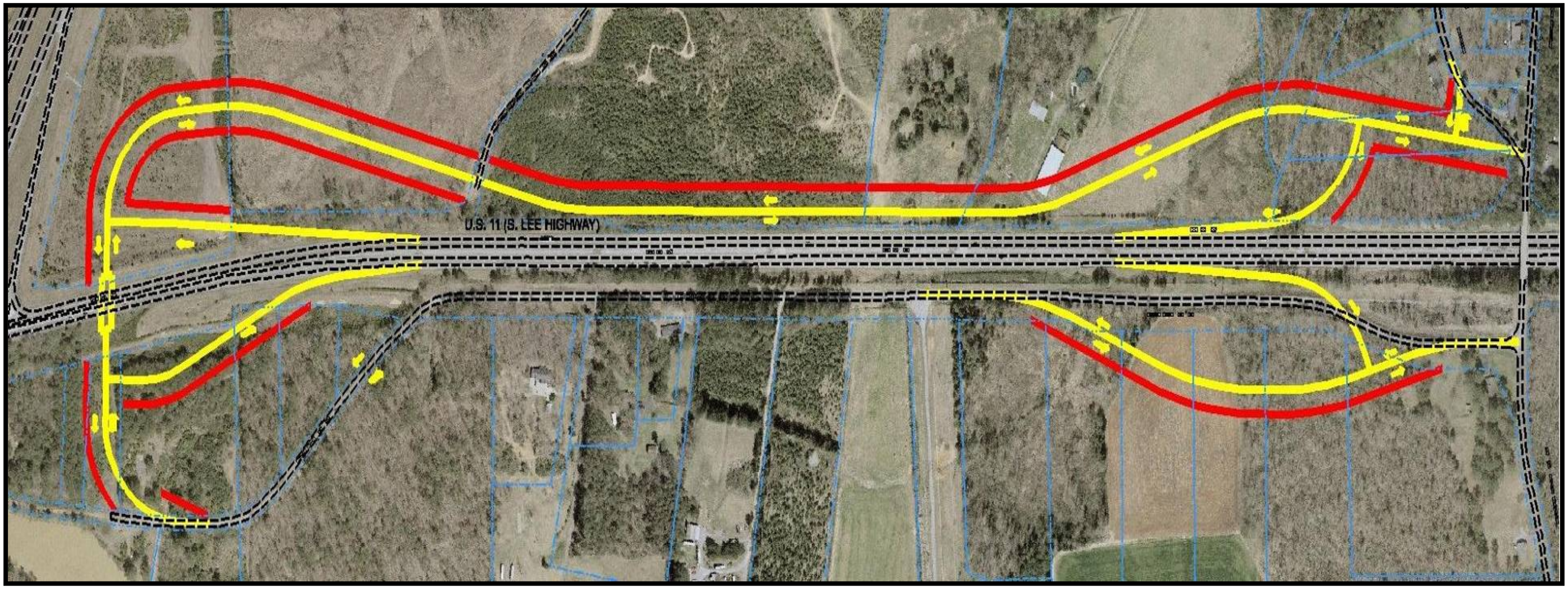


APD CONCEPT 4

- New system of separated on-ramps and off-ramps that are connected via a frontage road system located between the existing I-75 and South Lee Highway interchanges
- <u>Advantages:</u>
  - ✓ Frontage road connections to local roads and Humphrey Bridge Road on the north and south sides of US 64 BP
  - ✓ Least US 64 BP traffic impacted APD Concept due to no EB & WB traffic weaving conditions created
  - ✓ New overpass bridge structure on US 64 BP located the closest to I-75
- <u>Disadvantage:</u>
  - ✓ High cost for frontage roads

TDOT

APD CONCEPT 4



APPENDIX D

COST ESTIMATE WORKSHEETS

Bradley County

APD-40 New Interchange
Cost Estimate Summary

APD-40
Concept 1

ITEM		COST		
Clear & Grubbing:	$123,691	=	$124,000	$124,000
Earthwork:	$2,970,431	=	$2,970,000	$3,094,000
Pavement Removal:	$16,500	=	$17,000	$3,111,000
Erosion Control:	$250,000	=	$250,000	$3,361,000
Drainage:	$29,665	=	$30,000	$3,391,000
Structures:	$3,124,800	=	$3,125,000	$6,516,000
Railroad:	$0	=	$0	$6,516,000
Paving:	$906,385	=	$906,000	$7,422,000
Retaining Walls:	$0	=	$0	$7,422,000
Maintenance of Traffic:	$200,000	=	$200,000	$7,622,000
Topsoil:	$241,226	=	$241,000	$7,863,000
Seeding:	$31,661	=	$32,000	$7,895,000
Sodding:	$100,000	=	$100,000	$7,995,000
Signing:	$50,000	=	$50,000	$8,045,000
Signalization:	$300,000	=	$300,000	$8,345,000
Fencing:	$219,470	=	$219,000	$8,564,000
Guardrail:	$68,750	=	$69,000	$8,633,000
Rip-Rap:	$50,000	=	$50,000	$8,683,000
Other Construction:	$550,778	=	$551,000	$9,234,000
Sub-Total:	$9,233,357	=	$9,233,000	**$9,234,000**
10% Eng. & Cont.:	$923,336	=	$923,000	$923,000
Sub-Total:	$10,156,692	=	$10,157,000	**$10,157,000**

Total Construction Cost :	Sub-Total	+	Mobil.		
	$10,157,000	+	$435,000	=	**$10,592,000**
			10% Prel. Eng.		
	$10,592,000	+	$923,000	=	**$11,515,000**
	Row Total	+	Utility Total	+	Constr. Total
	$630,000	+	$573,000	+	$11,515,000
TOTAL SECTION COST :					**$12,718,000**

Mobilization Table

$0 to $1,000,000	5%	$	-
$1,000,000 to $5,000,000	$50,000 + 4.5% over $1,000,000	$	-
$5,000,000 to $10,000,000	$230,000 + 4% over $5,000,000	$	-
$10,000,000 to $20,000,000	$430,000 + 3.5% over $10,000,000	$	435,000
$20,000,000 +	$780,000 + 3% over $20,000,000	$	-

Right of Way Cost

Parcel	Area (sf)	Acres	Cost ($/Acre)*1.2 factor	Improvements (1.2 factor)	Land Cost	Total	
51-28	646	0.015	$ 11,272.80	$ -	$ 167.18	$ 167.18	
51-26	1,668	0.038	$ 3,505.20	$ -	$ 134.22	$ 134.22	
51-1	24,752	0.568	$ 13,290.00	$ 83,520.00	$ 7,551.75	$ 91,071.75	
51-34	41,010	0.941	$ 12,817.20	$ 72,000.00	$ 12,066.88	$ 84,066.88	
51-29	20,148	0.463	$ 12,817.20	$ -	$ 5,928.40	$ 5,928.40	
51-22	134,773	3.094	$ 5,760.00	$ -	$ 17,821.22	$ 17,821.22	
51-21	120,949	2.777	$ 5,760.00	$ -	$ 15,993.26	$ 15,993.26	
84-8	71,114	1.633	$ 12,096.00	$ -	$ 19,747.36	$ 19,747.36	
51-23	16,380	0.376	$ 5,402.40	$ -	$ 2,031.48	$ 2,031.48	
51-32	502	0.012	$ 8,082.00	$ -	$ 93.14	$ 93.14	
87-0	66,912	1.536	$ 8,082.00		$ 12,414.66	$ 12,414.66	
N. of U.S. 64	11,948	0.274	$ 32,548.80	$ -	$ 8,927.76	$ 8,927.76	
	251,158	5.766	$ 5,714.40	$ -	$ 32,948.05	$ 32,948.05	
	49,163	1.129	$ 63,011.20	$ -	$ 71,116.15	$ 71,116.15	
	14,459	0.332	$ 6,960.00	$ -	$ 2,310.25	$ 2,310.25	
Sub-Total						$ 365,000	(Rounded)
Total Acres	18.953						
Total Tracts	14						
Contengenices	0.43	X	$ 432,000		=	$ 185,760	
Total Land & Improvement Costs					=	$ 551,000	(Rounded)
Incidentals	14	X	$ 3,000	Per Tract for Incide	=	$ 42,000	
Replacement Housin	1	X	$ 12,000	Per Unit	=	$ 12,000	
Moving Expenses	1	X	$ 25,000	Per Unit	=	$ 25,000	
TOTAL ROW COSTS					=	$ 630,000	

201-07.05 Removal and Disposal of Brush and Trees (Clear. and Grub.)

Length (ft.)	Width (ft.)(Avg.)	Area (sq.ft./ac.)	Acres	Cost ($/ac.)	Total	
9559	75	716,925	16.458	$4,000	$ 65,833	So. Side of APD
6821	75	511,575	11.744	$4,000	$ 46,977	No. Side of APD
1185	100	118,500	2.720	$4,000	$ 10,882	Cross Road
17565					$ 123,691	

Maintenance of Traffic

Drums (Ea.)	Cost ($/drum)	Total	712-04.01 @ 50' spacing
351			

Signs (s.f.)	Cost ($/s.f.)

712-06 (14 Road work ahead and 4 End road work)(16 s.f. x 14+ 10 s.f. x 4)

712-02.02 Interconnected Portable Barrier Rail

Lgth.(ft.)	Cost ($/ft.)

712-07.03 Temporary Barricades

Lgth.(ft.)	No.	Total Lgth.	Cost ($/ft)	Total Barricades

Total Maintenance of Traffic $ 200,000

Signing

Signs (s.f.)	Cost ($/s.f.)	Total	713-13.03
		$ 50,000	

Utility Relocation Cost

	Lgth (ft)	No. of Poles	Cost ($/pole)	Cost ($/ft)	
8" Sewer	1200			$35.00	$42,000
12" Water	1200			$130.00	$156,000
Utility Poles		15	$15,000.00		$225,000
Pipe line X-ing					$150,000
				Total	$573,000.00

203-01 Road and Drain. Exc. (Uncl.)

Length (ft.)	Width (ft.)	Avg. Exc. Depth	Factor	C.Y.	Cost/cy		Total
16380	75	16	27	728000	$3.50		$2,548,000.00
1185	125	22	27	120694	$3.50		$422,430.56
						Total	$2,970,430.56

202-03.01 Pavement Removal

Area (sf)	/	sf/sy	*	Cost ($/sy)	Total
39600	/	9	*	$3.75	$16,500.00

Note: Based on 24" concrete pipe @ 100' per pipe (5 pipes)

Pipe Culvert	=	Bedding	+	Pipe	+	Headwalls	
Bedding	=	Length (ft)	*	cy/ft	*	Cost ($/cy)	
204-07	=	500	*	0.266	*	$30.00	**$133.00**
Pipe	=	Length (ft)	*	Cost ($/ft)			
607-05.02	=	500	*	$40.00			**$20,000.00**
Headwall Steel	=	lbs/wall	*	# H'walls	*	Cost ($/lb)	
611-07.02	=	172	*	10	*	$1.30	**$2,236.00**
Headwall Conc.	=	cy/wall	*	# H'walls	*	Cost ($/cy)	
611-07.01	=	1.52	*	10	*	$480.00	**$7,296.00**
	=						
						Total	**$29,665.00**

New Structure over U.S. 64

Length (ft.)	Width (ft.)	s.f.	Cost/s.f.	Total
310	96	29760	$105.00	**$3,124,800.00**

Paving

	Area (sq.ft.)	*	Depth (ft)	/	factor	*	Mass (lbs/cy)	Total cy or sy	/	lbs/Tons	Total Tons	*	Cost ($/ton or cy)		Total
Ramp Conc. Pvm't.															
501-01.02	80598	*	0.75	/	27			2238.83				*	$50.00	**$**	**111,942**
Ramp Treated Base															
313-03	80598	*	0.330	/	9			2955.26				*	$10.00	**$**	**29,553**
Ramp Base Stone															
303-01	80598	*	0.330	/	27	*	2.03	985.09			1999.726	*	$13.50	**$**	**26,996**
402-01	80598	/			9	*	0.35		/	231	13.57	*	$375.00	**$**	**5,088**
402-02	80598	/			9	*	12		/	2000	53.73	*	$15.00	**$**	**806**
Auxillary Lane															
Approx. $300,000 per Mi. @ 0.22 Mi.														**$**	**66,000**
Approx. $300,000 per Mi. @ 2.00 Mi.														**$**	**600,000**
Cross Road	Approx. $300,000 per Mi. @ 0.22 Mi.													**$**	**66,000**
													Total	**$**	**906,385**

Topsoil (203-07)

Based on 4:1 slope and 10' fill with 48' widening

Length (ft.)	Slope Lgth.(ft.)	Thk.(ft.)	cy factor	cy	Cost ($/cy)	Both Sides		Total
17565	41.2	0.5	27	13401.4	$9.00	2	$	241,226

Seeding (801-01)

Length (ft.)	Slope Lgth.(ft.)	sf	sf/unit		factor	units	Cost ($/unit)		Total
17565	41.2	723678	1,000	*	1.25	905	$35.00	$	31,661

Signalization

2 Signals at Ramps	$	300,000

Fencing

Length (ft.)	Cost ($/ft)		
707-02.01			
12910	$17.00	$	219,470

Guardrail

	(Length (ft)	*	Cost ($/ft)	+	(# Anch.)	*	Cost ($/Anch.)			Total
	1500	*	$17.50	+	6	*	$2,500.00			
			$26,250.00	+			$15,000.00			
705-10.29										
Conc. Barrier Wall at bridges	100		$275.00						$	27,500
									$	41,250
								Total	$	68,750

Bradley County

S. Lee Hwy Modification
Cost Estimate Summary

ITEM	COST			
Clear & Grubbing:	$0	=	$0	$0
Earthwork:	$3,975	=	$4,000	$4,000
Pavement Removal:	$583	=	$1,000	$5,000
Erosion Control:	$20,000	=	$20,000	$25,000
Drainage:	$0	=	$0	$25,000
Structures:	$0	=	$0	$25,000
Railroad:	$0	=	$0	$25,000
Paving:	$136,810	=	$137,000	$162,000
Retaining Walls:	$0	=	$0	$162,000
Maintenance of Traffic:	$50,000	=	$50,000	$212,000
Topsoil:	$2,413	=	$2,000	$214,000
Seeding:	$634	=	$1,000	$215,000
Sodding:	$0	=	$0	$215,000
Signing:	$15,000	=	$15,000	$230,000
Signalization:	$300,000	=	$300,000	$530,000
Fencing:	$0	=	$0	$530,000
Guardrail:	$0	=	$0	$530,000
Rip-Rap:	$0	=	$0	$530,000
Other Construction:	$52,942	=	$53,000	$583,000
Sub-Total:	$582,357	=	$582,000	**$583,000**
10% Eng. & Cont.:	$58,236	=	$58,000	$58,000
Sub-Total:	$640,593	=	$641,000	**$641,000**

Total Construction Cost :	Sub-Total	+	Mobil.		
	$641,000	+	$32,000	=	**$673,000**
			10% Prel. Eng.		
	$673,000	+	$58,000	=	**$731,000**
	Row Total	+	Utility Total	+	Constr. Total
	$0	+	$0	+	$731,000
TOTAL SECTION COST :					**$731,000**

Mobilization Table

$0 to $1,000,000	5%	$ 32,000
$1,000,000 to $5,000,000	$50,000 + 4.5% over $1,000,000	$ -
$5,000,000 to $10,000,000	$230,000 + 4% over $5,000,000	$ -
$10,000,000 to $20,000,000	$430,000 + 3.5% over $10,000,000	$ -
$20,000,000 +	$780,000 + 3% over $20,000,000	$ -

BRADLEY CO.

ESTIMATE BREAKDOWN AND QUANTITY SUMMARY

S. Lee Hwy

Right of Way Cost

Parcel	Area (sf)	Acres	Cost ($/Acre)*1.2 factor	Improvements (1.2 factor)	Land Cost	Total	
						$ -	
Sub-Total						$ -	(Rounded)
Total Acres	0.000						
Total Tracts	0						
Contengenices	0	X	$ -		=	$ -	
Total Land & Improvement Costs					=	$ -	(Rounded)
Incidentals	0	X	$ 3,000	Per Tract for Incide	=	$ -	
Replacement Housin	0	X	$ 12,000	Per Unit	=	$ -	
Moving Expenses	0	X	$ 25,000	Per Unit	=	$ -	
TOTAL ROW COSTS					=	$ -	

201-07.05 Removal and Disposal of Brush and Trees (Clear. and Grub.)

Length (ft.)	Width (ft.)(Avg.)	Area (sq.ft./ac.)	Acres	Cost ($/ac.)	Total
0	75	0	0.000	$4,000	$ -
0					$ -

Maintenance of Traffic

Drums (Ea.)	Cost ($/drum)	Total	712-04.01 @ 50' spacing
0			

Signs (s.f.)	Cost ($/s.f.)

712-06 (14 Road work ahead and 4 End road work)(16 s.f. x 14+ 10 s.f. x 4

712-02.02 Interconnected Portable Barrier Rail

Lgth.(ft.)	Cost ($/ft.)

712-07.03 Temporary Barricades

Lgth.(ft.)	No.	Total Lgth.	Cost ($/ft)	Total Barricades

Total Maintenance of Traffic **$ 50,000**

Signing

Signs (s.f.)	Cost ($/s.f.)	Total	713-13.03
		$ 15,000	

Utility Relocation Cost

	Lgth (ft)	No. of Poles	Cost ($/pole)	Cost ($/ft)	
8" Sewer				$35.00	$0
12" Water				$130.00	$0
Utility Poles		0	$15,000.00		$0
				Total	$0.00

203-01 Road and Drain. Exc. (Uncl.)

Area (sq. ft.)	Avg. Exc. Depth	Factor	C.Y.	Cost/cy	Total
20444	1.5	27	1136	$3.50	$3,975.22
				Total	$3,975.22

Widening - Ramps = 13,275 s.f.
Widening - Mainline = 7,169 s.f.

202-03.01 Pavement Removal

Area (sf)	/	sf/sy	*	Cost ($/sy)	Total
1400	/	9	*	$3.75	$583.33

Pipe Culvert	=	Bedding	+	Pipe	+	Headwalls	
Bedding	=	Length (ft)	*	cy/ft	*	Cost ($/cy)	
204-07	=	0	*	0.266	*	$30.00	$0.00
Pipe	=	Length (ft)	*	Cost ($/ft)			
607-05.02	=	0	*	$40.00			$0.00
Headwall Steel	=	lbs/wall	*	# H'walls	*	Cost ($/lb)	
611-07.02	=	0	*	0	*	$1.30	$0.00
Headwall Conc.	=	cy/wall	*	# H'walls	*	Cost ($/cy)	
611-07.01	=	0	*	0	*	$480.00	$0.00
	=						
						Total	$0.00

New Structure over U.S. 64

Length (ft.)	Width (ft.)	s.f.	Cost/s.f.	Total
0	0	0	$250.00	$0.00

Paving

	Area (sq.ft.)	*	Depth (ft)	/	factor	*	Mass (lbs/cy)	Total cy or sy	/	lbs/Tons	Total Tons	*	Cost ($/ton or cy)		Total
Ramp Conc. Pvm't.															
501-01.02	13275	*	0.75	/	27			368.75				*	$50.00	$	18,438
Ramp Treated Base															
313-03	13275	*	0.330	/	9			486.75				*	$10.00	$	4,868
Ramp Base Stone															
303-01	13275	*	0.330	/	27	*	2.03	162.25			329.368	*	$13.50	$	4,446
402-01	13275	/			9	*	0.35		/	231	2.23	*	$375.00	$	838
402-02	13275	/			9	*	12		/	2000	8.85	*	$15.00	$	133
Mainline															
411-02.10 (Surf.)	7169		0.104	27	3816	2000					53		$60.00	$	3,161
307-02.08 (B-M2)	7169		0.167	27	4068	2000					90		$60.00	$	5,411
307-02.01 (Gr. 'A')	7169		0.292	27	4140	2000					160		$60.00	$	9,629
303-01	7169		0.833	27	2.03						449		$14.00	$	6,286
	Lgth. (ft.)	Width (ft.)													
Outside Shld'r.	724	12	1.255	27	2.03						820		$14.00	$	11,477
	724	4.85	1.115	27	2.03						294		$14.00	$	4,121
Conc. Curb	702-01	Lgth. (ft.)			ft./c.y.										
		1200			8			150.00					$350.00	$	52,500
Conc. Med. Pvm't.	701-03	s.f.													
		5637	0.330		27			68.90					$225.00	$	15,502
													Total	$	136,810

Topsoil (203-07)

Based on 4:1 slope and 10' fill with 48' widening

Length (ft.)	Slope Lgth.(ft.)	Thk.(ft.)	cy factor	cy	Cost ($/cy)		Total
724	20	0.5	27	268.1	$9.00	$	2,413

Seeding (801-01)

Length (ft.)	Slope Lgth.(ft.)	sf	sf/unit		factor	units	Cost ($/unit)		Total
724	20	14480	1,000	*	1.25	18	$35.00	$	634

Signalization

2 Locations	$	300,000

Fencing

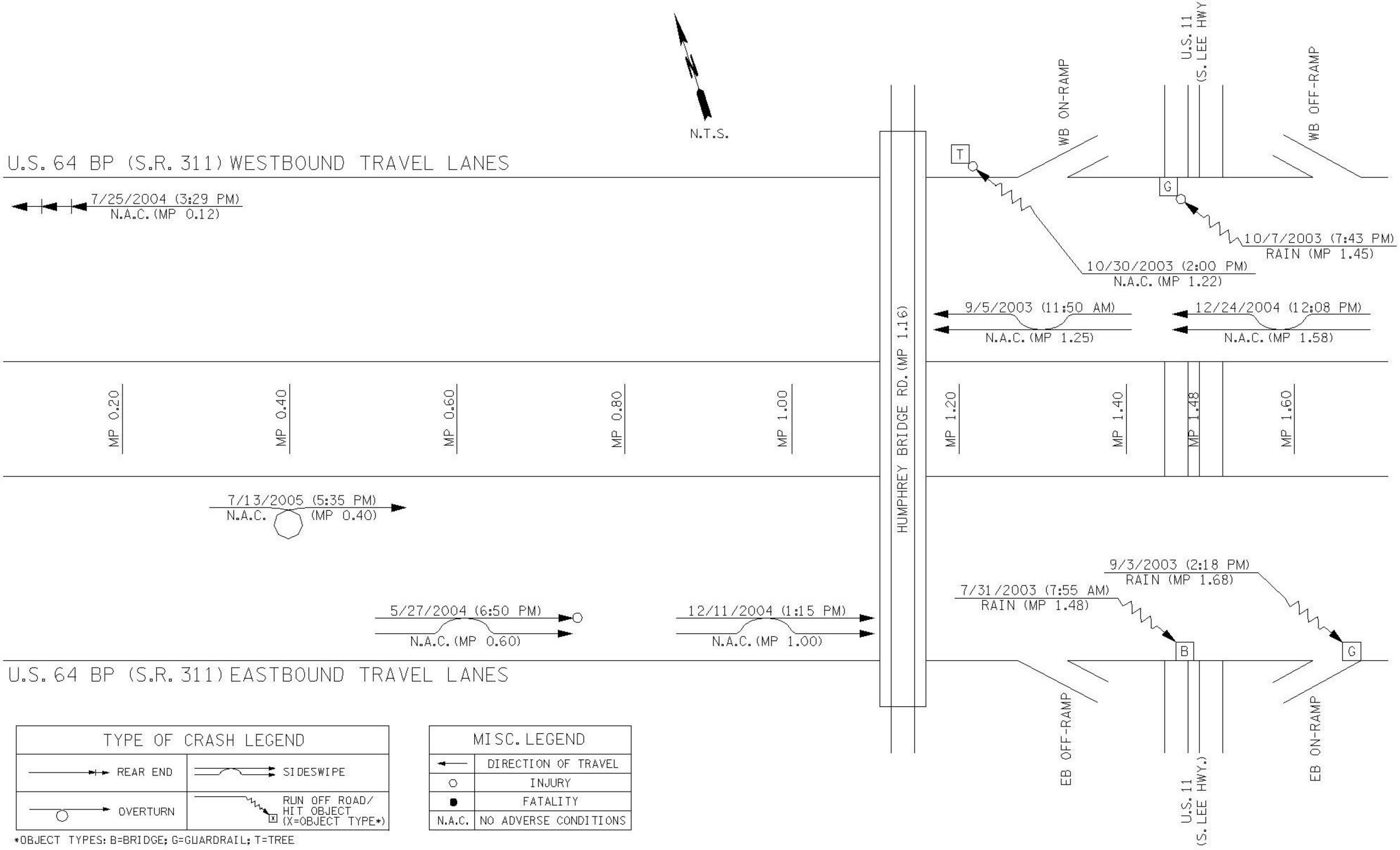
Length (ft.)	Cost ($/ft)		
707-02.01			
0	$17.00	$	-

Guardrail

(Length (ft)	*	Cost ($/ft)	+	(# Anch.)	*	Cost ($/Anch.)	Total
0	*	$17.50	+	6	*	$2,500.00	

APPENDIX E

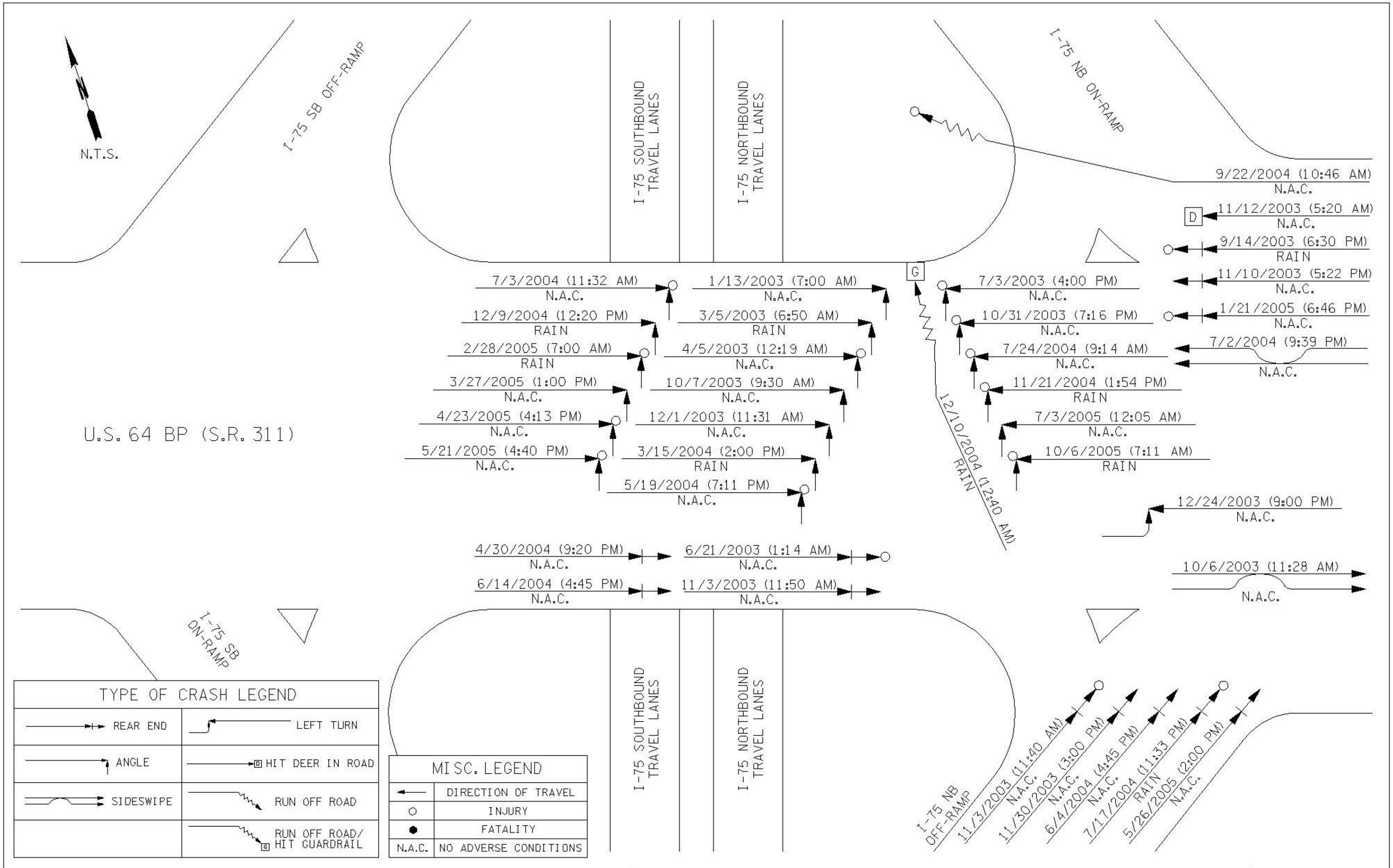
CRASH DIAGRAMS



LONG ENGINEERING, INC.

5550 Franklin Road
Suite 202
Nashville, Tennessee 37220
Tel 615.221.1131
Fax 615.221.1132
www.longeng.com

U.S. 64 BP (S.R. 311)
BETWEEN MP 0.06 AND MP 1.68
COLLISION DIAGRAM (2003-2005)



LONG ENGINEERING, INC.

5550 Franklin Road
Suite 202
Nashville, Tennessee 37220
Tel 615.221.1131
Fax 615.221.1132
www.longeng.com

U.S. 64 BP (S.R. 311)
AT I-75 (MP 0.00 TO MP 0.06)
COLLISION DIAGRAM (2003-2005)

CRASH SUMMARY SHEET
APD-40 (SR 311) BETWEEN I-75 AND S. LEE HIGHWAY (US 11, SR 2)
BRADLEY COUNTY, TN

DESCRIPTION	YEAR			TOTAL	PCT. OF TOTAL
	2003	2004	2005		
TYPE					
REAR END		1		1	10.0%
LEFT TURN				0	0.0%
STRAIGHT (HEAD ON)				0	0.0%
RIGHT TURN				0	0.0%
RIGHT ANGLE				0	0.0%
SIDESWIPE	1	3		4	40.0%
PEDESTRIAN/CYCLIST				0	0.0%
STRUCK OBJECT/ANIMAL IN ROAD				0	0.0%
RUN OFF THE ROAD	4			4	40.0%
OVERTURN			1	1	10.0%
OTHER				0	0.0%
INVOLVEMENT					
PASSENGER VEHICLES	6	9	1	16	100.0%
TRUCKS	Note: Vehicle classification information was not provided. All vehicle types were assumed to be passenger vehicles.				
BUSES					
MOTORCYCLES					
OTHER					
ROAD SURFACE					
DRY (No Adverse Conditions)	2	4	1	7	70.0%
WET (Rain)	3			3	30.0%
DAMAGE					
PROPERTY DAMAGE ONLY	3	3	1	7	70.0%
INJURY CRASHES (NO FATALITIES)	2	1		3	30.0%
FATALITY CRASHES				0	0.0%
NUMBER OF INJURIES	2	2		4	
NUMBER OF FATALITIES				0	
CRASH SUMMARY					
TOTAL CRASHES	5	4	1	10	
PCT. OF TOTAL	50.0%	40.0%	10.0%		

APPENDIX F

I-75 EXIT 20 INTERCHANGE MODIFICATION

FUNCTIONAL PLANS

TENNESSEE D.O.T.
DESIGN DIVISION
FILE NO.

Index Of Sheets

SHEET NO.	DESCRIPTION
1	.... TITLE SHEET
2-3	.... TYPICAL SECTIONS
4-6	.... LAYOUT SHEETS

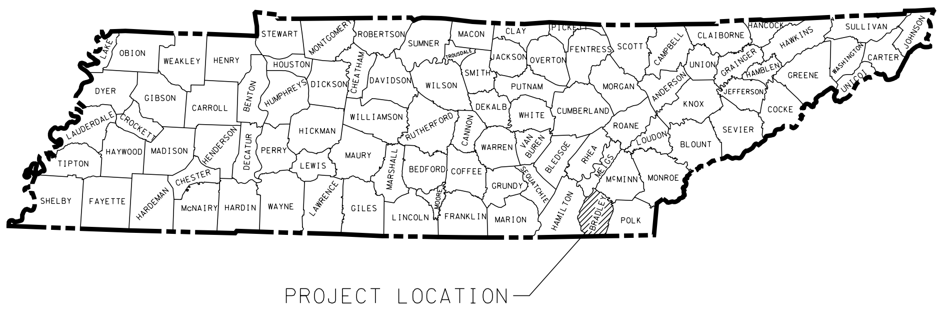
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING

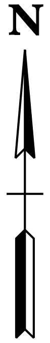
BRADLEY COUNTY

INTERCHANGE MODIFICATION STUDY
APD 40 (EXIT 20) AT I-75

FUNCTIONAL PLANS

TENN.	YEAR	SHEET NO.
	2009	1
FED. AID PROJ. NO.		
STATE PROJ. NO.		





SCALE: 1"= 1 MILE

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 LONG ENGINEERING ____________________ CHECKED BY ____________________

P.E. NO. ____________________

TRAFFIC DATA		
ADT ( )		
ADT (20)		
DHV (20)		
D		-
T (ADT)		%
T (DHV)		%
V		MPH

APPROVED: ____________________
CHIEF ENGINEER

DATE: ____________________

APPROVED: ____________________
COMMISSIONER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED:

____________________ DIVISION ADMINISTRATOR ________ DATE

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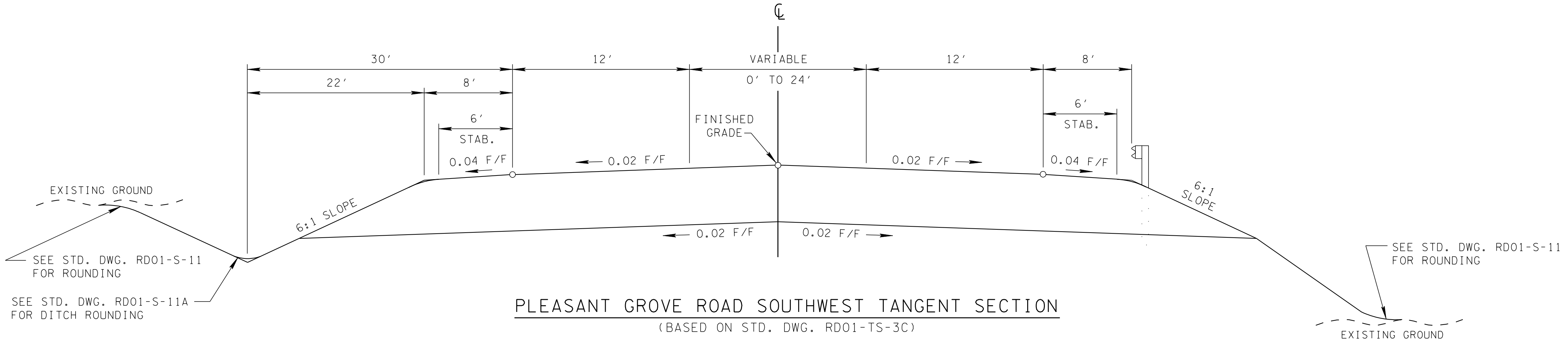
TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		2

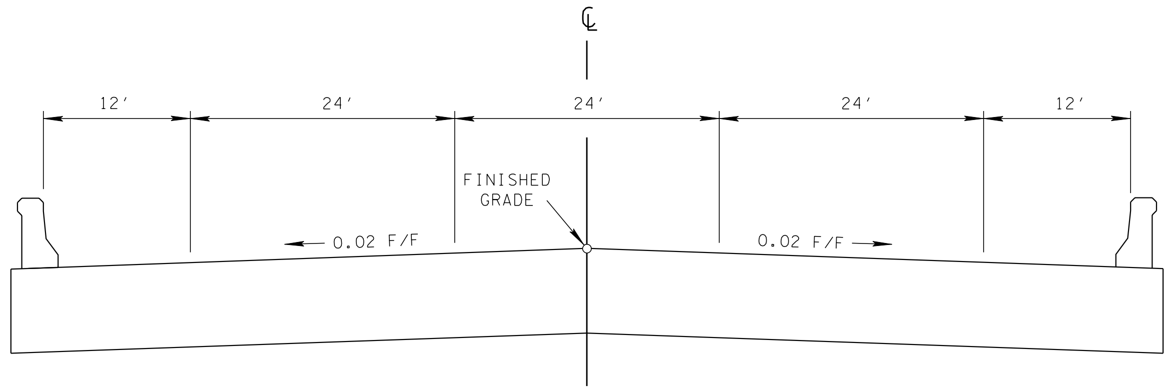
TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.



PLEASANT GROVE ROAD SOUTHWEST TANGENT SECTION

(BASED ON STD. DWG. RD01-TS-3C)



APD 40 OVER I-75 - TANGENT SECTION

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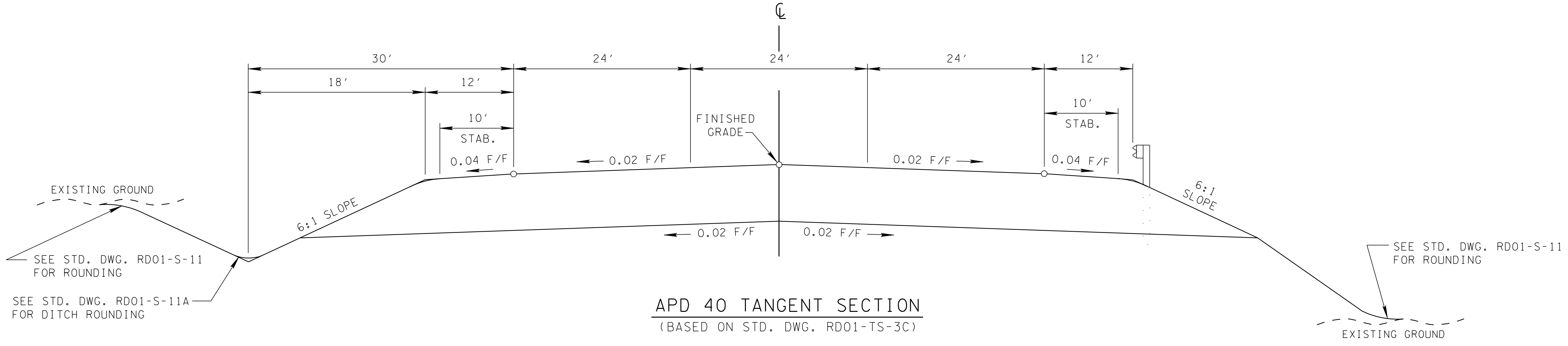

APD 40 TANGENT SECTION

(BASED ON STD. DWG. RD01-TS-3C)

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STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

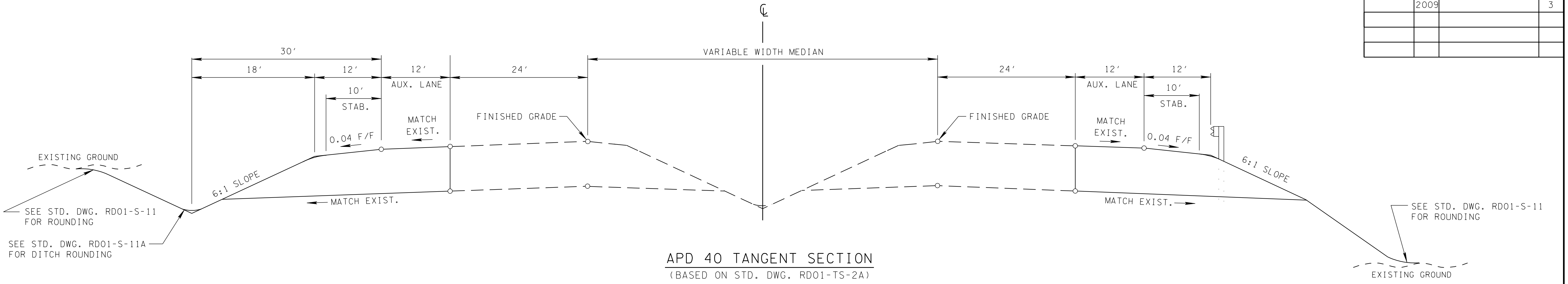
BRADLEY COUNTY
APD 40 @ I-75
TYPICAL SECTIONS

NOT TO SCALE

TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		3



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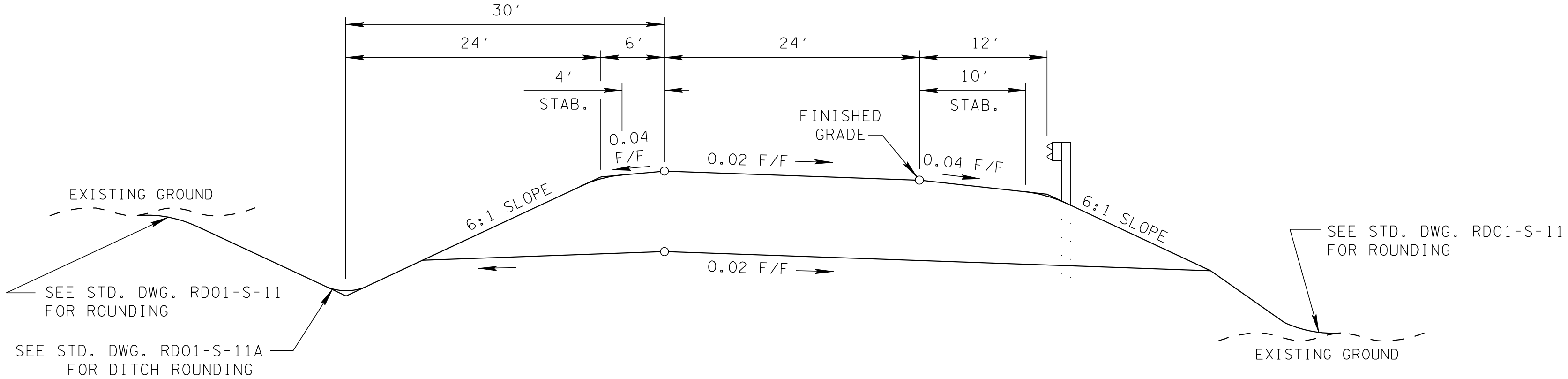

TWO LANE RAMPS - TANGENT SECTION
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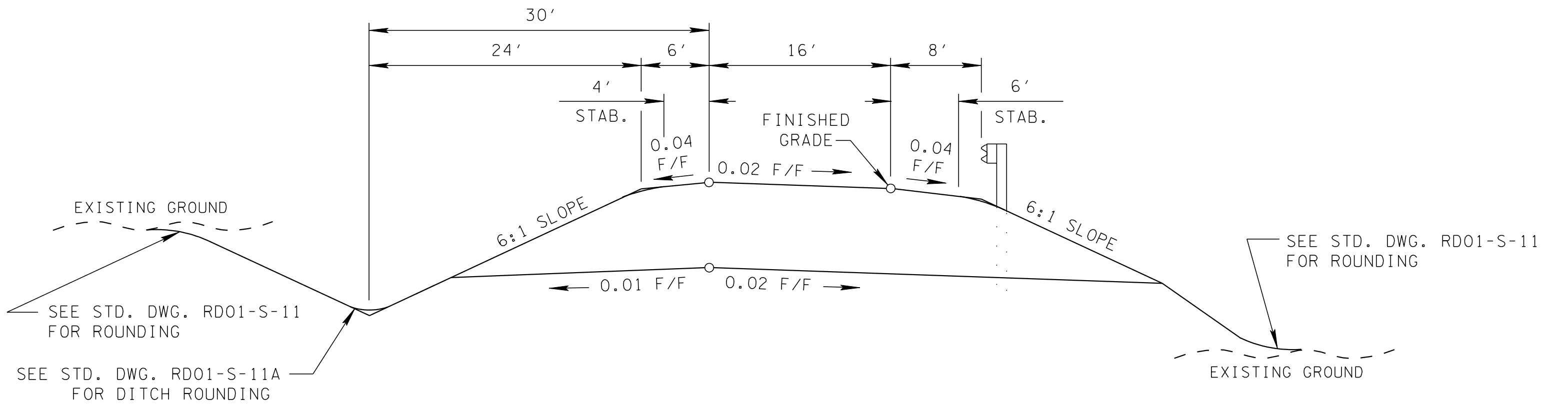

ONE LANE RAMPS - TANGENT SECTION
(BASED ON STD. DWG. RD01-TS-4)

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BRADLEY COUNTY
APD 40 @ I-75
TYPICAL SECTIONS

NOT TO SCALE

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TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		4

FINAL CONNECTION TO LOCAL ROAD SYSTEM DEPENDENT UPON APPROVED DEVELOPMENT PLAN. RAMP MAY BE EXTENDED APPROXIMATELY 600' TO CONNECT TO DEVELOPER RELOCATED STONE LAKE ROAD.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BRADLEY COUNTY
APD 40 @ I-75
FUNCTIONAL
LAYOUT

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TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		5

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BRADLEY COUNTY
APD 40 @ I-75
FUNCTIONAL
LAYOUT

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TENNESSEE D.O.T.
DESIGN DIVISION

FILE NO.

TYPE	YEAR	PROJECT NO.	SHEET NO.
	2009		6

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

BRADLEY COUNTY
APD 40 @ I-75
FUNCTIONAL
LAYOUT

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APPENDIX G

OCOEE REGIONAL GATEWAY: LAND USE REPORT

Cleveland Urban Area
METROPOLITAN PLANNING
ORGINIZATION

Ocoee Regional Gateway:

Land Use Analysis for Proposed APD-40 Intersection or Interchange and Related Improvements to nearby I-75 Exit 20 in Cleveland, Tennessee

INTRODUCTION

Purpose

A new access is being considered to APD-40 in Cleveland, Tennessee. The proposed access would involve the construction of an at-grade intersection or a grade-separated interchange on APD-40 at a point between U.S. 11 and I-75 Exit 20. No access presently exists in this section of APD-40. It is proposed to connect existing (e.g. Pleasant Grove Church Road and Stone Lake Road) and future local streets in the area to the new access via a frontage road system. The proposed project would serve commercial, industrial, and residential access needs and help to direct urban growth into areas readily served by utilities and other urban services.

A separate but related project would entail improvements to I-75 Exit 20 itself. The existing Exit 20 is an old-style diamond interchange that involves a two-lane bridge over I-75. The March 2005 Interchange Modification Study, Exit 20 on Interstate 75, Bradley County, Tennessee, prepared for TDOT by Volkert & Associates, Inc., recommended widening the bridge and northbound exit ramp and installing signalized intersection control at an estimated cost of under $1.6 million. These improvements would address congestion and safety issues. Bradley County, the City of Cleveland, the Cleveland Urban Area MPO (CUAMPO), the Southeast Tennessee RPO, and the Cleveland/Bradley Chamber of Commerce have all acted in support of this project individually or as the western terminus of Corridor K (the Chattanooga-Asheville Highway) that is described in more detail below.

The proposed APD-40 access is included in the Cleveland Urban Area MPO (CUAMPO) Long Range Transportation Plan. CUAMPO has urged the approval of this project by the

Tennessee Department of Transportation, as well as improvements to nearby Exit 20. These projects have received funding in three earmarks in the most recent SAFETEA-LU highway bill. Earmarked funding for Cleveland in the most recent highway bill, "SAFE, ACCOUNTABLE, FLEXIBLE, EFFICIENT, TRANSPORTATION EQUITY ACT: A LEGACY FOR USERS" (SAFET-LU), Public Law 109-59, includes the following:

Project 548 (page 119 STAT 1277 in the plain text version of bill) provides $1.92 million for "construction of an intersection/interchange in the City of Cleveland along I-75". This is a High Priority Project (HPP).

Project 4951 (page 119 STAT 1446 in the plain text version of the bill), also an HPP project, provides $1.25 million for "construction of an interchange on Highway 64 (APD 40) adjacent to I-75 Exit 20 in the City of Cleveland, TN for increased safety".

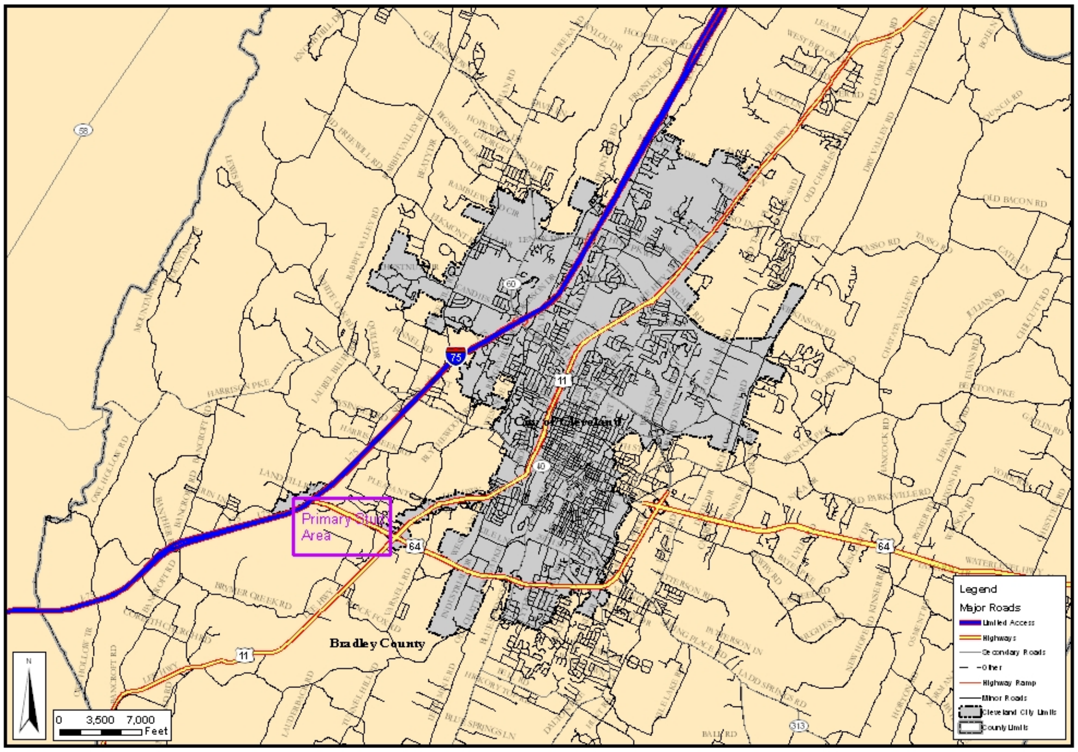
Project 387, a Transportation Improvement Project and not an HPP project, (page 119 STAT 1505 in the plain text version of the bill) provides $2.0 million for "construction of an interchange on Highway 64 (APD 40) adjacent to I-75 Exit 20 in the City of Cleveland, TN for increased safety".

This study examines the existing and anticipated future land use in the area near the proposed APD-40 access and Exit 20. The land use study will assist TDOT and it consultants in evaluating the transportation benefits of the proposed access on APD-40 and the proposed improvements to Exit 20. Apart from congestion and safety benefits, these two related projects provide other important benefits consistent with the plan goals of the Cleveland Urban Area MPO, TDOT, and the U.S. DOT as these are articulated in SAFETEA-LU. Specifically, the improvements would make possible the more efficient use of existing facilities, APD-40 and I-75 Exit 20; the improvements would enhance the connectivity of the surface transportation system and facilitate intermodal connections with air and rail facilities in Chattanooga and elsewhere; and the projects could enhance transportation system security by facilitating diversion of I-75 traffic during major fog events and similar situations.

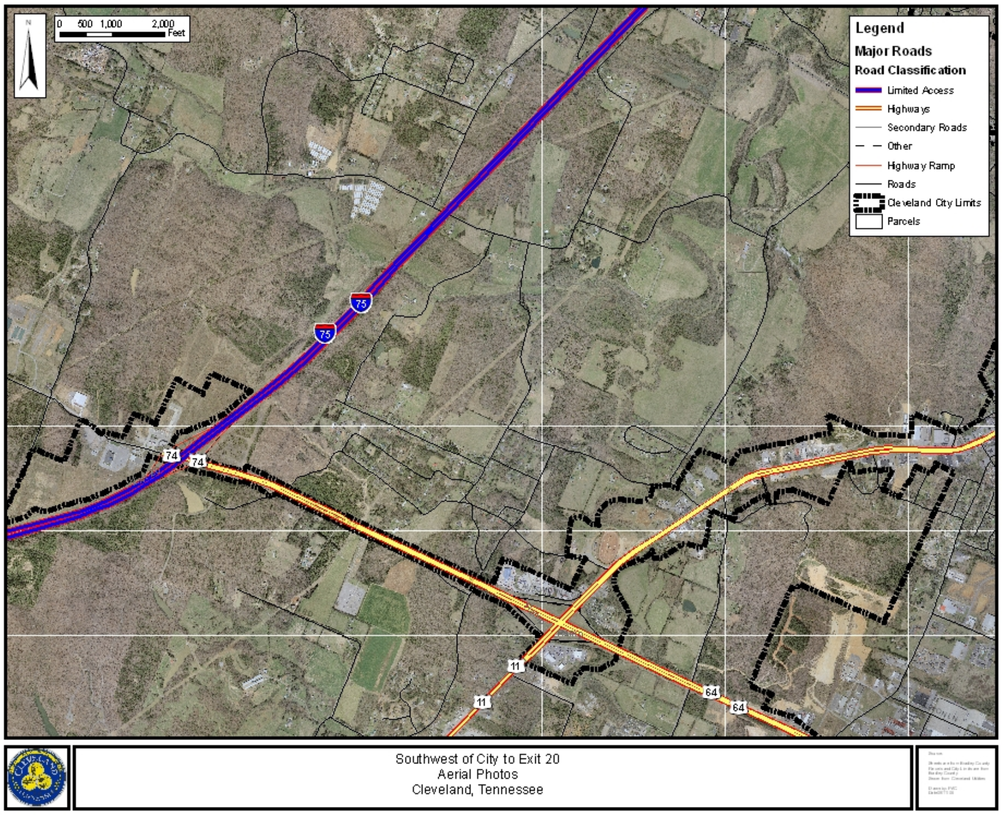
Description of the Study Area

The study area is in the City of Cleveland and Bradley County, in southeast Tennessee. The primary study area consists of lands along the APD-40/Pleasant Grove Road corridor between U.S. 11 and just west of I-75 Exit 20. The general location of this primary study area is illustrated in the county map below, and in more detail in other maps that follow. An aerial photograph is also included below which shows the study area (at the top of the aerial is the APD-40/U.S. 11 interchange and I-75 Exit 20 is at the bottom).

References will be made to areas beyond the immediate study area that would logically be served by the proposed access, and those which would generate traffic in the APD-40 corridor thereby affecting the land use pattern and trip origins and destinations in the area immediately served by the proposed APD-40 access and Exit 20.



Regional Map
Primary Study Area



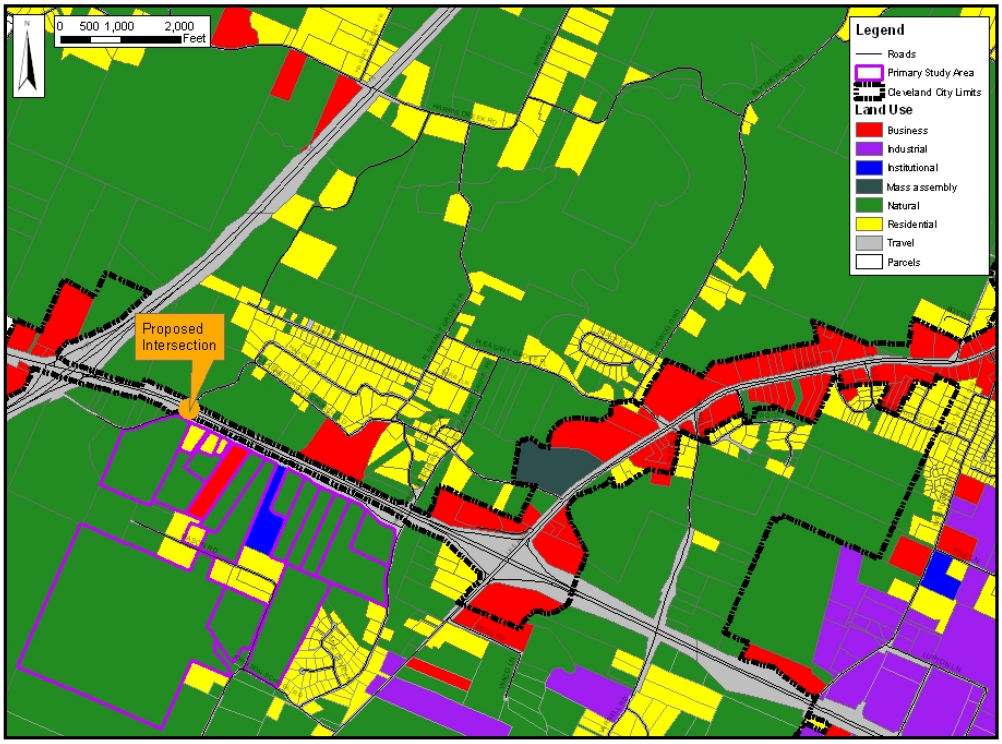
Southwest of City to Exit 20
Aerial Photos
Cleveland, Tennessee

EXISTING CONDITIONS

Existing land use is shown in the map and table below. Existing commercial uses are located along U.S. 11 and at its intersection with APD-40, and at I-75 Exit 20. Tourist-oriented developments exist at Exit 20 including an automobile travel center, fireworks stores, and a gas station/convenience store. Region serving facilities at Exit 20 include a multiplex movie theater, a large automobile dealership, and, just west of the study area, the Tri-State Exhibition Center and the Bradley County Landfill. Commercial and industrial uses are not located along the APD-40 corridor near the study area except car dealerships in a short section in the northwest quadrant of the APD-40/U.S. 11 intersection that is served by a frontage road connecting back to U.S. 11.

Other existing land uses along the APD-40 corridor between U.S. 11 and I-75 Exit 20 are generally pasture land and low-density residential. A major Cleveland Utilities electrical substation exists on the south side of APD-40 in the primary study area.

Other existing land uses beyond the primary study area impact traffic along the APD-40 corridor. Industrial uses, including large warehousing and distribution facilities have been developed along APD-40 east of the primary study area near Westland Drive. Other industrial, commercial, and residential users also access the APD-40 corridor and I-75 Exit 20 from Blue Springs Road, Dalton Pike, Blackburn Road, Spring Place Road, U.S. 64, and Overhead Bridge Road. Dalton Pike has experienced significant growth in residential subdivisions south of APD-40. Nearly 300 new housing units have been added on 250 acres along the Dalton Pike Corridor in the last five years. The Dalton Pike/APD-40 intersection is now the location of a Walmart Supercenter and several other new commercial enterprises. From a regional access standpoint, all of this development would most logically access I-75 from Exit 20 to go south to Chattanooga, where many residents work, or north toward Athens, Knoxville, etc.



Southwest of City to Exit 20
Existing Land Use
Cleveland, Tennessee

Existing Land Uses in the Study Area

Land Use	*# of Parcels*	*Area in Acres*
Industrial	59	435
Business	174	622
Mass Assembly	2	116
Natural	319	6032
Residential	1289	3836
Institutional	8	89

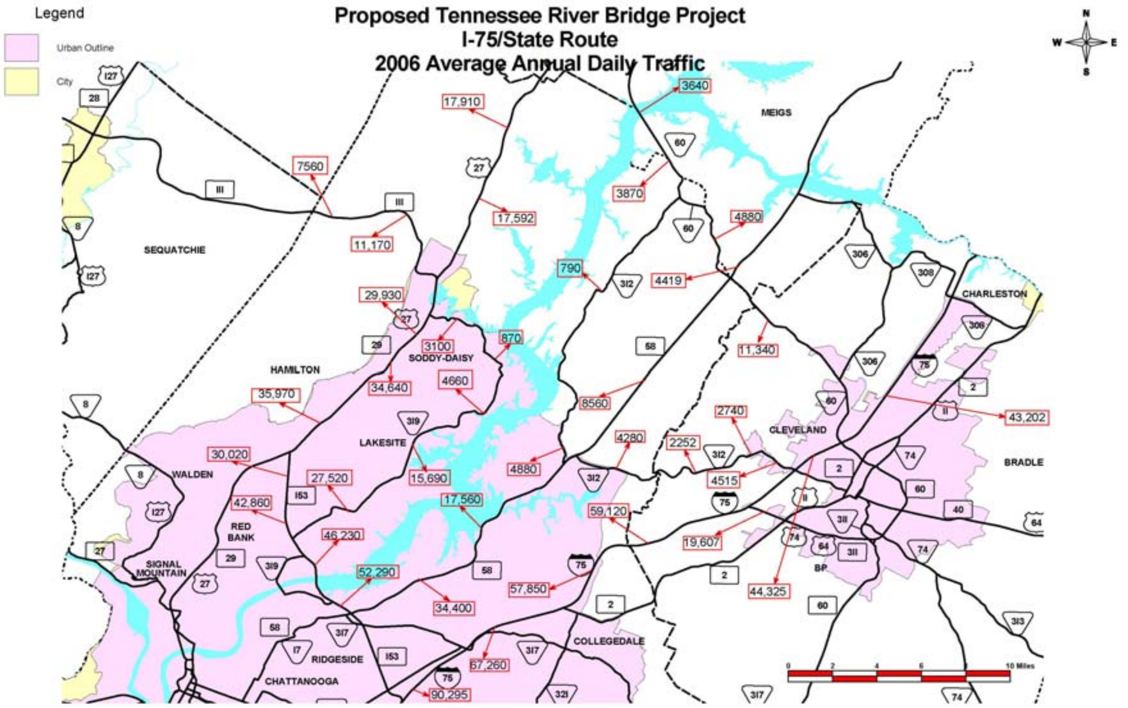
Existing Roads

The proposed intersection is where APD-40 Pleasant Grove Church and Stone Lake Road meet. APD-40 is a bypass road that runs from Exit 20 of Interstate 75 around the southern part of Cleveland until it meets 25th Street, which leads back to I-75 at Exit 25.

I-75 is the primary regional transportation connection Cleveland for north-south traffic. Chattanooga is 20 minutes to the south and Knoxville is around an hour and a half to the north. Beyond Chattanooga, I-75 continues to Atlanta, GA. Traffic from south Bradley County, east Bradley County, and from Polk County beyond to North Carolina uses the APD-40 corridor for an east-west connection to I-75. Because of the north-south orientation of the mountains, it is often important for regional east-west traffic to be able to get to I-75 in order to connect with the appropriate road.

North of APD-40 is primarily open land but there is a local street network serving mostly residential development. Pleasant Grove Church Road (Pleasant Grove Road) connects this area to U.S. 11 and Pleasant Grove Trail connects to Harrison Pike. Humphrey Bridge Road is the only crossing of APD-40 between U.S 11 and Exit 20. Humphrey Bridge Road intersects Stone Lake Road just south of APD-40. Stone Lake Road runs parallel to APD-40 almost the whole way from Exit 20 to U.S 11 such that it could possibly serve as a frontage road. APD-40 ends at the Exit 20 bridge and Pleasant Grove Road continues west on the other side of I-75 providing access to the interstate-oriented commercial areas as well as Tri-State Exhibition center, the Bradley County Landfill, etc.

The Average Annual Daily Traffic map below was prepared by TDOT for an analysis of a future toll-supported project that would provide a new river crossing (see discussion below). The 2006 AADT on I-75 just north of Exit 27 was 43,202; between Exits 27 and 25 the AADT was 44,325; and the AADT south of Exit 20 was 59,120. The AADT on APD-40 just east of Exit 20 was 19,607. It appears that a large volume of traffic is utilizing the substandard Exit 20 and improvements need to be made.



Existing Utilities

Electric and water are available to the areas south of APD 40 but sewer is not yet. The drainage in the area falls two different directions. The properties immediately adjacent to the CU substation fall to the north. The other areas fall to the south. A gravity sewer line could be constructed to serve the areas adjacent to the substation.

FUTURE CONDITIONS

The existing land use, the projected land use and the available infrastructure are important considerations for any planning in this area. Land Use as shown in the Bradley county future land use plan is expected to change from its current state and become a more commercial area. Most utilities are already provided and sewer, which is not currently available south of APD-40, is planned for that area according to a 1996 Cleveland Utilities plan.

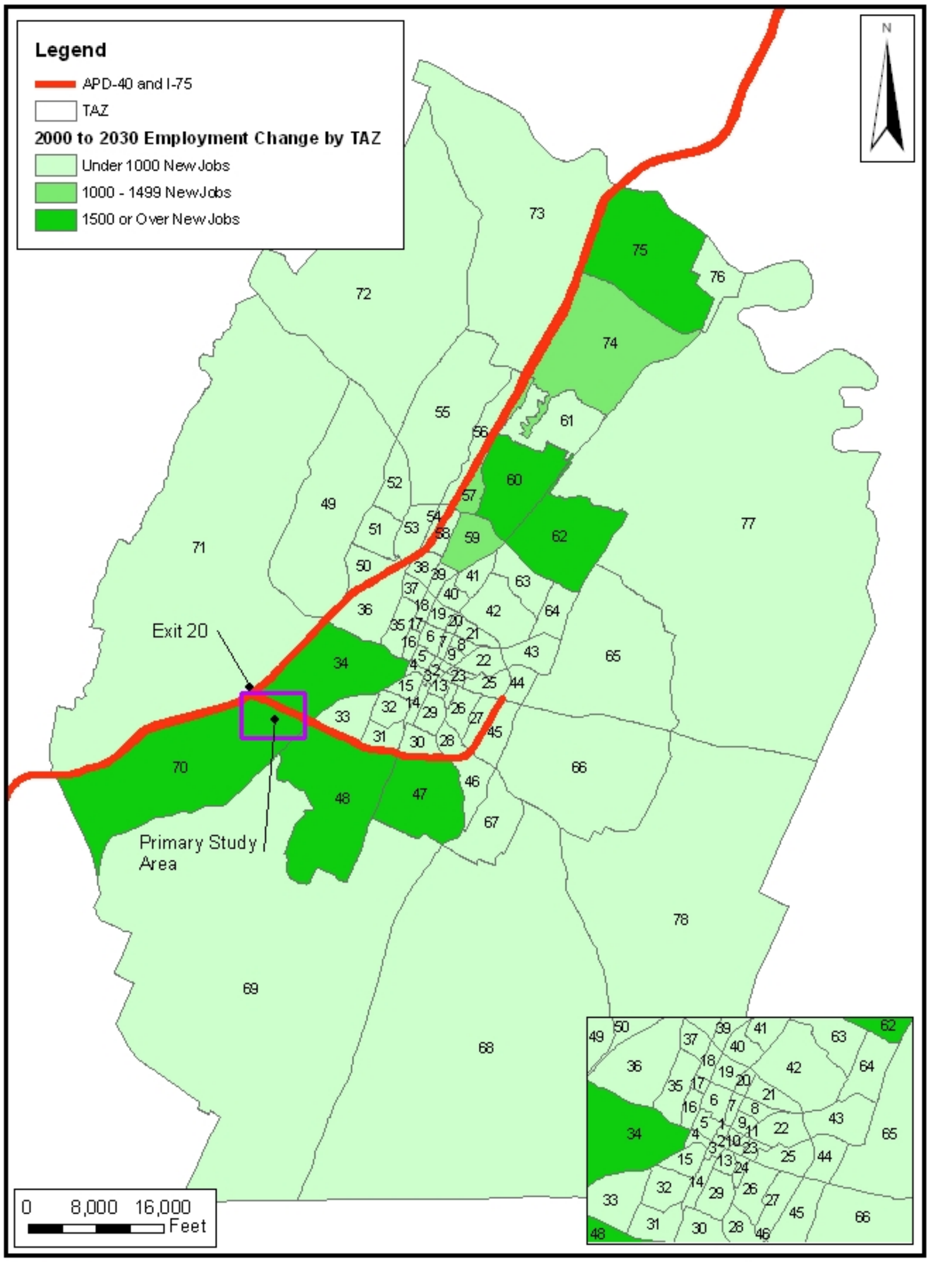
Future Population and Employment

The population in Bradley County in 2000 was 87,965 people. In 2030 the population is projected to be 138,607, an increase of 61.2%. The Traffic Analysis Zone (TAZ) located south of Exit 20 and east of I-75, TAZ 70, had 1216 people in 2000. In 2030 the population of TAZ 70 is expected to increase to 4716 people. This TAZ is bounded by APD 40 to the north the Bradley/Hamilton county line in the south, Highway 11 to the east and I-75 to the west. TAZ 34 is north of APD-40 had a population of 1593 in 2000, increasing to 4145 by 2030. TAZ 34 is bounded by I-75 to the west, U.S. 11 to the east, Harrison Pike to the north, and APD-40 to the south. In these two areas on opposite sides of APD-40, 6052 people are expected to be added by 2030. The table below summarizes the project population growth for the primary study area.

Employment growth in these TAZs 34 and 70 along APD 40 is expected to be greater than in most areas in Bradley County (see map below). TAZ 34 is expected to add 1959 jobs while TAZ 70 is expected to add 1849 new jobs, together over 3800 new jobs each. As shown by the table below, the four TAZs nearest the primary study area (34, 47, 48, and 70) are projected to add almost 7500 new jobs, about one-third of the projected job growth for Bradley County. Bradley County is projected to add over 23,000 new jobs by 2030.

2000-2030 POPULATION GROWTH				
	2000 Population	2030 Population	Growth 2000 to 2030	% Growth 2000 to 2030
Exit 20/APD-40 Area TAZs				
TAZ 34	1593	4145	2552	160.2%
TAZ 47	5529	5719	190	3.4%
TAZ 48	1064	2064	1000	93.9%
TAZ 70	1216	4716	3500	287.8%
Total Exit 20/APD-40 Area TAZs				
Bradley County			52,642	61.2%

2000-2030 EMPLOYMENT GROWTH		
	2000 to 2030	% of County
Exit 20/APD-40 Area TAZs		
TAZ 34	1959	8.48%
TAZ 47	1818	7.87%
TAZ 48	1852	8.02%
TAZ 70	1845	7.99%
Total Exit 20/APD-40 Area TAZs		
Bradley County	23,103	100.00%

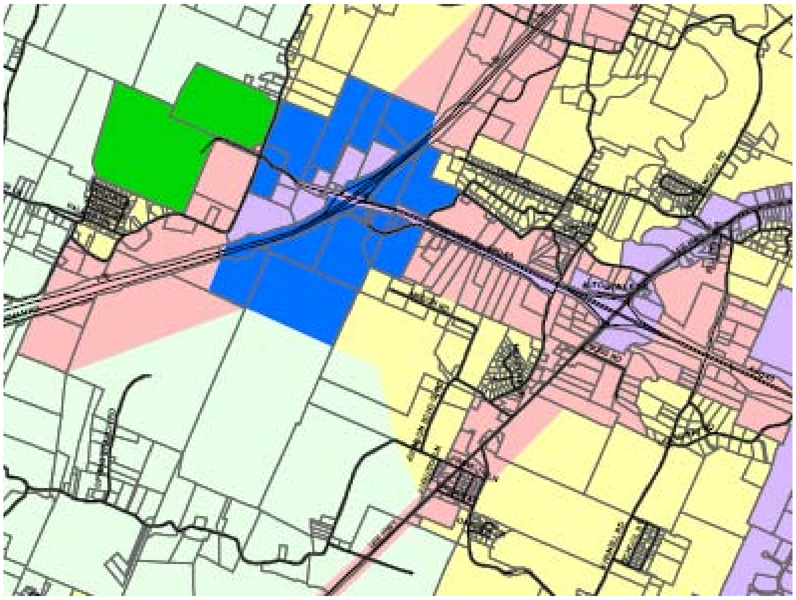


Projected Employment Change
from 2000 to 2030 by
Transportation Analysis Zone TAZ

Source :
Borders of Bradley County are from Bradley County
TAZ are form US Census Data
Drawn by : PAC
Date : 03/19/07

Future Land Use

Bradley County's 1995 Land Use Plan addressed the subject area. An excerpt from the plan's future land use map is shown below for the primary study area (the map has been updated to show the commercially zoned 2004 annexation by the City of Cleveland as indicated in the light purple). The blue indicates I-75 interchange-oriented development (typically commercial) and the pink indicates other commercial development. The yellow color indicates residential development. The darker green indicates public/semi-public uses, in this case the Bradley County landfill and the Tri-state Exhibition Center. The largest future land use outside the urbanized area is agricultural, woodland, and open space which is shown in light green. Overall, the proposed future land use for the primary study area is one of intensive interstate-oriented and commercial development along the major roadways with more intensive residential development in the areas north and south of APD-40. Access from APD-40 and a connecting frontage road system is necessary to support this future land use plan.



The study area plays a pivotal role in a vision for land use and development that is occurring at a regional level. Exit 20 is envisioned as the primary gateway into the Ocoee Region. Exit 20 and APD-40 lie at the western terminus of the long-awaited Chattanooga-Asheville Highway, Corridor K in the Applachian Regional Commission's Appalachian Developmental Highway System (ADHS). This vital highway project, planned for nearly 50 years and one of the last remaining pieces in ADHS system designed to bring transportation and prosperity to Appalachian counties, will be the critical east-west link that finally removes the transportation barrier between southeast Tennessee and northern Georgia in the west and North Carolina and the eastern seaboard to the east. CUAMPO has endorsed and urged the completion of this project as has the Southeast Tennessee RPO which ranked Corridor K as its number one priority. Much of the work on the North Carolina side of Corridor K has been completed but on the Tennessee side the critical passage around the Ocoee River gorge along or near U.S. 74 remains to be built in Polk County which is immediately east of Bradley County.

FINDINGS OF WILBUR SMITH ASSOCIATES REGARDING CORRIDOR K FROM: *Corridor K Economic Development and Transportation Study Final Report*

The Southeast Tennessee Development District hired Wilbur Smith Associates to conduct this economic development and transportation study of the Corridor K Region, in part to answer the question, “Is there an economic development need for this corridor?” We have concluded from our research that there is a clear economic development need for an improved east-west transportation corridor to serve this region. Based upon an analysis of the job attraction potential that could result from an improved east-west highway connection that would improve highway travel times, airport, rail, and port access, and expanded labor market our report estimates the creation of over 7,000 new jobs in the region within five years. If the average salary for the jobs gained is just $30,000 per year that would mean an annual influx of $210 million in personal income for the region.

The study conclusions are based on our research and input from regional stakeholders, discussions with the Steering Committee and Economic Development Advisory Committee, existing business surveys, interviews, and research.

1. **<u>The Corridor K Region needs transportation improvements that will enhance the economic sustainability of the region.</u>** While transportation alone is not a sufficient condition to cause economic development to occur, it is a crucial link to both sustainable existing businesses, to attracting new business opportunities to the Region, and to provide effective access to a larger market area in the future. For the Corridor K Region to have the competitive edge, it must build the infrastructure to sustain existing businesses, support entrepreneurial businesses, and create an environment that is attractive to new business.

2. **<u>The transportation infrastructure must be enhanced to support tourism.</u>** To improve the economic viability of tourism in the region the existing Hwy 64/74 must be improved to accommodate the needs of existing tourist related businesses and individuals including the Whitewater and Adventure Tourism Operators, hikers, rafters, and other users. Providing a safer route that will be a **destination** rather than a thru-road is important to enhancing tourism in the region. Additional tourism infrastructure is also needed to appeal to a wider visitor demographic, extend the tourism season, and promote more and longer overnight visits to the region.

3. **<u>Better access to Atlantic coastal ports is important to businesses in the region.</u>** Impacts of globalization have been more important to the Corridor K Region than expected, given the

existing transportation limitations. In a recent transportation survey, Fifty-eight percent of responding businesses in the region currently sell to international customers and fifty-one percent of businesses utilize components and materials from international suppliers. Businesses want the flexibility to be served by multiple ports because of international customer locations and competitiveness requirements.

4. **The transportation needs to support and enhance tourism are very different from the transportation needs of other business sectors in the region.** Visitors see the road as a destination; business sees the road as a safe and efficient means of moving goods and people. Visitors want to drive at a leisurely pace stopping to enjoy view sheds; business users want to reach their destination as quickly and as safely as possible. These two divergent sectors are very important to the Region's economic development. Accommodating these two transportation needs may suggest strategies that separate these two users.

5. **Incidents and backups on US 64/74 create problems for the region's employers and communities.** Many of the region's employers rely on workers who travel US 64/74 daily. The reliability of this workforce is affected by traffic conditions on the existing highway as employees can be delayed by accidents, rock slides, and other chokepoints created by oversize vehicles and tourist traffic. These delays also cut communities off from emergency services, access to schools, and create added costs for businesses.

6. **Some businesses in the region will not survive without improved transportation connections.** Global competition mandates that businesses continually focus on driving down their costs and remain responsive to their customers. Transportation costs, effective access to market areas to rapidly respond to customer needs, and access to new markets for business growth are critical to the survival and sustainability of many businesses in the region.

7. **Many employers in the region are highly reliant on truck transportation and have higher than average expenditures for transportation to market areas east or west of the region.** Lack of direct east-west connections, existing roadway deficiencies, and safety concerns limit economic development opportunities in the region. Businesses face adverse cost and travel time issues as goods must travel to Atlanta or Knoxville to go east, and conversely businesses in western North Carolina utilize these routes to travel to locations to the west.

8. **Deficiencies identified in past safety audits have been addressed to the extent possible however the existing highway may still have safety issues.** TDOT and NCDOT have promptly

made improvements to the existing corridor in response to safety audits but are limited by topography, proximity to the rivers, and environmental concerns. Crashes and fatal accidents after these safety improvements have been completed suggest that additional traffic operational and safety improvements are still needed.

9. **<u>Balancing economic prosperity and environmental stewardship is important to the people who live and work in the Region.</u>** To enhance tourism and maintain the quality of life, "Green Highways", eco-tourism, sustainable development, corridor overlays, and context sensitive solutions offer strategies that fit the ecological, economic, and transportation needs of the Region.

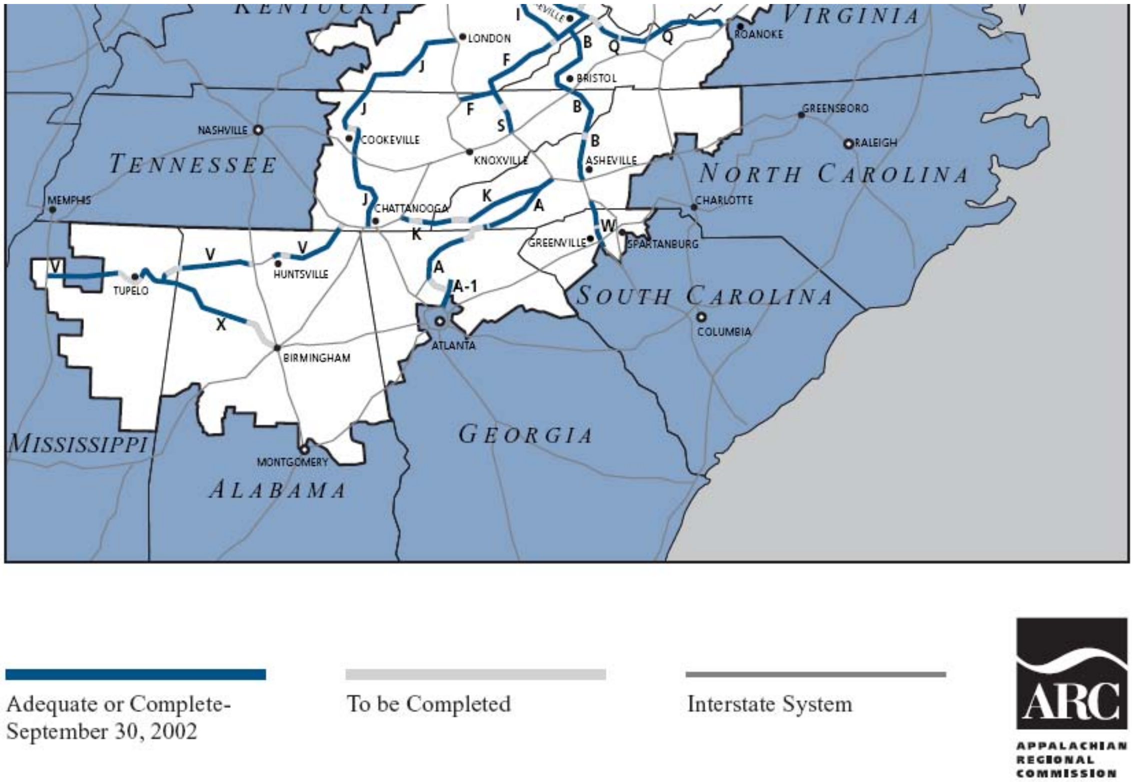
10. **<u>Improved transportation facilities are needed based upon the impact of the existing transportation system on the economy of the region.</u>** Fifty-five percent of the businesses participating in the study said there were barriers to growing their business in the region and the barriers most often sited were: transportation costs, lack of east-west connections, workforce availability and skills, and timeliness of deliveries.

11. **<u>In order for economic growth to occur in the Corridor K Region transportation improvements are necessary primarily related to east-west connection to Atlantic coast ports</u>.** Based upon our economic analysis, the completion of Corridor K could bring 3,700 jobs in targeted industrial and an additional 3,300 jobs in related business sectors across the region in a 5-year period. As international trade continues to expand access to ports and other intermodal facilities will increase, 86% of the businesses participating in this study said that transportation would have an increasing important role in their competitiveness in the future.

The global economy offers many new opportunities for businesses in the Region relative to exports and foreign investments. In 2006, over 18,406 companies located in North Carolina, Georgia, and Tennessee exported goods from those states and over 79% of those exporting firms were small and medium-sized businesses. Foreign-controlled companies employed almost half a million people in the three-state region and represent a sizeable percentage of the total manufacturing employment in these states.

The Corridor K Region has excellent north-south highway connections and rail lines. These transportation corridors have been important to the region for many years. As business operations within the region continue to change because of international trade, new technologies, and other factors, existing companies must constantly focus on driving down their costs and improving their reliability and responsiveness to customers in order to compete. To retain and expand jobs in existing industries, the regional transportation system must meet the needs of businesses. A manufacturer of lightweight high-value products may tend to rely more on air transportation, while a manufacturer of heavy equipment will rely more on rail or port transportation. Many businesses rely on a combination of transportation modes and, except for those businesses located adjacent to an airport, ocean port, or rail facility, they rely on the highway as their primary link between businesses and these other modes of transport.

In today's global marketplace the nature of competition has changed and will continue to evolve. For businesses in the Corridor K Region to effectively compete in the future, competitive advantages must be constantly monitored and assessed; improvements must be planned and implemented. Economic development in this global environment becomes the business of the entire community, the entire region. The economic development challenges we face today are more complex. Innovative solutions require a collaborative process that validates and expands on the important links between economic development, transportation, education and training, environmental stewardship and other factors in order to support an economic future we will be proud of.



Cleveland has long been the headquarters of the U.S. Forest Service for the Cherokee National Forest. The Cherokee National Forest is accessed from I-75 via Exit 20 and APD-40/U.S. 74. With the coming expiration of the U.S. Forest Service’s lease on its North Ocoee Street headquarters in Cleveland, it has been proposed that a new facility be built at the Exit 20 Ocoee Regional Gateway to serve as a headquarters for the Cherokee National Forests as well as a visitor welcome center for the thousands of visitors who access the forest via Exit 20 each year for the many recreational opportunities offered there.

The Ocoee Regional Gateway at Exit 20 and APD-40 is very important also in terms of tourism. Enhancing the quality of this gateway by improving Exit 20 and creating the new intersection/interchange access on APD-40 will be very important to the continued growth and development of tourism in Bradley County and the larger Ocoee Region. Melissa Alley Woody, Vice-President of the Cleveland-Bradley Chamber of Commerce Convention and Visitor’s Bureau, noted the following local attractions for which this gateway would provide the most logical access from I-75:

- Tri-State Exhibition Center
- KOA Campground
- Cleveland Speedway
- Apple Valley Orchard (receives periodic tour buses)
- Red Clay State Historical Park (receives periodic tour buses)
- Historic Downtown Cleveland
- Museum Center at 5ive Points
- Village Green Playhouse

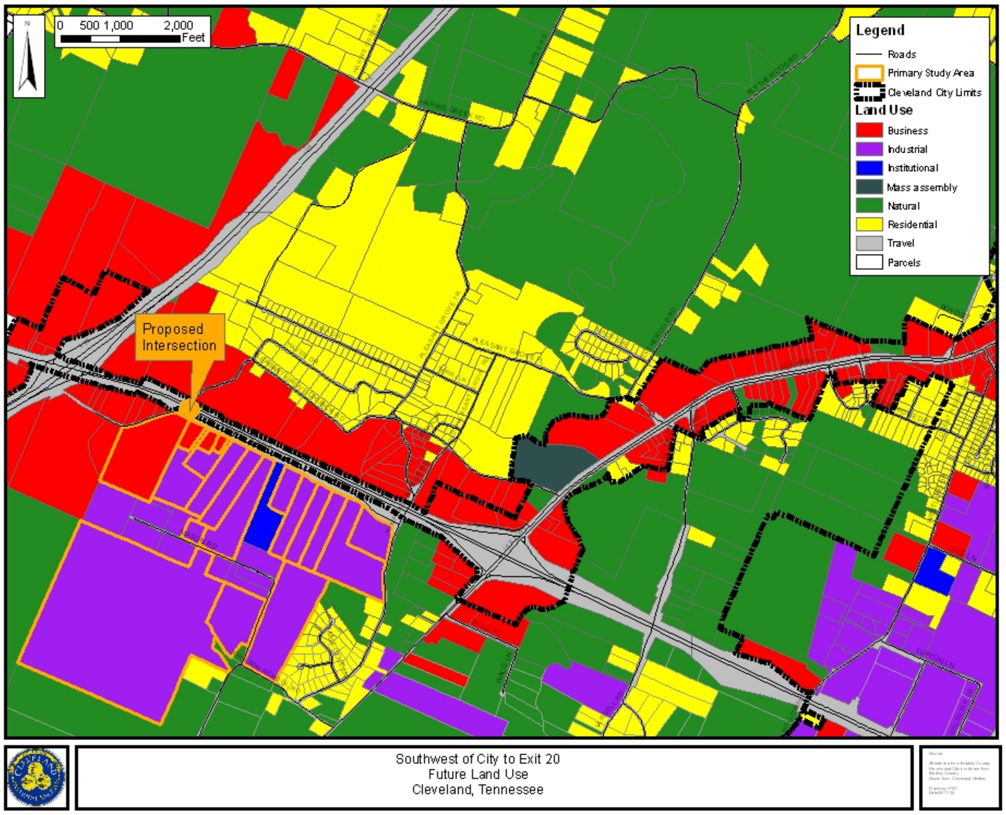
- Singing Echoes Museum and Festival Venue
- Cherokee National Forest
- Ocoee River
- Ocoee Whitewater Center
- All Whitewater Outfitters
- Tanasi Mountain Biking Trail System
- Hiwassee Scenic River (first scenic river in Tenn.)
- River Maze (seasonal corn maze)
- Scenic Railroad leaving from Gee Creek Camp area
- Several Forest Service Campgrounds
- Several restaurants, shops and lodging properties

The Ocoee Regional Gateway at Exit 20 promises to provide an important access to our national heritage, specifically to important sites in the Trail of Tears National Trail. Over one-third of the approximately 16,000 Cherokee persons who were removed from the region in 1838, a result of the Indian Removal Act passed by Congress in 1830, were assembled for removal in Bradley County. Several historic sites related to this dark chapter of our history and the trail head for the Trail of Tears National Trail are in Bradley County.

One important of the Trail of Tears that is especially relevant to the Exit 20 Ocoee Regional Gateway is the “Bell Route”, shown in green on the map above, which left from Charleston in Bradley County and followed approximately the current route of U.S. 11, crossing present-day APD-40 about a mile from Exit 20. Red Clay State Park, most readily accessed from Exit 20 and APD-40, was the site of the Red Clay Council Ground that was the primary location of tribal government in the years immediately preceding the removal.

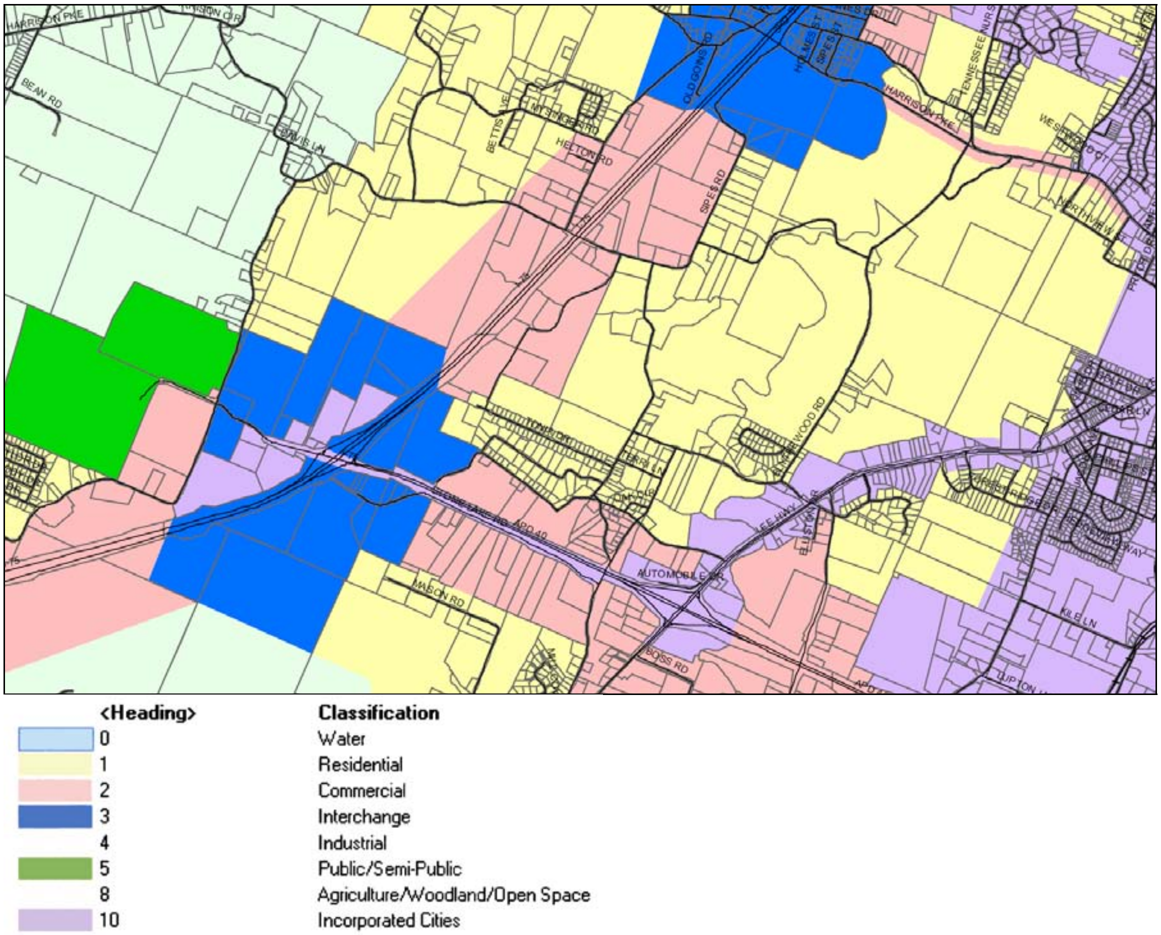
The south side of APD-40 is an ideal location for an industrial park if the proposed intersection is completed. The proximity of I-75 and APD-40 allows for easy access for shipping and employees without causing unnecessary traffic on local roads. There is a lot of undeveloped land currently available in this area and the future land use plan indicates it will become more commercial. Creating an industrial park here will provide job growth in the community. Water and electricity are already available to this location. Sewer is the only utility not available but plans have been made to make it available.

The area around Exit 20 is also the natural gateway to the Ocoee River rafting and recreation area. Of the three exits in Cleveland, Exit 20 provides the easiest access to Highway 64 and Polk County. In addition to an Industrial Park additional commercial and regional attractions around Exit 20 would be appropriate. Senator Lamar Alexander has proposed a future U.S. Forest Service site that could be located at this site. Moving the Cherokee National Forest Headquarters to this location along APD-40 near I-75 Exit 20, coupled with a Visitors Center would draw attention to the area by promoting the regional opportunities. A large outdoor recreation retailer, such as Bass Pro Shop, near this location complement the region's many outdoor activities in Polk County and elsewhere. This area around Exit 20 is the ideal location for an Ocoee Regional Gateway.



Proposed Future Land Use

Enterprise South is a mega industrial site 11 miles south of I-75 Exit 20. It has recently been considered by Kia and Toyota as a location for their new auto plants. In a February 28, 2007 *Chattanooga Times Free Press* article entitled "Auto plant still in future?" Toyota's site selection leader said he "expects to see a future auto assembly plant at Chattanooga's Enterprise South industrial park." If an auto plant does locate at Enterprise South, then an industrial park near Exit 20 in Cleveland would be in a good location for automobile industry-related businesses. After Toyota put a plant in Georgetown, Kentucky, the number of auto parts manufacturers grew from 55 to 175 in 2004 (February 25, 2007 *Chattanooga Times Free Press* article "Kentucky town offers glimpse at car plant bounty"). To capitalize on that kind of growth potential preparing this location in advance is key.



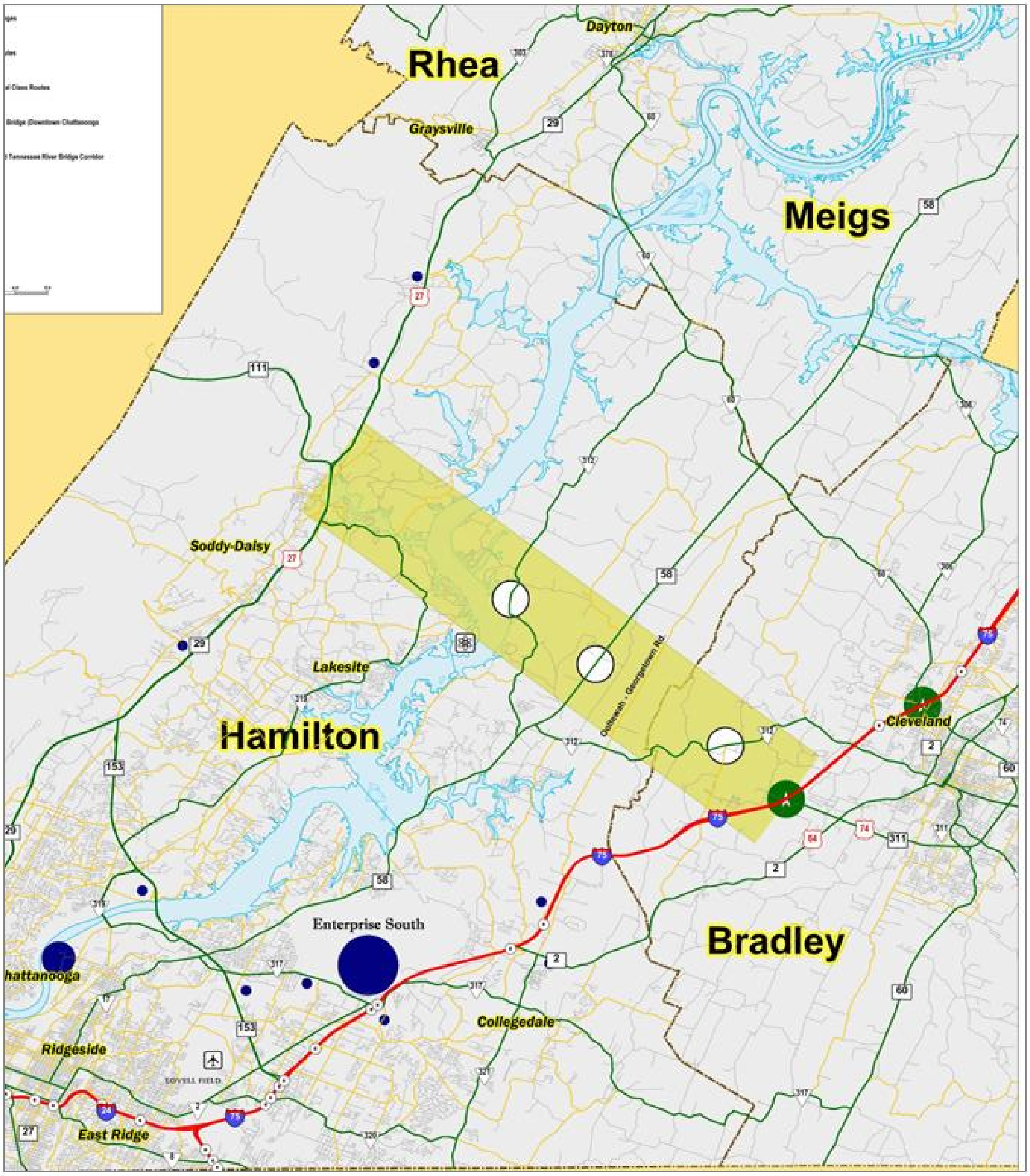
Future Land Use – Bradley County

Future Roads

New traffic lights are planned for the on and off ramps at Exit 20. These will facilitate safer movement of traffic, especially left turn movements, as motorists and truckers navigate the junction of I-75 and APD 40. The traffic lights, while an improvement, are not a substitute for the sorely needed improvements to the substandard Exit 20. The nearby interchange or intersection on APD-40 would connect to a future frontage road system that would serve commercial and industrial areas near the APD-40 corridor. Residential development north and south of the corridor would connect to APD-40 and Exit 20 via existing and future local roads.

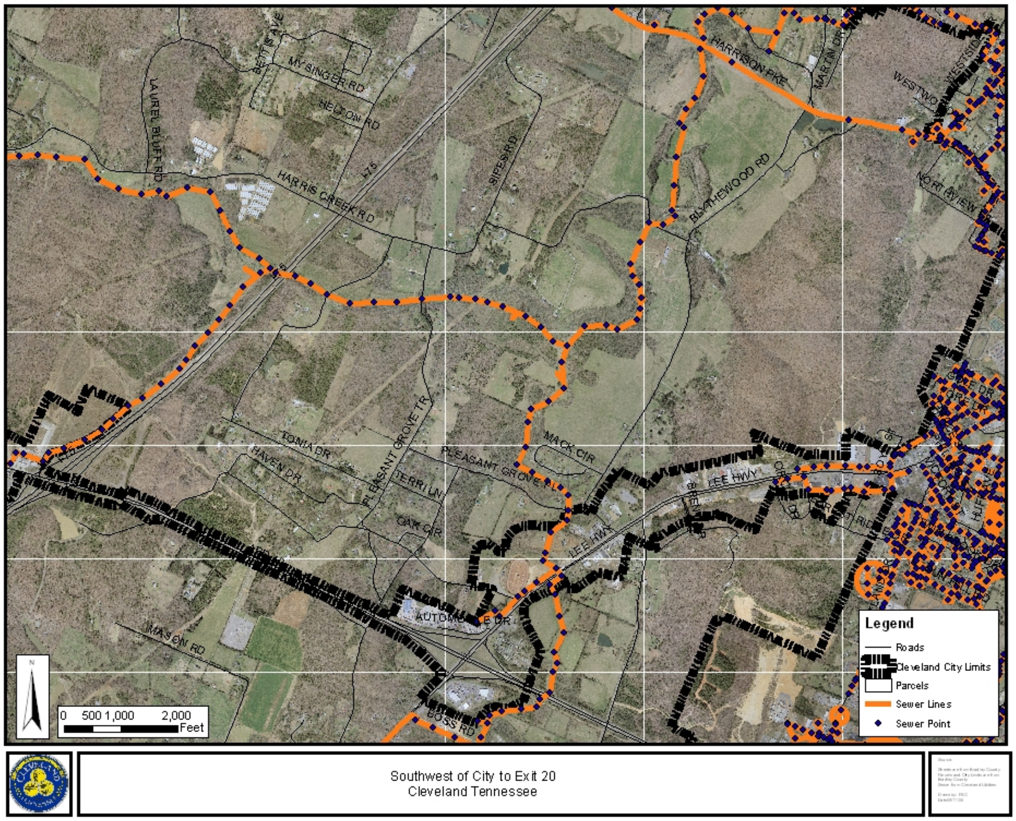
Corridor K was discussed above and it is the major national and regional facility of the future that runs along APD-40 and finds its western terminus at Exit 20. Also under consideration is a future toll-based facility that involves a new bridge crossing of the Tennessee River north of SR 153 in Hamilton County (see TDOT study area map below). This facility would involve an extension of SR 312 to Exit 20 and would connect through to SR 111 near Soddy Daisy. Such a connection would make a new major east-west route in the region, greatly facilitating travel and commerce. The importance or Corridor K and the future toll-based route, in terms of overall highway connectivity and the removal of east-west travel barriers, should not be overlooked.

STUDY AREA



Future Utilities

Most of the land in the study area is not affected by severe slopes. Cleveland Utilities prepared plans in 1996 to serve these areas but the lines were not constructed. The County has recently received a CDBG grant to construct sewers to serve the Tonia Drive area which would be part of the line extension to serve south side of APD 40. Future development areas north of APD-40, those areas which could be expected to develop more rapidly as a result of the major road improvements discussed in this report, would be served by connections to the main sewer lines already in place or those which are planned.



Aerial and sewer map

Conclusion

The land in the study area is a logical location for future urban development including commercial, industrial, and residential uses. These future land uses are supported by the plans of the Cleveland Urban Area MPO, Bradley County, and the City of Cleveland. The natural characteristics of the land, existing and proposed utilities, and existing and proposed roads would support such a development pattern. The proposed improvements to I-75 Exit 20 and the nearby APD-40 interchange or intersection are needed to meet current passenger and freight transportation needs, to mitigate safety and congestion concerns, and to support the aforementioned future logical pattern of development within the study area. The proposed improvements are also justified in terms of their connection to regional economic development in nearby Chattanooga, in terms of tourism and the public's access to the Cherokee National Forest and the historical and cultural resources associated with the Trail of Tears, and in terms of the future regional and national transportation systems that must make efficient use of existing facilities, provide intermodal connections, and enhance transportation security. The primary transportation improvements contemplated in this study, the improvements to I-75 Exit 20 and the nearby APD-40 interchange or intersection, are needed to support current needs of the area as well as the envisioned future land use and economic development.

APPENDIX H

COORDINATION MEETING SUMMARIES

LONG
ENGINEERING, INC

November 6, 2007

Mr. Ron Baker
Short Range Planning & Data Office
Suite 1000, James K. Polk Building
505 Deaderick Street
Nashville, Tennessee 37243-0334

RE: E1125, Work Order 10 & 13, Data Needs Meeting with Cleveland Representatives US-64 IJS and the Exit 20 IMS.

The following summarizes the meeting with City of Cleveland personnel on October 17, 2007.

<u>Attendees</u>

Greg Thomas	423-479-1913	gthomas@cityofclevelandtn.com
Anthony Casteel	423-479-1913	acasteel@ cityofclevelandtn.com
James Long	423-559-3330	jlong@cityofclevelandtn.com
Tom Grant	423-472-2851	tgrant@cityofclevelandtn.com
Brad Winkler	615-221-1131	bwinkler@longeng.com
Steve Bryan	615-221-1131	sbryan@longeng.com

On October 17-18 Long Engineering performed reconnaissance activities associated with the IJS and IMS of the US-64 corridor and I-75 in Bradley County, Tennessee.

In advance of this trip, we forwarded a “shopping list” for data requests. Upon meeting with the representatives identified above, Mr. Castel provided CDs with much of the information we requested. This included GIS shape files, the Transcad Files for the Cleveland transportation model, and current land use planning activities associated with the corridor.

Mr. Grant indicated that the GIS was Bentley based and the files were also available in dgn format and HMRs were available for the study area. The City prepared CDs with this information and we picked up from the Engineering Department on the 18th.

Sincerely,

LONG ENGINEERING, INC

Brad S. Winkler

Brad Winkler, P.E.
Project Manager
bwinkler@longeng.com

cc: Michael Updike, TDOT
Project File

LONG
ENGINEERING, INC

November 6, 2007

Mr. Ron Baker
Short Range Planning & Data Office
Suite 1000, James K. Polk Building
505 Deaderick Street
Nashville, Tennessee 37243-0334

**RE: E1125, Work Order 10 & 13, US-64 IJS and the Exit 20 IMS.
Additional Considerations for Studies**

The following summarizes the project working meeting with TDOT personnel on October 29, 2007.

Attendees

Bill Hart	741-3688	bill.hart@tdot.state.tn.us
Terry Gladden	253-2433	terry.gladden@tdot.state.tn.us
Ron Baker	741-6743	ron.baker@state.tn.us
Mike Updike	253-4007	mike.updike@state.tn.us
Brad Winkler	221-1131	bwinkler@longeng.com
Steve Bryan	221-1131	sbryan@longeng.com
Bob Baird	221-1131	bbaird@longeng.com

Long Engineering personnel met with TDOT personnel to discuss items specific to the above referenced projects. Many of these items were funding issues and deemed not necessary for Long Engineering's activities at this time.

The Team reviewed the base mapping compiled to date and discussed the known issues that have been brought to the table. These items are chiefly:

- Providing access to the area of land adjacent to US 64 that is slated for development by the City of Cleveland
- Improving the operation of the Exit 20 Interchange
- Consider access to a potential Forest Service Welcome Center
- As this location is the staring point for the ARC's Corridor K, there is interested in creating a gateway corridor.

Long Engineering will factor these items into the concept planning process and commence concept work which will consist of single line sketches and will target the week of 11/19 for an update meeting with TDOT personnel.

A stakeholders meeting is tentatively set for December 12. Long Engineering will coordinate this meeting with Janice Casteel (423) 593-3339 cell. TDOT will confirm this meeting date with Steve Allen prior to Long Engineering proceeding with meeting arrangements.

Sincerely,

LONG ENGINEERING, INC

Brad S. Winkler

Brad Winkler, P.E.
Project Manager
bwinkler@longeng.com

cc: Michael Updike, TDOT
Project File

LONG
ENGINEERING, INC

November 27, 2007

Mr. Ron Baker
Short Range Planning & Data Office
Suite 1000, James K. Polk Building
505 Deaderick Street
Nashville, Tennessee 37243-0334

**RE: E1125, Work Order 10 & 13, US-64 IJS and the Exit 20 IMS.
Progress Meeting/Initial Concepts**

The following summarizes the working meeting with TDOT personnel on November 21, 2007.

<u>Attendees</u>

Steve Allen	741-2208	steve.allen@tdot.state.tn.us
Terry Gladden	253-2433	terry.gladden@tdot.state.tn.us
Ron Baker	741-6743	ron.baker@tdot.state.tn.us
Mike Updike	253-4007	mike.updike@tdot.state.tn.us
Tony Armstrong	741-6741	tony.armstrong@tdot.state.tn.us
Brad Winkler	221-1131	bwinkler@longeng.com
Steve Bryan	221-1131	sbryan@longeng.com
Bob Baird	221-1131	bbaird@longeng.com

Long Engineering (LONG) personnel met with TDOT personnel to discuss the initial concepts for the above referenced projects. The following highlights general discussion items:

- Do not show slip ramps to any entrance ramps. Slip ramps off of exit ramps may be OK depending on circumstances.
- Show ROW constraints for loop ramp concepts at Exit 20.
- The structure over I-75 will be a minimum of five lanes. In all likelihood, there will be more than five lanes.
- No fly-over or signal options in lieu of new interchange. Signal concept is removed form further consideration.
- Area is classified as urban.
- Stay away from lake in all options except the SE quadrant loop ramp scenario.
- Show frontage roads, or other non-TDOT responsible infrastructure, as dashed. TDOT will be responsible to provide only the minimum route needed for connectivity to local roads.
- Other than the options listed below, the remaining concepts are removed from further consideration.

Action Items

- Revise concepts based on the following criteria:
  - Exit 20 Concepts
    1. Option 1 is Improved Traditional Diamond (no loops)
    2. Option 2 is Loop in NW Quadrant only
    3. Option 3 is Loop in both NW and SE Quadrants
    4. Option 4 is SPUI
  - APD Concepts
    1. Option 1 is original concept 6
    2. Option 2 is original concept 4 (with an adjusted entrance road)
    3. Option 3 is original concept 5A
    4. Option 4 is original concept 7
- LONG will prepare four (4) new drawings that pair the concepts above such that all eight options are depicted. Options from Exit 20 and APD Concepts may be interchangeable.
- Get TDOT concurrence on revised concepts by TDOT by 12/3.
- Prepare high-level cost estimates for approved single line option drawings.
- TDOT will supply traffic.
- Prepare stakeholder meeting materials.
- A stakeholders meeting is to be set upon confirmation with Steve Allen's schedule (Mid-December).
- Ron Baker is to call Janice Casteel to give her a status report.
- LONG will work with Ron and Janice to finalize meeting arrangements.

If you have any questions or comments let us know.

Sincerely,

LONG ENGINEERING, INC

Brad S. Winkler

Brad Winkler
Project Manager
bwinkler@longeng.com

cc: Steve Allen
Terry Gladden
Michael Updike
Tony Armstrong
Project File

LONG
ENGINEERING, INC

January 22, 2008

Mr. Ron Baker
Short Range Planning Office
Suite 1000, James K. Polk Building
505 Deaderick Street
Nashville, Tennessee 37243-0334

RE: E1125, Work Order 10 & 13, US-64 IJS and the Exit 20 IMS.
Project Stakeholder Meeting on December 20, 2007 in Cleveland, TN

The following summarizes the stakeholder meeting with TDOT, the City of Cleveland personnel and other stakeholders on December 20, 2007.

The meeting started at 1:00 PM in the auditorium at the Cleveland Chamber of Commerce. Prior to the meeting, attendees had the opportunity to review the available concepts displayed throughout the room. After the presentation concluded, attendees again had the opportunity to review the various concepts with TDOT and Long Engineering staff available for assistance. The concepts presented included four for Exit 20 and four for the APD interchange.

Cleveland Mayor Tom Rowland offered opening remarks and turned the presentation over to Steve Allen. Steve presented the concepts and discussed pros and cons for each scenario. After the Exit 20 concepts he entertained questions then presented the APD interchange concepts before again opening the presentation to questions and answers.

Questions and Discussion

The following summarizes the questions received and subsequent discussion for each location.

Exit 20 Concepts Discussion

- Ron Braam inquired as to how many lanes could I-75 accommodate. Steve Allen indicated that the highway was constructed such that additional lanes could be added to the inside without significantly impacting ramps. If more lanes were needed then those would need to be added to the outside.
- Gary Farlow asked Steve Allen which concept he preferred based on future projected traffic. Steve indicated that traffic analysis had not yet been done as the future volumes were just recently prepared. But, based on the potential ROW impacts and as long as the traffic analysis indicates that the concepts are feasible, his preference is for Concepts 1 or 4.

- John Brewer indicated his preference for a straight diamond improvement to minimize impact to adjacent properties.
- Megan Wilson indicated that there is a proposed signal to the west of the interchange and is concerned about its functionality and all the driveway cuts in the area. She indicated additional concern if the ramp terminal is signalized and shifted to the west.
- Tom Grant commented that the interchange serves the entire south end of Bradley County. The future model should cover this.
- This is the gateway to Corridor K and there is a federal earmark to fund the study of a new interchange on APD 40. Steve Allen indicated that TDOT's Chief Engineer, Paul Degges, indicated that some of the earmark possibly could be allocated to improvements at Exit 20 (this is being investigated).
- A question was asked if this would be designated the Sequoia Nuclear Plant Evacuation Route. Steve Allen responded that he wasn't sure but that any evacuation route would move traffic quickly away from the area.
- A question was asked regarding ROW and control at the ramps. Steve Allen responded that TDOT usually extends control access fencing 100 feet beyond the ends of the ramps and stops.
- Several locals indicated a preference to light the Exit 20 interchange. Steve Allen indicated this was not typically included in an Interchange Modification Study (IMS) but could be evaluated.

<u>APD Concept Discussion</u>

- The APD earmark is believed to be $5.17 million.
- It was noted that on Concept 1, the ROW needed to be adjusted on the south side of APD 40 at proposed relocations of the frontage road.
- It was noted that Concept 3 would limit the amount of developable land. Several locals indicated that this was not acceptable.
- Steve Allen stated that based on the current layout of Concept 4, the limited access ROW would prevent direct local access along the northern frontage road.[1]
- Steve Allen was asked which concept he preferred based on future projected traffic. Steve indicated that traffic analysis for the APD section had not yet been done as the future volumes were just recently prepared. But, based on the significant ROW impacts shown for Concepts 2 & 3, and as long as the traffic analysis indicates that the concepts are feasible, his preference is for Concepts 1 or 4.

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[1] After additional review, this may not be the case as the limits of controlled access may be adjusted. This would make Concept 4 more attractive to the locals than originally thought.

Exhibits

At the close of the meeting:

- The 100’ scale mounted displays were given to Scott Medlin for use at TDOT Region 2.
- One set of roll plots was given to the Cleveland Public Works Department for their use.
- The second set was given to State Representative Kevin Brooks.

Action Items

- Perform traffic analysis for each of the scenarios and discuss with TDOT before modifying or removing concepts from additional consideration.
- Coordinate with FHWA before public meeting
- A public meeting will be scheduled once the Exit 20 IMS and APD IJS are approved by TDOT and coordinated with the Federal Highway Administration (FHWA).

If you have any questions or comments let me know.

Sincerely,

LONG ENGINEERING, INC

Brad S. Winkler

Brad Winkler
Project Manager
bwinkler@longeng.com

cc: Steve Allen
Terry Gladden
Michael Updike
Project File

Attachment – List of Attendees
Meeting Presentation

List of Attendees

Name	Organization	Telephone	e-mail
Steve Allen	TDOT	615-741-2208	steve.allen@tdot.state.tn.us
Nermine Nashed	TDOT	615-741-0229	
Brad Winkler	Long Engineering	615-221-1131	bwinkler@longeng.com
Steve Bryan	Long Engineering	615-221-1131	sbryan@longeng.com
Bob Baird	Long Engineering	615-221-1131	bbaird@longeng.com
Gary Farlow	Chamber of Commerce	423-728-0804	gfarlow@clevelandchamber.com
Scott Medlin	TDOT	423-510-1118	scott.medlin@state.tn.us
Brian Beck	City of Cleveland	423-559-3330	bbeck@cityofclevelandtn.com
Mickey Torbett	United Community Bank	423-339-5460	mickey_torbett@ucbi.com
Mike Keith	City of Cleveland		
Bruce Jacobsen	Peyton SE	423-614-1063	bruce.jacobsen@kroger.com
Megan Wilson	City of Cleveland	423-593-2735	mwilson@cityofclevelandtn.com
Tom Rowland	City of Cleveland	423-476-8931	trowland@cityofclevelandtn.com
David Dumm	Fireworks Supermarket	423-478-3634	fireworksoveramerica14@earthlink.net
Daniel MacKey	Fireworks Supermarket	423-478-3634	fireworksoveramerica14@earthlink.net
James Rogers	Rogers & Rogers Inc.	423-238-4229	
Stephen A. Rogers	Rogers & Rogers Inc.	423-238-4229	
Patti Petitt	City of Cleveland	423-479-4129	
Wes Snyder	Cleveland Police Dept.	423-559-3311	
Bill Estes	City of Cleveland	423-595-0062	bestes@cityofclevelandtn.com
Jerry Bohannon	Chamber of Commerce	423-472-6587	jbohannon@clevelandchamber.com
Greg Thomas	City of Cleveland MPO	423-479-1913	gthomas@cityofclevelandtn.com
Tom Grant	City of Cleveland	423-472-2851	tgrant@cityofclevelandtn.com
Ron Braam	Mfg Demo Corp	423-476-6518	rbraam@synallloy.com
Kim Harpe	Southeast TN RPO	423-424-4268	kharpe@sedev.org
Randall Higgins	Times Free Press	423-479-7105	
Sandy Epperson	Horizon Travel Plaza	423-339-8820	store1017@horizontp.com
John H. Brewer	Brewer’s Exxon	423-479-2653	
Jonathan Jobe	City of Cleveland	423-593-3821	jonathanjobe@cityofclevelandtn.com
Ben Atchley	Cleveland Fire Dept.	423-476-6753	batchley@cityofclevelandtn.com
Terry Pierce	U.S. Forest Service	423-476-9700	terrypierce@fs.fed.us
Leigh McClure	U.S. Rep. Wamp	423-756-2342	
Kelly Fisher	U.S. Sen. Alexander		
David Davis	Banner	423-472-5041	
Kevin Brooks	State Representative	615-741-1350	rep.kevin.brooks@legislature.state.tn.us
Larry Arman		423-899-5182	acre4fun@comcast.net
Nelson Bowers		423-510-8440	nebco@aol.com
Chuck Atchley			
M. Schench		423-476-9163	

LONG
ENGINEERING, INC

January 29, 2008

Mr. Ron Baker
Short Range Planning Office
Suite 1000, James K. Polk Building
505 Deaderick Street
Nashville, Tennessee 37243-0334

RE: E1125, Work Order 10 & 13, US-64 BP (APD-40) IJS and the Exit 20 IMS. Traffic Analysis Review

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The following summarizes the project meeting with TDOT personnel on January 14, 2008.

Attendees

Ron Baker	741-6743	ron.baker@state.tn.us
Mike Updike	253-4007	mike.updike@state.tn.us
Brad Winkler	221-1131	bwinkler@longeng.com
Steve Bryan	221-1131	sbryan@longeng.com
Steve Allen	741-2208	steve.allen@state.tn.us
Terry Gladden	253-2433	terry.gladden@state.tn.us

Long Engineering personnel met with TDOT personnel to review the traffic analysis for APD interchange and Exit 20 Interchange studies.

Exit 20 Traffic Analysis

- Traffic analysis was completed for each of the four concepts presented at the December 20, 2007 stakeholder meeting in Cleveland, TN.

- For Concept 1, the critical movement is the westbound to southbound AM peak hour movement. A double left will be needed for this movement until 2028 at which time a triple left may be needed. It is important to note that future traffic projections are highly speculative due to the nature of the model and the potential for development in the area. As a result, a double westbound to southbound left movement for Concept 1 will initially be implemented since it is sufficient at this time, however the bridge structure will be designed to stripe out a third left turn lane in the future if it becomes necessary.

- A loop ramp as presented in Concepts 2 and 3 works best for this location. However, the ROW impacts and local preference may deem this as unacceptable.

- In order to better accommodate the westbound then south heavy volumes, consideration was given for a flyover. However, after sketching the flyover and reviewing the length of structure necessary, it was determined that such a structure would be cost prohibitive and not necessarily merited if future traffic does not meet projections. This concept could be revisited in the long-term.

- For Concept 4, a double left-tuning movement will be needed with the potential for a triple being required by 2028. Because the opposing left turn movements are such disproportionate, the application of a SPUI is out of context.

- Concept 1 will be presented to FHWA and discussed further.

APD Interchange Analysis

- Traffic analysis was completed for each of the four concepts presented at the December 20, 2007 stakeholder meeting in Cleveland, TN. Based on public input at the meeting, Concepts 2 and 3 should be removed from further consideration as they do not satisfy the needs of the community and will disrupt much of the land that the stakeholders are looking to develop.

- Concept 1 is conventional in design and shown to function at an acceptable level by the year 2033. There may be a need for the addition of auxiliary lanes along APD 40 between the on-ramps and the off-ramps.

- Concept 4 removes the weave situation, but is unconventional in design and may not be preferred over Concept 1.

- Both Concepts 1 and 4 will be presented to FHWA and discussed further.

Action Item
- Setup meeting with FHWA to present concept sketches.
    - Exit 20: Concept 1
    - APD: Concepts 1 and 4

Sincerely,

LONG ENGINEERING, INC

Brad S. Winkler

Brad Winkler, P.E.
Project Manager
bwinkler@longeng.com

cc: Steve Allen, TDOT
Michael Updike, TDOT
Terry Gladden, TDOT
Project File

Attachments: Traffic Data Tables and Exhibits

LONG
ENGINEERING, INC

April 2, 2008

Mr. Ron Baker
Short Range Planning Office
Suite 1000, James K. Polk Building
505 Deaderick Street
Nashville, Tennessee 37243-0334

RE: US-64 BP (APD-40) IJS and the Exit 20 IMS.
FHWA Meeting on 04-2-08
E1125, Work Order #10 – Project No. 06007-1237-14, PIN: 107386.00
E1125, Work Order #13 – Project No. 99107-7086-04, PIN: 110079.00

The following summarizes the project meeting with FHWA on April 2, 2008.

Attendees

Ron Baker	TDOT	741-6743	ron.baker@state.tn.us
Brad Winkler	LEI	221-1131	bwinkler@longeng.com
Steve Bryan	LEI	221-1131	sbryan@longeng.com
Brian Fouch	FWHA	781-5765	brian.fouch@fhwa.dot.gov
Rich Casalone	FHWA	781-5791	richard.casalone@ fhwa.dot.gov
Michael Smart	FHWA	781-5775	michael.smart@fhwa.dot.gov

General Discussion

TDOT and Long Engineering met with FHWA personnel to discuss the concepts that emerged from the December 20, 2007 stakeholder meeting and subsequent traffic operations analysis. This informational meeting preludes the submittal of required interchange studies.

FHWA was provided information packages highlighting the concepts presented at the stakeholder meeting and a summary of progress to date (attached). FHWA was also provided with 100 scale concept drawings for Concept 1 & Concept 4 for both the Exit 20 modification and proposed APD interchange.

FHWA confirmed that a Modification Study (IMS) is required for Exit 20 and a Justification Study (IJS) is required for the new APD interchange. As both projects are interrelated by proximity and functionality, both studies will reference each other and share common components.

Key points to consider:

- FHWA will need to know the level of commitment from local government officials for the APD interchange as a local connection to the proposed interchange.
- Be sure to document all removed concepts and show the process that was in place for advancing recommendations.
- FHWA requests that the proposed concepts be discussed with TDOT Design Division prior to IJS and IMS submittals.

Exit 20 Interchange

FHWA is in agreement that Concept 1 is preferred to Concept 4. The major concern for Concept 4 is the cost for the single-point structure being much greater than Concept 1. Additionally, since there is not a balance of opposing left-turns, a condition where the single-point functions best, then this option does not offer an improvement to Concept 1.

APD Interchange

FHWA is in agreement that Concept 1 is preferred to Concept 4. The major concern for Concept 4 is meeting driver expectations with the non-traditional ramp locations and the challenge to effectively sign and provide positive guidance for the configuration.

Action Item

- FHWA agreed that the preferred concepts for each case are Concept 1.
- TDOT Planning to review concept plans with TDOT Design Division.
- TDOT to determine level of commitment needed from local stakeholder regarding financial commitment (or commitment on build connecting roadways).
- Drafts of IMS and IJS to TDOT by April 30, 2008.

The above is from the notes and memory of the correspondent and is assumed to be a true and accurate account of this meeting. Please forward any comments, corrections, or clarifications to bwinkler@longeng.com.

Sincerely,

LONG ENGINEERING, INC

Brad S. Winkler

Brad Winkler, P.E.
Project Manager
bwinkler@longeng.com

cc: Meeting Attendees
Michael Updike, TDOT
Steve Allen, TDOT
Project File

Attachments: Meeting Handout

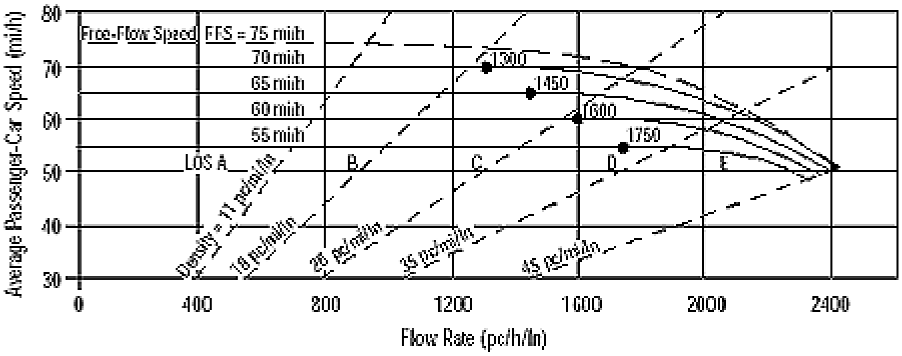
APPENDIX I

HIGHWAY CAPACITY ANALYSIS OUTPUT FILES

Mainline Segments

Highway Capacity Software
Computer Printouts

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 EB*
From/To	*I-75 to Prop Intx*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description   Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1439*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*859*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*15.5*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

N - Number of lanes

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10

E_T - Exhibits 23-8, 23-10, 23-11

f_p - Page 23-12

LOS, S, FFS, v_p - Exhibits 23-2, 23-3

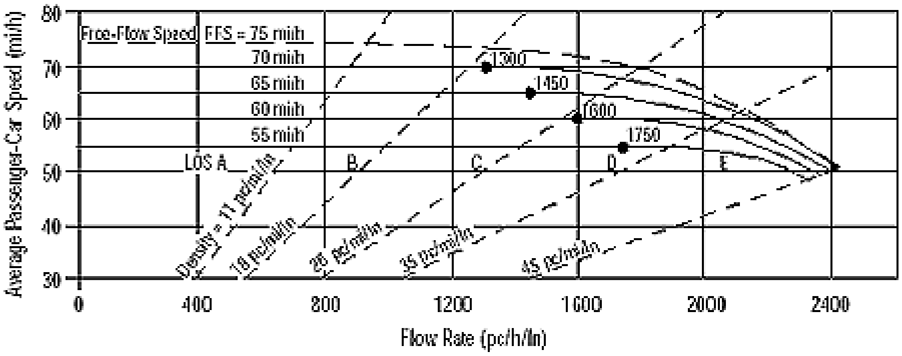
f_{LW} - Exhibit 23-4

f_{LC} - Exhibit 23-5

f_N - Exhibit 23-6

f_{ID} - Exhibit 23-7

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 EB*
From/To	*I-75 to Prop Intx*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1688*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1008*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*18.2*	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

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10

E_T - Exhibits 23-8, 23-10, 23-11

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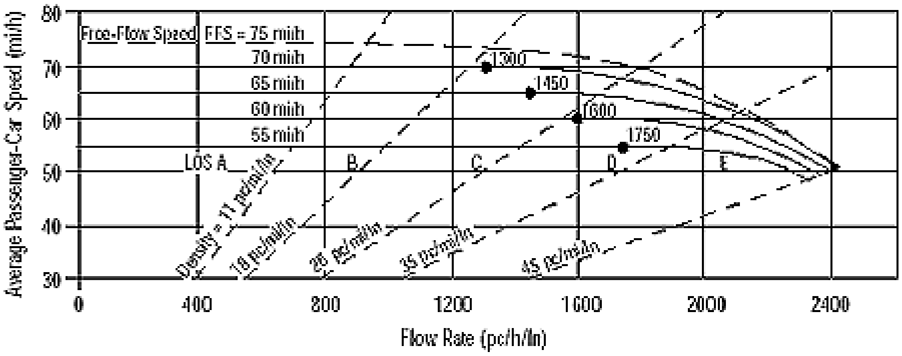
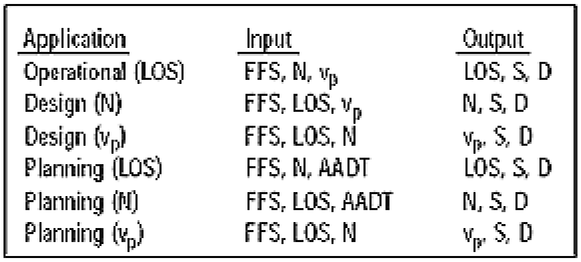
f_N - Exhibit 23-6

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Existing System Without Slip Lane

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

Flow Inputs

Volume, V	*2182*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1303*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*23.5*	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
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
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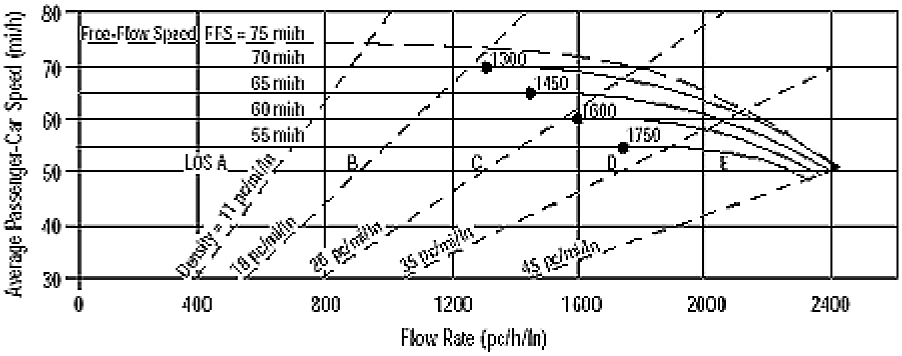
BASIC FREEWAY SEGMENTS WORKSHEET



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

General Information		***Site Information***	
Analyst	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description   Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*2553*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1525*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*27.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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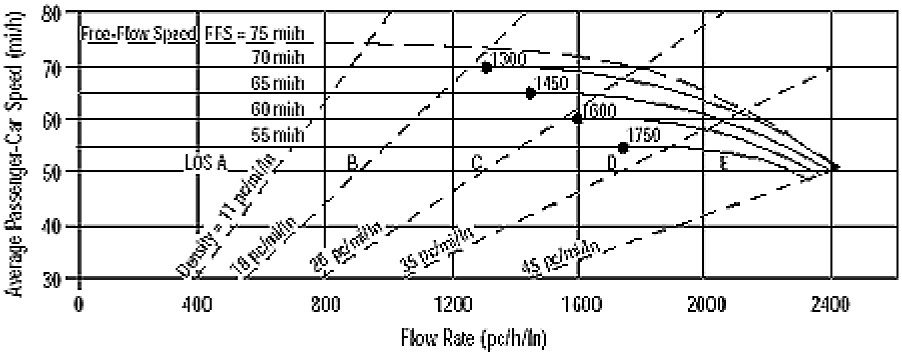
BASIC FREEWAY SEGMENTS WORKSHEET



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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1119*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

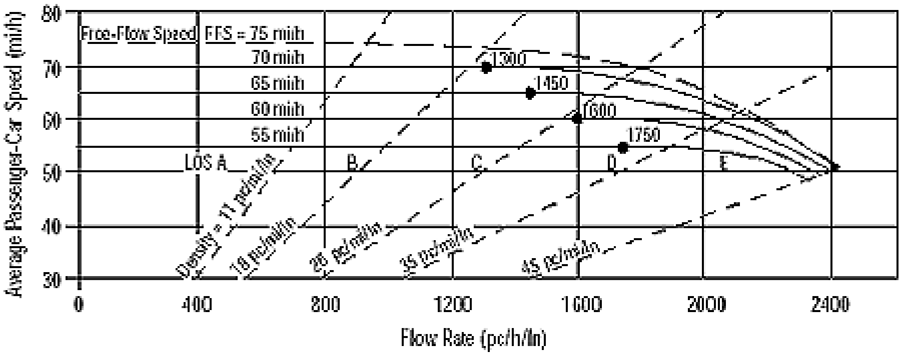
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**		
Operational (LOS)			Design (N)		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*668*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S	*55.5*	mi/h	S		mi/h
D = v_p / S	*12.0*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1718*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

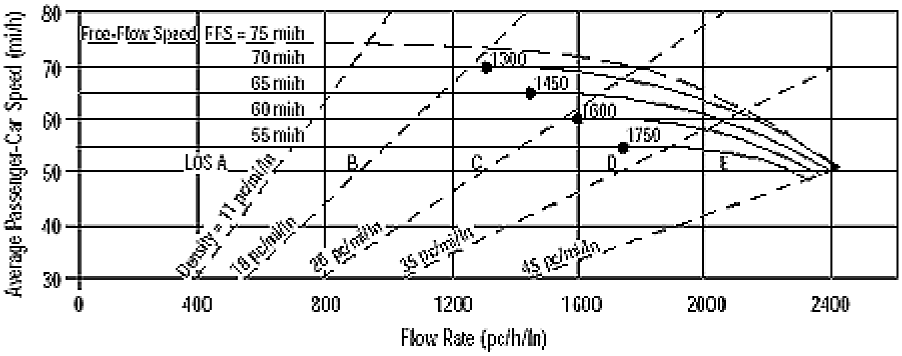
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

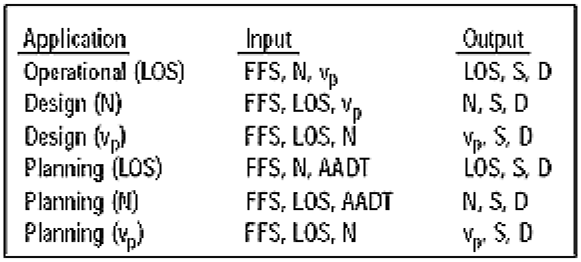
Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1026*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*18.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1682*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1005*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*18.1*	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

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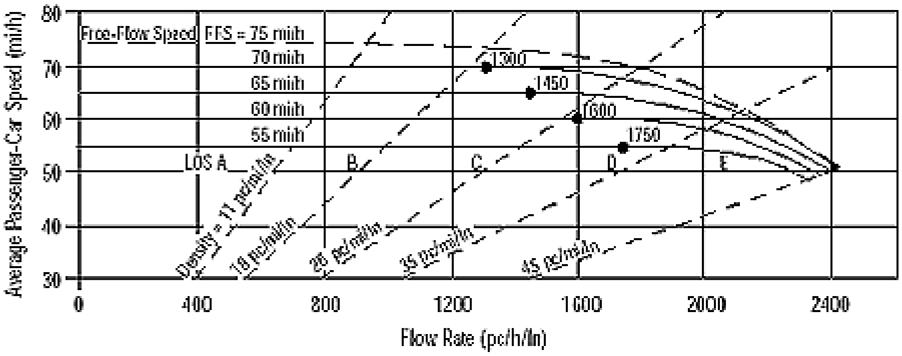

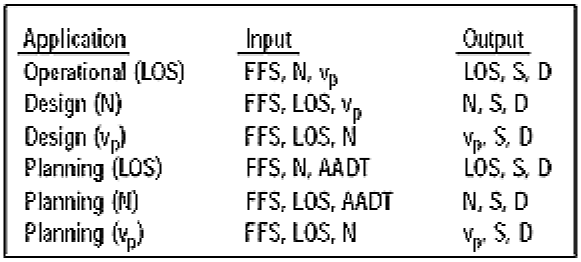

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2033*

Site Information

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*2542*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	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	*55.5*	mi/h
D = v_p / S	*27.4*	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
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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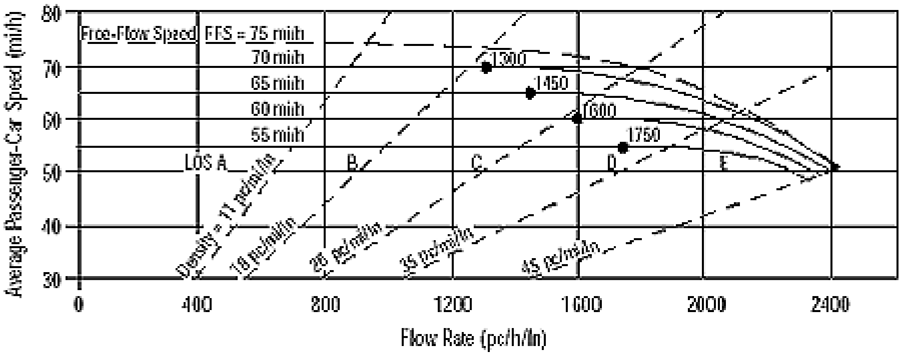


Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1657*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*990*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*17.8*	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	

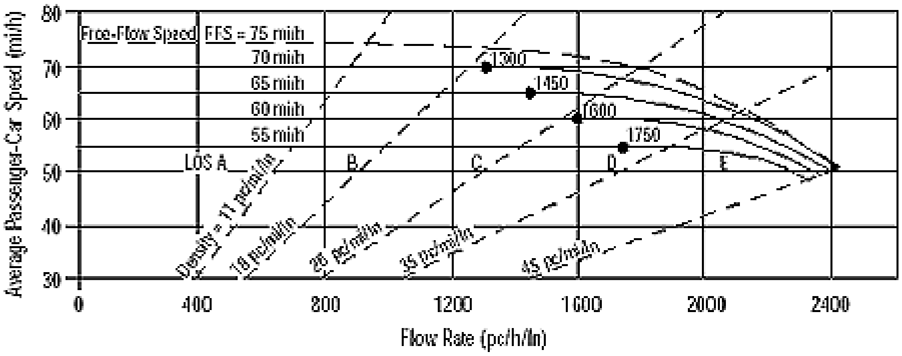
Glossary

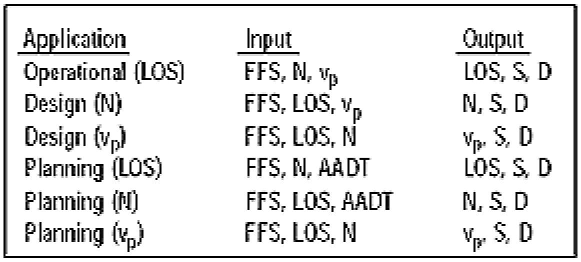
N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1313*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

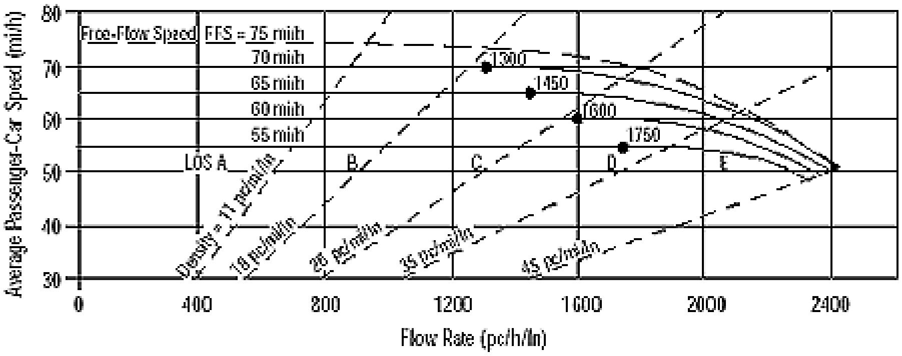
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*784*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*14.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 WB*
From/To	*East of S. Lee Hwy*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*2567*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1533*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*27.6*	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

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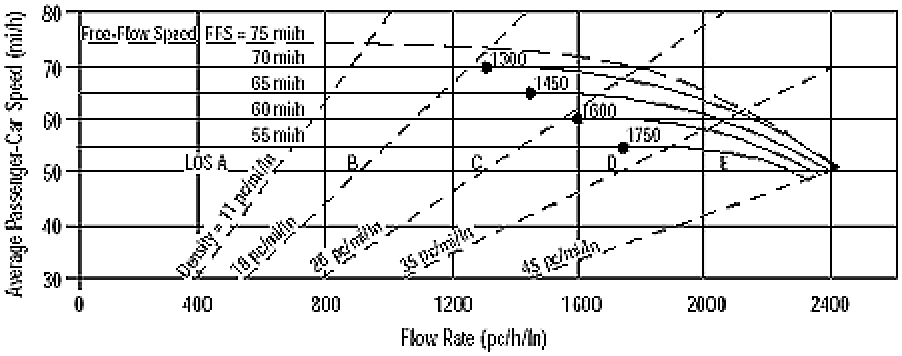

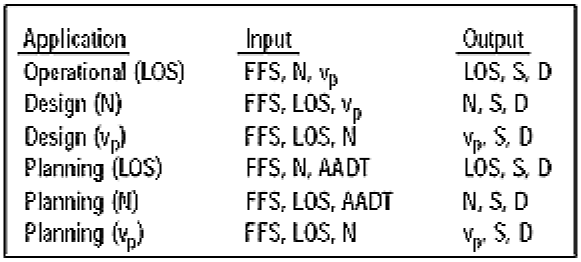

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information		***Site Information***	
Analyst	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1962*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1172*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*21.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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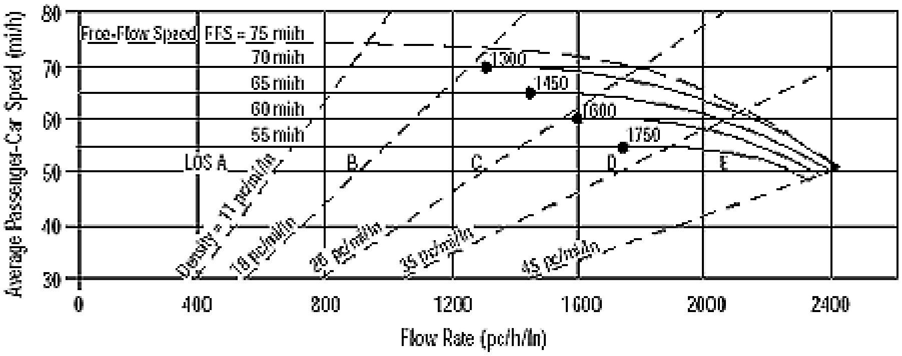


Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1751*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1046*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*18.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

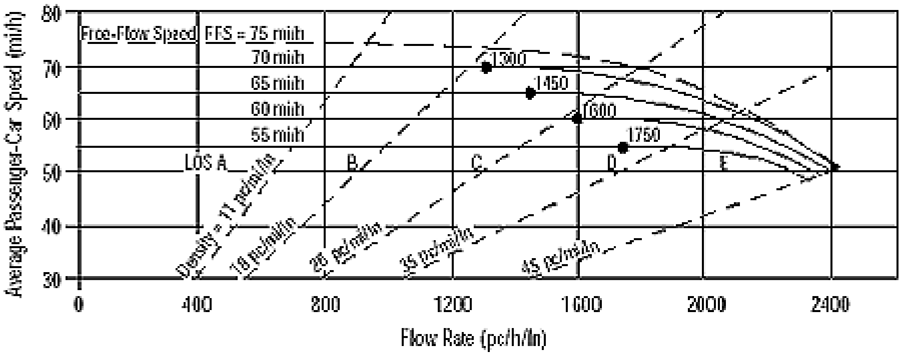
Glossary

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

Factor Location

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

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 WB*
From/To	*Prop Intx to I-75*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1638*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*978*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*17.6*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

N - Number of lanes

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10

E_T - Exhibits 23-8, 23-10, 23-11

f_p - Page 23-12

LOS, S, FFS, v_p - Exhibits 23-2, 23-3

f_{LW} - Exhibit 23-4

f_{LC} - Exhibit 23-5

f_N - Exhibit 23-6

f_{ID} - Exhibit 23-7

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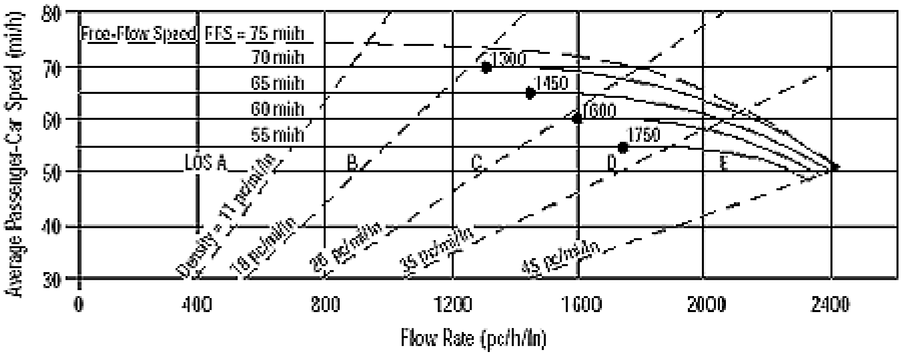

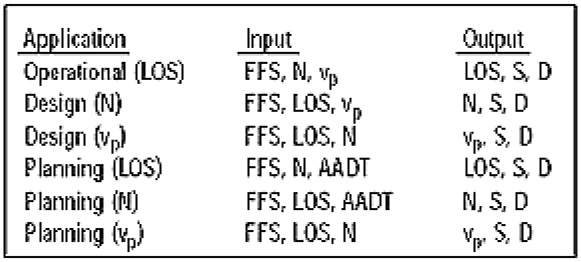

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*2700*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1612*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*29.0*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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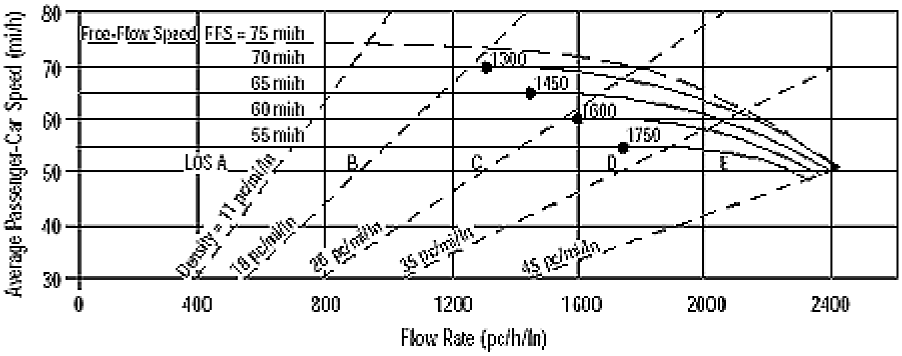

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / *Site Information*

Analyst	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*2513*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1501*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*27.0*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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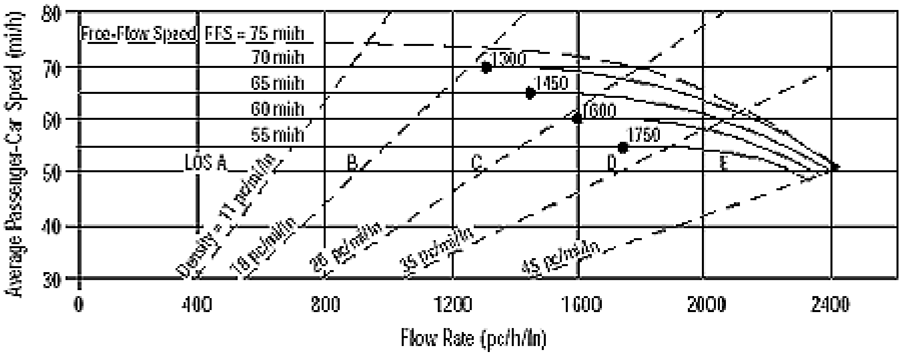
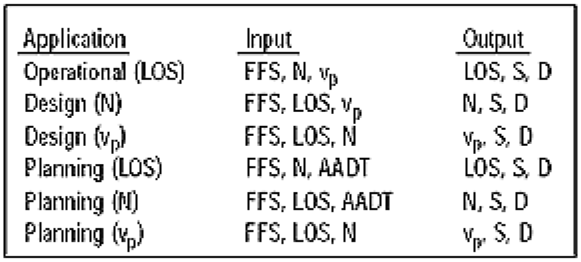
BASIC FREEWAY SEGMENTS WORKSHEET





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

General Information

Analyst	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Site Information

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*2595*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

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)	*1530*	pc/h/ln
S	*65.5*	mi/h
D = v_p / S	*23.4*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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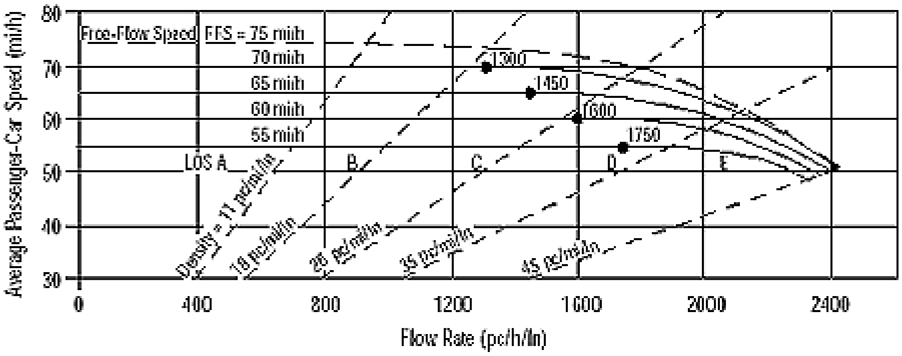
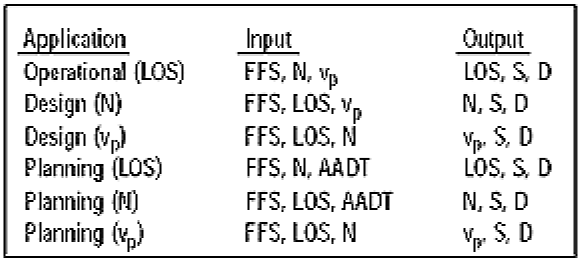
BASIC FREEWAY SEGMENTS WORKSHEET





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

General Information / *Site Information*

Analyst	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*4142*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

Speed Inputs / Calc Speed Adj and FFS

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

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2442*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S		mi/h	S	mi/h
D = v_p / S		pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*F*		Required Number of Lanes, N	

Glossary / Factor Location

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

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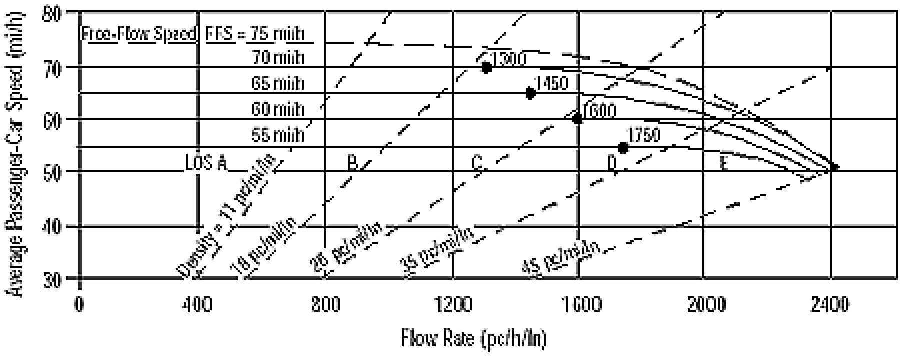
BASIC FREEWAY SEGMENTS WORKSHEET



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	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs				
Volume, V	*3788*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

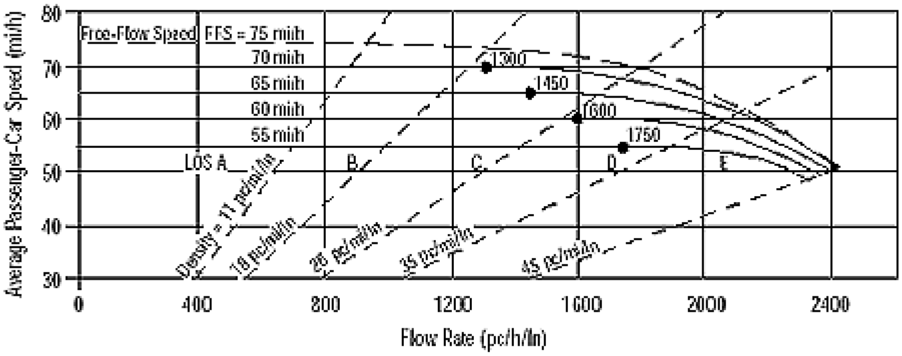
Calculate Flow Adjustments			
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.893*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*67.0*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1489*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*67.0*	mi/h	S	mi/h
D = v_p / S	*22.2*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*6066*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.893*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
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	*3.0*	mi/h
FFS	*67.0*	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	*53.1*	mi/h
D = v_p / S	*44.4*	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	

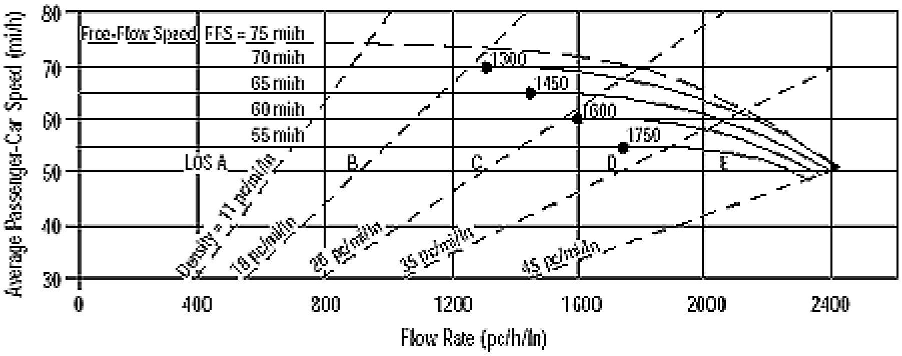
Glossary

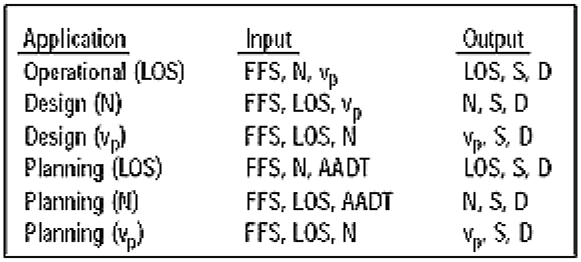
N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

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	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*North of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*1964*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

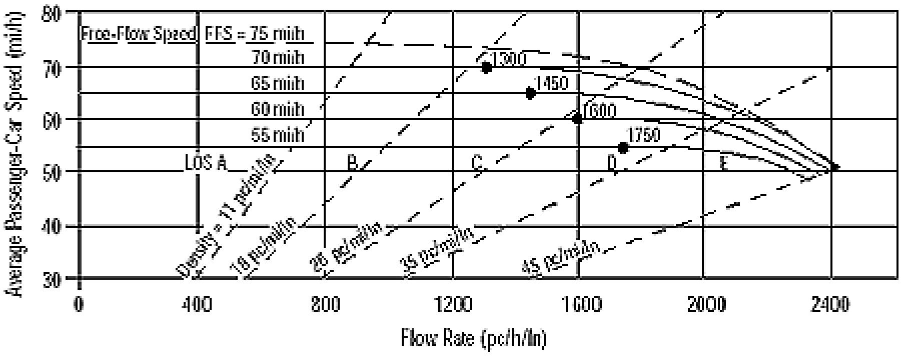
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

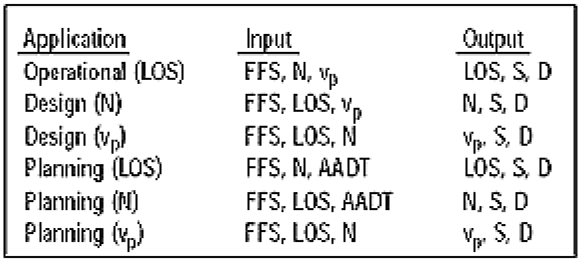
Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*65.5*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1163*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*65.5*	mi/h	S	mi/h
D = v_p / S	*17.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*North of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*3188*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

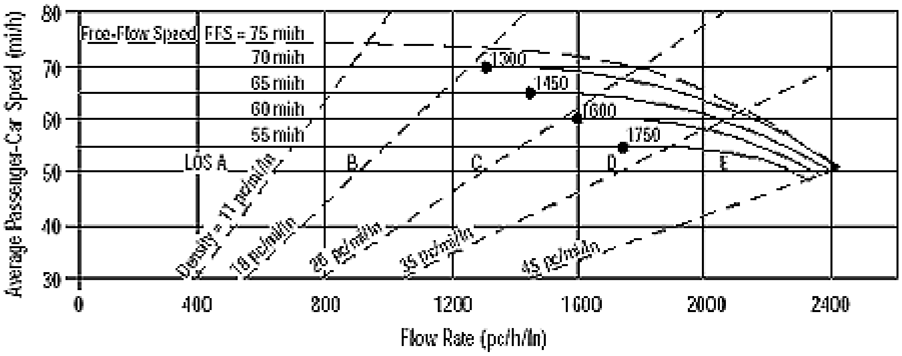
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.889*

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

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1888*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*63.4*	mi/h	S	mi/h
D = v_p / S	*29.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*North of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*2866*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*67.0*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1131*	pc/h/ln
S	*67.0*	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		

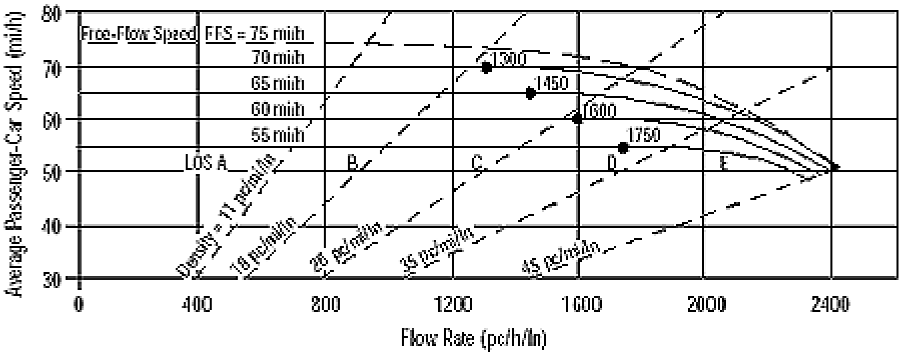
Glossary

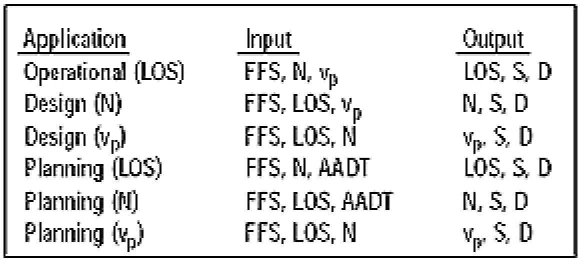
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*		
Agency or Company	*TDOT / Long Engineering*		
Date Performed	*05/04/2009*		
Analysis Time Period	*PM Peak Period*		

Site Information

Highway/Direction of Travel	*I-75 NB*
From/To	*North of APD-40*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*4616*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.889*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
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	*3.0*	mi/h
FFS	*67.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1822*	pc/h/ln
S	*65.3*	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

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10

E_T - Exhibits 23-8, 23-10, 23-11

f_p - Page 23-12

LOS, S, FFS, v_p - Exhibits 23-2, 23-3

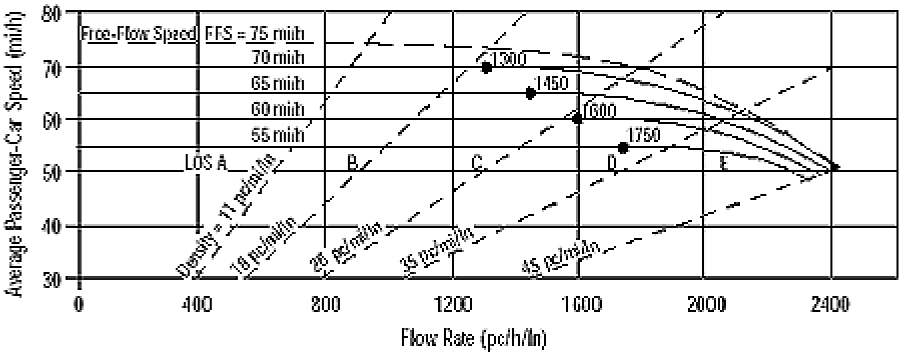
f_{LW} - Exhibit 23-4

f_{LC} - Exhibit 23-5

f_N - Exhibit 23-6

f_{ID} - Exhibit 23-7

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	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*North of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*2360*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

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)	*1397*	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

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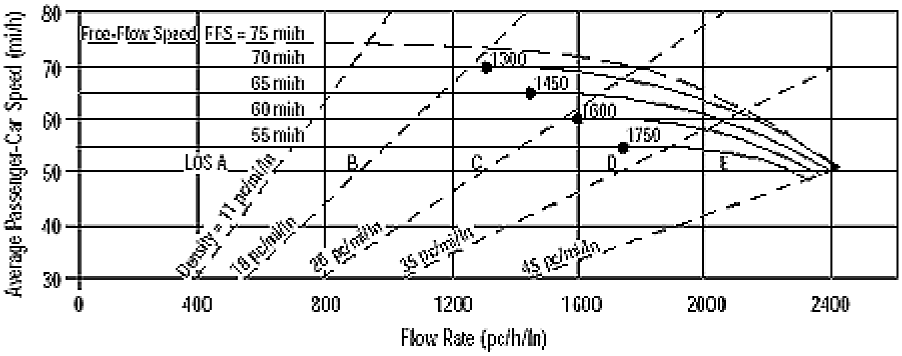
BASIC FREEWAY SEGMENTS WORKSHEET



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

General Information

Analyst	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*North of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

(Site Information)

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*2578*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

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)	*1526*	pc/h/ln
S	*65.5*	mi/h
D = v_p / S	*23.3*	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	

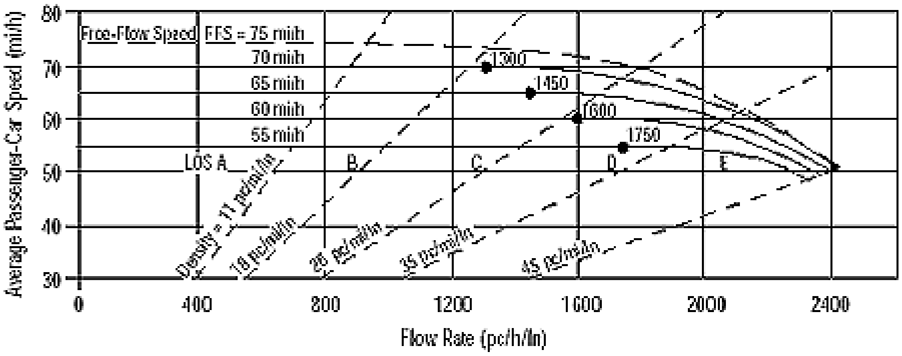
Glossary

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

Factor Location

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

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Highway/Direction of Travel	*I-75 SB*
From/To	*North of APD-40*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description   Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*3378*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
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	*3.0*	mi/h
FFS	*67.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1333*	pc/h/ln
S	*67.0*	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		

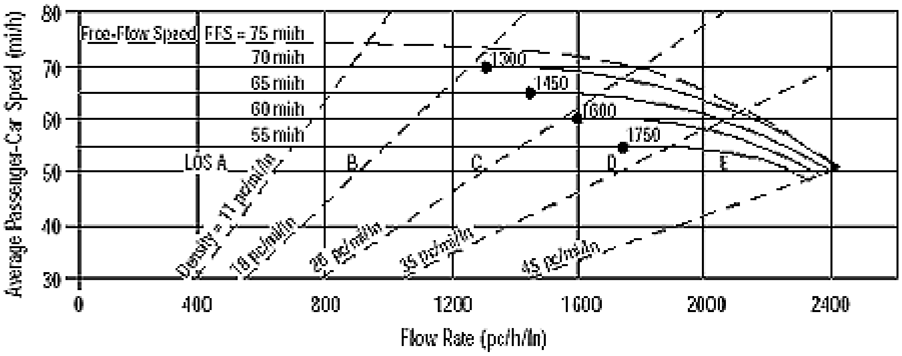
Glossary

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

Factor Location

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

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Highway/Direction of Travel	*I-75 SB*
From/To	*North of APD-40*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*3696*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.889*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
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	*3.0*	mi/h
FFS	*67.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1459*	pc/h/ln
S	*67.0*	mi/h
D = v_p / S	*21.8*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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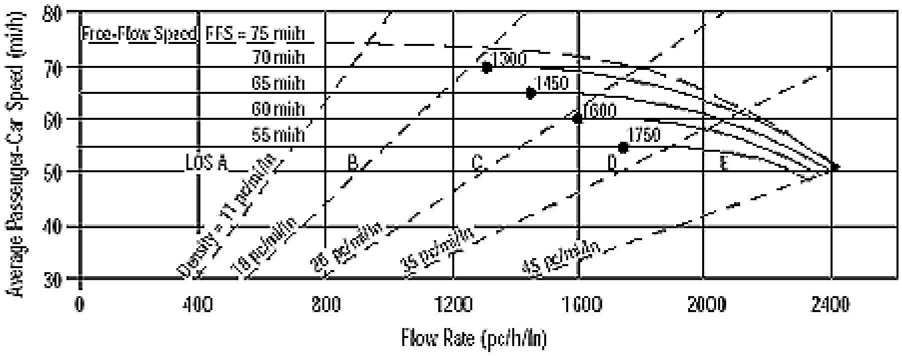
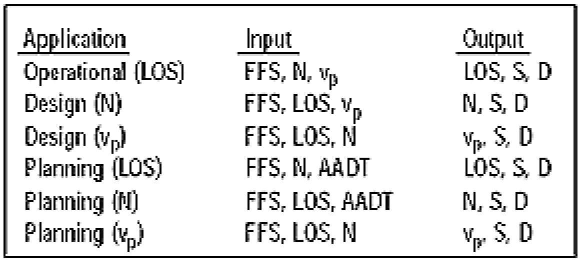
BASIC FREEWAY SEGMENTS WORKSHEET





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	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*3392*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

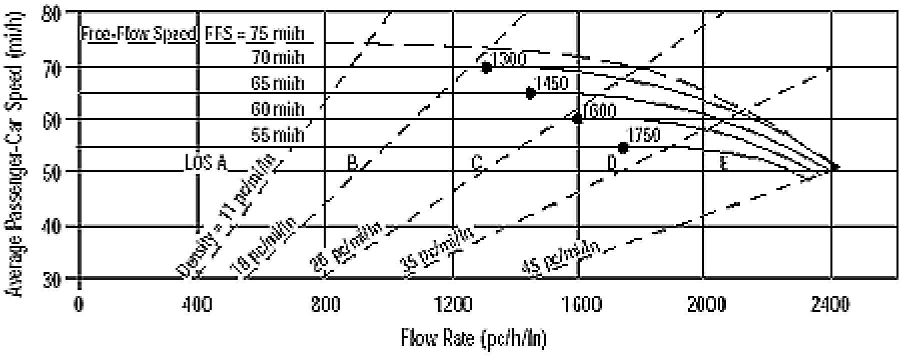
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

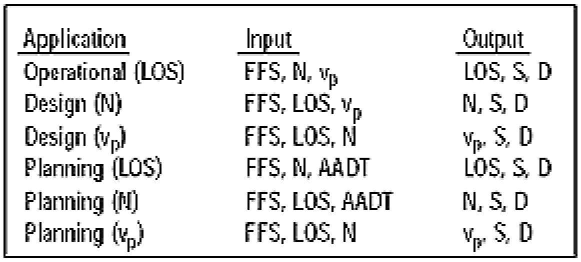
Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*65.5*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1999*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*61.8*	mi/h	S	mi/h
D = v_p / S	*32.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*3343*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

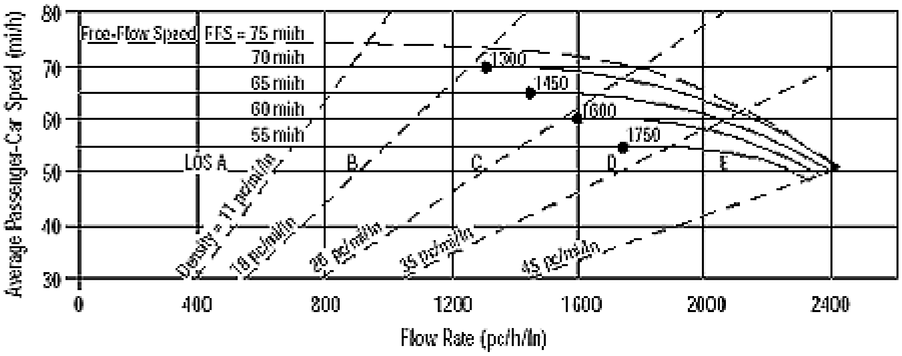
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

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

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1971*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*62.3*	mi/h	S	mi/h
D = v_p / S	*31.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*4959*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*67.0*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1949*	pc/h/ln
S	*63.7*	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		

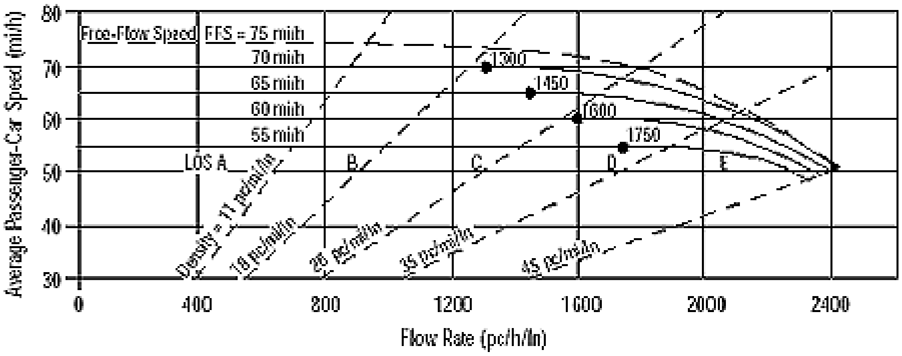
Glossary

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

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Existing System Without Slip Ramp

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

Flow Inputs

Volume, V	*4892*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*67.0*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1922*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*64.1*	mi/h	S	mi/h
D = v_p / S	*30.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

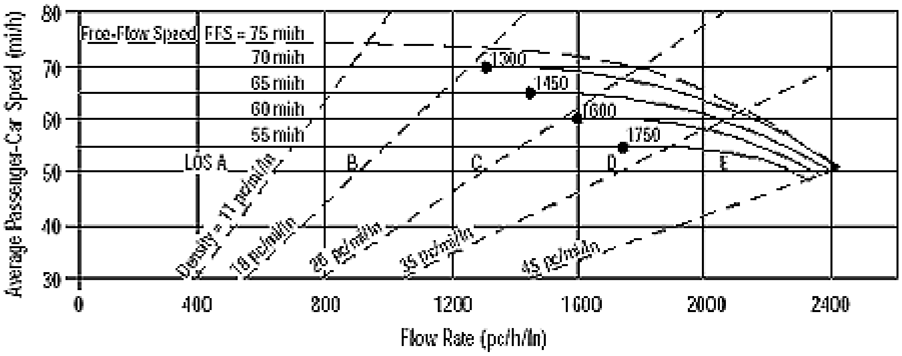
Glossary

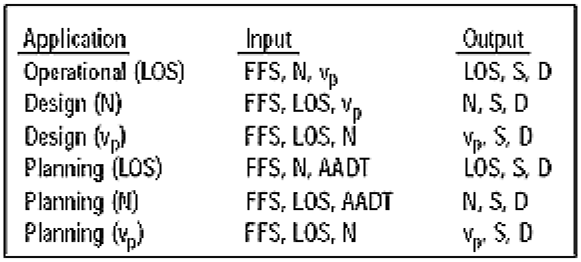
N - Number of lanes S - Speed
V - Hourly volume D - Density
v_p - Flow rate FFS - Free-flow speed
LOS - Level of service BFFS - Base free-flow speed
DDHV - Directional design hour volume

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 EB*
From/To	*I-75 to Prop Intx*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Existing System With Slip Ramp

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

Flow Inputs

Volume, V	*1272*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*760*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*13.7*	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	

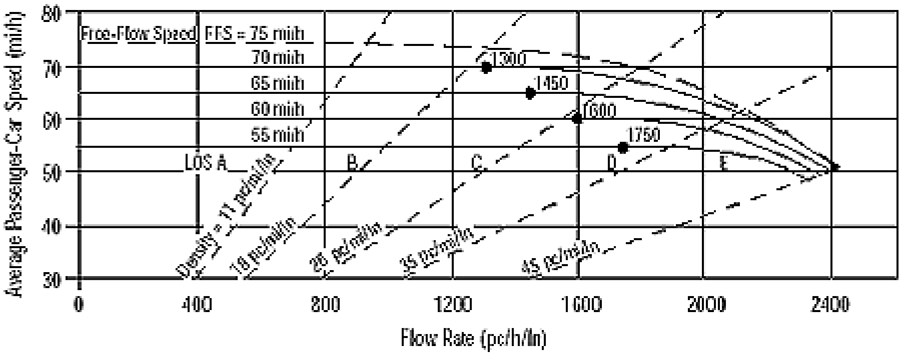
Glossary

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

Factor Location

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

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	*SKB*		
Agency or Company	*TDOT / Long Engineering*		
Date Performed	*05/04/2009*		
Analysis Time Period	*PM Peak Period*		

Site Information

Highway/Direction of Travel	*APD40 EB*
From/To	*I-75 to Prop Intx*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Existing System With Slip Ramp

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

Flow Inputs

Volume, V	*1565*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*935*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*16.8*	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		

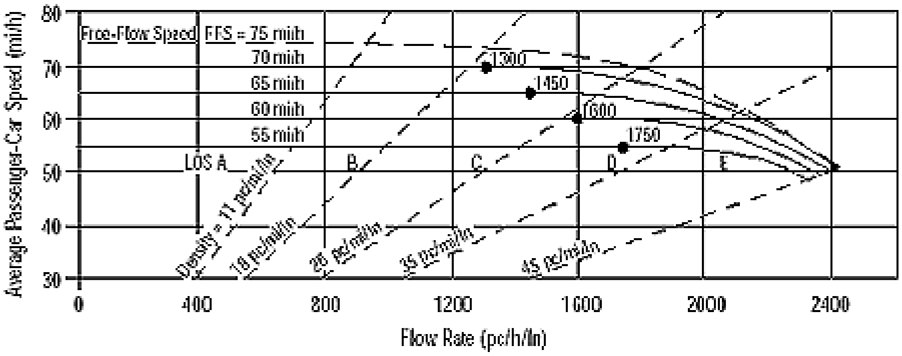
Glossary

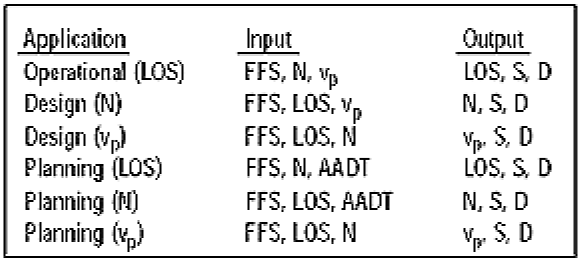
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 EB*
From/To	*I-75 to Prop Intx*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description Existing System With Slip Lane

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

Flow Inputs

Volume, V	*1930*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1153*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*20.8*	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		

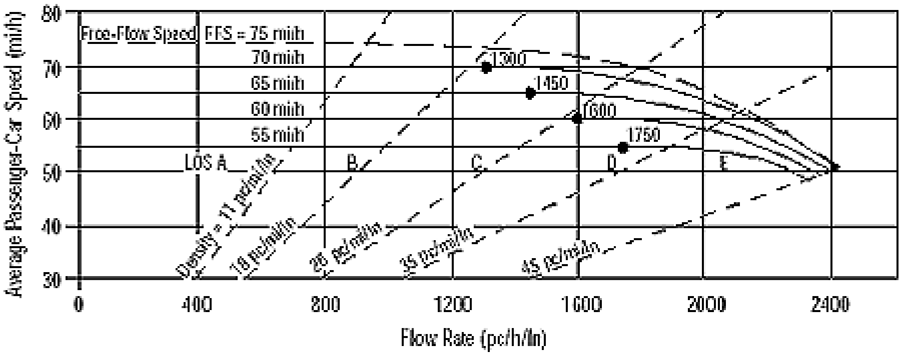
Glossary

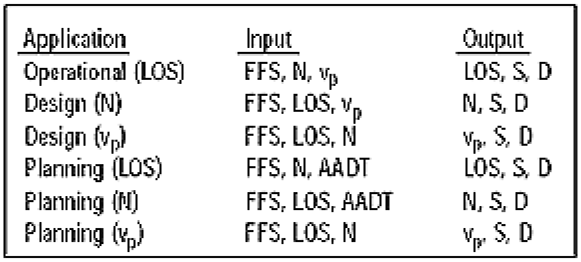
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 EB*
From/To	*I-75 to Prop Intx*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description Existing System With Slip Ramp

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

Flow Inputs

Volume, V	*2371*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1416*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*25.5*	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		

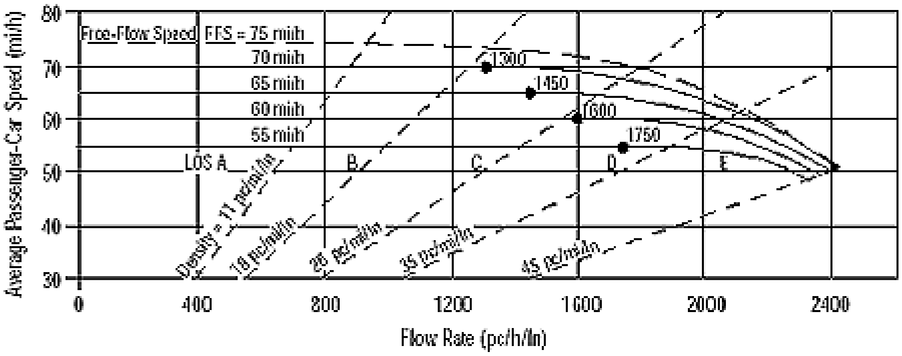
Glossary

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

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1510*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*902*	pc/h/ln
S	*55.5*	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		

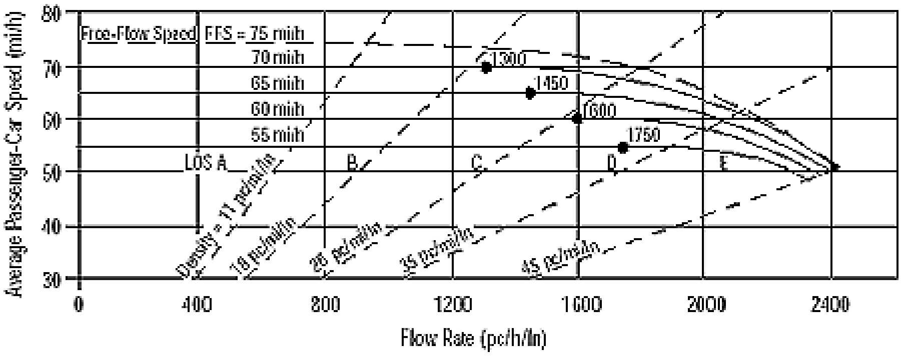
Glossary

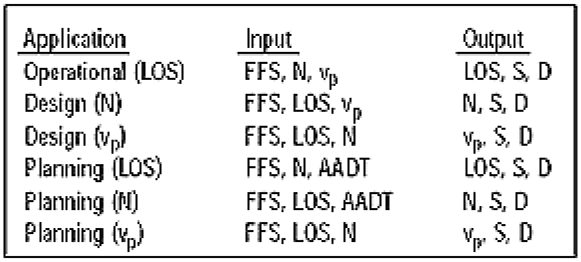
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1746*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1043*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*18.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

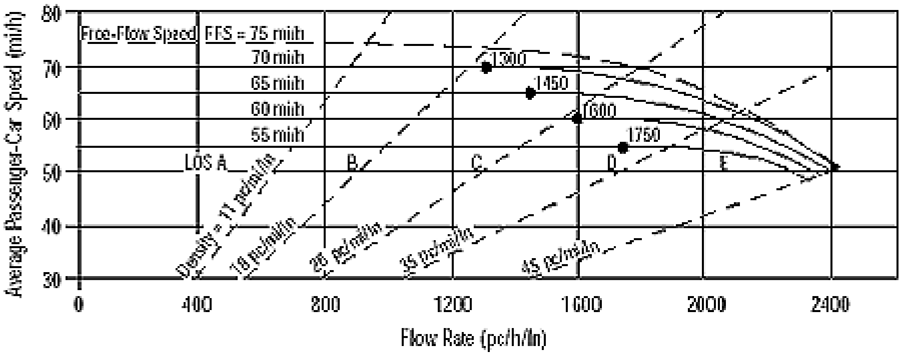
Glossary

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*2337*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

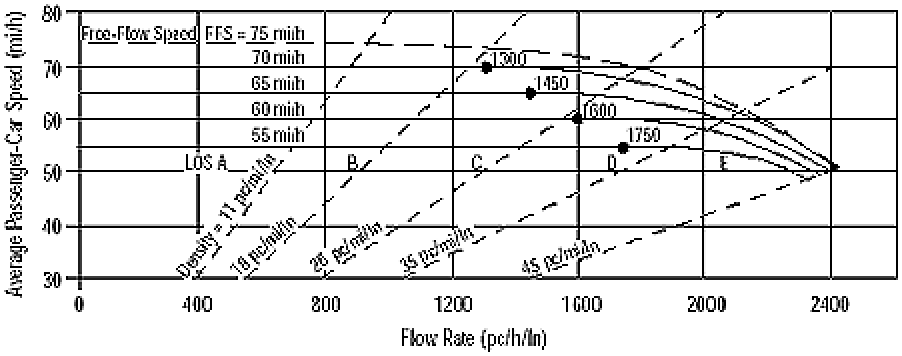
LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1396*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*25.2*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary / Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*2692*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

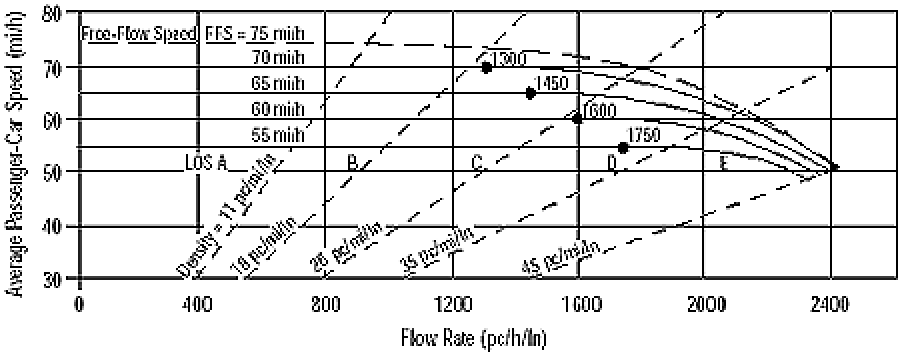
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1608*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*29.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs				
Volume, V	*1101*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*658*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*11.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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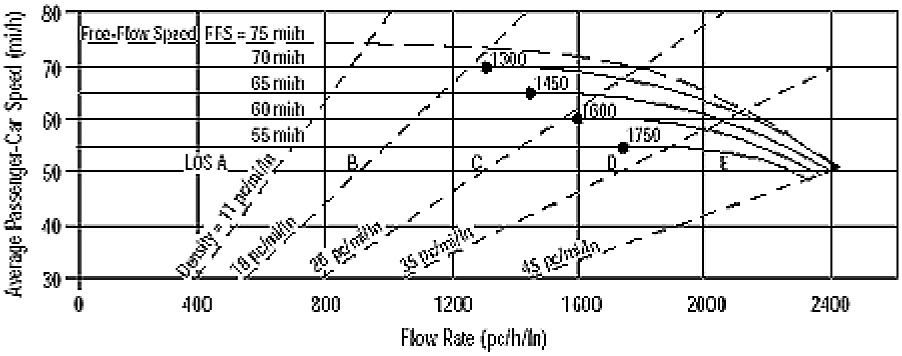
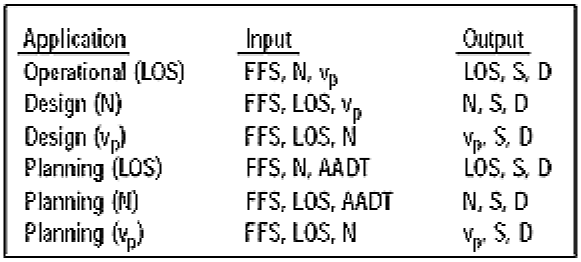
BASIC FREEWAY SEGMENTS WORKSHEET





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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1589*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*949*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*17.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

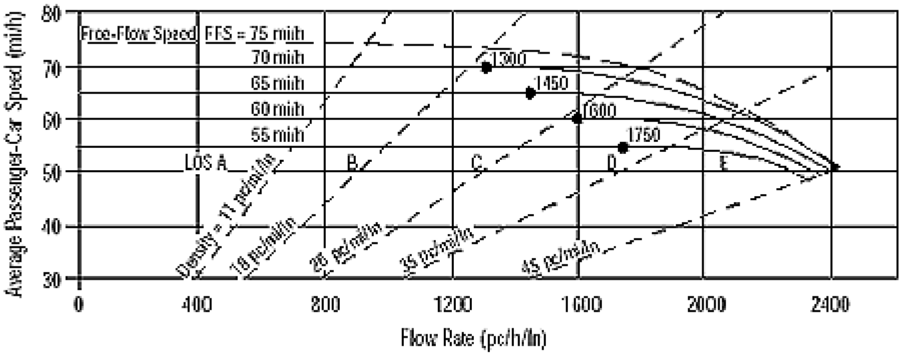
Glossary

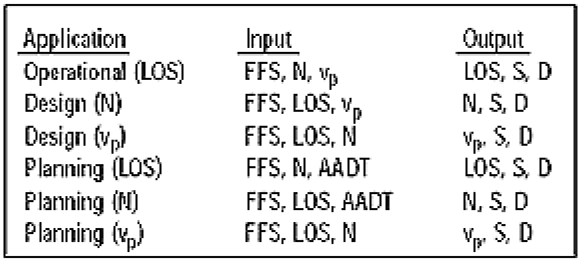
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1698*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1014*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*18.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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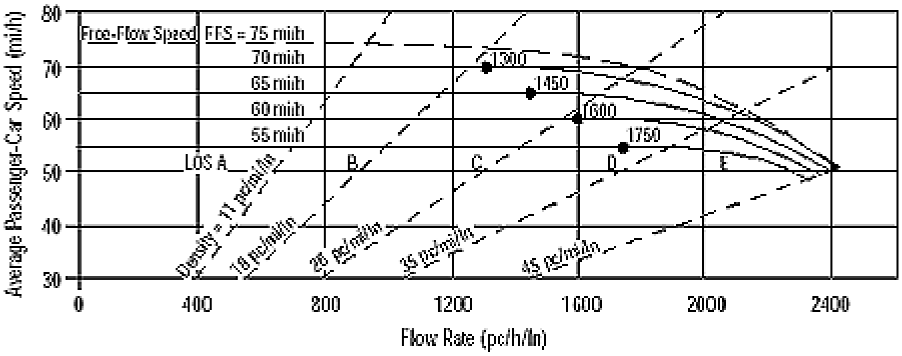
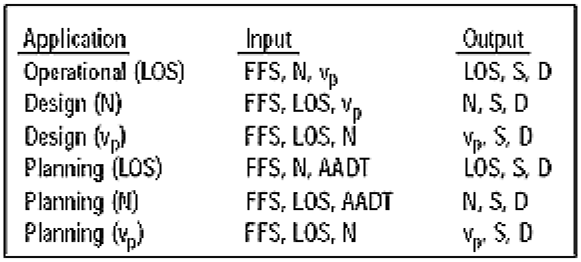
BASIC FREEWAY SEGMENTS WORKSHEET





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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description   Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*2649*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

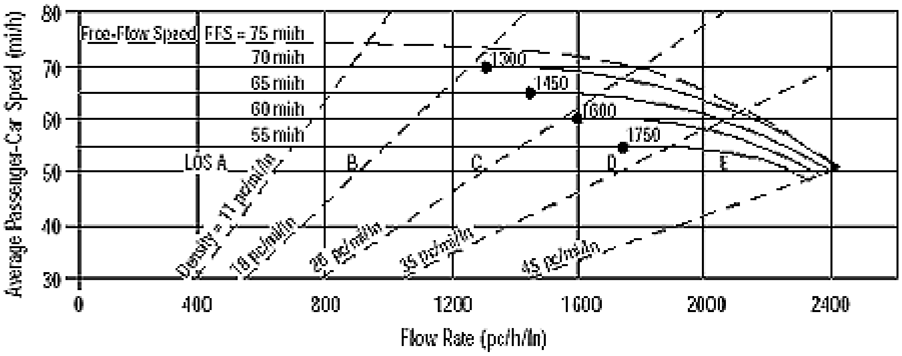
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

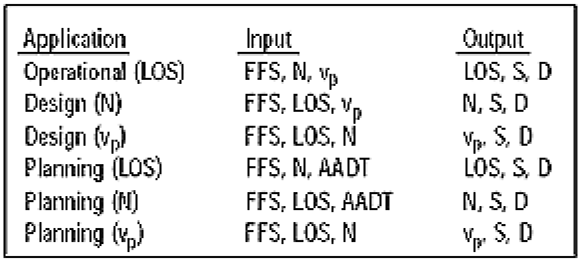
Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1582*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*28.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1097*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*655*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*11.8*	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

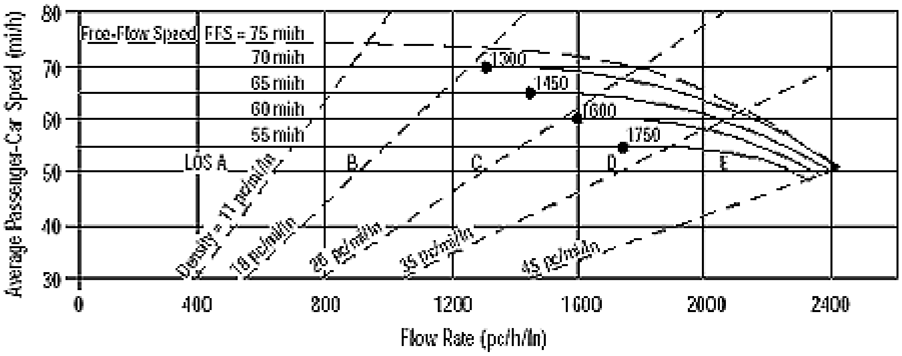
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume

S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10	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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 EB*
From/To	*East of S. Lee Hwy*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1940*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1159*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*20.9*	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		

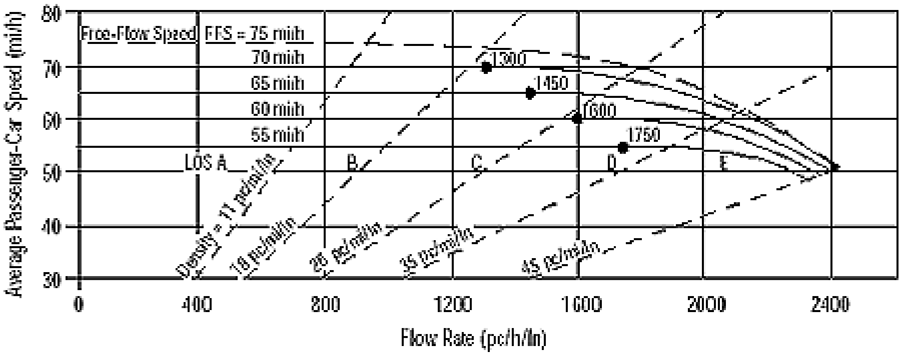
Glossary

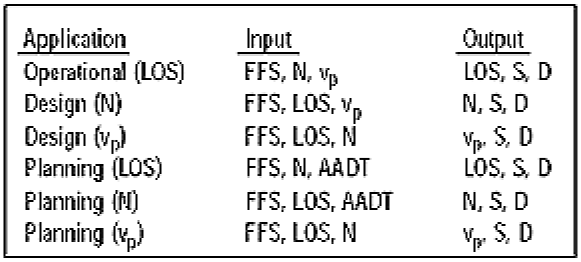
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1716*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1025*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*18.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary

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

Factor Location

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

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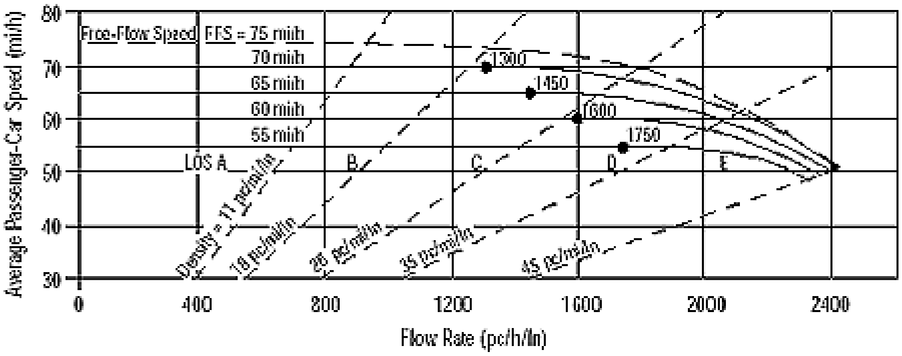
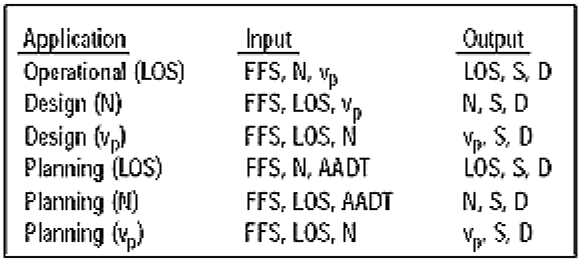




Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information		***Site Information***	
Analyst	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*3035*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

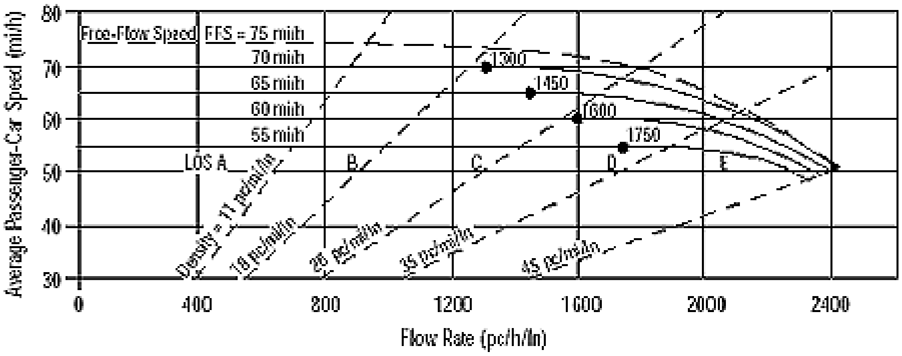
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1813*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*32.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1510*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

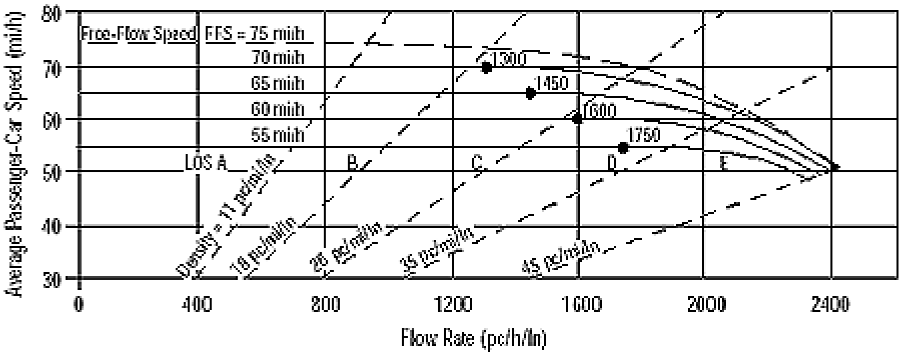
LOS and Performance Measures / Design (N)

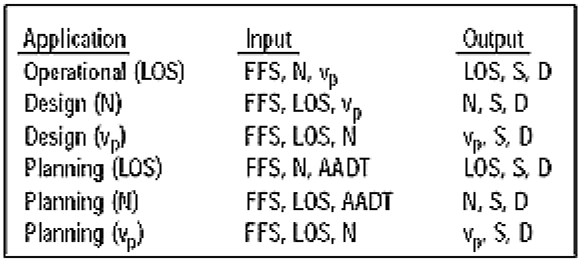
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*601*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*10.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary / Factor Location

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

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 EB*
From/To	*I-75 to Prop Intx*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1746*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*3.0*	mi/h
FFS	*57.0*	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	*57.0*	mi/h
D = v_p / S	*12.2*	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		

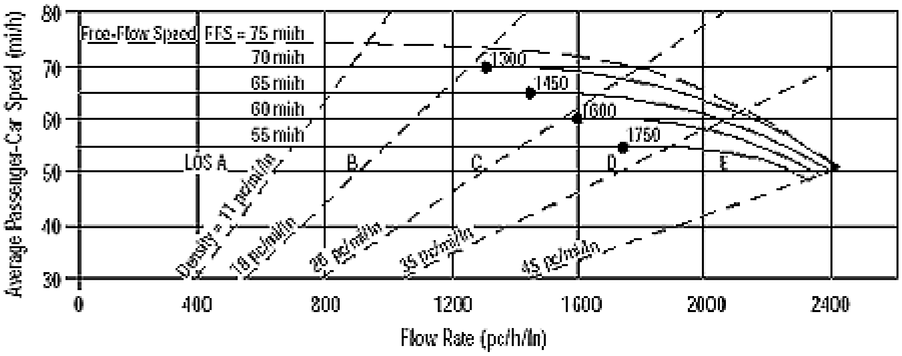
Glossary

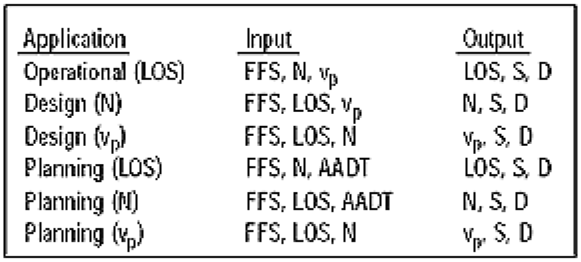
N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*2337*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*930*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*16.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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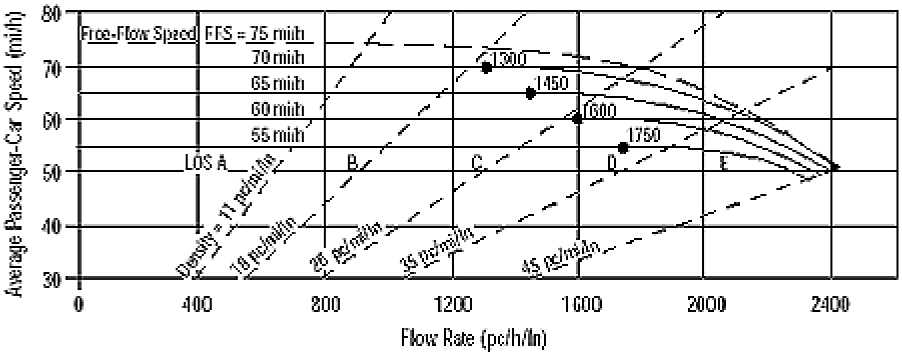
BASIC FREEWAY SEGMENTS WORKSHEET



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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description   Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*2692*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1072*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*18.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary

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

Factor Location

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

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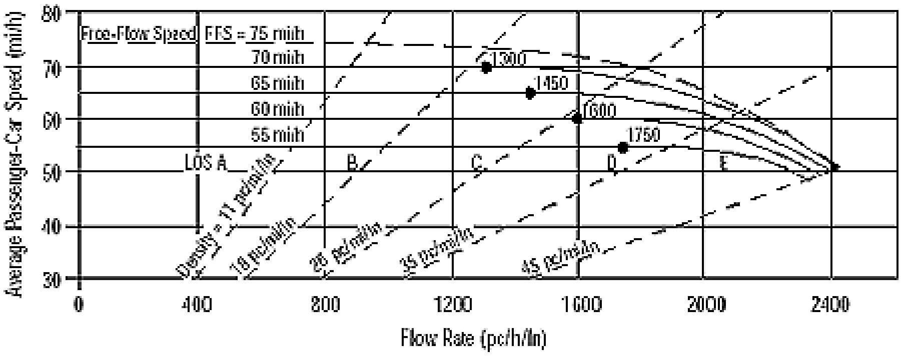
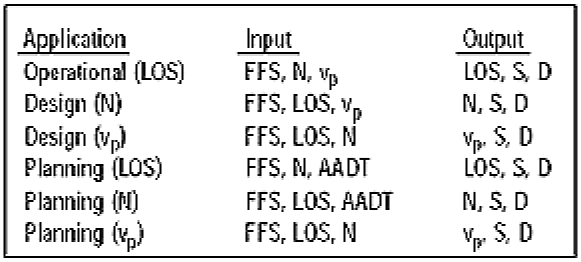




Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information		***Site Information***	
Analyst	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description   Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1101*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

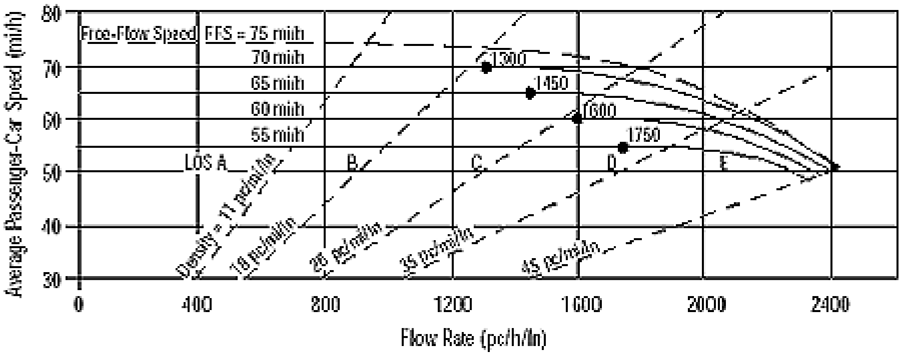
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*438*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*7.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1715*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

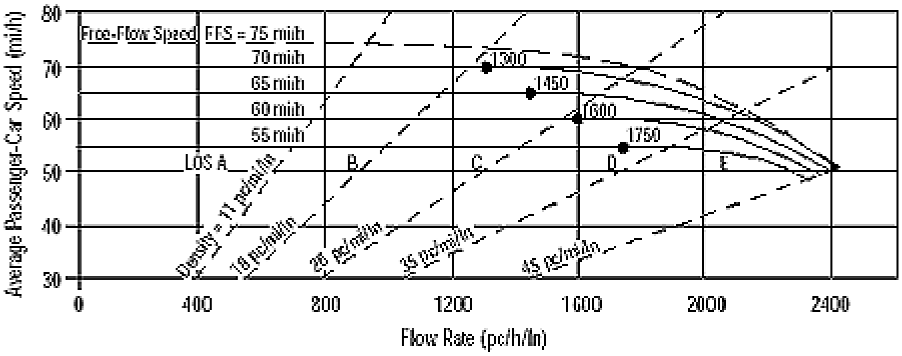
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*683*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*12.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 EB*
From/To	*Prop Intx to S. Lee Hwy*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1698*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*3.0*	mi/h
FFS	*57.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*676*	pc/h/ln
S	*57.0*	mi/h
D = v_p / S	*11.9*	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
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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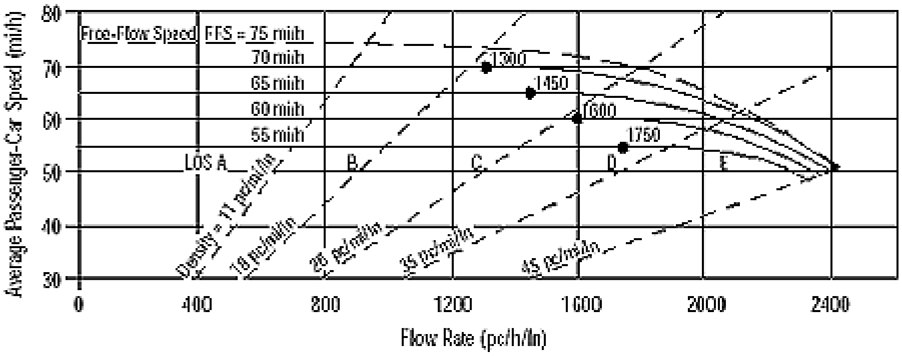
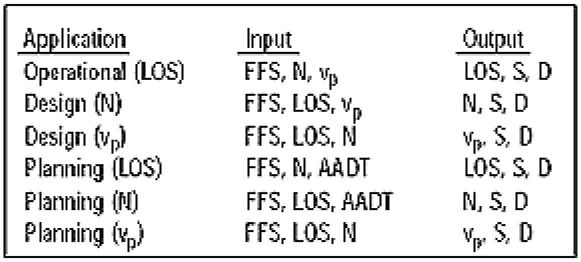
BASIC FREEWAY SEGMENTS WORKSHEET





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

General Information		***Site Information***	
Analyst	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*2649*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1055*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*18.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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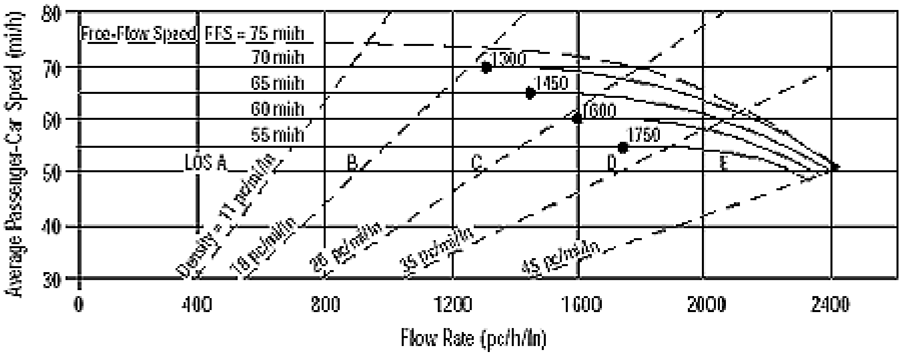
BASIC FREEWAY SEGMENTS WORKSHEET



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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 WB*
From/To	*East of S. Lee Hwy*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1958*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1169*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*21.1*	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	

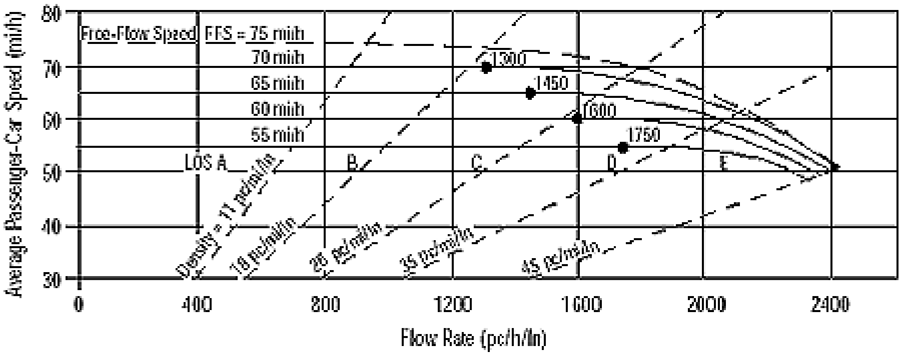
Glossary

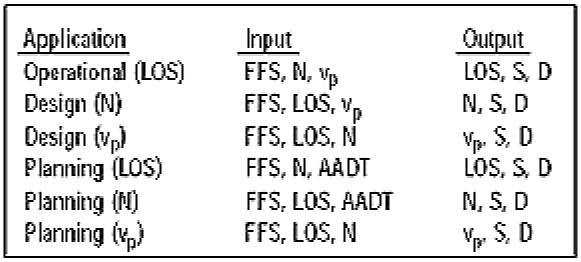
N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

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

Analyst	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 WB*
From/To	*East of S. Lee Hwy*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1190*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*711*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*12.8*	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	

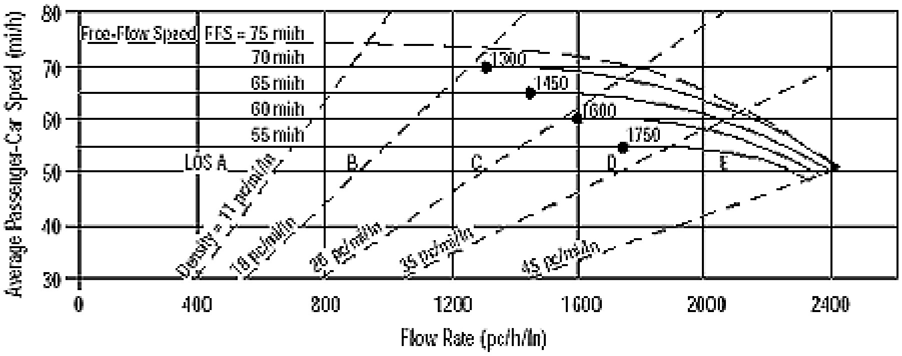
Glossary

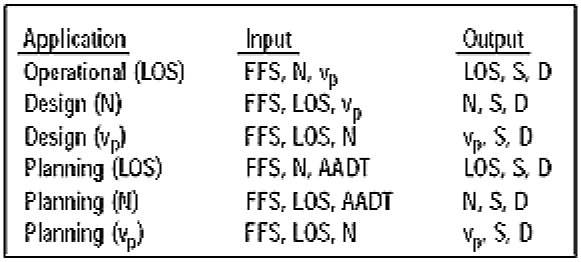
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*04/05/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Highway/Direction of Travel	*APD40 WB*
From/To	*East of S. Lee Hwy*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*3064*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1830*	pc/h/ln
S	*55.4*	mi/h
D = v_p / S	*33.0*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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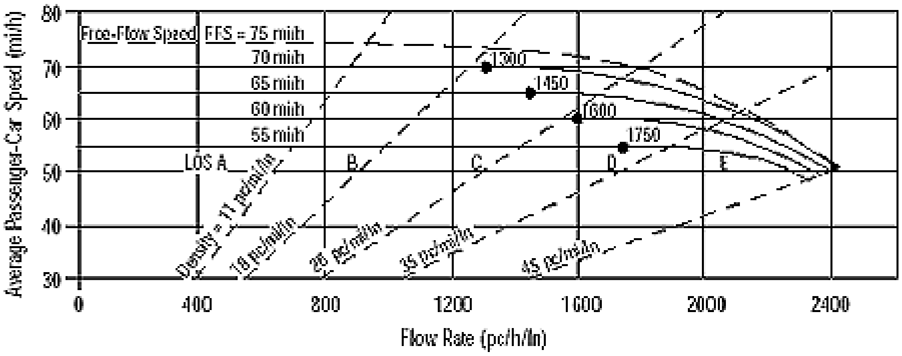
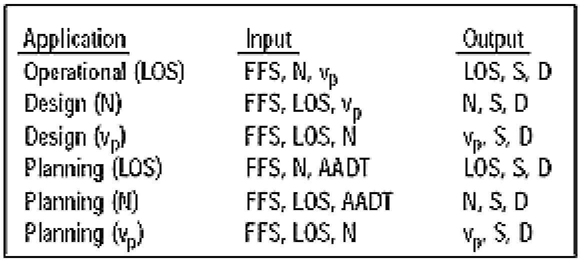




Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information		***Site Information***	
Analyst	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*East of S. Lee Hwy*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1845*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1102*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*19.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

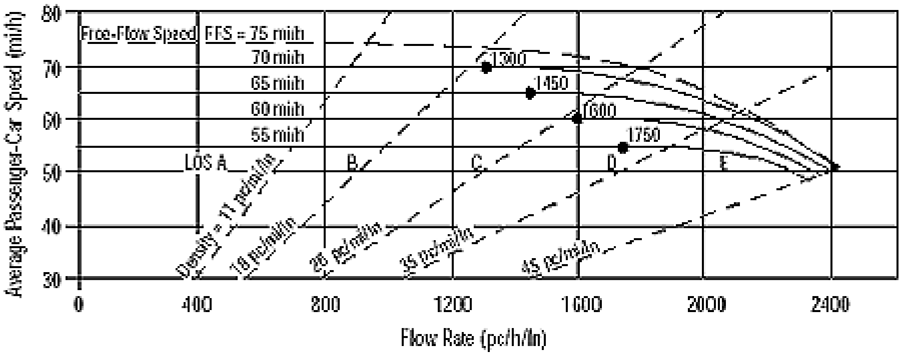
Glossary

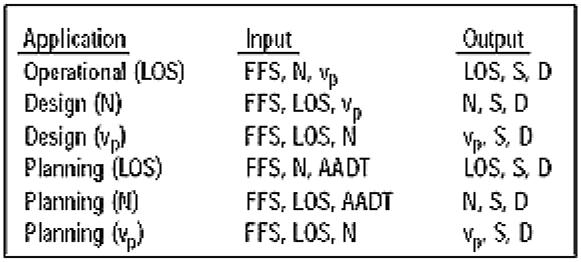
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*S. Lee Hwy to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs				
Volume, V	*1776*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

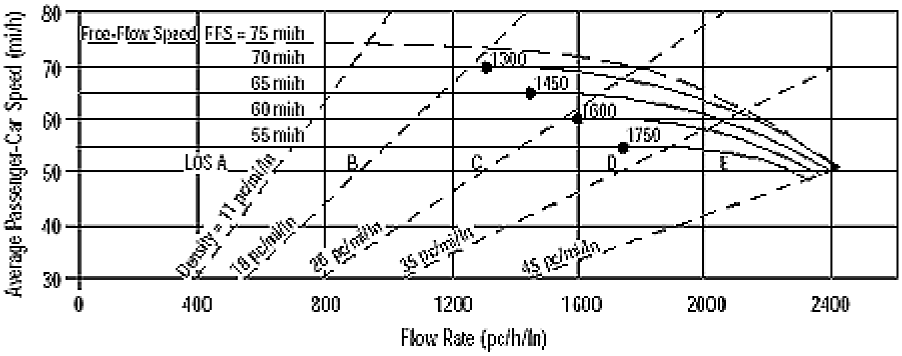
Calculate Flow Adjustments			
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

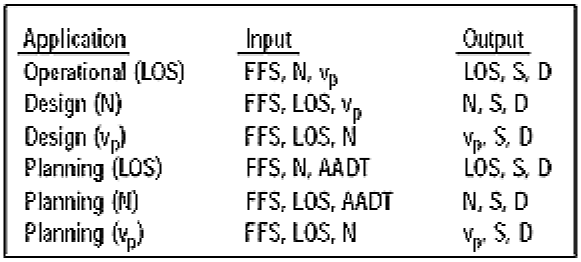
Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1061*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*19.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*S. Lee Hwy to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs				
Volume, V	*1203*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

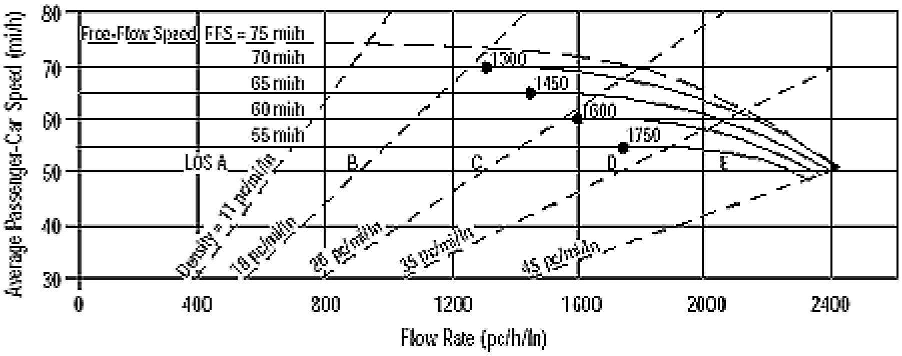
Calculate Flow Adjustments			
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*718*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*12.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*S. Lee Hwy to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*2731*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

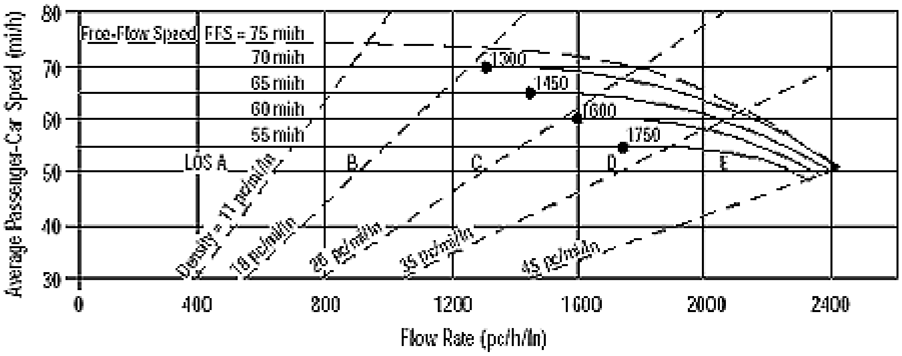
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1631*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*29.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*S. Lee Hwy to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1824*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1089*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*19.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary

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

Factor Location

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

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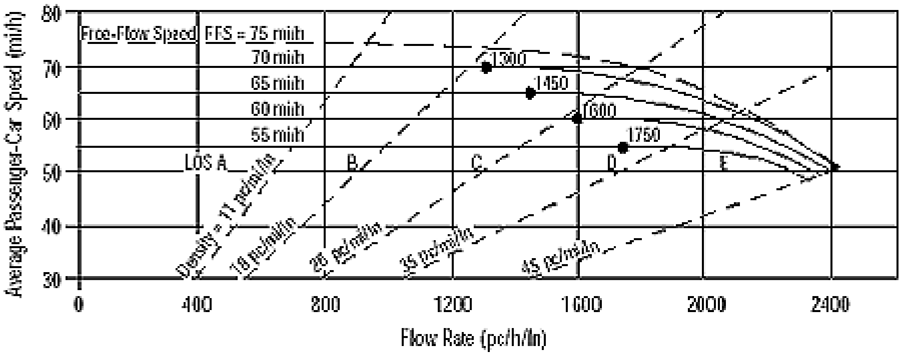
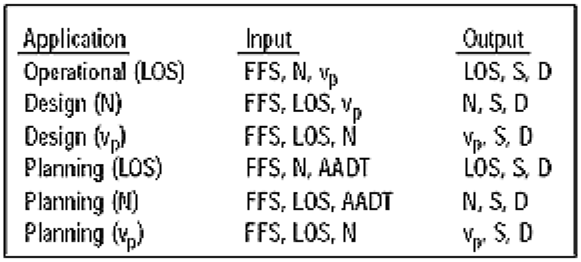
BASIC FREEWAY SEGMENTS WORKSHEET





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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1758*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1050*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*18.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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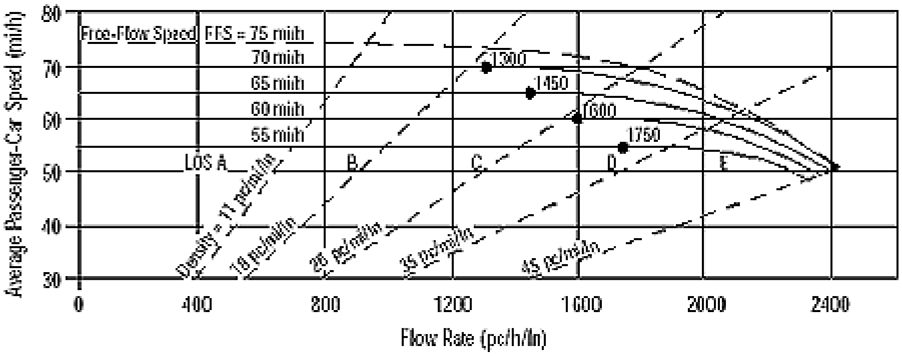

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

(Site Information in right columns)

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*1772*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1058*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*19.1*	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

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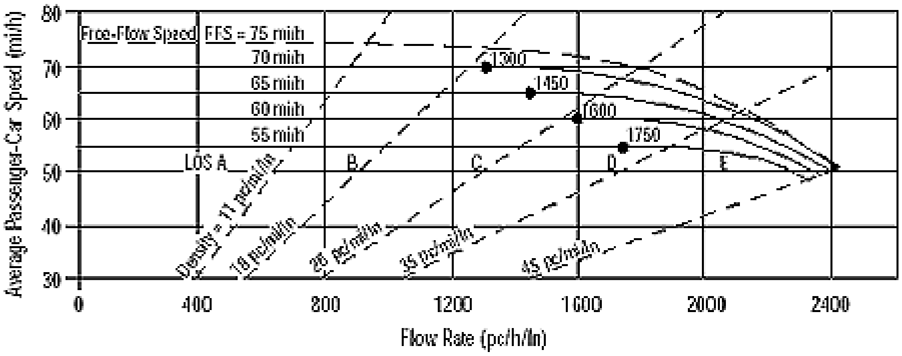
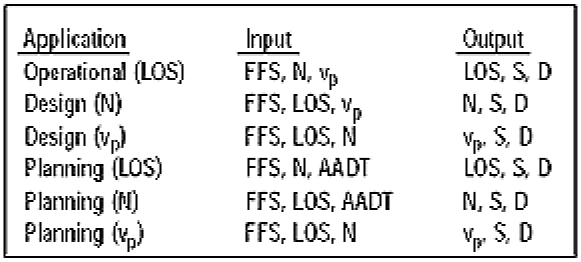
BASIC FREEWAY SEGMENTS WORKSHEET





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

General Information / Site Information

Analyst	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*2718*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1623*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*29.2*	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

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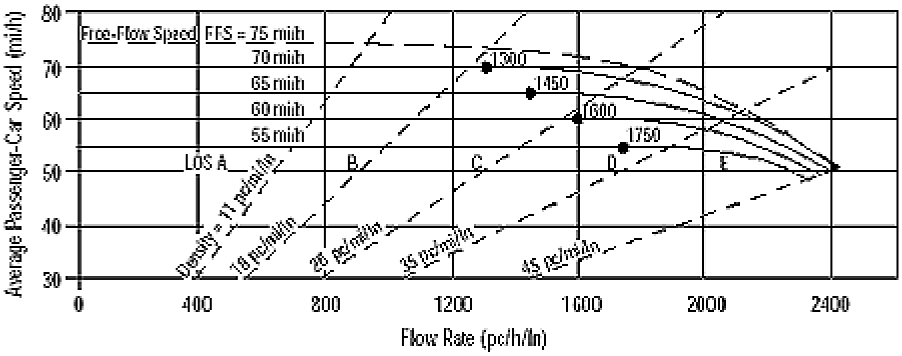

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information		***Site Information***	
Analyst	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*2736*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1634*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*29.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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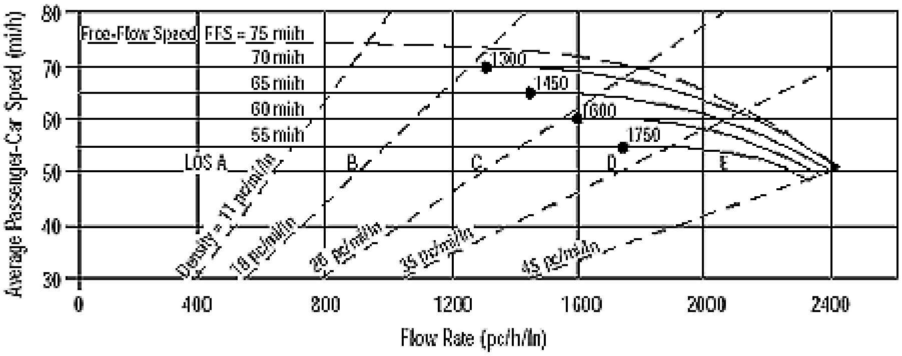
BASIC FREEWAY SEGMENTS WORKSHEET



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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*S. Lee Hwy to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1776*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*707*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*12.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary / Factor Location

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

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

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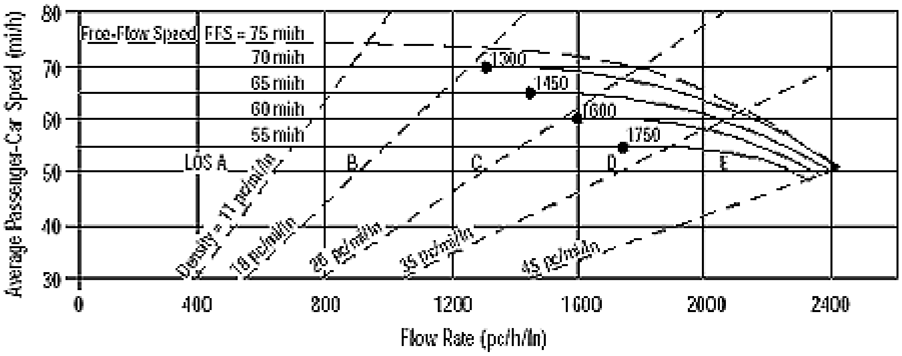
BASIC FREEWAY SEGMENTS WORKSHEET



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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*S. Lee Hwy to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1203*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

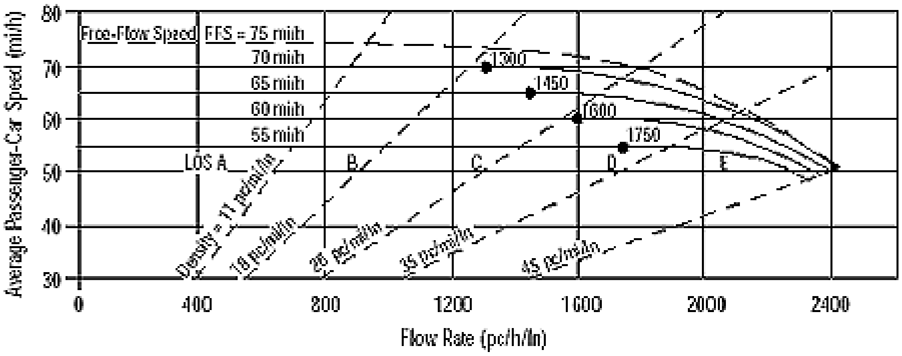
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

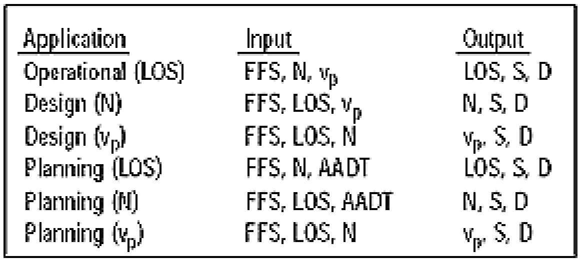
Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*479*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*8.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*S. Lee Hwy to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*2731*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

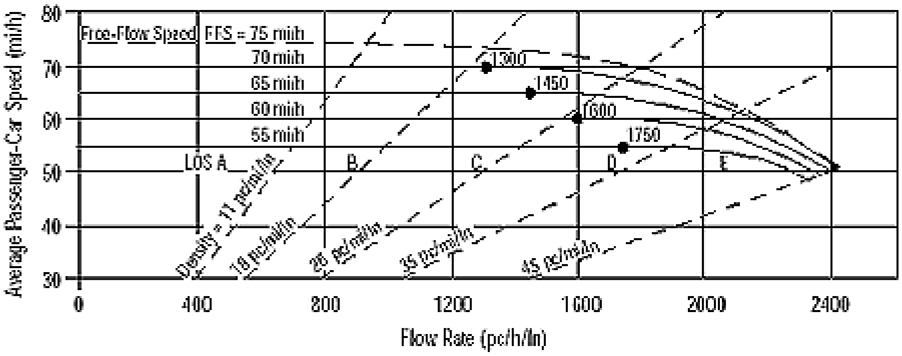
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

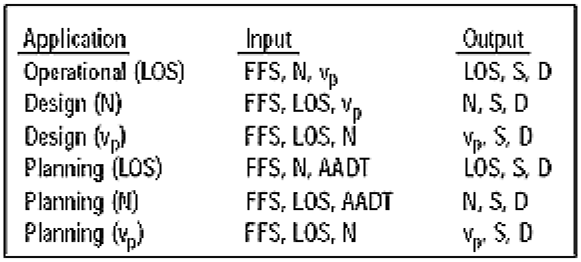
Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1087*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*19.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

BASIC FREEWAY SEGMENTS WORKSHEET





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

General Information / Site Information

General Information		Site Information	
Analyst	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*S. Lee Hwy to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1824*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*726*	pc/h/ln
S	*57.0*	mi/h
D = v_p / S	*12.7*	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
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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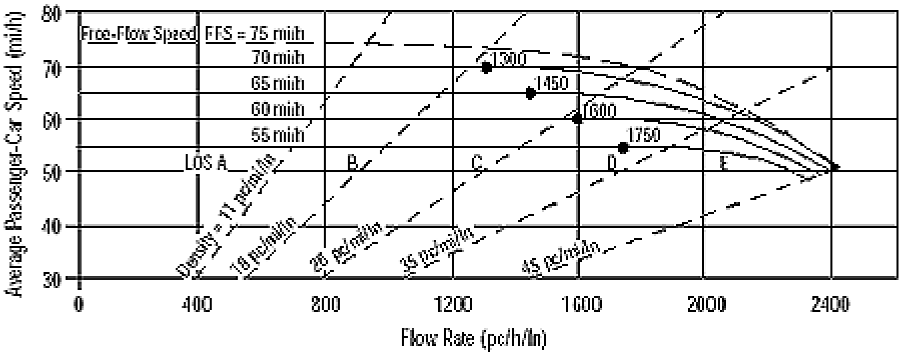
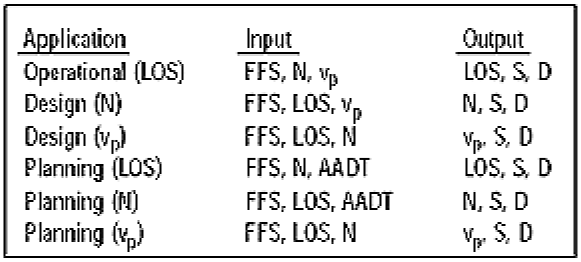




Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*SKB*		
Agency or Company	*TDOT / Long Engineering*		
Date Performed	*05/04/2009*		
Analysis Time Period	*AM Peak Period*		

Site Information

Highway/Direction of Travel	*APD40 WB*
From/To	*Prop Intx to I-75*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1758*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*3.0*	mi/h
FFS	*57.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*700*	pc/h/ln
S	*57.0*	mi/h
D = v_p / S	*12.3*	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		

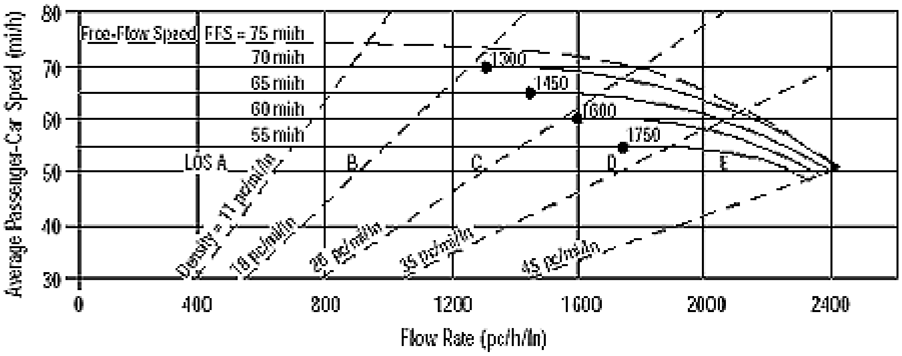
Glossary

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

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1687*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*672*	pc/h/ln
S	*57.0*	mi/h
D = v_p / S	*11.8*	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		

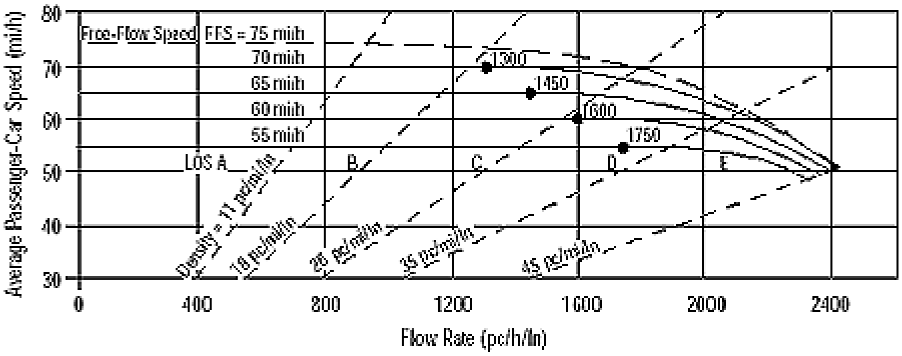
Glossary

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

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description   Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*2718*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

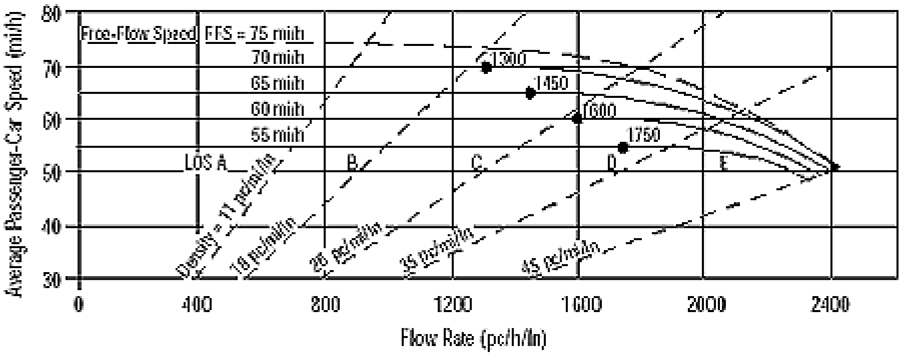
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1082*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*19.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 WB*
Agency or Company	*TDOT / Long Engineering*	From/To	*Prop Intx to I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*2736*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

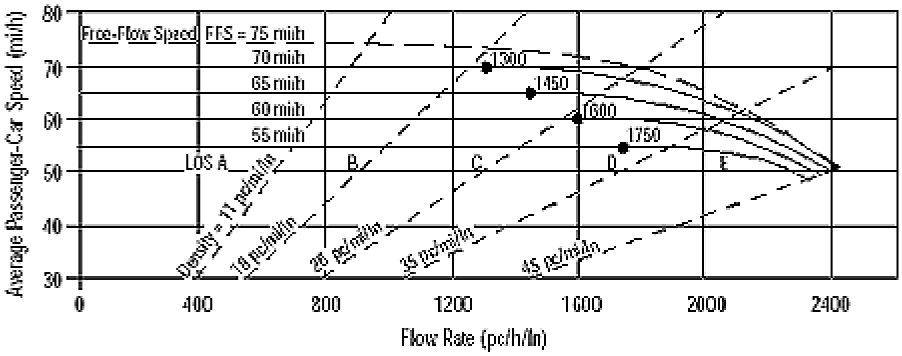
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

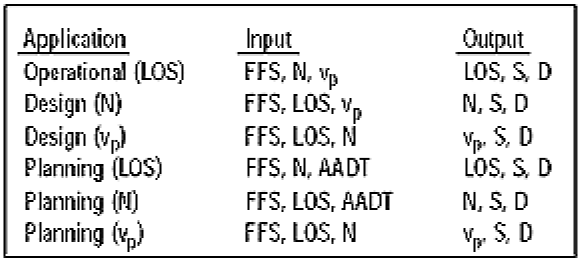
Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1089*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*19.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description   Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*2595*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

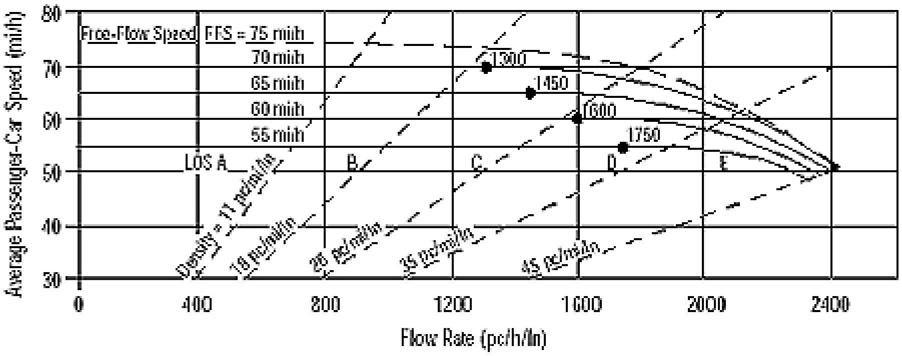
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

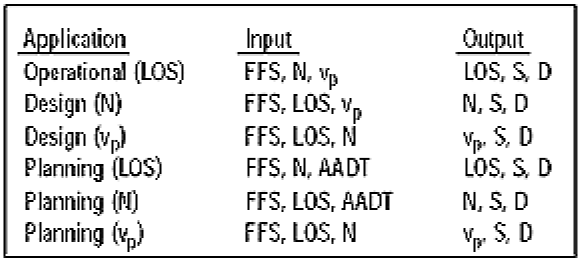
Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*65.5*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1530*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*65.5*	mi/h	S	mi/h
D = v_p / S	*23.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*4142*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

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

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2442*	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

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10

E_T - Exhibits 23-8, 23-10, 23-11

f_p - Page 23-12

LOS, S, FFS, v_p - Exhibits 23-2, 23-3

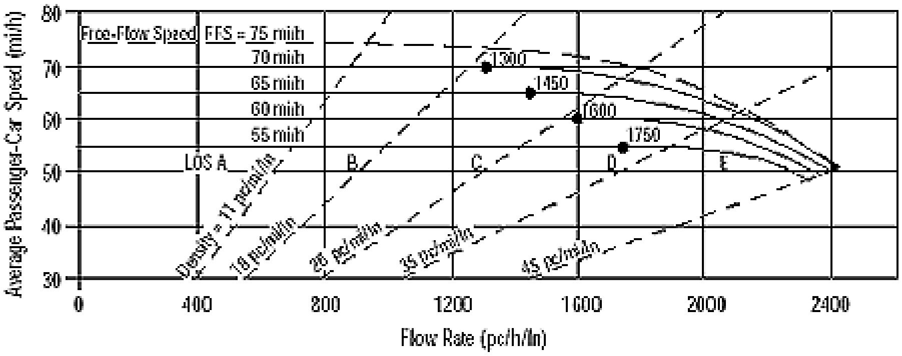
f_{LW} - Exhibit 23-4

f_{LC} - Exhibit 23-5

f_N - Exhibit 23-6

f_{ID} - Exhibit 23-7

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Highway/Direction of Travel	*I-75 NB*
From/To	*South of APD-40*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*3788*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.893*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
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	*3.0*	mi/h
FFS	*67.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1489*	pc/h/ln
S	*67.0*	mi/h
D = v_p / S	*22.2*	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		

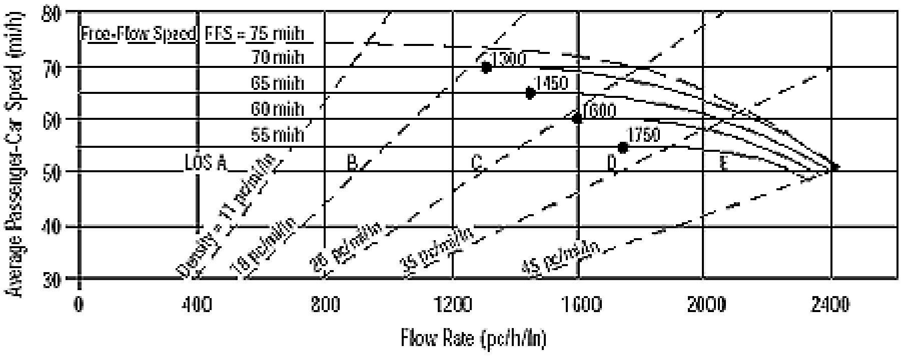
Glossary

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

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Ramp Slip

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

Flow Inputs

Volume, V	*6066*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.893*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*67.0*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
			Design (N)	
Operational (LOS)			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2359*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*53.1*	mi/h	S	mi/h
D = v_p / S	*44.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*E*		Required Number of Lanes, N	

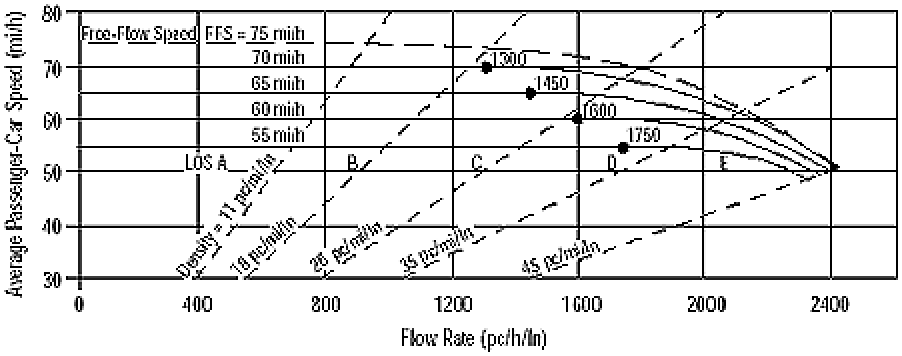
Glossary

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

Factor Location

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

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	*SKB*		
Agency or Company	*TDOT / Long Engineering*		
Date Performed	*05/04/2009*		
Analysis Time Period	*AM Peak Period*		

Site Information

Highway/Direction of Travel	*I-75 NB*
From/To	*North of APD-40*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*2147*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

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)	*1271*	pc/h/ln
S	*65.5*	mi/h
D = v_p / S	*19.4*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

N - Number of lanes

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10

E_T - Exhibits 23-8, 23-10, 23-11

f_p - Page 23-12

LOS, S, FFS, v_p - Exhibits 23-2, 23-3

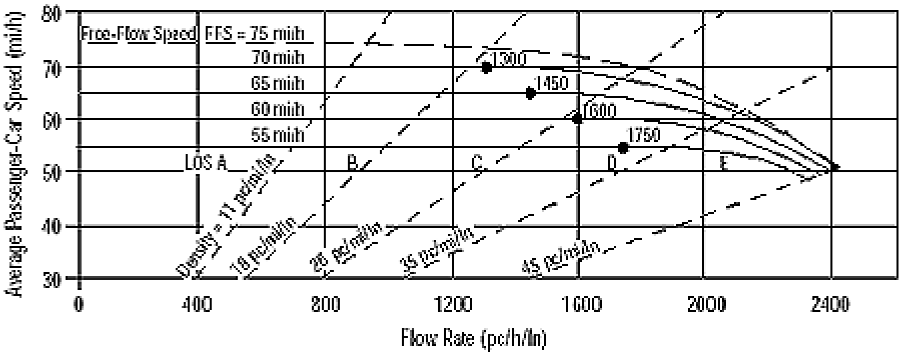
f_{LW} - Exhibit 23-4

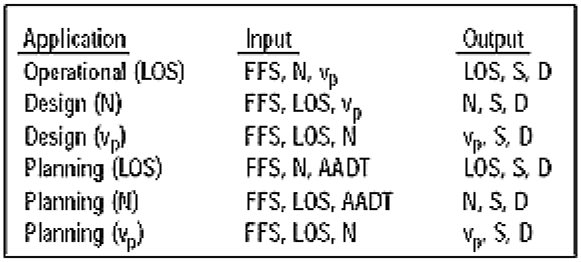
f_{LC} - Exhibit 23-5

f_N - Exhibit 23-6

f_{ID} - Exhibit 23-7

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	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Highway/Direction of Travel	*I-75 NB*
From/To	*North of APD-40*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*3460*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

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)	*2049*	pc/h/ln
S	*60.9*	mi/h
D = v_p / S	*33.6*	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

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

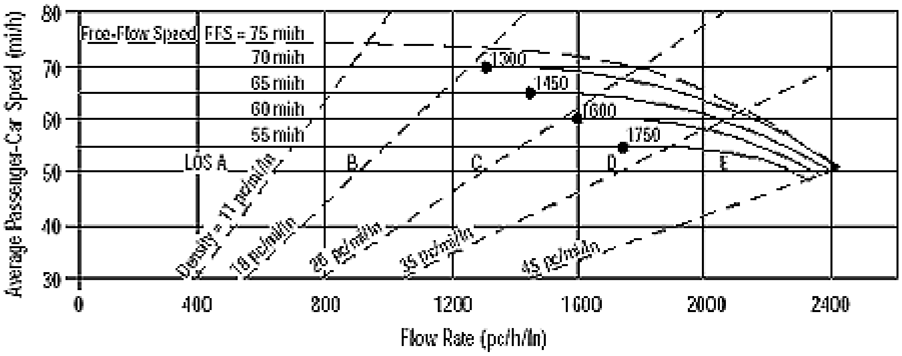
FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10	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	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*North of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*3137*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*67.0*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1238*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*67.0*	mi/h	S	mi/h
D = v_p / S	*18.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

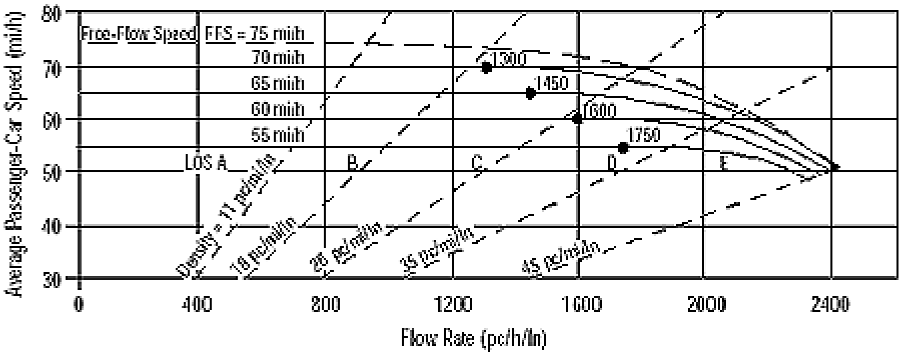
Glossary

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	*SKB*	Highway/Direction of Travel	*I-75 NB*
Agency or Company	*TDOT / Long Engineering*	From/To	*North of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description   Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*5052*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

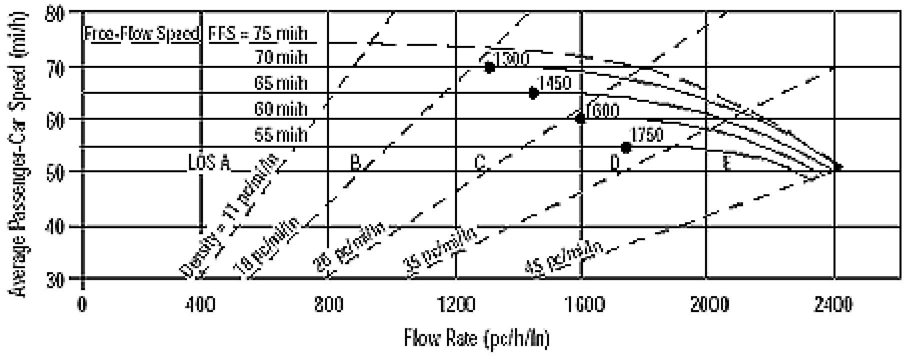
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

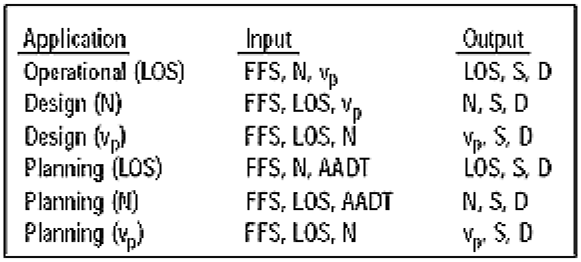
Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*67.0*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures			**Design (N)**		
Operational (LOS)			Design (N)		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1994*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S	*62.9*	mi/h	S		mi/h
D = v_p / S	*31.7*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		Required Number of Lanes, N		

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

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	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*North of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*2546*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

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

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1508*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*65.5*	mi/h	S	mi/h
D = v_p / S	*23.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

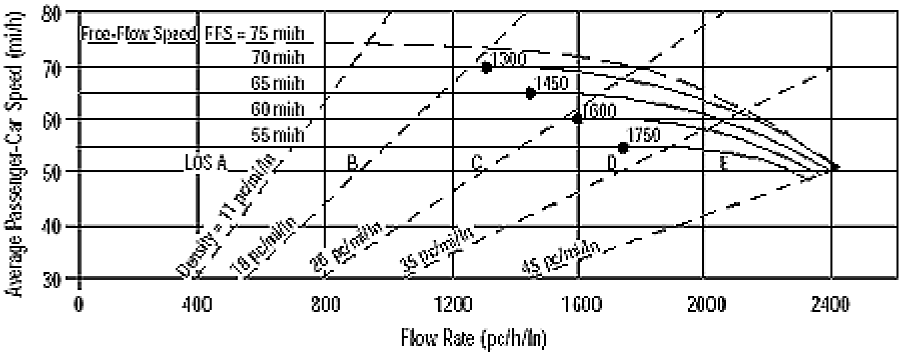
Glossary

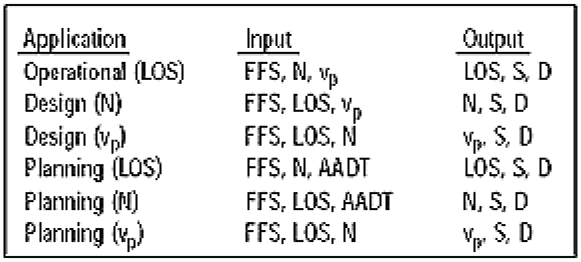
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*North of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*2773*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

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

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1642*	pc/h/ln
S	*65.2*	mi/h
D = v_p / S	*25.2*	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		

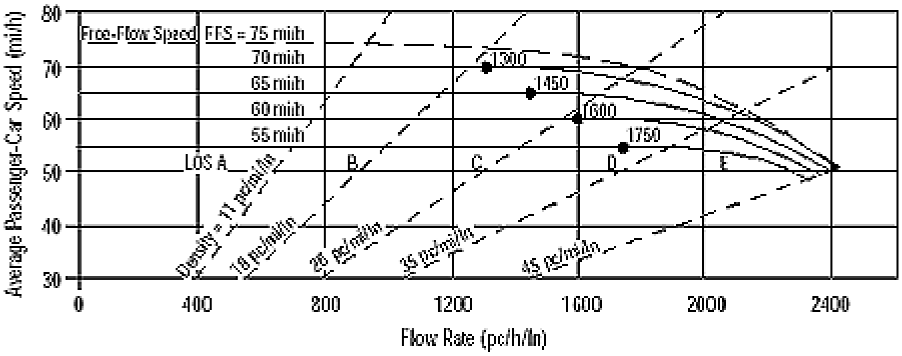
Glossary

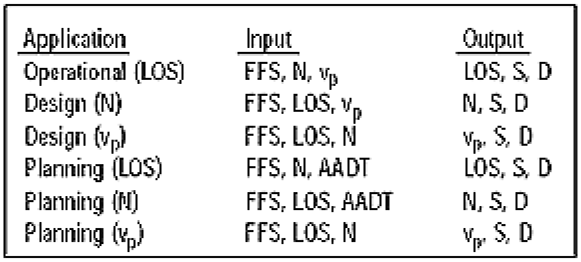
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*		
Agency or Company	*TDOT / Long Engineering*		
Date Performed	*05/04/2009*		
Analysis Time Period	*AM Peak Period*		

Site Information

Highway/Direction of Travel	*I-75 SB*
From/To	*North of APD-40*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*3697*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
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	*3.0*	mi/h
FFS	*67.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1459*	pc/h/ln
S	*67.0*	mi/h
D = v_p / S	*21.8*	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	

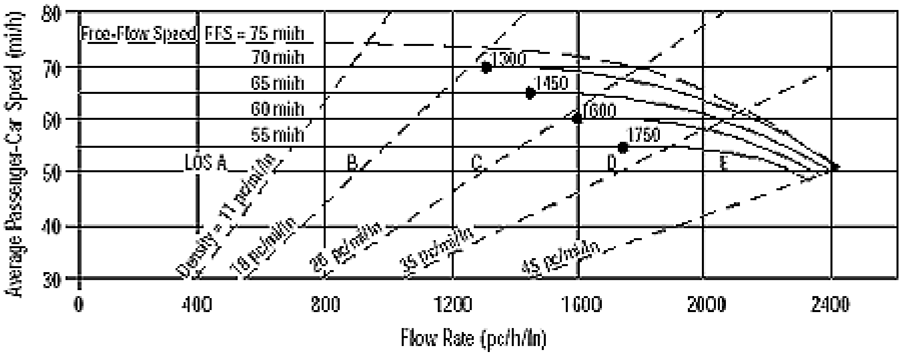
Glossary

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

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*North of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Site Information

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*4045*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*25*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.889*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
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	*3.0*	mi/h
FFS	*67.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1597*	pc/h/ln
S	*66.7*	mi/h
D = v_p / S	*23.9*	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

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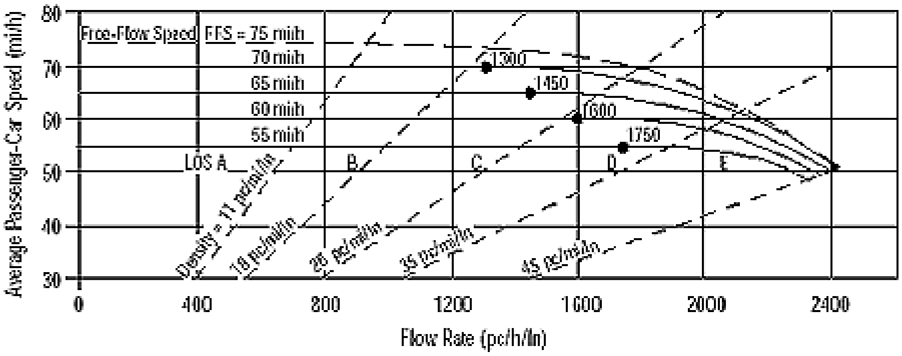
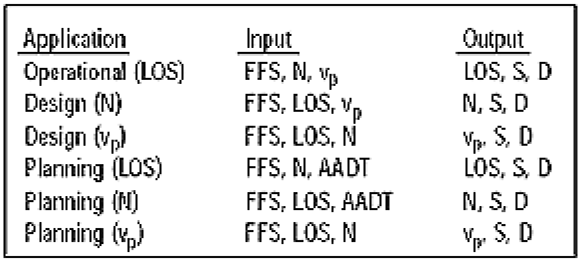
BASIC FREEWAY SEGMENTS WORKSHEET





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

General Information

Analyst	*SKB*
Agency or Company	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Highway/Direction of Travel	*I-75 SB*
From/To	*South of APD-40*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*3392*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

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)	*1999*	pc/h/ln
S	*61.8*	mi/h
D = v_p / S	*32.3*	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		

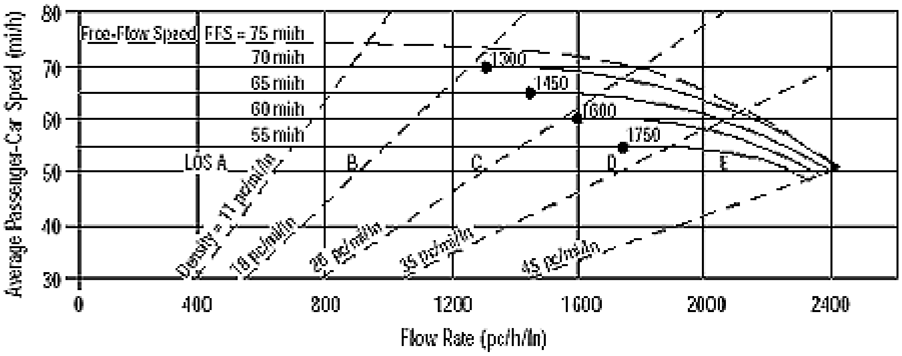
Glossary

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

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

(*Site Information*)

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*3343*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

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)	*1971*	pc/h/ln
S	*62.3*	mi/h
D = v_p / S	*31.7*	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		

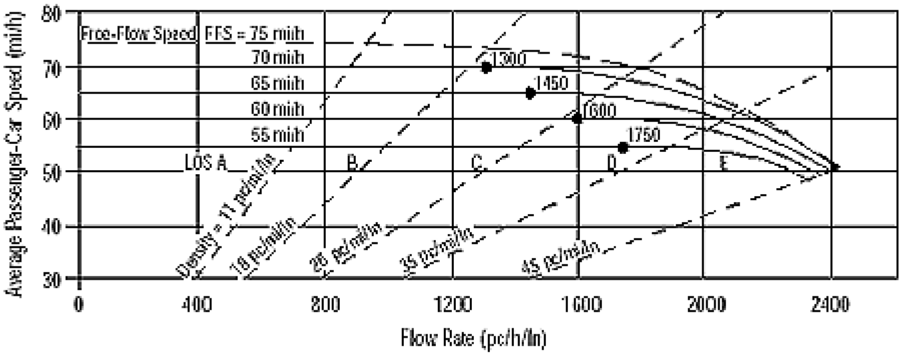
Glossary

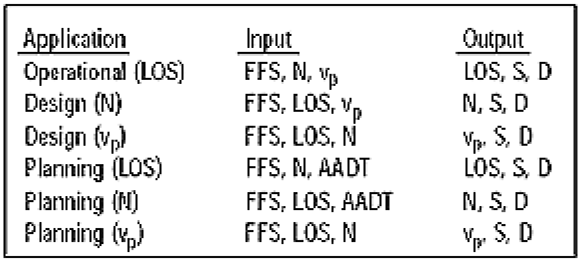
N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

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	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System Without Slip Ramp

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

Flow Inputs

Volume, V	*4959*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*67.0*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1949*	pc/h/ln
S	*63.7*	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

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10

E_T - Exhibits 23-8, 23-10, 23-11

f_p - Page 23-12

LOS, S, FFS, v_p - Exhibits 23-2, 23-3

f_{LW} - Exhibit 23-4

f_{LC} - Exhibit 23-5

f_N - Exhibit 23-6

f_{ID} - Exhibit 23-7

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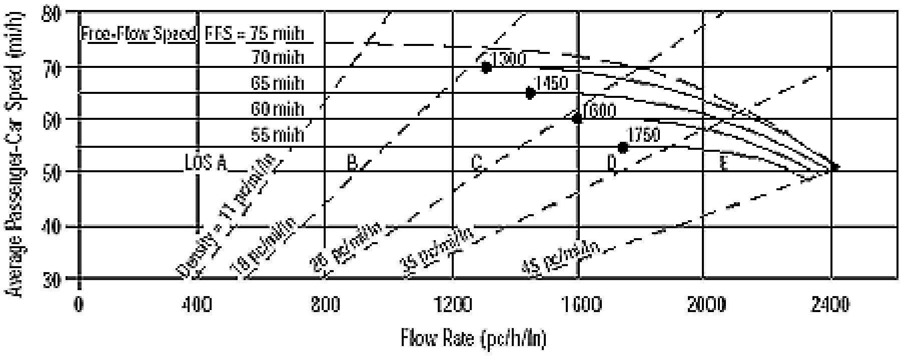
BASIC FREEWAY SEGMENTS WORKSHEET



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

General Information		Site Information	
Analyst	*SKB*	Highway/Direction of Travel	*I-75 SB*
Agency or Company	*TDOT / Long Engineering*	From/To	*South of APD-40*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description

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

Flow Inputs

Volume, V	*4892*	veh/h	Peak-Hour Factor, PHF	*0.95*
AADT		veh/day	%Trucks and Buses, P_T	*24*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.893*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*67.0*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1922*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*64.1*	mi/h	S	mi/h
D = v_p / S	*30.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

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

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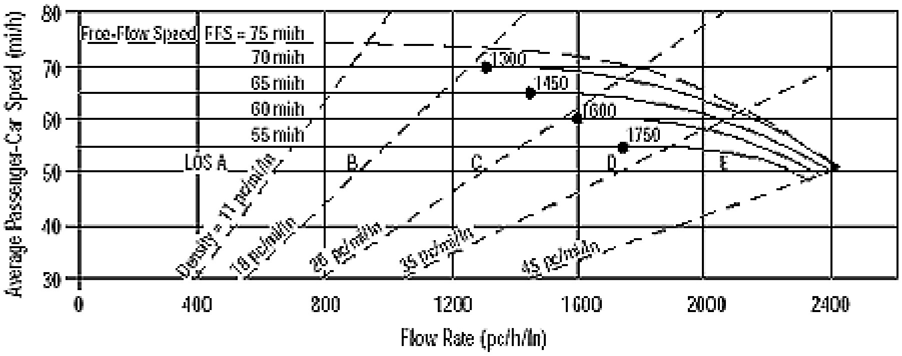
BASIC FREEWAY SEGMENTS WORKSHEET



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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Proposed System With Slip Ramp

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

Flow Inputs

Volume, V	*1343*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*802*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*14.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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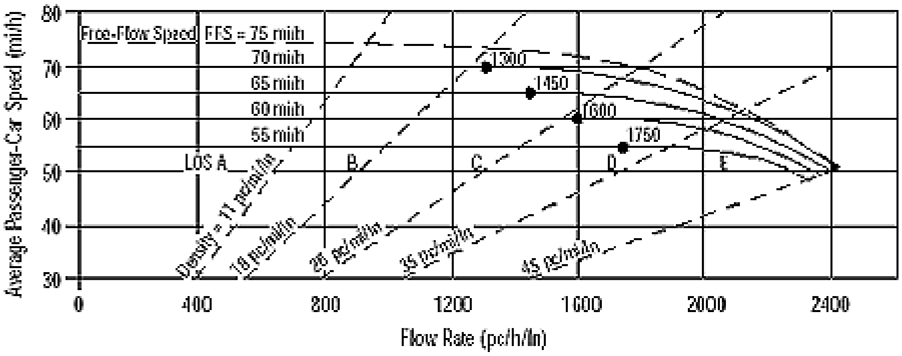
BASIC FREEWAY SEGMENTS WORKSHEET



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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Proposed System With Slip Ramp

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

Flow Inputs

Volume, V	*1623*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*969*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*17.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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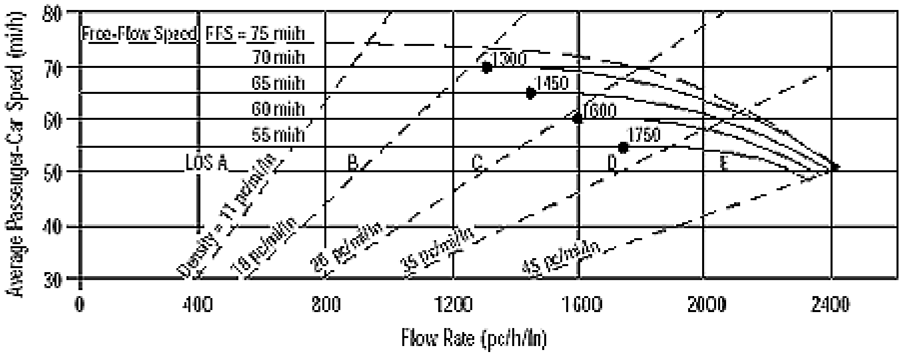
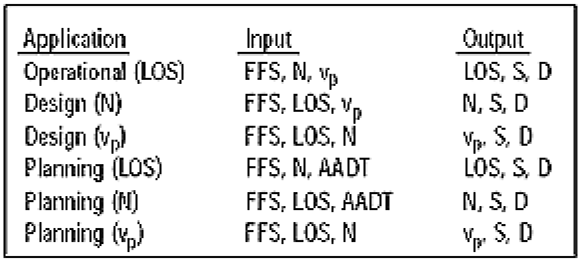
BASIC FREEWAY SEGMENTS WORKSHEET





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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description Proposed System With Slip Ramp

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

Flow Inputs

Volume, V	*1623*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs		
Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*2*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*55.5*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*969*	pc/h/ln
S	*55.5*	mi/h
D = v_p / S	*17.5*	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	

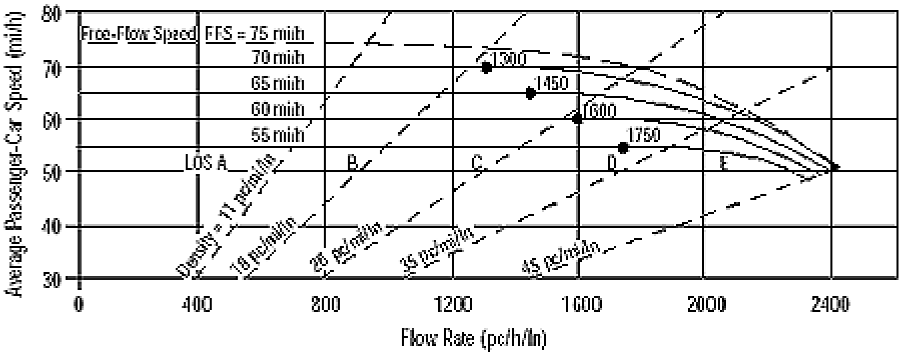
Glossary

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Proposed System With Slip Ramp

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

Flow Inputs

Volume, V	*2504*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs / Calc Speed Adj and FFS

Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*2*		f_N	*4.5*	mi/h
FFS (measured)		mi/h	FFS	*55.5*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1495*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*55.5*	mi/h	S	mi/h
D = v_p / S	*26.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

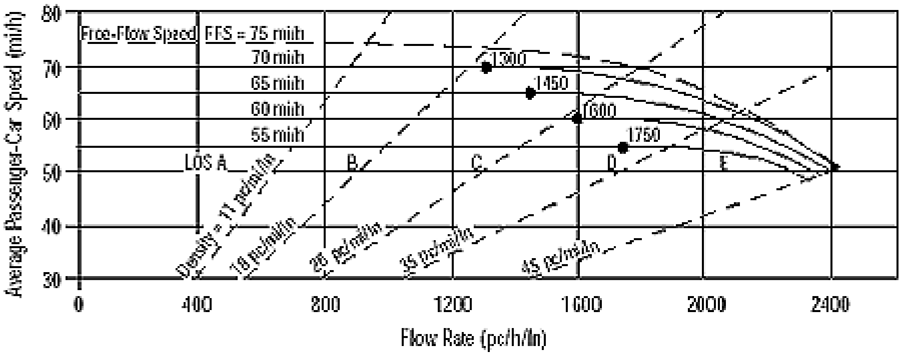
Glossary

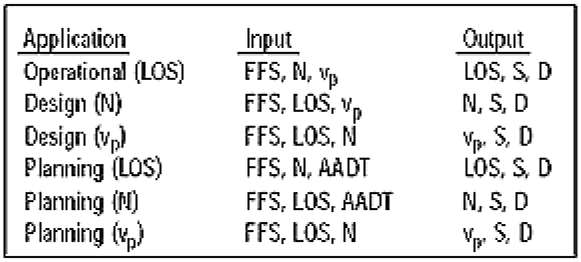
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description Proposed System With Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1343*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*3.0*	mi/h
FFS	*57.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*535*	pc/h/ln
S	*57.0*	mi/h
D = v_p / S	*9.4*	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	

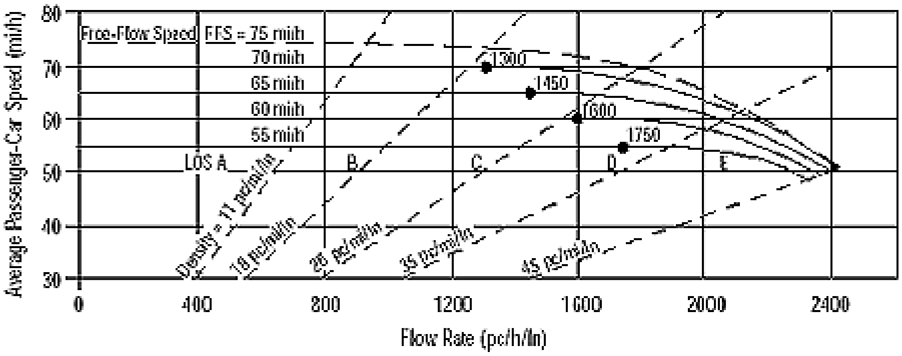
Glossary

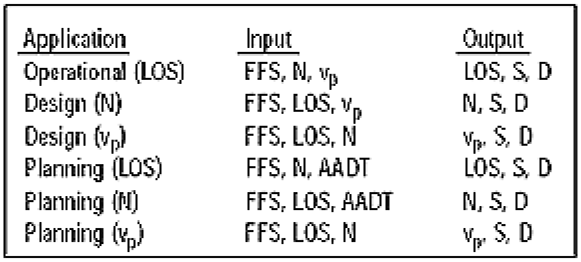
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

(*Site Information* heads the right half.)

Project Description Proposed System With Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*1623*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*3*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*60.0*	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	*3.0*	mi/h
FFS	*57.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*646*	pc/h/ln
S	*57.0*	mi/h
D = v_p / S	*11.3*	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	

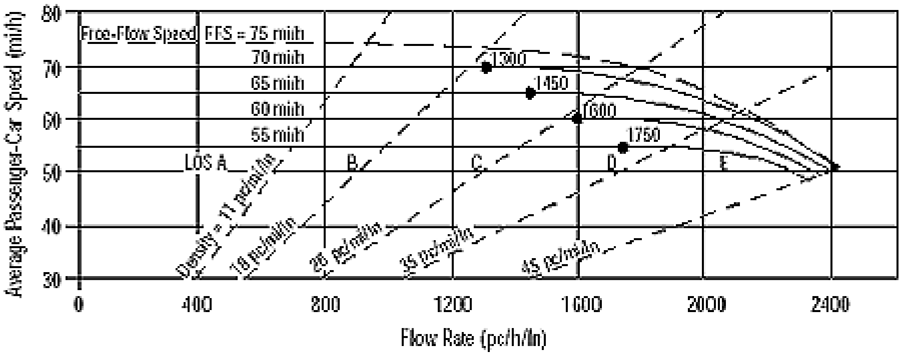
Glossary

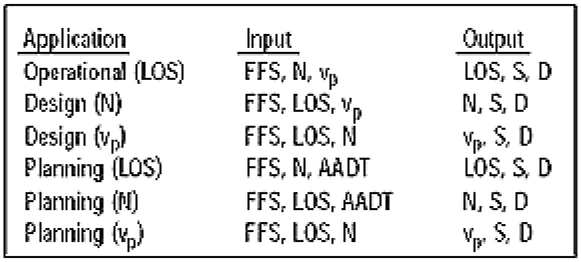
N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description Proposed System With Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*2085*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

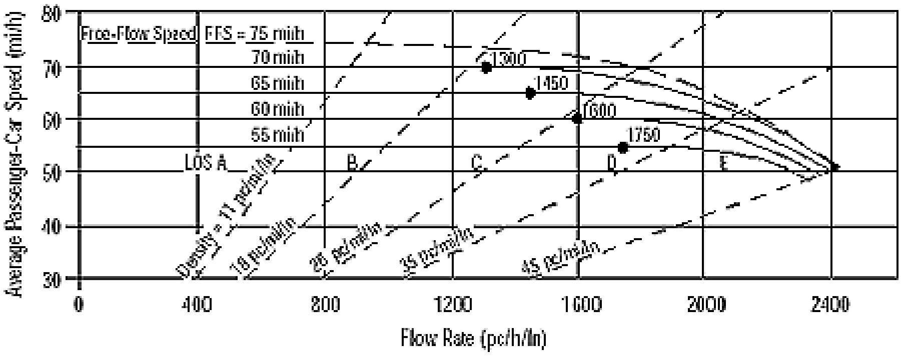
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

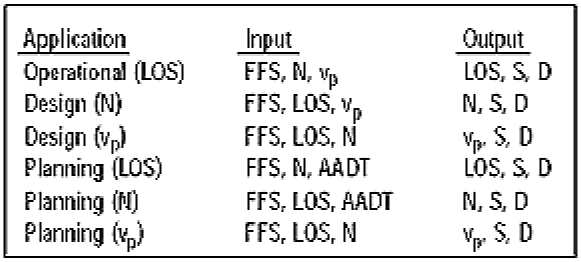
Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*830*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*14.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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	*SKB*	Highway/Direction of Travel	*APD40 EB*
Agency or Company	*TDOT / Long Engineering*	From/To	*I-75 to Prop Intx*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description Proposed System With Slip Ramp [With Auxiliary Lanes]

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

Flow Inputs

Volume, V	*2504*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
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	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*3*		f_N	*3.0*	mi/h
FFS (measured)		mi/h	FFS	*57.0*	mi/h
Base free-flow Speed, BFFS	*60.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*997*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	*57.0*	mi/h	S	mi/h
D = v_p / S	*17.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

Merge Ramps

Highway Capacity Software Computer Printouts

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S.Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 520 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	919	0.90	Level	15	0	0.930	1.00	1098
Ramp	200	0.90	Level	15	0	0.930	1.00	239
UpStream	520	0.90	Level	15	0	0.930	1.00	621
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 (Exhibit 25-5)

V_{12} = 1098 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1337	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1337	Exhibit 25-7	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 = 13.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.311 (Exibit 25-19)

S_R= 51.0 mph (Exhibit 25-19)

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

S = 51.0 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S.Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 364 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1324	0.90	Level	15	0	0.930	1.00	1581
Ramp	394	0.90	Level	15	0	0.930	1.00	471
UpStream	364	0.90	Level	15	0	0.930	1.00	435
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 (Exhibit 25-5)

V_{12} = 1581 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2052	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2052	Exhibit 25-7	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 = 19.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.327 (Exibit 25-19)

S_R= 50.8 mph (Exhibit 25-19)

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

S = 50.8 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S.Lee Hwy.
Date Performed	04/05/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description   Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 813 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1369	0.90	Level	15	0	0.930	1.00	1635
Ramp	313	0.90	Level	15	0	0.930	1.00	374
UpStream	813	0.90	Level	15	0	0.930	1.00	971
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 (Exhibit 25-5)

V_{12} = 1635 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2009	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2009	Exhibit 25-7	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 = 18.8 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.326 (Exibit 25-19)

S_R= 50.8 mph (Exhibit 25-19)

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

S = 50.8 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S.Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 584 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1975	0.90	Level	15	0	0.930	1.00	2359
Ramp	567	0.90	Level	15	0	0.930	1.00	677
UpStream	584	0.90	Level	15	0	0.930	1.00	698
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 (Exhibit 25-5)

V_{12} = 2359 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3036	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3036	Exhibit 25-7	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 = 26.6 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.378 (Exibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

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

S = 50.1 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 271 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 x f_{HV} x f_p
Freeway	1386	0.90	Level	15	0	0.930	1.00	1655
Ramp	365	0.90	Level	15	0	0.930	1.00	436
UpStream								
DownStream	271	0.90	Level	15	0	0.930	1.00	324

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 (Exhibit 25-5)

V_{12} = 1655 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2091	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2091	Exhibit 25-7	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 = 19.4 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.328 (Exibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

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

S = 50.7 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 245 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 x f_{HV} x f_p
Freeway	1068	0.90	Level	15	0	0.930	1.00	1276
Ramp	570	0.90	Level	15	0	0.930	1.00	681
UpStream								
DownStream	245	0.90	Level	15	0	0.930	1.00	293

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 (Exhibit 25-5)

V_{12} = 1276 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1957	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1957	Exhibit 25-7	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 = 18.2 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.324 (Exibit 25-19)

S_R= 50.8 mph (Exhibit 25-19)

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

S = 50.8 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 423 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 x f_{HV} x f_p
Freeway	2144	0.90	Level	15	0	0.930	1.00	2561
Ramp	556	0.90	Level	15	0	0.930	1.00	664
UpStream								
DownStream	423	0.90	Level	15	0	0.930	1.00	505

Merge Areas | Diverge Areas

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 (Exhibit 25-5)

V_{12} = 2561 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3225	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3225	Exhibit 25-7	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 = 28.1 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.395 (Exibit 25-19)

S_R= 49.9 mph (Exhibit 25-19)

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

S = 49.9 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 363 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 x f_{HV} x f_p
Freeway	1599	0.90	Level	15	0	0.930	1.00	1910
Ramp	914	0.90	Level	15	0	0.930	1.00	1092
UpStream								
DownStream	363	0.90	Level	15	0	0.930	1.00	434

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 (Exhibit 25-5)

V_{12} = 1910 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	3002	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3002	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

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 = 26.2 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.375 (Exibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

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

S = 50.1 mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75 NB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description   Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 1129 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	1466	0.95	Level	25	0	0.889	1.00	1736
Ramp	498	0.95	Level	15	0	0.930	1.00	564
UpStream	1129	0.95	Level	15	0	0.930	1.00	1278
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 (Exhibit 25-5)

V_{12} = 1736 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2300	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2300	Exhibit 25-7	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 = 20.0 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.315 (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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	I-75 NB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 1630 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	2512	0.95	Level	25	0	0.889	1.00	2975
Ramp	676	0.95	Level	15	0	0.930	1.00	765
UpStream	1630	0.95	Level	15	0	0.930	1.00	1844
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 (Exhibit 25-5)

V_{12} = 2975 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3740	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3740	Exhibit 25-7	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/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.440 (Exibit 25-19)

S_R= 57.7 mph (Exhibit 25-19)

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

S = 57.7 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	I-75 NB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☑ Yes ☐ On ☐ No ☑ Off		☐ Yes ☐ On ☑ No ☐ Off
L_{up} = 2500 ft		L_{down} = ft
V_u = 1700 veh/h	S_{FF} = 70.0 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	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 x f_{HV} x f_p
Freeway	2088	0.95	Level	25	0	0.889	1.00	2473
Ramp	778	0.95	Level	15	0	0.930	1.00	880
UpStream	1700	0.95	Level	15	0	0.930	1.00	1924
DownStream								

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} = 890.94 (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM} = 0.591 using Equation (Exhibit 25-5)	P_{FD} = using Equation (Exhibit 25-12)
V_{12} = 1463 pc/h	V_{12} = pc/h
V_3 or V_{av34} 1010 pc/h (Equation 25-4 or 25-5)	V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)	If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge)

	Actual	Capacity		LOS F?
V_{FO}	3353	Exhibit 25-7		No

Capacity Checks (Diverge)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2343	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

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 = 20.2 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = C (Exhibit 25-4)	LOS = (Exhibit 25-4)
Speed Determination	***Speed Determination***
M_S = 0.317 (Exibit 25-19)	D_s = (Exhibit 25-19)
S_R= 61.1 mph (Exhibit 25-19)	S_R= mph (Exhibit 25-19)
S_0= 68.2 mph (Exhibit 25-19)	S_0= mph (Exhibit 25-19)
S = 63.1 mph (Exhibit 25-14)	S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75 NB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 4616 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	3587	0.95	Level	25	0	0.889	1.00	4248
Ramp	1029	0.95	Level	15	0	0.930	1.00	1164
UpStream	4616	0.95	Level	15	0	0.930	1.00	5223
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 1331.57 (Equation 25-2 or 25-3)

P_{FM} = 0.591 using Equation (Exhibit 25-5)

V_{12} = 2513 pc/h

V_3 or V_{av34} 1735 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5412	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3677	Exhibit 25-7	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 = 30.5 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.430 (Exibit 25-19)

S_R= 58.0 mph (Exhibit 25-19)

S_0= 65.6 mph (Exhibit 25-19)

S = 60.2 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	I-75 SB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 277 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	2083	0.95	Level	24	0	0.893	1.00	2456
Ramp	1309	0.95	Level	15	0	0.930	1.00	1481
UpStream	277	0.95	Level	15	0	0.930	1.00	313
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 (Exhibit 25-5)

V_{12} = 2456 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3937	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3937	Exhibit 25-7	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 = 32.4 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.476 (Exibit 25-19)

S_R= 56.7 mph (Exhibit 25-19)

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

S = 56.7 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	I-75 SB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 129 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2449	0.95	Level	24	0	0.893	1.00	2887
Ramp	894	0.95	Level	15	0	0.930	1.00	1012
UpStream	129	0.95	Level	15	0	0.930	1.00	146
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 (Exhibit 25-5)

V_{12} = 2887 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	3899	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3899	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

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 = 32.3 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.468 (Exibit 25-19)

S_R= 56.9 mph (Exhibit 25-19)

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

S = 56.9 mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

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	SKB	Freeway/Dir of Travel	I-75 SB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 439 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	2939	0.95	Level	24	0	0.893	1.00	3465
Ramp	2020	0.95	Level	15	0	0.930	1.00	2286
UpStream	439	0.95	Level	15	0	0.930	1.00	497
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 1404.11 (Equation 25-2 or 25-3)

P_{FM} = 0.591 using Equation (Exhibit 25-5)

V_{12} = 2050 pc/h

V_3 or V_{av34} 1415 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5751	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4336	Exhibit 25-7	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 = 35.1 (pc/mi/ln)

LOS = E (Exhibit 25-4)

Speed Determination

M_S = 0.574 (Exibit 25-19)

S_R= 53.9 mph (Exhibit 25-19)

S_0= 66.7 mph (Exhibit 25-19)

S = 56.6 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	I-75 SB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 202 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	3494	0.95	Level	24	0	0.893	1.00	4119
Ramp	1398	0.95	Level	15	0	0.930	1.00	1582
UpStream	202	0.95	Level	15	0	0.930	1.00	229
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 1393.41 (Equation 25-2 or 25-3)

P_{FM} = 0.591 using Equation (Exhibit 25-5)

V_{12} = 2436 pc/h

V_3 or V_{av34} 1683 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5701	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4018	Exhibit 25-7	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 = 33.0 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.493 (Exibit 25-19)

S_R= 56.2 mph (Exhibit 25-19)

S_0= 65.7 mph (Exhibit 25-19)

S = 58.7 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 254 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 x f_{HV} x f_p
Freeway	961	0.90	Level	15	0	0.930	1.00	1148
Ramp	140	0.90	Level	15	0	0.930	1.00	167
UpStream								
DownStream	254	0.90	Level	15	0	0.930	1.00	303

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 (Exhibit 25-5)

V_{12} = 1148 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1315	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1315	Exhibit 25-7	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 = 13.5 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.311 (Exibit 25-19)

S_R= 51.0 mph (Exhibit 25-19)

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

S = 51.0 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☐ Yes ☐ On ☑ No ☐ Off		☑ Yes ☐ On ☐ No ☑ Off
L_{up} = ft		L_{down} = 1975 ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	V_D = 264 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 x f_{HV} x f_p
Freeway	1482	0.90	Level	15	0	0.930	1.00	1770
Ramp	233	0.90	Level	15	0	0.930	1.00	278
UpStream								
DownStream	264	0.90	Level	15	0	0.930	1.00	315

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} = 1.000 using Equation (Exhibit 25-5)	P_{FD} = using Equation (Exhibit 25-12)
V_{12} = 1770 pc/h	V_{12} = pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)	V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)	If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge)

	Actual	Capacity		LOS F?
V_{FO}	2048	Exhibit 25-7		No

Capacity Checks (Diverge)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2048	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

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 = 19.1 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = B (Exhibit 25-4)	LOS = (Exhibit 25-4)

Speed Determination	Speed Determination
M_S = 0.327 (Exibit 25-19)	D_s = (Exhibit 25-19)
S_R= 50.8 mph (Exhibit 25-19)	S_R= mph (Exhibit 25-19)
S_0= N/A mph (Exhibit 25-19)	S_0= mph (Exhibit 25-19)
S = 50.8 mph (Exhibit 25-14)	S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 858 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 x f_{HV} x f_p
Freeway	1479	0.90	Level	15	0	0.930	1.00	1767
Ramp	219	0.90	Level	15	0	0.930	1.00	262
UpStream								
DownStream	858	0.90	Level	15	0	0.930	1.00	1025

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 (Exhibit 25-5)

V_{12} = 1767 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	2029	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2029	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

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 = 19.0 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.326 (Exibit 25-19)

S_R= 50.8 mph (Exhibit 25-19)

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

S = 50.8 mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 412 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 x f_{HV} x f_p
Freeway	2280	0.90	Level	15	0	0.930	1.00	2723
Ramp	365	0.90	Level	15	0	0.930	1.00	436
UpStream								
DownStream	412	0.90	Level	15	0	0.930	1.00	492

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 (Exhibit 25-5)

V_{12} = 2723 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3159	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3159	Exhibit 25-7	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 = 27.7 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.388 (Exibit 25-19)

S_R= 50.0 mph (Exhibit 25-19)

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

S = 50.0 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S.Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 254 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	847	0.90	Level	15	0	0.930	1.00	1012
Ramp	240	0.90	Level	15	0	0.930	1.00	287
UpStream	254	0.90	Level	15	0	0.930	1.00	303
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 (Exhibit 25-5)

V_{12} = 1012 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1299	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1299	Exhibit 25-7	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 = 13.3 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.311 (Exibit 25-19)

S_R= 51.0 mph (Exhibit 25-19)

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

S = 51.0 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S.Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 310 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1405	0.90	Level	15	0	0.930	1.00	1678
Ramp	535	0.90	Level	15	0	0.930	1.00	639
UpStream	310	0.90	Level	15	0	0.930	1.00	370
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 (Exhibit 25-5)

V_{12} = 1678 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2317	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2317	Exhibit 25-7	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 = 21.1 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.336 (Exibit 25-19)

S_R= 50.6 mph (Exhibit 25-19)

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

S = 50.6 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S.Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 389 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1309	0.90	Level	15	0	0.930	1.00	1564
Ramp	407	0.90	Level	15	0	0.930	1.00	486
UpStream	389	0.90	Level	15	0	0.930	1.00	465
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 (Exhibit 25-5)

V_{12} = 1564 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2050	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2050	Exhibit 25-7	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 = 19.0 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.327 (Exibit 25-19)

S_R= 50.8 mph (Exhibit 25-19)

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

S = 50.8 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S.Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2000 ft

V_u = 467 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2178	0.90	Level	15	0	0.930	1.00	2601
Ramp	857	0.90	Level	15	0	0.930	1.00	1024
UpStream	467	0.90	Level	15	0	0.930	1.00	558
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 (Exhibit 25-5)

V_{12} = 2601 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3625	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3625	Exhibit 25-7	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 = 31.1 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.443 (Exibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

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

S = 49.2 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	[With AuxiliaryAM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 254 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 x f_{HV} x f_p
Freeway	961	0.90	Level	15	0	0.930	1.00	1148
Ramp	140	0.90	Level	15	0	0.930	1.00	167
UpStream								
DownStream	254	0.90	Level	15	0	0.930	1.00	303

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 2060.52 (Equation 25-2 or 25-3)

P_{FM} = 0.589 using Equation (Exhibit 25-5)

V_{12} = 676 pc/h

V_3 or V_{av34} 472 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1315	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	843	Exhibit 25-7	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 = 9.8 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Determination

M_S = 0.306 (Exibit 25-19)

S_R= 51.0 mph (Exhibit 25-19)

S_0= 55.0 mph (Exhibit 25-19)

S = 52.4 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description   Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 264 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 x f_{HV} x f_p
Freeway	1482	0.90	Level	15	0	0.930	1.00	1770
Ramp	233	0.90	Level	15	0	0.930	1.00	278
UpStream								
DownStream	264	0.90	Level	15	0	0.930	1.00	315

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 2142.13 (Equation 25-2 or 25-3)

P_{FM} = 0.591 using Equation (Exhibit 25-5)

V_{12} = 1045 pc/h

V_3 or V_{av34} 725 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2048	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1323	Exhibit 25-7	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 = 13.5 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.311 (Exibit 25-19)

S_R= 51.0 mph (Exhibit 25-19)

S_0= 54.2 mph (Exhibit 25-19)

S = 52.1 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 858 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 x f_{HV} x f_p
Freeway	1479	0.90	Level	15	0	0.930	1.00	1767
Ramp	219	0.90	Level	15	0	0.930	1.00	262
UpStream								
DownStream	858	0.90	Level	15	0	0.930	1.00	1025

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 6970.42 (Equation 25-2 or 25-3)

P_{FM} = 0.685 using Equation (Exhibit 25-5)

V_{12} = 1211 pc/h

V_3 or V_{av34} 556 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2029	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1473	Exhibit 25-7	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 = 14.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.314 (Exibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= 54.8 mph (Exhibit 25-19)

S = 51.9 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 412 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 x f_{HV} x f_p
Freeway	2280	0.90	Level	15	0	0.930	1.00	2723
Ramp	365	0.90	Level	15	0	0.930	1.00	436
UpStream								
DownStream	412	0.90	Level	15	0	0.930	1.00	492

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 3345.80 (Equation 25-2 or 25-3)

P_{FM} = 0.614 using Equation (Exhibit 25-5)

V_{12} = 1672 pc/h

V_3 or V_{av34} 1051 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3159	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2108	Exhibit 25-7	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 = 19.5 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.329 (Exibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

S_0= 53.0 mph (Exhibit 25-19)

S = 51.5 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 233 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 x f_{HV} x f_p
Freeway	1558	0.90	Level	15	0	0.930	1.00	1861
Ramp	218	0.90	Level	15	0	0.930	1.00	260
UpStream								
DownStream	233	0.90	Level	15	0	0.930	1.00	278

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 (Exhibit 25-5)

V_{12} = 1861 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2121	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2121	Exhibit 25-7	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 = 19.7 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.329 (Exibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

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

S = 50.7 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 78 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 x f_{HV} x f_p
Freeway	805	0.90	Level	15	0	0.930	1.00	962
Ramp	398	0.90	Level	15	0	0.930	1.00	475
UpStream								
DownStream	78	0.90	Level	15	0	0.930	1.00	93

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 (Exhibit 25-5)

V_{12} = 962 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	1437	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1437	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

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 = 14.3 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.313 (Exibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

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

S = 50.9 mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 356 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 x f_{HV} x f_p
Freeway	2413	0.90	Level	15	0	0.930	1.00	2882
Ramp	318	0.90	Level	15	0	0.930	1.00	380
UpStream								
DownStream	356	0.90	Level	15	0	0.930	1.00	425

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 (Exhibit 25-5)

V_{12} = 2882 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	3262	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3262	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

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 = 28.5 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.398 (Exibit 25-19)

S_R= 49.8 mph (Exhibit 25-19)

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

S = 49.8 mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 121 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 x f_{HV} x f_p
Freeway	1222	0.90	Level	15	0	0.930	1.00	1460
Ramp	602	0.90	Level	15	0	0.930	1.00	719
UpStream								
DownStream	121	0.90	Level	15	0	0.930	1.00	145

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 (Exhibit 25-5)

V_{12} = 1460 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2179	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2179	Exhibit 25-7	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 = 19.9 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.331 (Exibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

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

S = 50.7 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1900 ft

V_D = 538 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 x f_{HV} x f_p
Freeway	1543	0.90	Level	15	0	0.930	1.00	1843
Ramp	215	0.90	Level	15	0	0.930	1.00	257
UpStream								
DownStream	538	0.90	Level	15	0	0.930	1.00	643

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 (Exhibit 25-5)

V_{12} = 1843 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2100	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2100	Exhibit 25-7	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 = 19.5 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.328 (Exibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

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

S = 50.7 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description   Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1900 ft

V_D = 764 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 x f_{HV} x f_p
Freeway	1125	0.90	Level	15	0	0.930	1.00	1344
Ramp	647	0.90	Level	15	0	0.930	1.00	773
UpStream								
DownStream	764	0.90	Level	15	0	0.930	1.00	913

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 (Exhibit 25-5)

V_{12} = 1344 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2117	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2117	Exhibit 25-7	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 = 19.4 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.329 (Exibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

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

S = 50.7 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1900 ft

V_D = 891 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 x f_{HV} x f_p
Freeway	2375	0.90	Level	15	0	0.930	1.00	2837
Ramp	343	0.90	Level	15	0	0.930	1.00	410
UpStream								
DownStream	891	0.90	Level	15	0	0.930	1.00	1064

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 (Exhibit 25-5)

V_{12} = 2837 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3247	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3247	Exhibit 25-7	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 = 28.4 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.397 (Exibit 25-19)

S_R= 49.8 mph (Exhibit 25-19)

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

S = 49.8 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1900 ft

V_D = 1224 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 x f_{HV} x f_p
Freeway	1703	0.90	Level	15	0	0.930	1.00	2034
Ramp	1033	0.90	Level	15	0	0.930	1.00	1234
UpStream								
DownStream	1224	0.90	Level	15	0	0.930	1.00	1462

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 (Exhibit 25-5)

V_{12} = 2034 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3268	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3268	Exhibit 25-7	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 = 28.2 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.399 (Exibit 25-19)

S_R= 49.8 mph (Exhibit 25-19)

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

S = 49.8 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 233 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 x f_{HV} x f_p
Freeway	1558	0.90	Level	15	0	0.930	1.00	1861
Ramp	218	0.90	Level	15	0	0.930	1.00	260
UpStream								
DownStream	233	0.90	Level	15	0	0.930	1.00	278

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 1890.51 (Equation 25-2 or 25-3)

P_{FM} = 0.587 using Equation (Exhibit 25-5)

V_{12} = 1093 pc/h

V_3 or V_{av34} 768 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2121	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1353	Exhibit 25-7	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 = 13.7 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.312 (Exibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= 54.0 mph (Exhibit 25-19)

S = 52.0 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 78 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 x f_{HV} x f_p
Freeway	805	0.90	Level	15	0	0.930	1.00	962
Ramp	398	0.90	Level	15	0	0.930	1.00	475
UpStream								
DownStream	78	0.90	Level	15	0	0.930	1.00	93

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 632.44 (Equation 25-2 or 25-3)

P_{FM} = 0.587 using Equation (Exhibit 25-5)

V_{12} = 565 pc/h

V_3 or V_{av34} 397 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1437	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1040	Exhibit 25-7	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 = 11.2 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.308 (Exibit 25-19)

S_R= 51.0 mph (Exhibit 25-19)

S_0= 55.0 mph (Exhibit 25-19)

S = 52.0 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 356 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2413	0.90	Level	15	0	0.930	1.00	2882
Ramp	318	0.90	Level	15	0	0.930	1.00	380
UpStream								
DownStream	356	0.90	Level	15	0	0.930	1.00	425

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 2890.17 (Equation 25-2 or 25-3)

P_{FM} = 0.605 using Equation (Exhibit 25-5)

V_{12} = 1744 pc/h

V_3 or V_{av34} 1138 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3262	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2124	Exhibit 25-7	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 = 19.7 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.329 (Exibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

S_0= 52.7 mph (Exhibit 25-19)

S = 51.4 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1975 ft

V_D = 121 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 x f_{HV} x f_p
Freeway	1222	0.90	Level	15	0	0.930	1.00	1460
Ramp	602	0.90	Level	15	0	0.930	1.00	719
UpStream								
DownStream	121	0.90	Level	15	0	0.930	1.00	145

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 986.06 (Equation 25-2 or 25-3)

P_{FM} = 0.587 using Equation (Exhibit 25-5)

V_{12} = 857 pc/h

V_3 or V_{av34} 603 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2179	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1576	Exhibit 25-7	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 = 15.2 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = 0.315 (Exibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= 54.6 mph (Exhibit 25-19)

S = 51.9 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☐ On
☑ No ☐ Off		☐ No ☑ Off
L_{up} = ft		L_{down} = 1900 ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	V_D = 538 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 x f_{HV} x f_p
Freeway	1543	0.90	Level	15	0	0.930	1.00	1843
Ramp	215	0.90	Level	15	0	0.930	1.00	257
UpStream								
DownStream	538	0.90	Level	15	0	0.930	1.00	643

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge Areas)

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

L_{EQ} = 4372.66 (Equation 25-2 or 25-3)

P_{FM} = 0.638 using Equation (Exhibit 25-5)

V_{12} = 1175 pc/h

V_3 or V_{av34} 668 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge)

	Actual	Capacity		LOS F?
V_{FO}	2100	Exhibit 25-7		No

Capacity Checks (Diverge)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1432	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F) (Merge)

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

D_R = 14.3 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge)

M_S = 0.313 (Exibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= 54.4 mph (Exhibit 25-19)

S = 52.0 mph (Exhibit 25-14)

Speed Determination (Diverge)

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1900 ft

V_D = 764 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 x f_{HV} x f_p
Freeway	1125	0.90	Level	15	0	0.930	1.00	1344
Ramp	647	0.90	Level	15	0	0.930	1.00	773
UpStream								
DownStream	764	0.90	Level	15	0	0.930	1.00	913

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge Areas)

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

L_{EQ} = 6208.77 (Equation 25-2 or 25-3)

P_{FM} = 0.675 using Equation (Exhibit 25-5)

V_{12} = 907 pc/h

V_3 or V_{av34} 437 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	2117	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1680	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

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 = 16.0 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.317 (Exibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= 55.0 mph (Exhibit 25-19)

S = 51.7 mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1900 ft

V_D = 891 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 x f_{HV} x f_p
Freeway	2375	0.90	Level	15	0	0.930	1.00	2837
Ramp	343	0.90	Level	15	0	0.930	1.00	410
UpStream								
DownStream	891	0.90	Level	15	0	0.930	1.00	1064

Merge Areas | Diverge Areas

Estimation of v_{12} (Merge Areas)

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

L_{EQ} = 7235.63 (Equation 25-2 or 25-3)

P_{FM} = 0.696 using Equation (Exhibit 25-5)

V_{12} = 1974 pc/h

V_3 or V_{av34} 863 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	3247	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2384	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

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 = 21.7 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.339 (Exibit 25-19)

S_R= 50.6 mph (Exhibit 25-19)

S_0= 53.7 mph (Exhibit 25-19)

S = 51.4 mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

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	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	On-Ramp from Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 1900 ft

V_D = 1224 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 x f_{HV} x f_p
Freeway	1703	0.90	Level	15	0	0.930	1.00	2034
Ramp	1033	0.90	Level	15	0	0.930	1.00	1234
UpStream								
DownStream	1224	0.90	Level	15	0	0.930	1.00	1462

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 9942.20 (Equation 25-2 or 25-3)

P_{FM} = 0.751 using Equation (Exhibit 25-5)

V_{12} = 1527 pc/h

V_3 or V_{av34} 507 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3268	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2761	Exhibit 25-7	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 = 24.2 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.358 (Exibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 55.0 mph (Exhibit 25-19)

S = 51.0 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	I-75 NB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 1008 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	1587	0.95	Level	25	0	0.889	1.00	1879
Ramp	560	0.95	Level	15	0	0.930	1.00	634
UpStream	1008	0.95	Level	15	0	0.930	1.00	1141
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 (Exhibit 25-5)

V_{12} = 1879 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2513	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2513	Exhibit 25-7	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 = 21.6 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.324 (Exibit 25-19)

S_R= 60.9 mph (Exhibit 25-19)

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

S = 60.9 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	I-75 NB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 1480 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	2662	0.95	Level	25	0	0.889	1.00	3152
Ramp	798	0.95	Level	15	0	0.930	1.00	903
UpStream	1480	0.95	Level	15	0	0.930	1.00	1675
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 (Exhibit 25-5)

V_{12} = 3152 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4055	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4055	Exhibit 25-7	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 = 33.6 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.501 (Exibit 25-19)

S_R= 56.0 mph (Exhibit 25-19)

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

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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S =	56.0 mph (Exhibit 25-14)	S =	mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75 NB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 1575 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	2213	0.95	Level	25	0	0.889	1.00	2621
Ramp	924	0.95	Level	15	0	0.930	1.00	1046
UpStream	1575	0.95	Level	15	0	0.930	1.00	1782
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 958.14 (Equation 25-2 or 25-3)

P_{FM} = 0.591 using Equation (Exhibit 25-5)

V_{12} = 1550 pc/h

V_3 or V_{av34} 1071 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3667	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2596	Exhibit 25-7	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 = 22.1 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

M_S = 0.328 (Exibit 25-19)

S_R= 60.8 mph (Exhibit 25-19)

S_0= 67.9 mph (Exhibit 25-19)

S = 62.7 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	I-75 NB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 2208 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	3778	0.95	Level	25	0	0.889	1.00	4474
Ramp	1274	0.95	Level	15	0	0.930	1.00	1442
UpStream	2208	0.95	Level	15	0	0.930	1.00	2499
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 1439.42 (Equation 25-2 or 25-3)

P_{FM} = 0.591 using Equation (Exhibit 25-5)

V_{12} = 2646 pc/h

V_3 or V_{av34} 1828 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5916	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4088	Exhibit 25-7	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 = 33.6 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.509 (Exibit 25-19)

S_R= 55.8 mph (Exhibit 25-19)

S_0= 65.2 mph (Exhibit 25-19)

S = 58.4 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	I-75 SB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 377 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	2169	0.95	Level	24	0	0.893	1.00	2557
Ramp	1223	0.95	Level	15	0	0.930	1.00	1384
UpStream	377	0.95	Level	15	0	0.930	1.00	427
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 (Exhibit 25-5)

V_{12} = 2557 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3941	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3941	Exhibit 25-7	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 = 32.4 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.477 (Exibit 25-19)

S_R= 56.7 mph (Exhibit 25-19)

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

S = 56.7 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75 SB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 279 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	2494	0.95	Level	24	0	0.893	1.00	2940
Ramp	849	0.95	Level	15	0	0.930	1.00	961
UpStream	279	0.95	Level	15	0	0.930	1.00	316
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 (Exhibit 25-5)

V_{12} = 2940 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3901	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3901	Exhibit 25-7	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 = 32.3 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.469 (Exibit 25-19)

S_R= 56.9 mph (Exhibit 25-19)

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

S = 56.9 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75 SB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 564 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	3133	0.95	Level	24	0	0.893	1.00	3694
Ramp	1826	0.95	Level	15	0	0.930	1.00	2066
UpStream	564	0.95	Level	15	0	0.930	1.00	638
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = 1406.04 (Equation 25-2 or 25-3)

P_{FM} = 0.591 using Equation (Exhibit 25-5)

V_{12} = 2185 pc/h

V_3 or V_{av34} 1509 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5760	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4251	Exhibit 25-7	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 = 34.5 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.550 (Exibit 25-19)

S_R= 54.6 mph (Exhibit 25-19)

S_0= 66.4 mph (Exhibit 25-19)

S = 57.3 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 (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

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	SKB	Freeway/Dir of Travel	I-75 SB
Agency or Company	TDOT/ Long Engineering	Junction	APD-40
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 2500 ft

V_u = 414 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 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 x f_{HV} x f_p
Freeway	3631	0.95	Level	24	0	0.893	1.00	4281
Ramp	1261	0.95	Level	15	0	0.930	1.00	1427
UpStream	414	0.95	Level	15	0	0.930	1.00	468
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge Areas)

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

L_{EQ} = 1394.91 (Equation 25-2 or 25-3)

P_{FM} = 0.591 using Equation (Exhibit 25-5)

V_{12} = 2532 pc/h

V_3 or V_{av34} 1749 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	5708	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3959	Exhibit 25-7	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

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 = 32.6 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.480 (Exibit 25-19)

S_R= 56.5 mph (Exhibit 25-19)

S_0= 65.5 mph (Exhibit 25-19)

S = 59.0 mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

Diverge Ramps

Highway Capacity Software Computer Printouts

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 1079 veh/h

Terrain: Level

S_{FF} = 55.0 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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1439	0.90	Level	15	0	0.930	1.00	1719
Ramp	520	0.90	Level	15	0	0.930	1.00	621
UpStream	1079	0.90	Level	15	0	0.930	1.00	1289
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1719 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1719	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1098	Exhibit 25-14	4500	No
V_R	621	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1719	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 15.9 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.484 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

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

S = 48.7 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 1551 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1688	0.90	Level	15	0	0.930	1.00	2016
Ramp	364	0.90	Level	15	0	0.930	1.00	435
UpStream	1551	0.90	Level	15	0	0.930	1.00	1853
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2016 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2016	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1581	Exhibit 25-14	4500	No
V_R	435	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2016	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 18.4 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.467 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 1622 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2559	0.90	Level	15	0	0.930	1.00	3057
Ramp	813	0.90	Level	15	0	0.930	1.00	971
UpStream	1622	0.90	Level	15	0	0.930	1.00	1937
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3057 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3057	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2086	Exhibit 25-14	4500	No
V_R	971	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3057	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 27.4 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.515 (Exhibit 25-19)

S_R= 48.3 mph (Exhibit 25-19)

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

S = 48.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description   Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 2356 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2182	0.90	Level	15	0	0.930	1.00	2606
Ramp	584	0.90	Level	15	0	0.930	1.00	698
UpStream	2356	0.90	Level	15	0	0.930	1.00	2814
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2606 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2606	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1908	Exhibit 25-14	4500	No
V_R	698	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2606	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 23.5 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.491 (Exhibit 25-19)

S_R= 48.6 mph (Exhibit 25-19)

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

S = 48.6 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 2000 ft

V_D = 365 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 x f_{HV} x f_p
Freeway	1657	0.90	Level	15	0	0.930	1.00	1979
Ramp	271	0.90	Level	15	0	0.930	1.00	324
UpStream								
DownStream	365	0.90	Level	15	0	0.930	1.00	436

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1979 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1979	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1655	Exhibit 25-14	4500	No
V_R	324	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1979	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 18.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.457 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

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

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 2000 ft

V_D = 570 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 x f_{HV} x f_p
Freeway	1313	0.90	Level	15	0	0.930	1.00	1568
Ramp	245	0.90	Level	15	0	0.930	1.00	293
UpStream								
DownStream	570	0.90	Level	15	0	0.930	1.00	681

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1568 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1568	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1275	Exhibit 25-14	4500	No
V_R	293	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1568	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 14.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.454 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

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

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description   Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 2000 ft

V_D = 556 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 x f_{HV} x f_p
Freeway	2567	0.90	Level	15	0	0.930	1.00	3066
Ramp	423	0.90	Level	15	0	0.930	1.00	505
UpStream								
DownStream	556	0.90	Level	15	0	0.930	1.00	664

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3066 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3066	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2561	Exhibit 25-14	4500	No
V_R	505	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3066	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 27.5 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.473 (Exhibit 25-19)

S_R= 48.8 mph (Exhibit 25-19)

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

S = 48.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 2000 ft

V_D = 914 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 x f_{HV} x f_p
Freeway	1962	0.90	Level	15	0	0.930	1.00	2343
Ramp	363	0.90	Level	15	0	0.930	1.00	434
UpStream								
DownStream	914	0.90	Level	15	0	0.930	1.00	1092

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2343 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2343	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1909	Exhibit 25-14	4500	No
V_R	434	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2343	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 21.3 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.467 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 365 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1751	0.90	Level	15	0	0.930	1.00	2091
Ramp	476	0.90	Level	15	0	0.930	1.00	569
UpStream	365	0.90	Level	15	0	0.930	1.00	436
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2091 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2091	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1522	Exhibit 25-14	4500	No
V_R	569	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2091	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 19.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.479 (Exhibit 25-19)

S_R= 48.8 mph (Exhibit 25-19)

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

S = 48.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 570 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1638	0.90	Level	15	0	0.930	1.00	1956
Ramp	648	0.90	Level	15	0	0.930	1.00	774
UpStream	570	0.90	Level	15	0	0.930	1.00	681
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1956 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1956	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1182	Exhibit 25-14	4500	No
V_R	774	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1956	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.9 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.498 (Exhibit 25-19)

S_R= 48.5 mph (Exhibit 25-19)

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

S = 48.5 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 914 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2513	0.90	Level	15	0	0.930	1.00	3002
Ramp	985	0.90	Level	15	0	0.930	1.00	1177
UpStream	914	0.90	Level	15	0	0.930	1.00	1092
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3002 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3002	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1825	Exhibit 25-14	4500	No
V_R	1177	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3002	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 26.9 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.534 (Exhibit 25-19)

S_R= 48.1 mph (Exhibit 25-19)

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

S = 48.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 914 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2513	0.90	Level	15	0	0.930	1.00	3002
Ramp	985	0.90	Level	15	0	0.930	1.00	1177
UpStream	914	0.90	Level	15	0	0.930	1.00	1092
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3002 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3002	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1825	Exhibit 25-14	4500	No
V_R	1177	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3002	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 26.9 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.534 (Exhibit 25-19)

S_R= 48.1 mph (Exhibit 25-19)

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

S = 48.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 498 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 x f_{HV} x f_p
Freeway	2595	0.95	Level	24	0	0.893	1.00	3059
Ramp	1129	0.95	Level	15	0	0.930	1.00	1278
UpStream								
DownStream	498	0.95	Level	15	0	0.930	1.00	564

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3059 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3059	Exhibit 25-14	4800	No
$V_{FO} = V_F - V_R$	1781	Exhibit 25-14	4800	No
V_R	1278	Exhibit 25-3	4100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3059	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.413 (Exhibit 25-19)

S_R= 58.4 mph (Exhibit 25-19)

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

S = 58.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 676 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 x f_{HV} x f_p
Freeway	4142	0.95	Level	24	0	0.893	1.00	4883
Ramp	1630	0.95	Level	15	0	0.930	1.00	1844
UpStream								
DownStream	676	0.95	Level	15	0	0.930	1.00	765

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 4883 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4883	Exhibit 25-14	4800	Yes
$V_{FO} = V_F - V_R$	3039	Exhibit 25-14	4800	No
V_R	1844	Exhibit 25-3	4100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4883	Exhibit 25-14	4400:All	Yes

Level of Service Determination (if not F)

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

D_R = 32.7 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Determination

D_s = 0.464 (Exhibit 25-19)

S_R= 57.0 mph (Exhibit 25-19)

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

S = 57.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp [I-75 With 6 Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 676 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 x f_{HV} x f_p
Freeway	4142	0.95	Level	24	0	0.893	1.00	4883
Ramp	1630	0.95	Level	15	0	0.930	1.00	1844
UpStream								
DownStream	676	0.95	Level	15	0	0.930	1.00	765

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 0.553 using Equation (Exhibit 25-12)

V_{12} = 3525 pc/h

V_3 or V_{av34} 1358 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4883	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	3039	Exhibit 25-14	7200	No
V_R	1844	Exhibit 25-3	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3525	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 30.1 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.464 (Exhibit 25-19)

S_R= 57.0 mph (Exhibit 25-19)

S_0= 75.4 mph (Exhibit 25-19)

S = 61.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 778 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3788	0.95	Level	24	0	0.893	1.00	4466
Ramp	1700	0.95	Level	15	0	0.930	1.00	1924
UpStream								
DownStream	778	0.95	Level	15	0	0.930	1.00	880

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 0.450 using Equation (Exhibit 25-12)

V_{12} = 3068 pc/h

V_3 or V_{av34} 1398 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4466	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	2542	Exhibit 25-14	7200	No
V_R	1924	Exhibit 25-3	4100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3068	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.471 (Exhibit 25-19)

S_R= 56.8 mph (Exhibit 25-19)

S_0= 75.2 mph (Exhibit 25-19)

S = 61.5 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 1029 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 x f_{HV} x f_p
Freeway	6066	0.95	Level	24	0	0.893	1.00	7151
Ramp	2479	0.95	Level	15	0	0.930	1.00	2805
UpStream								
DownStream	1029	0.95	Level	15	0	0.930	1.00	1164

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 0.450 using Equation (Exhibit 25-12)

V_{12} = 4761 pc/h

V_3 or V_{av34} 2390 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7151	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	4346	Exhibit 25-14	7200	No
V_R	2805	Exhibit 25-3	4100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4761	Exhibit 25-14	4400:All	Yes

Level of Service Determination (if not F)

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

D_R = 31.7 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.550 (Exhibit 25-19)

S_R= 54.6 mph (Exhibit 25-19)

S_0= 71.4 mph (Exhibit 25-19)

S = 59.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 1309 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2360	0.95	Level	25	0	0.889	1.00	2795
Ramp	277	0.95	Level	15	0	0.930	1.00	313
UpStream								
DownStream	1309	0.95	Level	15	0	0.930	1.00	1481

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2795 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2795	Exhibit 25-14	4800	No
$V_{FO} = V_F - V_R$	2482	Exhibit 25-14	4800	No
V_R	313	Exhibit 25-3	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2795	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 23.8 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.326 (Exhibit 25-19)

S_R= 60.9 mph (Exhibit 25-19)

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

S = 60.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 894 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 x f_{HV} x f_p
Freeway	2578	0.95	Level	25	0	0.889	1.00	3053
Ramp	129	0.95	Level	15	0	0.930	1.00	146
UpStream								
DownStream	894	0.95	Level	15	0	0.930	1.00	1012

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3053 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3053	Exhibit 25-14	4800	No
$V_{FO} = V_F - V_R$	2907	Exhibit 25-14	4800	No
V_R	146	Exhibit 25-3	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3053	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 26.0 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.311 (Exhibit 25-19)

S_R= 61.3 mph (Exhibit 25-19)

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

S = 61.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☐ Yes ☐ On ☑ No ☐ Off		☑ Yes ☑ On ☐ No ☐ Off
L_{up} = ft	S_{FF} = 70.0 mph S_{FR} = 45.0 mph	L_{down} = 2500 ft
V_u = veh/h	Sketch (show lanes, L_A, L_D,V_R,V_f)	V_D = 2020 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 x f_{HV} x f_p
Freeway	3378	0.95	Level	25	0	0.889	1.00	4000
Ramp	439	0.95	Level	15	0	0.930	1.00	497
UpStream								
DownStream	2020	0.95	Level	15	0	0.930	1.00	2286

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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 0.637 using Equation (Exhibit 25-12)

V_{12} = 2729 pc/h

V_3 or V_{av34} 1271 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge)

	Actual	Capacity		LOS F?
V_F	4000	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	3503	Exhibit 25-14	7200	No
V_R	497	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2729	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F) (Merge)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge)

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

D_R = 23.2 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination (Merge)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge)

D_s = 0.343 (Exhibit 25-19)

S_R= 60.4 mph (Exhibit 25-19)

S_0= 75.7 mph (Exhibit 25-19)

S = 64.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 1398 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 x f_{HV} x f_p
Freeway	3696	0.95	Level	25	0	0.889	1.00	4377
Ramp	202	0.95	Level	15	0	0.930	1.00	229
UpStream								
DownStream	1398	0.95	Level	15	0	0.930	1.00	1582

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 0.640 using Equation (Exhibit 25-12)

V_{12} = 2884 pc/h

V_3 or V_{av34} 1493 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4377	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	4148	Exhibit 25-14	7200	No
V_R	229	Exhibit 25-3	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2884	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 24.6 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.319 (Exhibit 25-19)

S_R= 61.1 mph (Exhibit 25-19)

S_0= 74.9 mph (Exhibit 25-19)

S = 65.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 912 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1272	0.90	Level	15	0	0.930	1.00	1519
Ramp	353	0.90	Level	15	0	0.930	1.00	422
UpStream	912	0.90	Level	15	0	0.930	1.00	1089
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1519 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1519	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1097	Exhibit 25-14	4500	No
V_R	422	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1519	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 14.2 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.466 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 1428 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1565	0.90	Level	15	0	0.930	1.00	1869
Ramp	241	0.90	Level	15	0	0.930	1.00	288
UpStream	1428	0.90	Level	15	0	0.930	1.00	1706
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1869 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1869	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1581	Exhibit 25-14	4500	No
V_R	288	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1869	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.2 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.454 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

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

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 1370 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1930	0.90	Level	15	0	0.930	1.00	2305
Ramp	561	0.90	Level	15	0	0.930	1.00	670
UpStream	1370	0.90	Level	15	0	0.930	1.00	1636
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2305 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2305	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1635	Exhibit 25-14	4500	No
V_R	670	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2305	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 20.9 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.488 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

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

S = 48.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 2168 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2371	0.90	Level	15	0	0.930	1.00	2832
Ramp	396	0.90	Level	15	0	0.930	1.00	473
UpStream	2168	0.90	Level	15	0	0.930	1.00	2590
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2832 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2832	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2359	Exhibit 25-14	4500	No
V_R	473	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2832	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 25.5 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.471 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☑ Yes ☑ On ☐ No ☐ Off L_{up} = 1975 ft V_u = 912 veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	☐ 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 x f_{HV} x f_p
Freeway	1272	0.90	Level	15	0	0.930	1.00	1519
Ramp	353	0.90	Level	15	0	0.930	1.00	422
UpStream	912	0.90	Level	15	0	0.930	1.00	1089
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1519 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1519	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1097	Exhibit 25-14	4500	No
V_R	422	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1519	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 14.2 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.466 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 1428 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1565	0.90	Level	15	0	0.930	1.00	1869
Ramp	241	0.90	Level	15	0	0.930	1.00	288
UpStream	1428	0.90	Level	15	0	0.930	1.00	1706
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 1869 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	1869	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1581	Exhibit 25-14	4500	No
V_R	288	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1869	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 17.2 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.454 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

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

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 1370 veh/h

Terrain: Level

S_{FF} = 55.0 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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1930	0.90	Level	15	0	0.930	1.00	2305
Ramp	561	0.90	Level	15	0	0.930	1.00	670
UpStream	1370	0.90	Level	15	0	0.930	1.00	1636
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 2305 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	2305	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1635	Exhibit 25-14	4500	No
V_R	670	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2305	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 20.9 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.488 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

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

S = 48.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / *Site Information*

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 2168 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2371	0.90	Level	15	0	0.930	1.00	2832
Ramp	396	0.90	Level	15	0	0.930	1.00	473
UpStream	2168	0.90	Level	15	0	0.930	1.00	2590
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2832 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2832	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2359	Exhibit 25-14	4500	No
V_R	473	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2832	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 25.5 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.471 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 498 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 x f_{HV} x f_p
Freeway	2595	0.95	Level	24	0	0.893	1.00	3059
Ramp	1129	0.95	Level	15	0	0.930	1.00	1278
UpStream								
DownStream	498	0.95	Level	15	0	0.930	1.00	564

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3059 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3059	Exhibit 25-14	4800	No
$V_{FO} = V_F - V_R$	1781	Exhibit 25-14	4800	No
V_R	1278	Exhibit 25-3	4100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3059	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.413 (Exhibit 25-19)

S_R= 58.4 mph (Exhibit 25-19)

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

S = 58.4 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System With Slip Ramp [I-75 With 6 Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 676 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 x f_{HV} x f_p
Freeway	4142	0.95	Level	24	0	0.893	1.00	4883
Ramp	1630	0.95	Level	15	0	0.930	1.00	1844
UpStream								
DownStream	676	0.95	Level	15	0	0.930	1.00	765

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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 0.450 using Equation (Exhibit 25-12)

V_{12} = 3212 pc/h

V_3 or V_{av34} 1671 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	4883	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	3039	Exhibit 25-14	7200	No
V_R	1844	Exhibit 25-3	4100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3212	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 18.4 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.464 (Exhibit 25-19)

S_R= 57.0 mph (Exhibit 25-19)

S_0= 74.2 mph (Exhibit 25-19)

S = 61.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 676 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4142	0.95	Level	24	0	0.893	1.00	4883
Ramp	1630	0.95	Level	15	0	0.930	1.00	1844
UpStream								
DownStream	676	0.95	Level	15	0	0.930	1.00	765

Merge Areas	Diverge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

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 (Exhibit 25-12)

V_{12} = 4883 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4883	Exhibit 25-14	4800	Yes
$V_{FO} = V_F - V_R$	3039	Exhibit 25-14	4800	No
V_R	1844	Exhibit 25-3	4100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4883	Exhibit 25-14	4400: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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 32.7 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination

D_s = 0.464 (Exhibit 25-19)

S_R= 57.0 mph (Exhibit 25-19)

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

S = 57.0 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 778 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 x f_{HV} x f_p
Freeway	3788	0.95	Level	24	0	0.893	1.00	4466
Ramp	1700	0.95	Level	15	0	0.930	1.00	1924
UpStream								
DownStream	778	0.95	Level	15	0	0.930	1.00	880

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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 0.450 using Equation (Exhibit 25-12)

V_{12} = 3068 pc/h

V_3 or V_{av34} 1398 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	4466	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	2542	Exhibit 25-14	7200	No
V_R	1924	Exhibit 25-3	4100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3068	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 17.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.471 (Exhibit 25-19)

S_R= 56.8 mph (Exhibit 25-19)

S_0= 75.2 mph (Exhibit 25-19)

S = 61.5 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 1029 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 x f_{HV} x f_p
Freeway	6066	0.95	Level	24	0	0.893	1.00	7151
Ramp	2479	0.95	Level	15	0	0.930	1.00	2805
UpStream								
DownStream	1029	0.95	Level	15	0	0.930	1.00	1164

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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 0.450 using Equation (Exhibit 25-12)

V_{12} = 4761 pc/h

V_3 or V_{av34} 2390 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	7151	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	4346	Exhibit 25-14	7200	No
V_R	2805	Exhibit 25-3	4100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4761	Exhibit 25-14	4400:All	Yes

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 31.7 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.550 (Exhibit 25-19)

S_R= 54.6 mph (Exhibit 25-19)

S_0= 71.4 mph (Exhibit 25-19)

S = 59.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75 NB Slip Ramp
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Stone Lake Road
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1129	0.90	Level	15	0	0.930	1.00	1349
Ramp	167	0.90	Level	15	0	0.930	1.00	199
UpStream								
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1349 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1349	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1150	Exhibit 25-14	4500	No
V_R	199	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1349	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 11.4 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.446 (Exhibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

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

S = 49.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75 NB Slip Ramp
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Stone Lake Road
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1630	0.90	Level	15	0	0.930	1.00	1947
Ramp	123	0.90	Level	15	0	0.930	1.00	147
UpStream								
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1947 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1947	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1800	Exhibit 25-14	4500	No
V_R	147	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1947	Exhibit 25-14	4400:All	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 Determination

D_s = 0.441 (Exhibit 25-19)

S_R= 49.3 mph (Exhibit 25-19)

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

S = 49.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75 NB Slip Ramp
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Stone Lake Road
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1700	0.90	Level	15	0	0.930	1.00	2031
Ramp	252	0.90	Level	15	0	0.930	1.00	301
UpStream								
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2031 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2031	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1730	Exhibit 25-14	4500	No
V_R	301	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2031	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.2 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.455 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

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

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	I-75 NB Slip Ramp
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Stone Lake Road
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Existing System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2479	0.90	Level	15	0	0.930	1.00	2961
Ramp	188	0.90	Level	15	0	0.930	1.00	225
UpStream								
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2961 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2961	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2736	Exhibit 25-14	4500	No
V_R	225	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2961	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 25.2 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.448 (Exhibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

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

S = 49.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 961 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1510	0.90	Level	15	0	0.930	1.00	1804
Ramp	549	0.90	Level	15	0	0.930	1.00	656
UpStream	961	0.90	Level	15	0	0.930	1.00	1148
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1804 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1804	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1148	Exhibit 25-14	4500	No
V_R	656	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1804	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 16.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.487 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

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

S = 48.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1409 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1746	0.90	Level	15	0	0.930	1.00	2085
Ramp	264	0.90	Level	15	0	0.930	1.00	315
UpStream	1409	0.90	Level	15	0	0.930	1.00	1683
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 2085 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	2085	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1770	Exhibit 25-14	4500	No
V_R	315	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2085	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 19.0 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.456 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

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

S = 49.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1505 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2337	0.90	Level	15	0	0.930	1.00	2791
Ramp	858	0.90	Level	15	0	0.930	1.00	1025
UpStream	1505	0.90	Level	15	0	0.930	1.00	1798
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2791 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2791	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1766	Exhibit 25-14	4500	No
V_R	1025	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2791	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 25.1 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.520 (Exhibit 25-19)

S_R= 48.2 mph (Exhibit 25-19)

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

S = 48.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 2182 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2692	0.90	Level	15	0	0.930	1.00	3215
Ramp	412	0.90	Level	15	0	0.930	1.00	492
UpStream	2182	0.90	Level	15	0	0.930	1.00	2606
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12}

Diverge Areas

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

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

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 3215 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3215	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2723	Exhibit 25-14	4500	No
V_R	492	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3215	Exhibit 25-14	4400: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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 28.8 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination

D_s = 0.472 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 140 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1101	0.90	Level	15	0	0.930	1.00	1315
Ramp	254	0.90	Level	15	0	0.930	1.00	303
UpStream	140	0.90	Level	15	0	0.930	1.00	167
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 1315 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	1315	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1012	Exhibit 25-14	4500	No
V_R	303	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1315	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 12.4 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.455 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

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

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 223 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1715	0.90	Level	15	0	0.930	1.00	2048
Ramp	310	0.90	Level	15	0	0.930	1.00	370
UpStream	223	0.90	Level	15	0	0.930	1.00	266
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2048 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2048	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1678	Exhibit 25-14	4500	No
V_R	370	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2048	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 18.7 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.461 (Exhibit 25-19)

S_R= 49.0 mph (Exhibit 25-19)

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

S = 49.0 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 219 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1698	0.90	Level	15	0	0.930	1.00	2028
Ramp	389	0.90	Level	15	0	0.930	1.00	465
UpStream	219	0.90	Level	15	0	0.930	1.00	262
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2028 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2028	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1563	Exhibit 25-14	4500	No
V_R	465	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2028	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 18.5 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.470 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information | *Site Information*

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 365 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2645	0.90	Level	15	0	0.930	1.00	3159
Ramp	467	0.90	Level	15	0	0.930	1.00	558
UpStream	365	0.90	Level	15	0	0.930	1.00	436
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3159 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3159	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2601	Exhibit 25-14	4500	No
V_R	558	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3159	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 28.3 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.478 (Exhibit 25-19)

S_R= 48.8 mph (Exhibit 25-19)

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

S = 48.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 961 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1510	0.90	Level	15	0	0.930	1.00	1804
Ramp	549	0.90	Level	15	0	0.930	1.00	656
UpStream	961	0.90	Level	15	0	0.930	1.00	1148
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 18328.12 (Equation 25-8 or 25-9)

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 1804 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1804	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1148	Exhibit 25-14	6750	No
V_R	656	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1804	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 16.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.487 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 48.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1409 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1746	0.90	Level	15	0	0.930	1.00	2085
Ramp	264	0.90	Level	15	0	0.930	1.00	315
UpStream	1409	0.90	Level	15	0	0.930	1.00	1683
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

L_{EQ} = 17712.99 (Equation 25-8 or 25-9)

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 2085 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge)

	Actual	Capacity		LOS F?
V_F	2085	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1770	Exhibit 25-14	6750	No
V_R	315	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2085	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F) (Merge)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge)

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

D_R = 19.0 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge)

D_s = 0.456 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst SKB
Agency or Company TDOT / Long Engineering
Date Performed 05/04/2009
Analysis Time Period AM Peak Period

Site Information

Freeway/Dir of Travel APD-40 EB
Junction Off-Ramp to Prop. Intx.
Jurisdiction Cleveland, TN
Analysis Year 2033

Project Description Proposed System Without Slip Ramp [Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1505 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2337	0.90	Level	15	0	0.930	1.00	2791
Ramp	858	0.90	Level	15	0	0.930	1.00	1025
UpStream	1505	0.90	Level	15	0	0.930	1.00	1798
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 (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 31382.54 (Equation 25-8 or 25-9)
P_{FD} = 1.000 using Equation (Exhibit 25-12)
V_{12} = 2791 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2791	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1766	Exhibit 25-14	6750	No
V_R	1025	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2791	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 25.1 (pc/mi/ln)
LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.520 (Exhibit 25-19)
S_R= 48.2 mph (Exhibit 25-19)
S_0= 60.3 mph (Exhibit 25-19)
S = 48.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 2182 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	2692	0.90	Level	15	0	0.930	1.00	3215
Ramp	412	0.90	Level	15	0	0.930	1.00	492
UpStream	2182	0.90	Level	15	0	0.930	1.00	2606
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

L_{EQ} = 24229.91 (Equation 25-8 or 25-9)

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 3215 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	3215	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	2723	Exhibit 25-14	6750	No
V_R	492	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3215	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 28.8 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.472 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 140 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1101	0.90	Level	15	0	0.930	1.00	1315
Ramp	254	0.90	Level	15	0	0.930	1.00	303
UpStream	140	0.90	Level	15	0	0.930	1.00	167
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 2135.09 (Equation 25-8 or 25-9)

P_{FD} = 0.717 using Equation (Exhibit 25-12)

V_{12} = 1028 pc/h

V_3 or V_{av34} 287 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1315	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1012	Exhibit 25-14	6750	No
V_R	303	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1028	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 9.9 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Determination

D_s = 0.455 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 51.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 223 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1715	0.90	Level	15	0	0.930	1.00	2048
Ramp	310	0.90	Level	15	0	0.930	1.00	370
UpStream	223	0.90	Level	15	0	0.930	1.00	266
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 2956.08 (Equation 25-8 or 25-9)

P_{FD} = 0.718 using Equation (Exhibit 25-12)

V_{12} = 1576 pc/h

V_3 or V_{av34} 472 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2048	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1678	Exhibit 25-14	6750	No
V_R	370	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1576	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 14.7 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.461 (Exhibit 25-19)

S_R= 49.0 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 51.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 219 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1698	0.90	Level	15	0	0.930	1.00	2028
Ramp	389	0.90	Level	15	0	0.930	1.00	465
UpStream	219	0.90	Level	15	0	0.930	1.00	262
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 3183.32 (Equation 25-8 or 25-9)

P_{FD} = 0.718 using Equation (Exhibit 25-12)

V_{12} = 1587 pc/h

V_3 or V_{av34} 441 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2028	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1563	Exhibit 25-14	6750	No
V_R	465	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1587	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 14.8 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.470 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 51.0 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 365 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2649	0.90	Level	15	0	0.930	1.00	3164
Ramp	467	0.90	Level	15	0	0.930	1.00	558
UpStream	365	0.90	Level	15	0	0.930	1.00	436
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 4301.33 (Equation 25-8 or 25-9)

P_{FD} = 0.727 using Equation (Exhibit 25-12)

V_{12} = 2452 pc/h

V_3 or V_{av34} 712 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3164	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	2606	Exhibit 25-14	6750	No
V_R	558	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2452	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 22.2 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.478 (Exhibit 25-19)

S_R= 48.8 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 51.0 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 2000 ft

V_D = 218 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 x f_{HV} x f_p
Freeway	1958	0.90	Level	15	0	0.930	1.00	2339
Ramp	400	0.90	Level	15	0	0.930	1.00	478
UpStream								
DownStream	218	0.90	Level	15	0	0.930	1.00	260

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2339 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2339	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1861	Exhibit 25-14	4500	No
V_R	478	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2339	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 21.2 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.471 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 2000 ft

V_D = 398 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 x f_{HV} x f_p
Freeway	1190	0.90	Level	15	0	0.930	1.00	1421
Ramp	385	0.90	Level	15	0	0.930	1.00	460
UpStream								
DownStream	398	0.90	Level	15	0	0.930	1.00	475

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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 1421 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	1421	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	961	Exhibit 25-14	4500	No
V_R	460	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1421	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 13.3 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.469 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 2000 ft

V_D = 318 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 x f_{HV} x f_p
Freeway	3064	0.90	Level	15	0	0.930	1.00	3660
Ramp	651	0.90	Level	15	0	0.930	1.00	778
UpStream								
DownStream	318	0.90	Level	15	0	0.930	1.00	380

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3660 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3660	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2882	Exhibit 25-14	4500	No
V_R	778	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3660	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 32.6 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.498 (Exhibit 25-19)

S_R= 48.5 mph (Exhibit 25-19)

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

S = 48.5 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to S. Lee Hwy.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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} = 2000 ft

V_D = 602 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 x f_{HV} x f_p
Freeway	1845	0.90	Level	15	0	0.930	1.00	2204
Ramp	623	0.90	Level	15	0	0.930	1.00	744
UpStream								
DownStream	602	0.90	Level	15	0	0.930	1.00	719

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2204 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2204	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1460	Exhibit 25-14	4500	No
V_R	744	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2204	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 20.1 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.495 (Exhibit 25-19)

S_R= 48.6 mph (Exhibit 25-19)

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

S = 48.6 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 218 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1776	0.90	Level	15	0	0.930	1.00	2121
Ramp	233	0.90	Level	15	0	0.930	1.00	278
UpStream	218	0.90	Level	15	0	0.930	1.00	260
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2121 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2121	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1843	Exhibit 25-14	4500	No
V_R	278	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2121	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 19.3 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.453 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

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

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 398 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1203	0.90	Level	15	0	0.930	1.00	1437
Ramp	78	0.90	Level	15	0	0.930	1.00	93
UpStream	398	0.90	Level	15	0	0.930	1.00	475
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1437 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1437	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1344	Exhibit 25-14	4500	No
V_R	93	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1437	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 13.5 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.436 (Exhibit 25-19)

S_R= 49.3 mph (Exhibit 25-19)

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

S = 49.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / *Site Information*

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 318 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2731	0.90	Level	15	0	0.930	1.00	3262
Ramp	356	0.90	Level	15	0	0.930	1.00	425
UpStream	318	0.90	Level	15	0	0.930	1.00	380
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3262 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3262	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2837	Exhibit 25-14	4500	No
V_R	425	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3262	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 29.2 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.466 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

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

S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 602 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1824	0.90	Level	15	0	0.930	1.00	2179
Ramp	121	0.90	Level	15	0	0.930	1.00	145
UpStream	602	0.90	Level	15	0	0.930	1.00	719
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2179 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2179	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2034	Exhibit 25-14	4500	No
V_R	145	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2179	Exhibit 25-14	4400:All	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 = B (Exhibit 25-4)

Speed Determination

D_s = 0.441 (Exhibit 25-19)

S_R= 49.3 mph (Exhibit 25-19)

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

S = 49.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp ☑ Yes ☑ On ☐ No ☐ Off L_{up} = 1900 ft V_u = 215 veh/h	Terrain: Level S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1758	0.90	Level	15	0	0.930	1.00	2100
Ramp	538	0.90	Level	15	0	0.930	1.00	643
UpStream	215	0.90	Level	15	0	0.930	1.00	257
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 2100 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	2100	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1457	Exhibit 25-14	4500	No
V_R	643	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2100	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 19.2 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.486 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

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

S = 48.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 215 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1772	0.90	Level	15	0	0.930	1.00	2117
Ramp	538	0.90	Level	15	0	0.930	1.00	643
UpStream	215	0.90	Level	15	0	0.930	1.00	257
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2117 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2117	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1474	Exhibit 25-14	4500	No
V_R	643	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2117	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 19.3 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.486 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

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

S = 48.7 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 343 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2718	0.90	Level	15	0	0.930	1.00	3246
Ramp	891	0.90	Level	15	0	0.930	1.00	1064
UpStream	343	0.90	Level	15	0	0.930	1.00	410
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 3246 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	3246	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2182	Exhibit 25-14	4500	No
V_R	1064	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3246	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 29.0 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.524 (Exhibit 25-19)

S_R= 48.2 mph (Exhibit 25-19)

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

S = 48.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information — Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1033 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2736	0.90	Level	15	0	0.930	1.00	3268
Ramp	1224	0.90	Level	15	0	0.930	1.00	1462
UpStream	1033	0.90	Level	15	0	0.930	1.00	1234
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3268 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3268	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1806	Exhibit 25-14	4500	No
V_R	1462	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3268	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 29.2 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.560 (Exhibit 25-19)

S_R= 47.7 mph (Exhibit 25-19)

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

S = 47.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description   Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 218 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1776	0.90	Level	15	0	0.930	1.00	2121
Ramp	233	0.90	Level	15	0	0.930	1.00	278
UpStream	218	0.90	Level	15	0	0.930	1.00	260
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

L_{EQ} = 2635.45 (Equation 25-8 or 25-9)

P_{FD} = 0.714 using Equation (Exhibit 25-12)

V_{12} = 1594 pc/h

V_3 or V_{av34} 527 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	2121	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1843	Exhibit 25-14	6750	No
V_R	278	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1594	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 14.8 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.453 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 51.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 398 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1203	0.90	Level	15	0	0.930	1.00	1437
Ramp	78	0.90	Level	15	0	0.930	1.00	93
UpStream	398	0.90	Level	15	0	0.930	1.00	475
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 4897.77 (Equation 25-8 or 25-9)

P_{FD} = 0.806 using Equation (Exhibit 25-12)

V_{12} = 1177 pc/h

V_3 or V_{av34} 260 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1437	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1344	Exhibit 25-14	6750	No
V_R	93	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1177	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 11.2 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.436 (Exhibit 25-19)

S_R= 49.3 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 51.0 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 318 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2731	0.90	Level	15	0	0.930	1.00	3262
Ramp	356	0.90	Level	15	0	0.930	1.00	425
UpStream	318	0.90	Level	15	0	0.930	1.00	380
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 3341.36 (Equation 25-8 or 25-9)

P_{FD} = 0.706 using Equation (Exhibit 25-12)

V_{12} = 2428 pc/h

V_3 or V_{av34} 834 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3262	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	2837	Exhibit 25-14	6750	No
V_R	425	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2428	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 22.0 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.466 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 51.4 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1975 ft

V_u = 602 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1824	0.90	Level	15	0	0.930	1.00	2179
Ramp	121	0.90	Level	15	0	0.930	1.00	145
UpStream	602	0.90	Level	15	0	0.930	1.00	719
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 6530.60 (Equation 25-8 or 25-9)

P_{FD} = 0.852 using Equation (Exhibit 25-12)

V_{12} = 1878 pc/h

V_3 or V_{av34} 301 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2179	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	2034	Exhibit 25-14	6750	No
V_R	145	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1878	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.3 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.441 (Exhibit 25-19)

S_R= 49.3 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 50.5 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / *Site Information*

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 215 veh/h

Terrain: Level

S_{FF} = 55.0 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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1758	0.90	Level	15	0	0.930	1.00	2100
Ramp	538	0.90	Level	15	0	0.930	1.00	643
UpStream	215	0.90	Level	15	0	0.930	1.00	257
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 3648.91 (Equation 25-8 or 25-9)

P_{FD} = 0.717 using Equation (Exhibit 25-12)

V_{12} = 1687 pc/h

V_3 or V_{av34} 413 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2100	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1457	Exhibit 25-14	6750	No
V_R	643	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1687	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 15.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.486 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 50.6 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 215 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1772	0.90	Level	15	0	0.930	1.00	2117
Ramp	538	0.90	Level	15	0	0.930	1.00	643
UpStream	215	0.90	Level	15	0	0.930	1.00	257
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

L_{EQ} = 3628.76 (Equation 25-8 or 25-9)

P_{FD} = 0.716 using Equation (Exhibit 25-12)

V_{12} = 1699 pc/h

V_3 or V_{av34} 418 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	2117	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1474	Exhibit 25-14	6750	No
V_R	643	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1699	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 15.7 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.486 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 50.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 343 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2718	0.90	Level	15	0	0.930	1.00	3246
Ramp	891	0.90	Level	15	0	0.930	1.00	1064
UpStream	343	0.90	Level	15	0	0.930	1.00	410
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 6327.75 (Equation 25-8 or 25-9)

P_{FD} = 0.721 using Equation (Exhibit 25-12)

V_{12} = 2637 pc/h

V_3 or V_{av34} 609 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3246	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	2182	Exhibit 25-14	6750	No
V_R	1064	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2637	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 23.8 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.524 (Exhibit 25-19)

S_R= 48.2 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 50.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to I-75 NB
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1033 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2736	0.90	Level	15	0	0.930	1.00	3268
Ramp	1224	0.90	Level	15	0	0.930	1.00	1462
UpStream	1033	0.90	Level	15	0	0.930	1.00	1234
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 35204.83 (Equation 25-8 or 25-9)

P_{FD} = 0.982 using Equation (Exhibit 25-12)

V_{12} = 3235 pc/h

V_3 or V_{av34} 33 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3268	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1806	Exhibit 25-14	6750	No
V_R	1462	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3235	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 28.9 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.560 (Exhibit 25-19)

S_R= 47.7 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 47.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 560 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 x f_{HV} x f_p
Freeway	2595	0.95	Level	24	0	0.893	1.00	3059
Ramp	1008	0.95	Level	15	0	0.930	1.00	1141
UpStream								
DownStream	560	0.95	Level	15	0	0.930	1.00	634

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3059 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3059	Exhibit 25-14	4800	No
$V_{FO} = V_F - V_R$	1918	Exhibit 25-14	4800	No
V_R	1141	Exhibit 25-3	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3059	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 26.1 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.401 (Exhibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

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

S = 58.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 798 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 x f_{HV} x f_p
Freeway	4142	0.95	Level	24	0	0.893	1.00	4883
Ramp	1480	0.95	Level	15	0	0.930	1.00	1675
UpStream								
DownStream	798	0.95	Level	15	0	0.930	1.00	903

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 4883 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4883	Exhibit 25-14	4800	Yes
$V_{FO} = V_F - V_R$	3208	Exhibit 25-14	4800	No
V_R	1675	Exhibit 25-3	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4883	Exhibit 25-14	4400:All	Yes

Level of Service Determination (if not F)

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

D_R = 41.7 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Determination

D_s = 0.449 (Exhibit 25-19)

S_R= 57.4 mph (Exhibit 25-19)

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

S = 57.4 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp [I-75 With 6 Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 798 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 x f_{HV} x f_p
Freeway	4142	0.95	Level	24	0	0.893	1.00	4883
Ramp	1480	0.95	Level	15	0	0.930	1.00	1675
UpStream								
DownStream	798	0.95	Level	15	0	0.930	1.00	903

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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 0.561 using Equation (Exhibit 25-12)

V_{12} = 3474 pc/h

V_3 or V_{av34} 1409 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge)

	Actual	Capacity		LOS F?
V_F	4883	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	3208	Exhibit 25-14	7200	No
V_R	1675	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3474	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F) (Merge)

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

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge)

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

D_R = 29.6 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination (Merge)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge)

D_s = 0.449 (Exhibit 25-19)

S_R= 57.4 mph (Exhibit 25-19)

S_0= 75.2 mph (Exhibit 25-19)

S = 61.6 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 924 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 x f_{HV} x f_p
Freeway	3788	0.95	Level	24	0	0.893	1.00	4466
Ramp	1575	0.95	Level	15	0	0.930	1.00	1782
UpStream								
DownStream	924	0.95	Level	15	0	0.930	1.00	1046

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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 0.566 using Equation (Exhibit 25-12)

V_{12} = 3302 pc/h

V_3 or V_{av34} 1164 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	4466	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	2684	Exhibit 25-14	7200	No
V_R	1782	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3302	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 28.1 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.458 (Exhibit 25-19)

S_R= 57.2 mph (Exhibit 25-19)

S_0= 76.2 mph (Exhibit 25-19)

S = 61.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 1274 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	6066	0.95	Level	24	0	0.893	1.00	7151
Ramp	2288	0.95	Level	15	0	0.930	1.00	2589
UpStream								
DownStream	1274	0.95	Level	15	0	0.930	1.00	1442

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 0.462 using Equation (Exhibit 25-12)

V_{12} = 4697 pc/h

V_3 or V_{av34} 2454 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7151	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	4562	Exhibit 25-14	7200	No
V_R	2589	Exhibit 25-3	2100	Yes

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4697	Exhibit 25-14	4400:All	Yes

Level of Service Determination (if not F)

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

D_R = 40.1 (pc/mi/ln)

LOS = F (Exhibit 25-4)

Speed Determination

D_s = 0.531 (Exhibit 25-19)

S_R= 55.1 mph (Exhibit 25-19)

S_0= 71.1 mph (Exhibit 25-19)

S = 59.7 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2023

Project Description Proposed System Without Slip Ramp [Last Year With LOS D]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 822 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 x f_{HV} x f_p
Freeway	5104	0.95	Level	24	0	0.893	1.00	6017
Ramp	1844	0.95	Level	15	0	0.930	1.00	2087
UpStream								
DownStream	822	0.95	Level	15	0	0.930	1.00	930

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 0.514 using Equation (Exhibit 25-12)

V_{12} = 4105 pc/h

V_3 or V_{av34} 1912 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	6017	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	3930	Exhibit 25-14	7200	No
V_R	2087	Exhibit 25-3	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4105	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 35.1 (pc/mi/ln)

LOS = E (Exhibit 25-4)

Speed Determination

D_s = 0.486 (Exhibit 25-19)

S_R= 56.4 mph (Exhibit 25-19)

S_0= 73.2 mph (Exhibit 25-19)

S = 60.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 1223 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2546	0.95	Level	25	0	0.889	1.00	3015
Ramp	377	0.95	Level	15	0	0.930	1.00	427
UpStream								
DownStream	1223	0.95	Level	15	0	0.930	1.00	1384

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3015 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3015	Exhibit 25-14	4800	No
$V_{FO} = V_F - V_R$	2588	Exhibit 25-14	4800	No
V_R	427	Exhibit 25-3	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3015	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 25.7 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.336 (Exhibit 25-19)

S_R= 60.6 mph (Exhibit 25-19)

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

S = 60.6 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 849 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 x f_{HV} x f_p
Freeway	2773	0.95	Level	25	0	0.889	1.00	3284
Ramp	279	0.95	Level	15	0	0.930	1.00	316
UpStream								
DownStream	849	0.95	Level	15	0	0.930	1.00	961

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3284 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3284	Exhibit 25-14	4800	No
$V_{FO} = V_F - V_R$	2968	Exhibit 25-14	4800	No
V_R	316	Exhibit 25-3	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3284	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 28.0 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.326 (Exhibit 25-19)

S_R= 60.9 mph (Exhibit 25-19)

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

S = 60.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 1826 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 x f_{HV} x f_p
Freeway	3697	0.95	Level	25	0	0.889	1.00	4378
Ramp	564	0.95	Level	15	0	0.930	1.00	638
UpStream								
DownStream	1826	0.95	Level	15	0	0.930	1.00	2066

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 0.621 using Equation (Exhibit 25-12)

V_{12} = 2961 pc/h

V_3 or V_{av34} 1417 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4378	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	3740	Exhibit 25-14	7200	No
V_R	638	Exhibit 25-3	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2961	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 25.2 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.355 (Exhibit 25-19)

S_R= 60.0 mph (Exhibit 25-19)

S_0= 75.2 mph (Exhibit 25-19)

S = 64.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System Without Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 1261 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 x f_{HV} x f_p
Freeway	4045	0.95	Level	25	0	0.889	1.00	4790
Ramp	414	0.95	Level	15	0	0.930	1.00	468
UpStream								
DownStream	1261	0.95	Level	15	0	0.930	1.00	1427

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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 0.619 using Equation (Exhibit 25-12)

V_{12} = 3142 pc/h

V_3 or V_{av34} 1648 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	4790	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	4322	Exhibit 25-14	7200	No
V_R	468	Exhibit 25-3	2100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3142	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 26.8 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.340 (Exhibit 25-19)

S_R= 60.5 mph (Exhibit 25-19)

S_0= 74.3 mph (Exhibit 25-19)

S = 64.6 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst SKB
Agency or Company TDOT / Long Engineering
Date Performed 05/04/2009
Analysis Time Period AM Peak Period

Site Information

Freeway/Dir of Travel APD-40 EB
Junction Off-Ramp to Prop. Intx.
Jurisdiction Cleveland, TN
Analysis Year 2013

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 794 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1343	0.90	Level	15	0	0.930	1.00	1604
Ramp	382	0.90	Level	15	0	0.930	1.00	456
UpStream	794	0.90	Level	15	0	0.930	1.00	948
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 (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)
V_{12} = 1604 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1604	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1148	Exhibit 25-14	4500	No
V_R	456	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1604	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 14.9 (pc/mi/ln)
LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.469 (Exhibit 25-19)
S_R= 48.9 mph (Exhibit 25-19)
S_0= N/A mph (Exhibit 25-19)
S = 48.9 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1286 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1623	0.90	Level	15	0	0.930	1.00	1939
Ramp	141	0.90	Level	15	0	0.930	1.00	168
UpStream	1286	0.90	Level	15	0	0.930	1.00	1536
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1939 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1939	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1771	Exhibit 25-14	4500	No
V_R	168	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1939	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.8 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.443 (Exhibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

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

S = 49.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1253 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2085	0.90	Level	15	0	0.930	1.00	2490
Ramp	606	0.90	Level	15	0	0.930	1.00	724
UpStream	1253	0.90	Level	15	0	0.930	1.00	1497
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2490 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2490	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1766	Exhibit 25-14	4500	No
V_R	724	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2490	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 22.5 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.493 (Exhibit 25-19)

S_R= 48.6 mph (Exhibit 25-19)

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

S = 48.6 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1994 veh/h

Terrain: Level

S_{FF} = 55.0 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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2504	0.90	Level	15	0	0.930	1.00	2991
Ramp	224	0.90	Level	15	0	0.930	1.00	268
UpStream	1994	0.90	Level	15	0	0.930	1.00	2382
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2991 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2991	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2723	Exhibit 25-14	4500	No
V_R	268	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2991	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 26.8 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.452 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

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

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System With Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 794 veh/h

Terrain: Level

S $_{FF}$ = 55.0 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 x f_{HV} x f_p
Freeway	1343	0.90	Level	15	0	0.930	1.00	1604
Ramp	362	0.90	Level	15	0	0.930	1.00	432
UpStream	794	0.90	Level	15	0	0.930	1.00	948
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 12629.90 (Equation 25-8 or 25-9)

P_{FD} = 0.956 using Equation (Exhibit 25-12)

V_{12} = 1552 pc/h

V_3 or V_{av34} 52 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1604	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1172	Exhibit 25-14	6750	No
V_R	432	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1552	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 14.4 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.467 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 49.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description   Proposed System With Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1286 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1623	0.90	Level	15	0	0.930	1.00	1939
Ramp	141	0.90	Level	15	0	0.930	1.00	168
UpStream	1286	0.90	Level	15	0	0.930	1.00	1536
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 14937.42 (Equation 25-8 or 25-9)

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 1939 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1939	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1771	Exhibit 25-14	6750	No
V_R	168	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1939	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.8 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.443 (Exhibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 49.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System With Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1253 veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2085	0.90	Level	15	0	0.930	1.00	2490
Ramp	606	0.90	Level	15	0	0.930	1.00	724
UpStream	1253	0.90	Level	15	0	0.930	1.00	1497
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 20437.97 (Equation 25-8 or 25-9)

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 2490 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2490	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	1766	Exhibit 25-14	6750	No
V_R	724	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2490	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 22.5 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.493 (Exhibit 25-19)

S_R= 48.6 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 48.6 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Prop. Intx.
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System With Slip Ramp [With Auxiliary Lanes]

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 1900 ft

V_u = 1994 veh/h

Terrain: Level

S FF = 55.0 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 x f_{HV} x f_p
Freeway	2504	0.90	Level	15	0	0.930	1.00	2991
Ramp	224	0.90	Level	15	0	0.930	1.00	268
UpStream	1994	0.90	Level	15	0	0.930	1.00	2382
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 19945.57 (Equation 25-8 or 25-9)

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 2991 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2991	Exhibit 25-14	6750	No
$V_{FO} = V_F - V_R$	2723	Exhibit 25-14	6750	No
V_R	268	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2991	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 26.8 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.452 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 560 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 x f_{HV} x f_p
Freeway	2595	0.95	Level	24	0	0.893	1.00	3059
Ramp	1008	0.95	Level	15	0	0.930	1.00	1141
UpStream								
DownStream	560	0.95	Level	15	0	0.930	1.00	634

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 3059 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3059	Exhibit 25-14	4800	No
$V_{FO} = V_F - V_R$	1918	Exhibit 25-14	4800	No
V_R	1141	Exhibit 25-3	4100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3059	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.401 (Exhibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

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

S = 58.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information **Site Information**

Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System With Slip Ramp [I-75 With 6 Lanes]

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 798 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 x f_{HV} x f_p
Freeway	4142	0.95	Level	24	0	0.893	1.00	4883
Ramp	1480	0.95	Level	15	0	0.930	1.00	1675
UpStream								
DownStream	798	0.95	Level	15	0	0.930	1.00	903

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 0.450 using Equation (Exhibit 25-12)

V_{12} = 3119 pc/h

V_3 or V_{av34} 1764 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4883	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	3208	Exhibit 25-14	7200	No
V_R	1675	Exhibit 25-3	4100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3119	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 17.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.449 (Exhibit 25-19)

S_R= 57.4 mph (Exhibit 25-19)

S_0= 73.8 mph (Exhibit 25-19)

S = 62.4 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / *Site Information*

Analyst SKB
Agency or Company TDOT / Long Engineering
Date Performed 05/04/2009
Analysis Time Period PM Peak Period
Freeway/Dir of Travel I-75
Junction APD-40 Off-Ramp
Jurisdiction Cleveland, TN
Analysis Year 2013

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 2500 ft
V_D = 798 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 x f_{HV} x f_p
Freeway	4142	0.95	Level	24	0	0.893	1.00	4883
Ramp	1480	0.95	Level	15	0	0.930	1.00	1675
UpStream								
DownStream	798	0.95	Level	15	0	0.930	1.00	903

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} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 1.000 using Equation (Exhibit 25-12)
V_{12} = 4883 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	4883	Exhibit 25-14	4800	Yes
$V_{FO} = V_F - V_R$	3208	Exhibit 25-14	4800	No
V_R	1675	Exhibit 25-3	4100	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4883	Exhibit 25-14	4400:All	Yes

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 = (pc/mi/ln)
LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$
D_R = 32.7 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.449 (Exhibit 25-19)
S_R= 57.4 mph (Exhibit 25-19)
S_0= N/A mph (Exhibit 25-19)
S = 57.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 924 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 x f_{HV} x f_p
Freeway	3788	0.95	Level	24	0	0.893	1.00	4466
Ramp	1575	0.95	Level	15	0	0.930	1.00	1782
UpStream								
DownStream	924	0.95	Level	15	0	0.930	1.00	1046

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 0.450 using Equation (Exhibit 25-12)

V_{12} = 2990 pc/h

V_3 or V_{av34} 1476 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4466	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	2684	Exhibit 25-14	7200	No
V_R	1782	Exhibit 25-3	4100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2990	Exhibit 25-14	4400:All	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 Determination

D_s = 0.458 (Exhibit 25-19)

S_R= 57.2 mph (Exhibit 25-19)

S_0= 74.9 mph (Exhibit 25-19)

S = 62.0 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		**Site Information**	
Analyst	SKB	Freeway/Dir of Travel	I-75
Agency or Company	TDOT / Long Engineering	Junction	APD-40 Off-Ramp
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S $_{FF}$ = 70.0 mph S_{FR} = 45.0 mph

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

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2500 ft

V_D = 1274 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 x f_{HV} x f_p
Freeway	6066	0.95	Level	24	0	0.893	1.00	7151
Ramp	2208	0.95	Level	15	0	0.930	1.00	2499
UpStream								
DownStream	1274	0.95	Level	15	0	0.930	1.00	1442

Merge Areas

Estimation of v_{12}

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

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

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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} = 0.450 using Equation (Exhibit 25-12)

V_{12} = 4592 pc/h

V_3 or V_{av34} 2559 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7151	Exhibit 25-14	7200	No
$V_{FO} = V_F - V_R$	4652	Exhibit 25-14	7200	No
V_R	2499	Exhibit 25-3	4100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4592	Exhibit 25-14	4400:All	Yes

Level of Service Determination (if not F)

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

D_R = 30.2 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

D_s = 0.523 (Exhibit 25-19)

S_R= 55.4 mph (Exhibit 25-19)

S_0= 70.7 mph (Exhibit 25-19)

S = 60.0 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75 NB Slip Ramp
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Stone Lake Road
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Project Description   Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☐ Yes ☐ On ☑ No ☐ Off L_{up} = ft V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D,V_R,V_f)	☐ 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 x f_{HV} x f_p
Freeway	1008	0.90	Level	15	0	0.930	1.00	1204
Ramp	167	0.90	Level	15	0	0.930	1.00	199
UpStream								
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 1204 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	1204	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1005	Exhibit 25-14	4500	No
V_R	199	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1204	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 10.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.446 (Exhibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

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

S = 49.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		***Site Information***	
Analyst	SKB	Freeway/Dir of Travel	I-75 NB Slip Ramp
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Stone Lake Road
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1480	0.90	Level	15	0	0.930	1.00	1768
Ramp	123	0.90	Level	15	0	0.930	1.00	147
UpStream								
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} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

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

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

P_{FD} = 1.000 using Equation (Exhibit 25-12)

V_{12} = 1768 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	1768	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1621	Exhibit 25-14	4500	No
V_R	147	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1768	Exhibit 25-14	4400:All	No

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 = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

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

D_R = 15.0 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-14)

Speed Determination (Diverge Areas)

D_s = 0.441 (Exhibit 25-19)

S_R= 49.3 mph (Exhibit 25-19)

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

S = 49.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / **Site Information**

Analyst	SKB	Freeway/Dir of Travel	I-75 NB Slip Ramp
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Stone Lake Road
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	1575	0.90	Level	15	0	0.930	1.00	1881
Ramp	252	0.90	Level	15	0	0.930	1.00	301
UpStream								
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 1881 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1881	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	1580	Exhibit 25-14	4500	No
V_R	301	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1881	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 15.9 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.455 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

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

S = 49.1 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	I-75 NB Slip Ramp
Agency or Company	TDOT / Long Engineering	Junction	Off-Ramp to Stone Lake Road
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Project Description Proposed System With Slip Ramp

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 55.0 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 x f_{HV} x f_p
Freeway	2288	0.90	Level	15	0	0.930	1.00	2733
Ramp	188	0.90	Level	15	0	0.930	1.00	225
UpStream								
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 (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

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 Determination

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 (Exhibit 25-12)

V_{12} = 2733 pc/h

V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2733	Exhibit 25-14	4500	No
$V_{FO} = V_F - V_R$	2508	Exhibit 25-14	4500	No
V_R	225	Exhibit 25-3	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2733	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

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

D_R = 23.3 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Speed Determination

D_s = 0.448 (Exhibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

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

S = 49.2 mph (Exhibit 25-15)

APD-40 Weave Areas

Highway Capacity Software Computer Printouts

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1900
Terrain	Level
Weaving type	A
Volume ratio, VR	0.54
Weaving ratio, R	0.25

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	349	0.90	15	0	1.5	1.2	0.930	1.00	416
V_{o2}	349	0.90	15	0	1.5	1.2	0.930	1.00	416
V_{w1}	612	0.90	15	0	1.5	1.2	0.930	1.00	730
V_{w2}	200	0.90	15	0	1.5	1.2	0.930	1.00	238
V_w				968	V_{nw}				832
V									1800

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.68	0.47		
Weaving and non-weaving speeds, Si (mi/h)	41.85	45.59		

Number of lanes required for unconstrained operation, Nw	1.18
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	43.50
Weaving segment density, D (pc/mi/ln)	20.69
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	0.71
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.04
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	286	0.90	15	0	1.5	1.2	0.930	1.00	341
V_{o2}	213	0.90	15	0	1.5	1.2	0.930	1.00	254
V_{w1}	1196	0.90	15	0	1.5	1.2	0.930	1.00	1428
V_{w2}	51	0.90	15	0	1.5	1.2	0.930	1.00	60
V_w				1488	V_{nw}				595
V									2083

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.31	0.50
Weaving and non-weaving speeds, Si (mi/h)			28.60	44.95

Number of lanes required for unconstrained operation, Nw 1.46

Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	31.92
Weaving segment density, D (pc/mi/ln)	32.63
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1900
Terrain	Level
Weaving type	A
Volume ratio, VR	0.54
Weaving ratio, R	0.24

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	553	0.90	15	0	1.5	1.2	0.930	1.00	660
V_{o2}	527	0.90	15	0	1.5	1.2	0.930	1.00	629
V_{w1}	952	0.90	15	0	1.5	1.2	0.930	1.00	1137
V_{w2}	305	0.90	15	0	1.5	1.2	0.930	1.00	364
V_w				1501	V_{nw}				1289
V									2790

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.03	0.83		
Weaving and non-weaving speeds, Si (mi/h)	37.12	39.55		

Number of lanes required for unconstrained operation, Nw	1.25
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	38.20
Weaving segment density, D (pc/mi/ln)	36.51
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	0.72
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.04
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	432	0.90	15	0	1.5	1.2	0.930	1.00	515
V_{o2}	334	0.90	15	0	1.5	1.2	0.930	1.00	398
V_{w1}	1848	0.90	15	0	1.5	1.2	0.930	1.00	2207
V_{w2}	78	0.90	15	0	1.5	1.2	0.930	1.00	93
V_w				2300	V_{nw}				913
V									3213

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.52	0.89
Weaving and non-weaving speeds, Si (mi/h)			24.95	38.86

Number of lanes required for unconstrained operation, Nw 1.55

Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	27.78
Weaving segment density, D (pc/mi/ln)	57.83
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1975
Terrain	Level
Weaving type	A
Volume ratio, VR	0.30
Weaving ratio, R	0.33

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	739	0.90	15	0	1.5	1.2	0.930	1.00	882
V_{o2}	32	0.90	15	0	1.5	1.2	0.930	1.00	38
V_{w1}	222	0.90	15	0	1.5	1.2	0.930	1.00	265
V_{w2}	108	0.90	15	0	1.5	1.2	0.930	1.00	128
V_w				393	V_{nw}				920
V									1313

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.33	0.15		
Weaving and non-weaving speeds, Si (mi/h)	48.76	53.97		

Number of lanes required for unconstrained operation, Nw 0.80

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	52.30
Weaving segment density, D (pc/mi/ln)	12.55
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1975
Terrain	Level
Weaving type	A
Volume ratio, VR	0.27
Weaving ratio, R	0.42

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1214	0.90	15	0	1.5	1.2	0.930	1.00	1450
V_{o2}	42	0.90	15	0	1.5	1.2	0.930	1.00	50
V_{w1}	268	0.90	15	0	1.5	1.2	0.930	1.00	320
V_{w2}	191	0.90	15	0	1.5	1.2	0.930	1.00	228
V_w				548	V_{nw}				1500
V									2048

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.49	0.25		
Weaving and non-weaving speeds, Si (mi/h)	45.29	51.00		

Number of lanes required for unconstrained operation, Nw 0.77

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	49.34
Weaving segment density, D (pc/mi/ln)	20.75
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	East of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	0.30
Weaving seg length, L (ft)	1975	Weaving ratio, R	0.33
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	1140	0.90	15	0	1.5	1.2	0.930	1.00	1361
V_{o2}	50	0.90	15	0	1.5	1.2	0.930	1.00	59
V_{w1}	339	0.90	15	0	1.5	1.2	0.930	1.00	404
V_{w2}	169	0.90	15	0	1.5	1.2	0.930	1.00	201
V_w				605	V_{nw}				1420
V									2025

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.51	0.27		
Weaving and non-weaving speeds, Si (mi/h)	44.87	50.40		

Number of lanes required for unconstrained operation, Nw	0.83
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	48.61
Weaving segment density, D (pc/mi/ln)	20.83
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1975
Terrain	Level

Weaving type	A
Volume ratio, VR	0.27
Weaving ratio, R	0.43

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1877	0.90	15	0	1.5	1.2	0.930	1.00	2241
V_{o2}	64	0.90	15	0	1.5	1.2	0.930	1.00	76
V_{w1}	403	0.90	15	0	1.5	1.2	0.930	1.00	481
V_{w2}	301	0.90	15	0	1.5	1.2	0.930	1.00	359
V_w				840	V_{nw}				2317
V									3157

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.74	0.44		
Weaving and non-weaving speeds, Si (mi/h)	40.91	46.33		

Number of lanes required for unconstrained operation, Nw	0.81
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	44.75
Weaving segment density, D (pc/mi/ln)	35.27
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1900
Terrain	Level

Weaving type	A
Volume ratio, VR	0.54
Weaving ratio, R	0.25

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	349	0.90	15	0	1.5	1.2	0.930	1.00	416
V_{o2}	349	0.90	15	0	1.5	1.2	0.930	1.00	416
V_{w1}	612	0.90	15	0	1.5	1.2	0.930	1.00	730
V_{w2}	200	0.90	15	0	1.5	1.2	0.930	1.00	238
V_w				968	V_{nw}				832
V									1800

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.06	0.16
Weaving and non-weaving speeds, Si (mi/h)			36.80	53.83

Number of lanes required for unconstrained operation, Nw 1.71

Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	43.10
Weaving segment density, D (pc/mi/ln)	13.92
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	4656
Capacity as a 15-minute flow rate, c (veh/h)	4331
Capacity as a full-hour volume, c_h (veh/h)	3898

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	3	Volume ratio, VR	0.71
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.04
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	286	0.90	15	0	1.5	1.2	0.930	1.00	341
V_{o2}	213	0.90	15	0	1.5	1.2	0.930	1.00	254
V_{w1}	1196	0.90	15	0	1.5	1.2	0.930	1.00	1428
V_{w2}	51	0.90	15	0	1.5	1.2	0.930	1.00	60
V_w				1488	V_{nw}				595
V									2083

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.56	0.30
Weaving and non-weaving speeds, Si (mi/h)			32.60	49.70

Number of lanes required for unconstrained operation, Nw 2.09

Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	36.15
Weaving segment density, D (pc/mi/ln)	19.21
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	4656
Capacity as a 15-minute flow rate, c (veh/h)	4331
Capacity as a full-hour volume, c_h (veh/h)	3898

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	3	Volume ratio, VR	0.54
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.24
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	553	0.90	15	0	1.5	1.2	0.930	1.00	660
V_{o2}	527	0.90	15	0	1.5	1.2	0.930	1.00	629
V_{w1}	952	0.90	15	0	1.5	1.2	0.930	1.00	1137
V_{w2}	305	0.90	15	0	1.5	1.2	0.930	1.00	364
V_w				1501	V_{nw}				1289
V									2790

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.63	0.28
Weaving and non-weaving speeds, Si (mi/h)			32.12	50.13

Number of lanes required for unconstrained operation, Nw 1.78

Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	38.51
Weaving segment density, D (pc/mi/ln)	24.15
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	4656
Capacity as a 15-minute flow rate, c (veh/h)	4331
Capacity as a full-hour volume, c_h (veh/h)	3898

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	3	Volume ratio, VR	0.72
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.04
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	432	0.90	15	0	1.5	1.2	0.930	1.00	515
V_{o2}	334	0.90	15	0	1.5	1.2	0.930	1.00	398
V_{w1}	1848	0.90	15	0	1.5	1.2	0.930	1.00	2207
V_{w2}	78	0.90	15	0	1.5	1.2	0.930	1.00	93
V_w				2300	V_{nw}				913
V									3213

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.38	0.52
Weaving and non-weaving speeds, Si (mi/h)			28.33	44.54

Number of lanes required for unconstrained operation, Nw 2.20
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	31.60
Weaving segment density, D (pc/mi/ln)	33.89
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	4656
Capacity as a 15-minute flow rate, c (veh/h)	4331
Capacity as a full-hour volume, c_h (veh/h)	3898

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	East of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	3	Volume ratio, VR	0.30
Weaving seg length, L (ft)	1975	Weaving ratio, R	0.33
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	739	0.90	15	0	1.5	1.2	0.930	1.00	882
V_{o2}	32	0.90	15	0	1.5	1.2	0.930	1.00	38
V_{w1}	222	0.90	15	0	1.5	1.2	0.930	1.00	265
V_{w2}	108	0.90	15	0	1.5	1.2	0.930	1.00	128
V_w				393	V_{nw}				920
V									1313

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.22	0.09		
Weaving and non-weaving speeds, Si (mi/h)	51.74	56.23		

Number of lanes required for unconstrained operation, Nw	1.17
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	54.81
Weaving segment density, D (pc/mi/ln)	7.99
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	5420
Capacity as a 15-minute flow rate, c (veh/h)	5042
Capacity as a full-hour volume, c_h (veh/h)	4538

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	East of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	3	Volume ratio, VR	0.27
Weaving seg length, L (ft)	1975	Weaving ratio, R	0.42
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1214	0.90	15	0	1.5	1.2	0.930	1.00	1450
V_{o2}	42	0.90	15	0	1.5	1.2	0.930	1.00	50
V_{w1}	268	0.90	15	0	1.5	1.2	0.930	1.00	320
V_{w2}	191	0.90	15	0	1.5	1.2	0.930	1.00	228
V_w				548	V_{nw}				1500
V									2048

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.33	0.15		
Weaving and non-weaving speeds, Si (mi/h)	48.90	54.22		

Number of lanes required for unconstrained operation, Nw 1.12

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	52.68
Weaving segment density, D (pc/mi/ln)	12.96
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	5529
Capacity as a 15-minute flow rate, c (veh/h)	5143
Capacity as a full-hour volume, c_h (veh/h)	4629

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1975
Terrain	Level

Weaving type	A
Volume ratio, VR	0.30
Weaving ratio, R	0.33

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1140	0.90	15	0	1.5	1.2	0.930	1.00	1361
V_{o2}	50	0.90	15	0	1.5	1.2	0.930	1.00	59
V_{w1}	339	0.90	15	0	1.5	1.2	0.930	1.00	404
V_{w2}	169	0.90	15	0	1.5	1.2	0.930	1.00	201
V_w				605	V_{nw}				1420
V									2025

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.34	0.16		
Weaving and non-weaving speeds, Si (mi/h)	48.54	53.79		

Number of lanes required for unconstrained operation, Nw 1.20

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	52.10
Weaving segment density, D (pc/mi/ln)	12.96
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	5422
Capacity as a 15-minute flow rate, c (veh/h)	5044
Capacity as a full-hour volume, c_h (veh/h)	4540

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1975
Terrain	Level

Weaving type	A
Volume ratio, VR	0.27
Weaving ratio, R	0.43

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1877	0.90	15	0	1.5	1.2	0.930	1.00	2241
V_{o2}	64	0.90	15	0	1.5	1.2	0.930	1.00	76
V_{w1}	403	0.90	15	0	1.5	1.2	0.930	1.00	481
V_{w2}	301	0.90	15	0	1.5	1.2	0.930	1.00	359
V_w				840	V_{nw}				2317
V									3157

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.50	0.26		
Weaving and non-weaving speeds, Si (mi/h)	45.06	50.78		

Number of lanes required for unconstrained operation, Nw	1.16
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	49.12
Weaving segment density, D (pc/mi/ln)	21.42
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	5534
Capacity as a 15-minute flow rate, c (veh/h)	5148
Capacity as a full-hour volume, c_h (veh/h)	4633

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	East of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	0.22
Weaving seg length, L (ft)	1975	Weaving ratio, R	0.48
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1354	0.90	15	0	1.5	1.2	0.930	1.00	1617
V_{o2}	29	0.90	15	0	1.5	1.2	0.930	1.00	34
V_{w1}	204	0.90	15	0	1.5	1.2	0.930	1.00	243
V_{w2}	189	0.90	15	0	1.5	1.2	0.930	1.00	225
V_w				468	V_{nw}				1651
V									2119

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.46	0.22		
Weaving and non-weaving speeds, Si (mi/h)	45.78	51.74		

Number of lanes required for unconstrained operation, Nw 0.69

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	50.30
Weaving segment density, D (pc/mi/ln)	21.07
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1975
Terrain	Level

Weaving type	A
Volume ratio, VR	0.35
Weaving ratio, R	0.11

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	753	0.90	15	0	1.5	1.2	0.930	1.00	899
V_{o2}	26	0.90	15	0	1.5	1.2	0.930	1.00	31
V_{w1}	372	0.90	15	0	1.5	1.2	0.930	1.00	444
V_{w2}	52	0.90	0	0	1.5	1.2	1.000	1.00	57
V_w				501	V_{nw}				930
V									1431

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.39	0.20		
Weaving and non-weaving speeds, Si (mi/h)	47.28	52.44		

Number of lanes required for unconstrained operation, Nw	0.89
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	50.51
Weaving segment density, D (pc/mi/ln)	14.16
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1975
Terrain	Level
Weaving type	A
Volume ratio, VR	0.22
Weaving ratio, R	0.47

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	2098	0.90	15	0	1.5	1.2	0.930	1.00	2505
V_{o2}	41	0.90	15	0	1.5	1.2	0.930	1.00	48
V_{w1}	315	0.90	15	0	1.5	1.2	0.930	1.00	376
V_{w2}	277	0.90	15	0	1.5	1.2	0.930	1.00	330
V_w				706	V_{nw}				2553
V									3259

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.70	0.39		
Weaving and non-weaving speeds, Si (mi/h)	41.53	47.42		

Number of lanes required for unconstrained operation, Nw 0.71

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	46.01
Weaving segment density, D (pc/mi/ln)	35.42
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1975
Terrain	Level

Weaving type	A
Volume ratio, VR	0.34
Weaving ratio, R	0.13

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1141	0.90	15	0	1.5	1.2	0.930	1.00	1362
V_{o2}	40	0.90	15	0	1.5	1.2	0.930	1.00	47
V_{w1}	562	0.90	0	0	1.5	1.2	1.000	1.00	624
V_{w2}	81	0.90	15	0	1.5	1.2	0.930	1.00	96
V_w				720	V_{nw}				1409
V									2129

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.57	0.33		
Weaving and non-weaving speeds, Si (mi/h)	43.70	48.93		

Number of lanes required for unconstrained operation, Nw	0.90
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	47.02
Weaving segment density, D (pc/mi/ln)	22.64
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	0.39
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.34
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1071	0.90	15	0	1.5	1.2	0.930	1.00	1279
V_{o2}	66	0.90	15	0	1.5	1.2	0.930	1.00	78
V_{w1}	472	0.90	15	0	1.5	1.2	0.930	1.00	563
V_{w2}	248	0.90	15	0	1.5	1.2	0.930	1.00	296
V_w				859	V_{nw}				1357
V									2216

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.66	0.41		
Weaving and non-weaving speeds, Si (mi/h)	42.11	46.93		

Number of lanes required for unconstrained operation, Nw	0.98
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	44.94
Weaving segment density, D (pc/mi/ln)	24.66
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	0.47
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.41
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
V_{o1}	640	0.90	15	0	1.5	1.2	0.930	1.00	764
V_{o2}	279	0.90	15	0	1.5	1.2	0.930	1.00	333
V_{w1}	485	0.90	15	0	1.5	1.2	0.930	1.00	579
V_{w2}	368	0.90	0	0	1.5	1.2	1.000	1.00	408
V_w				987	V_{nw}				1097
V									2084

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.71	0.48		
Weaving and non-weaving speeds, Si (mi/h)	41.33	45.39		

Number of lanes required for unconstrained operation, Nw 1.11

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	43.37
Weaving segment density, D (pc/mi/ln)	24.02
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1900
Terrain	Level
Weaving type	A
Volume ratio, VR	0.37
Weaving ratio, R	0.22

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1596	0.90	15	0	1.5	1.2	0.930	1.00	1906
V_{o2}	112	0.90	15	0	1.5	1.2	0.930	1.00	133
V_{w1}	779	0.90	15	0	1.5	1.2	0.930	1.00	930
V_{w2}	231	0.90	0	0	1.5	1.2	1.000	1.00	256
V_w				1186	V_{nw}				2039
V									3225

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.92	0.63		
Weaving and non-weaving speeds, Si (mi/h)	38.44	42.62		

Number of lanes required for unconstrained operation, Nw 0.99

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	40.98
Weaving segment density, D (pc/mi/ln)	39.35
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1900
Terrain	Level

Weaving type	A
Volume ratio, VR	0.48
Weaving ratio, R	0.41

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	941	0.90	15	0	1.5	1.2	0.930	1.00	1123
V_{o2}	462	0.90	15	0	1.5	1.2	0.930	1.00	551
V_{w1}	762	0.90	15	0	1.5	1.2	0.930	1.00	910
V_{w2}	571	0.90	0	0	1.5	1.2	1.000	1.00	634
V_w				1544	V_{nw}				1674
V									3218

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.09	0.86		
Weaving and non-weaving speeds, Si (mi/h)	36.52	39.20		

Number of lanes required for unconstrained operation, Nw	1.18
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	37.87
Weaving segment density, D (pc/mi/ln)	42.49
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1975
Terrain	Level
Weaving type	A
Volume ratio, VR	0.22
Weaving ratio, R	0.48

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1354	0.90	15	0	1.5	1.2	0.930	1.00	1617
V_{o2}	29	0.90	15	0	1.5	1.2	0.930	1.00	34
V_{w1}	204	0.90	15	0	1.5	1.2	0.930	1.00	243
V_{w2}	189	0.90	15	0	1.5	1.2	0.930	1.00	225
V_w				468	V_{nw}				1651
V									2119

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.31	0.13		
Weaving and non-weaving speeds, Si (mi/h)	49.30	54.73		

Number of lanes required for unconstrained operation, Nw 1.00

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	53.43
Weaving segment density, D (pc/mi/ln)	13.22
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	5688
Capacity as a 15-minute flow rate, c (veh/h)	5291
Capacity as a full-hour volume, c_h (veh/h)	4762

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1975
Terrain	Level

Weaving type	A
Volume ratio, VR	0.35
Weaving ratio, R	0.11

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	753	0.90	15	0	1.5	1.2	0.930	1.00	899
V_{o2}	26	0.90	15	0	1.5	1.2	0.930	1.00	31
V_{w1}	372	0.90	15	0	1.5	1.2	0.930	1.00	444
V_{w2}	52	0.90	0	0	1.5	1.2	1.000	1.00	57
V_w				501	V_{nw}				930
V									1431

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.27	0.12		
Weaving and non-weaving speeds, Si (mi/h)	50.55	55.21		

Number of lanes required for unconstrained operation, Nw	1.29
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	53.48
Weaving segment density, D (pc/mi/ln)	8.92
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	5148
Capacity as a 15-minute flow rate, c (veh/h)	4789
Capacity as a full-hour volume, c_h (veh/h)	4310

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1975
Terrain	Level
Weaving type	A
Volume ratio, VR	0.22
Weaving ratio, R	0.47

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	2098	0.90	15	0	1.5	1.2	0.930	1.00	2505
V_{o2}	41	0.90	15	0	1.5	1.2	0.930	1.00	48
V_{w1}	315	0.90	15	0	1.5	1.2	0.930	1.00	376
V_{w2}	277	0.90	15	0	1.5	1.2	0.930	1.00	330
V_w				706	V_{nw}				2553
V									3259

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.47	0.23		
Weaving and non-weaving speeds, Si (mi/h)	45.62	51.62		

Number of lanes required for unconstrained operation, Nw	1.03
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	50.19
Weaving segment density, D (pc/mi/ln)	21.65
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	5702
Capacity as a 15-minute flow rate, c (veh/h)	5304
Capacity as a full-hour volume, c_h (veh/h)	4774

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	East of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1975
Terrain	Level
Weaving type	A
Volume ratio, VR	0.34
Weaving ratio, R	0.13

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1141	0.90	15	0	1.5	1.2	0.930	1.00	1362
V_{o2}	40	0.90	15	0	1.5	1.2	0.930	1.00	47
V_{w1}	562	0.90	0	0	1.5	1.2	1.000	1.00	624
V_{w2}	81	0.90	15	0	1.5	1.2	0.930	1.00	96
V_w				720	V_{nw}				1409
V									2129

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.38	0.19		
Weaving and non-weaving speeds, Si (mi/h)	47.53	52.73		

Number of lanes required for unconstrained operation, Nw 1.30

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	50.85
Weaving segment density, D (pc/mi/ln)	13.96
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	5212
Capacity as a 15-minute flow rate, c (veh/h)	4848
Capacity as a full-hour volume, c_h (veh/h)	4363

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	3	Volume ratio, VR	0.39
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.34
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1071	0.90	15	0	1.5	1.2	0.930	1.00	1279
V_{o2}	66	0.90	15	0	1.5	1.2	0.930	1.00	78
V_{w1}	472	0.90	15	0	1.5	1.2	0.930	1.00	563
V_{w2}	248	0.90	15	0	1.5	1.2	0.930	1.00	296
V_w				859	V_{nw}				1357
V									2216

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.04	0.14
Weaving and non-weaving speeds, Si (mi/h)			37.07	54.54

Number of lanes required for unconstrained operation, Nw 1.41

Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	46.12
Weaving segment density, D (pc/mi/ln)	16.02
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	4912
Capacity as a 15-minute flow rate, c (veh/h)	4569
Capacity as a full-hour volume, c_h (veh/h)	4112

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information / Site Information

Analyst	SKB	Freeway/Dir of Travel	APD-40 WB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	3	Volume ratio, VR	0.47
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.41
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	640	0.90	15	0	1.5	1.2	0.930	1.00	764
V_{o2}	279	0.90	15	0	1.5	1.2	0.930	1.00	333
V_{w1}	485	0.90	15	0	1.5	1.2	0.930	1.00	579
V_{w2}	368	0.90	0	0	1.5	1.2	1.000	1.00	408
V_w				987	V_{nw}				1097
V									2084

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.12	0.16
Weaving and non-weaving speeds, Si (mi/h)			36.26	53.72

Number of lanes required for unconstrained operation, Nw 1.59

Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	43.74
Weaving segment density, D (pc/mi/ln)	15.88
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	4656
Capacity as a 15-minute flow rate, c (veh/h)	4331
Capacity as a full-hour volume, c_h (veh/h)	3898

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1900
Terrain	Level

Weaving type	A
Volume ratio, VR	0.37
Weaving ratio, R	0.22

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	1596	0.90	15	0	1.5	1.2	0.930	1.00	1906
V_{o2}	112	0.90	15	0	1.5	1.2	0.930	1.00	133
V_{w1}	779	0.90	15	0	1.5	1.2	0.930	1.00	930
V_{w2}	231	0.90	0	0	1.5	1.2	1.000	1.00	256
V_w				1186	V_{nw}				2039
V									3225

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.45	0.21
Weaving and non-weaving speeds, Si (mi/h)			33.38	52.12

Number of lanes required for unconstrained operation, Nw	1.42
Maximum number of lanes, Nw (max)	1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	43.20
Weaving segment density, D (pc/mi/ln)	24.88
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	5019
Capacity as a 15-minute flow rate, c (veh/h)	4669
Capacity as a full-hour volume, c_h (veh/h)	4202

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 WB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1900
Terrain	Level

Weaving type	A
Volume ratio, VR	0.48
Weaving ratio, R	0.41

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	941	0.90	15	0	1.5	1.2	0.930	1.00	1123
V_{o2}	462	0.90	15	0	1.5	1.2	0.930	1.00	551
V_{w1}	762	0.90	15	0	1.5	1.2	0.930	1.00	910
V_{w2}	571	0.90	0	0	1.5	1.2	1.000	1.00	634
V_w				1544	V_{nw}				1674
V									3218

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.72	0.29
Weaving and non-weaving speeds, Si (mi/h)			31.56	49.88

Number of lanes required for unconstrained operation, Nw	1.68
Maximum number of lanes, Nw (max)	1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	39.01
Weaving segment density, D (pc/mi/ln)	27.50
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	4656
Capacity as a 15-minute flow rate, c (veh/h)	4331
Capacity as a full-hour volume, c_h (veh/h)	3898

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1900
Terrain	Level

Weaving type	A
Volume ratio, VR	0.54
Weaving ratio, R	0.21

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	399	0.90	15	0	1.5	1.2	0.930	1.00	476
V_{o2}	217	0.90	15	0	1.5	1.2	0.930	1.00	259
V_{w1}	577	0.90	15	0	1.5	1.2	0.930	1.00	689
V_{w2}	150	0.90	15	0	1.5	1.2	0.930	1.00	179
V_w				868	V_{nw}				735
V									1603

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.61	0.41		
Weaving and non-weaving speeds, Si (mi/h)	43.00	46.94		

Number of lanes required for unconstrained operation, Nw	1.17
Maximum number of lanes, Nw (max)	1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	44.72
Weaving segment density, D (pc/mi/ln)	17.92
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	0.74
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.02
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	308	0.90	15	0	1.5	1.2	0.930	1.00	367
V_{o2}	112	0.90	15	0	1.5	1.2	0.930	1.00	133
V_{w1}	1174	0.90	15	0	1.5	1.2	0.930	1.00	1402
V_{w2}	29	0.90	15	0	1.5	1.2	0.930	1.00	34
V_w				1436	V_{nw}				500
V									1936

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.23	0.49
Weaving and non-weaving speeds, Si (mi/h)			28.95	45.26

Number of lanes required for unconstrained operation, Nw	1.48
Maximum number of lanes, Nw (max)	1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	31.92
Weaving segment density, D (pc/mi/ln)	30.33
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	AM Peak Period	Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	0.54
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.21
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	590	0.90	15	0	1.5	1.2	0.930	1.00	704
V_{o2}	364	0.90	15	0	1.5	1.2	0.930	1.00	434
V_{w1}	889	0.90	15	0	1.5	1.2	0.930	1.00	1061
V_{w2}	242	0.90	15	0	1.5	1.2	0.930	1.00	289
V_w				1350	V_{nw}				1138
V									2488

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.0035		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.93	0.73		
Weaving and non-weaving speeds, Si (mi/h)	38.30	41.06		

Number of lanes required for unconstrained operation, Nw 1.24

Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	39.51
Weaving segment density, D (pc/mi/ln)	31.48
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	2
Weaving seg length, L (ft)	1900
Terrain	Level
Weaving type	A
Volume ratio, VR	0.74
Weaving ratio, R	0.02

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	464	0.90	15	0	1.5	1.2	0.930	1.00	554
V_{o2}	178	0.90	15	0	1.5	1.2	0.930	1.00	212
V_{w1}	1816	0.90	15	0	1.5	1.2	0.930	1.00	2169
V_{w2}	46	0.90	15	0	1.5	1.2	0.930	1.00	54
V_w				2223	V_{nw}				766
V									2989

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.40	0.86
Weaving and non-weaving speeds, Si (mi/h)			25.23	39.19

Number of lanes required for unconstrained operation, Nw 1.57

Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	27.76
Weaving segment density, D (pc/mi/ln)	53.84
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

b. Capacity constrained by basic freeway capacity.

c. Capacity occurs under constrained operating conditions.

d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.

e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.

f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).

g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.

h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.

i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1900
Terrain	Level

Weaving type	A
Volume ratio, VR	0.54
Weaving ratio, R	0.21

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	399	0.90	15	0	1.5	1.2	0.930	1.00	476
V_{o2}	217	0.90	15	0	1.5	1.2	0.930	1.00	259
V_{w1}	577	0.90	15	0	1.5	1.2	0.930	1.00	689
V_{w2}	150	0.90	15	0	1.5	1.2	0.930	1.00	179
V_w				868	V_{nw}				735
V									1603

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			0.96	0.14
Weaving and non-weaving speeds, Si (mi/h)			38.00	54.54

Number of lanes required for unconstrained operation, Nw	1.70
Maximum number of lanes, Nw (max)	1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	44.14
Weaving segment density, D (pc/mi/ln)	12.10
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	4656
Capacity as a 15-minute flow rate, c (veh/h)	4331
Capacity as a full-hour volume, c_h (veh/h)	3898

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst	SKB	Freeway/Dir of Travel	APD-40 EB
Agency/Company	TDOT / Long Engineering	Weaving Seg Location	West of Prop. Interchange
Date Performed	05/04/2009	Jurisdiction	Cleveland, TN
Analysis Time Period	PM Peak Period	Analysis Year	2013

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55	Weaving type	A
Weaving number of lanes, N	3	Volume ratio, VR	0.74
Weaving seg length, L (ft)	1900	Weaving ratio, R	0.02
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	308	0.90	15	0	1.5	1.2	0.930	1.00	367
V_{o2}	112	0.90	15	0	1.5	1.2	0.930	1.00	133
V_{w1}	1174	0.90	15	0	1.5	1.2	0.930	1.00	1402
V_{w2}	29	0.90	15	0	1.5	1.2	0.930	1.00	34
V_w				1436	V_{nw}				500
V									1936

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.50	0.29
Weaving and non-weaving speeds, Si (mi/h)			32.98	49.95

Number of lanes required for unconstrained operation, Nw 2.12

Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	36.16
Weaving segment density, D (pc/mi/ln)	17.85
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	4656
Capacity as a 15-minute flow rate, c (veh/h)	4331
Capacity as a full-hour volume, c_h (veh/h)	3898

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1900
Terrain	Level
Weaving type	A
Volume ratio, VR	0.54
Weaving ratio, R	0.21

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	590	0.90	15	0	1.5	1.2	0.930	1.00	704
V_{o2}	364	0.90	15	0	1.5	1.2	0.930	1.00	434
V_{w1}	889	0.90	15	0	1.5	1.2	0.930	1.00	1061
V_{w2}	242	0.90	15	0	1.5	1.2	0.930	1.00	289
V_w				1350	V_{nw}				1138
V									2488

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.47	0.25
Weaving and non-weaving speeds, Si (mi/h)			33.24	51.14

Number of lanes required for unconstrained operation, Nw 1.77
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	39.58
Weaving segment density, D (pc/mi/ln)	20.95
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	4656
Capacity as a 15-minute flow rate, c (veh/h)	4331
Capacity as a full-hour volume, c_h (veh/h)	3898

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

FREEWAY WEAVING WORKSHEET

General Information

Analyst	SKB
Agency/Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Freeway/Dir of Travel	APD-40 EB
Weaving Seg Location	West of Prop. Interchange
Jurisdiction	Cleveland, TN
Analysis Year	2033

Inputs

Freeway free-flow speed, S_{FF} (mi/h)	55
Weaving number of lanes, N	3
Weaving seg length, L (ft)	1900
Terrain	Level
Weaving type	A
Volume ratio, VR	0.74
Weaving ratio, R	0.02

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	fp	v
V_{o1}	464	0.90	15	0	1.5	1.2	0.930	1.00	554
V_{o2}	178	0.90	15	0	1.5	1.2	0.930	1.00	212
V_{w1}	1816	0.90	15	0	1.5	1.2	0.930	1.00	2169
V_{w2}	46	0.90	15	0	1.5	1.2	0.930	1.00	54
V_w				2223	V_{nw}				766
V									2989

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.35	0.0020
b (Exhibit 24-6)			2.20	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.29	0.51
Weaving and non-weaving speeds, Si (mi/h)			28.66	44.84

Number of lanes required for unconstrained operation, Nw	2.24
Maximum number of lanes, Nw (max)	1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment speed, S (mi/h)	31.58
Weaving segment density, D (pc/mi/ln)	31.55
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	4656
Capacity as a 15-minute flow rate, c (veh/h)	4331
Capacity as a full-hour volume, c_h (veh/h)	3898

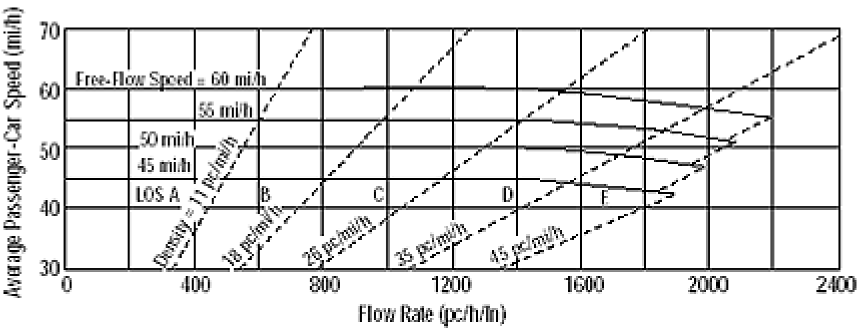
Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

Multi-Lane Highways

Highway Capacity Software
Computer Printouts

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	650	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	366
Speed, S (mi/h)	48.3
D (pc/mi/ln)	7.6
LOS	A

Design

Design (N)

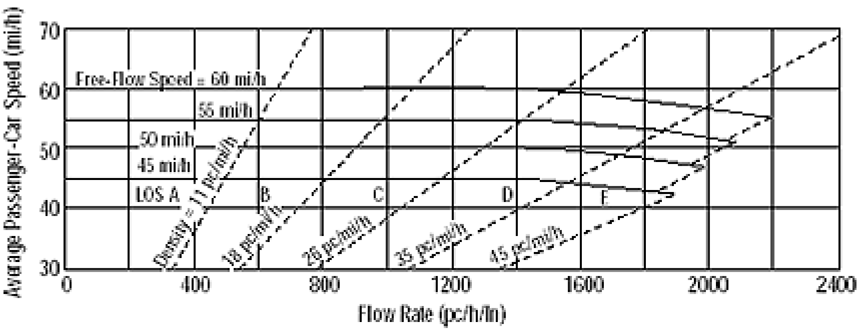
Required Number of Lanes, N

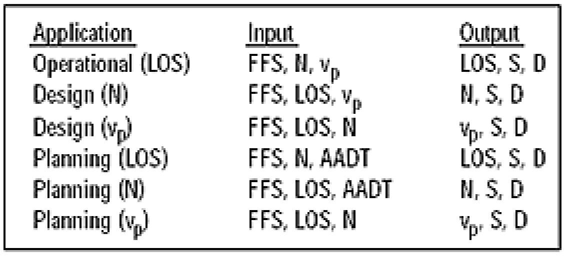
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	957	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	539
Speed, S (mi/h)	48.3
D (pc/mi/ln)	11.2
LOS	B

Design

Design (N)

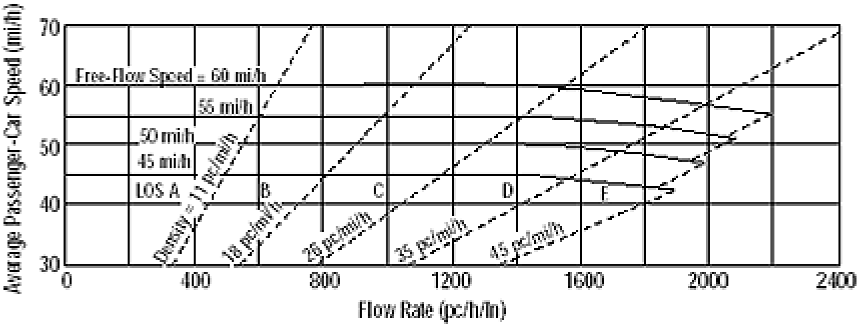
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	902	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

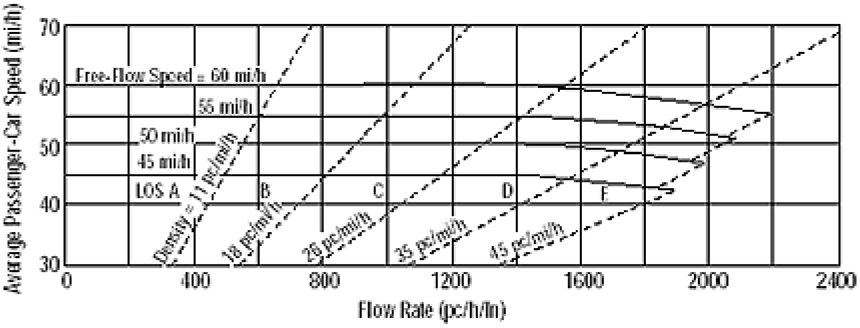
Flow Rate, v_p (pc/h/ln)	508
Speed, S (mi/h)	48.3
D (pc/mi/ln)	10.5
LOS	A

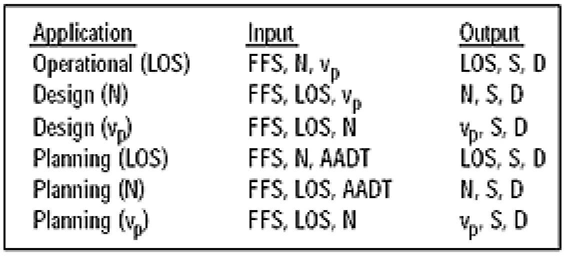
Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description   Existing System Without Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1160	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	654
Speed, S (mi/h)	48.3
D (pc/mi/ln)	13.6
LOS	B

Design

Design (N)

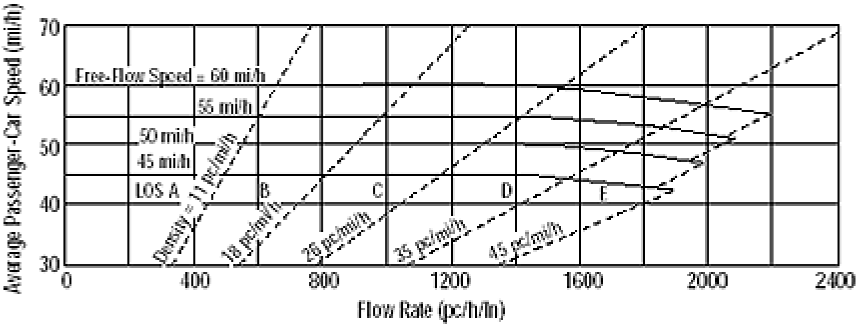
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1016	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	572
Speed, S (mi/h)	48.3
D (pc/mi/ln)	11.9
LOS	B

Design

Design (N)

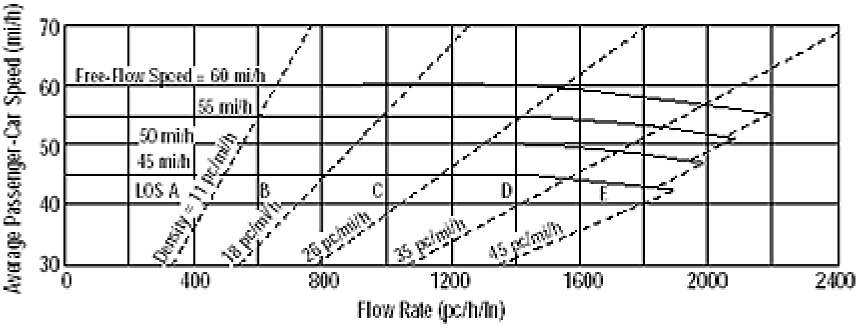
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description   Existing System Without Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1481	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	835
Speed, S (mi/h)	48.3
D (pc/mi/ln)	17.3
LOS	B

Design

Design (N)

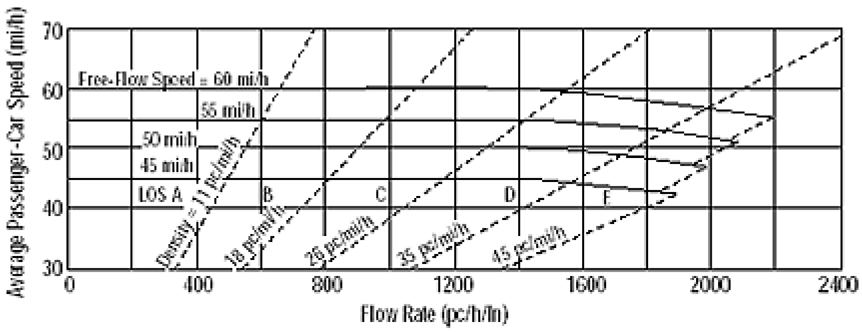
Required Number of Lanes, N

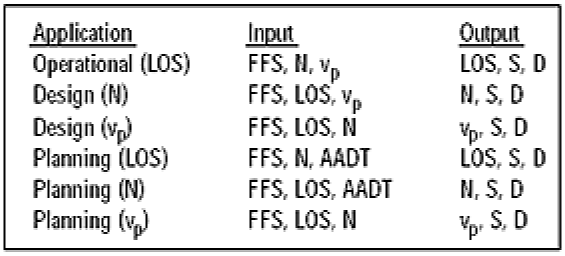
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1413	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	796
Speed, S (mi/h)	48.3
D (pc/mi/ln)	16.5
LOS	B

Design

Design (N)

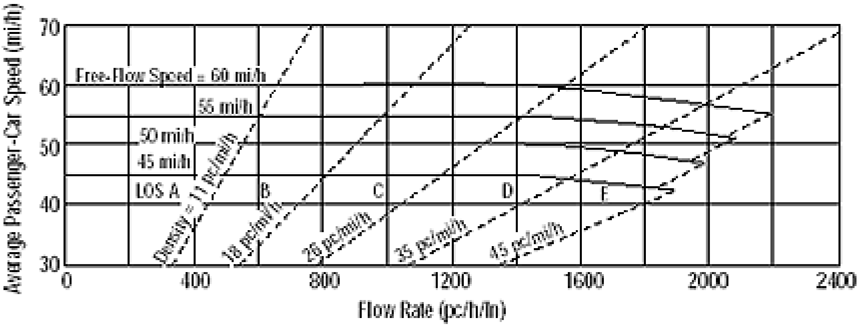
Required Number of Lanes, N

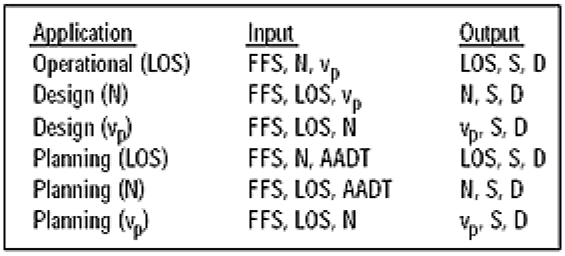
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1818	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	1025
Speed, S (mi/h)	48.3
D (pc/mi/ln)	21.2
LOS	C

Design

Design (N)

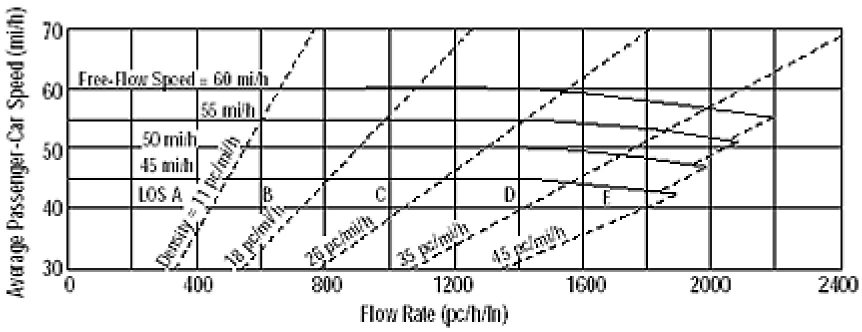
Required Number of Lanes, N

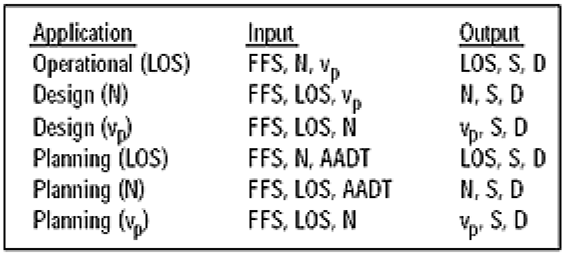
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description   Existing System Without Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	582	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	328
Speed, S (mi/h)	48.3
D (pc/mi/ln)	6.8
LOS	A

Design

Design (N)

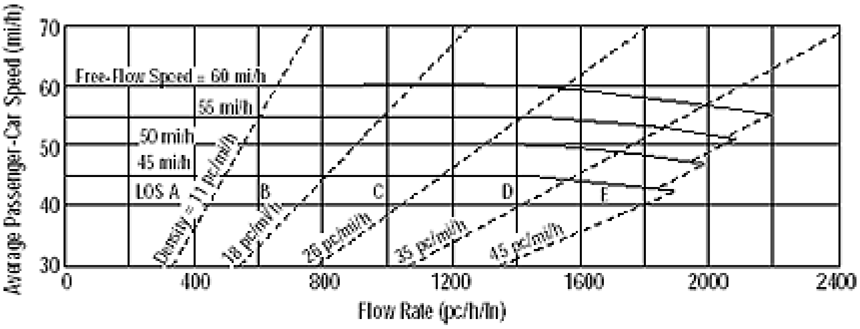
Required Number of Lanes, N

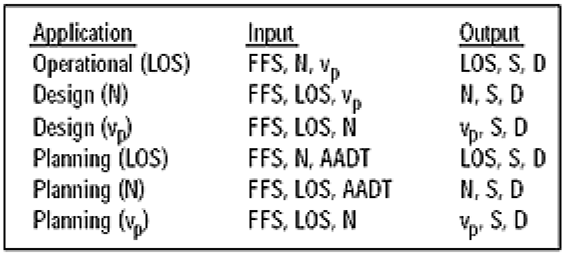
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1115	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	628
Speed, S (mi/h)	48.3
D (pc/mi/ln)	13.0
LOS	B

Design

Design (N)

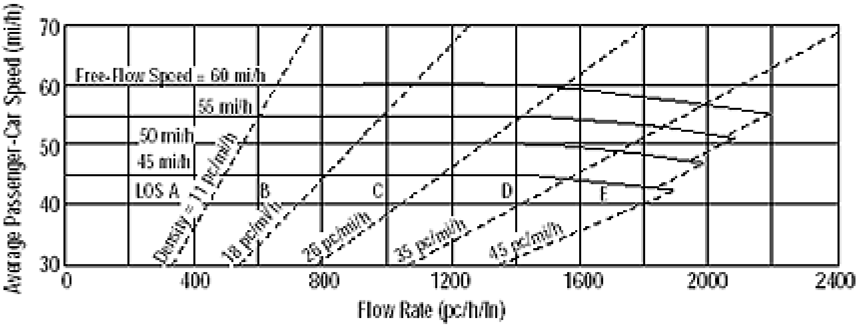
Required Number of Lanes, N

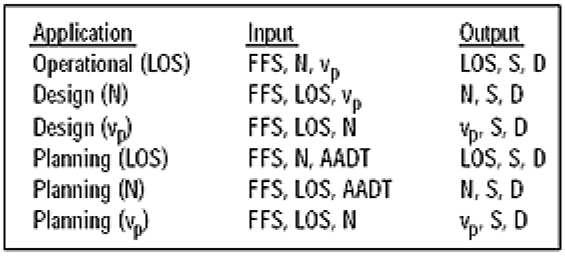
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description   Existing System Without Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1058	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	596
Speed, S (mi/h)	48.3
D (pc/mi/ln)	12.4
LOS	B

Design

Design (N)

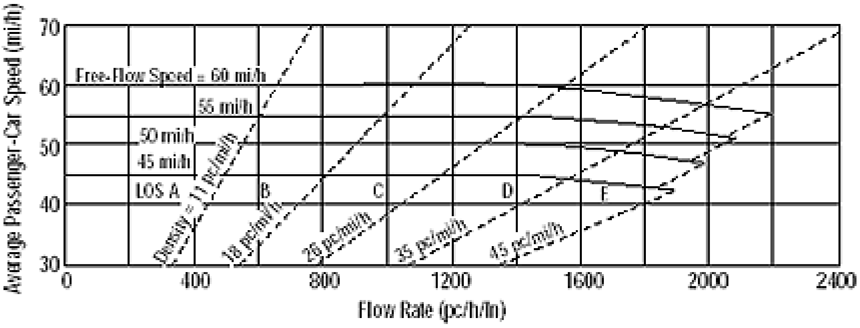
Required Number of Lanes, N

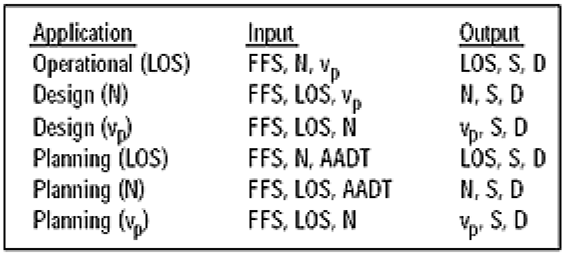
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	961	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	541
Speed, S (mi/h)	48.3
D (pc/mi/ln)	11.2
LOS	B

Design

Design (N)

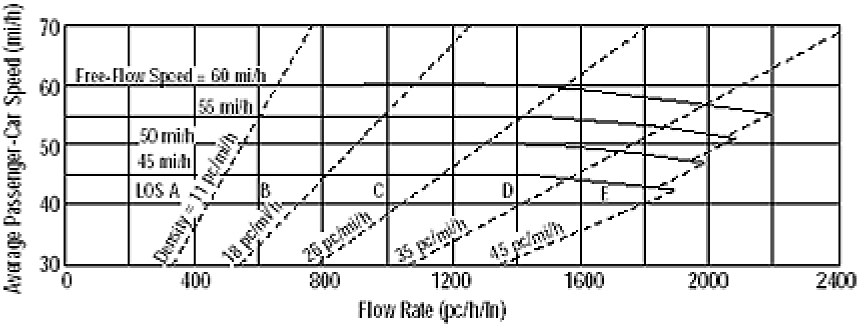
Required Number of Lanes, N

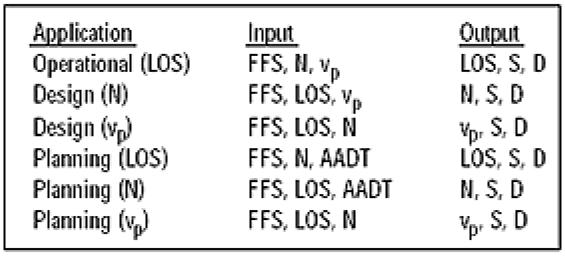
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description   Existing System Without Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	910	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	513
Speed, S (mi/h)	48.3
D (pc/mi/ln)	10.6
LOS	A

Design

Design (N)

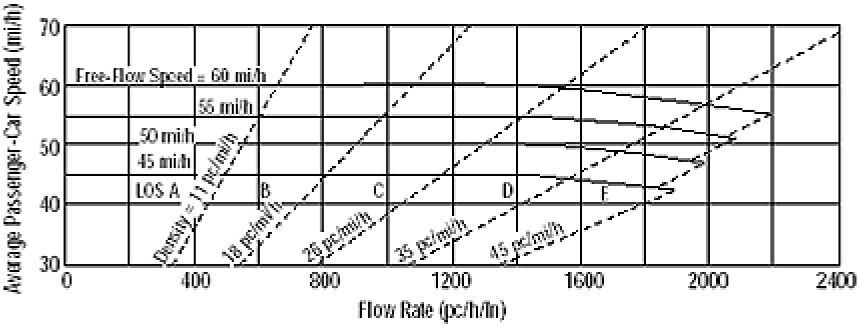
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1742	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	982
Speed, S (mi/h)	48.3
D (pc/mi/ln)	20.4
LOS	C

Design

Design (N)

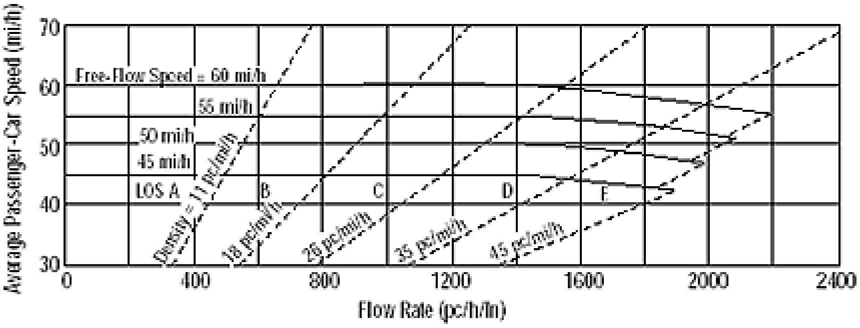
Required Number of Lanes, N

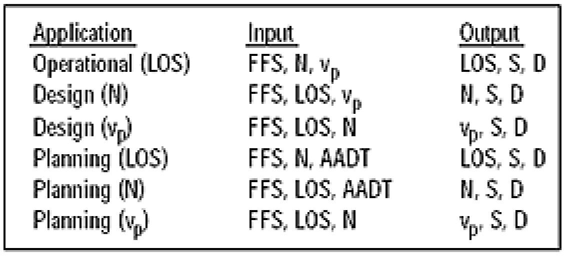
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1656	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	933
Speed, S (mi/h)	48.3
D (pc/mi/ln)	19.3
LOS	C

Design

Design (N)

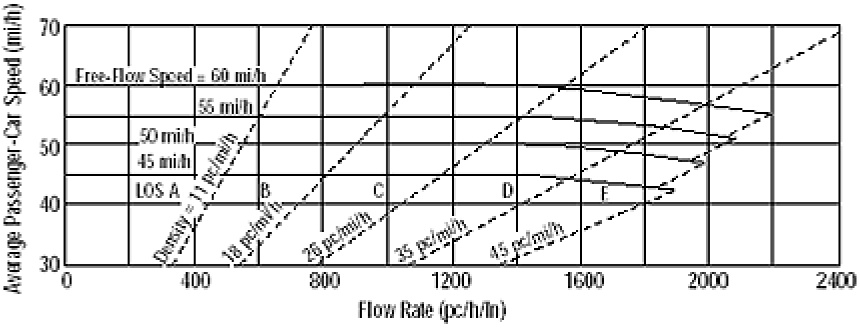
Required Number of Lanes, N

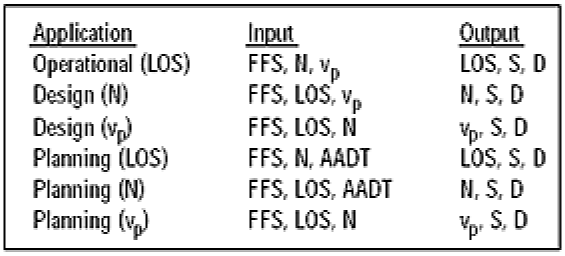
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Existing System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1527	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

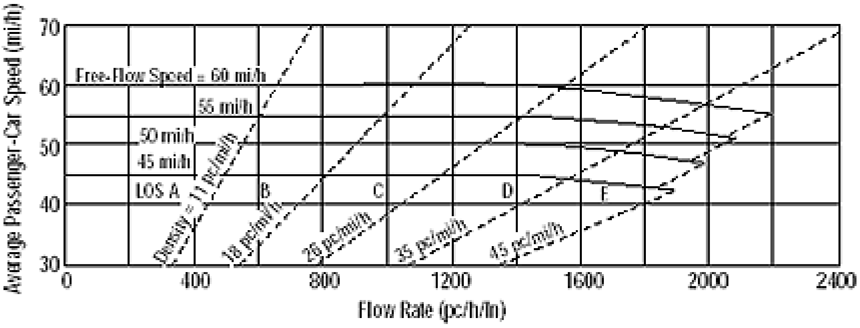
Flow Rate, v_p (pc/h/ln)	861
Speed, S (mi/h)	48.3
D (pc/mi/ln)	17.8
LOS	B

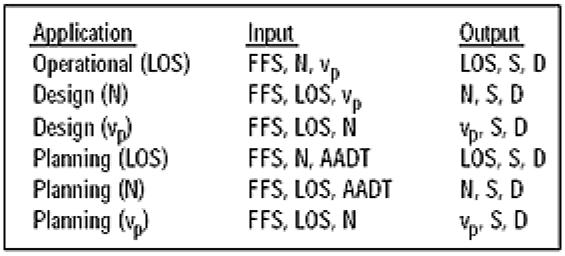
Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Existing System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	582	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	328
Speed, S (mi/h)	48.3
D (pc/mi/ln)	6.8
LOS	A

Design

Design (N)

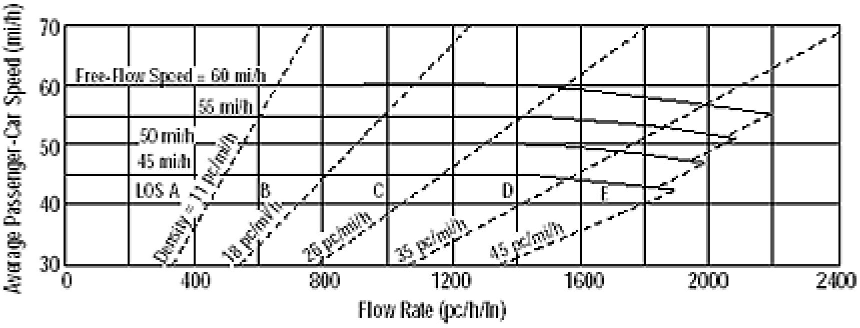
Required Number of Lanes, N

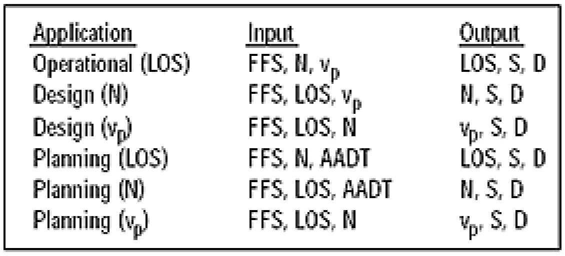
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description   Existing System With Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	948	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

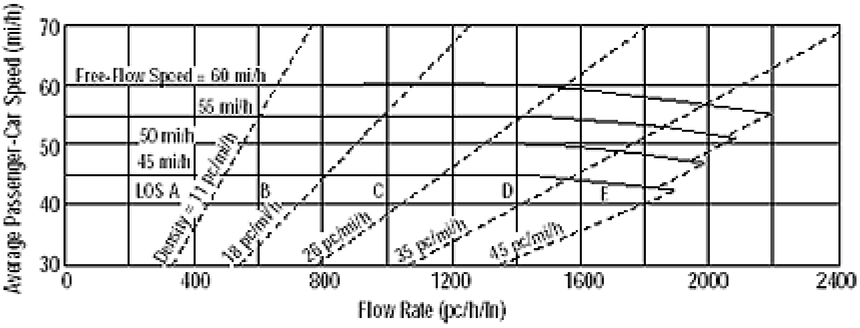
Flow Rate, v_p (pc/h/ln)	534
Speed, S (mi/h)	48.3
D (pc/mi/ln)	11.1
LOS	B

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Existing System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1058	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	596
Speed, S (mi/h)	48.3
D (pc/mi/ln)	12.4
LOS	B

Design

Design (N)

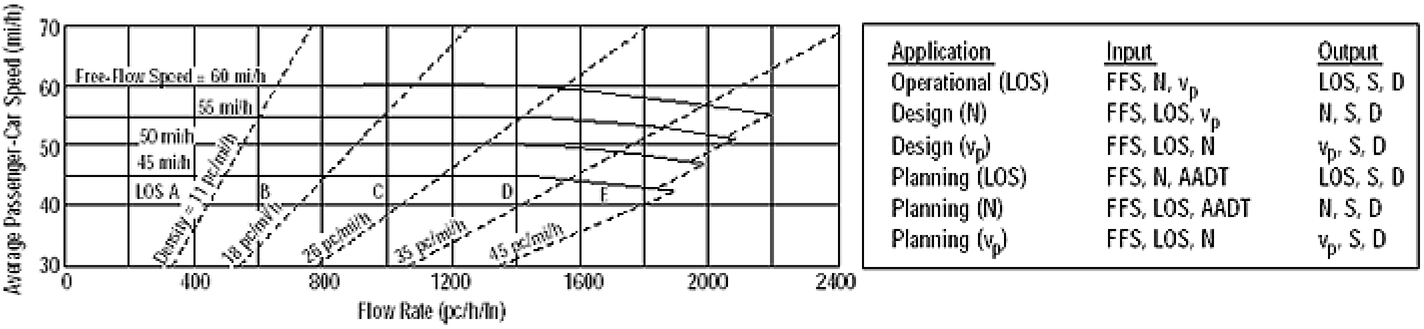
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description   Existing System With Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	838	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	472
Speed, S (mi/h)	48.3
D (pc/mi/ln)	9.8
LOS	A

Design

Design (N)

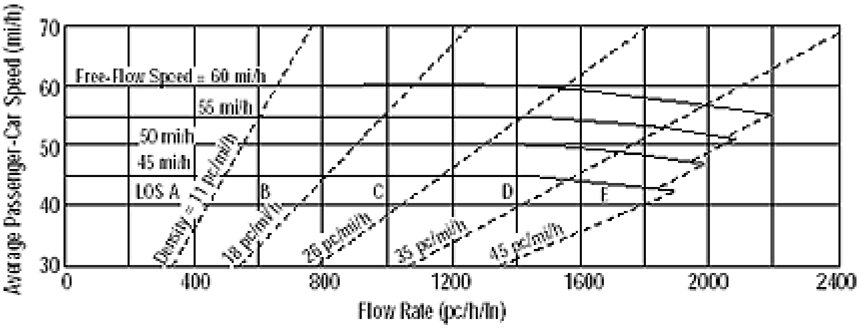
Required Number of Lanes, N

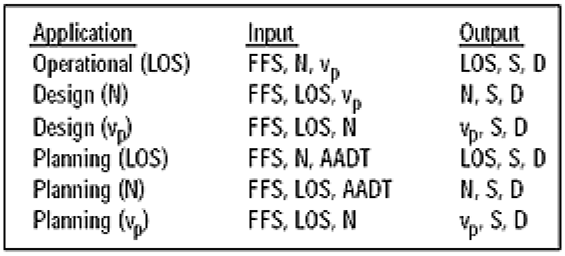
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Existing System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1413	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	796
Speed, S (mi/h)	48.3
D (pc/mi/ln)	16.5
LOS	B

Design

Design (N)

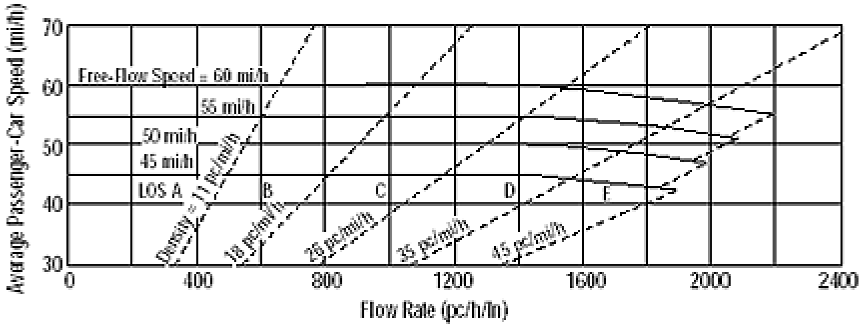
Required Number of Lanes, N

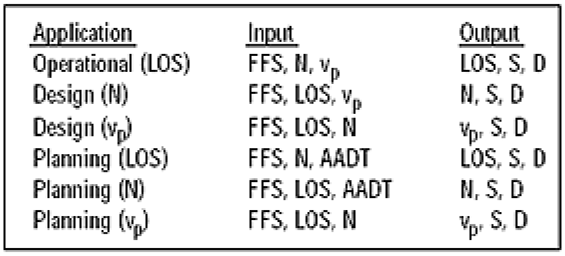
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Existing System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1818	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	1025
Speed, S (mi/h)	48.3
D (pc/mi/ln)	21.2
LOS	C

Design

Design (N)

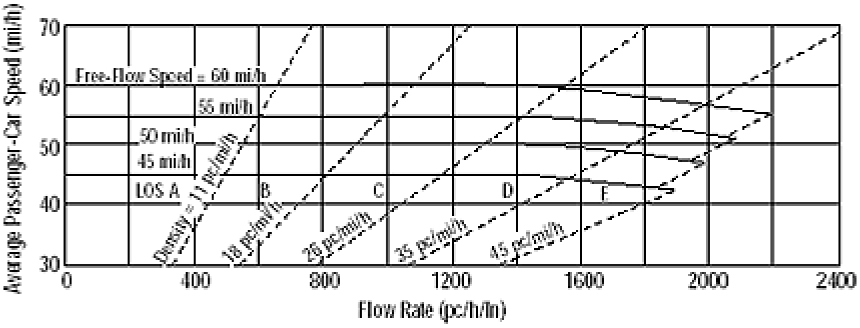
Required Number of Lanes, N

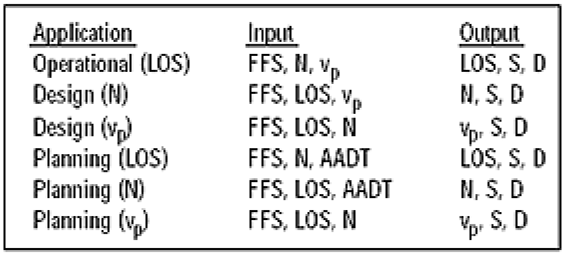
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Existing System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1686	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	950
Speed, S (mi/h)	48.3
D (pc/mi/ln)	19.7
LOS	C

Design

Design (N)

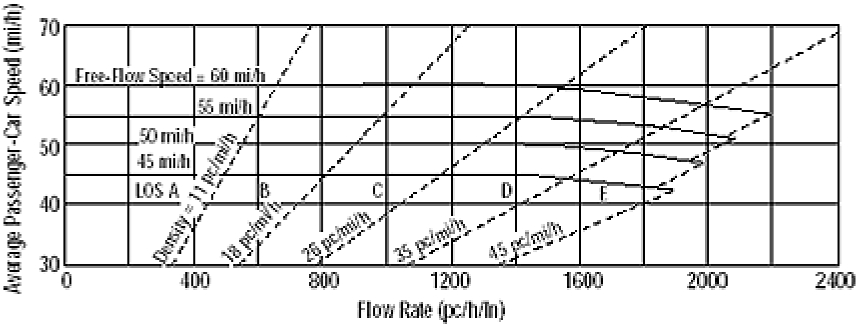
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Existing System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1339	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	755
Speed, S (mi/h)	48.3
D (pc/mi/ln)	15.6
LOS	B

Design

Design (N)

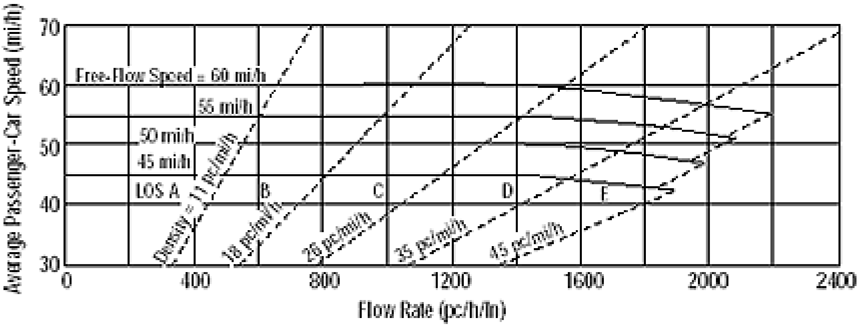
Required Number of Lanes, N

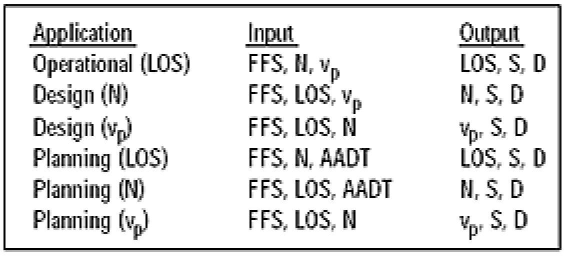
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	04/05/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	483	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

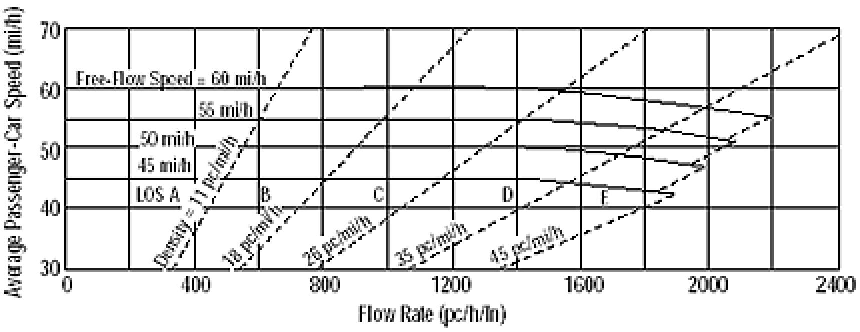
Flow Rate, v_p (pc/h/ln)	275
Speed, S (mi/h)	48.3
D (pc/mi/ln)	5.7
LOS	A

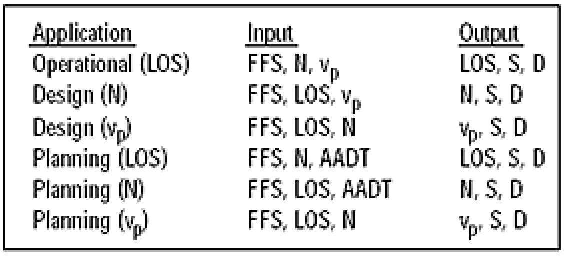
Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	04/05/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description   Proposed System Without Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	276	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	157
Speed, S (mi/h)	48.3
D (pc/mi/ln)	3.3
LOS	A

Design

Design (N)

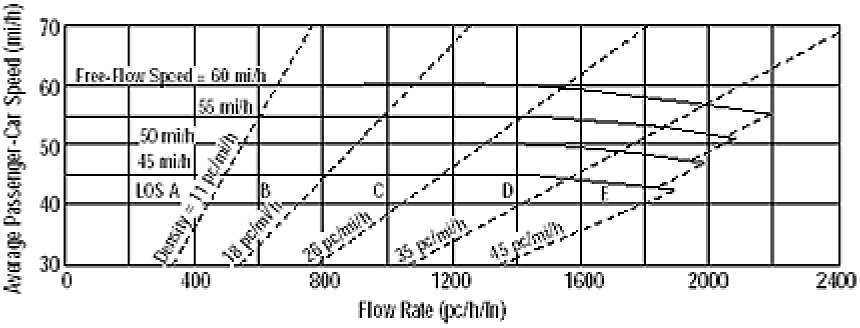
Required Number of Lanes, N

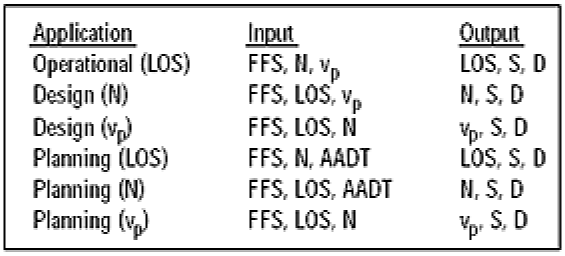
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	251	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	142
Speed, S (mi/h)	48.3
D (pc/mi/ln)	2.9
LOS	A

Design

Design (N)

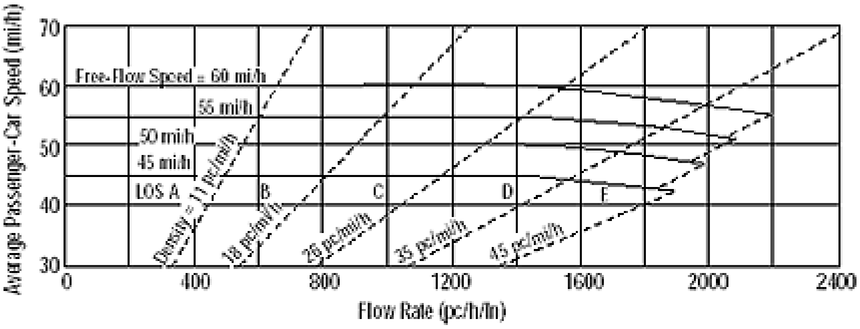
Required Number of Lanes, N

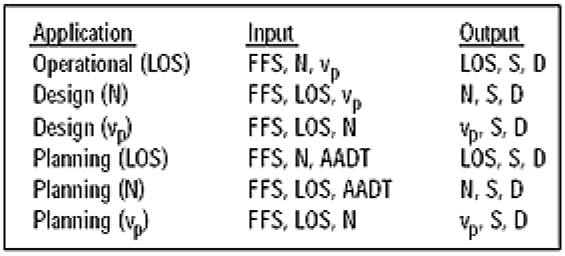
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	536	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	305
Speed, S (mi/h)	48.3
D (pc/mi/ln)	6.3
LOS	A

Design

Design (N)

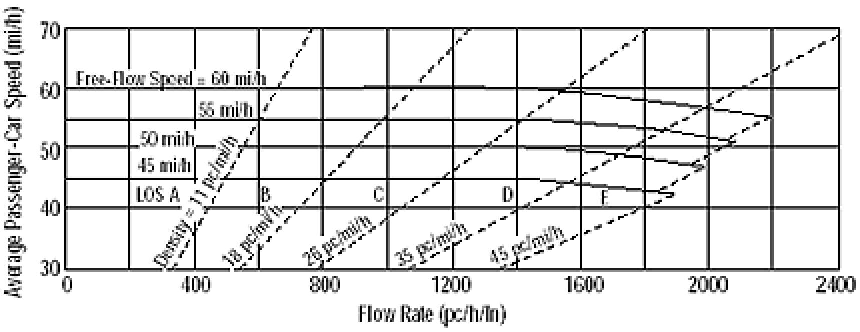
Required Number of Lanes, N

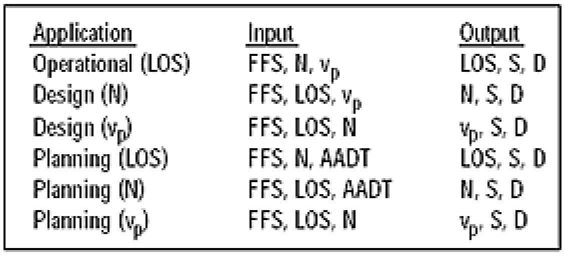
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	752	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	428
Speed, S (mi/h)	48.3
D (pc/mi/ln)	8.9
LOS	A

Design

Design (N)

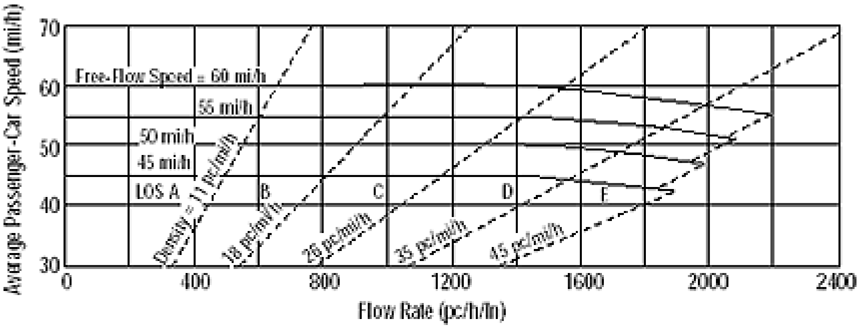
Required Number of Lanes, N

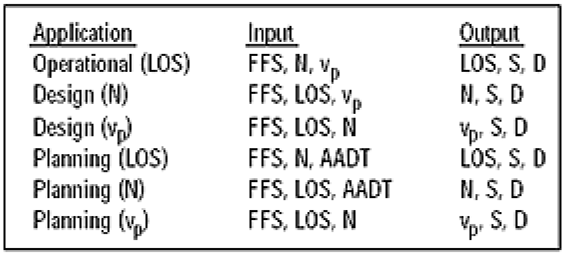
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	449	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	255
Speed, S (mi/h)	48.3
D (pc/mi/ln)	5.3
LOS	A

Design

Design (N)

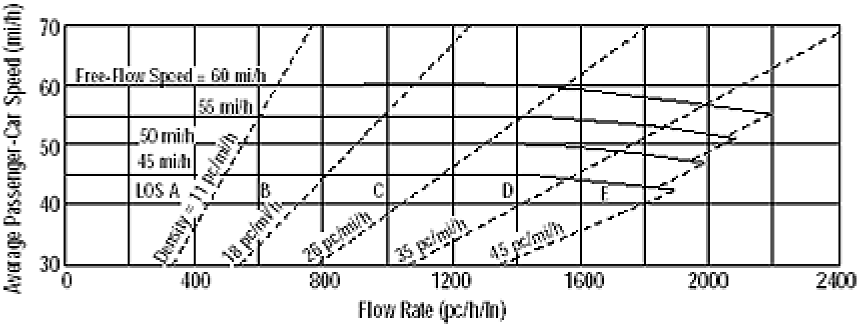
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description   Proposed System Without Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	402	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	228
Speed, S (mi/h)	48.3
D (pc/mi/ln)	4.7
LOS	A

Design

Design (N)

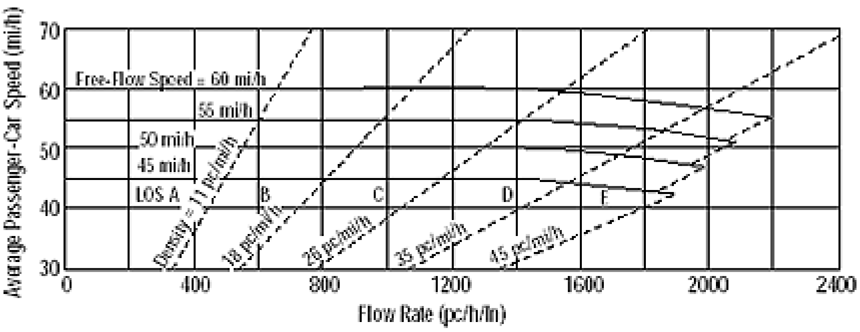
Required Number of Lanes, N

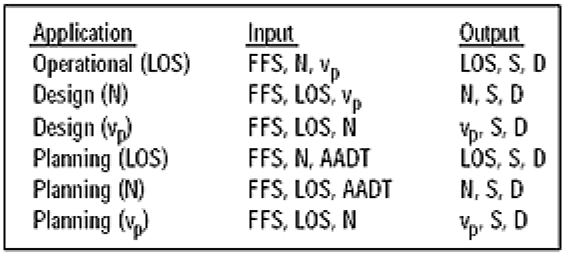
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	867	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	493
Speed, S (mi/h)	48.3
D (pc/mi/ln)	10.2
LOS	A

Design

Design (N)

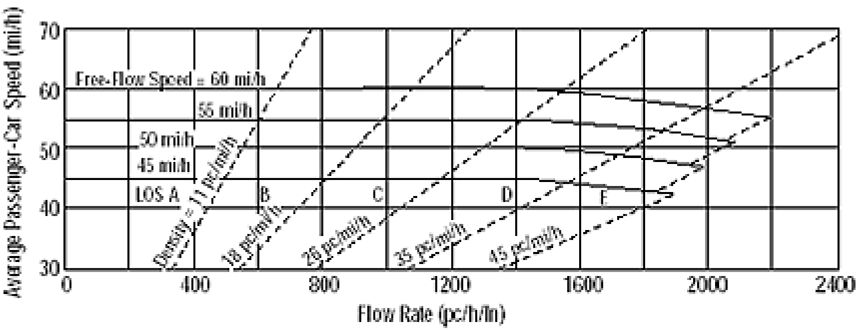
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	296	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	166
Speed, S (mi/h)	48.3
D (pc/mi/ln)	3.4
LOS	A

Design

Design (N)

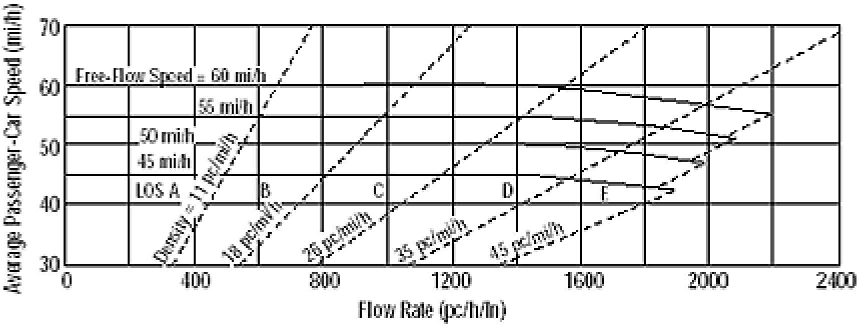
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	516	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	290
Speed, S (mi/h)	48.3
D (pc/mi/ln)	6.0
LOS	A

Design

Design (N)

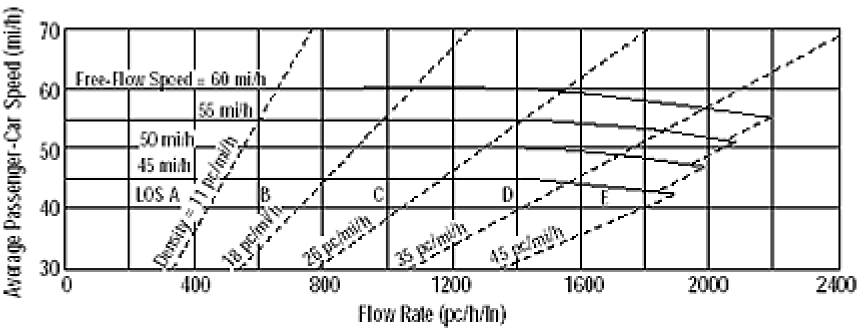
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	494	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	278
Speed, S (mi/h)	48.3
D (pc/mi/ln)	5.8
LOS	A

Design

Design (N)

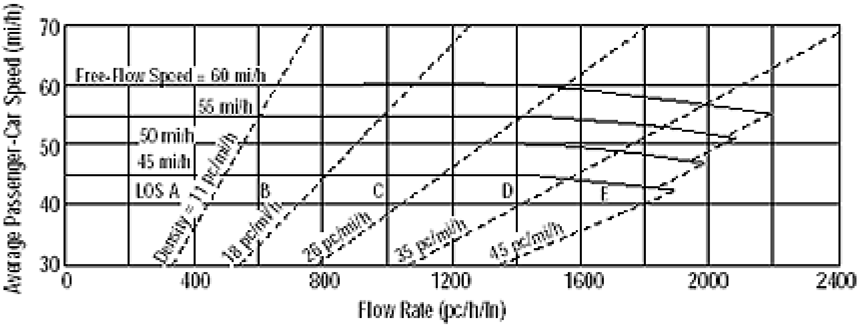
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	241	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	135
Speed, S (mi/h)	48.3
D (pc/mi/ln)	2.8
LOS	A

Design

Design (N)

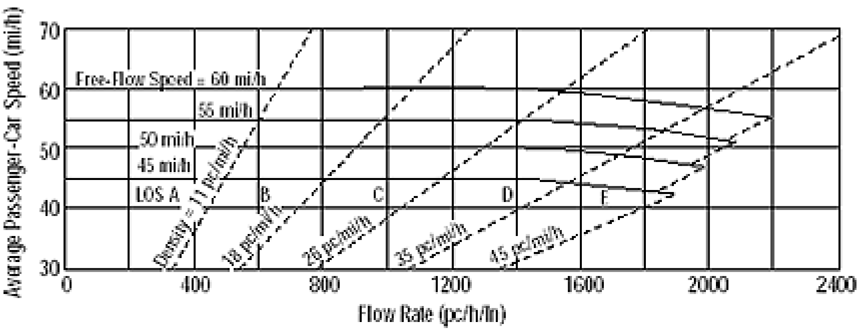
Required Number of Lanes, N

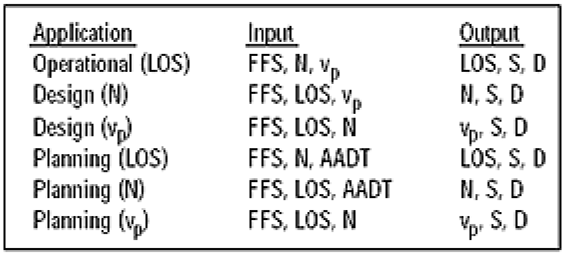
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	468	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	263
Speed, S (mi/h)	48.3
D (pc/mi/ln)	5.5
LOS	A

Design

Design (N)

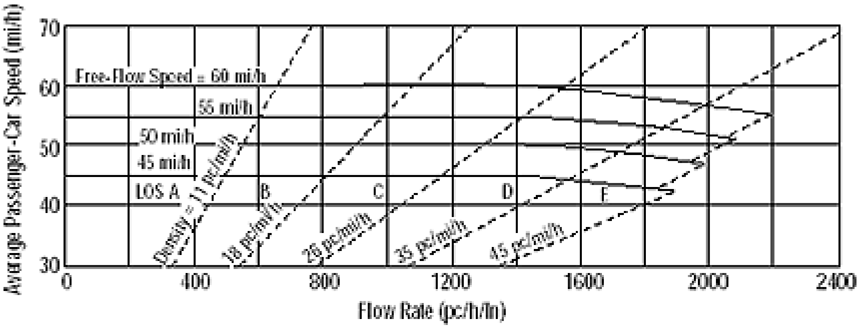
Required Number of Lanes, N

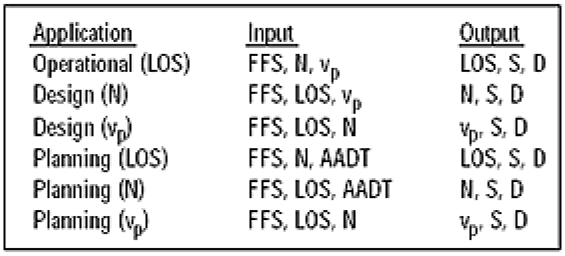
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	817	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	460
Speed, S (mi/h)	48.3
D (pc/mi/ln)	9.5
LOS	A

Design

Design (N)

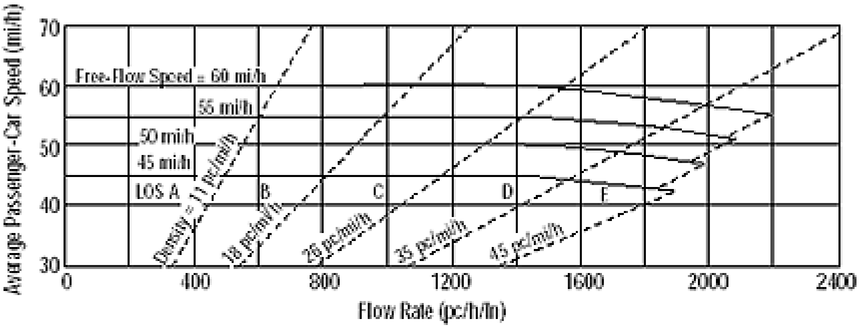
Required Number of Lanes, N

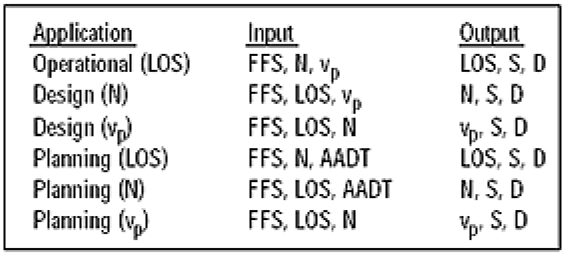
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	782	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

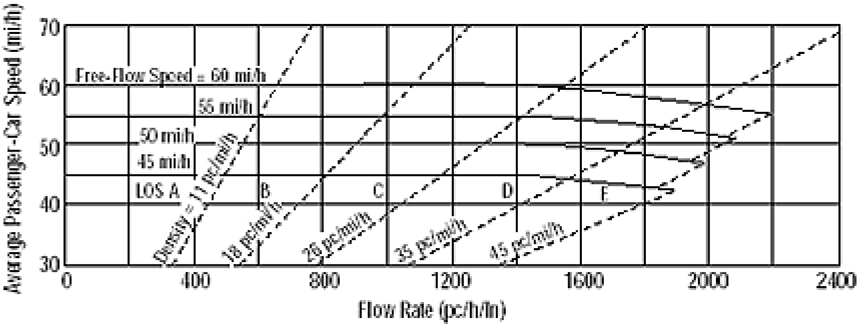
Flow Rate, v_p (pc/h/ln)	440
Speed, S (mi/h)	48.3
D (pc/mi/ln)	9.1
LOS	A

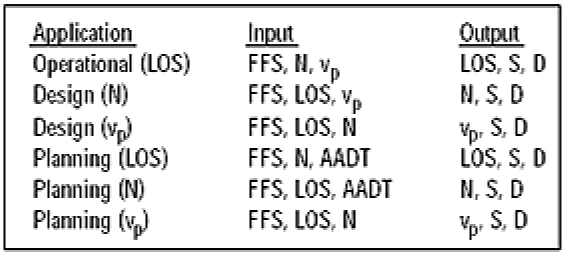
Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	382	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	215
Speed, S (mi/h)	48.3
D (pc/mi/ln)	4.5
LOS	A

Design

Design (N)

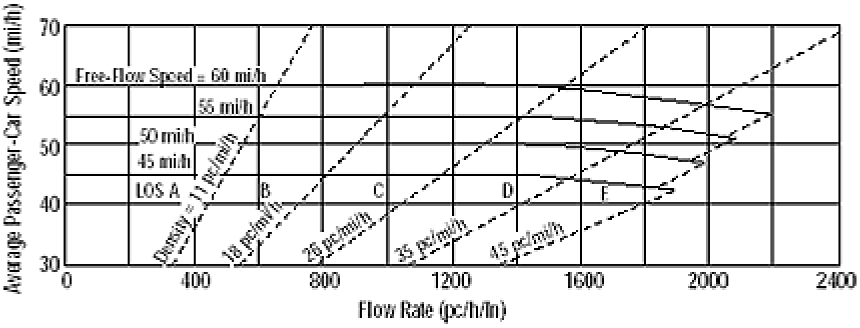
Required Number of Lanes, N

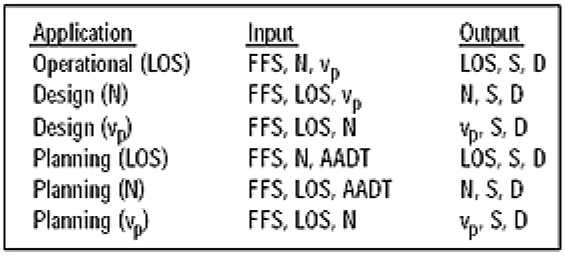
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description   Proposed System With Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	743	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	418
Speed, S (mi/h)	48.3
D (pc/mi/ln)	8.7
LOS	A

Design

Design (N)

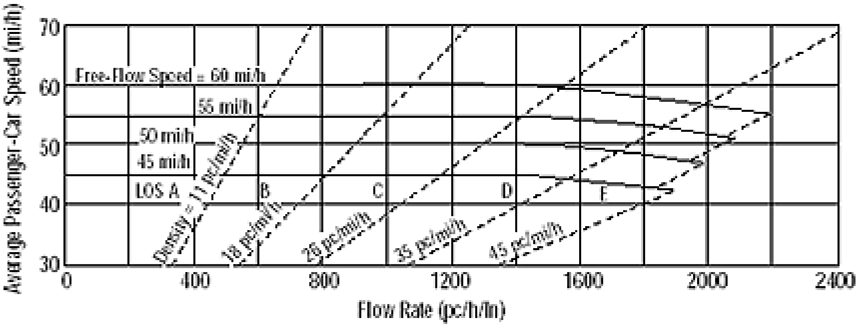
Required Number of Lanes, N

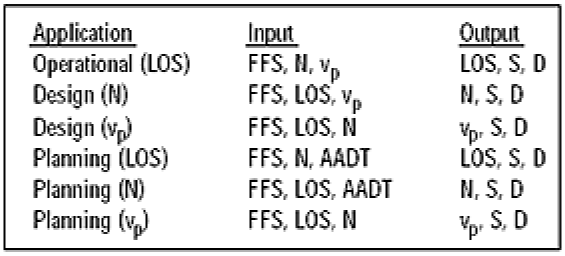
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description   Proposed System With Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	885	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	499
Speed, S (mi/h)	48.3
D (pc/mi/ln)	10.3
LOS	A

Design

Design (N)

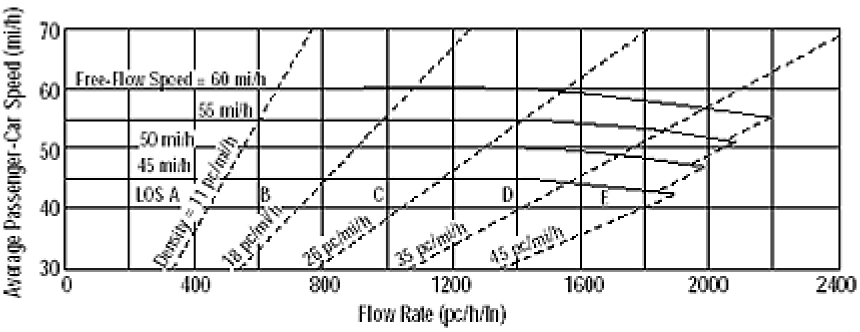
Required Number of Lanes, N

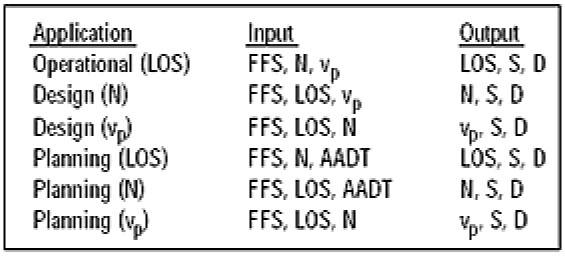
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description   Proposed System With Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1227	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	691
Speed, S (mi/h)	48.3
D (pc/mi/ln)	14.3
LOS	B

Design

Design (N)

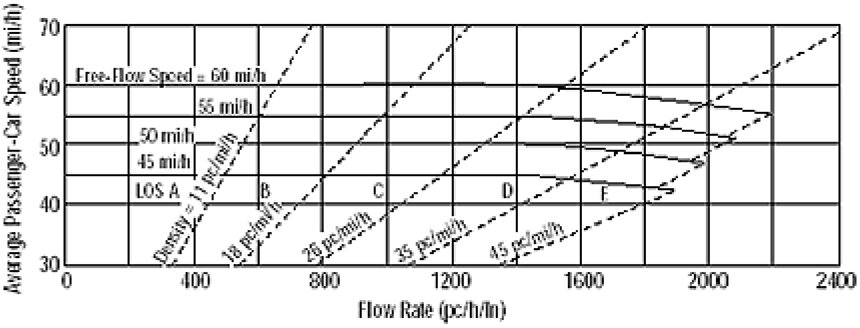
Required Number of Lanes, N

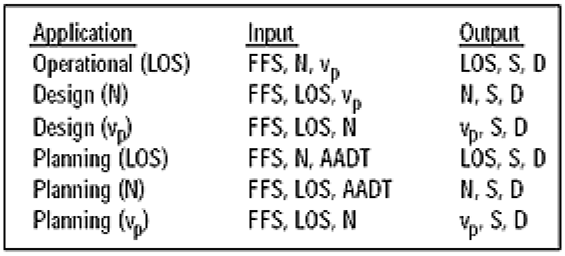
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1121	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	632
Speed, S (mi/h)	48.3
D (pc/mi/ln)	13.1
LOS	B

Design

Design (N)

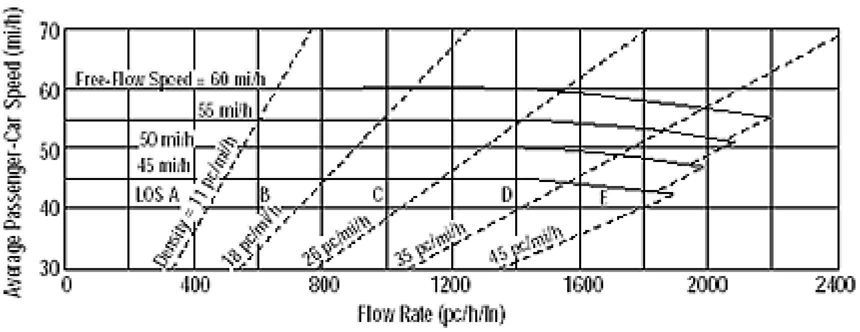
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1188	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	669
Speed, S (mi/h)	48.3
D (pc/mi/ln)	13.9
LOS	B

Design

Design (N)

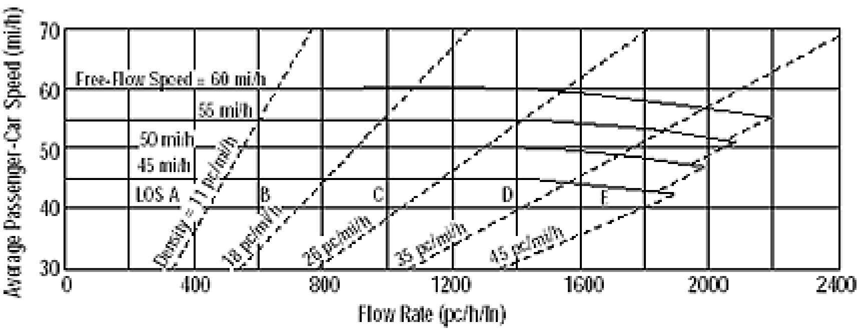
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1408	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	793
Speed, S (mi/h)	48.3
D (pc/mi/ln)	16.4
LOS	B

Design

Design (N)

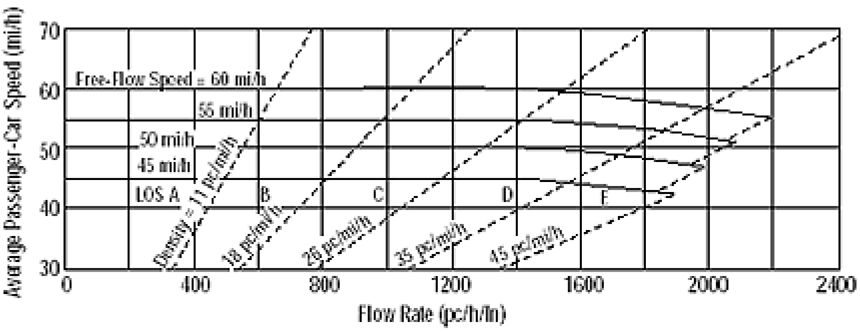
Required Number of Lanes, N

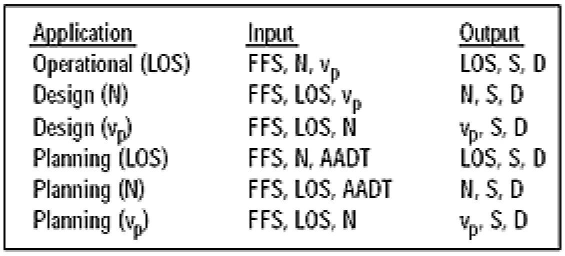
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1951	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	1100
Speed, S (mi/h)	48.3
D (pc/mi/ln)	22.8
LOS	C

Design

Design (N)

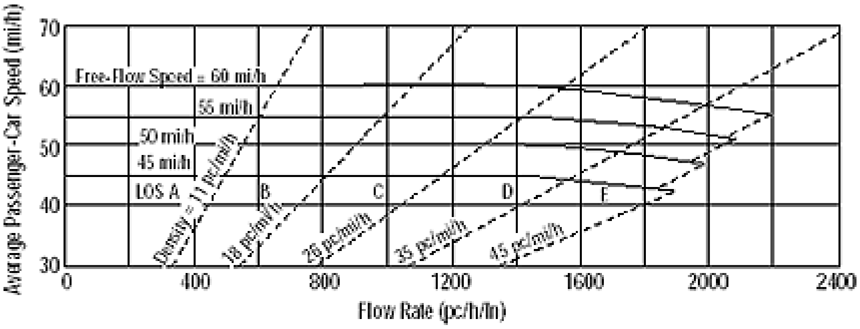
Required Number of Lanes, N

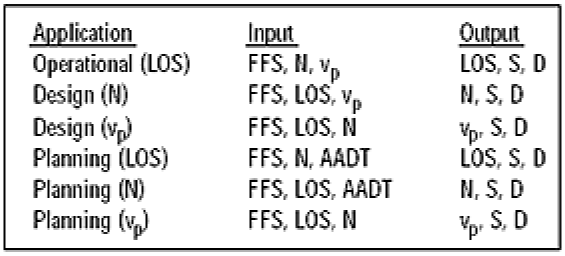
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1783	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	1005
Speed, S (mi/h)	48.3
D (pc/mi/ln)	20.8
LOS	C

Design

Design (N)

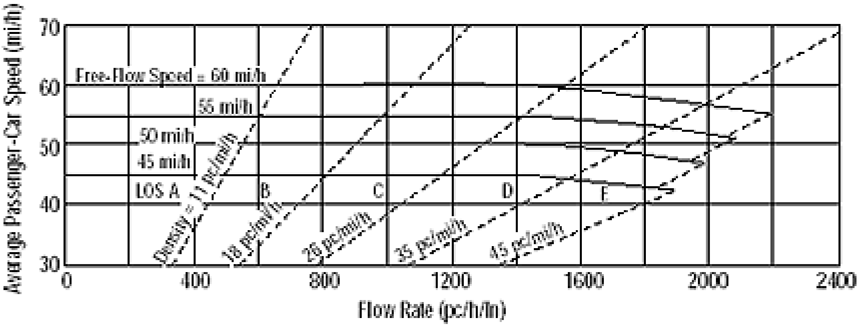
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	448	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	252
Speed, S (mi/h)	48.3
D (pc/mi/ln)	5.2
LOS	A

Design

Design (N)

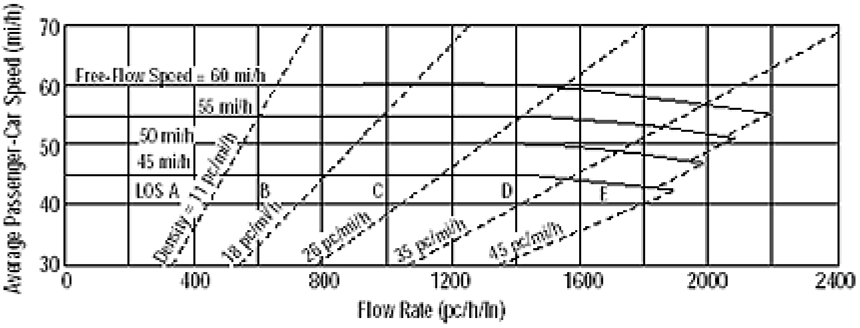
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	776	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	437
Speed, S (mi/h)	48.3
D (pc/mi/ln)	9.1
LOS	A

Design

Design (N)

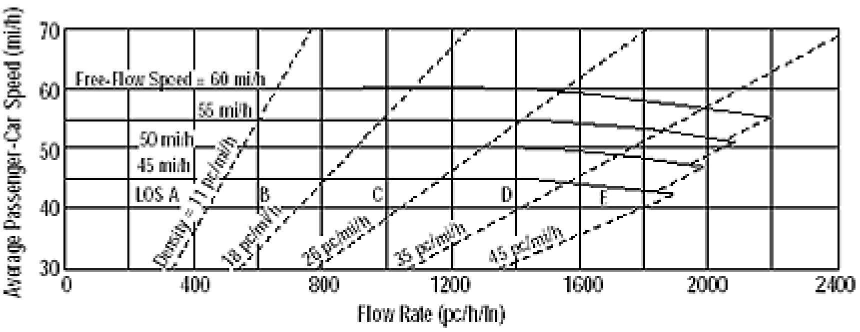
Required Number of Lanes, N

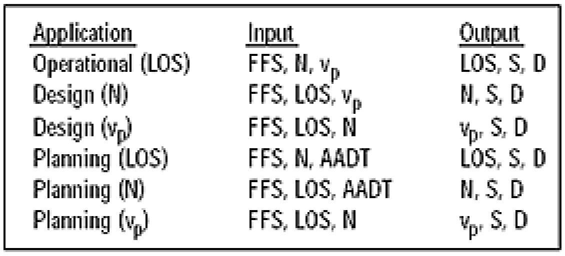
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1121	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	632
Speed, S (mi/h)	48.3
D (pc/mi/ln)	13.1
LOS	B

Design

Design (N)

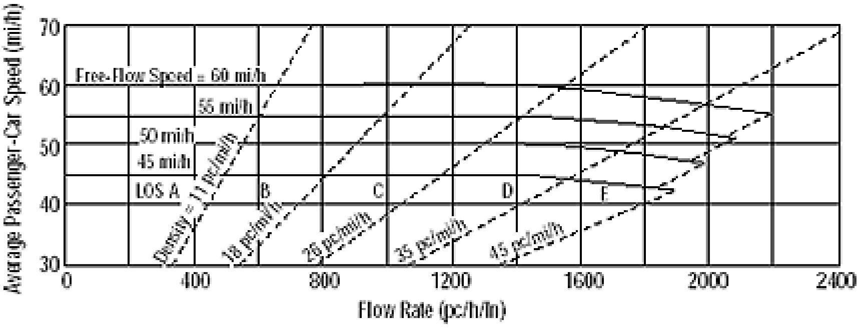
Required Number of Lanes, N

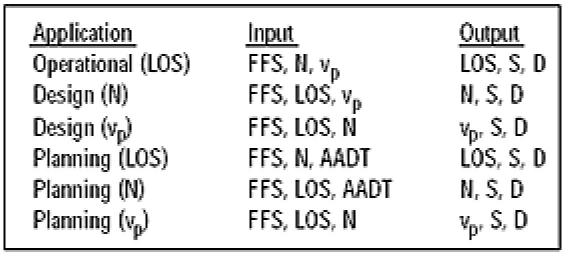
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	777	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	438
Speed, S (mi/h)	48.3
D (pc/mi/ln)	9.1
LOS	A

Design

Design (N)

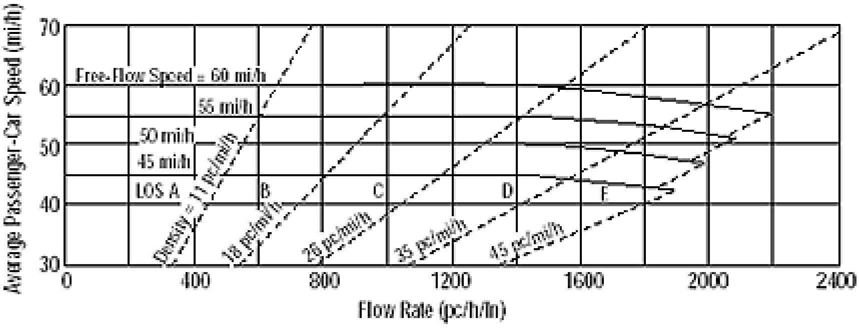
Required Number of Lanes, N

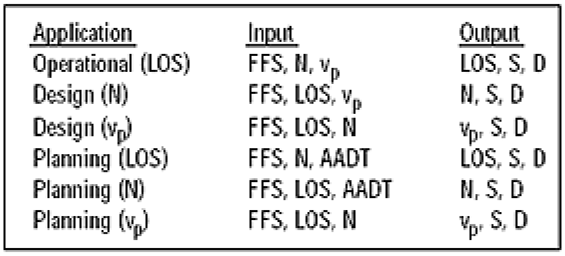
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description   Proposed System With Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	710	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	400
Speed, S (mi/h)	48.3
D (pc/mi/ln)	8.3
LOS	A

Design

Design (N)

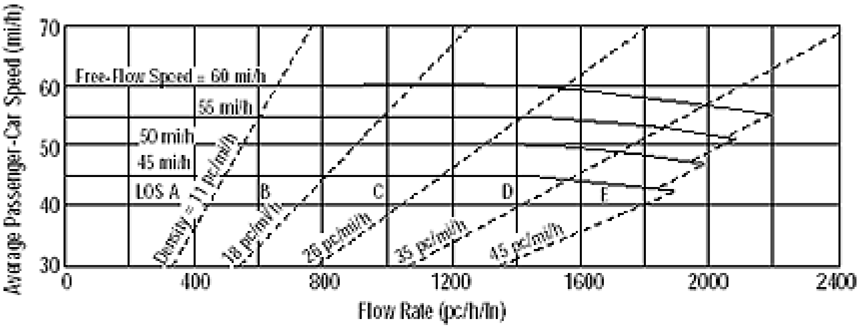
Required Number of Lanes, N

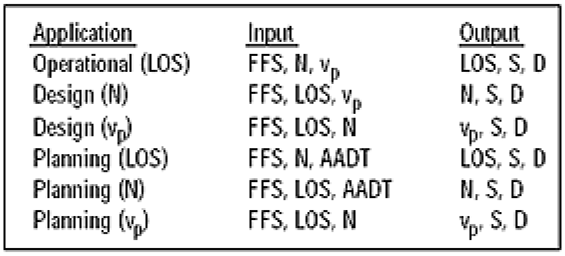
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1245	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	702
Speed, S (mi/h)	48.3
D (pc/mi/ln)	14.5
LOS	B

Design

Design (N)

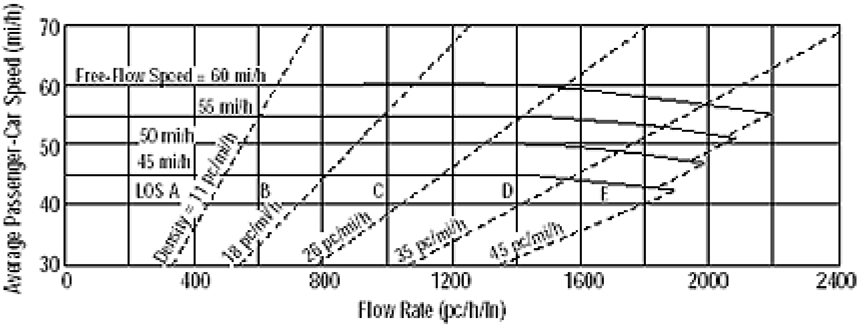
Required Number of Lanes, N

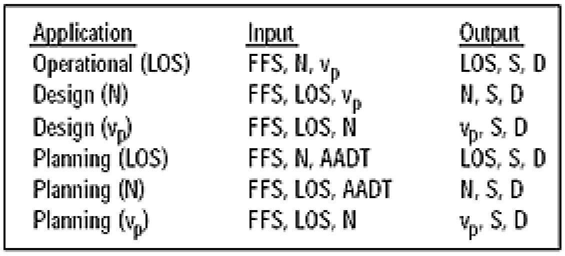
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description   Proposed System With Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1784	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	1005
Speed, S (mi/h)	48.3
D (pc/mi/ln)	20.8
LOS	C

Design

Design (N)

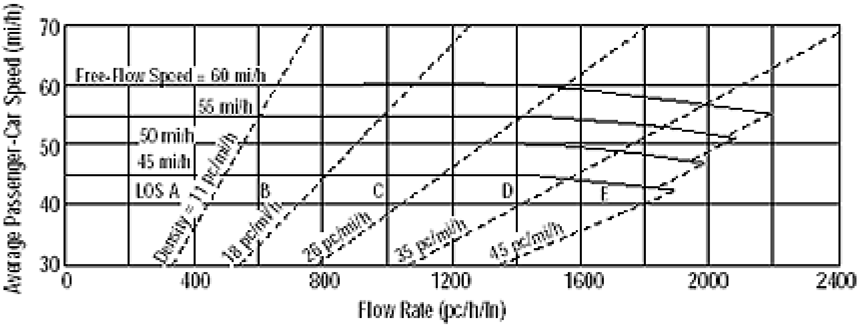
Required Number of Lanes, N

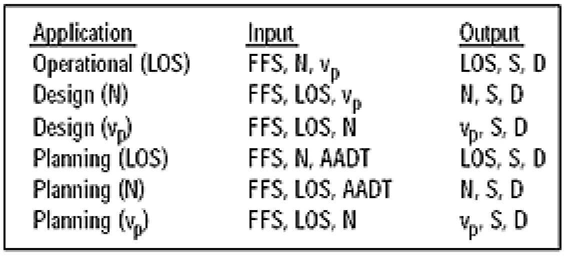
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	S. Lee Hwy.
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	1247	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	703
Speed, S (mi/h)	48.3
D (pc/mi/ln)	14.6
LOS	B

Design

Design (N)

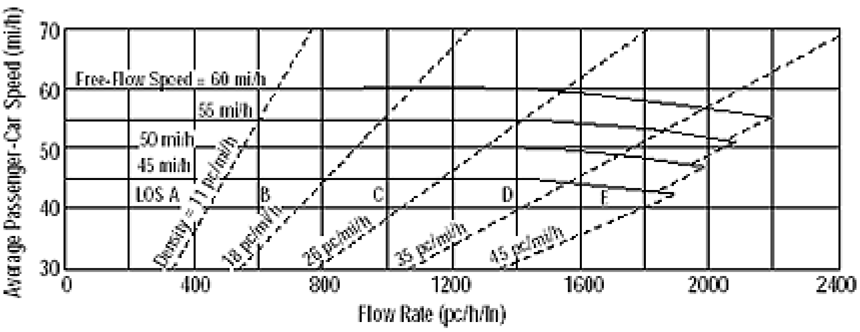
Required Number of Lanes, N

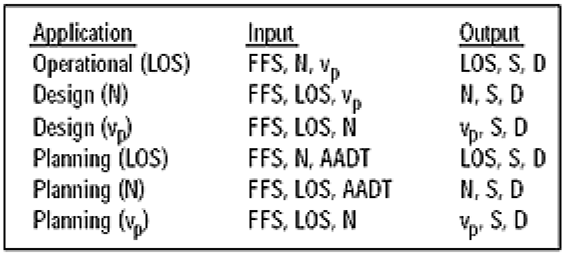
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	04/05/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	483	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	275
Speed, S (mi/h)	48.3
D (pc/mi/ln)	5.7
LOS	A

Design

Design (N)

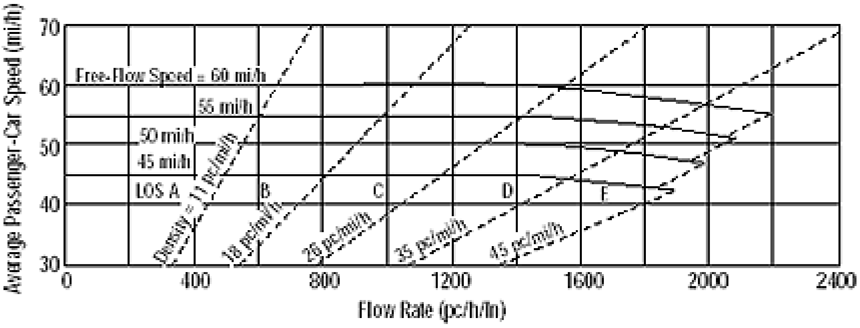
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	04/05/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	276	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	157
Speed, S (mi/h)	48.3
D (pc/mi/ln)	3.3
LOS	A

Design

Design (N)

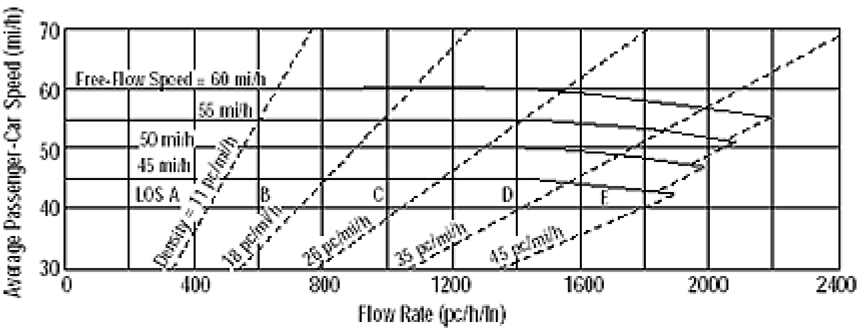
Required Number of Lanes, N

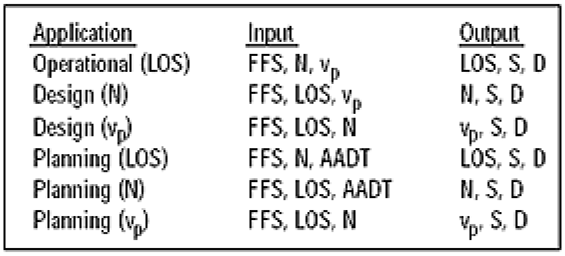
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	251	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	142
Speed, S (mi/h)	48.3
D (pc/mi/ln)	2.9
LOS	A

Design

Design (N)

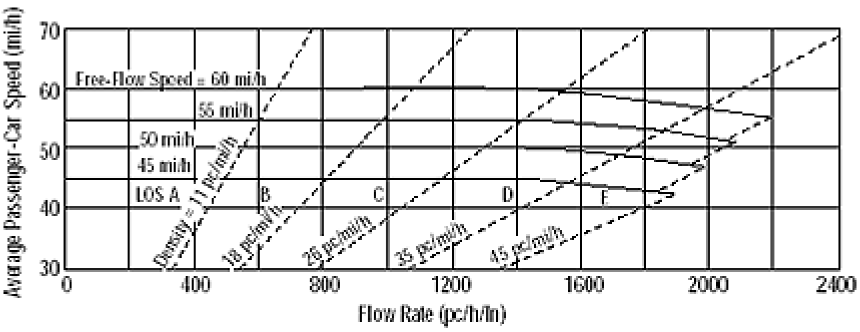
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	536	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	305
Speed, S (mi/h)	48.3
D (pc/mi/ln)	6.3
LOS	A

Design

Design (N)

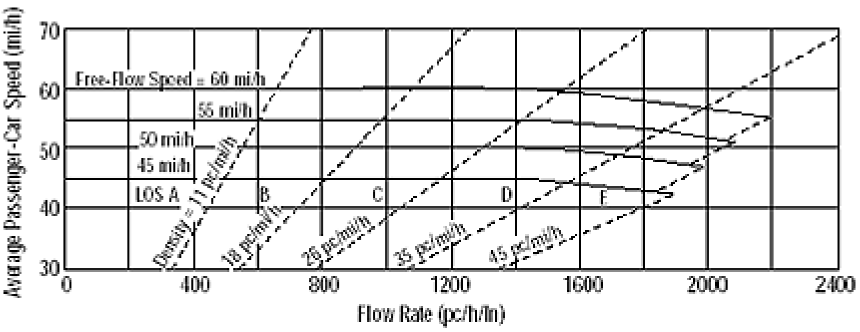
Required Number of Lanes, N

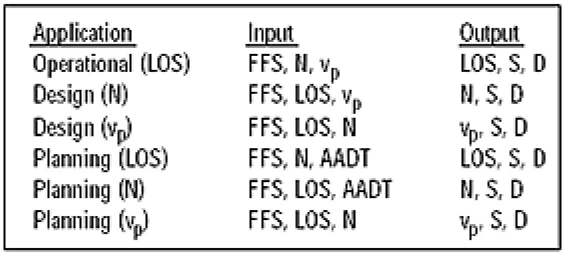
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description   Proposed System Without Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	752	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	428
Speed, S (mi/h)	48.3
D (pc/mi/ln)	8.9
LOS	A

Design

Design (N)

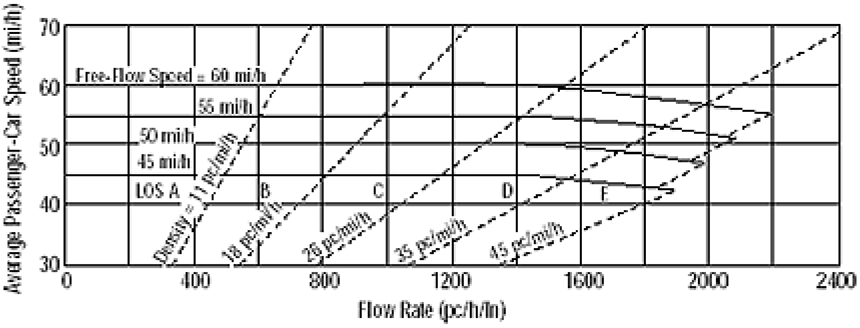
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	449	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	255
Speed, S (mi/h)	48.3
D (pc/mi/ln)	5.3
LOS	A

Design

Design (N)

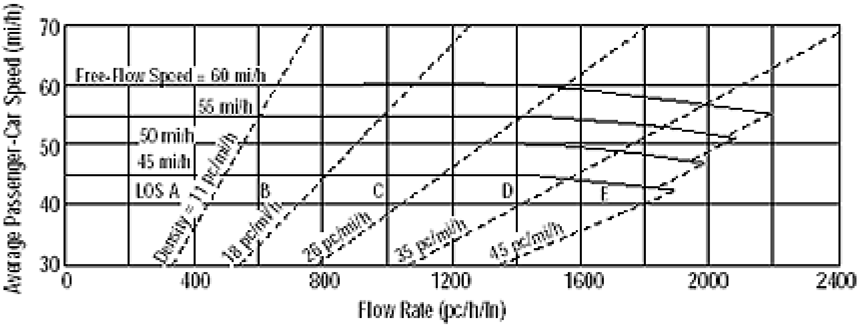
Required Number of Lanes, N

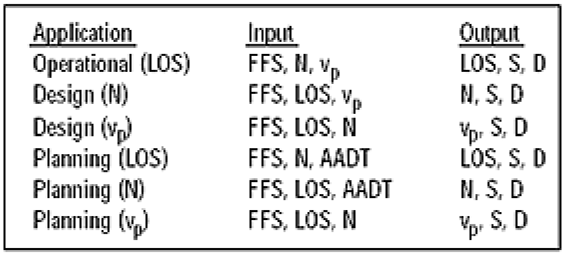
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description   Proposed System Without Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	402	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	228
Speed, S (mi/h)	48.3
D (pc/mi/ln)	4.7
LOS	A

Design

Design (N)

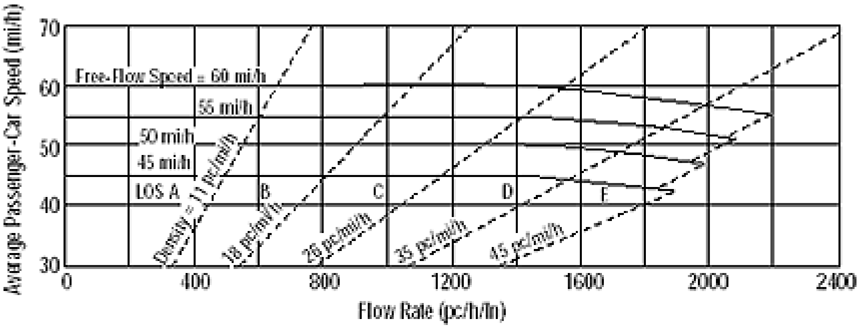
Required Number of Lanes, N

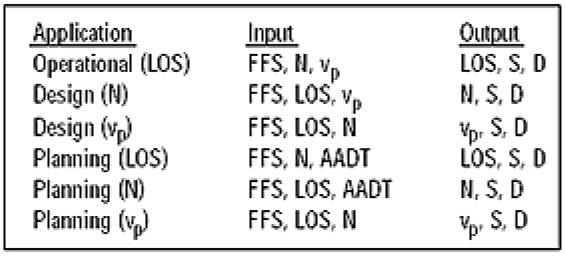
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	North of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System Without Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	867	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	5
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.976

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

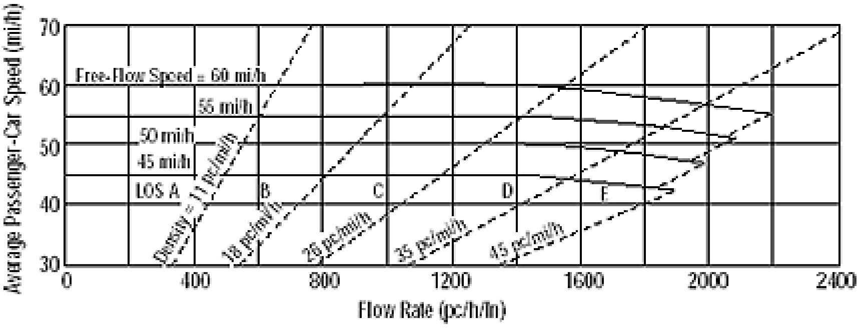
Flow Rate, v_p (pc/h/ln)	493
Speed, S (mi/h)	48.3
D (pc/mi/ln)	10.2
LOS	A

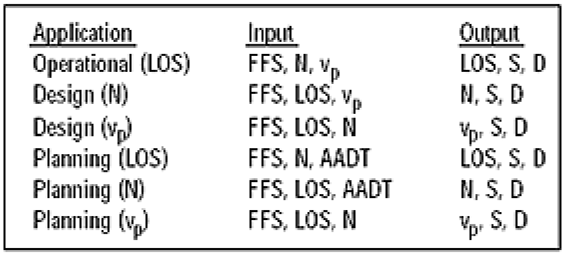
Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	296	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	166
Speed, S (mi/h)	48.3
D (pc/mi/ln)	3.4
LOS	A

Design

Design (N)

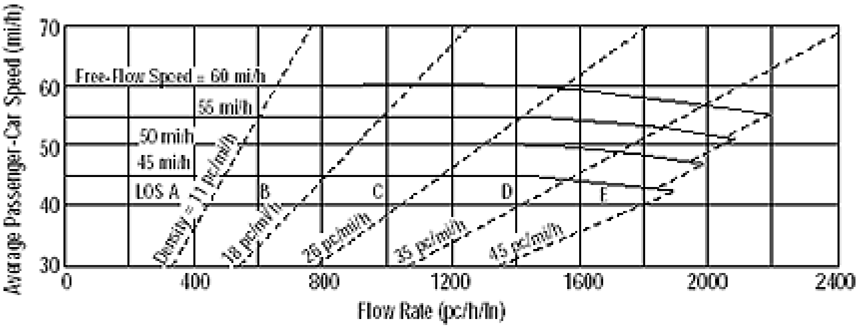
Required Number of Lanes, N

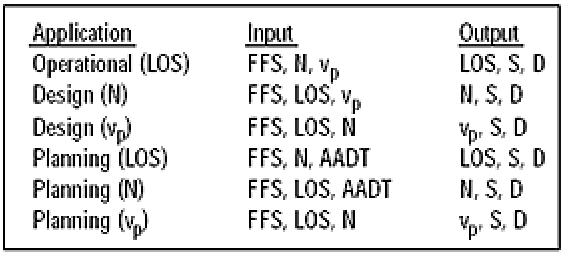
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	349	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	196
Speed, S (mi/h)	48.3
D (pc/mi/ln)	4.1
LOS	A

Design

Design (N)

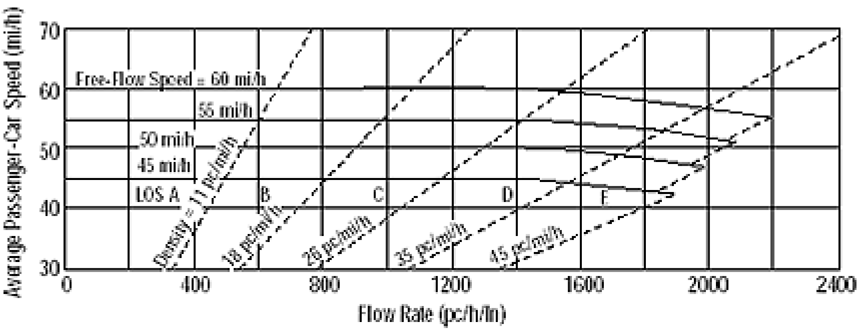
Required Number of Lanes, N

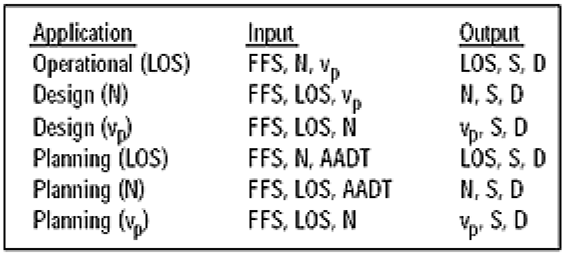
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	04/05/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	494	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	278
Speed, S (mi/h)	48.3
D (pc/mi/ln)	5.8
LOS	A

Design

Design (N)

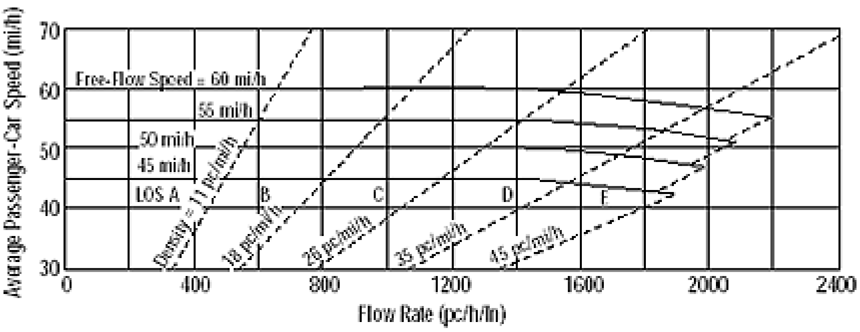
Required Number of Lanes, N

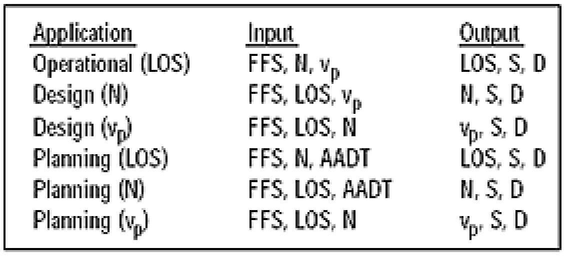
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	04/05/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2013

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	118	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	66
Speed, S (mi/h)	48.3
D (pc/mi/ln)	1.4
LOS	A

Design

Design (N)

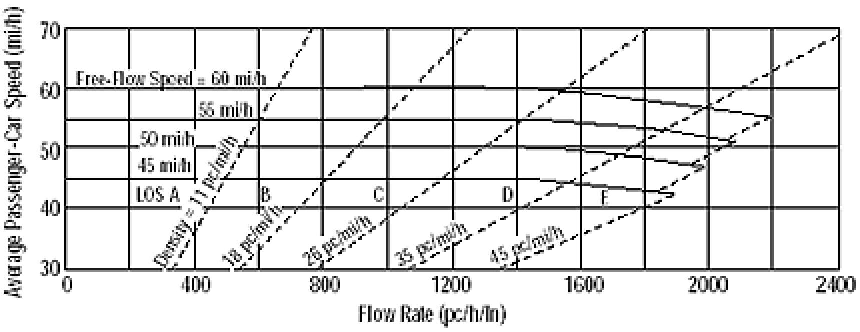
Required Number of Lanes, N

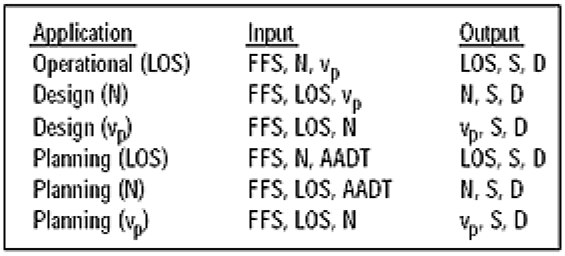
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description   Proposed System With Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	468	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	263
Speed, S (mi/h)	48.3
D (pc/mi/ln)	5.5
LOS	A

Design

Design (N)

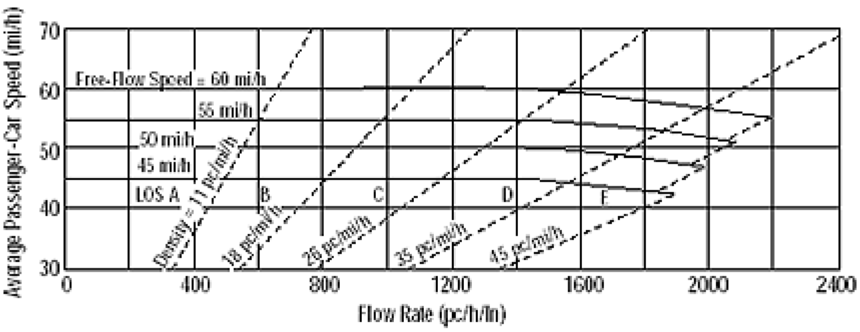
Required Number of Lanes, N

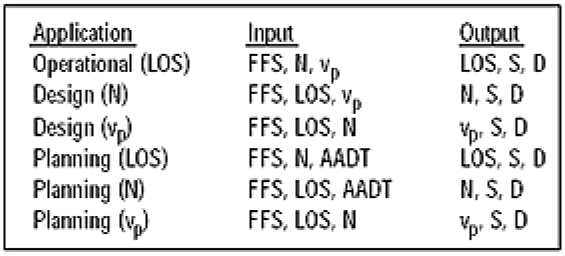
Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)





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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	AM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description   Proposed System With Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	595	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	335
Speed, S (mi/h)	48.3
D (pc/mi/ln)	6.9
LOS	A

Design

Design (N)

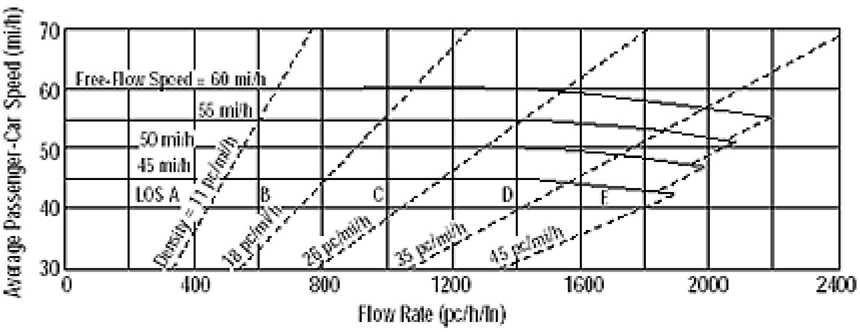
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 1)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description   Proposed System With Slip Ramp

☑ Oper.(LOS)   ☐ Des. (N)   ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	782	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	440
Speed, S (mi/h)	48.3
D (pc/mi/ln)	9.1
LOS	A

Design

Design (N)

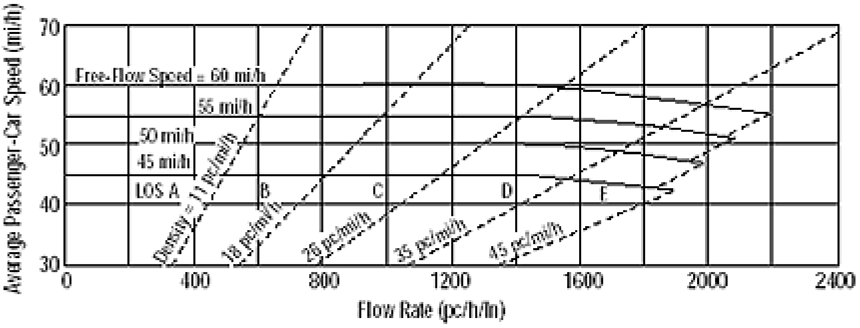
Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

MULTILANE HIGHWAYS WORKSHEET(Direction 2)



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	SKB
Agency or Company	TDOT / Long Engineering
Date Performed	05/04/2009
Analysis Time Period	PM Peak Period

Site Information

Highway/Direction to Travel	Proposed Interchange Mainline
From/To	South of APD-40
Jurisdiction	Cleveland, TN
Analysis Year	2033

Project Description Proposed System With Slip Ramp

☑ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	194	Peak-Hour Factor, PHF	0.90
AADT(veh/h)		%Trucks and Buses, P_T	3
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.985

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	7
Median Type, M	Divided
FFS (measured)	
Base Free-Flow Speed, BFFS	50.0

Calc Speed Adj and FFS

f_{LW} (mi/h)	0.0
f_{LC} (mi/h)	0.0
f_A (mi/h)	1.8
f_M (mi/h)	0.0
FFS (mi/h)	48.3

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	109
Speed, S (mi/h)	48.3
D (pc/mi/ln)	2.3
LOS	A

Design

Design (N)

Required Number of Lanes, N

Flow Rate, v_p (pc/h)

Max Service Flow Rate (pc/h/ln)

Design LOS

Two-Lane Highways

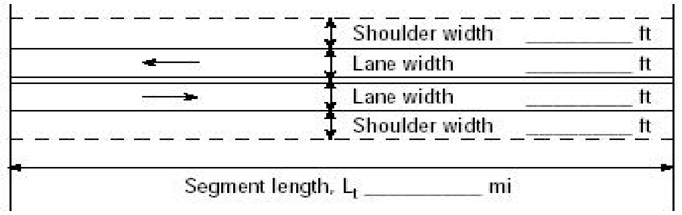
Highway Capacity Software
Computer Printouts

TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		**Site Information**	
Analyst	*SKB*	Highway	*Pleasant Grove Road*
Agency or Company	*TDOT / Long Engineering*	From/To	*West of I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description: *Existing System Without Slip Ramp*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*423* veh/h
Directional split	*61 / 39*
Peak-hour factor, PHF	*0.90*
No-passing zone	*100*
% Trucks and Buses , P_T	*3* %
% Recreational vehicles, P_R	*0*%
Access points/ *mi*	*12*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.7*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.979*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*480*
v_p * highest directional split proportion[2] (pc/h)	*293*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*1.3 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*3.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*40.7 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*4.3*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*32.7*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.997*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*471*
v_p * highest directional split proportion[2] (pc/h)	*287*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*33.9*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*21.7*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*55.6*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.15*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*59*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*212*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*1.8*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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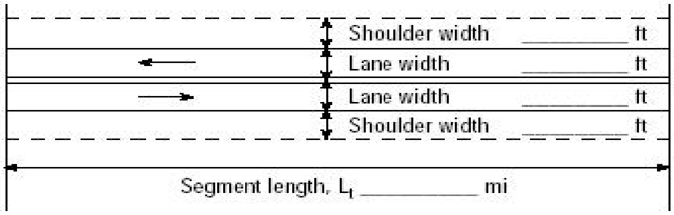
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		**Site Information**	
Analyst	*SKB*	Highway	*Pleasant Grove Road*
Agency or Company	*TDOT / Long Engineering*	From/To	*West of I-75*
Date Performed	*04/05/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description: *Existing System Without Slip Ramp*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*481* veh/h
Directional split	*64 / 36*
Peak-hour factor, PHF	*0.90*
No-passing zone	*100*
% Trucks and Buses , P_T	*3* %
% Recreational vehicles, P_R	*0*%
Access points/ *mi*	*12*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.7*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.979*
Two-way flow rate^1, v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*546*
v_p * highest directional split proportion^2 (pc/h)	*349*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width^3, f_{LS} (Exhibit 20-5)	*1.3 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*3.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*40.7 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*4.1*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*32.4*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.997*
Two-way flow rate^1, v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*536*
v_p * highest directional split proportion^2 (pc/h)	*343*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*37.6*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*21.4*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*58.9*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.17*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*67*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*241*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*2.1*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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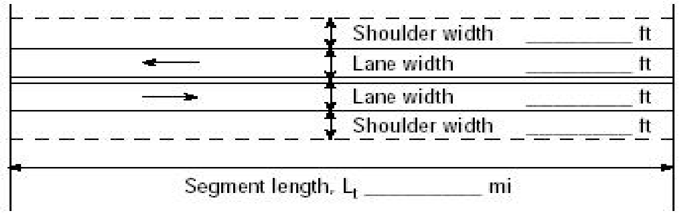
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		**Site Information**	
Analyst	*SKB*	Highway	*Pleasant Grove Road*
Agency or Company	*TDOT / Long Engineering*	From/To	*West of I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description: *Existing System Without Slip Ramp*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*643* veh/h
Directional split	*61 / 39*
Peak-hour factor, PHF	*0.90*
No-passing zone	*100*
% Trucks and Buses , P_T	*3* %
% Recreational vehicles, P_R	*0*%
Access points/ *mi*	*12*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.994*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*719*
v_p * highest directional split proportion[2] (pc/h)	*439*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*1.3 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*3.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*40.7 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*3.4*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*31.8*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.997*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*717*
v_p * highest directional split proportion[2] (pc/h)	*437*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*46.8*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*17.0*
Percent time-spent-following, PTSF(%)=BPTSF+f $_{d/np}$	*63.8*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.22*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*89*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*322*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*2.8*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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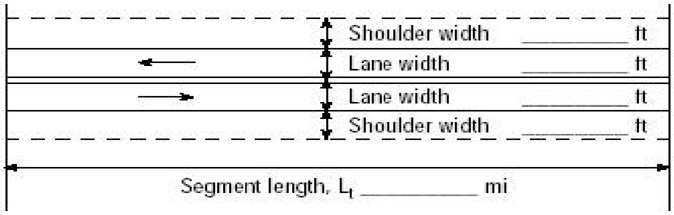
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*SKB*	Highway	*Pleasant Grove Road*
Agency or Company	*TDOT / Long Engineering*	From/To	*West of I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description: *Existing System Without Slip Ramp*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*722 veh/h*
Directional split	*64 / 36*
Peak-hour factor, PHF	*0.90*
No-passing zone	*100*
% Trucks and Buses , P_T	*3 %*
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*12*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.994*
Two-way flow rate^1, v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*807*
v_p * highest directional split proportion^2 (pc/h)	*516*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width^3, f_{LS} (Exhibit 20-5)	*1.3 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*3.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*40.7 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*3.0*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*31.5*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.997*
Two-way flow rate^1, v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*805*
v_p * highest directional split proportion^2 (pc/h)	*515*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*50.7*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*14.4*
Percent time-spent-following, PTSF(%)=BPTSF+f $_{d/np}$	*65.1*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.25*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*100*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*361*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*3.2*

Notes

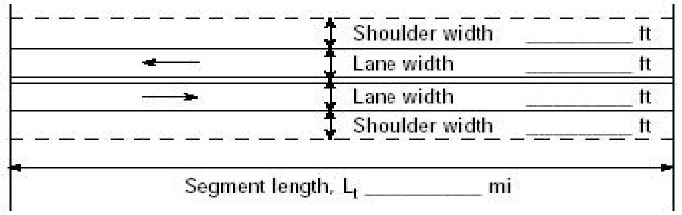
1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		**Site Information**	
Analyst	*SKB*	Highway	*Pleasant Grove Road*
Agency or Company	*TDOT / Long Engineering*	From/To	*West of I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2013*

Project Description: *Proposed System Without Slip Ramp*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*514* veh/h
Directional split	*65 / 35*
Peak-hour factor, PHF	*0.90*
No-passing zone	*100*
% Trucks and Buses , P_T	*3* %
% Recreational vehicles, P_R	*0*%
Access points/ *mi*	*12*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.7*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*0.979*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*583*
v_p * highest directional split proportion[2] (pc/h)	*379*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	mi/h	Base free-flow speed, $BFFS_{FM}$	*45.0* mi/h
Observed volume, V_f	veh/h	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*1.3* mi/h
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	mi/h	Adj. for access points, f_A (Exhibit 20-6)	*3.0* mi/h
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*40.7* mi/h

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*4.0*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*32.2*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*0.997*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*573*
v_p * highest directional split proportion[2] (pc/h)	*372*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*39.6*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*21.1*
Percent time-spent-following, PTSF(%)=BPTSF+f $_{d/np}$	*60.6*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.18*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*71*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*257*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*2.2*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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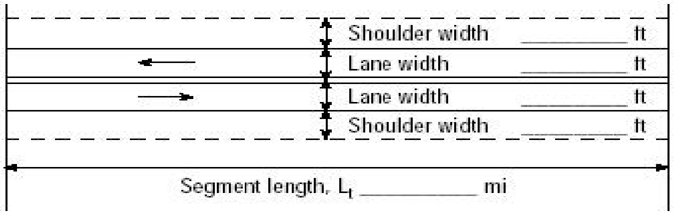
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*SKB*	Highway	*Pleasant Grove Road*
Agency or Company	*TDOT / Long Engineering*	From/To	*West of I-75*
Date Performed	*04/05/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2013*

Project Description: *Proposed System Without Slip Ramp*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*520* veh/h
Directional split	*65 / 35*
Peak-hour factor, PHF	*0.90*
No-passing zone	*100*
% Trucks and Buses , P_T	*3* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*12*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.7*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*0.979*
Two-way flow rate^1, v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*590*
v_p * highest directional split proportion^2 (pc/h)	*384*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width^3, f_{LS} (Exhibit 20-5)	*1.3 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*3.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*40.7 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*3.9*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*32.2*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*0.997*
Two-way flow rate^1, v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*580*
v_p * highest directional split proportion^2 (pc/h)	*377*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*39.9*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*21.0*
Percent time-spent-following, PTSF(%)=BPTSF+f $_{d/np}$	*60.9*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.18*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*72*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*260*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*2.2*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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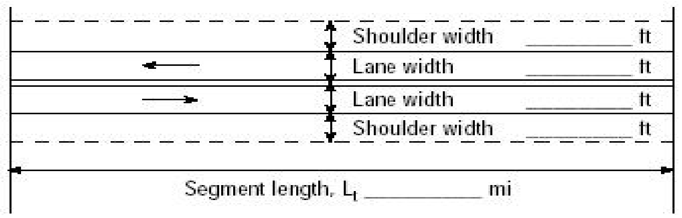
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*SKB*	Highway	*Pleasant Grove Road*
Agency or Company	*TDOT / Long Engineering*	From/To	*West of I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*AM Peak Period*	Analysis Year	*2033*

Project Description: *Proposed System Without Slip Ramp*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*786* veh/h
Directional split	*65 / 35*
Peak-hour factor, PHF	*0.90*
No-passing zone	*100*
% Trucks and Buses , P_T	*3* %
% Recreational vehicles, P_R	*0*%
Access points/ *mi*	*12*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))$	*0.994*
Two-way flow rate¹, v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*879*
v_p * highest directional split proportion² (pc/h)	*571*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
		Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Field Measured speed, S_{FM}	*mi/h*	Adj. for lane width and shoulder width³, f_{LS} (Exhibit 20-5)	*1.3 mi/h*
Observed volume, V_f	*veh/h*	Adj. for access points, f_A (Exhibit 20-6)	*3.0 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*40.7 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*2.8*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*31.0*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))$	*0.997*
Two-way flow rate¹, v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*876*
v_p * highest directional split proportion² (pc/h)	*569*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*53.7*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*13.7*
Percent time-spent-following, PTSF(%)=BPTSF+f $_{d/np}$	*67.4*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.27*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*109*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*393*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*3.5*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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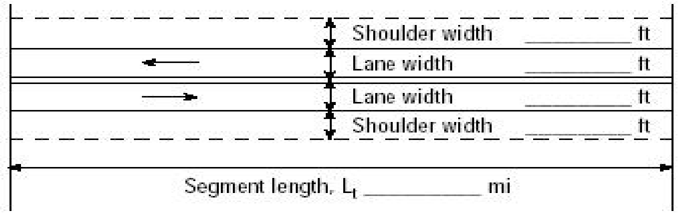
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*SKB*	Highway	*Pleasant Grove Road*
Agency or Company	*TDOT / Long Engineering*	From/To	*West of I-75*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Analysis Time Period	*PM Peak Period*	Analysis Year	*2033*

Project Description: *Proposed System Without Slip Ramp*

Input Data



☐ Class I highway ☑ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*799* veh/h
Directional split	*65 / 35*
Peak-hour factor, PHF	*0.90*
No-passing zone	*100*
% Trucks and Buses , P_T	*3* %
% Recreational vehicles, P_R	*0*%
Access points/ *mi*	*12*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.994*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*893*
v_p * highest directional split proportion[2] (pc/h)	*580*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
		Base free-flow speed, $BFFS_{FM}$	*45.0 mi/h*
Field Measured speed, S_{FM}	*mi/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*1.3 mi/h*
Observed volume, V_f	*veh/h*	Adj. for access points, f_A (Exhibit 20-6)	*3.0 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*40.7 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*2.8*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*31.0*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T$-1)+$P_R(E_R$-1))	*0.997*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*890*
v_p * highest directional split proportion[2] (pc/h)	*579*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*54.3*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*13.6*
Percent time-spent-following, PTSF(%)=BPTSF+f $_{d/np}$	*67.8*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.28*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*111*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*400*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*3.6*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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Ramp Terminal
Unsignalized Intersections

Highway Capacity Software
Computer Printouts

TWO-WAY STOP CONTROL SUMMARY

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*AM Peak Period*		

Project Description *Existing System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*538*	*44*	*156*	*789*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*572*	*46*	*165*	*839*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*194*		*326*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*206*	*0*	*346*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*165*				*206*		*346*
C (m) (veh/h)		*951*				*209*		*629*
v/c		*0.17*				*0.99*		*0.55*
95% queue length		*0.63*				*8.60*		*3.35*
Control Delay (s/veh)		*9.6*				*106.5*		*17.5*
LOS		*A*				*F*		*C*
Approach Delay (s/veh)	--	--				*50.7*		
Approach LOS	--	--				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*PM Peak Period*		

Project Description *Existing System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*980*	*78*	*316*	*754*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*1042*	*82*	*336*	*802*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*157*		*207*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*167*	*0*	*220*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*336*				*167*		*220*
C (m) (veh/h)		*611*				*78*		*644*
v/c		*0.55*				*2.14*		*0.34*
95% queue length		*3.34*				*15.24*		*1.51*
Control Delay (s/veh)		*17.9*				*640.1*		*13.5*
LOS		*C*				*F*		*B*
Approach Delay (s/veh)	--	--				*283.9*		
Approach LOS	--	--				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2033*
Analysis Time Period	*AM Peak Period*		

Project Description *Existing System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*841*	*69*	*244*	*1232*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*894*	*73*	*259*	*1310*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*303*		*510*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*322*	*0*	*542*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*259*				*322*		*542*
C (m) (veh/h)		*702*				*70*		*461*
v/c		*0.37*				*4.60*		*1.18*
95% queue length		*1.70*				*34.95*		*20.19*
Control Delay (s/veh)		*13.1*				*1740*		*127.8*
LOS		*B*				*F*		*F*
Approach Delay (s/veh)	--	--				*728.5*		
Approach LOS	--	--				*F*		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2033*
Analysis Time Period	*PM Peak Period*		

Project Description *Existing System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*	North/South Street: *S. Lee Hwy.*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*1543*	*113*	*454*	*1198*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*1641*	*120*	*482*	*1274*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*255*		*329*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*271*	*0*	*350*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*482*				*271*		*350*
C (m) (veh/h)		*347*				*0*		*473*
v/c		*1.39*						*0.74*
95% queue length		*24.31*						*6.11*
Control Delay (s/veh)		*221.9*						*31.3*
LOS		*F*				*F*		*D*
Approach Delay (s/veh)	*--*	*--*						
Approach LOS	*--*	*--*						

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*AM Peak Period*		

Project Description *Existing System Without Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp*	North/South Street: *S. Lee Hwy.*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*211*	*521*			*803*	*154*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*234*	*578*	*0*	*0*	*892*	*171*
Percent Heavy Vehicles	*3*	--	--	*3*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*142*		*129*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*157*	*0*	*143*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*234*		*157*		*143*			
C (m) (veh/h)	*645*		*186*		*745*			
v/c	*0.36*		*0.84*		*0.19*			
95% queue length	*1.65*		*6.07*		*0.71*			
Control Delay (s/veh)	*13.7*		*81.9*		*11.0*			
LOS	*B*		*F*		*B*			
Approach Delay (s/veh)	--	--	*48.1*					
Approach LOS	--	--	*E*					

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TWO-WAY STOP CONTROL SUMMARY

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 WB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*PM Peak Period*		

Project Description *Existing System Without Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*347*	*790*			*937*	*223*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*385*	*877*	*0*	*0*	*1041*	*247*
Percent Heavy Vehicles	*3*	--	--	*3*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*133*		*112*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*147*	*0*	*124*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*385*		*147*		*124*			
C (m) (veh/h)	*529*		*37*		*614*			
v/c	*0.73*		*3.97*		*0.20*			
95% queue length	*6.01*		*16.99*		*0.75*			
Control Delay (s/veh)	*27.9*		*1560*		*12.3*			
LOS	*D*		*F*		*B*			
Approach Delay (s/veh)	--	--	*851.6*					
Approach LOS	--	--	*F*					

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2033*
Analysis Time Period	*AM Peak Period*		

Project Description *Existing System Without Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp* | North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*329*	*815*			*1254*	*227*
Peak-Hour Factor, PHF	*0.94*	*0.94*	*0.90*	*0.90*	*0.94*	*0.94*
Hourly Flow Rate, HFR (veh/h)	*350*	*867*	*0*	*0*	*1334*	*241*
Percent Heavy Vehicles	*3*	--	--	*3*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*0*		*201*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.94*	*0.90*	*0.94*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*0*	*0*	*213*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*350*		*0*		*213*			
C (m) (veh/h)	*410*		*23*		*617*			
v/c	*0.85*		*0.00*		*0.35*			
95% queue length	*8.30*		*0.00*		*1.54*			
Control Delay (s/veh)	*47.6*		*161.5*		*13.9*			
LOS	*E*		*F*		*B*			
Approach Delay (s/veh)	--	--	*13.9*					
Approach LOS	--	--	*B*					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2033*
Analysis Time Period	*PM Peak Period*		

Project Description *Existing System Without Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*552*	*1246*			*1456*	*362*
Peak-Hour Factor, PHF	*0.94*	*0.94*	*0.90*	*0.90*	*0.94*	*0.94*
Hourly Flow Rate, HFR (veh/h)	*587*	*1325*	*0*	*0*	*1548*	*385*
Percent Heavy Vehicles	*3*	--	--	*3*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*196*		*167*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.94*	*0.90*	*0.94*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*208*	*0*	*177*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*587*		*208*		*177*			
C (m) (veh/h)	*297*		*0*		*457*			
v/c	*1.98*				*0.39*			
95% queue length	*41.55*				*1.80*			
Control Delay (s/veh)	*479.8*				*17.8*			
LOS	*F*		*F*		*C*			
Approach Delay (s/veh)	--	--						
Approach LOS	--	--						

HCS+^{TM} Version 5.3

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*AM Peak Period*		

Project Description *Existing System With Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*	North/South Street: *S. Lee Hwy.*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*538*	*44*	*156*	*789*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*572*	*46*	*165*	*839*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*194*		*159*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*206*	*0*	*169*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*165*				*206*		*169*
C (m) (veh/h)		*951*				*209*		*629*
v/c		*0.17*				*0.99*		*0.27*
95% queue length		*0.63*				*8.60*		*1.08*
Control Delay (s/veh)		*9.6*				*106.5*		*12.8*
LOS		*A*				*F*		*B*
Approach Delay (s/veh)	--	--				*64.3*		
Approach LOS	--	--				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Intersection	*APD-40 EB @ S. Lee Hwy.*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description *Existing System With Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*980*	*78*	*316*	*754*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*1042*	*82*	*336*	*802*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*157*		*84*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*167*	*0*	*89*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*336*				*167*		*89*
C (m) (veh/h)		*611*				*78*		*644*
v/c		*0.55*				*2.14*		*0.14*
95% queue length		*3.34*				*15.24*		*0.48*
Control Delay (s/veh)		*17.9*				*640.1*		*11.5*
LOS		*C*				*F*		*B*
Approach Delay (s/veh)	--	--				*421.6*		
Approach LOS	--	--				*F*		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Intersection	*APD-40 EB @ S. Lee Hwy.*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description *Existing System With Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*841*	*69*	*244*	*1232*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*894*	*73*	*259*	*1310*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*303*		*258*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*322*	*0*	*274*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*259*				*322*		*274*
C (m) (veh/h)		*702*				*70*		*461*
v/c		*0.37*				*4.60*		*0.59*
95% queue length		*1.70*				*34.95*		*3.78*
Control Delay (s/veh)		*13.1*				*1740*		*23.6*
LOS		*B*				*F*		*C*
Approach Delay (s/veh)	*--*	*--*				*950.7*		
Approach LOS	*--*	*--*				*F*		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2033*
Analysis Time Period	*PM Peak Period*		

Project Description *Existing System With Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*1543*	*113*	*454*	*1198*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*1641*	*120*	*482*	*1274*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*255*		*141*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*271*	*0*	*150*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*482*				*271*		*150*
C (m) (veh/h)		*347*				*0*		*473*
v/c		*1.39*						*0.32*
95% queue length		*24.31*						*1.35*
Control Delay (s/veh)		*221.9*						*16.1*
LOS		*F*				*F*		*C*
Approach Delay (s/veh)	*--*	*--*						
Approach LOS	*--*	*--*						

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*Slip Ramp @ Stone Lake Road*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*AM Peak Period*		

Project Description *Existing/Proposed System With Slip Ramp*

East/West Street: *Slip Ramp*	North/South Street: *Stone Lake Road*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*272*			*1429*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.90*	*0.90*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*289*	*0*	*0*	*1520*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*T*			*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*55*		*112*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*58*	*0*	*119*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration						*L*		*R*
v (veh/h)						*58*		*119*
C (m) (veh/h)						*193*		*144*
v/c						*0.30*		*0.83*
95% queue length						*1.20*		*5.30*
Control Delay (s/veh)						*31.5*		*95.0*
LOS						*D*		*F*
Approach Delay (s/veh)	*--*	*--*				*74.2*		
Approach LOS	*--*	*--*				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Intersection	*Slip Ramp @ Stone Lake Road*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description *Existing/Proposed System With Slip Ramp*

East/West Street: *Slip Ramp*

North/South Street: *Stone Lake Road*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*1532*			*295*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.90*	*0.90*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*1629*	*0*	*0*	*313*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*T*			*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*41*		*82*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*43*	*0*	*87*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration						*L*		*R*
v (veh/h)						*43*		*87*
C (m) (veh/h)						*171*		*720*
v/c						*0.25*		*0.12*
95% queue length						*0.95*		*0.41*
Control Delay (s/veh)						*33.0*		*10.7*
LOS						*D*		*B*
Approach Delay (s/veh)	--	--				*18.1*		
Approach LOS	--	--				*C*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Intersection	*Slip Ramp @ Stone Lake Road*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description *Existing/Proposed System With Slip Ramp*

East/West Street: *Slip Ramp*

North/South Street: *Stone Lake Road*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*462*			*2409*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.90*	*0.90*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*491*	*0*	*0*	*2562*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*T*			*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*83*		*169*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*88*	*0*	*179*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration						*L*		*R*
v (veh/h)						*88*		*179*
C (m) (veh/h)						*57*		*33*
v/c						*1.54*		*5.42*
95% queue length						*8.00*		*21.39*
Control Delay (s/veh)						*433.1*		*2231*
LOS						*F*		*F*
Approach Delay (s/veh)	*--*	*--*				*1638*		
Approach LOS	*--*	*--*				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Intersection	*Slip Ramp @ Stone Lake Road*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description *Existing/Proposed System With Slip Ramp*

East/West Street: *Slip Ramp*	North/South Street: *Stone Lake Road*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*2559*			*509*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.90*	*0.90*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*2722*	*0*	*0*	*541*	*0*
Percent Heavy Vehicles	*0*	--	--	*3*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*T*			*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*62*		*126*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*65*	*0*	*134*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration						*L*		*R*
v (veh/h)						*65*		*134*
C (m) (veh/h)						*46*		*535*
v/c						*1.41*		*0.25*
95% queue length						*6.27*		*0.98*
Control Delay (s/veh)						*417.9*		*14.0*
LOS						*F*		*B*
Approach Delay (s/veh)	--	--				*145.9*		
Approach LOS	--	--				*F*		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Intersection	*APD-40 EB @ Prop Interchange*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *Proposed Interchange*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*235*	*61*	*79*	*231*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*250*	*64*	*84*	*245*	*0*
Percent Heavy Vehicles	*0*	--	--	*5*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*264*		*285*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*280*	*0*	*303*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*84*				*280*		*303*
C (m) (veh/h)		*1222*				*576*		*918*
v/c		*0.07*				*0.49*		*0.33*
95% queue length		*0.22*				*2.65*		*1.45*
Control Delay (s/veh)		*8.2*				*17.0*		*10.8*
LOS		*A*				*C*		*B*
Approach Delay (s/veh)	--	--				*13.8*		
Approach LOS	--	--				*B*		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ Prop. Interchange*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*PM Peak Period*		

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*	North/South Street: *Proposed Interchange*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*447*	*47*	*186*	*61*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*475*	*50*	*197*	*64*	*0*
Percent Heavy Vehicles	*0*	--	--	*5*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*84*		*180*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*89*	*0*	*191*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*197*				*89*		*191*
C (m) (veh/h)		*1017*				*468*		*1031*
v/c		*0.19*				*0.19*		*0.19*
95% queue length		*0.72*				*0.69*		*0.68*
Control Delay (s/veh)		*9.4*				*14.5*		*9.3*
LOS		*A*				*B*		*A*
Approach Delay (s/veh)	--	--				*10.9*		
Approach LOS	--	--				*B*		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Intersection	*APD-40 EB @ Prop. Interchange*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *Proposed Interchange*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*372*	*96*	*123*	*371*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*395*	*102*	*130*	*394*	*0*
Percent Heavy Vehicles	*0*	--	--	*5*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*412*		*446*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*438*	*0*	*474*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*130*				*438*		*474*
C (m) (veh/h)		*1042*				*406*		*833*
v/c		*0.12*				*1.08*		*0.57*
95% queue length		*0.43*				*14.97*		*3.66*
Control Delay (s/veh)		*8.9*				*99.6*		*14.9*
LOS		*A*				*F*		*B*
Approach Delay (s/veh)	--	--				*55.5*		
Approach LOS	--	--				*F*		

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TWO-WAY STOP CONTROL SUMMARY

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ Prop. Interchange*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2033*
Analysis Time Period	*PM Peak Period*		

Project Description *Proposed System Without Slip Ramp*	
East/West Street: *APD-40 EB Off-Ramp*	North/South Street: *Proposed Interchange*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*708*	*74*	*291*	*101*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*753*	*78*	*309*	*107*	*0*
Percent Heavy Vehicles	*0*	--	--	*5*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*131*		*281*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*139*	*0*	*298*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*309*				*139*		*298*
C (m) (veh/h)		*778*				*254*		*1002*
v/c		*0.40*				*0.55*		*0.30*
95% queue length		*1.91*				*3.00*		*1.25*
Control Delay (s/veh)		*12.6*				*35.1*		*10.1*
LOS		*B*				*E*		*B*
Approach Delay (s/veh)	--	--				*18.0*		
Approach LOS	--	--				*C*		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ Prop. Interchange*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*AM Peak Period*		

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp*

North/South Street: *Proposed Interchange*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*113*	*386*			*174*	*102*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*125*	*428*	*0*	*0*	*193*	*113*
Percent Heavy Vehicles	*3*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*136*		*97*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*151*	*0*	*107*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*125*		*151*		*107*			
C (m) (veh/h)	*1244*		*410*		*821*			
v/c	*0.10*		*0.37*		*0.13*			
95% queue length	*0.33*		*1.66*		*0.45*			
Control Delay (s/veh)	*8.2*		*18.8*		*10.0*			
LOS	*A*		*C*		*B*			
Approach Delay (s/veh)	--	--	*15.2*					
Approach LOS	--	--	*C*					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Intersection	*APD-40 WB @ Prop. Interchange*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description *Proposed System Without Slip Ramp*	
East/West Street: *APD-40 WB Off-Ramp*	North/South Street: *Proposed Interchange*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*314*	*217*			*203*	*333*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*348*	*241*	*0*	*0*	*225*	*370*
Percent Heavy Vehicles	*3*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*44*		*34*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*48*	*0*	*37*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*348*		*48*		*37*			
C (m) (veh/h)	*970*		*214*		*927*			
v/c	*0.36*		*0.22*		*0.04*			
95% queue length	*1.64*		*0.83*		*0.12*			
Control Delay (s/veh)	*10.8*		*26.6*		*9.0*			
LOS	*B*		*D*		*A*			
Approach Delay (s/veh)	--	--	*19.0*					
Approach LOS	--	--	*C*					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Intersection	*APD-40 WB @ Prop. Interchange*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp*

North/South Street: *Proposed Interchange*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*176*	*608*			*282*	*167*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*195*	*675*	*0*	*0*	*313*	*185*
Percent Heavy Vehicles	*3*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*212*		*144*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*235*	*0*	*160*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*195*		*235*		*160*			
C (m) (veh/h)	*1055*		*233*		*699*			
v/c	*0.18*		*1.01*		*0.23*			
95% queue length	*0.68*		*9.51*		*0.88*			
Control Delay (s/veh)	*9.2*		*106.1*		*11.7*			
LOS	*A*		*F*		*B*			
Approach Delay (s/veh)	--	--	*67.9*					
Approach LOS	--	--	*F*					

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Intersection	*APD-40 WB @ Prop. Interchange*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp*

North/South Street: *Proposed Interchange*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*490*	*349*			*324*	*543*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*544*	*387*	*0*	*0*	*360*	*603*
Percent Heavy Vehicles	*3*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*68*		*53*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*75*	*0*	*58*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*544*		*75*		*58*			
C (m) (veh/h)	*704*		*39*		*843*			
v/c	*0.77*		*1.92*		*0.07*			
95% queue length	*7.44*		*8.01*		*0.22*			
Control Delay (s/veh)	*25.3*		*655.7*		*9.6*			
LOS	*D*		*F*		*A*			
Approach Delay (s/veh)	--	--	*374.0*					
Approach LOS	--	--	*F*					

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*AM Peak Period*		

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*	North/South Street: *S. Lee Hwy.*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*392*	*56*	*194*	*684*	
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*435*	*62*	*215*	*760*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*162*		*92*			
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*180*	*0*	*102*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*215*				*180*		*102*
C (m) (veh/h)		*1056*				*195*		*662*
v/c		*0.20*				*0.92*		*0.15*
95% queue length		*0.76*				*7.33*		*0.54*
Control Delay (s/veh)		*9.3*				*95.4*		*11.4*
LOS		*A*				*F*		*B*
Approach Delay (s/veh)	--	--				*65.0*		
Approach LOS	--	--				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*PM Peak Period*		

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*972*	*149*	*386*	*654*	
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*1080*	*165*	*428*	*726*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*187*		*123*			
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*207*	*0*	*136*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*428*				*207*		*136*
C (m) (veh/h)		*549*				*34*		*677*
v/c		*0.78*				*6.09*		*0.20*
95% queue length		*7.19*				*24.76*		*0.75*
Control Delay (s/veh)		*31.0*				*2521*		*11.6*
LOS		*D*				*F*		*B*
Approach Delay (s/veh)	*--*	*--*				*1526*		
Approach LOS	*--*	*--*				*F*		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Intersection	*APD-40 EB @ S. Lee Hwy.*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*623*	*87*	*320*	*1101*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*662*	*92*	*340*	*1171*	*0*
Percent Heavy Vehicles	*0*	--	--	*3*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*245*		*144*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*260*	*0*	*153*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*340*				*260*		*153*
C (m) (veh/h)		*845*				*64*		*505*
v/c		*0.40*				*4.06*		*0.30*
95% queue length		*1.96*				*27.98*		*1.27*
Control Delay (s/veh)		*12.1*				*1510*		*15.2*
LOS		*B*				*F*		*C*
Approach Delay (s/veh)	--	--				*956.4*		
Approach LOS	--	--				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2033*
Analysis Time Period	*PM Peak Period*		

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*	North/South Street: *S. Lee Hwy.*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*1532*	*252*	*605*	*1073*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*1629*	*268*	*643*	*1141*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*293*		*174*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*311*	*0*	*185*	*0*	*0*	*0*
Percent Heavy Vehicles	*3*	*0*	*3*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*643*				*311*		*185*
C (m) (veh/h)		*307*				*0*		*516*
v/c		*2.09*						*0.36*
95% queue length		*47.12*						*1.61*
Control Delay (s/veh)		*530.7*						*15.8*
LOS		*F*				*F*		*C*
Approach Delay (s/veh)	*--*	*--*						
Approach LOS	*--*	*--*						

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2013*
Analysis Time Period	*AM Peak Period*		

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp*	North/South Street: *S. Lee Hwy.*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*63*	*491*			*730*	*155*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*70*	*545*	*0*	*0*	*811*	*172*
Percent Heavy Vehicles	*3*	--	--	*3*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*148*		*252*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*164*	*0*	*280*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*70*		*164*		*280*			
C (m) (veh/h)	*692*		*404*		*762*			
v/c	*0.10*		*0.41*		*0.37*			
95% queue length	*0.34*		*1.93*		*1.70*			
Control Delay (s/veh)	*10.8*		*19.9*		*12.4*			
LOS	*B*		*C*		*B*			
Approach Delay (s/veh)	--	--	*15.2*					
Approach LOS	--	--	*C*					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Intersection	*APD-40 WB @ S. Lee Hwy.*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description *Proposed System W/O Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*152*	*1007*			*875*	*246*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*168*	*1118*	*0*	*0*	*972*	*273*
Percent Heavy Vehicles	*3*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*165*		*220*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*183*	*0*	*244*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*168*		*183*		*244*			
C (m) (veh/h)	*549*		*122*		*524*			
v/c	*0.31*		*1.50*		*0.47*			
95% queue length	*1.29*		*12.93*		*2.44*			
Control Delay (s/veh)	*14.4*		*327.5*		*17.7*			
LOS	*B*		*F*		*C*			
Approach Delay (s/veh)	--	--	*150.5*					
Approach LOS	--	--	*F*					

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2033*
Analysis Time Period	*AM Peak Period*		

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp*

North/South Street: *S. Lee Hwy.*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*99*	*769*			*1189*	*219*
Peak-Hour Factor, PHF	*0.94*	*0.94*	*0.90*	*0.90*	*0.94*	*0.94*
Hourly Flow Rate, HFR (veh/h)	*105*	*818*	*0*	*0*	*1264*	*232*
Percent Heavy Vehicles	*3*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*232*		*419*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.94*	*0.90*	*0.94*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*246*	*0*	*445*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*105*		*246*		*445*			
C (m) (veh/h)	*440*		*226*		*638*			
v/c	*0.24*		*1.09*		*0.70*			
95% queue length	*0.92*		*10.94*		*5.61*			
Control Delay (s/veh)	*15.7*		*131.4*		*22.6*			
LOS	*C*		*F*		*C*			
Approach Delay (s/veh)	*--*	*--*	*61.3*					
Approach LOS	*--*	*--*	*F*					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ S. Lee Hwy.*
Agency/Co.	*TDOT / Long Engineering*	Jurisdiction	*Cleveland, TN*
Date Performed	*05/04/2009*	Analysis Year	*2033*
Analysis Time Period	*PM Peak Period*		

Project Description *Proposed System Without Slip Ramp*

East/West Street: *APD-40 WB Off-Ramp*	North/South Street: *S. Lee Hwy.*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*238*	*1587*			*1419*	*364*
Peak-Hour Factor, PHF	*0.94*	*0.94*	*0.90*	*0.90*	*0.94*	*0.94*
Hourly Flow Rate, HFR (veh/h)	*253*	*1688*	*0*	*0*	*1509*	*387*
Percent Heavy Vehicles	*3*	*--*	*--*	*3*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*1*	*2*	*0*	*0*	*2*	*1*
Configuration	*L*	*T*			*T*	*R*
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*259*		*364*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.94*	*0.90*	*0.94*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*275*	*0*	*387*
Percent Heavy Vehicles	*3*	*0*	*3*	*3*	*0*	*3*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*L*		*L*		*R*			
v (veh/h)	*253*		*275*		*387*			
C (m) (veh/h)	*307*		*12*		*359*			
v/c	*0.82*		*22.92*		*1.08*			
95% queue length	*6.93*		*35.76*		*13.92*			
Control Delay (s/veh)	*54.1*		*10472*		*104.5*			
LOS	*F*		*F*		*F*			
Approach Delay (s/veh)	--	--	*4411*					
Approach LOS	--	--	*F*					

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Intersection	*APD-40 EB @ Prop Interchange*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description *Proposed System With Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *Proposed Interchange*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*235*	*61*	*79*	*231*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*250*	*64*	*84*	*245*	*0*
Percent Heavy Vehicles	*0*	*--*	*--*	*5*	*--*	*--*
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*264*		*118*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*280*	*0*	*125*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*84*				*280*		*125*
C (m) (veh/h)		*1222*				*576*		*918*
v/c		*0.07*				*0.49*		*0.14*
95% queue length		*0.22*				*2.65*		*0.47*
Control Delay (s/veh)		*8.2*				*17.0*		*9.5*
LOS		*A*				*C*		*A*
Approach Delay (s/veh)	--	--				*14.7*		
Approach LOS	--	--				*B*		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Intersection	*APD-40 EB @ Prop. Interchange*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2013*

Project Description *Proposed System With Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *Proposed Interchange*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*447*	*47*	*186*	*61*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*475*	*50*	*197*	*64*	*0*
Percent Heavy Vehicles	*0*	--	--	*5*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*84*		*57*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*89*	*0*	*60*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*197*				*89*		*60*
C (m) (veh/h)		*1017*				*468*		*1031*
v/c		*0.19*				*0.19*		*0.06*
95% queue length		*0.72*				*0.69*		*0.19*
Control Delay (s/veh)		*9.4*				*14.5*		*8.7*
LOS		*A*				*B*		*A*
Approach Delay (s/veh)	--	--				*12.2*		
Approach LOS	--	--				*B*		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*AM Peak Period*

Site Information

Intersection	*APD-40 EB @ Prop. Interchange*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description *Proposed System With Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *Proposed Interchange*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*372*	*96*	*123*	*371*	
Peak-Hour Factor, PHF	*0.90*	*0.94*	*0.94*	*0.94*	*0.94*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*395*	*102*	*130*	*394*	*0*
Percent Heavy Vehicles	*0*	--	--	*5*	--	--
Median Type	*Raised curb*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*1*	*1*	*2*	*0*
Configuration		*T*	*R*	*L*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*412*		*194*			
Peak-Hour Factor, PHF	*0.94*	*0.90*	*0.94*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*438*	*0*	*206*	*0*	*0*	*0*
Percent Heavy Vehicles	*5*	*0*	*5*	*0*	*0*	*0*
Percent Grade (%)	*0*			*0*		
Flared Approach		*Y*			*N*	
Storage		*2*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*				*L*		*R*
v (veh/h)		*130*				*438*		*206*
C (m) (veh/h)		*1042*				*406*		*833*
v/c		*0.12*				*1.08*		*0.25*
95% queue length		*0.43*				*14.97*		*0.97*
Control Delay (s/veh)		*8.9*				*99.6*		*10.7*
LOS		*A*				*F*		*B*
Approach Delay (s/veh)	--	--				*71.2*		
Approach LOS	--	--				*F*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*SKB*
Agency/Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Analysis Time Period	*PM Peak Period*

Site Information

Intersection	*APD-40 EB @ Prop. Interchange*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Project Description *Proposed System With Slip Ramp*

East/West Street: *APD-40 EB Off-Ramp*

North/South Street: *Proposed Interchange*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		708	74	291	101	
Peak-Hour Factor, PHF	0.90	0.94	0.94	0.94	0.94	0.90
Hourly Flow Rate, HFR (veh/h)	0	753	78	309	107	0
Percent Heavy Vehicles	0	--	--	5	--	--
Median Type	Raised curb					
RT Channelized			0			0
Lanes	0	2	1	1	2	0
Configuration		T	R	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	131		93			
Peak-Hour Factor, PHF	0.94	0.90	0.94	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	139	0	98	0	0	0
Percent Heavy Vehicles	5	0	5	0	0	0
Percent Grade (%)	0			0		
Flared Approach		Y			N	
Storage		2			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L				L		R
v (veh/h)		309				139		98
C (m) (veh/h)		778				254		1002
v/c		0.40				0.55		0.10
95% queue length		1.91				3.00		0.32
Control Delay (s/veh)		12.6				35.1		9.0
LOS		B				E		A
Approach Delay (s/veh)	--	--				24.3		
Approach LOS	--	--				C		

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Ramp Terminal
Signalized Intersections

Highway Capacity Software
Computer Printouts

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		1					2	1	1	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	194		326					538	44	156	789	
% Heavy Vehicles	3		3					3	3	3	3	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = 30.0	G = 0.0	G = 0.0	G = 0.0	G = 5.0	G = 31.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25

Cycle Length C = 80.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	206		347					572	47	166	839	
Lane Group Capacity	657		588					1361	608	374	1756	
v/c Ratio	0.31		0.59					0.42	0.08	0.44	0.48	
Green Ratio	0.38		0.38					0.39	0.39	0.51	0.50	
Uniform Delay d_1	17.7		20.1					17.9	15.5	11.3	13.1	
Delay Factor k	0.11		0.18					0.11	0.11	0.11	0.11	
Incremental Delay d_2	0.3		1.6					0.2	0.1	0.8	0.2	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	18.0		21.6					18.1	15.5	12.1	13.3	
Lane Group LOS	B		C					B	B	B	B	
Approach Delay	20.3						17.9			13.1		
Approach LOS	C						B			B		
Intersection Delay	16.3			Intersection LOS						B		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*206*		*347*					*572*	*47*	*166*	*839*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*729*	*1844*	
Capacity/Lane Group	*657*		*588*					*1361*	*608*	*374*	*1756*	
Flow Ratio	*0.1*		*0.2*					*0.2*	*0.0*	*0.2*	0.2	
v/c Ratio	*0.31*		*0.59*					*0.42*	*0.08*	*0.44*	*0.48*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*3.2*		*6.2*					*4.9*	*0.7*	*1.8*	*6.4*	
k_B	*0.5*		*0.5*					*0.5*	*0.5*	*0.4*	*0.6*	
Q_2	*0.2*		*0.7*					*0.4*	*0.0*	*0.3*	*0.6*	
Q Average	*3.5*		*6.8*					*5.3*	*0.7*	*2.1*	*7.0*	

Percentile Back of Queue (95th percentile)

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
$f_{B\%}$	*2.0*		*1.9*					*1.9*	*2.1*	*2.0*	*1.9*	
Back of Queue	*6.9*		*13.1*					*10.2*	*1.5*	*4.3*	*13.3*	

Queue Storage Ratio

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*1*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*157*		*326*					*980*	*78*	*316*	*754*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *25.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *22.0*	G = *29.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *90.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*167*		*347*					*1043*	*83*	*336*	*802*	
Lane Group Capacity	*487*		*436*					*1132*	*505*	*428*	*2146*	
v/c Ratio	*0.34*		*0.80*					*0.92*	*0.16*	*0.79*	*0.37*	
Green Ratio	*0.28*		*0.28*					*0.32*	*0.32*	*0.24*	*0.61*	
Uniform Delay d_1	*25.9*		*30.1*					*29.4*	*21.8*	*31.8*	*8.8*	
Delay Factor k	*0.11*		*0.34*					*0.44*	*0.11*	*0.33*	*0.11*	
Incremental Delay d_2	*0.4*		*9.9*					*12.2*	*0.2*	*9.3*	*0.1*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*26.4*		*40.0*					*41.6*	*22.0*	*41.1*	*8.9*	
Lane Group LOS	*C*		*D*					*D*	*C*	*D*	*A*	
Approach Delay	*35.6*						*40.1*			*18.4*		
Approach LOS	*D*						*D*			*B*		
Intersection Delay	*30.4*			Intersection LOS						*C*		

*HCS+*TM Version 5.3 Generated: 5/13/2009 10:09 AM

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*167*		*347*					*1043*	*83*	*336*	*802*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*1752*	*1844*	
Capacity/Lane Group	*487*		*436*					*1132*	*505*	*428*	*2146*	
Flow Ratio	*0.1*		*0.2*					*0.3*	*0.1*	*0.2*	0.2	
v/c Ratio	*0.34*		*0.80*					*0.92*	*0.16*	*0.79*	*0.37*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*3.3*		*8.0*					*13.2*	*1.5*	*7.9*	*5.3*	
k_B	*0.4*		*0.4*					*0.5*	*0.5*	*0.4*	*0.7*	
Q_2	*0.2*		*1.4*					*3.6*	*0.1*	*1.4*	*0.4*	
Q Average	*3.6*		*9.5*					*16.8*	*1.6*	*9.2*	*5.7*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*2.0*		*1.9*					*1.7*	*2.0*	*1.9*	*1.9*	
Back of Queue	*7.1*		*17.6*					*29.2*	*3.2*	*17.1*	*11.1*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 10:10 AM

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*1*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*303*		*510*					*841*	*69*	*244*	*1232*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = *36.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *12.0*	G = *28.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*322*		*543*					*895*	*73*	*260*	*1311*	
Lane Group Capacity	*701*		*627*					*1093*	*488*	*316*	*1717*	
v/c Ratio	*0.46*		*0.87*					*0.82*	*0.15*	*0.82*	*0.76*	
Green Ratio	*0.40*		*0.40*					*0.31*	*0.31*	*0.50*	*0.49*	
Uniform Delay d_1	*19.8*		*24.8*					*28.7*	*22.4*	*20.2*	*18.8*	
Delay Factor k	*0.11*		*0.40*					*0.36*	*0.11*	*0.36*	*0.32*	
Incremental Delay d_2	*0.5*		*12.2*					*5.0*	*0.1*	*15.9*	*2.1*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*20.3*		*37.0*					*33.7*	*22.5*	*36.2*	*20.9*	
Lane Group LOS	*C*		*D*					*C*	*C*	*D*	*C*	
Approach Delay	*30.8*						*32.8*			*23.4*		
Approach LOS	*C*						*C*			*C*		
Intersection Delay	*28.0*			Intersection LOS						*C*		

*HCS+*TM Version 5.3

Generated: 5/13/2009 10:11 AM

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*322*		*543*					*895*	*73*	*260*	*1311*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*631*	*1844*	
Capacity/Lane Group	*701*		*627*					*1093*	*488*	*316*	*1717*	
Flow Ratio	*0.2*		*0.3*					*0.3*	*0.0*	*0.4*	0.4	
v/c Ratio	*0.46*		*0.87*					*0.82*	*0.15*	*0.82*	*0.76*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*5.9*		*12.5*					*10.9*	*1.3*	*3.7*	*14.0*	
k_B	*0.6*		*0.5*					*0.5*	*0.4*	*0.3*	*0.6*	
Q_2	*0.5*		*2.7*					*1.9*	*0.1*	*1.3*	*2.0*	
Q Average	*6.4*		*15.1*					*12.8*	*1.4*	*5.0*	*16.0*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.9*		*1.8*					*1.8*	*2.1*	*2.0*	*1.7*	
Back of Queue	*12.3*		*26.6*					*23.0*	*2.9*	*9.7*	*27.9*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*2*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*303*		*510*					*841*	*69*	*244*	*1232*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *36.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *12.0*	G = *28.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*322*		*543*					*895*	*73*	*260*	*1311*	
Lane Group Capacity	*701*		*627*					*1093*	*488*	*454*	*1717*	
v/c Ratio	*0.46*		*0.87*					*0.82*	*0.15*	*0.57*	*0.76*	
Green Ratio	*0.40*		*0.40*					*0.31*	*0.31*	*0.13*	*0.49*	
Uniform Delay d_1	*19.8*		*24.8*					*28.7*	*22.4*	*36.6*	*18.8*	
Delay Factor k	*0.11*		*0.40*					*0.36*	*0.11*	*0.17*	*0.32*	
Incremental Delay d_2	*0.5*		*12.2*					*5.0*	*0.1*	*1.8*	*2.1*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*20.3*		*37.0*					*33.7*	*22.5*	*38.3*	*20.9*	
Lane Group LOS	*C*		*D*					*C*	*C*	*D*	*C*	
Approach Delay	*30.8*						*32.8*			*23.7*		
Approach LOS	*C*						*C*			*C*		
Intersection Delay	*28.1*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*322*		*543*					*895*	*73*	*260*	*1311*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*1752*	*1844*	
Capacity/Lane Group	*701*		*627*					*1093*	*488*	*454*	*1717*	
Flow Ratio	*0.2*		*0.3*					*0.3*	*0.0*	*0.1*	0.4	
v/c Ratio	*0.46*		*0.87*					*0.82*	*0.15*	*0.57*	*0.76*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*5.9*		*12.5*					*10.9*	*1.3*	*3.1*	*14.0*	
k_B	*0.6*		*0.5*					*0.5*	*0.4*	*0.3*	*0.6*	
Q_2	*0.5*		*2.7*					*1.9*	*0.1*	*0.4*	*2.0*	
Q Average	*6.4*		*15.1*					*12.8*	*1.4*	*3.5*	*16.0*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.9*		*1.8*					*1.8*	*2.1*	*2.0*	*1.7*	
Back of Queue	*12.3*		*26.6*					*23.0*	*2.9*	*7.0*	*27.9*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 10:14 AM

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		1					2	1	1	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	255		329					1543	113	454	1198	
% Heavy Vehicles	3		3					3	3	3	3	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = 27.0	G = 0.0	G = 0.0	G = 0.0	G = 28.0	G = 51.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 120.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	271		350					1641	120	483	1274	
Lane Group Capacity	394		353					1493	666	471	2429	
v/c Ratio	0.69		0.99					1.10	0.18	1.03	0.52	
Green Ratio	0.22		0.22					0.43	0.43	0.70	0.69	
Uniform Delay d_1	42.6		46.4					34.5	21.5	39.2	9.0	
Delay Factor k	0.26		0.49					0.50	0.11	0.50	0.13	
Incremental Delay d_2	5.0		45.5					55.4	0.1	48.1	0.2	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	47.6		91.9					89.9	21.6	87.3	9.2	
Lane Group LOS	D		F					F	C	F	A	
Approach Delay	72.6						85.2			30.7		
Approach LOS	E						F			C		
Intersection Delay	60.2			Intersection LOS						E		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*271*		*350*					*1641*	*120*	*483*	*1274*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*672*	*1844*	
Capacity/Lane Group	*394*		*353*					*1493*	*666*	*471*	*2429*	
Flow Ratio	*0.2*		*0.2*					*0.5*	*0.1*	*0.7*	0.4	
v/c Ratio	*0.69*		*0.99*					*1.10*	*0.18*	*1.03*	*0.52*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*8.3*		*11.6*					*28.7*	*2.5*	*6.3*	*10.8*	
k_B	*0.5*		*0.4*					*0.7*	*0.6*	*0.5*	*0.9*	
Q_2	*1.0*		*4.2*					*14.8*	*0.1*	*6.4*	*1.0*	
Q Average	*9.3*		*15.8*					*43.5*	*2.6*	*12.7*	*11.8*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.9*		*1.7*					*1.6*	*2.0*	*1.8*	*1.8*	
Back of Queue	*17.2*		*27.7*					*67.6*	*5.3*	*22.8*	*21.4*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 10:15 AM

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*2*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*255*		*329*					*1543*	*113*	*454*	*1198*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *28.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *18.0*	G = *50.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *110.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*271*		*350*					*1641*	*120*	*483*	*1274*	
Lane Group Capacity	*446*		*399*					*1596*	*713*	*557*	*2299*	
v/c Ratio	*0.61*		*0.88*					*1.03*	*0.17*	*0.87*	*0.55*	
Green Ratio	*0.25*		*0.25*					*0.45*	*0.45*	*0.16*	*0.65*	
Uniform Delay d_1	*36.2*		*39.3*					*30.0*	*17.7*	*44.8*	*10.3*	
Delay Factor k	*0.19*		*0.40*					*0.50*	*0.11*	*0.40*	*0.15*	
Incremental Delay d_2	*2.4*		*19.3*					*30.1*	*0.1*	*13.6*	*0.3*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*38.5*		*58.7*					*60.1*	*17.8*	*58.5*	*10.6*	
Lane Group LOS	*D*		*E*					*E*	*B*	*E*	*B*	
Approach Delay	*49.9*						*57.2*			*23.8*		
Approach LOS	*D*						*E*			*C*		
Intersection Delay	*41.9*			Intersection LOS						*D*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*271*		*350*					*1641*	*120*	*483*	*1274*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*1752*	*1844*	
Capacity/Lane Group	*446*		*399*					*1596*	*713*	*557*	*2299*	
Flow Ratio	*0.2*		*0.2*					*0.5*	*0.1*	*0.1*	0.4	
v/c Ratio	*0.61*		*0.88*					*1.03*	*0.17*	*0.87*	*0.55*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*7.3*		*10.3*					*26.3*	*2.2*	*7.4*	*11.1*	
k_B	*0.5*		*0.4*					*0.7*	*0.6*	*0.4*	*0.9*	
Q_2	*0.7*		*2.3*					*10.2*	*0.1*	*1.8*	*1.1*	
Q Average	*8.0*		*12.6*					*36.5*	*2.3*	*9.1*	*12.1*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*1.9*		*1.8*					*1.6*	*2.0*	*1.9*	*1.8*	
Back of Queue	*15.1*		*22.6*					*57.7*	*4.7*	*17.0*	*21.9*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 10:18 AM

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*1*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*142*		*129*	*211*	*521*			*803*	*154*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = *27.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *7.0*	G = *32.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*

Duration of Analysis (hrs) = *0.25*

Cycle Length C = *80.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*151*		*137*	*224*	*554*			*854*	*164*
Lane Group Capacity				*591*		*529*	*314*	*1888*			*1405*	*627*
v/c Ratio				*0.26*		*0.26*	*0.71*	*0.29*			*0.61*	*0.26*
Green Ratio				*0.34*		*0.34*	*0.55*	*0.54*			*0.40*	*0.40*
Uniform Delay d_1				*19.2*		*19.2*	*11.8*	*10.2*			*19.0*	*16.1*
Delay Factor k				*0.11*		*0.11*	*0.28*	*0.11*			*0.19*	*0.11*
Incremental Delay d_2				*0.2*		*0.3*	*7.5*	*0.1*			*0.8*	*0.2*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*19.4*		*19.5*	*19.2*	*10.2*			*19.8*	*16.3*
Lane Group LOS				*B*		*B*	*B*	*B*			*B*	*B*
Approach Delay				*19.5*			*12.8*			*19.2*		
Approach LOS				*B*			*B*			*B*		
Intersection Delay	*16.9*			Intersection LOS						*B*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*151*		*137*	*224*	*554*			*854*	*164*
Satflow/Lane				*1752*		*1568*	*572*	*1844*			*1844*	*1568*
Capacity/Lane Group				*591*		*529*	*314*	*1888*			*1405*	*627*
Flow Ratio				*0.1*		*0.1*	*0.4*	*0.2*			0.2	*0.1*
v/c Ratio				*0.26*		*0.26*	*0.71*	*0.29*			*0.61*	*0.26*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*2.4*		*2.2*	*2.4*	*3.5*			*7.9*	*2.4*
k_B				*0.5*		*0.4*	*0.3*	*0.6*			*0.5*	*0.5*
Q_2				*0.2*		*0.2*	*0.7*	*0.3*			*0.8*	*0.2*
Q Average				*2.6*		*2.4*	*3.1*	*3.8*			*8.7*	*2.6*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.0*		*2.0*	*2.0*	*2.0*			*1.9*	*2.0*
Back of Queue				*5.2*		*4.8*	*6.3*	*7.5*			*16.3*	*5.3*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 10:23 AM

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*1*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*133*		*112*	*347*	*790*			*937*	*223*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = *19.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *18.0*	G = *29.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *80.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*141*		*119*	*369*	*840*			*997*	*237*
Lane Group Capacity				*416*		*372*	*486*	*2239*			*1273*	*568*
v/c Ratio				*0.34*		*0.32*	*0.76*	*0.38*			*0.78*	*0.42*
Green Ratio				*0.24*		*0.24*	*0.65*	*0.64*			*0.36*	*0.36*
Uniform Delay d_1				*25.3*		*25.2*	*18.3*	*6.9*			*22.7*	*19.2*
Delay Factor k				*0.11*		*0.11*	*0.31*	*0.11*			*0.33*	*0.11*
Incremental Delay d_2				*0.5*		*0.5*	*6.9*	*0.1*			*3.3*	*0.5*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*25.8*		*25.7*	*25.2*	*7.0*			*26.0*	*19.7*
Lane Group LOS				*C*		*C*	*C*	*A*			*C*	*B*
Approach Delay				*25.7*			*12.6*			*24.8*		
Approach LOS				*C*			*B*			*C*		
Intersection Delay	*19.4*			Intersection LOS						*B*		

HCS+^{TM} Version 5.3

Generated: 5/13/2009 10:24 AM

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*141*		*119*	*369*	*840*			*997*	*237*
Satflow/Lane				*1752*		*1568*	*748*	*1844*			*1844*	*1568*
Capacity/Lane Group				*416*		*372*	*486*	*2239*			*1273*	*568*
Flow Ratio				*0.1*		*0.1*	*0.5*	*0.2*			0.3	*0.2*
v/c Ratio				*0.34*		*0.32*	*0.76*	*0.38*			*0.78*	*0.42*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*2.6*		*2.2*	*3.5*	*4.7*			*10.3*	*4.0*
k_B				*0.4*		*0.4*	*0.4*	*0.7*			*0.5*	*0.5*
Q_2				*0.2*		*0.2*	*1.2*	*0.4*			*1.7*	*0.3*
Q Average				*2.8*		*2.3*	*4.7*	*5.1*			*12.0*	*4.3*
Percentile Back of Queue (95th percentile)												
$f_{B\%}$				*2.0*		*2.0*	*2.0*	*2.0*			*1.8*	*2.0*
Back of Queue				*5.6*		*4.8*	*9.2*	*9.9*			*21.7*	*8.4*
Queue Storage Ratio												
Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 10:25 AM

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*1*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*222*		*201*	*329*	*815*			*1254*	*227*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = *26.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *24.0*	G = *46.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*

Duration of Analysis (hrs) = *0.25*

Cycle Length C = *110.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*236*		*214*	*350*	*867*			*1334*	*241*
Lane Group Capacity				*414*		*371*	*449*	*2363*			*1469*	*656*
v/c Ratio				*0.57*		*0.58*	*0.78*	*0.37*			*0.91*	*0.37*
Green Ratio				*0.24*		*0.24*	*0.68*	*0.67*			*0.42*	*0.42*
Uniform Delay d_1				*37.1*		*37.1*	*30.7*	*7.8*			*30.0*	*22.0*
Delay Factor k				*0.16*		*0.17*	*0.33*	*0.11*			*0.43*	*0.11*
Incremental Delay d_2				*1.9*		*2.2*	*8.6*	*0.1*			*8.6*	*0.4*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*38.9*		*39.4*	*39.2*	*7.9*			*38.6*	*22.3*
Lane Group LOS				*D*		*D*	*D*	*A*			*D*	*C*
Approach Delay				*39.1*			*16.9*			*36.1*		
Approach LOS				*D*			*B*			*D*		
Intersection Delay	*29.3*			Intersection LOS						*C*		

HCS+™ Version 5.3

Generated: 5/13/2009 10:29 AM

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*236*		*214*	*350*	*867*			*1334*	*241*
Satflow/Lane				*1752*		*1568*	*659*	*1844*			*1844*	*1568*
Capacity/Lane Group				*414*		*371*	*449*	*2363*			*1469*	*656*
Flow Ratio				*0.1*		*0.1*	*0.5*	*0.2*			0.4	*0.2*
v/c Ratio				*0.57*		*0.58*	*0.78*	*0.37*			*0.91*	*0.37*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*6.4*		*5.8*	*4.1*	*6.0*			*20.1*	*5.1*
k_B				*0.5*		*0.4*	*0.5*	*0.9*			*0.7*	*0.6*
Q_2				*0.6*		*0.6*	*1.5*	*0.5*			*4.4*	*0.3*
Q Average				*7.0*		*6.3*	*5.6*	*6.5*			*24.5*	*5.4*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*1.9*		*1.9*	*1.9*	*1.9*			*1.7*	*1.9*
Back of Queue				*13.3*		*12.2*	*10.9*	*12.6*			*40.4*	*10.5*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 10:30 AM

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*2*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*222*		*201*	*329*	*815*			*1254*	*227*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = *26.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *24.0*	G = *46.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *110.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*236*		*214*	*350*	*867*			*1334*	*241*
Lane Group Capacity				*414*		*371*	*742*	*2363*			*1469*	*656*
v/c Ratio				*0.57*		*0.58*	*0.47*	*0.37*			*0.91*	*0.37*
Green Ratio				*0.24*		*0.24*	*0.22*	*0.67*			*0.42*	*0.42*
Uniform Delay d_1				*37.1*		*37.1*	*37.5*	*7.8*			*30.0*	*22.0*
Delay Factor k				*0.16*		*0.17*	*0.11*	*0.11*			*0.43*	*0.11*
Incremental Delay d_2				*1.9*		*2.2*	*0.5*	*0.1*			*8.6*	*0.4*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*38.9*		*39.4*	*38.0*	*7.9*			*38.6*	*22.3*
Lane Group LOS				*D*		*D*	*D*	*A*			*D*	*C*
Approach Delay				*39.1*			*16.6*			*36.1*		
Approach LOS				*D*			*B*			*D*		
Intersection Delay	*29.2*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*236*		*214*	*350*	*867*			*1334*	*241*
Satflow/Lane				*1752*		*1568*	*1752*	*1844*			*1844*	*1568*
Capacity/Lane Group				*414*		*371*	*742*	*2363*			*1469*	*656*
Flow Ratio				*0.1*		*0.1*	*0.1*	*0.2*			0.4	*0.2*
v/c Ratio				*0.57*		*0.58*	*0.47*	*0.37*			*0.91*	*0.37*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*6.4*		*5.8*	*4.8*	*6.0*			*20.1*	*5.1*
k_B				*0.5*		*0.4*	*0.4*	*0.9*			*0.7*	*0.6*
Q_2				*0.6*		*0.6*	*0.4*	*0.5*			*4.4*	*0.3*
Q Average				*7.0*		*6.3*	*5.2*	*6.5*			*24.5*	*5.4*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*1.9*		*1.9*	*2.0*	*1.9*			*1.7*	*1.9*
Back of Queue				*13.3*		*12.2*	*10.1*	*12.6*			*40.4*	*10.5*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*1*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*196*		*167*	*552*	*1246*			*1456*	*362*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = *17.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *32.0*	G = *47.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *110.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*209*		*178*	*587*	*1326*			*1549*	*385*
Lane Group Capacity				*271*		*242*	*577*	*2650*			*1501*	*670*
v/c Ratio				*0.77*		*0.74*	*1.02*	*0.50*			*1.03*	*0.57*
Green Ratio				*0.15*		*0.15*	*0.76*	*0.75*			*0.43*	*0.43*
Uniform Delay d_1				*44.6*		*44.4*	*15.1*	*5.3*			*31.5*	*23.9*
Delay Factor k				*0.32*		*0.29*	*0.50*	*0.11*			*0.50*	*0.17*
Incremental Delay d_2				*12.8*		*11.1*	*41.9*	*0.1*			*31.9*	*1.2*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*57.4*		*55.5*	*57.0*	*5.5*			*63.4*	*25.1*
Lane Group LOS				*E*		*E*	*E*	*A*			*E*	*C*
Approach Delay				*56.5*			*21.3*			*55.8*		
Approach LOS				*E*			*C*			*E*		
Intersection Delay	*40.2*			Intersection LOS						*D*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*209*		*178*	*587*	*1326*			*1549*	*385*
Satflow/Lane				*1752*		*1568*	*755*	*1844*			*1844*	*1568*
Capacity/Lane Group				*271*		*242*	*577*	*2650*			*1501*	*670*
Flow Ratio				*0.1*		*0.1*	*0.8*	*0.4*			0.4	*0.2*
v/c Ratio				*0.77*		*0.74*	*1.02*	*0.50*			*1.03*	*0.57*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*6.1*		*5.2*	*6.0*	*8.4*			*24.8*	*8.9*
k_B				*0.4*		*0.3*	*0.6*	*0.9*			*0.7*	*0.6*
Q_2				*1.1*		*0.8*	*7.0*	*0.9*			*10.0*	*0.8*
Q Average				*7.2*		*6.0*	*13.0*	*9.3*			*34.8*	*9.7*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*1.9*		*1.9*	*1.8*	*1.9*			*1.6*	*1.8*
Back of Queue				*13.7*		*11.6*	*23.3*	*17.3*			*55.3*	*18.0*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*2*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*196*		*167*	*552*	*1246*			*1456*	*362*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = *18.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *22.0*	G = *46.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *100.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*209*		*178*	*587*	*1326*			*1549*	*385*
Lane Group Capacity				*315*		*282*	*749*	*2529*			*1616*	*721*
v/c Ratio				*0.66*		*0.63*	*0.78*	*0.52*			*0.96*	*0.53*
Green Ratio				*0.18*		*0.18*	*0.22*	*0.72*			*0.46*	*0.46*
Uniform Delay d_1				*38.2*		*37.9*	*36.8*	*6.3*			*26.1*	*19.3*
Delay Factor k				*0.24*		*0.21*	*0.33*	*0.13*			*0.47*	*0.14*
Incremental Delay d_2				*5.2*		*4.5*	*5.5*	*0.2*			*13.8*	*0.8*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*43.4*		*42.4*	*42.2*	*6.5*			*39.9*	*20.1*
Lane Group LOS				*D*		*D*	*D*	*A*			*D*	*C*
Approach Delay				*42.9*			*17.5*			*36.0*		
Approach LOS				*D*			*B*			*D*		
Intersection Delay	*28.2*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*209*		*178*	*587*	*1326*			*1549*	*385*
Satflow/Lane				*1752*		*1568*	*1752*	*1844*			*1844*	*1568*
Capacity/Lane Group				*315*		*282*	*749*	*2529*			*1616*	*721*
Flow Ratio				*0.1*		*0.1*	*0.2*	*0.4*			0.4	*0.2*
v/c Ratio				*0.66*		*0.63*	*0.78*	*0.52*			*0.96*	*0.53*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*5.4*		*4.6*	*7.9*	*8.7*			*21.8*	*7.7*
k_B				*0.4*		*0.3*	*0.4*	*0.9*			*0.7*	*0.6*
Q_2				*0.7*		*0.6*	*1.3*	*0.9*			*6.3*	*0.7*
Q Average				*6.1*		*5.1*	*9.2*	*9.6*			*28.1*	*8.3*
Percentile Back of Queue (95th percentile)												
$f_{B\%}$				*1.9*		*2.0*	*1.9*	*1.9*			*1.6*	*1.9*
Back of Queue				*11.7*		*10.0*	*17.2*	*17.8*			*45.7*	*15.7*
Queue Storage Ratio												
Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ I-75 NB Off-Ramp*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*	*1*			*1*		*1*					
Lane Group	*L*	*T*			*T*		*L*					
Volume (vph)	*22*	*360*			*1275*		*50*					
% Heavy Vehicles	*15*	*15*			*15*		*15*					
PHF	*0.94*	*0.94*			*0.94*		*0.94*					
Pretimed/Actuated (P/A)	*A*	*A*			*A*		*A*					
Startup Lost Time	*2.0*	*2.0*			*2.0*		*2.0*					
Extension of Effective Green	*2.0*	*2.0*			*2.0*		*2.0*					
Arrival Type	*3*	*3*			*3*		*3*					
Unit Extension	*3.0*	*3.0*			*3.0*		*3.0*					
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*		*0*	*0*				
Lane Width	*12.0*	*12.0*			*12.0*		*12.0*					
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*			
Parking/Hour												
Bus Stops/Hour	*0*	*0*			*0*		*0*					
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*				

Phasing	EB Only	EW Perm	03	04	NB Only	06	07	08
Timing	G = *5.0*	G = *84.0*	G = *0.0*	G = *0.0*	G = *7.0*	G = *0.0*	G = *0.0*	G = *0.0*
	Y = *4*	Y = *5*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y = *0*

Duration of Analysis (hrs) = *0.25*

Cycle Length C = *110.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*23*	*383*			*1356*		*53*					
Lane Group Capacity	*299*	*1397*			*1262*		*100*					
v/c Ratio	*0.08*	*0.27*			*1.07*		*0.53*					
Green Ratio	*0.85*	*0.85*			*0.76*		*0.06*					
Uniform Delay d_1	*2.8*	*1.7*			*13.0*		*49.9*					
Delay Factor k	*0.11*	*0.11*			*0.50*		*0.13*					
Incremental Delay d_2	*0.1*	*0.1*			*47.9*		*5.3*					
PF Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Control Delay	*2.9*	*1.8*			*60.9*		*55.2*					
Lane Group LOS	*A*	*A*			*E*		*E*					
Approach Delay	*1.9*			*60.9*			*55.2*					
Approach LOS	*A*			*E*			*E*					
Intersection Delay	*47.5*			Intersection LOS						*D*		

INITIAL QUEUE DELAY WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Input Parameters

Period (i) *AM Peak Period*

Duration, T *0.25 h*

Cycle Length, C *110.0 s*

	EB			WB			NB			SB		
Lane Group	*L*	*T*			*T*		*L*					
Initial Queue, Q_b (veh)	*0.0*	*0.0*			*0.0*		*0.0*					
Green Ratio, g/C	*0.85*	*0.85*			*0.76*		*0.06*					
v/c Ratio, X (X = v/c)	*0.08*	*0.27*			*1.07*		*0.53*					
Adjusted Lane Group Capacity, c (veh/h)	*299*	*1397*			*1262*		*100*					
Duration of Unmet Demand in T (h)	*0.00*	*0.00*			*0.00*		*0.00*					
Case	*I*	*I*			*II*		*I*					
Cases I and II (Q_b = 0)												
Initial Queue Delay, d_3 = 0, and Uniform Delay, $d_{1,}$ is as shown on Capacity and LOS Worksheet												
Case III (Q_b > 0) (X <= 1.0) (t < T)												
Initial Queue Delay, d_3 (s)												
Uniform Delay, d_1 (s)												
Case IV (Q_b > 0) (X <= 1.0) (t = T)												
Delay Parameter, u												
Initial Queue Delay, d_3 (s)												
Uniform Delay												
Case V (Q_b > 0) (X > 1.0) (t = T)												
Initial Queue Delay, d_3 (s)												
Uniform Delay, d_1 (s)												

SHORT REPORT

General Information

Analyst *SKB*
Agency or Co. *TDOT / Long Engineering*
Date Performed *05/04/2009*
Time Period *AM Peak Period*

Site Information

Intersection *APD-40 @ I-75 NB Off-Ramp*
Area Type *All other areas*
Jurisdiction *Cleveland, TN*
Analysis Year *2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*	*2*			*2*		*2*					
Lane Group	*L*	*T*			*T*		*L*					
Volume (vph)	*22*	*360*			*1275*		*50*					
% Heavy Vehicles	*15*	*15*			*15*		*15*					
PHF	*0.94*	*0.94*			*0.94*		*0.94*					
Pretimed/Actuated (P/A)	*A*	*A*			*A*		*A*					
Startup Lost Time	*2.0*	*2.0*			*2.0*		*2.0*					
Extension of Effective Green	*2.0*	*2.0*			*2.0*		*2.0*					
Arrival Type	*3*	*3*			*3*		*3*					
Unit Extension	*3.0*	*3.0*			*3.0*		*3.0*					
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*		*0*	*0*				
Lane Width	*12.0*	*12.0*			*12.0*		*12.0*					
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*			
Parking/Hour												
Bus Stops/Hour	*0*	*0*			*0*		*0*					
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*				

Phasing	EB Only	EW Perm	03	04	NB Only	06	07	08
Timing	G = *5.0*	G = *41.0*	G = *0.0*	G = *0.0*	G = *20.0*	G = *0.0*	G = *0.0*	G = *0.0*
	Y = *4*	Y = *5*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *80.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*23*	*383*			*1356*		*53*					
Lane Group Capacity	*188*	*1966*			*1612*		*762*					
v/c Ratio	*0.12*	*0.19*			*0.84*		*0.07*					
Green Ratio	*0.64*	*0.63*			*0.51*		*0.25*					
Uniform Delay d_1	*9.7*	*6.4*			*16.7*		*22.9*					
Delay Factor k	*0.11*	*0.11*			*0.38*		*0.11*					
Incremental Delay d_2	*0.3*	*0.0*			*4.2*		*0.0*					
PF Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Control Delay	*10.0*	*6.5*			*20.9*		*22.9*					
Lane Group LOS	*B*	*A*			*C*		*C*					
Approach Delay	*6.7*			*20.9*			*22.9*					
Approach LOS	*A*			*C*			*C*					
Intersection Delay	*17.8*			Intersection LOS						*B*		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*	*T*			*T*		*L*					
Initial Queue/Lane	*0.0*	*0.0*			*0.0*		*0.0*					
Flow Rate/Lane Group	*23*	*383*			*1356*		*53*					
Satflow/Lane	*287*	*1652*			*1652*		*1570*					
Capacity/Lane Group	*188*	*1966*			*1612*		*762*					
Flow Ratio	*0.1*	*0.1*			*0.4*		*0.0*					
v/c Ratio	*0.12*	*0.19*			*0.84*		*0.07*					
I Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Arrival Type	*3*	*3*			*3*		*3*					
Platoon Ratio	*1.00*	*1.00*			*1.00*		*1.00*					
PF Factor	*1.00*	*1.00*			*1.00*		*1.00*					
Q_1	*0.2*	*1.9*			*13.6*		*0.5*					
k_B	*0.2*	*0.7*			*0.6*		*0.4*					
Q_2	*0.0*	*0.2*			*2.7*		*0.0*					
Q Average	*0.2*	*2.1*			*16.2*		*0.5*					

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.1*	*2.0*			*1.7*		*2.1*					
Back of Queue	*0.5*	*4.2*			*28.3*		*1.0*					

Queue Storage Ratio

Queue Spacing	*25.0*	*25.0*			*25.0*		*25.0*					
Queue Storage	*0*	*0*			*0*		*0*					
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ I-75 NB Off-Ramp*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*	*1*			*1*		*1*					
Lane Group	*L*	*T*			*T*		*L*					
Volume (vph)	*28*	*137*			*990*		*79*					
% Heavy Vehicles	*15*	*15*			*15*		*15*					
PHF	*0.90*	*0.90*			*0.90*		*0.90*					
Pretimed/Actuated (P/A)	*A*	*A*			*A*		*A*					
Startup Lost Time	*2.0*	*2.0*			*2.0*		*2.0*					
Extension of Effective Green	*2.0*	*2.0*			*2.0*		*2.0*					
Arrival Type	*3*	*3*			*3*		*3*					
Unit Extension	*3.0*	*3.0*			*3.0*		*3.0*					
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*		*0*	*0*				
Lane Width	*12.0*	*12.0*			*12.0*		*12.0*					
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*			
Parking/Hour												
Bus Stops/Hour	*0*	*0*			*0*		*0*					
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*				

Phasing	EB Only	EW Perm	03	04	NB Only	06	07	08
Timing	G = *5.0*	G = *61.0*	G = *0.0*	G = *0.0*	G = *10.0*	G = *0.0*	G = *0.0*	G = *0.0*
	Y = *4*	Y = *5*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*31*	*152*			*1100*		*88*					
Lane Group Capacity	*325*	*1285*			*1120*		*174*					
v/c Ratio	*0.10*	*0.12*			*0.98*		*0.51*					
Green Ratio	*0.79*	*0.78*			*0.68*		*0.11*					
Uniform Delay d_1	*4.1*	*2.4*			*14.0*		*37.7*					
Delay Factor k	*0.11*	*0.11*			*0.49*		*0.11*					
Incremental Delay d_2	*0.1*	*0.0*			*22.6*		*2.4*					
PF Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Control Delay	*4.2*	*2.5*			*36.5*		*40.1*					
Lane Group LOS	*A*	*A*			*D*		*D*					
Approach Delay	*2.8*			*36.5*			*40.1*					
Approach LOS	*A*			*D*			*D*					
Intersection Delay	*32.3*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*	*T*			*T*		*L*					
Initial Queue/Lane	*0.0*	*0.0*			*0.0*		*0.0*					
Flow Rate/Lane Group	*31*	*152*			*1100*		*88*					
Satflow/Lane	*413*	*1652*			*1652*		*1570*					
Capacity/Lane Group	*325*	*1285*			*1120*		*174*					
Flow Ratio	*0.1*	*0.1*			*0.7*		*0.1*					
v/c Ratio	*0.10*	*0.12*			*0.98*		*0.51*					
I Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Arrival Type	*3*	*3*			*3*		*3*					
Platoon Ratio	*1.00*	*1.00*			*1.00*		*1.00*					
PF Factor	*1.00*	*1.00*			*1.00*		*1.00*					
Q_1	*0.2*	*0.9*			*26.5*		*2.1*					
k_B	*0.3*	*0.8*			*0.7*		*0.2*					
Q_2	*0.0*	*0.1*			*8.9*		*0.2*					
Q Average	*0.2*	*1.0*			*35.4*		*2.3*					

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.1*	*2.1*			*1.6*		*2.0*					
Back of Queue	*0.4*	*2.1*			*56.1*		*4.7*					

Queue Storage Ratio

Queue Spacing	*25.0*	*25.0*			*25.0*		*25.0*					
Queue Storage	*0*	*0*			*0*		*0*					
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 @ I-75 NB Off-Ramp*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*	*2*			*2*		*2*					
Lane Group	*L*	*T*			*T*		*L*					
Volume (vph)	*28*	*137*			*990*		*79*					
% Heavy Vehicles	*15*	*15*			*15*		*15*					
PHF	*0.90*	*0.90*			*0.90*		*0.90*					
Pretimed/Actuated (P/A)	*A*	*A*			*A*		*A*					
Startup Lost Time	*2.0*	*2.0*			*2.0*		*2.0*					
Extension of Effective Green	*2.0*	*2.0*			*2.0*		*2.0*					
Arrival Type	*3*	*3*			*3*		*3*					
Unit Extension	*3.0*	*3.0*			*3.0*		*3.0*					
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*		*0*	*0*				
Lane Width	*12.0*	*12.0*			*12.0*		*12.0*					
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*			
Parking/Hour												
Bus Stops/Hour	*0*	*0*			*0*		*0*					
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*				

Phasing	EB Only	EW Perm	03	04	NB Only	06	07	08
Timing	G = *5.0*	G = *37.0*	G = *0.0*	G = *0.0*	G = *24.0*	G = *0.0*	G = *0.0*	G = *0.0*
	Y = *4*	Y = *5*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *80.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*31*	*152*			*1100*		*88*					
Lane Group Capacity	*215*	*1809*			*1455*		*914*					
v/c Ratio	*0.14*	*0.08*			*0.76*		*0.10*					
Green Ratio	*0.59*	*0.57*			*0.46*		*0.30*					
Uniform Delay d_1	*9.7*	*7.6*			*17.8*		*20.2*					
Delay Factor k	*0.11*	*0.11*			*0.31*		*0.11*					
Incremental Delay d_2	*0.3*	*0.0*			*2.3*		*0.0*					
PF Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Control Delay	*10.0*	*7.6*			*20.1*		*20.2*					
Lane Group LOS	*B*	*A*			*C*		*C*					
Approach Delay	*8.0*			*20.1*			*20.2*					
Approach LOS	*A*			*C*			*C*					
Intersection Delay	*18.5*			Intersection LOS						*B*		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*	*T*			*T*		*L*					
Initial Queue/Lane	*0.0*	*0.0*			*0.0*		*0.0*					
Flow Rate/Lane Group	*31*	*152*			*1100*		*88*					
Satflow/Lane	*365*	*1652*			*1652*		*1570*					
Capacity/Lane Group	*215*	*1809*			*1455*		*914*					
Flow Ratio	*0.1*	*0.0*			*0.3*		*0.0*					
v/c Ratio	*0.14*	*0.08*			*0.76*		*0.10*					
I Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Arrival Type	*3*	*3*			*3*		*3*					
Platoon Ratio	*1.00*	*1.00*			*1.00*		*1.00*					
PF Factor	*1.00*	*1.00*			*1.00*		*1.00*					
Q_1	*0.3*	*0.8*			*10.6*		*0.7*					
k_B	*0.3*	*0.6*			*0.5*		*0.4*					
Q_2	*0.0*	*0.1*			*1.6*		*0.0*					
Q Average	*0.3*	*0.8*			*12.2*		*0.8*					

Percentile Back of Queue (95th percentile)

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
$f_{B\%}$	*2.1*	*2.1*			*1.8*		*2.1*					
Back of Queue	*0.7*	*1.7*			*22.0*		*1.6*					

Queue Storage Ratio

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Queue Spacing	*25.0*	*25.0*			*25.0*		*25.0*					
Queue Storage	*0*	*0*			*0*		*0*					
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 @ I-75 NB Off-Ramp*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*	*1*			*1*		*1*					
Lane Group	*L*	*T*			*T*		*L*					
Volume (vph)	*35*	*560*			*1957*		*78*					
% Heavy Vehicles	*15*	*15*			*15*		*15*					
PHF	*0.94*	*0.94*			*0.94*		*0.94*					
Pretimed/Actuated (P/A)	*A*	*A*			*A*		*A*					
Startup Lost Time	*2.0*	*2.0*			*2.0*		*2.0*					
Extension of Effective Green	*2.0*	*2.0*			*2.0*		*2.0*					
Arrival Type	*3*	*3*			*3*		*3*					
Unit Extension	*3.0*	*3.0*			*3.0*		*3.0*					
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*		*0*	*0*				
Lane Width	*12.0*	*12.0*			*12.0*		*12.0*					
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*			
Parking/Hour												
Bus Stops/Hour	*0*	*0*			*0*		*0*					
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*				

Phasing	EB Only	EW Perm	03	04	NB Only	06	07	08
Timing	G = *5.0*	G = *96.0*	G = *0.0*	G = *0.0*	G = *5.0*	G = *0.0*	G = *0.0*	G = *0.0*
	Y = *4*	Y = *5*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *120.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*37*	*596*			*2082*		*83*					
Lane Group Capacity	*179*	*1446*			*1322*		*65*					
v/c Ratio	*0.21*	*0.41*			*1.57*		*1.28*					
Green Ratio	*0.88*	*0.88*			*0.80*		*0.04*					
Uniform Delay d_1	*3.6*	*1.5*			*12.0*		*57.5*					
Delay Factor k	*0.11*	*0.11*			*0.50*		*0.50*					
Incremental Delay d_2	*0.6*	*0.2*			*262.4*		*203.0*					
PF Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Control Delay	*4.1*	*1.7*			*274.4*		*260.5*					
Lane Group LOS	*A*	*A*			*F*		*F*					
Approach Delay	*1.8*			*274.4*			*260.5*					
Approach LOS	*A*			*F*			*F*					
Intersection Delay	*212.3*			Intersection LOS						*F*		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp [1NBL]*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*	*T*			*T*		*L*					
Initial Queue/Lane	*0.0*	*0.0*			*0.0*		*0.0*					
Flow Rate/Lane Group	*37*	*596*			*2082*		*83*					
Satflow/Lane	*204*	*1652*			*1652*		*1570*					
Capacity/Lane Group	*179*	*1446*			*1322*		*65*					
Flow Ratio	*0.2*	*0.4*			*1.3*		*0.1*					
v/c Ratio	*0.21*	*0.41*			*1.57*		*1.28*					
I Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Arrival Type	*3*	*3*			*3*		*3*					
Platoon Ratio	*1.00*	*1.00*			*1.00*		*1.00*					
PF Factor	*1.00*	*1.00*			*1.00*		*1.00*					
Q_1	*0.1*	*3.9*			*69.4*		*2.8*					
k_B	*0.3*	*1.0*			*1.0*		*0.2*					
Q_2	*0.1*	*0.7*			*97.6*		*2.8*					
Q Average	*0.2*	*4.6*			*167.0*		*5.6*					

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.1*	*2.0*			*1.5*		*1.9*					
Back of Queue	*0.5*	*9.0*			*250*		*10.9*					

Queue Storage Ratio

Queue Spacing	*25.0*	*25.0*			*25.0*		*25.0*					
Queue Storage	*0*	*0*			*0*		*0*					
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+™ Version 5.3

Generated: 5/13/2009 11:04 AM

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ I-75 NB Off-Ramp*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*	*2*			*2*		*2*					
Lane Group	*L*	*T*			*T*		*L*					
Volume (vph)	*35*	*560*			*1957*		*78*					
% Heavy Vehicles	*15*	*15*			*15*		*15*					
PHF	*0.94*	*0.94*			*0.94*		*0.94*					
Pretimed/Actuated (P/A)	*A*	*A*			*A*		*A*					
Startup Lost Time	*2.0*	*2.0*			*2.0*		*2.0*					
Extension of Effective Green	*2.0*	*2.0*			*2.0*		*2.0*					
Arrival Type	*3*	*3*			*3*		*3*					
Unit Extension	*3.0*	*3.0*			*3.0*		*3.0*					
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*		*0*	*0*				
Lane Width	*12.0*	*12.0*			*12.0*		*12.0*					
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*			
Parking/Hour												
Bus Stops/Hour	*0*	*0*			*0*		*0*					
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*				

Phasing	EB Only	EW Perm	03	04	NB Only	06	07	08
Timing	G = *5.0*	G = *66.0*	G = *0.0*	G = *0.0*	G = *15.0*	G = *0.0*	G = *0.0*	G = *0.0*
	Y = *4*	Y = *5*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *100.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*37*	*596*			*2082*		*83*					
Lane Group Capacity	*151*	*2360*			*2076*		*457*					
v/c Ratio	*0.25*	*0.25*			*1.00*		*0.18*					
Green Ratio	*0.76*	*0.75*			*0.66*		*0.15*					
Uniform Delay d_1	*18.4*	*3.9*			*17.0*		*37.1*					
Delay Factor k	*0.11*	*0.11*			*0.50*		*0.11*					
Incremental Delay d_2	*0.8*	*0.1*			*20.4*		*0.2*					
PF Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Control Delay	*19.2*	*3.9*			*37.4*		*37.3*					
Lane Group LOS	*B*	*A*			*D*		*D*					
Approach Delay	*4.8*			*37.4*			*37.3*					
Approach LOS	*A*			*D*			*D*					
Intersection Delay	*30.1*			Intersection LOS						*C*		

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Generated: 5/13/2009 2:57 PM

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp [2NBL]*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*	*T*			*T*		*L*					
Initial Queue/Lane	*0.0*	*0.0*			*0.0*		*0.0*					
Flow Rate/Lane Group	*37*	*596*			*2082*		*83*					
Satflow/Lane	*190*	*1652*			*1652*		*1570*					
Capacity/Lane Group	*151*	*2360*			*2076*		*457*					
Flow Ratio	*0.2*	*0.2*			*0.7*		*0.0*					
v/c Ratio	*0.25*	*0.25*			*1.00*		*0.18*					
I Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Arrival Type	*3*	*3*			*3*		*3*					
Platoon Ratio	*1.00*	*1.00*			*1.00*		*1.00*					
PF Factor	*1.00*	*1.00*			*1.00*		*1.00*					
Q_1	*0.2*	*2.7*			*30.4*		*1.0*					
k_B	*0.2*	*0.8*			*0.8*		*0.3*					
Q_2	*0.1*	*0.3*			*10.5*		*0.1*					
Q Average	*0.3*	*3.0*			*40.8*		*1.1*					

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.1*	*2.0*			*1.6*		*2.1*					
Back of Queue	*0.7*	*6.0*			*63.8*		*2.2*					

Queue Storage Ratio

Queue Spacing	*25.0*	*25.0*			*25.0*		*25.0*					
Queue Storage	*0*	*0*			*0*		*0*					
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 @ I-75 NB Off-Ramp*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1	1			1		1					
Lane Group	L	T			T		L					
Volume (vph)	44	203			1528		123					
% Heavy Vehicles	15	15			15		15					
PHF	0.94	0.94			0.94		0.94					
Pretimed/Actuated (P/A)	A	A			A		A					
Startup Lost Time	2.0	2.0			2.0		2.0					
Extension of Effective Green	2.0	2.0			2.0		2.0					
Arrival Type	3	3			3		3					
Unit Extension	3.0	3.0			3.0		3.0					
Ped/Bike/RTOR Volume	0	0		0	0		0	0				
Lane Width	12.0	12.0			12.0		12.0					
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour	0	0			0		0					
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EB Only	EW Perm	03	04	NB Only	06	07	08
Timing	G = 5.0	G = 91.0	G = 0.0	G = 0.0	G = 10.0	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 5	Y = 0	Y = 0	Y = 5	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 120.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	47	216			1626		131					
Lane Group Capacity	231	1377			1253		131					
v/c Ratio	0.20	0.16			1.30		1.00					
Green Ratio	0.84	0.83			0.76		0.08					
Uniform Delay d_1	4.2	1.9			14.5		55.0					
Delay Factor k	0.11	0.11			0.50		0.50					
Incremental Delay d_2	0.4	0.1			140.0		78.6					
PF Factor	1.000	1.000			1.000		1.000					
Control Delay	4.6	2.0			154.5		133.6					
Lane Group LOS	A	A			F		F					
Approach Delay	2.4			154.5			133.6					
Approach LOS	A			F			F					
Intersection Delay	133.3			Intersection LOS						F		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*	*T*			*T*		*L*					
Initial Queue/Lane	*0.0*	*0.0*			*0.0*		*0.0*					
Flow Rate/Lane Group	*47*	*216*			*1626*		*131*					
Satflow/Lane	*275*	*1652*			*1652*		*1570*					
Capacity/Lane Group	*231*	*1377*			*1253*		*131*					
Flow Ratio	*0.2*	*0.1*			*1.0*		*0.1*					
v/c Ratio	*0.20*	*0.16*			*1.30*		*1.00*					
I Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Arrival Type	*3*	*3*			*3*		*3*					
Platoon Ratio	*1.00*	*1.00*			*1.00*		*1.00*					
PF Factor	*1.00*	*1.00*			*1.00*		*1.00*					
Q_1	*0.3*	*1.4*			*54.2*		*4.4*					
k_B	*0.3*	*1.0*			*0.9*		*0.2*					
Q_2	*0.1*	*0.2*			*50.4*		*2.0*					
Q Average	*0.3*	*1.6*			*104.6*		*6.4*					

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.1*	*2.1*			*1.5*		*1.9*					
Back of Queue	*0.7*	*3.2*			*157*		*12.2*					

Queue Storage Ratio

Queue Spacing	*25.0*	*25.0*			*25.0*		*25.0*					
Queue Storage	*0*	*0*			*0*		*0*					
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+™ Version 5.3

Generated: 5/13/2009 11:07 AM

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ I-75 NB Off-Ramp*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*	*2*			*2*		*2*					
Lane Group	*L*	*T*			*T*		*L*					
Volume (vph)	*44*	*203*			*1528*		*123*					
% Heavy Vehicles	*15*	*15*			*15*		*15*					
PHF	*0.94*	*0.94*			*0.94*		*0.94*					
Pretimed/Actuated (P/A)	*A*	*A*			*A*		*A*					
Startup Lost Time	*2.0*	*2.0*			*2.0*		*2.0*					
Extension of Effective Green	*2.0*	*2.0*			*2.0*		*2.0*					
Arrival Type	*3*	*3*			*3*		*3*					
Unit Extension	*3.0*	*3.0*			*3.0*		*3.0*					
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*		*0*	*0*				
Lane Width	*12.0*	*12.0*			*12.0*		*12.0*					
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*			
Parking/Hour												
Bus Stops/Hour	*0*	*0*			*0*		*0*					
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*				

Phasing	EB Only	EW Perm	03	04	NB Only	06	07	08
Timing	G = *5.0*	G = *56.0*	G = *0.0*	G = *0.0*	G = *25.0*	G = *0.0*	G = *0.0*	G = *0.0*
	Y = *4*	Y = *5*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *100.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*47*	*216*			*1626*		*131*					
Lane Group Capacity	*151*	*2045*			*1762*		*762*					
v/c Ratio	*0.31*	*0.11*			*0.92*		*0.17*					
Green Ratio	*0.66*	*0.65*			*0.56*		*0.25*					
Uniform Delay d_1	*15.3*	*6.6*			*20.0*		*29.4*					
Delay Factor k	*0.11*	*0.11*			*0.44*		*0.11*					
Incremental Delay d_2	*1.2*	*0.0*			*8.6*		*0.1*					
PF Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Control Delay	*16.4*	*6.6*			*28.6*		*29.5*					
Lane Group LOS	*B*	*A*			*C*		*C*					
Approach Delay	*8.4*			*28.6*			*29.5*					
Approach LOS	*A*			*C*			*C*					
Intersection Delay	*26.1*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp [2NBL]*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*	*T*			*T*		*L*					
Initial Queue/Lane	*0.0*	*0.0*			*0.0*		*0.0*					
Flow Rate/Lane Group	*47*	*216*			*1626*		*131*					
Satflow/Lane	*219*	*1652*			*1652*		*1570*					
Capacity/Lane Group	*151*	*2045*			*1762*		*762*					
Flow Ratio	*0.2*	*0.1*			*0.5*		*0.0*					
v/c Ratio	*0.31*	*0.11*			*0.92*		*0.17*					
I Factor	*1.000*	*1.000*			*1.000*		*1.000*					
Arrival Type	*3*	*3*			*3*		*3*					
Platoon Ratio	*1.00*	*1.00*			*1.00*		*1.00*					
PF Factor	*1.00*	*1.00*			*1.00*		*1.00*					
Q_1	*0.5*	*1.2*			*21.6*		*1.5*					
k_B	*0.2*	*0.8*			*0.7*		*0.4*					
Q_2	*0.1*	*0.1*			*5.2*		*0.1*					
Q Average	*0.6*	*1.3*			*26.8*		*1.5*					
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*2.1*	*2.1*			*1.6*		*2.1*					
Back of Queue	*1.2*	*2.6*			*43.8*		*3.2*					
Queue Storage Ratio												
Queue Spacing	*25.0*	*25.0*			*25.0*		*25.0*					
Queue Storage	*0*	*0*			*0*		*0*					
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ I-75 SB Off-Ramp*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		*1*		*0*	*1*					*1*		
Lane Group		*T*			*LT*					*L*		
Volume (vph)		*124*		*1177*	*148*					*258*		
% Heavy Vehicles		*15*		*15*	*15*					*15*		
PHF		*0.94*		*0.94*	*0.94*					*0.94*		
Pretimed/Actuated (P/A)		*A*		*A*	*A*					*A*		
Startup Lost Time		*2.0*			*2.0*					*2.0*		
Extension of Effective Green		*2.0*			*2.0*					*2.0*		
Arrival Type		*3*			*3*					*3*		
Unit Extension		*3.0*			*3.0*					*3.0*		
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width		*12.0*			*12.0*					*12.0*		
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour		*0*			*0*					*0*		
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	EW Perm	03	04	SB Only	06	07	08
Timing	G = *79.0*	G = *9.0*	G = *0.0*	G = *0.0*	G = *18.0*	G = *0.0*	G = *0.0*	G = *0.0*
	Y = *4*	Y = *5*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *120.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		*132*			*1409*					*274*		
Lane Group Capacity		*124*			*1085*					*236*		
v/c Ratio		*1.06*			*1.30*					*1.16*		
Green Ratio		*0.08*			*0.77*					*0.15*		
Uniform Delay d_1		*55.5*			*14.0*					*51.0*		
Delay Factor k		*0.50*			*0.50*					*0.50*		
Incremental Delay d_2		*99.2*			*141.2*					*109.0*		
PF Factor		*1.000*			*1.000*					*1.000*		
Control Delay		*154.7*			*155.2*					*160.0*		
Lane Group LOS		*F*			*F*					*F*		
Approach Delay	*154.7*			*155.2*						*160.0*		
Approach LOS	*F*			*F*						*F*		
Intersection Delay	*155.9*			Intersection LOS						*F*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group		*T*			*LT*					*L*		
Initial Queue/Lane		*0.0*			*0.0*					*0.0*		
Flow Rate/Lane Group		*132*			*1409*					*274*		
Satflow/Lane		*1652*			*1409*					*1570*		
Capacity/Lane Group		*124*			*1085*					*236*		
Flow Ratio		*0.1*			*1.0*					*0.2*		
v/c Ratio		*1.06*			*1.30*					*1.16*		
I Factor		*1.000*			*1.000*					*1.000*		
Arrival Type		*3*			*3*					*3*		
Platoon Ratio		*1.00*			*1.00*					*1.00*		
PF Factor		*1.00*			*1.00*					*1.00*		
Q_1		*4.4*			*31.3*					*9.1*		
k_B		*0.2*			*0.9*					*0.3*		
Q_2		*2.5*			*43.9*					*6.6*		
Q Average		*6.9*			*75.3*					*15.7*		

Percentile Back of Queue (95th percentile)

$f_{B\%}$		*1.9*			*1.5*					*1.8*		
Back of Queue		*13.2*			*114*					*27.5*		

Queue Storage Ratio

Queue Spacing		*25.0*			*25.0*					*25.0*		
Queue Storage		*0*			*0*					*0*		
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ I-75 SB Off-Ramp*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		*1*		*0*	*1*					*1*		
Lane Group		*T*			*LT*					*L*		
Volume (vph)		*51*		*774*	*295*					*114*		
% Heavy Vehicles		*15*		*15*	*15*					*15*		
PHF		*0.94*		*0.94*	*0.94*					*0.94*		
Pretimed/Actuated (P/A)		*A*		*A*	*A*					*A*		
Startup Lost Time		*2.0*			*2.0*					*2.0*		
Extension of Effective Green		*2.0*			*2.0*					*2.0*		
Arrival Type		*3*			*3*					*3*		
Unit Extension		*3.0*			*3.0*					*3.0*		
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width		*12.0*			*12.0*					*12.0*		
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour		*0*			*0*					*0*		
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	EW Perm	03	04	SB Only	06	07	08
Timing	G = *65.0*	G = *8.0*	G = *0.0*	G = *0.0*	G = *13.0*	G = *0.0*	G = *0.0*	G = *0.0*
	Y = *4*	Y = *5*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *100.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		*54*			*1137*					*121*		
Lane Group Capacity		*132*			*1105*					*204*		
v/c Ratio		*0.41*			*1.03*					*0.59*		
Green Ratio		*0.08*			*0.77*					*0.13*		
Uniform Delay d_1		*43.8*			*11.5*					*41.0*		
Delay Factor k		*0.11*			*0.50*					*0.18*		
Incremental Delay d_2		*2.1*			*34.7*					*4.6*		
PF Factor		*1.000*			*1.000*					*1.000*		
Control Delay		*45.8*			*46.2*					*45.6*		
Lane Group LOS		*D*			*D*					*D*		
Approach Delay	*45.8*			*46.2*						*45.6*		
Approach LOS	*D*			*D*						*D*		
Intersection Delay	*46.2*			Intersection LOS						*D*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group		*T*			*LT*					*L*		
Initial Queue/Lane		*0.0*			*0.0*					*0.0*		
Flow Rate/Lane Group		*54*			*1137*					*121*		
Satflow/Lane		*1652*			*1435*					*1570*		
Capacity/Lane Group		*132*			*1105*					*204*		
Flow Ratio		*0.0*			*0.8*					*0.1*		
v/c Ratio		*0.41*			*1.03*					*0.59*		
I Factor		*1.000*			*1.000*					*1.000*		
Arrival Type		*3*			*3*					*3*		
Platoon Ratio		*1.00*			*1.00*					*1.00*		
PF Factor		*1.00*			*1.00*					*1.00*		
Q_1		*1.4*			*20.2*					*3.2*		
k_B		*0.2*			*0.8*					*0.3*		
Q_2		*0.1*			*12.7*					*0.4*		
Q Average		*1.6*			*32.9*					*3.6*		

Percentile Back of Queue (95th percentile)

$f_{B\%}$		*2.0*			*1.6*					*2.0*		
Back of Queue		*3.2*			*52.5*					*7.1*		

Queue Storage Ratio

Queue Spacing		*25.0*			*25.0*					*25.0*		
Queue Storage		*0*			*0*					*0*		
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 11:15 AM

SHORT REPORT

General Information

Analyst SKB
Agency or Co. TDOT / Long Engineering
Date Performed 05/04/2009
Time Period AM Peak Period

Site Information

Intersection APD-40 @ I-75 SB Off-Ramp
Area Type All other areas
Jurisdiction Cleveland, TN
Analysis Year 2033

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		1		0	1					1		
Lane Group		T			LT					L		
Volume (vph)		186		1814	221					409		
% Heavy Vehicles		15		15	15					15		
PHF		0.94		0.94	0.94					0.94		
Pretimed/Actuated (P/A)		A		A	A					A		
Startup Lost Time		2.0			2.0					2.0		
Extension of Effective Green		2.0			2.0					2.0		
Arrival Type		3			3					3		
Unit Extension		3.0			3.0					3.0		
Ped/Bike/RTOR Volume	0	0		0	0		0	0		0	0	
Lane Width		12.0			12.0					12.0		
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour		0			0					0		
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	WB Only	EW Perm	03	04	SB Only	06	07	08
Timing	G = 78.0	G = 9.0	G = 0.0	G = 0.0	G = 19.0	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 5	Y = 0	Y = 0	Y = 5	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25 Cycle Length C = 120.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		198			2165					435		
Lane Group Capacity		124			1072					249		
v/c Ratio		1.60			2.02					1.75		
Green Ratio		0.08			0.76					0.16		
Uniform Delay d_1		55.5			14.5					50.5		
Delay Factor k		0.50			0.50					0.50		
Incremental Delay d_2		303.0			462.1					352.3		
PF Factor		1.000			1.000					1.000		
Control Delay		358.5			476.6					402.8		
Lane Group LOS		F			F					F		
Approach Delay	358.5			476.6						402.8		
Approach LOS	F			F						F		
Intersection Delay	456.8			Intersection LOS						F		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group		*T*			*LT*					*L*		
Initial Queue/Lane		*0.0*			*0.0*					*0.0*		
Flow Rate/Lane Group		*198*			*2165*					*435*		
Satflow/Lane		*1652*			*1407*					*1570*		
Capacity/Lane Group		*124*			*1072*					*249*		
Flow Ratio		*0.1*			*1.5*					*0.3*		
v/c Ratio		*1.60*			*2.02*					*1.75*		
I Factor		*1.000*			*1.000*					*1.000*		
Arrival Type		*3*			*3*					*3*		
Platoon Ratio		*1.00*			*1.00*					*1.00*		
PF Factor		*1.00*			*1.00*					*1.00*		
Q_1		*6.6*			*48.7*					*14.5*		
k_B		*0.2*			*0.9*					*0.4*		
Q_2		*9.8*			*138.3*					*24.1*		
Q Average		*16.4*			*187.0*					*38.6*		

Percentile Back of Queue (95th percentile)

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
$f_{B\%}$		*1.7*			*1.5*					*1.6*		
Back of Queue		*28.6*			*280*					*60.5*		

Queue Storage Ratio

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Queue Spacing		*25.0*			*25.0*					*25.0*		
Queue Storage		*0*			*0*					*0*		
Average Queue Storage Ratio												
95% Queue Storage Ratio												

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group		*T*			*LT*					*L*		
Initial Queue/Lane		*0.0*			*0.0*					*0.0*		
Flow Rate/Lane Group		*73*			*1756*					*189*		
Satflow/Lane		*1652*			*1490*					*1570*		
Capacity/Lane Group		*69*			*1234*					*144*		
Flow Ratio		*0.0*			*1.2*					*0.1*		
v/c Ratio		*1.06*			*1.42*					*1.31*		
I Factor		*1.000*			*1.000*					*1.000*		
Arrival Type		*3*			*3*					*3*		
Platoon Ratio		*1.00*			*1.00*					*1.00*		
PF Factor		*1.00*			*1.00*					*1.00*		
Q_1		*2.4*			*39.7*					*6.3*		
k_B		*0.2*			*0.9*					*0.3*		
Q_2		*1.5*			*68.2*					*6.5*		
Q Average		*3.9*			*107.9*					*12.8*		
Percentile Back of Queue (95th percentile)												
$f_{B\%}$		*2.0*			*1.5*					*1.8*		
Back of Queue		*7.8*			*162*					*23.0*		
Queue Storage Ratio												
Queue Spacing		*25.0*			*25.0*					*25.0*		
Queue Storage		*0*			*0*					*0*		
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 11:23 AM

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group		*T*			*LT*					*L*		
Initial Queue/Lane		*0.0*			*0.0*					*0.0*		
Flow Rate/Lane Group		*73*			*1756*					*189*		
Satflow/Lane		*1652*			*1490*					*1570*		
Capacity/Lane Group		*69*			*1234*					*144*		
Flow Ratio		*0.0*			*1.2*					*0.1*		
v/c Ratio		*1.06*			*1.42*					*1.31*		
I Factor		*1.000*			*1.000*					*1.000*		
Arrival Type		*3*			*3*					*3*		
Platoon Ratio		*1.00*			*1.00*					*1.00*		
PF Factor		*1.00*			*1.00*					*1.00*		
Q_1		*2.4*			*39.7*					*6.3*		
k_B		*0.2*			*0.9*					*0.3*		
Q_2		*1.5*			*68.2*					*6.5*		
Q Average		*3.9*			*107.9*					*12.8*		

Percentile Back of Queue (95th percentile)

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
$f_{B\%}$		*2.0*			*1.5*					*1.8*		
Back of Queue		*7.8*			*162*					*23.0*		

Queue Storage Ratio

	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT
Queue Spacing		*25.0*			*25.0*					*25.0*		
Queue Storage		*0*			*0*					*0*		
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+™ Version 5.3 Generated: 5/13/2009 3:03 PM

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*2*		*1*					*2*	*1*	*1*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*194*		*159*					*538*	*44*	*156*	*789*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = *29.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *5.0*	G = *32.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *80.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*206*		*169*					*572*	*47*	*166*	*839*	
Lane Group Capacity	*1234*		*568*					*1405*	*627*	*386*	*1800*	
v/c Ratio	*0.17*		*0.30*					*0.41*	*0.07*	*0.43*	*0.47*	
Green Ratio	*0.36*		*0.36*					*0.40*	*0.40*	*0.52*	*0.51*	
Uniform Delay d_1	*17.3*		*18.2*					*17.2*	*14.8*	*10.7*	*12.5*	
Delay Factor k	*0.11*		*0.11*					*0.11*	*0.11*	*0.11*	*0.11*	
Incremental Delay d_2	*0.1*		*0.3*					*0.2*	*0.1*	*0.8*	*0.2*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*17.4*		*18.5*					*17.4*	*14.9*	*11.5*	*12.7*	
Lane Group LOS	*B*		*B*					*B*	*B*	*B*	*B*	
Approach Delay	*17.9*						*17.2*			*12.5*		
Approach LOS	*B*						*B*			*B*		
Intersection Delay	*15.0*			Intersection LOS						*B*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*206*		*169*					*572*	*47*	*166*	*839*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*735*	*1844*	
Capacity/Lane Group	*1234*		*568*					*1405*	*627*	*386*	*1800*	
Flow Ratio	*0.1*		*0.1*					*0.2*	*0.0*	*0.2*	0.2	
v/c Ratio	*0.17*		*0.30*					*0.41*	*0.07*	*0.43*	*0.47*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*1.6*		*2.7*					*4.8*	*0.6*	*1.8*	*6.3*	
k_B	*0.5*		*0.5*					*0.5*	*0.5*	*0.4*	*0.6*	
Q_2	*0.1*		*0.2*					*0.4*	*0.0*	*0.3*	*0.5*	
Q Average	*1.7*		*2.9*					*5.1*	*0.7*	*2.1*	*6.8*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.0*		*2.0*					*2.0*	*2.1*	*2.0*	*1.9*	
Back of Queue	*3.5*		*5.8*					*10.0*	*1.4*	*4.2*	*13.0*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	2		1					2	1	1	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	157		84					980	78	316	754	
% Heavy Vehicles	3		3					3	3	3	3	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = 22.0	G = 0.0	G = 0.0	G = 0.0	G = 19.0	G = 35.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 90.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	167		89					1043	83	336	802	
Lane Group Capacity	832		383					1366	610	460	2263	
v/c Ratio	0.20		0.23					0.76	0.14	0.73	0.35	
Green Ratio	0.24		0.24					0.39	0.39	0.66	0.64	
Uniform Delay d_1	27.0		27.2					23.9	17.7	20.5	7.4	
Delay Factor k	0.11		0.11					0.32	0.11	0.29	0.11	
Incremental Delay d_2	0.1		0.3					2.6	0.1	5.9	0.1	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	27.1		27.5					26.5	17.8	26.4	7.5	
Lane Group LOS	C		C					C	B	C	A	
Approach Delay	27.3						25.9			13.0		
Approach LOS	C						C			B		
Intersection Delay	20.2			Intersection LOS						C		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*167*		*89*					*1043*	*83*	*336*	*802*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*701*	*1844*	
Capacity/Lane Group	*832*		*383*					*1366*	*610*	*460*	*2263*	
Flow Ratio	*0.0*		*0.1*					*0.3*	*0.1*	*0.5*	0.2	
v/c Ratio	*0.20*		*0.23*					*0.76*	*0.14*	*0.73*	*0.35*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*1.7*		*1.8*					*11.9*	*1.3*	*3.4*	*4.8*	
k_B	*0.4*		*0.4*					*0.6*	*0.5*	*0.4*	*0.8*	
Q_2	*0.1*		*0.1*					*1.7*	*0.1*	*1.1*	*0.4*	
Q Average	*1.8*		*1.9*					*13.6*	*1.4*	*4.5*	*5.3*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*2.0*		*2.0*					*1.8*	*2.1*	*2.0*	*1.9*	
Back of Queue	*3.7*		*3.9*					*24.2*	*2.9*	*8.9*	*10.3*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		1					2	1	1	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	303		258					841	69	244	1232	
% Heavy Vehicles	3		3					3	3	3	3	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = 31.0	G = 0.0	G = 0.0	G = 0.0	G = 14.0	G = 31.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 90.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	322		274					895	73	260	1311	
Lane Group Capacity	603		540					1210	540	372	1912	
v/c Ratio	0.53		0.51					0.74	0.14	0.70	0.69	
Green Ratio	0.34		0.34					0.34	0.34	0.56	0.54	
Uniform Delay d_1	23.7		23.4					26.0	20.3	15.7	14.9	
Delay Factor k	0.14		0.12					0.30	0.11	0.27	0.25	
Incremental Delay d_2	0.9		0.8					2.5	0.1	5.7	1.0	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	24.6		24.2					28.4	20.4	21.4	15.9	
Lane Group LOS	C		C					C	C	C	B	
Approach Delay	24.4						27.8			16.8		
Approach LOS	C						C			B		
Intersection Delay	21.7			Intersection LOS						C		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*322*		*274*					*895*	*73*	*260*	*1311*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*668*	*1844*	
Capacity/Lane Group	*603*		*540*					*1210*	*540*	*372*	*1912*	
Flow Ratio	*0.2*		*0.2*					*0.3*	*0.0*	*0.4*	0.4	
v/c Ratio	*0.53*		*0.51*					*0.74*	*0.14*	*0.70*	*0.69*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*6.5*		*5.4*					*10.3*	*1.3*	*3.2*	*12.5*	
k_B	*0.5*		*0.5*					*0.5*	*0.5*	*0.4*	*0.7*	
Q_2	*0.6*		*0.5*					*1.4*	*0.1*	*0.8*	*1.5*	
Q Average	*7.0*		*5.9*					*11.7*	*1.3*	*4.1*	*14.0*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*1.9*		*1.9*					*1.8*	*2.1*	*2.0*	*1.8*	
Back of Queue	*13.4*		*11.4*					*21.3*	*2.7*	*8.0*	*24.8*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*2*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*303*		*258*					*841*	*69*	*244*	*1232*	
% Heavy Vehicles	*5*		*5*					*5*	*5*	*5*	*5*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *27.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *19.0*	G = *30.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*322*		*274*					*895*	*73*	*260*	*1311*	
Lane Group Capacity	*516*		*461*					*1148*	*513*	*705*	*2029*	
v/c Ratio	*0.62*		*0.59*					*0.78*	*0.14*	*0.37*	*0.65*	
Green Ratio	*0.30*		*0.30*					*0.33*	*0.33*	*0.21*	*0.59*	
Uniform Delay d_1	*27.1*		*26.8*					*27.0*	*21.0*	*30.4*	*12.3*	
Delay Factor k	*0.21*		*0.18*					*0.33*	*0.11*	*0.11*	*0.22*	
Incremental Delay d_2	*2.4*		*2.1*					*3.5*	*0.1*	*0.3*	*0.7*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*29.5*		*28.9*					*30.5*	*21.1*	*30.7*	*13.0*	
Lane Group LOS	*C*		*C*					*C*	*C*	*C*	*B*	
Approach Delay	*29.2*						*29.8*			*15.9*		
Approach LOS	*C*						*C*			*B*		
Intersection Delay	*22.7*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*322*		*274*					*895*	*73*	*260*	*1311*	
Satflow/Lane	*1719*		*1538*					*1809*	*1538*	*1719*	*1809*	
Capacity/Lane Group	*516*		*461*					*1148*	*513*	*705*	*2029*	
Flow Ratio	*0.2*		*0.2*					*0.3*	*0.0*	*0.1*	0.4	
v/c Ratio	*0.62*		*0.59*					*0.78*	*0.14*	*0.37*	*0.65*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*6.9*		*5.8*					*10.6*	*1.3*	*2.8*	*11.4*	
k_B	*0.5*		*0.4*					*0.5*	*0.5*	*0.4*	*0.7*	
Q_2	*0.7*		*0.6*					*1.6*	*0.1*	*0.2*	*1.3*	
Q Average	*7.7*		*6.5*					*12.2*	*1.4*	*3.1*	*12.7*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.9*		*1.9*					*1.8*	*2.1*	*2.0*	*1.8*	
Back of Queue	*14.5*		*12.4*					*22.1*	*2.8*	*6.1*	*22.8*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*1*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*255*		*141*					*1543*	*113*	*454*	*1198*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = *21.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *31.0*	G = *54.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *120.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*271*		*150*					*1641*	*120*	*483*	*1274*	
Lane Group Capacity	*307*		*274*					*1580*	*706*	*514*	*2605*	
v/c Ratio	*0.88*		*0.55*					*1.04*	*0.17*	*0.94*	*0.49*	
Green Ratio	*0.17*		*0.17*					*0.45*	*0.45*	*0.75*	*0.74*	
Uniform Delay d_1	*48.3*		*45.2*					*33.0*	*19.7*	*37.6*	*6.3*	
Delay Factor k	*0.41*		*0.15*					*0.50*	*0.11*	*0.45*	*0.11*	
Incremental Delay d_2	*24.6*		*2.3*					*33.3*	*0.1*	*25.5*	*0.1*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*72.9*		*47.5*					*66.3*	*19.8*	*63.0*	*6.4*	
Lane Group LOS	*E*		*D*					*E*	*B*	*E*	*A*	
Approach Delay	*63.8*						*63.2*			*22.0*		
Approach LOS	*E*						*E*			*C*		
Intersection Delay	*44.9*			Intersection LOS						*D*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*271*		*150*					*1641*	*120*	*483*	*1274*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*685*	*1844*	
Capacity/Lane Group	*307*		*274*					*1580*	*706*	*514*	*2605*	
Flow Ratio	*0.2*		*0.1*					*0.5*	*0.1*	*0.7*	0.4	
v/c Ratio	*0.88*		*0.55*					*1.04*	*0.17*	*0.94*	*0.49*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*8.8*		*4.6*					*28.7*	*2.4*	*5.3*	*9.0*	
k_B	*0.4*		*0.4*					*0.7*	*0.7*	*0.5*	*1.0*	
Q_2	*2.1*		*0.4*					*11.1*	*0.1*	*4.1*	*0.9*	
Q Average	*10.9*		*5.0*					*39.8*	*2.5*	*9.4*	*10.0*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.8*		*2.0*					*1.6*	*2.0*	*1.9*	*1.8*	
Back of Queue	*19.9*		*9.8*					*62.3*	*5.1*	*17.5*	*18.4*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 11:56 AM

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*2*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*255*		*141*					*1543*	*113*	*454*	*1198*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *24.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *20.0*	G = *52.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *110.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*271*		*150*					*1641*	*120*	*483*	*1274*	
Lane Group Capacity	*382*		*342*					*1660*	*741*	*619*	*2426*	
v/c Ratio	*0.71*		*0.44*					*0.99*	*0.16*	*0.78*	*0.53*	
Green Ratio	*0.22*		*0.22*					*0.47*	*0.47*	*0.18*	*0.69*	
Uniform Delay d_1	*39.8*		*37.2*					*28.7*	*16.6*	*42.9*	*8.2*	
Delay Factor k	*0.27*		*0.11*					*0.49*	*0.11*	*0.33*	*0.13*	
Incremental Delay d_2	*6.0*		*0.9*					*19.3*	*0.1*	*6.4*	*0.2*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*45.8*		*38.1*					*48.0*	*16.7*	*49.3*	*8.5*	
Lane Group LOS	*D*		*D*					*D*	*B*	*D*	*A*	
Approach Delay	*43.0*						*45.9*			*19.7*		
Approach LOS	*D*						*D*			*B*		
Intersection Delay	*33.9*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*271*		*150*					*1641*	*120*	*483*	*1274*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*1752*	*1844*	
Capacity/Lane Group	*382*		*342*					*1660*	*741*	*619*	*2426*	
Flow Ratio	*0.2*		*0.1*					*0.5*	*0.1*	*0.1*	0.4	
v/c Ratio	*0.71*		*0.44*					*0.99*	*0.16*	*0.78*	*0.53*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*7.7*		*4.0*					*26.0*	*2.1*	*7.2*	*9.9*	
k_B	*0.4*		*0.4*					*0.7*	*0.7*	*0.4*	*0.9*	
Q_2	*1.0*		*0.3*					*8.2*	*0.1*	*1.2*	*1.0*	
Q Average	*8.7*		*4.3*					*34.2*	*2.2*	*8.4*	*10.9*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*1.9*		*2.0*					*1.6*	*2.0*	*1.9*	*1.8*	
Back of Queue	*16.2*		*8.4*					*54.4*	*4.5*	*15.8*	*19.9*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 12:01 PM

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*Slip Ramp @ Stone Lake Road*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*1*			*1*	
Lane Group	*L*		*R*					*T*			*T*	
Volume (vph)	*55*		*112*					*272*			*1429*	
% Heavy Vehicles	*5*		*5*					*5*			*5*	
PHF	*0.94*		*0.94*					*0.94*			*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*			*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*			*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*			*2.0*	
Arrival Type	*3*		*3*					*3*			*3*	
Unit Extension	*3.0*		*3.0*					*3.0*			*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*			*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*			*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	Thru Only	06	07	08
Timing	G = *11.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *79.0*	G = *0.0*	G = *0.0*	G =
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y =

Duration of Analysis (hrs) = *0.25*		Cycle Length C = *100.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*59*		*119*					*289*			*1520*	
Lane Group Capacity	*189*		*169*					*1430*			*1430*	
v/c Ratio	*0.31*		*0.70*					*0.20*			*1.06*	
Green Ratio	*0.11*		*0.11*					*0.79*			*0.79*	
Uniform Delay d_1	*41.0*		*42.9*					*2.6*			*10.5*	
Delay Factor k	*0.11*		*0.27*					*0.11*			*0.50*	
Incremental Delay d_2	*0.9*		*12.5*					*0.1*			*42.5*	
PF Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Control Delay	*42.0*		*55.4*					*2.7*			*53.0*	
Lane Group LOS	*D*		*E*					*A*			*D*	
Approach Delay	*51.0*						*2.7*			*53.0*		
Approach LOS	*D*						*A*			*D*		
Intersection Delay	*45.5*			Intersection LOS						*D*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing/Proposed System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	L		R					T			T	
Initial Queue/Lane	0.0		0.0					0.0			0.0	
Flow Rate/Lane Group	59		119					289			1520	
Satflow/Lane	1719		1538					1810			1810	
Capacity/Lane Group	189		169					1430			1430	
Flow Ratio	0.0		0.1					0.2			0.8	
v/c Ratio	0.31		0.70					0.20			1.06	
I Factor	1.000		1.000					1.000			1.000	
Arrival Type	3		3					3			3	
Platoon Ratio	1.00		1.00					1.00			1.00	
PF Factor	1.00		1.00					1.00			1.00	
Q_1	1.5		3.2					2.0			42.2	
k_B	0.3		0.3					0.9			0.9	
Q_2	0.1		0.6					0.2			19.9	
Q Average	1.6		3.7					2.2			62.2	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	2.0		2.0					2.0			1.5	
Back of Queue	3.3		7.4					4.5			94.4	

Queue Storage Ratio

Queue Spacing	25.0		25.0					25.0			25.0	
Queue Storage	0		0					0			0	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*Slip Ramp @ Stone Lake Road*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*1*			*1*	
Lane Group	*L*		*R*					*T*			*T*	
Volume (vph)	*41*		*82*					*1532*			*295*	
% Heavy Vehicles	*5*		*5*					*5*			*5*	
PHF	*0.94*		*0.94*					*0.94*			*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*			*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*			*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*			*2.0*	
Arrival Type	*3*		*3*					*3*			*3*	
Unit Extension	*3.0*		*3.0*					*3.0*			*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*			*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*			*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	Thru Only	06	07	08
Timing	G = *9.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *91.0*	G = *0.0*	G = *0.0*	G =
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y =
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *110.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*44*		*87*					*1630*			*314*	
Lane Group Capacity	*141*		*126*					*1497*			*1497*	
v/c Ratio	*0.31*		*0.69*					*1.09*			*0.21*	
Green Ratio	*0.08*		*0.08*					*0.83*			*0.83*	
Uniform Delay d_1	*47.6*		*49.1*					*9.5*			*2.0*	
Delay Factor k	*0.11*		*0.26*					*0.50*			*0.11*	
Incremental Delay d_2	*1.3*		*14.9*					*51.4*			*0.1*	
PF Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Control Delay	*48.9*		*64.0*					*60.9*			*2.1*	
Lane Group LOS	*D*		*E*					*E*			*A*	
Approach Delay	*58.9*						*60.9*			*2.1*		
Approach LOS	*E*						*E*			*A*		
Intersection Delay	*51.9*			Intersection LOS						*D*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing/Proposed System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*			*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*			*0.0*	
Flow Rate/Lane Group	*44*		*87*					*1630*			*314*	
Satflow/Lane	*1719*		*1538*					*1810*			*1810*	
Capacity/Lane Group	*141*		*126*					*1497*			*1497*	
Flow Ratio	*0.0*		*0.1*					*0.9*			0.2	
v/c Ratio	*0.31*		*0.69*					*1.09*			*0.21*	
I Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Arrival Type	*3*		*3*					*3*			*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*			*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*			*1.00*	
Q_1	*1.3*		*2.6*					*49.8*			*2.0*	
k_B	*0.2*		*0.2*					*1.0*			*1.0*	
Q_2	*0.1*		*0.5*					*24.8*			*0.3*	
Q Average	*1.4*		*3.0*					*74.6*			*2.3*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.1*		*2.0*					*1.5*			*2.0*	
Back of Queue	*2.8*		*6.1*					*113*			*4.6*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*			*25.0*	
Queue Storage	*0*		*0*					*0*			*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*Slip Ramp @ Stone Lake Road*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*1*			*1*	
Lane Group	*L*		*R*					*T*			*T*	
Volume (vph)	*83*		*169*					*462*			*2409*	
% Heavy Vehicles	*5*		*5*					*5*			*5*	
PHF	*0.94*		*0.94*					*0.94*			*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*			*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*			*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*			*2.0*	
Arrival Type	*3*		*3*					*3*			*3*	
Unit Extension	*3.0*		*3.0*					*3.0*			*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*			*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*			*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	Thru Only	06	07	08
Timing	G = *8.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *102.0*	G = *0.0*	G = *0.0*	G =
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y =
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *120.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*88*		*180*					*491*			*2563*	
Lane Group Capacity	*115*		*103*					*1539*			*1539*	
v/c Ratio	*0.77*		*1.75*					*0.32*			*1.67*	
Green Ratio	*0.07*		*0.07*					*0.85*			*0.85*	
Uniform Delay d_1	*55.1*		*56.0*					*1.9*			*9.0*	
Delay Factor k	*0.32*		*0.50*					*0.11*			*0.50*	
Incremental Delay d_2	*26.0*		*373.2*					*0.1*			*302.3*	
PF Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Control Delay	*81.0*		*429.2*					*2.0*			*311.3*	
Lane Group LOS	*F*		*F*					*A*			*F*	
Approach Delay	*314.9*						*2.0*			*311.3*		
Approach LOS	*F*						*A*			*F*		
Intersection Delay	*265.9*			Intersection LOS						*F*		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing/Proposed System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*			*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*			*0.0*	
Flow Rate/Lane Group	*88*		*180*					*491*			*2563*	
Satflow/Lane	*1719*		*1538*					*1810*			*1810*	
Capacity/Lane Group	*115*		*103*					*1539*			*1539*	
Flow Ratio	*0.1*		*0.1*					*0.3*			1.4	
v/c Ratio	*0.77*		*1.75*					*0.32*			*1.67*	
I Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Arrival Type	*3*		*3*					*3*			*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*			*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*			*1.00*	
Q_1	*2.9*		*6.0*					*3.4*			*85.4*	
k_B	*0.2*		*0.2*					*1.1*			*1.1*	
Q_2	*0.6*		*10.1*					*0.5*			*130.6*	
Q Average	*3.5*		*16.1*					*3.9*			*216.0*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.0*		*1.7*					*2.0*			*1.5*	
Back of Queue	*7.0*		*28.1*					*7.7*			*324*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*			*25.0*	
Queue Storage	*0*		*0*					*0*			*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*Slip Ramp @ Stone Lake Road*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*			*2*	
Lane Group	*L*		*R*					*T*			*T*	
Volume (vph)	*83*		*169*					*462*			*2409*	
% Heavy Vehicles	*5*		*5*					*5*			*5*	
PHF	*0.94*		*0.94*					*0.94*			*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*			*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*			*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*			*2.0*	
Arrival Type	*3*		*3*					*3*			*3*	
Unit Extension	*3.0*		*3.0*					*3.0*			*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*			*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*			*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	Thru Only	06	07	08
Timing	G = *16.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *64.0*	G = *0.0*	G = *0.0*	G =
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y =
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*88*		*180*					*491*			*2563*	
Lane Group Capacity	*306*		*273*					*2450*			*2450*	
v/c Ratio	*0.29*		*0.66*					*0.20*			*1.05*	
Green Ratio	*0.18*		*0.18*					*0.71*			*0.71*	
Uniform Delay d_1	*32.1*		*34.5*					*4.4*			*13.0*	
Delay Factor k	*0.11*		*0.23*					*0.11*			*0.50*	
Incremental Delay d_2	*0.5*		*5.8*					*0.0*			*31.7*	
PF Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Control Delay	*32.6*		*40.2*					*4.4*			*44.7*	
Lane Group LOS	*C*		*D*					*A*			*D*	
Approach Delay	*37.7*						*4.4*			*44.7*		
Approach LOS	*D*						*A*			*D*		
Intersection Delay	*38.2*			Intersection LOS						*D*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing/Proposed System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*			*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*			*0.0*	
Flow Rate/Lane Group	*88*		*180*					*491*			*2563*	
Satflow/Lane	*1719*		*1538*					*1809*			*1809*	
Capacity/Lane Group	*306*		*273*					*2450*			*2450*	
Flow Ratio	*0.1*		*0.1*					*0.1*			0.7	
v/c Ratio	*0.29*		*0.66*					*0.20*			*1.05*	
I Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Arrival Type	*3*		*3*					*3*			*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*			*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*			*1.00*	
Q_1	*1.9*		*4.2*					*2.2*			*33.7*	
k_B	*0.3*		*0.3*					*0.8*			*0.8*	
Q_2	*0.1*		*0.6*					*0.2*			*16.0*	
Q Average	*2.0*		*4.8*					*2.4*			*49.6*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.0*		*2.0*					*2.0*			*1.5*	
Back of Queue	*4.2*		*9.4*					*4.8*			*76.3*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*			*25.0*	
Queue Storage	*0*		*0*					*0*			*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*Slip Ramp @ Stone Lake Road*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*1*			*1*	
Lane Group	*L*		*R*					*T*			*T*	
Volume (vph)	*62*		*126*					*2559*			*509*	
% Heavy Vehicles	*5*		*5*					*5*			*5*	
PHF	*0.94*		*0.94*					*0.94*			*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*			*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*			*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*			*2.0*	
Arrival Type	*3*		*3*					*3*			*3*	
Unit Extension	*3.0*		*3.0*					*3.0*			*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*			*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*			*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	Thru Only	06	07	08
Timing	G = *6.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *104.0*	G = *0.0*	G = *0.0*	G =
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y =

Duration of Analysis (hrs) = *0.25*

Cycle Length C = *120.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*66*		*134*					*2722*			*541*	
Lane Group Capacity	*86*		*77*					*1569*			*1569*	
v/c Ratio	*0.77*		*1.74*					*1.73*			*0.34*	
Green Ratio	*0.05*		*0.05*					*0.87*			*0.87*	
Uniform Delay d_1	*56.3*		*57.0*					*8.0*			*1.5*	
Delay Factor k	*0.32*		*0.50*					*0.50*			*0.11*	
Incremental Delay d_2	*33.4*		*381.1*					*333.4*			*0.1*	
PF Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Control Delay	*89.7*		*438.1*					*341.4*			*1.7*	
Lane Group LOS	*F*		*F*					*F*			*A*	
Approach Delay	*323.2*						*341.4*			*1.7*		
Approach LOS	*F*						*F*			*A*		
Intersection Delay	*287.3*			Intersection LOS						*F*		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing/Proposed System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*			*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*			*0.0*	
Flow Rate/Lane Group	*66*		*134*					*2722*			*541*	
Satflow/Lane	*1719*		*1538*					*1810*			*1810*	
Capacity/Lane Group	*86*		*77*					*1569*			*1569*	
Flow Ratio	*0.0*		*0.1*					*1.5*			0.3	
v/c Ratio	*0.77*		*1.74*					*1.73*			*0.34*	
I Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Arrival Type	*3*		*3*					*3*			*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*			*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*			*1.00*	
Q_1	*2.2*		*4.5*					*90.7*			*3.4*	
k_B	*0.2*		*0.2*					*1.1*			*1.1*	
Q_2	*0.5*		*7.5*					*146.6*			*0.6*	
Q Average	*2.7*		*12.0*					*237.4*			*4.0*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.0*		*1.8*					*1.5*			*2.0*	
Back of Queue	*5.4*		*21.7*					*356*			*7.9*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*			*25.0*	
Queue Storage	*0*		*0*					*0*			*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*Slip Ramp @ Stone Lake Road*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*			*2*	
Lane Group	*L*		*R*					*T*			*T*	
Volume (vph)	*62*		*126*					*2559*			*509*	
% Heavy Vehicles	*5*		*5*					*5*			*5*	
PHF	*0.94*		*0.94*					*0.94*			*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*			*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*			*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*			*2.0*	
Arrival Type	*3*		*3*					*3*			*3*	
Unit Extension	*3.0*		*3.0*					*3.0*			*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*		*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*			*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*			*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	Thru Only	06	07	08
Timing	G = *12.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *68.0*	G = *0.0*	G = *0.0*	G =
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *5*	Y = *0*	Y = *0*	Y =
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*66*		*134*					*2722*			*541*	
Lane Group Capacity	*229*		*205*					*2603*			*2603*	
v/c Ratio	*0.29*		*0.65*					*1.05*			*0.21*	
Green Ratio	*0.13*		*0.13*					*0.76*			*0.76*	
Uniform Delay d_1	*35.2*		*37.0*					*11.0*			*3.2*	
Delay Factor k	*0.11*		*0.23*					*0.50*			*0.11*	
Incremental Delay d_2	*0.7*		*7.3*					*31.1*			*0.0*	
PF Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Control Delay	*35.8*		*44.3*					*42.1*			*3.2*	
Lane Group LOS	*D*		*D*					*D*			*A*	
Approach Delay	*41.5*						*42.1*			*3.2*		
Approach LOS	*D*						*D*			*A*		
Intersection Delay	*36.0*			Intersection LOS						*D*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Existing/Proposed System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*			*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*			*0.0*	
Flow Rate/Lane Group	*66*		*134*					*2722*			*541*	
Satflow/Lane	*1719*		*1538*					*1809*			*1809*	
Capacity/Lane Group	*229*		*205*					*2603*			*2603*	
Flow Ratio	*0.0*		*0.1*					*0.8*			0.2	
v/c Ratio	*0.29*		*0.65*					*1.05*			*0.21*	
I Factor	*1.000*		*1.000*					*1.000*			*1.000*	
Arrival Type	*3*		*3*					*3*			*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*			*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*			*1.00*	
Q_1	*1.5*		*3.2*					*35.7*			*2.1*	
k_B	*0.3*		*0.3*					*0.8*			*0.8*	
Q_2	*0.1*		*0.5*					*16.7*			*0.2*	
Q Average	*1.6*		*3.7*					*52.4*			*2.3*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*2.0*		*2.0*					*1.5*			*2.0*	
Back of Queue	*3.3*		*7.3*					*80.3*			*4.6*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*			*25.0*	
Queue Storage	*0*		*0*					*0*			*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		2					2	1	2	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	264		285					235	61	79	231	
% Heavy Vehicles	5		5					5	5	5	5	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = 25.0	G = 0.0	G = 0.0	G = 0.0	G = 19.0	G = 22.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 80.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	281		303					250	65	84	246	
Lane Group Capacity	537		851					947	423	793	1938	
v/c Ratio	0.52		0.36					0.26	0.15	0.11	0.13	
Green Ratio	0.31		0.31					0.28	0.28	0.24	0.56	
Uniform Delay d_1	22.6		21.3					22.7	22.0	23.9	8.2	
Delay Factor k	0.13		0.11					0.11	0.11	0.11	0.11	
Incremental Delay d_2	0.9		0.3					0.1	0.2	0.1	0.0	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	23.5		21.5					22.8	22.1	23.9	8.3	
Lane Group LOS	C		C					C	C	C	A	
Approach Delay	22.5						22.7			12.3		
Approach LOS	C						C			B		
Intersection Delay	19.8			Intersection LOS						B		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*281*		*303*					*250*	*65*	*84*	*246*	
Satflow/Lane	*1719*		*1538*					*1809*	*1538*	*1719*	*1809*	
Capacity/Lane Group	*537*		*851*					*947*	*423*	*793*	*1938*	
Flow Ratio	*0.2*		*0.1*					*0.1*	*0.0*	*0.0*	0.1	
v/c Ratio	*0.52*		*0.36*					*0.26*	*0.15*	*0.11*	*0.13*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*5.1*		*2.9*					*2.3*	*1.1*	*0.7*	*1.4*	
k_B	*0.4*		*0.4*					*0.4*	*0.4*	*0.4*	*0.6*	
Q_2	*0.5*		*0.2*					*0.2*	*0.1*	*0.0*	*0.1*	
Q Average	*5.6*		*3.2*					*2.4*	*1.2*	*0.8*	*1.4*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*1.9*		*2.0*					*2.0*	*2.1*	*2.1*	*2.1*	
Back of Queue	*10.9*		*6.3*					*4.9*	*2.4*	*1.6*	*3.0*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+™ Version 5.3

Generated: 5/13/2009 12:22 PM

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*2*					*2*	*1*	*2*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*84*		*180*					*447*	*47*	*186*	*61*	
% Heavy Vehicles	*5*		*5*					*5*	*5*	*5*	*5*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *21.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *21.0*	G = *24.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *80.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*89*		*191*					*476*	*50*	*198*	*65*	
Lane Group Capacity	*451*		*715*					*1034*	*461*	*876*	*2110*	
v/c Ratio	*0.20*		*0.27*					*0.46*	*0.11*	*0.23*	*0.03*	
Green Ratio	*0.26*		*0.26*					*0.30*	*0.30*	*0.26*	*0.61*	
Uniform Delay d_1	*22.9*		*23.4*					*22.7*	*20.3*	*23.1*	*6.1*	
Delay Factor k	*0.11*		*0.11*					*0.11*	*0.11*	*0.11*	*0.11*	
Incremental Delay d_2	*0.2*		*0.2*					*0.3*	*0.1*	*0.1*	*0.0*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*23.2*		*23.6*					*23.1*	*20.4*	*23.3*	*6.1*	
Lane Group LOS	*C*		*C*					*C*	*C*	*C*	*A*	
Approach Delay	*23.5*						*22.8*			*19.0*		
Approach LOS	*C*						*C*			*B*		
Intersection Delay	*22.0*			Intersection LOS						*C*		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*89*		*191*					*476*	*50*	*198*	*65*	
Satflow/Lane	*1719*		*1538*					*1809*	*1538*	*1719*	*1809*	
Capacity/Lane Group	*451*		*715*					*1034*	*461*	*876*	*2110*	
Flow Ratio	*0.1*		*0.1*					*0.1*	*0.0*	*0.1*	0.0	
v/c Ratio	*0.20*		*0.27*					*0.46*	*0.11*	*0.23*	*0.03*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*1.5*		*1.9*					*4.5*	*0.8*	*1.8*	*0.3*	
k_B	*0.4*		*0.4*					*0.4*	*0.4*	*0.4*	*0.7*	
Q_2	*0.1*		*0.1*					*0.4*	*0.0*	*0.1*	*0.0*	
Q Average	*1.6*		*2.0*					*4.9*	*0.9*	*1.9*	*0.3*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.0*		*2.0*					*2.0*	*2.1*	*2.0*	*2.1*	
Back of Queue	*3.4*		*4.1*					*9.5*	*1.8*	*3.8*	*0.7*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		2					2	1	2	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	412		446					372	96	123	371	
% Heavy Vehicles	5		5					5	5	5	5	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = 32.0	G = 0.0	G = 0.0	G = 0.0	G = 20.0	G = 24.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 90.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	438		474					396	102	131	395	
Lane Group Capacity	611		968					919	410	742	1837	
v/c Ratio	0.72		0.49					0.43	0.25	0.18	0.22	
Green Ratio	0.36		0.36					0.27	0.27	0.22	0.53	
Uniform Delay d_1	25.1		22.6					27.3	25.9	28.3	11.1	
Delay Factor k	0.28		0.11					0.11	0.11	0.11	0.11	
Incremental Delay d_2	4.0		0.4					0.3	0.3	0.1	0.1	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	29.1		23.0					27.7	26.2	28.4	11.1	
Lane Group LOS	C		C					C	C	C	B	
Approach Delay	25.9						27.4			15.4		
Approach LOS	C						C			B		
Intersection Delay	23.5			Intersection LOS						C		

HCS+TM Version 5.3

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	L		R					T	R	L	T	
Initial Queue/Lane	0.0		0.0					0.0	0.0	0.0	0.0	
Flow Rate/Lane Group	438		474					396	102	131	395	
Satflow/Lane	1719		1538					1809	1538	1719	1809	
Capacity/Lane Group	611		968					919	410	742	1837	
Flow Ratio	0.3		0.2					0.1	0.1	0.0	0.1	
v/c Ratio	0.72		0.49					0.43	0.25	0.18	0.22	
I Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Arrival Type	3		3					3	3	3	3	
Platoon Ratio	1.00		1.00					1.00	1.00	1.00	1.00	
PF Factor	1.00		1.00					1.00	1.00	1.00	1.00	
Q_1	9.5		5.2					4.3	2.0	1.4	2.7	
k_B	0.5		0.5					0.4	0.4	0.4	0.7	
Q_2	1.2		0.5					0.3	0.1	0.1	0.2	
Q Average	10.7		5.7					4.6	2.1	1.4	2.9	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	1.8		1.9					2.0	2.0	2.1	2.0	
Back of Queue	19.6		11.0					9.1	4.3	3.0	5.9	

Queue Storage Ratio

Queue Spacing	25.0		25.0					25.0	25.0	25.0	25.0	
Queue Storage	0		0					0	0	0	0	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		2					2	1	2	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	131		281					708	74	291	101	
% Heavy Vehicles	5		5					5	5	5	5	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = 24.0	G = 0.0	G = 0.0	G = 0.0	G = 23.0	G = 29.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 90.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	139		299					753	79	310	107	
Lane Group Capacity	458		726					1110	496	853	2144	
v/c Ratio	0.30		0.41					0.68	0.16	0.36	0.05	
Green Ratio	0.27		0.27					0.32	0.32	0.26	0.62	
Uniform Delay d_1	26.3		27.2					26.5	21.8	27.5	6.6	
Delay Factor k	0.11		0.11					0.25	0.11	0.11	0.11	
Incremental Delay d_2	0.4		0.4					1.7	0.2	0.3	0.0	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	26.7		27.6					28.1	21.9	27.8	6.6	
Lane Group LOS	C		C					C	C	C	A	
Approach Delay	27.3						27.6			22.3		
Approach LOS	C						C			C		
Intersection Delay	26.2			Intersection LOS						C		

HCS+^{TM} Version 5.3

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*139*		*299*					*753*	*79*	*310*	*107*	
Satflow/Lane	*1719*		*1538*					*1809*	*1538*	*1719*	*1809*	
Capacity/Lane Group	*458*		*726*					*1110*	*496*	*853*	*2144*	
Flow Ratio	*0.1*		*0.1*					*0.2*	*0.1*	*0.1*	0.0	
v/c Ratio	*0.30*		*0.41*					*0.68*	*0.16*	*0.36*	*0.05*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*2.8*		*3.5*					*8.6*	*1.4*	*3.3*	*0.5*	
k_B	*0.4*		*0.4*					*0.5*	*0.5*	*0.4*	*0.7*	
Q_2	*0.2*		*0.3*					*1.0*	*0.1*	*0.2*	*0.0*	
Q Average	*3.0*		*3.7*					*9.6*	*1.5*	*3.5*	*0.6*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*2.0*		*2.0*					*1.9*	*2.1*	*2.0*	*2.1*	
Back of Queue	*5.9*		*7.4*					*17.7*	*3.1*	*7.0*	*1.2*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*2*		*1*	*2*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*136*		*97*	*113*	*386*			*174*	*102*
% Heavy Vehicles				*5*		*5*	*5*	*5*			*5*	*5*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = *22.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *21.0*	G = *23.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *80.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*145*		*103*	*120*	*411*			*185*	*109*
Lane Group Capacity				*918*		*423*	*876*	*2067*			*990*	*442*
v/c Ratio				*0.16*		*0.24*	*0.14*	*0.20*			*0.19*	*0.25*
Green Ratio				*0.28*		*0.28*	*0.26*	*0.60*			*0.29*	*0.29*
Uniform Delay d_1				*22.0*		*22.5*	*22.6*	*7.3*			*21.5*	*21.9*
Delay Factor k				*0.11*		*0.11*	*0.11*	*0.11*			*0.11*	*0.11*
Incremental Delay d_2				*0.1*		*0.3*	*0.1*	*0.0*			*0.1*	*0.3*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*22.1*		*22.8*	*22.6*	*7.3*			*21.6*	*22.1*
Lane Group LOS				*C*		*C*	*C*	*A*			*C*	*C*
Approach Delay				*22.4*			*10.8*			*21.8*		
Approach LOS				*C*			*B*			*C*		
Intersection Delay	*16.5*			Intersection LOS						*B*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*145*		*103*	*120*	*411*			*185*	*109*
Satflow/Lane				*1719*		*1538*	*1719*	*1809*			*1809*	*1538*
Capacity/Lane Group				*918*		*423*	*876*	*2067*			*990*	*442*
Flow Ratio				*0.0*		*0.1*	*0.0*	*0.1*			0.1	*0.1*
v/c Ratio				*0.16*		*0.24*	*0.14*	*0.20*			*0.19*	*0.25*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*1.2*		*1.8*	*1.0*	*2.2*			*1.6*	*1.9*
k_B				*0.4*		*0.4*	*0.4*	*0.7*			*0.4*	*0.4*
Q_2				*0.1*		*0.1*	*0.1*	*0.2*			*0.1*	*0.1*
Q Average				*1.3*		*1.9*	*1.1*	*2.3*			*1.7*	*2.0*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.1*		*2.0*	*2.1*	*2.0*			*2.0*	*2.0*
Back of Queue				*2.7*		*3.9*	*2.3*	*4.7*			*3.5*	*4.0*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				2		1	2	2			2	1
Lane Group				L		R	L	T			T	R
Volume (vph)				44		34	217	314			203	333
% Heavy Vehicles				5		5	5	5			5	5
PHF				0.94		0.94	0.94	0.94			0.94	0.94
Pretimed/Actuated (P/A)				A		A	A	A			A	A
Startup Lost Time				2.0		2.0	2.0	2.0			2.0	2.0
Extension of Effective Green				2.0		2.0	2.0	2.0			2.0	2.0
Arrival Type				3		3	3	3			3	3
Unit Extension				3.0		3.0	3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0		0	0	0	0	0		0	0	0
Lane Width				12.0		12.0	12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0		0	0	0			0	0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	WB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = 21.0	G = 0.0	G = 0.0	G = 0.0	G = 23.0	G = 32.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 90.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				47		36	231	334			216	354
Lane Group Capacity				779		359	853	2258			1225	547
v/c Ratio				0.06		0.10	0.27	0.15			0.18	0.65
Green Ratio				0.23		0.23	0.26	0.66			0.36	0.36
Uniform Delay d_1				26.8		27.1	26.8	5.9			19.9	24.3
Delay Factor k				0.11		0.11	0.11	0.11			0.11	0.22
Incremental Delay d_2				0.0		0.1	0.2	0.0			0.1	2.7
PF Factor				1.000		1.000	1.000	1.000			1.000	1.000
Control Delay				26.9		27.2	27.0	5.9			20.0	26.9
Lane Group LOS				C		C	C	A			C	C
Approach Delay				27.0			14.5			24.3		
Approach LOS				C			B			C		
Intersection Delay	20.0			Intersection LOS						B		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*47*		*36*	*231*	*334*			*216*	*354*
Satflow/Lane				*1719*		*1538*	*1719*	*1809*			*1809*	*1538*
Capacity/Lane Group				*779*		*359*	*853*	*2258*			*1225*	*547*
Flow Ratio				*0.0*		*0.0*	*0.1*	*0.1*			0.1	*0.2*
v/c Ratio				*0.06*		*0.10*	*0.27*	*0.15*			*0.18*	*0.65*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*0.5*		*0.7*	*2.4*	*1.7*			*1.9*	*7.4*
k_B				*0.4*		*0.4*	*0.4*	*0.8*			*0.5*	*0.5*
Q_2				*0.0*		*0.0*	*0.2*	*0.1*			*0.1*	*0.9*
Q Average				*0.5*		*0.7*	*2.5*	*1.8*			*2.1*	*8.3*
Percentile Back of Queue (95th percentile)												
$f_{B\%}$				*2.1*		*2.1*	*2.0*	*2.0*			*2.0*	*1.9*
Back of Queue				*1.0*		*1.6*	*5.1*	*3.7*			*4.2*	*15.5*
Queue Storage Ratio												
Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				2		1	2	2			2	1
Lane Group				L		R	L	T			T	R
Volume (vph)				212		144	176	608			282	167
% Heavy Vehicles				5		5	5	5			5	5
PHF				0.94		0.94	0.94	0.94			0.94	0.94
Pretimed/Actuated (P/A)				A		A	A	A			A	A
Startup Lost Time				2.0		2.0	2.0	2.0			2.0	2.0
Extension of Effective Green				2.0		2.0	2.0	2.0			2.0	2.0
Arrival Type				3		3	3	3			3	3
Unit Extension				3.0		3.0	3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0		0	0	0	0	0		0	0	0
Lane Width				12.0		12.0	12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0		0	0	0			0	0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	WB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = 27.0	G = 0.0	G = 0.0	G = 0.0	G = 23.0	G = 26.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 90.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				226		153	187	647			300	178
Lane Group Capacity				1001		461	853	2029			995	444
v/c Ratio				0.23		0.33	0.22	0.32			0.30	0.40
Green Ratio				0.30		0.30	0.26	0.59			0.29	0.29
Uniform Delay d_1				23.7		24.5	26.4	9.4			24.9	25.7
Delay Factor k				0.11		0.11	0.11	0.11			0.11	0.11
Incremental Delay d_2				0.1		0.4	0.1	0.1			0.2	0.6
PF Factor				1.000		1.000	1.000	1.000			1.000	1.000
Control Delay				23.8		24.9	26.5	9.5			25.1	26.3
Lane Group LOS				C		C	C	A			C	C
Approach Delay				24.2			13.3			25.6		
Approach LOS				C			B			C		
Intersection Delay	19.2			Intersection LOS						B		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*226*		*153*	*187*	*647*			*300*	*178*
Satflow/Lane				*1719*		*1538*	*1719*	*1809*			*1809*	*1538*
Capacity/Lane Group				*1001*		*461*	*853*	*2029*			*995*	*444*
Flow Ratio				*0.1*		*0.1*	*0.1*	*0.2*			0.1	*0.1*
v/c Ratio				*0.23*		*0.33*	*0.22*	*0.32*			*0.30*	*0.40*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*2.2*		*3.0*	*1.9*	*4.3*			*3.1*	*3.6*
k_B				*0.5*		*0.4*	*0.4*	*0.7*			*0.5*	*0.4*
Q_2				*0.1*		*0.2*	*0.1*	*0.3*			*0.2*	*0.3*
Q Average				*2.3*		*3.2*	*2.0*	*4.6*			*3.3*	*3.9*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Back of Queue				*4.7*		*6.4*	*4.1*	*9.1*			*6.5*	*7.7*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				1		1	2	2			2	1
Lane Group				L		R	L	T			T	R
Volume (vph)				68		53	490	349			324	543
% Heavy Vehicles				5		5	5	5			5	5
PHF				0.94		0.94	0.94	0.94			0.94	0.94
Pretimed/Actuated (P/A)				A		A	A	A			A	A
Startup Lost Time				2.0		2.0	2.0	2.0			2.0	2.0
Extension of Effective Green				2.0		2.0	2.0	2.0			2.0	2.0
Arrival Type				3		3	3	3			3	3
Unit Extension				3.0		3.0	3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0		0	0	0	0	0		0	0	0
Lane Width				12.0		12.0	12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0		0	0	0			0	0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	WB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = 15.0	G = 0.0	G = 0.0	G = 0.0	G = 21.0	G = 40.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 90.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				72		56	521	371			345	578
Lane Group Capacity				287		256	779	2488			1531	684
v/c Ratio				0.25		0.22	0.67	0.15			0.23	0.85
Green Ratio				0.17		0.17	0.23	0.72			0.44	0.44
Uniform Delay d_1				32.6		32.4	31.3	3.9			15.4	22.2
Delay Factor k				0.11		0.11	0.24	0.11			0.11	0.38
Incremental Delay d_2				0.5		0.4	2.2	0.0			0.1	9.6
PF Factor				1.000		1.000	1.000	1.000			1.000	1.000
Control Delay				33.1		32.9	33.6	3.9			15.5	31.8
Lane Group LOS				C		C	C	A			B	C
Approach Delay				33.0			21.2			25.7		
Approach LOS				C			C			C		
Intersection Delay	24.1			Intersection LOS						C		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*72*		*56*	*521*	*371*			*345*	*578*
Satflow/Lane				*1719*		*1538*	*1719*	*1809*			*1809*	*1538*
Capacity/Lane Group				*287*		*256*	*779*	*2488*			*1531*	*684*
Flow Ratio				*0.0*		*0.0*	*0.2*	*0.1*			0.1	*0.4*
v/c Ratio				*0.25*		*0.22*	*0.67*	*0.15*			*0.23*	*0.85*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*1.6*		*1.2*	*6.1*	*1.5*			*2.8*	*12.9*
k_B				*0.3*		*0.3*	*0.4*	*0.8*			*0.6*	*0.5*
Q_2				*0.1*		*0.1*	*0.8*	*0.1*			*0.2*	*2.5*
Q Average				*1.7*		*1.3*	*6.9*	*1.7*			*3.0*	*15.4*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.0*		*2.1*	*1.9*	*2.0*			*2.0*	*1.8*
Back of Queue				*3.4*		*2.7*	*13.1*	*3.4*			*6.0*	*27.0*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		1					2	1	1	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	162		92					392	56	194	684	
% Heavy Vehicles	3		3					3	3	3	3	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = *30.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *5.0*	G = *31.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *80.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	172		98					417	60	206	728	
Lane Group Capacity	657		588					1361	608	452	1756	
v/c Ratio	0.26		0.17					0.31	0.10	0.46	0.41	
Green Ratio	0.38		0.38					0.39	0.39	0.51	0.50	
Uniform Delay d_1	17.3		16.7					17.0	15.6	13.4	12.6	
Delay Factor k	0.11		0.11					0.11	0.11	0.11	0.11	
Incremental Delay d_2	0.2		0.1					0.1	0.1	0.7	0.2	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	17.5		16.8					17.2	15.7	14.1	12.8	
Lane Group LOS	B		B					B	B	B	B	
Approach Delay	17.3						17.0			13.1		
Approach LOS	B						B			B		
Intersection Delay	14.9			Intersection LOS						B		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*172*		*98*					*417*	*60*	*206*	*728*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*882*	*1844*	
Capacity/Lane Group	*657*		*588*					*1361*	*608*	*452*	*1756*	
Flow Ratio	*0.1*		*0.1*					*0.1*	*0.0*	*0.2*	0.2	
v/c Ratio	*0.26*		*0.17*					*0.31*	*0.10*	*0.46*	*0.41*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*2.6*		*1.5*					*3.4*	*0.8*	*2.3*	*5.4*	
k_B	*0.5*		*0.5*					*0.5*	*0.5*	*0.4*	*0.6*	
Q_2	*0.2*		*0.1*					*0.2*	*0.1*	*0.3*	*0.4*	
Q Average	*2.8*		*1.5*					*3.6*	*0.9*	*2.6*	*5.8*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*2.0*		*2.1*					*2.0*	*2.1*	*2.0*	*1.9*	
Back of Queue	*5.7*		*3.2*					*7.2*	*1.9*	*5.3*	*11.2*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		1					2	1	1	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	187		123					972	149	386	654	
% Heavy Vehicles	5		5					5	5	5	5	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = 24.0	G = 0.0	G = 0.0	G = 0.0	G = 26.0	G = 36.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25

Cycle Length C = 100.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	199		131					1034	159	411	696	
Lane Group Capacity	413		369					1240	554	520	2274	
v/c Ratio	0.48		0.36					0.83	0.29	0.79	0.31	
Green Ratio	0.24		0.24					0.36	0.36	0.67	0.66	
Uniform Delay d_1	32.7		31.6					29.3	22.8	25.4	7.2	
Delay Factor k	0.11		0.11					0.37	0.11	0.34	0.11	
Incremental Delay d_2	0.9		0.6					5.1	0.3	8.1	0.1	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	33.5		32.2					34.3	23.1	33.5	7.3	
Lane Group LOS	C		C					C	C	C	A	
Approach Delay	33.0						32.8			17.0		
Approach LOS	C						C			B		
Intersection Delay	26.2			Intersection LOS						C		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*199*		*131*					*1034*	*159*	*411*	*696*	
Satflow/Lane	*1719*		*1538*					*1809*	*1538*	*775*	*1809*	
Capacity/Lane Group	*413*		*369*					*1240*	*554*	*520*	*2274*	
Flow Ratio	*0.1*		*0.1*					*0.3*	*0.1*	*0.5*	0.2	
v/c Ratio	*0.48*		*0.36*					*0.83*	*0.29*	*0.79*	*0.31*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*4.8*		*3.0*					*13.8*	*3.2*	*4.7*	*4.3*	
k_B	*0.4*		*0.4*					*0.6*	*0.5*	*0.5*	*0.8*	
Q_2	*0.4*		*0.2*					*2.4*	*0.2*	*1.7*	*0.4*	
Q Average	*5.1*		*3.2*					*16.2*	*3.4*	*6.4*	*4.7*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.0*		*2.0*					*1.7*	*2.0*	*1.9*	*2.0*	
Back of Queue	*10.0*		*6.5*					*28.3*	*6.7*	*12.3*	*9.2*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*1*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*245*		*144*					*623*	*87*	*320*	*1101*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = *32.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *16.0*	G = *28.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*261*		*153*					*663*	*93*	*340*	*1171*	
Lane Group Capacity	*623*		*558*					*1093*	*488*	*460*	*1873*	
v/c Ratio	*0.42*		*0.27*					*0.61*	*0.19*	*0.74*	*0.63*	
Green Ratio	*0.36*		*0.36*					*0.31*	*0.31*	*0.54*	*0.53*	
Uniform Delay d_1	*22.0*		*20.7*					*26.3*	*22.7*	*13.9*	*14.7*	
Delay Factor k	*0.11*		*0.11*					*0.19*	*0.11*	*0.30*	*0.21*	
Incremental Delay d_2	*0.5*		*0.3*					*1.0*	*0.2*	*6.2*	*0.7*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*22.4*		*21.0*					*27.3*	*22.9*	*20.1*	*15.4*	
Lane Group LOS	*C*		*C*					*C*	*C*	*C*	*B*	
Approach Delay	*21.9*						*26.8*			*16.4*		
Approach LOS	*C*						*C*			*B*		
Intersection Delay	*20.2*			Intersection LOS						*C*		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*261*		*153*					*663*	*93*	*340*	*1171*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*846*	*1844*	
Capacity/Lane Group	*623*		*558*					*1093*	*488*	*460*	*1873*	
Flow Ratio	*0.1*		*0.1*					*0.2*	*0.1*	*0.4*	0.3	
v/c Ratio	*0.42*		*0.27*					*0.61*	*0.19*	*0.74*	*0.63*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*4.9*		*2.7*					*7.4*	*1.7*	*4.5*	*10.8*	
k_B	*0.5*		*0.5*					*0.5*	*0.4*	*0.4*	*0.7*	
Q_2	*0.4*		*0.2*					*0.7*	*0.1*	*1.1*	*1.1*	
Q Average	*5.3*		*2.9*					*8.1*	*1.8*	*5.6*	*11.9*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.9*		*2.0*					*1.9*	*2.0*	*1.9*	*1.8*	
Back of Queue	*10.3*		*5.9*					*15.3*	*3.7*	*10.8*	*21.5*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*2*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*245*		*144*					*623*	*87*	*320*	*1101*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *27.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *21.0*	G = *28.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*261*		*153*					*663*	*93*	*340*	*1171*	
Lane Group Capacity	*526*		*470*					*1093*	*488*	*794*	*2068*	
v/c Ratio	*0.50*		*0.33*					*0.61*	*0.19*	*0.43*	*0.57*	
Green Ratio	*0.30*		*0.30*					*0.31*	*0.31*	*0.23*	*0.59*	
Uniform Delay d_1	*25.9*		*24.4*					*26.3*	*22.7*	*29.4*	*11.4*	
Delay Factor k	*0.11*		*0.11*					*0.19*	*0.11*	*0.11*	*0.16*	
Incremental Delay d_2	*0.7*		*0.4*					*1.0*	*0.2*	*0.4*	*0.4*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*26.6*		*24.8*					*27.3*	*22.9*	*29.8*	*11.8*	
Lane Group LOS	*C*		*C*					*C*	*C*	*C*	*B*	
Approach Delay	*26.0*						*26.8*			*15.8*		
Approach LOS	*C*						*C*			*B*		
Intersection Delay	*20.5*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*261*		*153*					*663*	*93*	*340*	*1171*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*1752*	*1844*	
Capacity/Lane Group	*526*		*470*					*1093*	*488*	*794*	*2068*	
Flow Ratio	*0.1*		*0.1*					*0.2*	*0.1*	*0.1*	0.3	
v/c Ratio	*0.50*		*0.33*					*0.61*	*0.19*	*0.43*	*0.57*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*5.4*		*3.0*					*7.4*	*1.7*	*3.7*	*9.5*	
k_B	*0.5*		*0.4*					*0.5*	*0.4*	*0.4*	*0.7*	
Q_2	*0.5*		*0.2*					*0.7*	*0.1*	*0.3*	*0.9*	
Q Average	*5.8*		*3.2*					*8.1*	*1.8*	*4.0*	*10.4*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.9*		*2.0*					*1.9*	*2.0*	*2.0*	*1.8*	
Back of Queue	*11.3*		*6.4*					*15.3*	*3.7*	*8.0*	*19.1*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*1*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*293*		*174*					*1532*	*252*	*605*	*1073*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = *21.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *36.0*	G = *49.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *120.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*312*		*185*					*1630*	*268*	*644*	*1141*	
Lane Group Capacity	*307*		*274*					*1434*	*640*	*588*	*2605*	
v/c Ratio	*1.02*		*0.68*					*1.14*	*0.42*	*1.10*	*0.44*	
Green Ratio	*0.17*		*0.17*					*0.41*	*0.41*	*0.75*	*0.74*	
Uniform Delay d_1	*49.5*		*46.3*					*35.5*	*25.3*	*36.8*	*5.9*	
Delay Factor k	*0.50*		*0.25*					*0.50*	*0.11*	*0.50*	*0.11*	
Incremental Delay d_2	*55.6*		*6.5*					*70.6*	*0.4*	*65.8*	*0.1*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*105.1*		*52.8*					*106.1*	*25.8*	*102.6*	*6.0*	
Lane Group LOS	*F*		*D*					*F*	*C*	*F*	*A*	
Approach Delay	*85.6*						*94.8*			*40.9*		
Approach LOS	*F*						*F*			*D*		
Intersection Delay	*70.7*			Intersection LOS						*E*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*312*		*185*					*1630*	*268*	*644*	*1141*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*783*	*1844*	
Capacity/Lane Group	*307*		*274*					*1434*	*640*	*588*	*2605*	
Flow Ratio	*0.2*		*0.1*					*0.5*	*0.2*	*0.8*	0.3	
v/c Ratio	*1.02*		*0.68*					*1.14*	*0.42*	*1.10*	*0.44*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*10.4*		*5.8*					*28.5*	*6.4*	*7.7*	*7.6*	
k_B	*0.4*		*0.4*					*0.7*	*0.6*	*0.6*	*1.0*	
Q_2	*4.3*		*0.7*					*17.2*	*0.4*	*11.2*	*0.8*	
Q Average	*14.7*		*6.5*					*45.7*	*6.8*	*18.9*	*8.4*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*1.8*		*1.9*					*1.5*	*1.9*	*1.7*	*1.9*	
Back of Queue	*25.9*		*12.5*					*70.7*	*13.0*	*32.3*	*15.8*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*2*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*293*		*174*					*1532*	*252*	*605*	*1073*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *20.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *21.0*	G = *45.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *100.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*312*		*185*					*1630*	*268*	*644*	*1141*	
Lane Group Capacity	*350*		*314*					*1580*	*706*	*715*	*2458*	
v/c Ratio	*0.89*		*0.59*					*1.03*	*0.38*	*0.90*	*0.46*	
Green Ratio	*0.20*		*0.20*					*0.45*	*0.45*	*0.21*	*0.70*	
Uniform Delay d_1	*38.9*		*36.3*					*27.5*	*18.2*	*38.5*	*6.7*	
Delay Factor k	*0.42*		*0.18*					*0.50*	*0.11*	*0.42*	*0.11*	
Incremental Delay d_2	*23.6*		*2.9*					*31.2*	*0.3*	*14.6*	*0.1*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*62.6*		*39.2*					*58.7*	*18.6*	*53.0*	*6.8*	
Lane Group LOS	*E*		*D*					*E*	*B*	*D*	*A*	
Approach Delay	*53.9*						*53.0*			*23.5*		
Approach LOS	*D*						*D*			*C*		
Intersection Delay	*40.5*			Intersection LOS						*D*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*312*		*185*					*1630*	*268*	*644*	*1141*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*1752*	*1844*	
Capacity/Lane Group	*350*		*314*					*1580*	*706*	*715*	*2458*	
Flow Ratio	*0.2*		*0.1*					*0.5*	*0.2*	*0.2*	0.3	
v/c Ratio	*0.89*		*0.59*					*1.03*	*0.38*	*0.90*	*0.46*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*8.4*		*4.7*					*23.8*	*4.9*	*9.0*	*7.4*	
k_B	*0.4*		*0.4*					*0.7*	*0.6*	*0.4*	*0.9*	
Q_2	*2.2*		*0.5*					*10.2*	*0.4*	*2.4*	*0.7*	
Q Average	*10.6*		*5.2*					*34.0*	*5.3*	*11.3*	*8.1*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.8*		*2.0*					*1.6*	*1.9*	*1.8*	*1.9*	
Back of Queue	*19.5*		*10.1*					*54.1*	*10.3*	*20.6*	*15.3*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*03/03/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*1*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*148*		*252*	*63*	*491*			*730*	*155*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = *30.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *5.0*	G = *31.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*

Duration of Analysis (hrs) = *0.25*

Cycle Length C = *80.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*157*		*268*	*67*	*522*			*777*	*165*
Lane Group Capacity				*657*		*588*	*289*	*1756*			*1361*	*608*
v/c Ratio				*0.24*		*0.46*	*0.23*	*0.30*			*0.57*	*0.27*
Green Ratio				*0.38*		*0.38*	*0.51*	*0.50*			*0.39*	*0.39*
Uniform Delay d_1				*17.2*		*18.8*	*11.3*	*11.7*			*19.3*	*16.8*
Delay Factor k				*0.11*		*0.11*	*0.11*	*0.11*			*0.17*	*0.11*
Incremental Delay d_2				*0.2*		*0.6*	*0.4*	*0.1*			*0.6*	*0.2*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*17.4*		*19.4*	*11.7*	*11.8*			*19.8*	*17.0*
Lane Group LOS				*B*		*B*	*B*	*B*			*B*	*B*
Approach Delay				*18.6*			*11.8*			*19.4*		
Approach LOS				*B*			*B*			*B*		
Intersection Delay	*16.9*			Intersection LOS						*B*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*157*		*268*	*67*	*522*			*777*	*165*
Satflow/Lane				*1752*		*1568*	*562*	*1844*			*1844*	*1568*
Capacity/Lane Group				*657*		*588*	*289*	*1756*			*1361*	*608*
Flow Ratio				*0.1*		*0.2*	*0.1*	*0.1*			0.2	*0.1*
v/c Ratio				*0.24*		*0.46*	*0.23*	*0.30*			*0.57*	*0.27*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*2.4*		*4.5*	*0.7*	*3.6*			*7.1*	*2.5*
k_B				*0.5*		*0.5*	*0.3*	*0.6*			*0.5*	*0.5*
Q_2				*0.2*		*0.4*	*0.1*	*0.3*			*0.7*	*0.2*
Q Average				*2.6*		*4.9*	*0.8*	*3.8*			*7.8*	*2.7*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.0*		*2.0*	*2.1*	*2.0*			*1.9*	*2.0*
Back of Queue				*5.2*		*9.5*	*1.7*	*7.6*			*14.8*	*5.4*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				1		1	1	2			2	1
Lane Group				L		R	L	T			T	R
Volume (vph)				165		220	152	1007			875	246
% Heavy Vehicles				3		3	3	3			3	3
PHF				0.94		0.94	0.94	0.94			0.94	0.94
Pretimed/Actuated (P/A)				A		A	A	A			A	A
Startup Lost Time				2.0		2.0	2.0	2.0			2.0	2.0
Extension of Effective Green				2.0		2.0	2.0	2.0			2.0	2.0
Arrival Type				3		3	3	3			3	3
Unit Extension				3.0		3.0	3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0		0	0	0	0	0		0	0	0
Lane Width				12.0		12.0	12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0		0	0	0			0	0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = 28.0	G = 0.0	G = 0.0	G = 0.0	G = 5.0	G = 33.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 80.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				176		234	162	1071			931	262
Lane Group Capacity				613		549	255	1844			1449	647
v/c Ratio				0.29		0.43	0.64	0.58			0.64	0.40
Green Ratio				0.35		0.35	0.54	0.52			0.41	0.41
Uniform Delay d_1				18.8		19.9	12.1	13.0			18.8	16.6
Delay Factor k				0.11		0.11	0.22	0.17			0.22	0.11
Incremental Delay d_2				0.3		0.5	5.1	0.5			1.0	0.4
PF Factor				1.000		1.000	1.000	1.000			1.000	1.000
Control Delay				19.0		20.4	17.3	13.5			19.8	17.0
Lane Group LOS				B		C	B	B			B	B
Approach Delay				19.8			14.0			19.2		
Approach LOS				B			B			B		
Intersection Delay	17.0			Intersection LOS						B		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*176*		*234*	*162*	*1071*			*931*	*262*
Satflow/Lane				*1752*		*1568*	*474*	*1844*			*1844*	*1568*
Capacity/Lane Group				*613*		*549*	*255*	*1844*			*1449*	*647*
Flow Ratio				*0.1*		*0.1*	*0.3*	*0.3*			0.3	*0.2*
v/c Ratio				*0.29*		*0.43*	*0.64*	*0.58*			*0.64*	*0.40*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*2.8*		*4.0*	*1.7*	*8.5*			*8.7*	*4.1*
k_B				*0.5*		*0.4*	*0.3*	*0.6*			*0.5*	*0.5*
Q_2				*0.2*		*0.3*	*0.5*	*0.9*			*0.9*	*0.3*
Q Average				*3.0*		*4.3*	*2.2*	*9.4*			*9.6*	*4.4*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.0*		*2.0*	*2.0*	*1.9*			*1.9*	*2.0*
Back of Queue				*6.1*		*8.5*	*4.5*	*17.4*			*17.8*	*8.7*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*1*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*232*		*419*	*99*	*769*			*1189*	*219*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = *33.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *5.0*	G = *38.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*247*		*446*	*105*	*818*			*1265*	*233*
Lane Group Capacity				*642*		*575*	*179*	*1834*			*1483*	*662*
v/c Ratio				*0.38*		*0.78*	*0.59*	*0.45*			*0.85*	*0.35*
Green Ratio				*0.37*		*0.37*	*0.53*	*0.52*			*0.42*	*0.42*
Uniform Delay d_1				*21.0*		*25.2*	*16.7*	*13.4*			*23.5*	*17.6*
Delay Factor k				*0.11*		*0.33*	*0.18*	*0.11*			*0.39*	*0.11*
Incremental Delay d_2				*0.4*		*6.6*	*4.9*	*0.2*			*5.0*	*0.3*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*21.4*		*31.8*	*21.6*	*13.6*			*28.5*	*18.0*
Lane Group LOS				*C*		*C*	*C*	*B*			*C*	*B*
Approach Delay				*28.1*			*14.5*			*26.9*		
Approach LOS				*C*			*B*			*C*		
Intersection Delay	*23.5*			Intersection LOS						*C*		

*HCS+*TM Version 5.3

Generated: 5/13/2009 12:52 PM

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*247*		*446*	*105*	*818*			*1265*	*233*
Satflow/Lane				*1752*		*1568*	*337*	*1844*			*1844*	*1568*
Capacity/Lane Group				*642*		*575*	*179*	*1834*			*1483*	*662*
Flow Ratio				*0.1*		*0.3*	*0.3*	*0.2*			0.4	*0.1*
v/c Ratio				*0.38*		*0.78*	*0.59*	*0.45*			*0.85*	*0.35*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*4.6*		*9.9*	*1.3*	*6.7*			*15.0*	*4.0*
k_B				*0.5*		*0.5*	*0.2*	*0.7*			*0.6*	*0.5*
Q_2				*0.3*		*1.6*	*0.3*	*0.5*			*2.9*	*0.3*
Q Average				*4.9*		*11.4*	*1.6*	*7.2*			*17.9*	*4.2*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.0*		*1.8*	*2.0*	*1.9*			*1.7*	*2.0*
Back of Queue				*9.6*		*20.8*	*3.3*	*13.7*			*30.8*	*8.4*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3 Generated: 5/13/2009 12:53 PM

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*2*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*232*		*419*	*99*	*769*			*1189*	*219*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = *31.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *10.0*	G = *35.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *90.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*247*		*446*	*105*	*818*			*1265*	*233*
Lane Group Capacity				*603*		*540*	*378*	*1912*			*1366*	*610*
v/c Ratio				*0.41*		*0.83*	*0.28*	*0.43*			*0.93*	*0.38*
Green Ratio				*0.34*		*0.34*	*0.11*	*0.54*			*0.39*	*0.39*
Uniform Delay d_1				*22.5*		*27.0*	*36.7*	*12.2*			*26.3*	*19.7*
Delay Factor k				*0.11*		*0.36*	*0.11*	*0.11*			*0.44*	*0.11*
Incremental Delay d_2				*0.5*		*10.2*	*0.4*	*0.2*			*11.0*	*0.4*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*23.0*		*37.2*	*37.1*	*12.3*			*37.2*	*20.1*
Lane Group LOS				*C*		*D*	*D*	*B*			*D*	*C*
Approach Delay				*32.1*			*15.1*			*34.6*		
Approach LOS				*C*			*B*			*C*		
Intersection Delay	*28.3*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*247*		*446*	*105*	*818*			*1265*	*233*
Satflow/Lane				*1752*		*1568*	*1752*	*1844*			*1844*	*1568*
Capacity/Lane Group				*603*		*540*	*378*	*1912*			*1366*	*610*
Flow Ratio				*0.1*		*0.3*	*0.0*	*0.2*			0.4	*0.1*
v/c Ratio				*0.41*		*0.83*	*0.28*	*0.43*			*0.93*	*0.38*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*4.7*		*10.2*	*1.2*	*6.4*			*15.9*	*4.2*
k_B				*0.5*		*0.5*	*0.3*	*0.7*			*0.6*	*0.5*
Q_2				*0.4*		*1.9*	*0.1*	*0.5*			*4.3*	*0.3*
Q Average				*5.1*		*12.2*	*1.3*	*6.9*			*20.1*	*4.5*
Percentile Back of Queue (95th percentile)												
$f_{B\%}$				*2.0*		*1.8*	*2.1*	*1.9*			*1.7*	*2.0*
Back of Queue				*9.9*		*21.9*	*2.8*	*13.1*			*34.2*	*8.8*
Queue Storage Ratio												
Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*1*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*259*		*364*	*238*	*1587*			*1419*	*364*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = *29.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *13.0*	G = *44.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *100.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*276*		*387*	*253*	*1688*			*1510*	*387*
Lane Group Capacity				*508*		*455*	*302*	*2142*			*1545*	*690*
v/c Ratio				*0.54*		*0.85*	*0.84*	*0.79*			*0.98*	*0.56*
Green Ratio				*0.29*		*0.29*	*0.62*	*0.61*			*0.44*	*0.44*
Uniform Delay d_1				*29.9*		*33.5*	*28.8*	*14.6*			*27.5*	*20.8*
Delay Factor k				*0.14*		*0.38*	*0.37*	*0.33*			*0.48*	*0.16*
Incremental Delay d_2				*1.2*		*14.2*	*18.4*	*2.0*			*17.7*	*1.0*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*31.1*		*47.7*	*47.2*	*16.7*			*45.2*	*21.9*
Lane Group LOS				*C*		*D*	*D*	*B*			*D*	*C*
Approach Delay				*40.8*			*20.7*			*40.5*		
Approach LOS				*D*			*C*			*D*		
Intersection Delay	*32.0*			Intersection LOS						*C*		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*276*		*387*	*253*	*1688*			*1510*	*387*
Satflow/Lane				*1752*		*1568*	*487*	*1844*			*1844*	*1568*
Capacity/Lane Group				*508*		*455*	*302*	*2142*			*1545*	*690*
Flow Ratio				*0.2*		*0.2*	*0.5*	*0.5*			0.4	*0.2*
v/c Ratio				*0.54*		*0.85*	*0.84*	*0.79*			*0.98*	*0.56*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*6.5*		*10.1*	*3.0*	*18.5*			*21.7*	*8.0*
k_B				*0.5*		*0.5*	*0.4*	*0.8*			*0.6*	*0.6*
Q_2				*0.6*		*2.1*	*1.5*	*2.7*			*7.0*	*0.7*
Q Average				*7.0*		*12.2*	*4.5*	*21.2*			*28.6*	*8.7*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*1.9*		*1.8*	*2.0*	*1.7*			*1.6*	*1.9*
Back of Queue				*13.4*		*22.1*	*8.8*	*35.7*			*46.4*	*16.3*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information

Analyst	*SKB*
Agency or Co.	*TDOT / Long Engineering*
Date Performed	*05/04/2009*
Time Period	*PM Peak Period*

Site Information

Intersection	*APD-40 WB @ South Lee Hwy.*
Area Type	*All other areas*
Jurisdiction	*Cleveland, TN*
Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*2*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*259*		*364*	*238*	*1587*			*1419*	*364*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = *30.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *12.0*	G = *44.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *100.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*276*		*387*	*253*	*1688*			*1510*	*387*
Lane Group Capacity				*526*		*470*	*408*	*2107*			*1545*	*690*
v/c Ratio				*0.52*		*0.82*	*0.62*	*0.80*			*0.98*	*0.56*
Green Ratio				*0.30*		*0.30*	*0.12*	*0.60*			*0.44*	*0.44*
Uniform Delay d_1				*29.1*		*32.5*	*41.8*	*15.4*			*27.5*	*20.8*
Delay Factor k				*0.13*		*0.36*	*0.20*	*0.34*			*0.48*	*0.16*
Incremental Delay d_2				*1.0*		*11.3*	*2.9*	*2.3*			*17.7*	*1.0*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*30.0*		*43.9*	*44.7*	*17.7*			*45.2*	*21.9*
Lane Group LOS				*C*		*D*	*D*	*B*			*D*	*C*
Approach Delay				*38.1*			*21.2*			*40.5*		
Approach LOS				*D*			*C*			*D*		
Intersection Delay	*31.8*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*276*		*387*	*253*	*1688*			*1510*	*387*
Satflow/Lane				*1752*		*1568*	*1752*	*1844*			*1844*	*1568*
Capacity/Lane Group				*526*		*470*	*408*	*2107*			*1545*	*690*
Flow Ratio				*0.2*		*0.2*	*0.1*	*0.5*			0.4	*0.2*
v/c Ratio				*0.52*		*0.82*	*0.62*	*0.80*			*0.98*	*0.56*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*6.4*		*10.0*	*3.4*	*19.0*			*21.7*	*8.0*
k_B				*0.5*		*0.5*	*0.3*	*0.8*			*0.6*	*0.6*
Q_2				*0.5*		*1.8*	*0.4*	*2.8*			*7.0*	*0.7*
Q Average				*6.9*		*11.8*	*3.9*	*21.8*			*28.6*	*8.7*
Percentile Back of Queue (95th percentile)												
$f_{B\%}$				*1.9*		*1.8*	*2.0*	*1.7*			*1.6*	*1.9*
Back of Queue				*13.2*		*21.4*	*7.7*	*36.6*			*46.4*	*16.3*
Queue Storage Ratio												
Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		1					2	1	1	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	162		92					392	56	194	684	
% Heavy Vehicles	3		3					3	3	3	3	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = 30.0	G = 0.0	G = 0.0	G = 0.0	G = 5.0	G = 31.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25

Cycle Length C = 80.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	172		98					417	60	206	728	
Lane Group Capacity	657		588					1361	608	452	1756	
v/c Ratio	0.26		0.17					0.31	0.10	0.46	0.41	
Green Ratio	0.38		0.38					0.39	0.39	0.51	0.50	
Uniform Delay d_1	17.3		16.7					17.0	15.6	13.4	12.6	
Delay Factor k	0.11		0.11					0.11	0.11	0.11	0.11	
Incremental Delay d_2	0.2		0.1					0.1	0.1	0.7	0.2	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	17.5		16.8					17.2	15.7	14.1	12.8	
Lane Group LOS	B		B					B	B	B	B	
Approach Delay	17.3						17.0			13.1		
Approach LOS	B						B			B		
Intersection Delay	14.9			Intersection LOS						B		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*172*		*98*					*417*	*60*	*206*	*728*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*882*	*1844*	
Capacity/Lane Group	*657*		*588*					*1361*	*608*	*452*	*1756*	
Flow Ratio	*0.1*		*0.1*					*0.1*	*0.0*	*0.2*	0.2	
v/c Ratio	*0.26*		*0.17*					*0.31*	*0.10*	*0.46*	*0.41*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*2.6*		*1.5*					*3.4*	*0.8*	*2.3*	*5.4*	
k_B	*0.5*		*0.5*					*0.5*	*0.5*	*0.4*	*0.6*	
Q_2	*0.2*		*0.1*					*0.2*	*0.1*	*0.3*	*0.4*	
Q Average	*2.8*		*1.5*					*3.6*	*0.9*	*2.6*	*5.8*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.0*		*2.1*					*2.0*	*2.1*	*2.0*	*1.9*	
Back of Queue	*5.7*		*3.2*					*7.2*	*1.9*	*5.3*	*11.2*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		1					2	1	1	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	187		123					972	149	386	654	
% Heavy Vehicles	5		5					5	5	5	5	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = 24.0	G = 0.0	G = 0.0	G = 0.0	G = 26.0	G = 36.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 100.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	199		131					1034	159	411	696	
Lane Group Capacity	413		369					1240	554	520	2274	
v/c Ratio	0.48		0.36					0.83	0.29	0.79	0.31	
Green Ratio	0.24		0.24					0.36	0.36	0.67	0.66	
Uniform Delay d_1	32.7		31.6					29.3	22.8	25.4	7.2	
Delay Factor k	0.11		0.11					0.37	0.11	0.34	0.11	
Incremental Delay d_2	0.9		0.6					5.1	0.3	8.1	0.1	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	33.5		32.2					34.3	23.1	33.5	7.3	
Lane Group LOS	C		C					C	C	C	A	
Approach Delay	33.0						32.8			17.0		
Approach LOS	C						C			B		
Intersection Delay	26.2			Intersection LOS						C		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*199*		*131*					*1034*	*159*	*411*	*696*	
Satflow/Lane	*1719*		*1538*					*1809*	*1538*	*775*	*1809*	
Capacity/Lane Group	*413*		*369*					*1240*	*554*	*520*	*2274*	
Flow Ratio	*0.1*		*0.1*					*0.3*	*0.1*	*0.5*	0.2	
v/c Ratio	*0.48*		*0.36*					*0.83*	*0.29*	*0.79*	*0.31*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*4.8*		*3.0*					*13.8*	*3.2*	*4.7*	*4.3*	
k_B	*0.4*		*0.4*					*0.6*	*0.5*	*0.5*	*0.8*	
Q_2	*0.4*		*0.2*					*2.4*	*0.2*	*1.7*	*0.4*	
Q Average	*5.1*		*3.2*					*16.2*	*3.4*	*6.4*	*4.7*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*2.0*		*2.0*					*1.7*	*2.0*	*1.9*	*2.0*	
Back of Queue	*10.0*		*6.5*					*28.3*	*6.7*	*12.3*	*9.2*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*1*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*245*		*144*					*623*	*87*	*320*	*1101*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = *32.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *16.0*	G = *28.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *90.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*261*		*153*					*663*	*93*	*340*	*1171*	
Lane Group Capacity	*623*		*558*					*1093*	*488*	*460*	*1873*	
v/c Ratio	*0.42*		*0.27*					*0.61*	*0.19*	*0.74*	*0.63*	
Green Ratio	*0.36*		*0.36*					*0.31*	*0.31*	*0.54*	*0.53*	
Uniform Delay d_1	*22.0*		*20.7*					*26.3*	*22.7*	*13.9*	*14.7*	
Delay Factor k	*0.11*		*0.11*					*0.19*	*0.11*	*0.30*	*0.21*	
Incremental Delay d_2	*0.5*		*0.3*					*1.0*	*0.2*	*6.2*	*0.7*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*22.4*		*21.0*					*27.3*	*22.9*	*20.1*	*15.4*	
Lane Group LOS	*C*		*C*					*C*	*C*	*C*	*B*	
Approach Delay	*21.9*						*26.8*			*16.4*		
Approach LOS	*C*						*C*			*B*		
Intersection Delay	*20.2*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*261*		*153*					*663*	*93*	*340*	*1171*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*846*	*1844*	
Capacity/Lane Group	*623*		*558*					*1093*	*488*	*460*	*1873*	
Flow Ratio	*0.1*		*0.1*					*0.2*	*0.1*	*0.4*	0.3	
v/c Ratio	*0.42*		*0.27*					*0.61*	*0.19*	*0.74*	*0.63*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*4.9*		*2.7*					*7.4*	*1.7*	*4.5*	*10.8*	
k_B	*0.5*		*0.5*					*0.5*	*0.4*	*0.4*	*0.7*	
Q_2	*0.4*		*0.2*					*0.7*	*0.1*	*1.1*	*1.1*	
Q Average	*5.3*		*2.9*					*8.1*	*1.8*	*5.6*	*11.9*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*1.9*		*2.0*					*1.9*	*2.0*	*1.9*	*1.8*	
Back of Queue	*10.3*		*5.9*					*15.3*	*3.7*	*10.8*	*21.5*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*2*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*245*		*144*					*623*	*87*	*320*	*1101*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *27.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *21.0*	G = *28.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*261*		*153*					*663*	*93*	*340*	*1171*	
Lane Group Capacity	*526*		*470*					*1093*	*488*	*794*	*2068*	
v/c Ratio	*0.50*		*0.33*					*0.61*	*0.19*	*0.43*	*0.57*	
Green Ratio	*0.30*		*0.30*					*0.31*	*0.31*	*0.23*	*0.59*	
Uniform Delay d_1	*25.9*		*24.4*					*26.3*	*22.7*	*29.4*	*11.4*	
Delay Factor k	*0.11*		*0.11*					*0.19*	*0.11*	*0.11*	*0.16*	
Incremental Delay d_2	*0.7*		*0.4*					*1.0*	*0.2*	*0.4*	*0.4*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*26.6*		*24.8*					*27.3*	*22.9*	*29.8*	*11.8*	
Lane Group LOS	*C*		*C*					*C*	*C*	*C*	*B*	
Approach Delay	*26.0*						*26.8*			*15.8*		
Approach LOS	*C*						*C*			*B*		
Intersection Delay	*20.5*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*261*		*153*					*663*	*93*	*340*	*1171*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*1752*	*1844*	
Capacity/Lane Group	*526*		*470*					*1093*	*488*	*794*	*2068*	
Flow Ratio	*0.1*		*0.1*					*0.2*	*0.1*	*0.1*	0.3	
v/c Ratio	*0.50*		*0.33*					*0.61*	*0.19*	*0.43*	*0.57*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*5.4*		*3.0*					*7.4*	*1.7*	*3.7*	*9.5*	
k_B	*0.5*		*0.4*					*0.5*	*0.4*	*0.4*	*0.7*	
Q_2	*0.5*		*0.2*					*0.7*	*0.1*	*0.3*	*0.9*	
Q Average	*5.8*		*3.2*					*8.1*	*1.8*	*4.0*	*10.4*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.9*		*2.0*					*1.9*	*2.0*	*2.0*	*1.8*	
Back of Queue	*11.3*		*6.4*					*15.3*	*3.7*	*8.0*	*19.1*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+^{TM} Version 5.3

Generated: 5/13/2009 12:43 PM

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*1*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*293*		*174*					*1532*	*252*	*605*	*1073*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	NS Perm	07	08
Timing	G = *21.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *36.0*	G = *49.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *120.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*312*		*185*					*1630*	*268*	*644*	*1141*	
Lane Group Capacity	*307*		*274*					*1434*	*640*	*588*	*2605*	
v/c Ratio	*1.02*		*0.68*					*1.14*	*0.42*	*1.10*	*0.44*	
Green Ratio	*0.17*		*0.17*					*0.41*	*0.41*	*0.75*	*0.74*	
Uniform Delay d_1	*49.5*		*46.3*					*35.5*	*25.3*	*36.8*	*5.9*	
Delay Factor k	*0.50*		*0.25*					*0.50*	*0.11*	*0.50*	*0.11*	
Incremental Delay d_2	*55.6*		*6.5*					*70.6*	*0.4*	*65.8*	*0.1*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*105.1*		*52.8*					*106.1*	*25.8*	*102.6*	*6.0*	
Lane Group LOS	*F*		*D*					*F*	*C*	*F*	*A*	
Approach Delay	*85.6*						*94.8*			*40.9*		
Approach LOS	*F*						*F*			*D*		
Intersection Delay	*70.7*			Intersection LOS						*E*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*312*		*185*					*1630*	*268*	*644*	*1141*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*783*	*1844*	
Capacity/Lane Group	*307*		*274*					*1434*	*640*	*588*	*2605*	
Flow Ratio	*0.2*		*0.1*					*0.5*	*0.2*	*0.8*	0.3	
v/c Ratio	*1.02*		*0.68*					*1.14*	*0.42*	*1.10*	*0.44*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*10.4*		*5.8*					*28.5*	*6.4*	*7.7*	*7.6*	
k_B	*0.4*		*0.4*					*0.7*	*0.6*	*0.6*	*1.0*	
Q_2	*4.3*		*0.7*					*17.2*	*0.4*	*11.2*	*0.8*	
Q Average	*14.7*		*6.5*					*45.7*	*6.8*	*18.9*	*8.4*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*1.8*		*1.9*					*1.5*	*1.9*	*1.7*	*1.9*	
Back of Queue	*25.9*		*12.5*					*70.7*	*13.0*	*32.3*	*15.8*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 EB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*1*					*2*	*1*	*2*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*293*		*174*					*1532*	*252*	*605*	*1073*	
% Heavy Vehicles	*3*		*3*					*3*	*3*	*3*	*3*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *20.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *21.0*	G = *45.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *100.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*312*		*185*					*1630*	*268*	*644*	*1141*	
Lane Group Capacity	*350*		*314*					*1580*	*706*	*715*	*2458*	
v/c Ratio	*0.89*		*0.59*					*1.03*	*0.38*	*0.90*	*0.46*	
Green Ratio	*0.20*		*0.20*					*0.45*	*0.45*	*0.21*	*0.70*	
Uniform Delay d_1	*38.9*		*36.3*					*27.5*	*18.2*	*38.5*	*6.7*	
Delay Factor k	*0.42*		*0.18*					*0.50*	*0.11*	*0.42*	*0.11*	
Incremental Delay d_2	*23.6*		*2.9*					*31.2*	*0.3*	*14.6*	*0.1*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*62.6*		*39.2*					*58.7*	*18.6*	*53.0*	*6.8*	
Lane Group LOS	*E*		*D*					*E*	*B*	*D*	*A*	
Approach Delay	*53.9*						*53.0*			*23.5*		
Approach LOS	*D*						*D*			*C*		
Intersection Delay	*40.5*			Intersection LOS						*D*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*312*		*185*					*1630*	*268*	*644*	*1141*	
Satflow/Lane	*1752*		*1568*					*1844*	*1568*	*1752*	*1844*	
Capacity/Lane Group	*350*		*314*					*1580*	*706*	*715*	*2458*	
Flow Ratio	*0.2*		*0.1*					*0.5*	*0.2*	*0.2*	0.3	
v/c Ratio	*0.89*		*0.59*					*1.03*	*0.38*	*0.90*	*0.46*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*8.4*		*4.7*					*23.8*	*4.9*	*9.0*	*7.4*	
k_B	*0.4*		*0.4*					*0.7*	*0.6*	*0.4*	*0.9*	
Q_2	*2.2*		*0.5*					*10.2*	*0.4*	*2.4*	*0.7*	
Q Average	*10.6*		*5.2*					*34.0*	*5.3*	*11.3*	*8.1*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.8*		*2.0*					*1.6*	*1.9*	*1.8*	*1.9*	
Back of Queue	*19.5*		*10.1*					*54.1*	*10.3*	*20.6*	*15.3*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*03/03/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*1*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*148*		*252*	*63*	*491*			*730*	*155*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = *30.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *5.0*	G = *31.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*

Duration of Analysis (hrs) = *0.25*

Cycle Length C = *80.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*157*		*268*	*67*	*522*			*777*	*165*
Lane Group Capacity				*657*		*588*	*289*	*1756*			*1361*	*608*
v/c Ratio				*0.24*		*0.46*	*0.23*	*0.30*			*0.57*	*0.27*
Green Ratio				*0.38*		*0.38*	*0.51*	*0.50*			*0.39*	*0.39*
Uniform Delay d_1				*17.2*		*18.8*	*11.3*	*11.7*			*19.3*	*16.8*
Delay Factor k				*0.11*		*0.11*	*0.11*	*0.11*			*0.17*	*0.11*
Incremental Delay d_2				*0.2*		*0.6*	*0.4*	*0.1*			*0.6*	*0.2*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*17.4*		*19.4*	*11.7*	*11.8*			*19.8*	*17.0*
Lane Group LOS				*B*		*B*	*B*	*B*			*B*	*B*
Approach Delay				*18.6*			*11.8*			*19.4*		
Approach LOS				*B*			*B*			*B*		
Intersection Delay	*16.9*			Intersection LOS						*B*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*157*		*268*	*67*	*522*			*777*	*165*
Satflow/Lane				*1752*		*1568*	*562*	*1844*			*1844*	*1568*
Capacity/Lane Group				*657*		*588*	*289*	*1756*			*1361*	*608*
Flow Ratio				*0.1*		*0.2*	*0.1*	*0.1*			0.2	*0.1*
v/c Ratio				*0.24*		*0.46*	*0.23*	*0.30*			*0.57*	*0.27*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*2.4*		*4.5*	*0.7*	*3.6*			*7.1*	*2.5*
k_B				*0.5*		*0.5*	*0.3*	*0.6*			*0.5*	*0.5*
Q_2				*0.2*		*0.4*	*0.1*	*0.3*			*0.7*	*0.2*
Q Average				*2.6*		*4.9*	*0.8*	*3.8*			*7.8*	*2.7*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.0*		*2.0*	*2.1*	*2.0*			*1.9*	*2.0*
Back of Queue				*5.2*		*9.5*	*1.7*	*7.6*			*14.8*	*5.4*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				1		1	1	2			2	1
Lane Group				L		R	L	T			T	R
Volume (vph)				165		220	152	1007			875	246
% Heavy Vehicles				3		3	3	3			3	3
PHF				0.94		0.94	0.94	0.94			0.94	0.94
Pretimed/Actuated (P/A)				A		A	A	A			A	A
Startup Lost Time				2.0		2.0	2.0	2.0			2.0	2.0
Extension of Effective Green				2.0		2.0	2.0	2.0			2.0	2.0
Arrival Type				3		3	3	3			3	3
Unit Extension				3.0		3.0	3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0		0	0	0	0	0		0	0	0
Lane Width				12.0		12.0	12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0		0	0	0			0	0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = 28.0	G = 0.0	G = 0.0	G = 0.0	G = 5.0	G = 33.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 80.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				176		234	162	1071			931	262
Lane Group Capacity				613		549	255	1844			1449	647
v/c Ratio				0.29		0.43	0.64	0.58			0.64	0.40
Green Ratio				0.35		0.35	0.54	0.52			0.41	0.41
Uniform Delay d_1				18.8		19.9	12.1	13.0			18.8	16.6
Delay Factor k				0.11		0.11	0.22	0.17			0.22	0.11
Incremental Delay d_2				0.3		0.5	5.1	0.5			1.0	0.4
PF Factor				1.000		1.000	1.000	1.000			1.000	1.000
Control Delay				19.0		20.4	17.3	13.5			19.8	17.0
Lane Group LOS				B		C	B	B			B	B
Approach Delay				19.8			14.0			19.2		
Approach LOS				B			B			B		
Intersection Delay	17.0			Intersection LOS						B		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*176*		*234*	*162*	*1071*			*931*	*262*
Satflow/Lane				*1752*		*1568*	*474*	*1844*			*1844*	*1568*
Capacity/Lane Group				*613*		*549*	*255*	*1844*			*1449*	*647*
Flow Ratio				*0.1*		*0.1*	*0.3*	*0.3*			0.3	*0.2*
v/c Ratio				*0.29*		*0.43*	*0.64*	*0.58*			*0.64*	*0.40*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*2.8*		*4.0*	*1.7*	*8.5*			*8.7*	*4.1*
k_B				*0.5*		*0.4*	*0.3*	*0.6*			*0.5*	*0.5*
Q_2				*0.2*		*0.3*	*0.5*	*0.9*			*0.9*	*0.3*
Q Average				*3.0*		*4.3*	*2.2*	*9.4*			*9.6*	*4.4*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.0*		*2.0*	*2.0*	*1.9*			*1.9*	*2.0*
Back of Queue				*6.1*		*8.5*	*4.5*	*17.4*			*17.8*	*8.7*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*1*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*232*		*419*	*99*	*769*			*1189*	*219*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = *33.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *5.0*	G = *38.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *90.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*247*		*446*	*105*	*818*			*1265*	*233*
Lane Group Capacity				*642*		*575*	*179*	*1834*			*1483*	*662*
v/c Ratio				*0.38*		*0.78*	*0.59*	*0.45*			*0.85*	*0.35*
Green Ratio				*0.37*		*0.37*	*0.53*	*0.52*			*0.42*	*0.42*
Uniform Delay d_1				*21.0*		*25.2*	*16.7*	*13.4*			*23.5*	*17.6*
Delay Factor k				*0.11*		*0.33*	*0.18*	*0.11*			*0.39*	*0.11*
Incremental Delay d_2				*0.4*		*6.6*	*4.9*	*0.2*			*5.0*	*0.3*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*21.4*		*31.8*	*21.6*	*13.6*			*28.5*	*18.0*
Lane Group LOS				*C*		*C*	*C*	*B*			*C*	*B*
Approach Delay				*28.1*			*14.5*			*26.9*		
Approach LOS				*C*			*B*			*C*		
Intersection Delay	*23.5*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*247*		*446*	*105*	*818*			*1265*	*233*
Satflow/Lane				*1752*		*1568*	*337*	*1844*			*1844*	*1568*
Capacity/Lane Group				*642*		*575*	*179*	*1834*			*1483*	*662*
Flow Ratio				*0.1*		*0.3*	*0.3*	*0.2*			0.4	*0.1*
v/c Ratio				*0.38*		*0.78*	*0.59*	*0.45*			*0.85*	*0.35*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*4.6*		*9.9*	*1.3*	*6.7*			*15.0*	*4.0*
k_B				*0.5*		*0.5*	*0.2*	*0.7*			*0.6*	*0.5*
Q_2				*0.3*		*1.6*	*0.3*	*0.5*			*2.9*	*0.3*
Q Average				*4.9*		*11.4*	*1.6*	*7.2*			*17.9*	*4.2*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.0*		*1.8*	*2.0*	*1.9*			*1.7*	*2.0*
Back of Queue				*9.6*		*20.8*	*3.3*	*13.7*			*30.8*	*8.4*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*2*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*232*		*419*	*99*	*769*			*1189*	*219*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = *31.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *10.0*	G = *35.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*

Duration of Analysis (hrs) = *0.25*

Cycle Length C = *90.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*247*		*446*	*105*	*818*			*1265*	*233*
Lane Group Capacity				*603*		*540*	*378*	*1912*			*1366*	*610*
v/c Ratio				*0.41*		*0.83*	*0.28*	*0.43*			*0.93*	*0.38*
Green Ratio				*0.34*		*0.34*	*0.11*	*0.54*			*0.39*	*0.39*
Uniform Delay d_1				*22.5*		*27.0*	*36.7*	*12.2*			*26.3*	*19.7*
Delay Factor k				*0.11*		*0.36*	*0.11*	*0.11*			*0.44*	*0.11*
Incremental Delay d_2				*0.5*		*10.2*	*0.4*	*0.2*			*11.0*	*0.4*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*23.0*		*37.2*	*37.1*	*12.3*			*37.2*	*20.1*
Lane Group LOS				*C*		*D*	*D*	*B*			*D*	*C*
Approach Delay				*32.1*			*15.1*			*34.6*		
Approach LOS				*C*			*B*			*C*		
Intersection Delay	*28.3*			Intersection LOS						*C*		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*247*		*446*	*105*	*818*			*1265*	*233*
Satflow/Lane				*1752*		*1568*	*1752*	*1844*			*1844*	*1568*
Capacity/Lane Group				*603*		*540*	*378*	*1912*			*1366*	*610*
Flow Ratio				*0.1*		*0.3*	*0.0*	*0.2*			0.4	*0.1*
v/c Ratio				*0.41*		*0.83*	*0.28*	*0.43*			*0.93*	*0.38*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*4.7*		*10.2*	*1.2*	*6.4*			*15.9*	*4.2*
k_B				*0.5*		*0.5*	*0.3*	*0.7*			*0.6*	*0.5*
Q_2				*0.4*		*1.9*	*0.1*	*0.5*			*4.3*	*0.3*
Q Average				*5.1*		*12.2*	*1.3*	*6.9*			*20.1*	*4.5*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*2.0*		*1.8*	*2.1*	*1.9*			*1.7*	*2.0*
Back of Queue				*9.9*		*21.9*	*2.8*	*13.1*			*34.2*	*8.8*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+™ Version 5.3

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*1*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*259*		*364*	*238*	*1587*			*1419*	*364*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	NS Perm	07	08
Timing	G = *29.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *13.0*	G = *44.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*

Duration of Analysis (hrs) = *0.25*

Cycle Length C = *100.0*

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*276*		*387*	*253*	*1688*			*1510*	*387*
Lane Group Capacity				*508*		*455*	*302*	*2142*			*1545*	*690*
v/c Ratio				*0.54*		*0.85*	*0.84*	*0.79*			*0.98*	*0.56*
Green Ratio				*0.29*		*0.29*	*0.62*	*0.61*			*0.44*	*0.44*
Uniform Delay d_1				*29.9*		*33.5*	*28.8*	*14.6*			*27.5*	*20.8*
Delay Factor k				*0.14*		*0.38*	*0.37*	*0.33*			*0.48*	*0.16*
Incremental Delay d_2				*1.2*		*14.2*	*18.4*	*2.0*			*17.7*	*1.0*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*31.1*		*47.7*	*47.2*	*16.7*			*45.2*	*21.9*
Lane Group LOS				*C*		*D*	*D*	*B*			*D*	*C*
Approach Delay				*40.8*			*20.7*			*40.5*		
Approach LOS				*D*			*C*			*D*		
Intersection Delay	*32.0*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*276*		*387*	*253*	*1688*			*1510*	*387*
Satflow/Lane				*1752*		*1568*	*487*	*1844*			*1844*	*1568*
Capacity/Lane Group				*508*		*455*	*302*	*2142*			*1545*	*690*
Flow Ratio				*0.2*		*0.2*	*0.5*	*0.5*			0.4	*0.2*
v/c Ratio				*0.54*		*0.85*	*0.84*	*0.79*			*0.98*	*0.56*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*6.5*		*10.1*	*3.0*	*18.5*			*21.7*	*8.0*
k_B				*0.5*		*0.5*	*0.4*	*0.8*			*0.6*	*0.6*
Q_2				*0.6*		*2.1*	*1.5*	*2.7*			*7.0*	*0.7*
Q Average				*7.0*		*12.2*	*4.5*	*21.2*			*28.6*	*8.7*

Percentile Back of Queue (95th percentile)

$f_{B\%}$				*1.9*		*1.8*	*2.0*	*1.7*			*1.6*	*1.9*
Back of Queue				*13.4*		*22.1*	*8.8*	*35.7*			*46.4*	*16.3*

Queue Storage Ratio

Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+™ Version 5.3

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 WB @ South Lee Hwy.*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				*1*		*1*	*2*	*2*			*2*	*1*
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Volume (vph)				*259*		*364*	*238*	*1587*			*1419*	*364*
% Heavy Vehicles				*3*		*3*	*3*	*3*			*3*	*3*
PHF				*0.94*		*0.94*	*0.94*	*0.94*			*0.94*	*0.94*
Pretimed/Actuated (P/A)				*A*		*A*	*A*	*A*			*A*	*A*
Startup Lost Time				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Extension of Effective Green				*2.0*		*2.0*	*2.0*	*2.0*			*2.0*	*2.0*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Unit Extension				*3.0*		*3.0*	*3.0*	*3.0*			*3.0*	*3.0*
Ped/Bike/RTOR Volume	*0*	*0*		*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*
Lane Width				*12.0*		*12.0*	*12.0*	*12.0*			*12.0*	*12.0*
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour				*0*		*0*	*0*	*0*			*0*	*0*
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	WB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = *30.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *12.0*	G = *44.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*						Cycle Length C = *100.0*		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				*276*		*387*	*253*	*1688*			*1510*	*387*
Lane Group Capacity				*526*		*470*	*408*	*2107*			*1545*	*690*
v/c Ratio				*0.52*		*0.82*	*0.62*	*0.80*			*0.98*	*0.56*
Green Ratio				*0.30*		*0.30*	*0.12*	*0.60*			*0.44*	*0.44*
Uniform Delay d_1				*29.1*		*32.5*	*41.8*	*15.4*			*27.5*	*20.8*
Delay Factor k				*0.13*		*0.36*	*0.20*	*0.34*			*0.48*	*0.16*
Incremental Delay d_2				*1.0*		*11.3*	*2.9*	*2.3*			*17.7*	*1.0*
PF Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Control Delay				*30.0*		*43.9*	*44.7*	*17.7*			*45.2*	*21.9*
Lane Group LOS				*C*		*D*	*D*	*B*			*D*	*C*
Approach Delay				*38.1*			*21.2*			*40.5*		
Approach LOS				*D*			*C*			*D*		
Intersection Delay	*31.8*			Intersection LOS						*C*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System W/O Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group				*L*		*R*	*L*	*T*			*T*	*R*
Initial Queue/Lane				*0.0*		*0.0*	*0.0*	*0.0*			*0.0*	*0.0*
Flow Rate/Lane Group				*276*		*387*	*253*	*1688*			*1510*	*387*
Satflow/Lane				*1752*		*1568*	*1752*	*1844*			*1844*	*1568*
Capacity/Lane Group				*526*		*470*	*408*	*2107*			*1545*	*690*
Flow Ratio				*0.2*		*0.2*	*0.1*	*0.5*			0.4	*0.2*
v/c Ratio				*0.52*		*0.82*	*0.62*	*0.80*			*0.98*	*0.56*
I Factor				*1.000*		*1.000*	*1.000*	*1.000*			*1.000*	*1.000*
Arrival Type				*3*		*3*	*3*	*3*			*3*	*3*
Platoon Ratio				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
PF Factor				*1.00*		*1.00*	*1.00*	*1.00*			*1.00*	*1.00*
Q_1				*6.4*		*10.0*	*3.4*	*19.0*			*21.7*	*8.0*
k_B				*0.5*		*0.5*	*0.3*	*0.8*			*0.6*	*0.6*
Q_2				*0.5*		*1.8*	*0.4*	*2.8*			*7.0*	*0.7*
Q Average				*6.9*		*11.8*	*3.9*	*21.8*			*28.6*	*8.7*
Percentile Back of Queue (95th percentile)												
$f_{B\%}$				*1.9*		*1.8*	*2.0*	*1.7*			*1.6*	*1.9*
Back of Queue				*13.2*		*21.4*	*7.7*	*36.6*			*46.4*	*16.3*
Queue Storage Ratio												
Queue Spacing				*25.0*		*25.0*	*25.0*	*25.0*			*25.0*	*25.0*
Queue Storage				*0*		*0*	*0*	*0*			*0*	*0*
Average Queue Storage Ratio												
95% Queue Storage Ratio												

HCS+™ Version 5.3

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	*1*		*2*					*2*	*1*	*2*	*2*	
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Volume (vph)	*264*		*118*					*235*	*61*	*79*	*231*	
% Heavy Vehicles	*5*		*5*					*5*	*5*	*5*	*5*	
PHF	*0.94*		*0.94*					*0.94*	*0.94*	*0.94*	*0.94*	
Pretimed/Actuated (P/A)	*A*		*A*					*A*	*A*	*A*	*A*	
Startup Lost Time	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Extension of Effective Green	*2.0*		*2.0*					*2.0*	*2.0*	*2.0*	*2.0*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Unit Extension	*3.0*		*3.0*					*3.0*	*3.0*	*3.0*	*3.0*	
Ped/Bike/RTOR Volume	*0*	*0*	*0*	*0*	*0*		*0*	*0*	*0*	*0*	*0*	
Lane Width	*12.0*		*12.0*					*12.0*	*12.0*	*12.0*	*12.0*	
Parking/Grade/Parking	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*	*N*	*0*	*N*
Parking/Hour												
Bus Stops/Hour	*0*		*0*					*0*	*0*	*0*	*0*	
Minimum Pedestrian Time		*3.2*			*3.2*			*3.2*			*3.2*	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = *25.0*	G = *0.0*	G = *0.0*	G = *0.0*	G = *19.0*	G = *22.0*	G = *0.0*	G = *0.0*
	Y = *5*	Y = *0*	Y = *0*	Y = *0*	Y = *4*	Y = *5*	Y = *0*	Y = *0*
Duration of Analysis (hrs) = *0.25*					Cycle Length C = *80.0*			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	*281*		*126*					*250*	*65*	*84*	*246*	
Lane Group Capacity	*537*		*851*					*947*	*423*	*793*	*1938*	
v/c Ratio	*0.52*		*0.15*					*0.26*	*0.15*	*0.11*	*0.13*	
Green Ratio	*0.31*		*0.31*					*0.28*	*0.28*	*0.24*	*0.56*	
Uniform Delay d_1	*22.6*		*19.8*					*22.7*	*22.0*	*23.9*	*8.2*	
Delay Factor k	*0.13*		*0.11*					*0.11*	*0.11*	*0.11*	*0.11*	
Incremental Delay d_2	*0.9*		*0.1*					*0.1*	*0.2*	*0.1*	*0.0*	
PF Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Control Delay	*23.5*		*19.9*					*22.8*	*22.1*	*23.9*	*8.3*	
Lane Group LOS	*C*		*B*					*C*	*C*	*C*	*A*	
Approach Delay	*22.4*						*22.7*			*12.3*		
Approach LOS	*C*						*C*			*B*		
Intersection Delay	*19.3*			Intersection LOS						*B*		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*281*		*126*					*250*	*65*	*84*	*246*	
Satflow/Lane	*1719*		*1538*					*1809*	*1538*	*1719*	*1809*	
Capacity/Lane Group	*537*		*851*					*947*	*423*	*793*	*1938*	
Flow Ratio	*0.2*		*0.0*					*0.1*	*0.0*	*0.0*	0.1	
v/c Ratio	*0.52*		*0.15*					*0.26*	*0.15*	*0.11*	*0.13*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*5.1*		*1.1*					*2.3*	*1.1*	*0.7*	*1.4*	
k_B	*0.4*		*0.4*					*0.4*	*0.4*	*0.4*	*0.6*	
Q_2	*0.5*		*0.1*					*0.2*	*0.1*	*0.0*	*0.1*	
Q Average	*5.6*		*1.2*					*2.4*	*1.2*	*0.8*	*1.4*	
Percentile Back of Queue (95th percentile)												
$f_{B\%}$	*1.9*		*2.1*					*2.0*	*2.1*	*2.1*	*2.1*	
Back of Queue	*10.9*		*2.5*					*4.9*	*2.4*	*1.6*	*3.0*	
Queue Storage Ratio												
Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2013*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		2					2	1	2	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	84		57					447	47	186	61	
% Heavy Vehicles	5		5					5	5	5	5	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = 21.0	G = 0.0	G = 0.0	G = 0.0	G = 21.0	G = 24.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 80.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	89		61					476	50	198	65	
Lane Group Capacity	451		715					1034	461	876	2110	
v/c Ratio	0.20		0.09					0.46	0.11	0.23	0.03	
Green Ratio	0.26		0.26					0.30	0.30	0.26	0.61	
Uniform Delay d_1	22.9		22.3					22.7	20.3	23.1	6.1	
Delay Factor k	0.11		0.11					0.11	0.11	0.11	0.11	
Incremental Delay d_2	0.2		0.1					0.3	0.1	0.1	0.0	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	23.2		22.3					23.1	20.4	23.3	6.1	
Lane Group LOS	C		C					C	C	C	A	
Approach Delay	22.8						22.8			19.0		
Approach LOS	C						C			B		
Intersection Delay	21.8			Intersection LOS						C		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*89*		*61*					*476*	*50*	*198*	*65*	
Satflow/Lane	*1719*		*1538*					*1809*	*1538*	*1719*	*1809*	
Capacity/Lane Group	*451*		*715*					*1034*	*461*	*876*	*2110*	
Flow Ratio	*0.1*		*0.0*					*0.1*	*0.0*	*0.1*	0.0	
v/c Ratio	*0.20*		*0.09*					*0.46*	*0.11*	*0.23*	*0.03*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*1.5*		*0.6*					*4.5*	*0.8*	*1.8*	*0.3*	
k_B	*0.4*		*0.4*					*0.4*	*0.4*	*0.4*	*0.7*	
Q_2	*0.1*		*0.0*					*0.4*	*0.0*	*0.1*	*0.0*	
Q Average	*1.6*		*0.6*					*4.9*	*0.9*	*1.9*	*0.3*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.0*		*2.1*					*2.0*	*2.1*	*2.0*	*2.1*	
Back of Queue	*3.4*		*1.3*					*9.5*	*1.8*	*3.8*	*0.7*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

SHORT REPORT

General Information		Site Information	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*AM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		2					2	1	2	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	412		194					372	96	123	371	
% Heavy Vehicles	5		5					5	5	5	5	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = 32.0	G = 0.0	G = 0.0	G = 0.0	G = 20.0	G = 24.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 90.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	438		206					396	102	131	395	
Lane Group Capacity	611		968					919	410	742	1837	
v/c Ratio	0.72		0.21					0.43	0.25	0.18	0.22	
Green Ratio	0.36		0.36					0.27	0.27	0.22	0.53	
Uniform Delay d_1	25.1		20.2					27.3	25.9	28.3	11.1	
Delay Factor k	0.28		0.11					0.11	0.11	0.11	0.11	
Incremental Delay d_2	4.0		0.1					0.3	0.3	0.1	0.1	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	29.1		20.3					27.7	26.2	28.4	11.1	
Lane Group LOS	C		C					C	C	C	B	
Approach Delay	26.3						27.4			15.4		
Approach LOS	C						C			B		
Intersection Delay	23.2			Intersection LOS						C		

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BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*438*		*206*					*396*	*102*	*131*	*395*	
Satflow/Lane	*1719*		*1538*					*1809*	*1538*	*1719*	*1809*	
Capacity/Lane Group	*611*		*968*					*919*	*410*	*742*	*1837*	
Flow Ratio	0.3		0.1					0.1	0.1	0.0	0.1	
v/c Ratio	*0.72*		*0.21*					*0.43*	*0.25*	*0.18*	*0.22*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*9.5*		*2.0*					*4.3*	*2.0*	*1.4*	*2.7*	
k_B	*0.5*		*0.5*					*0.4*	*0.4*	*0.4*	*0.7*	
Q_2	*1.2*		*0.1*					*0.3*	*0.1*	*0.1*	*0.2*	
Q Average	*10.7*		*2.2*					*4.6*	*2.1*	*1.4*	*2.9*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*1.8*		*2.0*					*2.0*	*2.0*	*2.1*	*2.0*	
Back of Queue	*19.6*		*4.4*					*9.1*	*4.3*	*3.0*	*5.9*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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SHORT REPORT

General Information		**Site Information**	
Analyst	*SKB*	Intersection	*APD-40 @ Prop. Interchange*
Agency or Co.	*TDOT / Long Engineering*	Area Type	*All other areas*
Date Performed	*05/04/2009*	Jurisdiction	*Cleveland, TN*
Time Period	*PM Peak Period*	Analysis Year	*2033*

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		2					2	1	2	2	
Lane Group	L		R					T	R	L	T	
Volume (vph)	131		93					708	74	291	101	
% Heavy Vehicles	5		5					5	5	5	5	
PHF	0.94		0.94					0.94	0.94	0.94	0.94	
Pretimed/Actuated (P/A)	A		A					A	A	A	A	
Startup Lost Time	2.0		2.0					2.0	2.0	2.0	2.0	
Extension of Effective Green	2.0		2.0					2.0	2.0	2.0	2.0	
Arrival Type	3		3					3	3	3	3	
Unit Extension	3.0		3.0					3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0	0	0	
Lane Width	12.0		12.0					12.0	12.0	12.0	12.0	
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0					0	0	0	0	
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = 24.0	G = 0.0	G = 0.0	G = 0.0	G = 23.0	G = 29.0	G = 0.0	G = 0.0
	Y = 5	Y = 0	Y = 0	Y = 0	Y = 4	Y = 5	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25					Cycle Length C = 90.0			

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	139		99					753	79	310	107	
Lane Group Capacity	458		726					1110	496	853	2144	
v/c Ratio	0.30		0.14					0.68	0.16	0.36	0.05	
Green Ratio	0.27		0.27					0.32	0.32	0.26	0.62	
Uniform Delay d_1	26.3		25.1					26.5	21.8	27.5	6.6	
Delay Factor k	0.11		0.11					0.25	0.11	0.11	0.11	
Incremental Delay d_2	0.4		0.1					1.7	0.2	0.3	0.0	
PF Factor	1.000		1.000					1.000	1.000	1.000	1.000	
Control Delay	26.7		25.2					28.1	21.9	27.8	6.6	
Lane Group LOS	C		C					C	C	C	A	
Approach Delay	26.1						27.6			22.3		
Approach LOS	C						C			C		
Intersection Delay	25.9			Intersection LOS						C		

BACK-OF-QUEUE WORKSHEET

General Information

Project Description *Proposed System With Slip Ramp*

Average Back of Queue

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Lane Group	*L*		*R*					*T*	*R*	*L*	*T*	
Initial Queue/Lane	*0.0*		*0.0*					*0.0*	*0.0*	*0.0*	*0.0*	
Flow Rate/Lane Group	*139*		*99*					*753*	*79*	*310*	*107*	
Satflow/Lane	*1719*		*1538*					*1809*	*1538*	*1719*	*1809*	
Capacity/Lane Group	*458*		*726*					*1110*	*496*	*853*	*2144*	
Flow Ratio	*0.1*		*0.0*					*0.2*	*0.1*	*0.1*	0.0	
v/c Ratio	*0.30*		*0.14*					*0.68*	*0.16*	*0.36*	*0.05*	
I Factor	*1.000*		*1.000*					*1.000*	*1.000*	*1.000*	*1.000*	
Arrival Type	*3*		*3*					*3*	*3*	*3*	*3*	
Platoon Ratio	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
PF Factor	*1.00*		*1.00*					*1.00*	*1.00*	*1.00*	*1.00*	
Q_1	*2.8*		*1.0*					*8.6*	*1.4*	*3.3*	*0.5*	
k_B	*0.4*		*0.4*					*0.5*	*0.5*	*0.4*	*0.7*	
Q_2	*0.2*		*0.1*					*1.0*	*0.1*	*0.2*	*0.0*	
Q Average	*3.0*		*1.1*					*9.6*	*1.5*	*3.5*	*0.6*	

Percentile Back of Queue (95th percentile)

$f_{B\%}$	*2.0*		*2.1*					*1.9*	*2.1*	*2.0*	*2.1*	
Back of Queue	*5.9*		*2.3*					*17.7*	*3.1*	*7.0*	*1.2*	

Queue Storage Ratio

Queue Spacing	*25.0*		*25.0*					*25.0*	*25.0*	*25.0*	*25.0*	
Queue Storage	*0*		*0*					*0*	*0*	*0*	*0*	
Average Queue Storage Ratio												
95% Queue Storage Ratio												

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