FINAL REPORT

to

THE FLORIDA DEPARTMENT OF TRANSPORTATION
ROADWAY DESIGN OFFICE

on Project

"Multimodal Arterial LOS Modeling and Testing"

FDOT Contract BDK-75-977-13, (UF Project 00076293)

March 2009

University of Florida
Transportation Research Center
Department of Civil and Coastal Engineering

Disclaimer

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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16. Abstract

The Highway Capacity and Quality and Service Committee has extensively deliberated the multimodal level of service (LOS) models resulting from the recently completed NCHRP 3-70 project, and has tentatively approved the bus, bicycle, and pedestrian models for inclusion in the 2010 Highway Capacity Manual (HCM). A decision by the committee on the automobile LOS model has been postponed until it is presented with feedback from agencies who have applied these models (for testing purposes) in their jurisdictions. Although the multimodal models have been tentatively approved, the committee would also like to obtain real-world testing results from agencies if possible. Given that the FDOT currently implements multimodal level of service models in its ARTPLAN software (which is widely used throughout the state), it has a strong interest in the NCHRP 3-70 models. Thus, the objective of this project was to perform testing of the NCHRP 3-70 multimodal LOS models in several Florida metropolitan areas.

Individuals from the various organizations involved with LOS analysis in these metropolitan areas were recruited to participate in this project. These individuals, with the assistance of the research team, collected data for the test arterials and performed the LOS analyses for the different modes and arterials. Based on the input received from the agency participants, the following recommendations are offered: 1) An integrated multimodal analysis approach is appropriate and desirable; 2) Adopt the NCHRP 3-70 transit LOS model and bicycle and pedestrian segment and intersection LOS models for use in the HCM 2010 and Florida Q/LOS Handbook, with some minor revisions; 3) Do not adopt the bicycle and pedestrian facility LOS models until an LOS threshold scale can be developed that is consistent with the segment and intersection models; 4) Pursue research that will result in the development of a sidepath model; 5) Changing the HCM 2000 auto LOS methodology to incorporate one of the NCHRP 3-70 models (stops or speed) is not recommended; and 6) For analysis consistency across modes, three urban street classes are recommended (with appropriate revisions to the LOS threshold values).

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EXECUTIVE SUMMARY

The National Cooperative Highway Research Program (NCHRP) funded a project (initiated in 2003) that resulted in the development of multimodal (automobile, bicycle, pedestrian, transit) level of service models based on traveler perceptions and on data obtained from several cities throughout the U.S. The new level of service (LOS) models were recently presented to the Highway Capacity and Quality and Service Committee (HCQSC) for consideration of inclusion in the next edition of the Highway Capacity Manual (HCM) (tentatively 2010).

The HCQSC has extensively deliberated the LOS models resulting from NCHRP 3-70, and has tentatively approved the bus, bicycle, and pedestrian models. A decision by the committee on the automobile LOS model has been postponed until it is presented with feedback from agencies who have applied these models (for testing purposes) in their jurisdictions. Although the multimodal models have been tentatively approved, the committee would also like to obtain real-world testing results from agencies if possible. To accomplish this testing, the NCHRP 3-70 research team requested and received funding from the NCHRP, referred to as Phase 3.

The budget for the NCHRP 3-70 Phase 3 project allowed for testing in a maximum of seven jurisdictions. Given that the FDOT currently implements multimodal level of service models in its ARTPLAN software (which is widely used throughout the state), it has a particularly strong interest in the outcome of the NCHRP 3-70 project. Thus, the objective of this project was to expand upon the NCHRP 3-70 Phase 3 effort by including testing in Florida.

Testing was performed in four Florida metropolitan areas—Gainesville, Tampa, Tallahassee, and Orlando. Testing was performed for all four modes and for four different arterials in each of the first three areas, while testing in the Orlando region was just for the automobile mode and three arterials. Individuals from the various organizations involved with LOS analysis in those cities (e.g., MPOs, transit agencies, public works departments) were recruited to participate in this project. These individuals, with the assistance of the research team, collected data for the test arterials and performed the LOS analyses for the different modes and arterials.

Following this effort, a meeting was convened with the research team and participating agency personnel to discuss the LOS analysis results, data collection issues, and model application issues. Based on the input received at this meeting, the following recommendations are offered:

- An integrated multimodal analysis approach is appropriate and desirable.
- Adopt the NCHRP 3-70 transit LOS model and bicycle and pedestrian segment and intersection LOS models for use in the HCM 2010 and Florida Q/LOS Handbook, with some minor revisions.
- Do not adopt the bicycle and pedestrian facility LOS models until an LOS threshold scale can be developed that is consistent with the segment and intersection models.
- Pursue research that will result in the development of a sidepath model.
- Changing the HCM 2000 auto LOS methodology to incorporate one of the NCHRP 3-70 models (stops or speed) is not recommended.
- For analysis consistency across modes, three urban street classes are recommended (with appropriate revisions to the LOS threshold values).

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INTRODUCTION

The Highway Capacity Manual (HCM) 2000 [Transportation Research Board, 2000] contains an analysis procedure for arterial streets. This procedure, however, only evaluates the performance of the arterial in terms of the automobile mode. In an effort to support the analysis of arterials that consider all users of the facility, the Florida Department of Transportation (FDOT) has funded several previous projects that resulted in the development of level of service models for bus, bicycle, and pedestrian modes. These models have been incorporated in the FDOT ARTPLAN software since 2002. These models were developed primarily from data collected at field sites in Florida. Based on the experimental design and source of data for these models, the level of service (LOS) results from these models are intended to directly reflect traveler perception of the transportation conditions. The automobile level of service analysis methodology contained in ARTPLAN is still based on the methodology contained in the Highway Capacity Manual 2000.

More recently, the National Cooperative Highway Research Program (NCHRP) funded a project (initiated in 2003) that resulted in the development of multimodal level of service models, but based on data obtained from several cities throughout the U.S. An additional objective of this project was to develop a level of service methodology for automobiles that would be based on traveler perceptions. These objectives have been accomplished and the new level of service models were recently presented to the Highway Capacity and Quality and Service Committee (HCQSC) for consideration of inclusion in the next edition of the HCM (tentatively 2010).

The HCQSC has extensively deliberated the LOS models resulting from NCHRP 3-70, and has tentatively approved the bus, bicycle, and pedestrian models. A decision by the committee on the automobile LOS model has been postponed until they are presented with feedback from agencies who have applied these models (for testing purposes) in their jurisdictions. Although the multimodal models have been tentatively approved, the committee would also like to obtain real-world testing results from agencies if possible.

To accomplish this testing, the NCHRP 3-70 research team requested and received funding from the NCHRP, referred to as Phase 3. In their proposal for Phase 3, the NCHRP 3-70 team identified their objective as:

> The objective of Phase 3 of this project is to assess how well the LOS results produced by the NCHRP 3-70 Multimodal Level of Service (MMLOS) Method (and its data/analysis requirements) match local agency expectations. The intent is to secure feedback from a representative sample of public agencies as to the strengths and weaknesses of the MMLOS Method and to refine the method to better address the needs of public agencies in the United States. This objective will be accomplished through training of public agency technical staff on the MMLOS method, testing the method on various prototypical urban streets, and obtaining feedback from public agencies on any needed refinements to make the MMLOS method a useful tool for evaluating the multimodal level of service provided by urban streets.

The budget for the NCHRP 3-70 Phase 3 project allowed for testing in a maximum of seven jurisdictions. Given that the FDOT currently implements multimodal level of service models in their ARTPLAN software (which is widely used throughout the state), they have a particularly strong interest in the outcome of the NCHRP 3-70 project. Thus, the FDOT funded this project so that Phase 3 could be extended to several cities in Florida.

The objective of this project was to expand upon the NCHRP 3-70 Phase 3 effort by including testing in Florida, and for three different locations within the state. Thus, the objective of this FDOT project is essentially the same as that for the NCHRP 3-70 Phase 3 project, but with emphasis on Florida testing and results.

REVIEW OF EXISTING AND PROPOSED METHODOLOGIES

This section provides an overview of the various level of service models for automobile, bicycle, pedestrian, and transit modes that are currently in use in Florida and those under consideration for use in Florida (namely, those resulting from NCHRP 3-70). Before getting into the details of the models, it is useful to review the definition and scope of an urban street as considered in this report. An urban street is defined as a public road with traffic signal control at least once every two miles. The methodologies described in this section are generally not designed to be applied to residential streets, nor to rural roads with infrequent or no signal control. However, it is recognized that there could situations such as these when is it reasonable to apply these models, but that is left to the analyst's judgment.

ARTPLAN

ARTPLAN is FDOT's recommended tool for performing planning and preliminary engineering analysis of signalized arterials. It performs level of service analysis for the automobile, bus, bicycle, and pedestrian modes. It enables the analyst to see the changes in LOS from one mode to the other as changes are made to the design and operation of the urban street. The methodology, however, does not provide for the computation of an overall weighted average of the LOS results across the four modes of travel. Weighing the tradeoffs of improving the LOS for one mode versus worsening it for another mode are left to the analyst and the public agency operating the urban street.

For the automobile mode, ARTPLAN largely implements the HCM 2000 (Chapter 15) LOS methodology. The primary difference is that a different method for determining segment running time is used. The ARTPLAN method also considers flow rate on the arterial segment in this calculation. Further information of the HCM 2000 arterial level of service analysis methodology can be found in Chapter 15 of the HCM 2000 [Transportation Research Board, 2000].

The bicycle and pedestrian LOS methodologies are based on results from FDOT research projects conducted by Sprinkle Consulting and the University of Florida. The bus LOS methodology is based on a simplified version of the model presented in the Transit Capacity and Quality of Service Manual [Transportation Research Board, 2003]. Additional details can be found in FDOT's Quality/Level of Service Handbook [FDOT, 2002].

Figure 1 provides an overview of how the modes and their levels of service are linked.

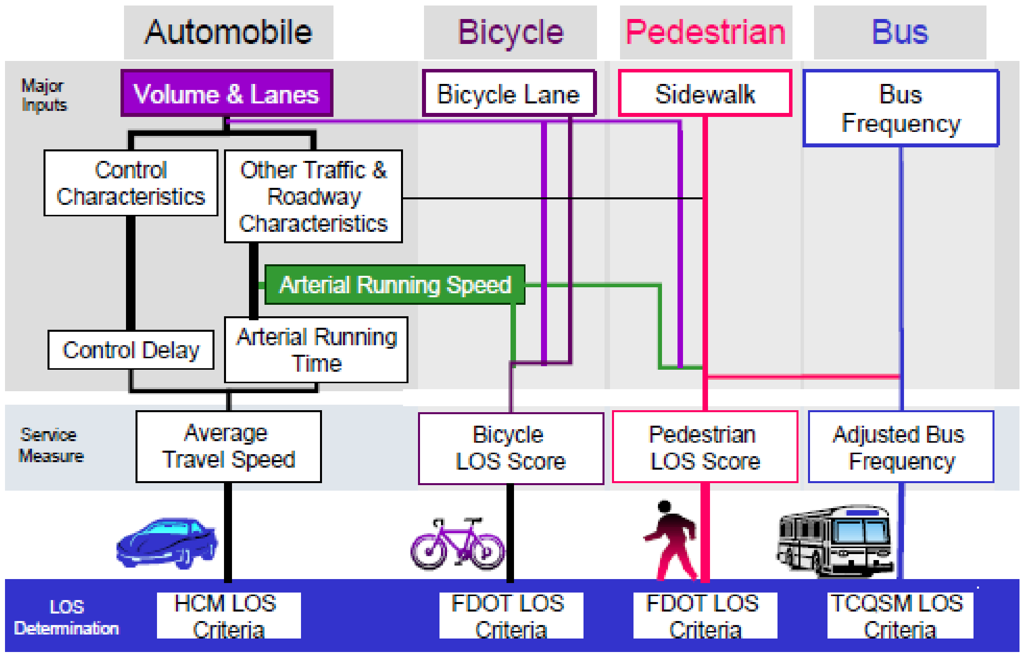

Figure 1: ARTPLAN Simplified Multimodal Flow Chart
Source: Exhibit 5-2 of 2002 FDOT Q/LOS Handbook

NCHRP 3-70

The NCHRP 3-70 models address the perceived quality of service for passenger car (automobile) drivers, bus passengers, bicycle riders, and pedestrians to the extent that these perceptions are influenced by factors that fall exclusively within the right of way of the urban street. Environmental factors that fall outside of the right-of way, such as buildings, parking lots, scenery, and landscaped front yards are specifically excluded from the LOS methodology, because these factors are not specifically under the direct control of the agency operating the urban street. The methodology provides for the estimation of a separate mean level of service for each of four modes of travel on the urban street: auto driver, bus passenger, bicyclist, and pedestrian. However, like ARTPLAN, the levels of service across each of the modes are not combined into one overall arterial street LOS.

The models developed in the NCHRP 3-70 project are based on input from travelers (i.e., user perception based research). In this project, the research team identified travel routes that encompassed the variety of roadway, traffic, and control conditions that they wanted to account for, and then asked regular citizens to view pre-recorded video of the routes as they were traveled by the research team. The citizens were then asked to rate their assessment of the operating conditions (for the mode being investigated), usually on qualitative scale (such as 'excellent' to 'poor' that was later translated into numerical values corresponding to LOS 'A' to 'F').

The complete documentation for the results of the NCHRP 3-70 research project can be found in the final report (NCHRP Report 616) [Transportation Research Board, 2008] and the Users Guide (NCHRP Report 128) [Transportation Research Board, 2008].

Automobile LOS

The NCHRP 3-70 research team developed several different models for the determination of auto LOS. Ultimately, two models were identified as possible replacements for the HCM 2000 method. One model is based on a combination of stops and left turn lane presence, hereafter referred to as the 'stops' model, and the other model is based on a combination of average travel speed and median type, hereafter referred to as the 'speed' model. Both models follow the same mathematical formulation, as described below.

The probability that a person will rate a given segment as LOS "*J*" or worse is given by the ordered cumulative logit model as shown in Eq. 1.

$$\Pr\left(\mathrm{LOS} \leq J\right) = \frac{1}{1 + e^{(-\alpha_{(J)} - \sum_k \beta_k x_k)}} \qquad [1]$$

Where:

Pr(LOS $\leq J$)	= Probability than an individual will respond with Level of Service grade of "J" or worse
J	= A, B, C, D, E, or F
e	= Exponential function (equal to 2.718…)
α_J	= Alpha. Maximum numerical threshold for LOS grade "*J*"
β_k	= Beta. Calibration parameters for attributes.
X_k	= Attributes (*k*) of the facility.

The alpha and beta parameters are shown in Table 1.

Table 1. Alpha and Beta Parameters for Stops and Speed Auto LOS Models

Beta Parameter Values	**Stops**	**Speed**
β_1 = Stops (stops/mi) or Speed (mi/h)	0.253	-0.084
β_2 = LT Lane or Median Type	-0.3434	-0.22
Alpha Parameter Values		
F	-3.8044	-1.19
E	-2.7047	-0.2
D	-1.7389	0.71
C	-0.6234	1.8
B	1.1614	3.62

In the stops model, a stop is defined as when a vehicle's speed drops below 5 mi/h. Stops per mile are simply the number of stops made over the length of segment/facility divided by the length of the segment/facility (in miles). Since it is not expected that most practitioners will measure the number of stops directly, an estimation method can be used instead. This estimation method is documented in the final report for NCHRP 3-79 [Bonneson et al., 2008]. Likewise, an estimation method for average travel speed along a segment is available in the final report for NCHRP 3-79. For the purposes of this study, however, stops per mile and average speed were measured directly from the field. In the stops model, the presence of a left turn (LT) lane is indicated with a 1 (yes) or 0 (no). In the speed model, median type is represented with a 3 (raised median), 2 (two-way left-turn lane), 1 (one-way street), or 0 (no median).

The result from applying Eq.1 is a probability for response by an individual for LOS A-F (i.e., six probability values). Eq. 2 is then applied to arrive at an overall LOS index value.

$$LOSIndexValue = \sum_{J=1}^{6} \Pr(LOS = J) \times W_J \qquad [2]$$

Where:

Pr(LOS = J) = Probability that an individual will respond with level of service grade of "J".
J = A, B, C, D, E, or F
W_J = 1 for LOS A, 2 for LOS B, 3 for C, 4 for D, 5 for E, 6 for F.

As can be seen by the weighting term in this equation, greater weight is given to the probability values corresponding to the poorer levels of service. The resulting LOS index value is then used with Table 2 to arrive at a segment LOS. It should be noted that Table 2 applies to all modes in the NCHRP 3-70 methodology.

Table 2. NCHRP 3-70 LOS Thresholds

LOS Index Value	**LOS**
Index ≤ 2.00	A
2.00 < Index ≤ 2.75	B
2.75 < Index ≤ 3.50	C
3.50 < Index ≤ 4.25	D
4.25< Index ≤ 5.00	E
Index >5.00	F

To arrive at a facility LOS, Eq. 2 is also applied, but to the segment length weighted values of stops per mile and left turn lane presence or average speed and median type. Again, Table 2 is applied to determine the facility LOS.

Notes:
1) If any directional segment hourly demand/capacity ratio (d/c) exceeds 1.00 for any mode, that direction of street is considered to be operating at LOS F for that mode of travel for its entire length (regardless of the computed level of service).
2) If the movement of any mode is legally prohibited for a given direction of travel on the street, then the level of service for that mode is LOS "F" for that direction.

One of the other auto models for which results are presented later is referred to as 'NCHRP 3-79'. It should be pointed out that these model results are simply based on the measured average travel speeds and a LOS threshold table (see Table 3) that uses percent of free-flow speed (i.e., average travel speed divided by free-flow speed). For the purposes of this study, free-flow speed was taken as the posted speed limit. This table essentially represents a consolidated version of the HCM 2000 LOS thresholds table that is based on average travel speed, but uses four different sets of thresholds which are a function of the free-flow speed of the facility.

Table 3. Percent Free Flow Speed LOS Thresholds

LOS	% FFS
A	≥ 85%
B	≥ 67%
C	≥ 50%
D	≥ 40%
E	≥ 30%
F	< 30%

Source: NCHRP 3-79

Transit LOS

Transit level of service is designed to apply only to scheduled, fixed route public transit service operating within the street itself. Only service with pickup/drop-off service within the section of the street being studied is included in the LOS computations. The transit level of service (LOS) is based on a combination of the access experience, the waiting experience, and the ride experience. The access experience is represented by the pedestrian level of service score for pedestrian access to bus stops in the direction of travel along the street. The waiting and riding experiences are combined into a transit wait/ride score. Eq. 3 is used to combine the various experiences into a single LOS index value.

$$\textit{Transit LOS Score} = 6.0 - 1.50 \times \textit{TransitWaitRideScore} + 0.15 \times \textit{PedLOS} \quad [3]$$

Where:

PedLOS = The pedestrian LOS numerical value for the direction of the facility being analyzed (A=1, F=6).

TransitWaitRideScore = The transit ride and waiting time score is calculated according to Eq. 4.

$$TransitWaitRideScore = f_h \times F_{ptt} \quad [4]$$

Where:

f_h = Headway factor, or the multiplicative change in ridership expected on a route at a headway *h*, relative to the ridership at 60-minute headways;

F_{ptt} = Perceived travel time factor, or the multiplicative change in ridership expected at a perceived travel time rate *PTTR,* relative to the ridership expected at a baseline travel time rate. The baseline travel time rate is 4 minutes per mile, except for central business districts (CBD) of metropolitan areas with populations over 5 million, in which case it is 6 minutes per mile.

The *TransitWaitRideScore* headway factor (f_h) is calculated according to Eq. 5.

$$f_h = 4 \times \exp(-0.0239 \times headway) \quad [5]$$

Where headway is the average number of minutes between bus arrivals. The perceived travel time factor (F_{ptt}) is calculated according to Eq. 6.

$$F_{PTT} = \frac{(e\text{-}1)BTTR - (e+1)PTTR}{(e\text{-}1)PTTR - (e+1)BTTR} \qquad [6]$$

Where:

F_{PTT} = Perceived Travel Time Factor
PTTR = Perceived Travel Time Rate (min/mi) (See Eq. 7)
BTTR = Base Travel Time Rate (min/mi) Use 6 minutes per mile for the main central business district of metropolitan areas with population greater than or equal to 5 million. Use 4 minutes per mile for all other areas.
e = ridership elasticity with respect to changes in the travel time rate. The suggested default value is .0.40, but local values may be substituted.

$$PTTR = a_1 \times IVTTR + a_2 \times EWTR - ATR \qquad [7]$$

Where:

PTTR = Perceived travel time rate
IVTTR = Actual in-vehicle travel time rate, in minutes per mile (Default = 4.00) (see Eq. 8)
EWTR = Excess wait time rate due to late arrivals (minutes/mile)
= Excess wait time/average trip length (Default = 2.00) (see Eq. 10)
a_1 = Passenger load weighting factor (a function of the average load on buses in the analysis segment during the peak 15 minutes) (Default = 1.00); (see Eq. 9 and Table 4).
a_2 = 2 (wait time factor converting actual wait times into perceived wait times)
ATR = Amenity time rate = perceived travel time rate reduction due to the provision of certain bus stop amenities (see Eq. 11)

$$IVTTR = \frac{60}{Speed} \qquad [8]$$

Where:

IVTTR = In-Vehicle Travel Time Rate (min/mi)
Speed = Average speed of bus over study section of street (mi/h)

$$a_1 = Max\left\{1.00, 1.22 \times LF + 0.33\left[\left(LF - 1\right) + \sqrt{\left(LF - 1\right)^2}\right]\right\} \qquad [9]$$

Where:

a_1 = Passenger load weighting factor
LF = Load factor (passengers/seat)

Table 4. Passenger Load Weighting Factor a_1

Load Factor (pass/seat)	a_1
≤0.80	1.00 default
1.00	1.19
1.10	1.41
1.20	1.62
1.30	1.81
1.40	1.99
1.50	2.16
1.60	2.32

Source: Exhibit 6 of NCHRP 128 Report

$$EWTR = \frac{[Late \times (1 - OTP)]^2}{ATL} \qquad [10]$$

Where:

EWTR = Excess Wait Time Rate (min/mi)
Late = Minutes late before the agency counts a bus arrival as late
OTP = On-Time Performance. Agency reported proportion of buses arriving on-time
ATL = Average passenger trip length (miles)

$$ATR = \frac{1.3 \times Shelter + 0.2 \times Bench}{ATL} \qquad [11]$$

Where:

ATR = Amenity Time Rate (min/mi)
Shelter = Proportion of bus stops in study section direction with shelters
Bench = Proportion of bus stops in study section direction with benches
ATL = Average passenger trip length (miles)

The resulting LOS index value from Eq. 3 is compared to the values Table 2 to arrive at a transit LOS.

Pedestrian LOS

The overall pedestrian level of service for an urban street is based on a combination of pedestrian density and facility geometrics/perceived safety. Both the LOS according to density and the LOS according to other factors (geometrics/perceived safety) are computed. The final level of service for the facility is the worse of the two computed levels of service. The density-based method for the determination of pedestrian LOS is taken directly from Chapter 18 of the HCM 2000. However, this method is not reviewed in this study as the pedestrian density for the studied facilities was never high enough to be the controlling method.

There are separate models for pedestrian segment and pedestrian intersection LOS, and then the facility pedestrian LOS includes segment and intersection LOS among its components.

Each of these models is described below. Pedestrian segment LOS is calculated according to Eq. 12.

$$\text{Ped Seg LOS} = -1.2276 \ln (W_{ol} + W_l + f_p \times \%OSP + f_b \times W_b + f_{sw} \times Ws) + 0.0091(V/(4*PHF*L)) + 0.0004\ SPD^2 + 6.0468 \quad [12]$$

Where:

Ped Seg LOS = Pedestrian LOS index value for a segment
W_{ol} = Width of outside lane
W_l = Width of shoulder or bicycle lane
f_p = On-street parking effect coefficient (= 0.20)
%OSP = Percent of segment with on-street parking
f_b = Buffer area coefficient
= 5.37 for any continuous barrier at least 3 ft high separating walkway from motor vehicle traffic. A discontinuous barrier (e.g. trees, bollards, etc.) can be considered a continuous barrier if they are at least 3 feet high and are spaced 20 feet on center or less.
W_b = Buffer width (distance between edge of pavement and sidewalk, in feet)
f_{sw} = Sidewalk presence coefficient (= 6 – 0.3Ws)
W_s = Width of sidewalk. For widths greater than 10 feet, use 10 feet
V = Directional volume of motorized vehicles in the direction closest to the pedestrian (veh/h)
PHF = Peak hour factor
L = Total number of through lanes for direction of traffic closest to pedestrians.
SPD = Average running speed of motorized vehicle traffic (mi/h)

Pedestrian intersection LOS is calculated according to Eq. 13.

$$\text{Ped Int LOS (Signal)} = 0.00569(RTOR+PermLefts) + 0.00013(PerpTrafVol*PerpTrafSpeed) + 0.0681(LanesCrossed^{0.514}) + 0.0401\ln(PedDelay) - RTCI(0.0027PerpTrafVol - 0.1946) + 1.7806 \quad [13]$$

Where:

Ped Int LOS = Pedestrian LOS index value for an intersection
RTOR+PermLefts = Sum of the number of right-turn-on-red vehicles and the number of motorists making a permitted left turn in a 15 minute period.
*PerpTrafVol*PerpTrafSpeed* = Product of the traffic in the outside through lane of the street being crossed and the midblock 85th percentile speed of traffic on the street being crossed in a 15 minute period.
LanesCrossed = The number of lanes being crossed by the pedestrian
PedDelay = Average number of seconds the pedestrian is delayed before being able to cross the intersection. If delay = 0, use 1.00 seconds.
RTCI = Number of right turn channelization islands on the crossing. Can take on only the following values: 0, 1, or 2.

Pedestrian facility LOS is calculated according to Eq. 14.

$$PedFacLOS = (0.318 \times PSeg + 0.220 \times PInt + 1.606) \times (RCDF) \qquad [14]$$

Where:

PedFacLOS = Pedestrian LOS index value for a facility
PSeg = Pedestrian segment LOS index value (see Eq. 12)
PInt = Pedestrian intersection LOS index value (see Eq. 13)
RCDF = Roadway crossing difficulty factor (See Eq. 15)

RCDF = Max[0.80, Min{[(XLOS#-NXLOS#)/7.5 + 1.00],1.20}] [15]

Where:

RCDF = Roadway crossing difficulty factor
XLOS# = Roadway crossing difficulty LOS Number (See Eq. 16)
NXLOS# = Non-crossing Pedestrian LOS Number
= (0.318 PSeg + 0.220 Pint + 1.606)
PSeg = Pedestrian segment LOS value (See Eq. 12).
PInt = Pedestrian intersection LOS value (See Eq. 13).

XLOS = Min [WaitForGap, DivertToSignal] [16]

Where:

XLOS = Crossing LOS score (based on Table 5)
WaitForGap = Delay waiting for safe gap to cross (see Eq. 17)
DivertToSignal = Delay diverting to nearest signalized intersection to cross (see Eq. 18)

Table 5. Pedestrian Crossing LOS Score

Minimum of Wait or Divert Delay (Seconds)	XLOS Score
10	1
20	2
30	3
40	4
60	5
> 60	6

$$MeanWait = \frac{1}{\lambda}[\exp(\lambda t) - 1] - t \qquad [17]$$

Where:

Mean Wait (*WaitForGap*) = seconds waiting, must be greater than or equal to zero.
t = The acceptable gap plus the time it takes for a vehicle to pass by the pedestrian.
= Crossing distance/ped walk speed + vehicle pass-by time
The average pass-by time = Average Vehicle Length/Average Speed, converted to seconds.

λ = The average vehicle flow rate in vehicles per second. (If vehicle arrival rate is zero, mean wait is zero.)

$$DivertToSignal = Ped\ Geometric\ Delay + Ped\ Cycle\ Delay \tag{18}$$

Where:

DivertToSignal = Delay diverting to nearest signalized intersection to cross
Ped Geometric Delay = 2/3 × (Block Length)/Ped Walking Speed

$$PedCycleDelay = \frac{(CycleLength - XingPedWalkTime)^4}{8 \times CycleLength^3}$$

Bicycle LOS

Bicycle LOS is a function of bicyclists' experiences with traffic conflicts and perceived safety and comfort on street segments and at intersections. There are separate models for bicycle segment and bicycle intersection LOS, and then the facility bicycle LOS includes segment and intersection LOS among its components. Each of these models is described below. Bicycle segment LOS is calculated according to Eq. 19.

$$\begin{aligned} BSeg = 0.507 \times \ln\left(\frac{V}{4 \times PHF \times L}\right) + 0.199 \times F_S \times (1 + 10.38 \times HV)^2 \\ + 7.066 \times \left(\frac{1}{PC}\right)^2 - .005 \times W_e^{\,2} + 0.760 \end{aligned} \tag{19}$$

Where:

BSeg = Bicycle LOS index value for directional segment of street
PHF = Peak Hour Factor (if unknown, use 0.90 as default value)
L = Total number of directional through lanes
V = Directional motorized vehicle volume (veh/h). (Note: V > 4 × PHF × L)
F_s = Effective speed factor = 1.1199 ln(S − 20) + 0.8103
S = Average running speed of motorized vehicles (mph) (Note: S >= 21)
HV = Proportion of heavy vehicles in motorized vehicle volume.
Note: if the auto volume is < 200 veh/h, the %HV used in this equation must be <= 50% to avoid unrealistically poor LOS results for low volume and high percent HV conditions.
PC = FHWA five point pavement surface condition rating (5=Excellent, 1=Poor)
(A default of 3 may be used for good to excellent pavement)
W_e = Average effective width of outside through lane (ft)
= W_v – (10 ft × *%OSP*) (ft) ** If W_l < 4
= W_v + W_l – 2 (10 x *%OSP*) (ft) ** Otherwise
%OSP = Percentage of segment with occupied on-street parking
W_l = width of paving between the outside lane stripe and the edge of pavement (ft)
W_v = Effective width as a function of traffic volume (ft)
= W_t (ft) ** If *V* > 160 veh/h or street is divided
= W_t × (2–(0.005 × *V*)) (ft) ** Otherwise

W_t = Width of outside through lane plus paved shoulder (including bike lane where present) (ft)
Note: parking lane can be counted as shoulder only if 0% occupied.

Bicycle intersection LOS is calculated according to Eq. 20.

$$BInt = -0.2144W_t + 0.0153CD + 0.0066\left[V / \left(4 \times PHF \times L\right)\right] + 4.1324 \qquad [20]$$

Where:

Bint = bicycle intersection score
W_t = total width of outside through lane and bike lane (if present) on study direction of street (ft).
CD = The curb-to-curb width of the cross-street at the intersection (ft).
V = Volume of directional traffic (veh/h)
L = Total number of through lanes on the subject approach to the intersection

Bicycle facility LOS is calculated according to Eq. 21.

$$BicycleFacLOS = 0.160 \times (ABSeg) + 0.011 \times (\exp(ABInt)) + 0.035 \times (Cflt) + 2.85 \qquad [21]$$

Where:

BicycleFacLOS = Bicycle LOS index value for a facility
ABSeg = The length weighted average segment bicycle score (See Eq. 19)
ABInt = Average intersection bicycle score (See Eq. 20)
Cflt = Number of unsignalized conflicts per mile, i.e., the sum of the number of unsignalized intersections per mile and the number of driveways per mile

STUDY APPROACH

This section describes the tasks that were performed to accomplish the project objective.

Recruitment of Participating Agencies

With the assistance of the Systems Planning Office, requests for agency participation in the study were made. To facilitate face-to-face meetings, it was desired to have participating agencies that were within a 2-3 hour (driving time) proximity to Gainesville. It was also desirable to have the agencies represent a variety of different-sized urban areas.

Based upon these criteria, the selected urban areas and associated agencies participated in this study are as follows:

- Tampa
    a. Hillsborough County Metropolitan Planning Organization
    b. Hillsborough Area Regional Transit
- Gainesville
    a. North Central Florida Regional Planning Council (NCFRPC)
    b. City of Gainesville Planning Department
    c. Regional Transit System of Gainesville
    d. Alachua County Public Works
    e. Alachua County Growth Management
- Tallahassee
    a. Tallahassee-Leon County Planning Department
    b. Capital Region Transportation Planning Agency
    c. StarMetro Tallahassee Transit
- Orlando
    a. Florida Department of Transportation, District 5

Each jurisdiction identified a point of contact for their area to be available to the principal investigator and research support team. The point of contact helped collect data for the investigative team, and identify gaps in the data collection for their jurisdiction. The point of contact also provided integral comments and question regarding the tools used in this investigation, and critiques about the output of the tool in comparison to the standard model output currently in use in their jurisdiction.

Kick-Off / Model Training Meeting

A meeting was convened of the research team and the participating agency personnel. The purpose of the meeting was to introduce the project, provide an overview of the various LOS models being tested in this project, provide training on the use and application of the various LOS models, and give an overview of data collection requirements and methods. Since most, if not all, of the participants are familiar with the current FDOT models, this session focused primarily on the NCHRP 3-70 models. The meeting agenda is included in Appendix A.

The meeting was convened on 10/2/2008 at the University of Florida. The meeting participants are listed in Table 6.

Table 6. Kick-Off Meeting Participants

Name	Agency
Scott Washburn	UF CCE (Principal Investigator)
Bruce Landis	Sprinkle Consulting (Project Team)
Peyton McLeod	Sprinkle Consulting (Project Team)
Benito Perez	UF CCE (Graduate Research Assistant)
Jorge Barrios	UF CCE (Undergraduate Research Assistant)
Doug McLeod	FDOT Project Manager
Rick Dowling	Dowling Associates (NCHRP 3-70 PI)
Jon Weiss	FDOT – District 5
Terry Rains	FDOT – District 5
Mike Escalante	North Central Florida Regional Planning Council
Marlie Sanderson	North Central Florida Regional Planning Council
Michael Fay	Alachua County Public Works
Chris Zeigler	Alachua County Public Works
Jesus Gomez	Gainesville Regional Transit System
Doug Robinson	Gainesville Regional Transit System
Jonathan Paul	Alachua County Growth Management
Cherie Horne	Tallahassee-Leon County Planning Dept.
Harry Reed	Capital Region Transportation Planning Agency (CRPTA)
Samuel Scheib	STARMETRO - Tallahassee
Steve Feigenbaum	Hillsborough Area Regional Transit Authority (HART)
Gena Torres	Hillsborough MPO

At the kick-off meeting, introductions were held, followed by a background overview of the project by the principal investigators. Participants were informed of their roles in this project and how the results and their input will be used to guide the implementation of multimodal level of service in the next update to the ARTPLAN software. A tutorial of the NCHRP 3-70 spreadsheet tool was given and data collection needs for the NCHRP 3-70 models were reviewed. This was followed by breakout sessions for each jurisdiction to deliberate on arterials to be used for analysis, of which further detail is provided in the following section.

Selection of Test Arterials

In the breakout session, the participating agency personnel were given time to deliberate the selection of four arterials for multimodal LOS analysis. The four arterials selected had to represent a diversity of arterials in their jurisdictions, subject to the following criteria:

a) At least 1 from each of the following categories
   i) Non-state collector
   ii) Class I arterial
   iii) Class II arterial
   iv) Class III or IV arterial
   v) Perceived bicycle and pedestrian friendly roadway
b) At least 1 from the following area types
   i) Suburban

ii) Downtown or multimodal district
c) Arterials with a maximum of 5 segments

After discussion by personnel within each jurisdiction, and guidance offered by research team members, the arterials selected for analysis are as follows.

Gainesville

Each of the four selected arterials in the Gainesville area is identified in Figure 2.

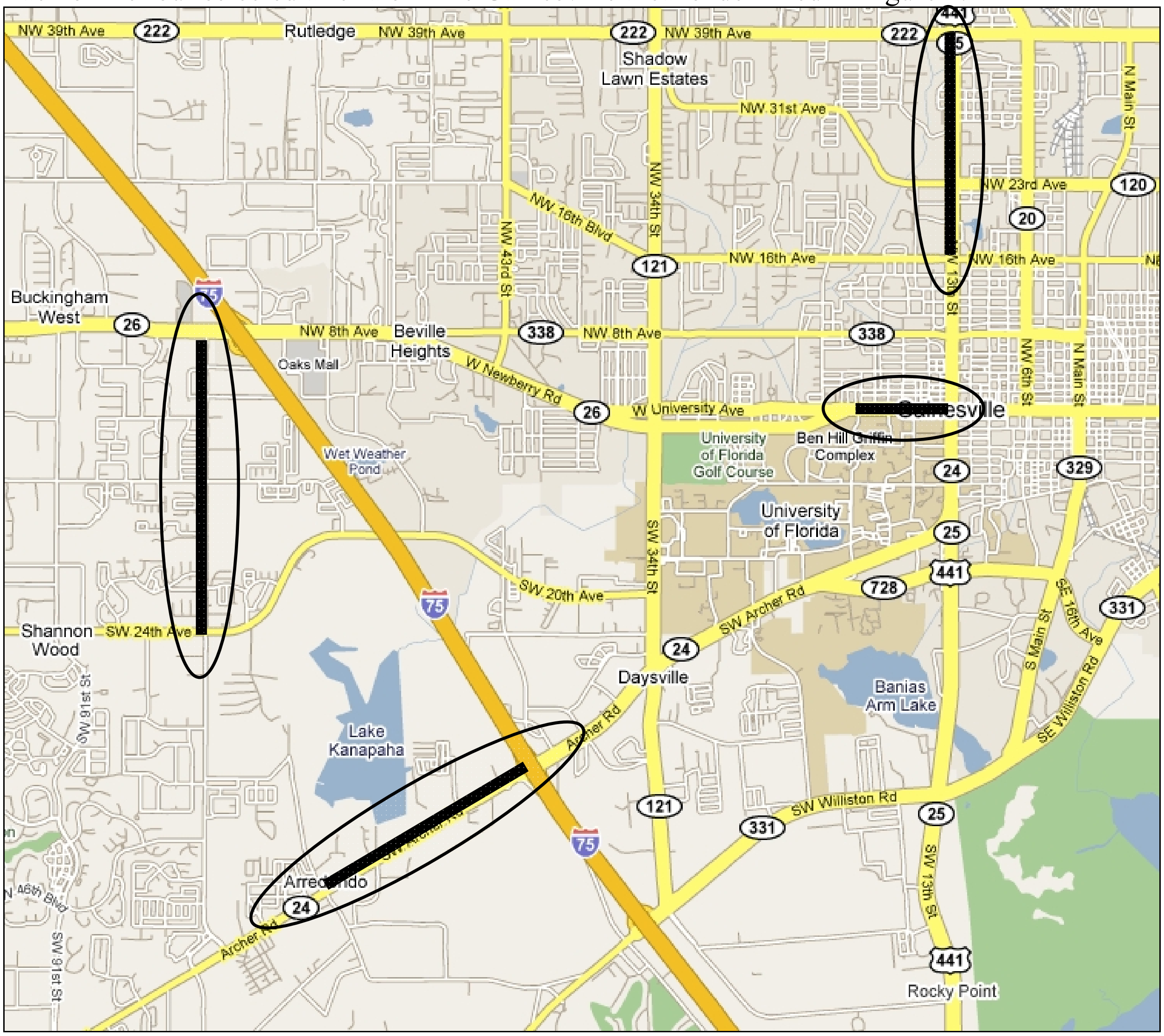

Figure 2. Gainesville area selected arterials

The characteristics of each of the selected arterial sections and a zoomed in map view follow.

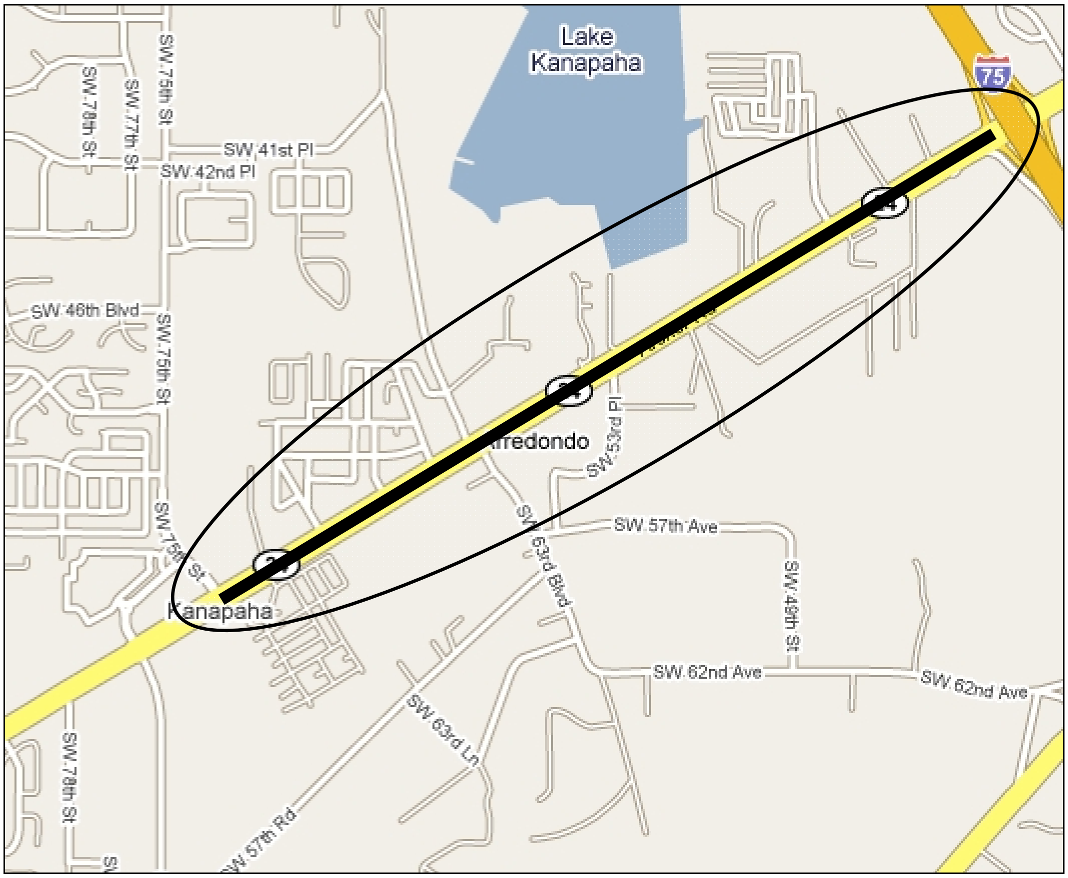

Figure 3. Archer Road (State Road 24)

Archer Road (State Road 24)

Class I Arterial
From I-75 to Tower Road (SW 75th Street)
4-lane divided roadway
Suburban. Bike Lanes Present.
Length: 2.52 miles (13300 ft)

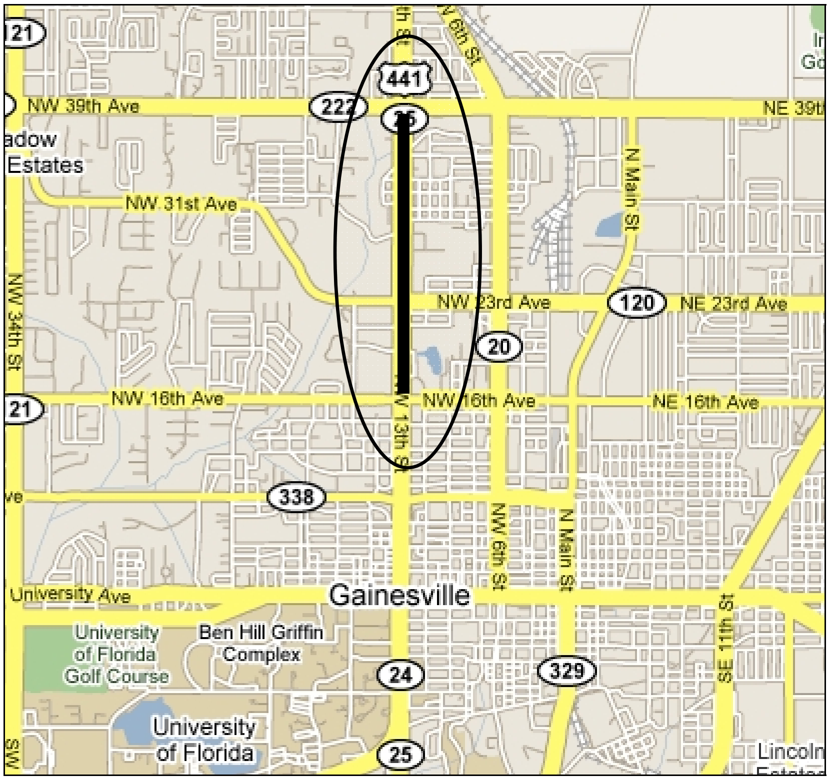

Figure 4. Northwest 13th Street (US 441)

Northwest 13th Street (US 441)

Class II Arterial

From NW 16th Avenue to NW 39th Avenue

4-lane divided roadway

Partial Bike/ Pedestrian

Length: 1.50 miles (7910 feet)

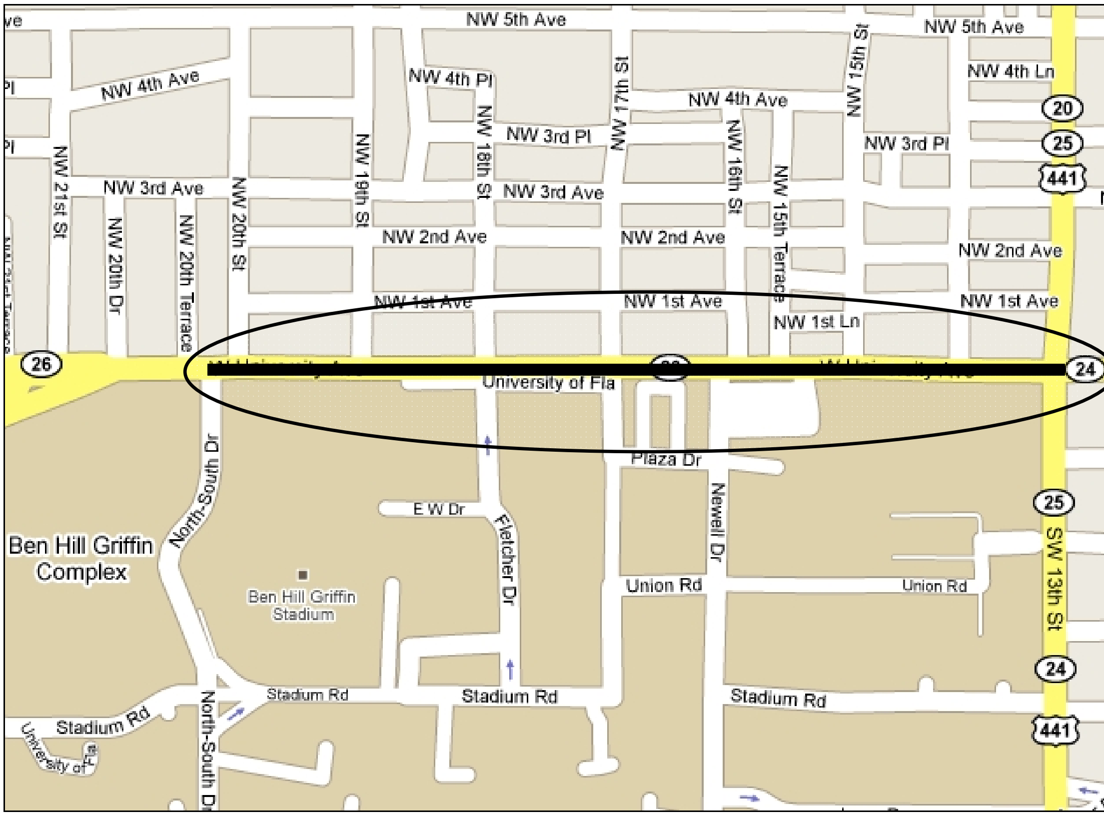

Figure 5. West University Avenue (State Road 26)

West University Avenue (SR-26)

Class III Arterial

From US-441 (W. 13th Street) to Gale Lemerand Drive

4-lane divided roadway

Downtown central business district setting

Length: 0.62 miles (3285 feet)

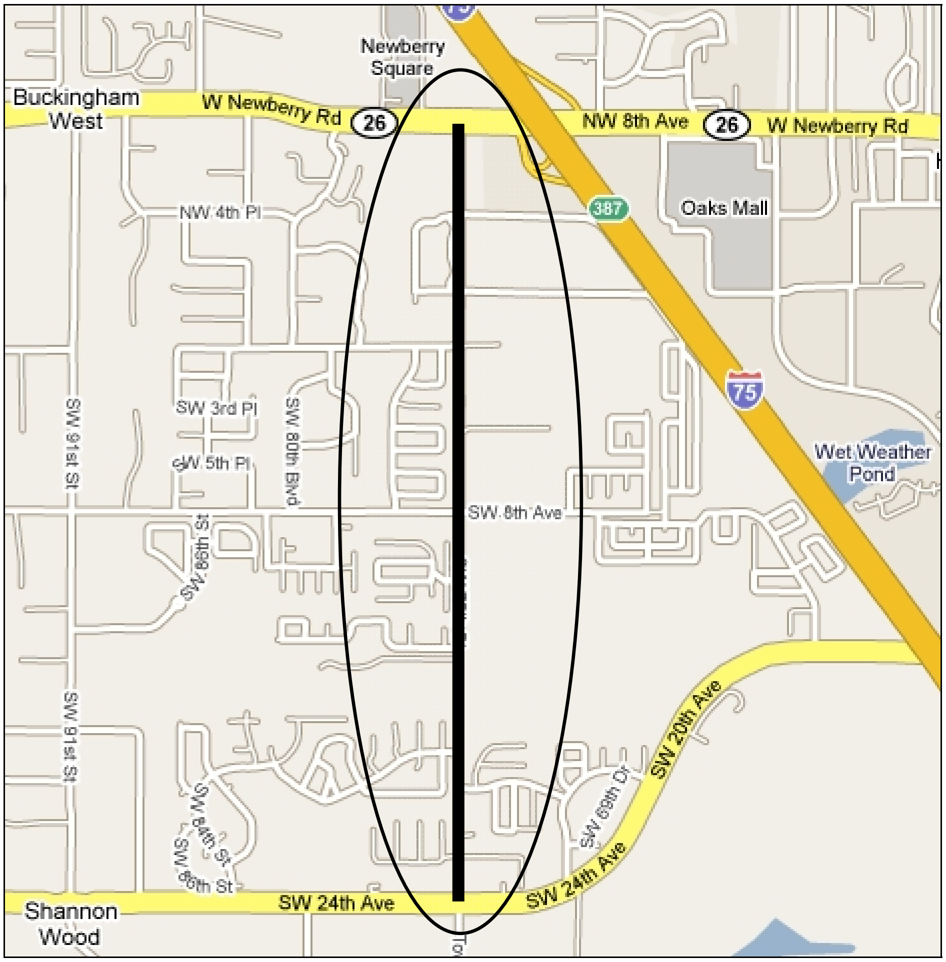

Figure 6. Tower Road (SW 75th St)

Tower Road

Non-state Collector

From SR-26 (Newberry Road) to SW 24th Avenue

4-lane divided roadway (north of 8th Ave), 2-lane undivided from 8th to 24th

Multi-use trail on last segment

Length: 2.04 miles (10770 feet)

Tallahassee

Each of the four selected arterials in the Tallahassee area is identified in Figure 7.

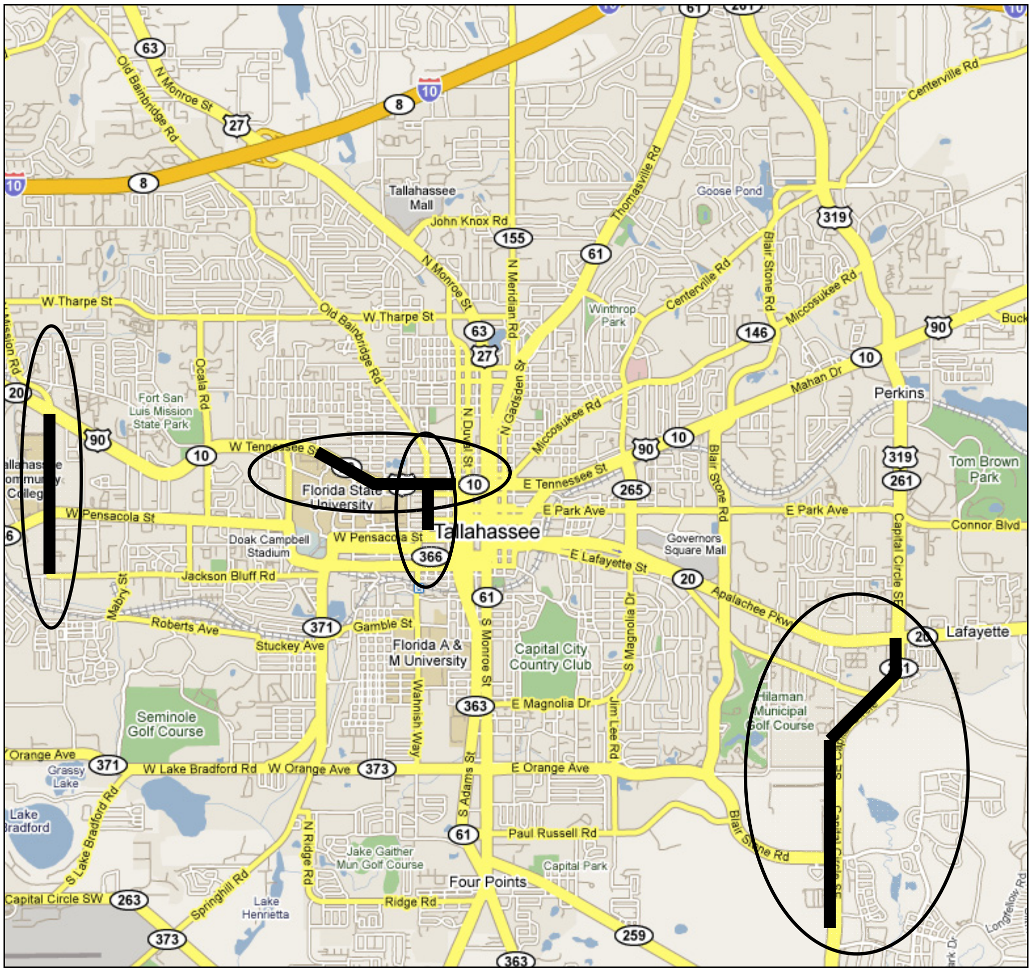

Figure 7. Tallahassee area selected arterials

The characteristics of each of the selected arterial sections and a zoomed in map view follow.

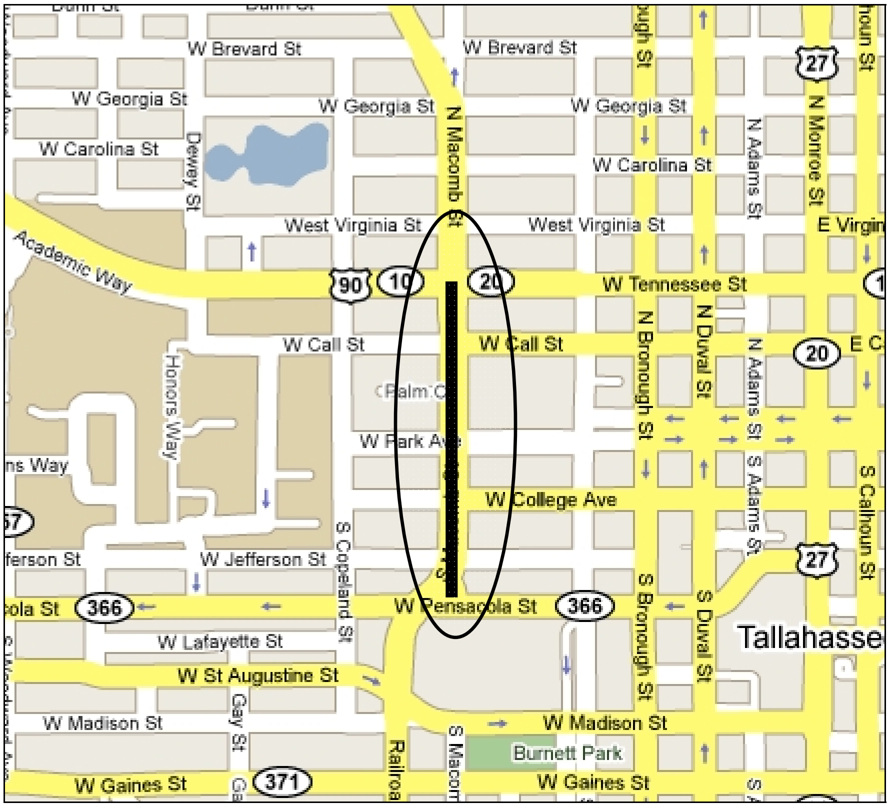

Figure 8. North Macomb Street

North Macomb Street

Non-state collector
From West Tennessee Street to West Pensacola Street
Has bike lanes
Big hill, high volume
Length: 0.42 miles (2230 feet)

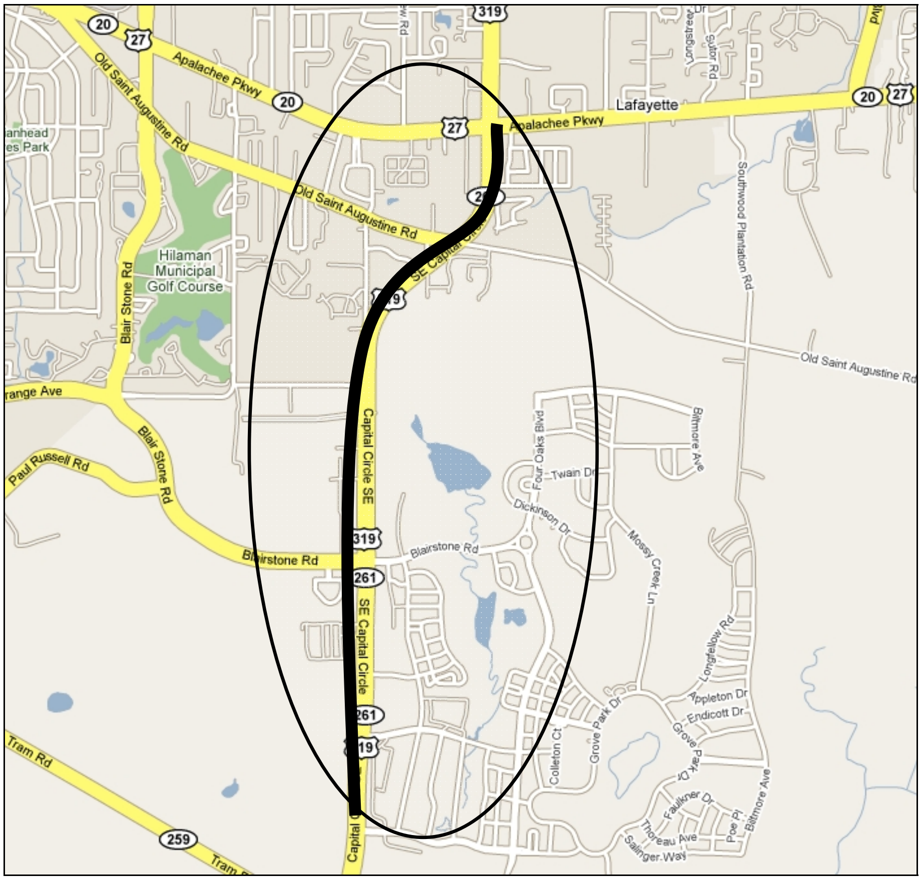

Figure 9. Capital Circle SE

Capital Circle Southeast

- Class I Arterial
- From Apalachee Parkway to Shumard Oak Road
- 6-lane roadway
- Very high volume, high speed
- Has bike lanes and side path
- Length: 3.01 miles (15906 ft)

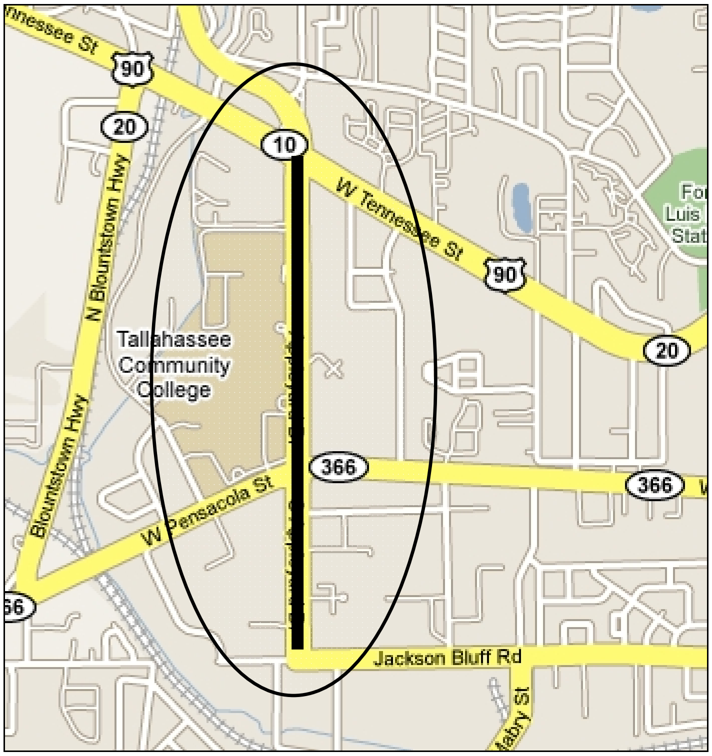

Figure 10. Appleyard Drive

Appleyard Drive

Class II Arterial

From West Tennessee Street to Jackson Bluff Road

4-lane divided roadway

Has bike lanes

Multiple transit routes

Length: 1.27 miles (6710 feet)

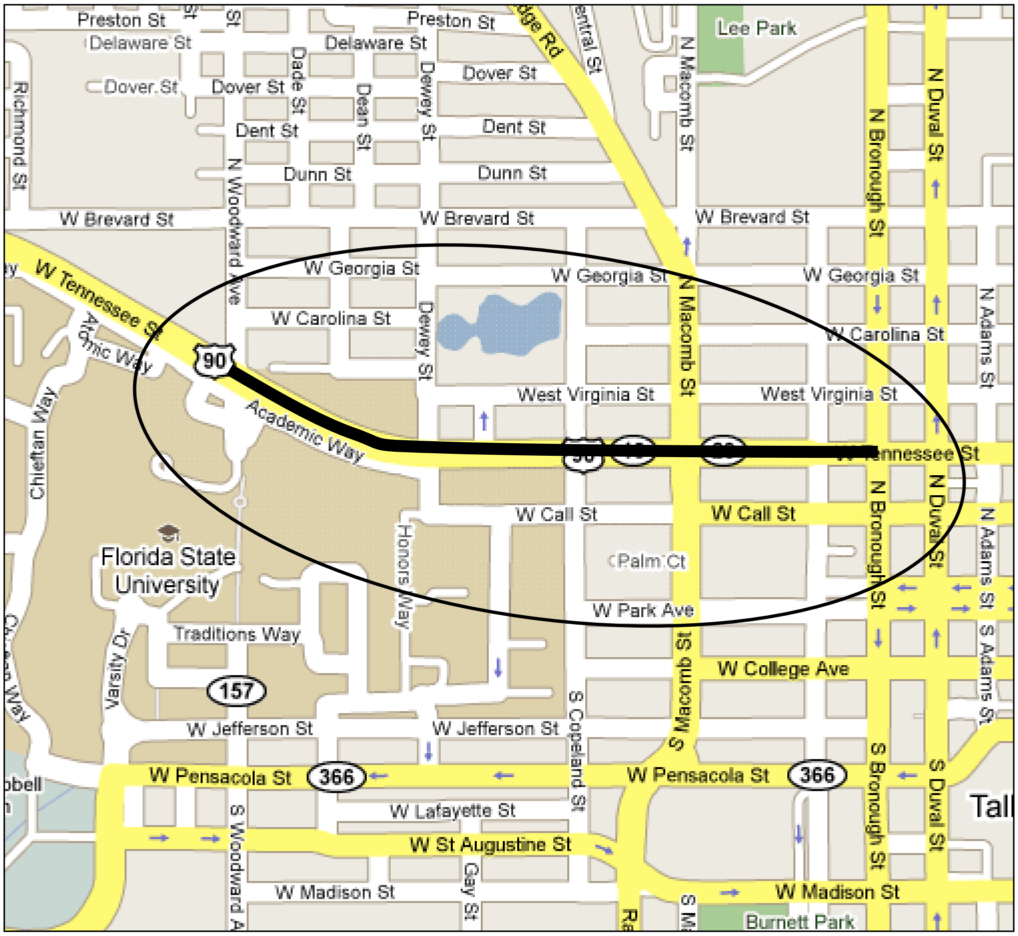

Figure 11. West Tennessee Street

West Tennessee Street

- Class IV Arterial
- From North Woodward Avenue to North Bronough Street
- Six-lane divided
- Urban and not bike friendly
- Length: 0.82 miles (4450 feet)

Tampa

Each of the four selected arterials in the Tallahassee area is identified in Figure 12.

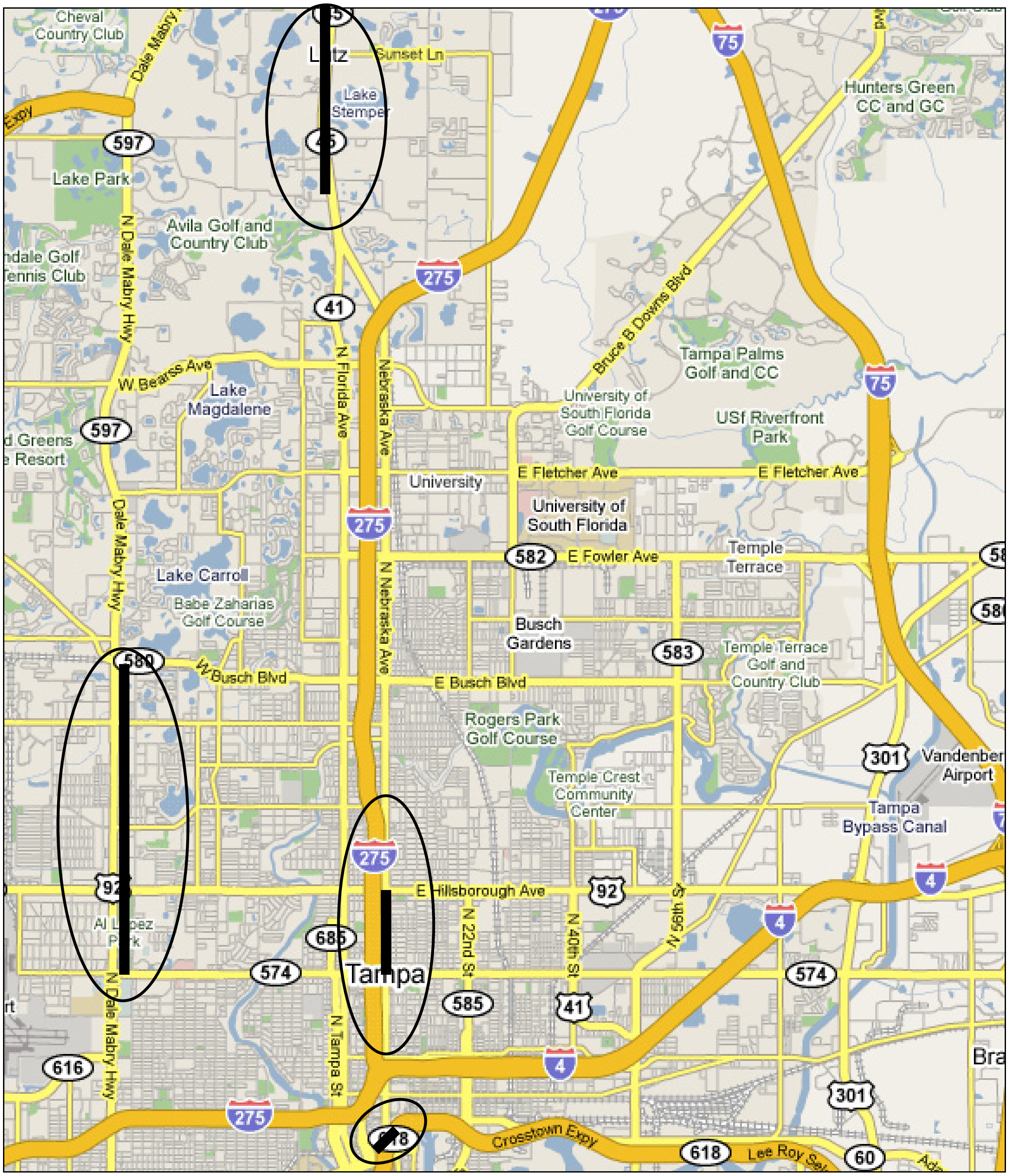

Figure 12. Tampa area selected arterials

The characteristics of each of the selected arterial sections and a zoomed in map view follow.

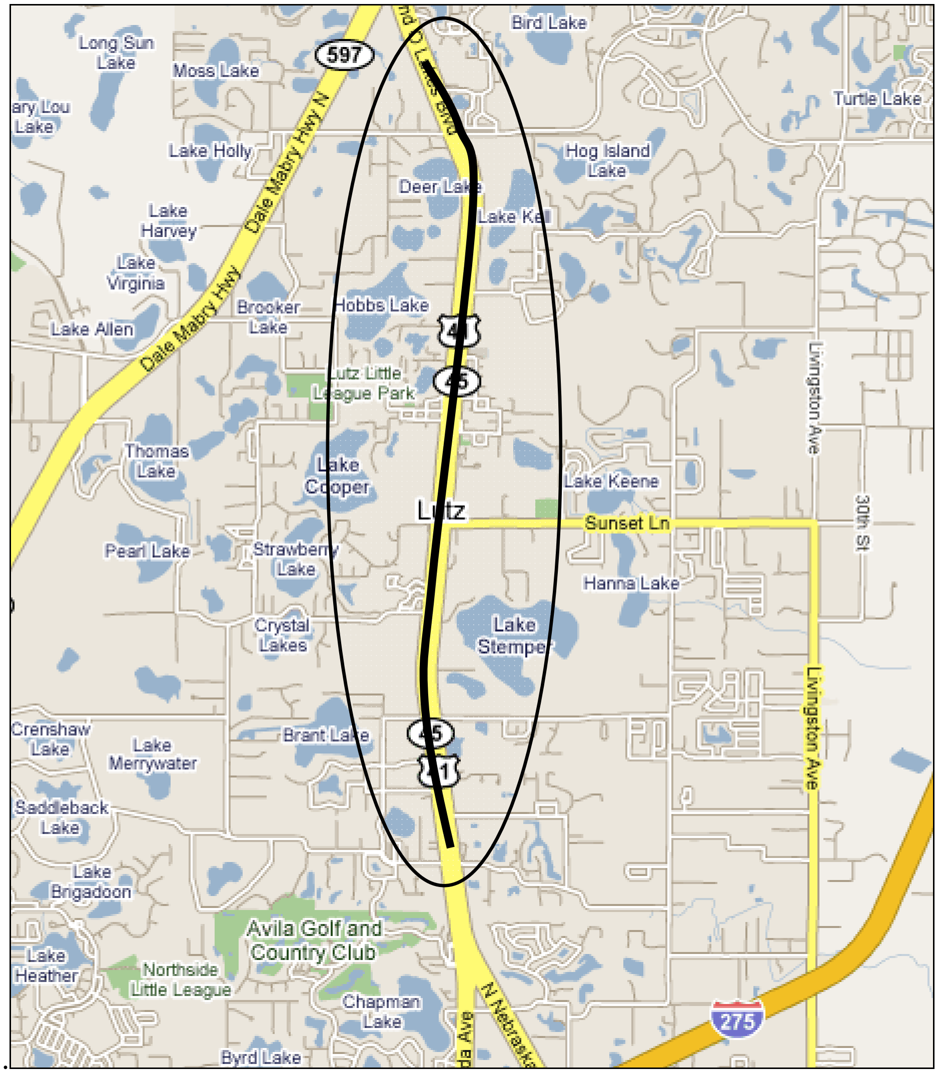

Figure 13. US 41

US 41 (in Lutz)

Class I Arterial

From Crenshaw Lake Road to County Line Road

6-lane divided roadway

Has paved shoulder on one side (wide curb lane on the other), has sidewalk on one side.

Length: 3.85 miles (20330 feet)

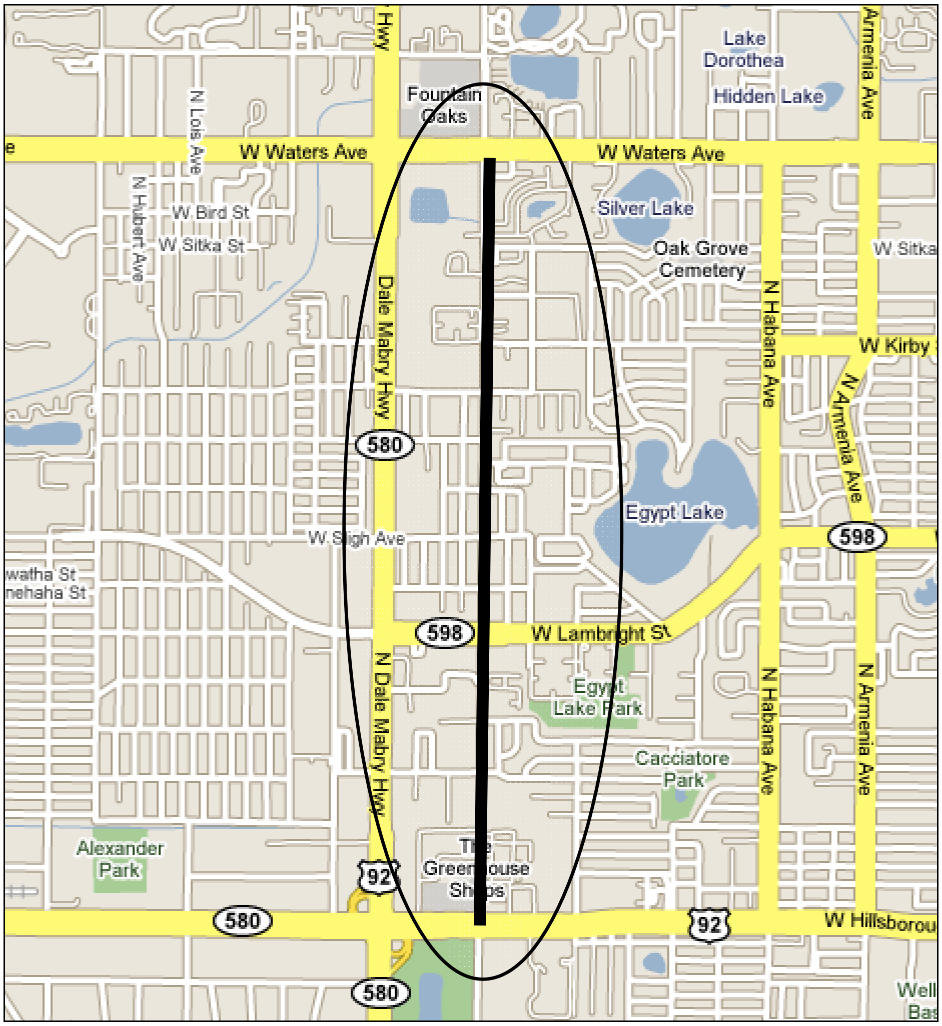

Figure 14. Himes Avenue

Himes Avenue

Non-state collector

From Hillsborough Avenue to Busch Boulevard (northern terminus is T-intersection; thus, 100% turns)

Two lane undivided roadway

Parallels Dale Mabry Highway (major roadway)

Not bicycle friendly or pedestrian friendly

Has transit

Length: 2.75 miles (14540 feet)

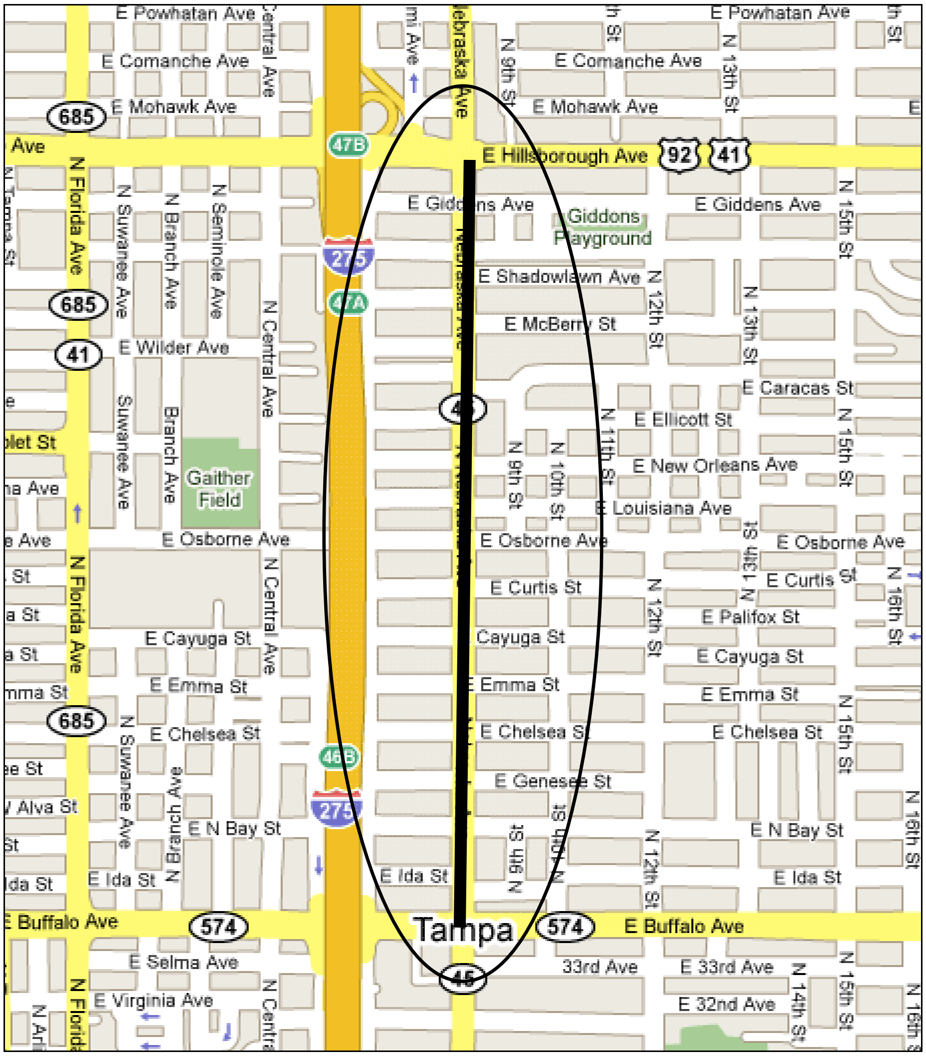

Figure 15. Nebraska Avenue

Nebraska Avenue

- Class II Arterial
- From Martin Luther King Avenue to Hillsborough Avenue
- Originally a 4-lane roadway, now a 2-lane roadway (went through “road diet” process”)
- Has bike lanes
- Great transit (has bus bays) and pedestrian friendly
- Length: 1.01 miles (5310 feet)

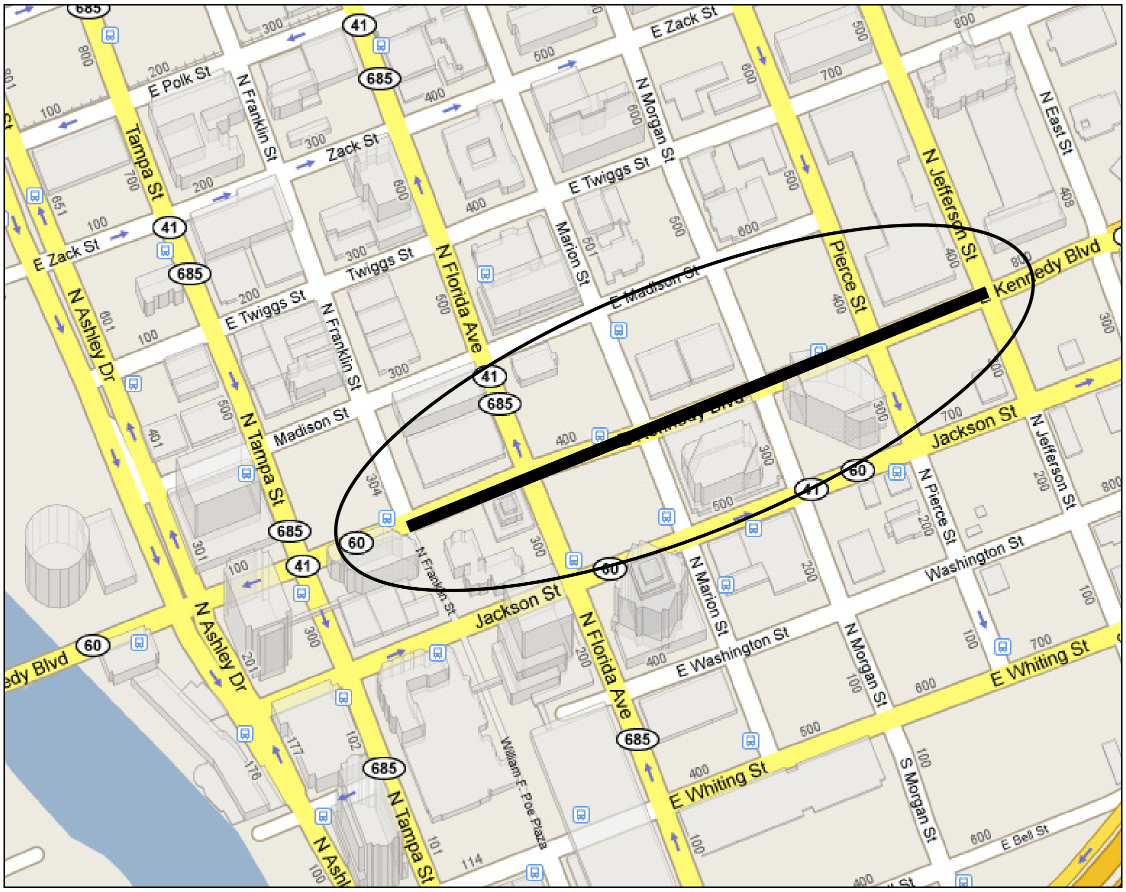

Figure 16. Kennedy Boulevard

Kennedy Boulevard (SR-60)

Class III Arterial
4-lane, one way
From Jefferson Street to Franklin Street
Downtown road. Not bike friendly.
Pedestrian friendly.
Some transit (only one route on the facility, but the general area is quite well served).
Length: 0.27 miles (1450 feet)

Data Collection

In addition to the aforementioned criteria in selecting arterials, some of the arterials were also chosen based on the availability of existing data. Even so, there were some analysis parameters which either had not been previously collected or required an update due to changed conditions (traffic volumes, etc).

The combined set of data elements needed for all the models being tested are as follows:

- Roadway variables
    - Number of lanes
        - Midblock
        - Intersections
    - Presence of left turn lanes
    - Presence of right turn lanes
    - Presence of medians
    - Outside lane widths
    - Posted speed limit
    - Presence of sidewalks
    - Presence of trees
    - Sidewalk widths
    - Presence of bicycle lanes / paved shoulders / on-street parking
    - Widths of bicycle lanes / paved shoulders / on-street parking
    - Pavement quality
        - Roadway lanes
        - Bicycle lanes / paved shoulders
    - Bus stops with shelters and/or benches
    - Obstacle to Bus Stop (ARTPLAN)
    - Bus Span of Service (ARTPLAN)
- Traffic variables
    - Daily motorized vehicle volumes
    - Hourly directional motorized vehicle volumes
    - Cross street volumes
    - Turning movement volumes or percents at intersections
    - Percent heavy vehicles
    - Percent on-street parking occupied
    - Pedestrian flow rate
    - Bus frequency
    - Bus span of service
    - Bus on-time performance
    - Average bus speed between bus stops (including loading and unloading passengers)
    - Ratio of passengers to seats
- Signalization variables
    - Distances between signals
    - Signal timing plans (with an emphasis on)
        - Cycle length (C)
        - Through effective green to cycle length ratios (g/C)
    - Arrival type

For those data items listed above not readily available from existing sources, research team members and/or participating agency personnel collected the data items from the field. Additionally, the following items were measured from the field to ensure the most accuracy in the analysis results:

- Average number of vehicle stops per mile
- Average automobile travel speed
- Average pedestrian delay to cross street at signals

With the guidelines in data collection highlighted above, each jurisdiction proceeded to collect data for their four arterials, later to be used in the data analysis stage. Additional detail about data collection in each of the jurisdictions is described in the following sections.

Gainesville

The data collection team consisted of Michael Escalante, Doug Robinson, Benito Perez, and Jorge Barrios. If data were readily available through a database or a previous traffic study, such data were pulled from those sources. Arterial geometry (number of lanes, etc.) was confirmed in the field. For transit load factors and passenger counts, data were pulled from automated passenger counters. See the Gainesville data sheets in Appendix B for more information.

Travel Speed and Stops: To determine the average travel speed along the arterials, the data collection team performed six "average car" runs on each one of them. Performing an "average car" run, the driver is simply instructed to travel according to his or her best judgment of the traffic stream's speed. The runs were performed between 4:00 PM and 6:30 PM, and were recorded using four video cameras mounted in the Transportation Research Center's Honda Pilot (see Figures 17-20). In order to compute both average running speed and stops per mile, the number and length of the stops were recorded using a stopwatch. The LOS models being tested also required segment-specific speeds and number of stops, which were obtained from the video by measuring the travel times from one intersection to the next, counting the stops in the process.

- Stops – A stop was recorded whenever the car's speedometer fell below 5 mi/h. An additional stop was recorded in the case of a cycle failure, even if the car stayed under 5 mi/h at the signal. To obtain the number of stops per mile, the number of stops was divided by the distance traveled. This was also done at the segment level.

- Speed – The average speed was computed as the distance traveled (as measured from Google Maps) divided by the average travel times of the runs. This was done for the entire arterial length and for each segment.

Figure 17. Honda Pilot Image from NW 13th Street

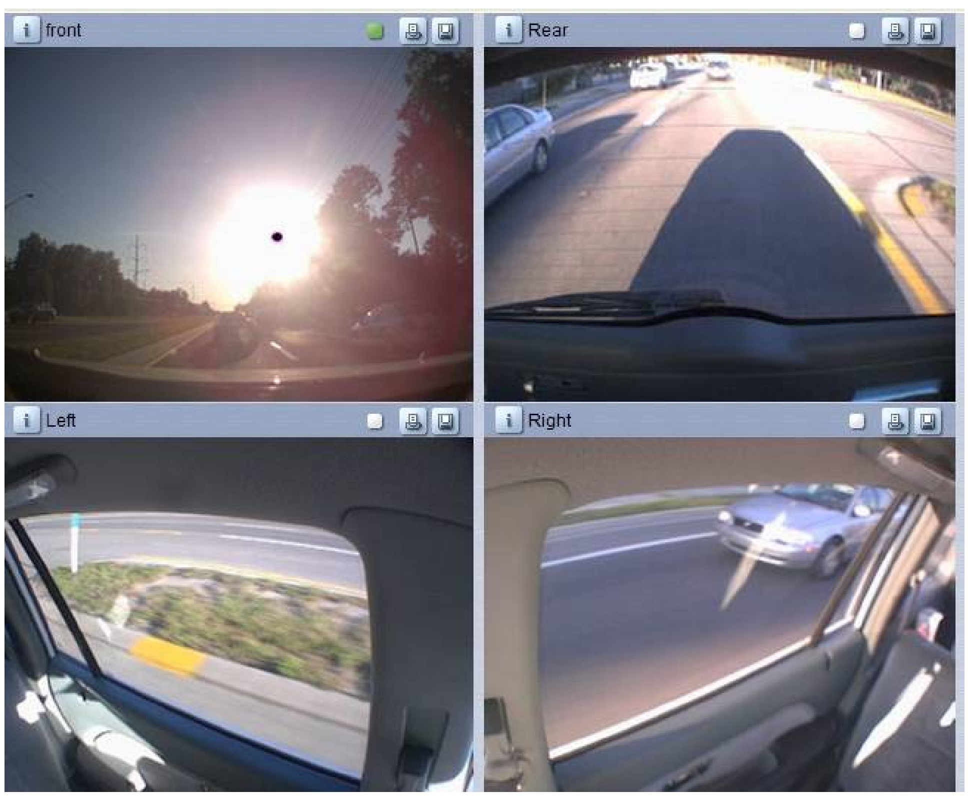

Figure 18. Honda Pilot Image from Archer Road

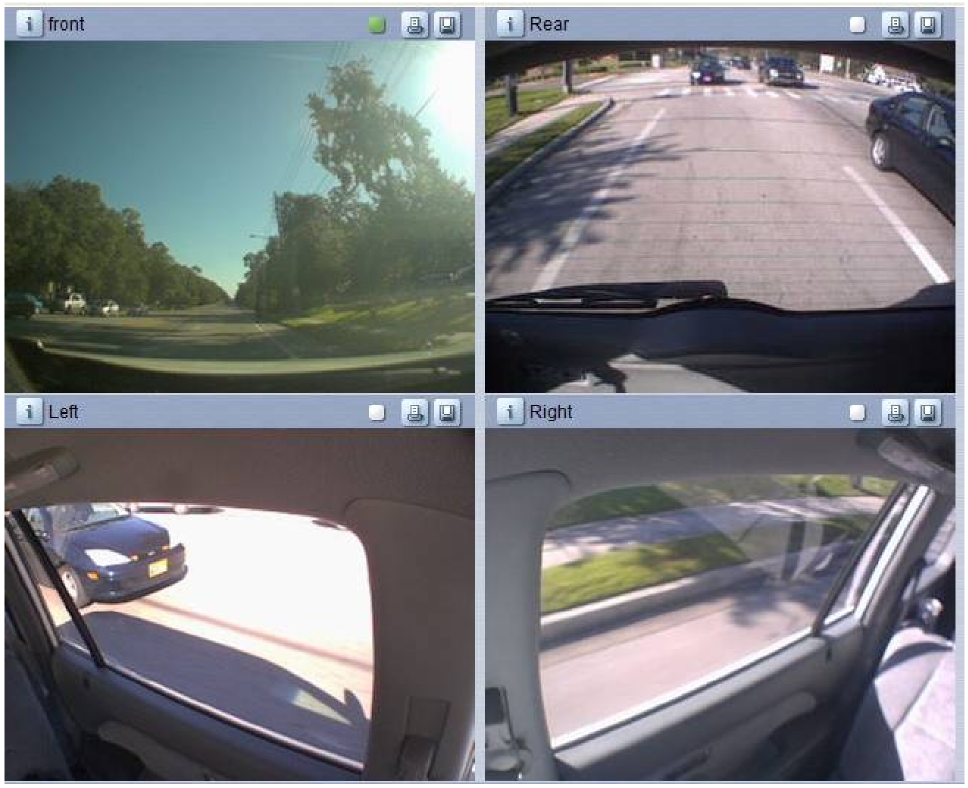

Figure 19. Honda Pilot Image from Tower Road

Figure 20. Honda Pilot Image from W. University Ave

Cross street volumes: Noting that the analysis results are not particularly sensitive to this variable, and taking into account the time constraints of the project, the data collection team decided to approximate the volumes using the cross-street green to cycle ratios. The procedure was as follows:

- Cross-streets' g/C ratios were recorded using a stopwatch.
- A volume to capacity ratio was estimated based on the amount of cars going through the green light.
- The saturation flow rate (1900 for through and 1805 for left turns) was multiplied by the number of lanes, the g/C ratio for each movement, and the estimated v/c ratio.

It is worth mentioning that the volumes for the cross-streets that had been previously recorded by a study commissioned by the NCFRPC closely resembled the approximations.

Green times and cycle length: Green times and cycle lengths were available through signal timing sheets; however, it was decided to observe these in field during the peak period to confirm the times that result from the actual peak period traffic demands. The data collection team went out during peak hour and recorded the new timings with the use of a stopwatch.

Tampa

The data collection team consisted of Gena Torres, Steve Feigenbaum, and Sprinkle Consulting. If data were readily available through a database or a previous traffic study, such data were pulled from those sources. For arterial geometrics, data were obtained from the field. For transit load factors and passenger counts, data were obtained from automated passenger counters. See the Tampa data sheets in Appendix C for more information.

Travel Speed and Stops: To find the average speed in the arterials, the data collection team performed three to five "floating car" runs on each one of them. Performing a "floating car" run, the driver is instructed to pass as many vehicles as pass his/her vehicle. The runs were performed between 3:30 PM and 5:30 PM. In order to compute both average running speed and stops per mile, the number and length of the stops were recorded using a stopwatch on a segment-by-segment basis.

- Stops – A stop was recorded whenever the car's speedometer fell below 5 mi/h. For a cycle failure, two or more stops were recorded, even if the car stayed under 5 mi/h at the signal. To obtain the number of stops per mile, the number of stops was divided by the distance traveled.

- Speed – The average speed was computed as the distance traveled (as measured from Google Maps) divided by the average travel times of the runs. This was done for the entire arterial length and for each segment.

Cross street volumes: The data collection team conducted abbreviated turning movement counts to determine cross street traffic volumes.

Green times and cycle length: Green times and cycle lengths were not readily available to the data collection team. The data collection team went out during the peak hour and recorded the signal timings with the use of a stopwatch.

Tallahassee

The data collection team consisted of Cherie Horne, Samuel Scheib, and Sprinkle Consulting. If data were readily available through a database or a previous traffic study, such data were pulled from those sources. For arterial geometrics, most data were readily available from a database (http://tlcgis6.co.leon.fl.us/TrafficSite/Default.aspx) maintained by the Capital Region Transportation Planning Agency. Any missing arterial geometrics data were then collected from the field. See the Tallahassee data sheets in Appendix D for more information.

Travel Speed and Stops: To find the average speed in the arterials, the data collection team performed six "floating car" runs on each one of them. Performing a "floating car" run, the driver is instructed to pass as many vehicles as pass his/her vehicle. The runs were performed between 7:00 AM and 9:30 AM (the morning peak period was chosen to better facilitate the collection of transit data). In order to compute both average running speed and stops per mile, the number and length of the stops were recorded using a stopwatch on a segment-by-segment basis.

- Stops – A stop was recorded whenever the car's speedometer fell below 5 mi/h. For a cycle failure, two or more stops were recorded, even if the car stayed under 5 mi/h at the signal. To obtain the number of stops per mile, the number of stops was divided by the distance traveled.

- Speed – The average speed was computed as the distance traveled (as measured from Google Maps) divided by the average travel times of the runs. This was done for the entire arterial length and for each segment.

Cross street volumes: Traffic count data were obtained from the Tallahassee traffic engineering department.

Green times and cycle length: These data were obtained from the signal timing plans of the Capital Region Transportation Planning Agency.

Level of Service Analysis

Once all the required data had been obtained and/or collected, the agency personnel, with the assistance of research team members when necessary, applied the data to the following models.

a) *Auto*
   i) *NCHRP 3-70 stops model*
   ii) *NCHRP 3-70 speed model*
   iii) *Current HCM speed model using ARTPLAN*
   iv) *NCHRP 3-79 speed model (%FFS LOS thresholds)*
b) *Bicycle*
   i) *NCHRP 3-70 model*
   ii) *Current Florida model using ARTPLAN*

c) Pedestrian
i) NCHRP 3-70 model
ii) Current Florida model using ARTPLAN
d) Transit
i) NCHRP 3-70 model
ii) Current Florida model using ARTPLAN

LOS analysis for Gainesville was conducted by Scott Washburn, Benito Perez, and Jorge Barrios. LOS analysis for Tallahassee was conducted by Peyton McLeod and Cherie Horne. LOS analysis for Tampa was conducted by Peyton McLeod. LOS analysis for Orlando was conducted by Masood Mirza (Ghyabi and Associates—consultant for District 5).

Spreadsheet Tool Issues

During the data analysis process, some issues emerged with the spreadsheet tool used for the LOS analyses. Those issues and their resolutions are listed in Table 7.

Table 7. Spreadsheet Tool Issues

Problem	Solution	Spreadsheet Version
Data entry in the MMLOS worksheet	All data (whether it comes from the field or NCHRP 3-79) is entered in the 5 data entry sheets (layout, xsect1-3, xsect4-5, traffic, transit)	MMLOS 4
Pedestrian LOS parameters in MMLOS worksheet	Pedestrian LOS parameters moved to the “parameters” worksheet	MMLOS 4
Entering travel time information for traffic worksheet	Enter speed in traffic worksheet. Remove travel time from worksheet.	MMLOS 4
PHF double applied to Ped LOS segment	Formula resolved to remove doubling of PHF.	MMLOS 6
Double counting of lanes in capacity computation.	Saturation flow is input	MMLOS 6
Tree spacing computation = yes/no	Tree Spacing Factor	MMLOS 6
On lines 168-173 column E and lines 223-228, column F shows “#DIV/0!” if no buses.	Removed “#DIV/0!” error by tweaking formula to yield 0.	MMLOS 6
When entering bus stops on segment, what is relevant is if there is one within a reasonable distance?	Count stops if within 500 feet of arterial end point.	MMLOS 6
Arterial crossing distance for RCDF calculation included parking lanes and median.	Reduced arterial crossing distance for RCDF calculation to exclude parking lanes and median	MMLOS 7
Traffic volumes for the bike and ped segment LOS calculations refer back to the demand volume.	Corrected directional traffic volume computation to include turning volumes	MMLOS 8
Six lane arterial capacity	Added capability for 8 lane arterial	MMLOS 8
Mean wait ped time calculation error.	Corrected computation of mean ped wait time to cross arterial at signal (0.5 wait^2/cycle)	MMLOS 8
Clarity issues to where segment length is determined.	Moved segment length dimension arrows in layout worksheet to show measuring stop bar to stop bar distances.	MMLOS 8
No mechanism to account for two-stage crossings	Kicks in two stage crossing calculation if median is 6 feet or greater.	MMLOS 9

Issue in clearing spreadsheet for another arterial, or carrying over data from another spreadsheet without re-entering data.	Macros added to automate printing, updating, and clearing	MMLOS 9

ARTERIAL LOS RESULTS, EVALUATION, AND FURTHER ANALYSIS

LOS Analysis Results

A summary of the LOS analysis results are given in Tables 8-10. For a complete review of the data spreadsheets for each arterial, please refer to Appendixes B-D.

Table 8. LOS results for Gainesville arterials

Street: Archer Road

Direction =	WB									
Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 3-79 LOS #4	Transit LOS	Artplan Transit LOS	Bicycle LOS	Artplan Bicycle LOS	Pedestrian LOS	Artplan Pedestrian LOS
1	B	A	B	B	E	D	E	F	D	D
2	B	A	A	A	E	D	E	E	D	D
3	B	A	B	B	E	D	E	E	D	D
Facility	B	A	A	B	E	D	E	E	D	D

Street: NW 13th St

Direction =	NB									
Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 3-79 LOS #4	Transit LOS	Artplan Transit LOS	Bicycle LOS	Artplan Bicycle LOS	Pedestrian LOS	Artplan Pedestrian LOS
1	B	A	A	A	C	E	F	E	D	D
2	C	C	D	D	C	E	F	E	D	D
3	B	A	A	A	B	E	D	C	D	D
4	B	B	C	C	B	E	D	C	D	D
5	B	A	B	B	C	D	E	C	D	D
Facility	B	B	C	B	C	E	E	D	D	D

Street: W University Ave

Direction =	WB									
Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 3-79 LOS #4	Transit LOS	Artplan Transit LOS	Bicycle LOS	Artplan Bicycle LOS	Pedestrian LOS	Artplan Pedestrian LOS
1	C	C	C	C	C	D	E	D	C	D
2	B	C	C	C	C	C	E	D	C	D
3	B	B	A	A	B	C	D	D	C	D
4	B	B	B	B	B	D	D	D	C	D
Facility	B	B	C	C	C	D	D	D	C	D

Street: Tower Road (SW 75th St)

Direction =	SB									
Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 3-79 LOS #4	Transit LOS	Artplan Transit LOS	Bicycle LOS	Artplan Bicycle LOS	Pedestrian LOS	Artplan Pedestrian LOS
1	B	B	C	C	E	E	E	D	C	D
2	B	A	B	A	E	E	D	D	C	D
3	B	A	B	B	E	E	D	C	C	C
4	B	B	B	C	E	E	E	E	C	D
Facility	B	B	B	B	E	E	E	D	C	D

Table 9. LOS Results for Tampa arterials

Street: Himes Avenue

Direction =	NB	

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	C	C	C	D	F	D
2	B	C	B	B	D	F	D
3	B	B	A	A	D	E	D
4	F (v/c>1)	F (v/c>1)	E	E	D	F	E
Facility	F (v/c>1)	F (v/c>1)	C	C	D	F	D

Street: Nebraska Avenue

Direction =	NB	

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	B	C	C	C	D	D
2	C	C	D	D	C	E	D
3	B	C	D	D	C	F	F
Facility	B	C	D	D	B	E	E

Street: US 41

Direction =	NB	

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	A	A	A	F	D	E
2	B	A	A	A	F	F	E
3	B	A	A	A	F	D	D
4	B	A	A	A	F	E	D
5	B	A	A	A	F	E	E
Facility	B	A	A	A	F	E	E

Street: Kennedy Boulevard

Direction =	WB	

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	B	B	B	A	D	D
2	B	B	B	B	A	D	D
3	B	B	B	B	A	D	D
4	B	B	A	A	A	D	D
5	B	B	A	A	A	D	D
Facility	B	B	A	A	A	D	D

Table 10. LOS Results for Tallahassee arterials

Street: Capital Circle Southeast

Direction =	SB	

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	A	A	A	F	E	D
2	B	A	A	A	F	E	E
3	B	B	C	C	B	E	D
4	B	A	A	B	B	E	D
5	B	A	A	A	F	E	D
Facility	B	A	A	B	F	E	D

Street: Macomb Street

Direction =	SB	

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	B	B	B	F	D	C
2	B	A	A	A	F	D	C
3	B	B	A	B	F	D	C
4	C	A	A	A	F	E	C
5	B	B	B	B	F	D	C
Facility	B	B	A	A	F	D	C

Street: West Tennessee Street

Direction =	EB	

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	A	B	A	A	D	C
2	C	C	C	C	A	F	C
3	C	C	D	E	A	E	C
4	C	B	A	A	A	F	C
5	B	C	B	C	A	D	C
Facility	B	B	B	C	A	E	C

Street: Appleyard Drive

Direction =	SB	

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	A	A	A	E	D	C
2	B	A	A	A	D	D	D
3	B	A	A	A	D	D	C
Facility	B	A	A	A	D	D	C

LOS Models Feedback and Assessment

A follow-up meeting was convened on 12/11/08 at the University of Florida, with the key participating agency staff members and appropriate research team personnel. This meeting was of a "roundtable" discussion format for all of the study participants to explain their thought processes and justification for how they evaluated each of the models to the researchers, as well as the other participants. The participants for this meeting are listed in Table 11.

Table 11. Follow-Up Meeting Participants

Name	Agency
Scott Washburn	UF CCE (Principal Investigator)
Bruce Landis	Sprinkle Consulting (Project Team)
Peyton McLeod	Sprinkle Consulting (Project Team)
Benito Perez	UF CCE (Graduate Research Assistant)
Jorge Barrios	UF CCE (Undergraduate Research Assistant)
Doug McLeod	FDOT Project Manager
Terry Rains	FDOT – District 5
Mike Escalante	North Central Florida Regional Planning Council
Cherie Horne	Tallahassee-Leon County Planning Dept.
Samuel Scheib	STARMETRO - Tallahassee
Gena Torres	Hillsborough MPO
Masood Mirza	Ghyabi & Associates

Before the follow-up meeting was convened, a participant survey was drafted by the research team and distributed to the participants. The intent of the survey was to let the project participants know what kind of feedback the research team would be seeking at the follow-up meeting and give them time in advance to consider their responses to the questions. A copy of the survey is included in Appendix E. The survey responses are included in Appendix F.

The follow-up meeting was conducted with the aim of being fluid in its structure, so participants could provide comments pertaining to key agenda items that were most relevant to their experience and participation in the project. The majority of the discussion at this meeting was spent on the following topics:

- LOS analysis feedback
- Data collection issues
- Model application issues

These issues, as well as a couple of others, are presented in the remainder of this section.

LOS Analysis Feedback

Each jurisdiction provided an overview of the arterials selected for analysis. Jurisdiction representatives gave an overview of the facility operations, environment, and data collection methods for the auto models, followed by a second round to address the transit, bicycle, and pedestrian models. The following is a summary of participant comments regarding LOS values resulting from the analyses.

AUTO

Archer Road (Gainesville)

- SW 43rd St – adjacent to I-75 ramp – could impact segment LOS
- Lots of bus stops but not many buses.
- Not many signals along segment.

NW 13th Street (Gainesville)

- Mike Escalante was skeptical about the facility LOS B or C, citing a previous LOS report that classified it as E or failing.
- Mike Escalante also pointed out that there may have been a signal retiming project between his last LOS report and the follow-up meeting, which might explain the discrepancy.

W. University Ave (Gainesville)

- Some variance on roadway.
- Stopped frequently.
- 17th Ave and Gale Lemerand intersections: Stops a result of auto demands on cross street. Stops at other intersections usually a result of pedestrian actuation.
- LOS may be too optimistic—should be high LOS C or low LOS D.

Tower Road (Gainesville)

- LOS B for segment 4 seems too good. There can be considerable midblock congestion that may not be accounted for (pointed out that this congestion is usually worse earlier in the day when schools let out—travel time runs were made closer to 6:00).
- Signal delay at 24th (downstream signal for segment 4) is low, but LOS should better reflect mid-block congestion and high percent time spent following (like a two-lane highway).

Himes Ave (Tampa)

- v/c > 1 condition is a result of terminating T-intersection on north end of roadway. There is a long cycle length, and Himes is the minor road at this intersection—thus receiving a relatively small proportion of green time.
- However, Gena considered the LOS at this intersection to be ‘E’, as there are traffic backups, but not ‘F’.
- Bruce noted that in the MPO study five years ago all intersections along Himes were LOS E.

Nebraska Ave (Tampa)

- Gena’s perception is that off-peak LOS is B and peak LOS is C.

US-41 (Tampa)

- The very good LOS results are likely a result of performing the travel time runs a little too early (3:30-4:00 PM). Peak period is probably between 4:00-5:00 PM.

Kennedy Blvd (Tampa)

- Signal coordination is good, so good LOS is reasonable.

Capital Circle SE (Tallahassee)
- Street goes to State office complex and is made for getting cars moving, so good LOS is reasonable.
- Recently went from two lanes to six, designed for "all motor access" with "gigantic facilities".
- Cherie—"It is probably an A". Sam—"Absolutely".

Macomb Street (Tallahassee)
- Cherie—"within the A and B…because the lights are synchronized". Sam—"It's not a great A. Maybe a low A, high B". Cherie—"Yeah, low A, high B".

West Tennessee St (Tallahassee)
- Similar to Gainesville's University Ave. Getting B's – surprising, unrealistic. Traffic counts from AM city study. Thought AM peak was higher. Traffic picks up at lunch time or afternoon. PM Peak probably will fail. Could have been an anomalous day that was chosen for travel time runs.
- Between Copeland and Macomb: LOS C – Getting caught at light (C vs D vs E). If stuck at light – LOS D; If make light – LOS C. Signals are coordinated.

Appleyard Drive (Tallahassee)
- LOS A or B sounds right. 'A' if you catch lights, 'B' if you don't (but this is more common). It is a big road with not much traffic. Increase in cycle length recently, so red light running has increased as motorists don't want to get caught at traffic light.
- Did not include segments up to Monroe – could have impacted facility LOS.
- End point is a T-intersection that is stop controlled.
- Not a lot of traffic generators along this street, mainly just Tallahassee Community College (TCC) and student housing.

Orlando
- Arterials Tested (auto only)
  - SR 50 –Primrose Drive to Bennet Road (Orange County)
    - One mile long.
  - SR 500 (Orange Blossom Trail) – From US 192 (Vine St) to Osceola Pkwy (Orange County)
    - About 2 miles long.
    - Plenty of variability in the speed, from about 30 mi/h to 55 mi/h.
  - SR 45 - From SR 40 to Marion County
    - About 4.5 miles long
- Used existing studies as a starting point
  - Short counts were taken to validate the existing data.
- ARTPLAN, HCS, and SYNCHRO were compared to NCHRP 3-70 and NCHRP 3-79 (i.e., the %FFS LOS threshold scale)

- Terry Rains and Masood Mirza agree that except for one or two places, the results were generally very comparable, with the NCHRP 3-79 results probably being most consistent with the ARTPLAN, HCS, and SYNCHRO results.

BICYCLE/PEDESTRIAN/TRANSIT

Archer Road (Gainesville)

- Despite nice bike lane, bicycle LOS is poor, due to high automobile volume and speed.
- Bruce commented that he has a picture of a bicyclist on the sidewalk of this section of Archer even though there is a perfect bike lane facility. Having poster child of bike-friendly geometry doesn't guarantee usage.

NW 13th St (Gainesville)

- Transit comparable to Univ Ave.
- Bike lanes in the last three segments.
- Concern about bike LOS on segment 5 being too low. Volume drops for segment 5, but the speed limit is increased. So increase in speed appears to have outweighed decrease in traffic volume for bicycle LOS.
- Mike wondered whether this was the correct trade-off.

University Ave (Gainesville)

- Mike does not "have any qualms about the transit LOS"
- Bike LOS should be E
- Ped LOS C is good

Tower Road (Gainesville)

- Bicycle LOS is E for segment 4, even though the facility has a continuous sidepath (see Figure 21) with about 20 ft of buffer. Mike argued that this is where bicyclists ride as pedestrian usage of the sidepath is minimal. The current model ignores this because it is not technically a bike lane, but bicyclists using the sidepath (as they often do) would not rate the LOS this poorly. How can this be incorporated in the model?

Figure 21. Sidepath on west side of Tower Road between 8th and 24th.

Himes Ave (Tampa)

- Values are right on
- Transit – One Route – 30 min headway
- Transit LOS affected by poor pedestrian LOS
    - Walking conditions to stops are poor
    - Lot of apartments along roadway
- Busy cyclist and pedestrian roadway
- No shoulder for bikes – narrow auto lanes with high volume
- Decent buffer for pedestrian sidewalk

Nebraska Ave (Tampa):

- Gena questions the low bicycle and pedestrian LOS, pointing out the facility's pedestrian accommodations. It has complete sidewalks and ramps, in addition to the buffered bike lane and the buffer strip.

US-41 (Tampa)

- Wide buffer lane for bikes, but no bike lanes.

Kennedy Blvd (Tampa)

- Motorized vehicle speeds are high, especially since signal coordination is good. High motorized vehicle volume. However, pedestrian LOS should be better as on-street parking is present. On the other hand, with the parking and no bike lane, bicycle LOS should be worse.
- Bruce indicated that the low pedestrian LOS could be a factor of the abundance of signals, which increases the cross-street delays and amount of mid-block crossings.
- Transit service is excellent, despite pedestrian LOS
    - Parallel transit facilities
    - Bus mall on this street. 25 transit routes came in vicinity of route

Capital Circle SE (Tallahassee)

- Poor LOS values for bike, ped, and transit are reasonable
- Truck route
- Only some places where road can be safely crossed. Trying to survive crossing the street shouldn't have to be the goal.
- One transit access point
- Trails on side (but not part of LOS methodology)

Macomb Street (Tallahassee)

- Street runs radially across system.
- Transit stops quarter mile away, but none along system.
    - Have to go out of way to go along Macomb
- Good bike facility – LOS C instead of D
- Good ped facility

West Tennessee St (Tallahassee)

- Avg bus headway – buses come in bursts, in 30 min headway.
    - 6 routes come in at same time, but nothing in between.
    - Transit LOS is B or C, not A.
    - If you make transit connection, then good.
- Bike – no bike lane – expect E's and F's
    - High volume, low speed posted
    - Bicycling fanatics advise they wouldn't use.

Appleyard Drive (Tallahassee)

- StarMetro Transit office there, but Transit LOS D?
- Bike lane and wide outer lane. Bike LOS C, maybe D, but not E.
- Ped LOS C is reasonable.

Data Collection Issues

Most jurisdictions were in agreement that precise data collection is costly and time intensive and prefer estimation or default values when acceptable. Overall, most jurisdictions felt that their resources would not permit them to collect data, and thus would have to rely on consultant support. Some specific comments/issues follow.

AUTO

- Not reasonable to collect travel speed and stops data from the field. Will need to rely on estimation methods (e.g., NCHRP 3-79)
- Percent turns –reasonable to determine if turning counts are already done.
- Prefer to obtain signal timing data (g/C) from signal timing plans rather than field data. It was acknowledged by participants, however, that they do not know how to determine proper green times and cycle lengths for actuated signals, and just rely on traffic department to provide appropriate numbers.
- Not reasonable to determine arrival type—rely on default value
- Not likely to measure right turns on red (RTOR)
- Adjusted saturation flow rates, used other tools, such as Synchro or HCS
- Data on roadway geometry is not always readily available or current, and it is time consuming to collect in the field. For state roadways, information can be obtained from the roadway characteristics inventory (RCI) database, but access to this is limited.

BICYCLE/PEDESTRIAN/TRANSIT

- There was some confusion expressed about how to measure the pedestrian crossing time—is the amount of time displayed for the 'Walk' and/or flashing 'Don't Walk' indications, the average amount of time a pedestrian spends crossing the intersection, or something else. Clarification was provided that it is supposed to be the amount of time the 'Walk' indication is displayed.
- Participants indicated that collecting load factor data is difficult. The research team asked what would be necessary to ensure that load factor data are collected. Participants stated that larger jurisdictions with resources can invest in auto passenger counters for their transit vehicles, but for smaller jurisdictions, they would have to rely on occasional counts by their staff or consultants.
- Ridership information most critical – actual headway and span of service
- Participants were not sure how to measure or determine 'average passenger trip length'.

Model Application Issues

AUTO

An issue was raised about the Tower Road arterial—whether the model should account for a facility transition from urban arterial to rural arterial, as seen in segment four (SW 8th Ave to SW 24th Ave). As mentioned previously, there was concern that the auto speed model was not properly accounting for mid-block friction. This segment is an undivided two-lane roadway with midblock left turns reducing auto speed. This issue, however, is related more to the field conditions that were experienced during the travel time runs rather than an issue with the model. Since the travel time runs were made later in the day, there was not as much friction from significant amount of left turns that are made into and out of the school areas. Furthermore, the analysis direction was southbound, which is less likely to experience delay from left turn vehicles since the schools are on the west side of the road.

A question was raised about how different conditions (such as a cycle failure) contributed to the LOS results. This led to a discussion about the general mathematical formulation of the NCHRP 3-70 models and the inability to directly translate a certain input, such as delay, into an LOS ranking. This also led to the general question about whether the full spectrum of LOS values (i.e., A-F) for the NCHRP 3-70 auto LOS models could be obtained under realistic conditions. This question is addressed in more detail later in this report.

The NCHRP 3-70 models assume that free-flow speed is the same as posted speed. The question was asked whether that is that realistic. It was pointed out that ARTPLAN assumes the free-flow speed is 5 mi/h higher than the posted speed limit.

TRANSIT

The viability of the on-time performance variable was questioned. "On-time performance is not really a good indicator here (better in a comprehensive operational analysis (COA) than in this). OTP is a percentage. If I watch for ten buses throughout the day on one route, for example, and seven times it comes within 5 minutes of the scheduled time, then I have a 70% OTP for that day. Well, in this case, I am looking at one stop for one bus in the course of an hour: If he is on-time, it is 100% OTP, if late 0%, both misleading. With route 24 having 2 buses per hour, I am increasing my possibilities to 0, 50, and 100%, still not very good. Perhaps this should be done at least for the full hour for all buses, rather than for each individual bus/route." "…on-time performance is an indicator used for a system, not a route. It made no sense because if you have a bus that comes once an hour, if it was on time, it got 100% -- if it was not on time, it got zero percent. If the bus comes twice an hour, the choices were zero, 50 and 100. So you can't use it for a route, it has to be for a system."

A question was raised about the definition of average headway versus the intent of the variable. The definition simply states that it is the length of the analysis time period divided by the number of buses arriving in the analysis time period. However, one participant described a situation that occurs in Tallahassee where six buses all arrive at the top of the hour, with no buses arriving in between. By the definition, the average headway is 10 min/bus. The reality, though, is that the headway is 60 min/bus.

A question was raised about the counting of bus stops along a segment. It was brought up that while there may not be a bus stop on a specific segment, there may be one on an adjacent segment that is easily within walking distance. Thus, if the intent of the model is to determine whether there is reasonable transit access for a specific segment, that could still be the case even if a segment does not have a bus stop but there is one close on an adjacent segment.

A related question was raised about the counting of bus stops along an arterial. A participant described a situation with Macomb Street (Tallahassee) where there are many bus stops (serving a variety of transit routes) along this road and within a reasonable distance of this road (quarter mile), but that none of them can really be used to move directly along Macomb Street. So while access to transit is very good on this street, the transit service for moving along Macomb Street is poor. It could be done, but only through a series of "zigzag" transit rides (using several buses) and would take longer than walking the route.

The usefulness of the load factor variable was questioned. It was indicated that this is important to transit operators, but not necessarily transit users.

It was mentioned that span of service is a very important variable, which is in ARTPLAN but not the NCHRP 3-70 model. One participant commented that since the model would likely be used for only peak-hour analysis, bus service can then be considered as a given and thus not a necessary input. This led to some discussion about how the transit user views this issue—i.e., an important factor for them when deciding whether to use the bus is whether the bus will be running when they want to ride it, which is a function of span of service.

One participant asked why there was no obstruction to bus stop variable in the NCHRP 3-70 model like there is in ARTPLAN. The question was not answered definitively, with the research team responding that they needed to double check if this issue is now adequately handled by the crossing difficulty factor in the pedestrian LOS model (which affects transit LOS).

Participants were not sure how 'average passenger trip length' factored into the transit LOS methodology and whether it was worth the difficulty of trying to collect this information. Cherie indicated that obtaining data on average passenger trip length may be problematic unless the arterial is on an "express" route. She estimated the average trip length to be ½ of the overall length of the route. It was suggested that the model should include a default to be used in case no data are readily available (this is actually the case).

BICYCLE/PEDESTRIAN

A discussion emerged about the bicycle model and the inability to obtain an LOS higher than C for the facility. This question emerged after discussions with the Gainesville jurisdiction, and their plans to develop a Multimodal Transit Development (MMTD). The planners and concurrency managers involved in this project desired to have bicycle facilities achieve higher than an LOS C, so politicians have a valid reason to support the MMTD. Bruce Landis pointed out that LOS values for the pedestrian and bicycle facilities will rarely, if ever, reach LOS A or B, due to the user perception data calibration. This is because the facilities being evaluated in the study are arterials, which have high volumes and traffic speeds. If one were to go to a neighborhood street with low volume and speed, one will find pedestrian and bicycle LOS conditions of A or B per user perception.

Participants responded back to the point made by Bruce Landis with the concern of political misunderstandings. Some contended that politicians will often not understand that the LOS values are relative to essentially a best-case condition C rather than A. Thus, while an LOS improvement from E to C would be a significant improvement, a politician may still consider the

C LOS value as a mediocre condition and underestimate the significance of the multimodal improvements. Planners would have a difficult time trying to advocate a project for the bicycle and pedestrian modes if the LOS condition can only improve "slightly from a high D to a low D." Participants expressed a desire for the creation of two scales, one to address technical LOS values and one to address political realities. Bruce Landis added that the LOS values have been calibrated exclusively to qualitative user perception research, and to deviate from such research would invalidate it. It was stressed again by some participants that the LOS results need to be useful to political decision makers, and they were doubtful that this could be the case with a practical upper limit of LOS C. Otherwise it will be very difficult to demonstrate to commissioners the viability of multimodal improvements.

A question was raised on the topic of off-street (sidepath) bicycle facilities, and if there is a methodology to evaluate their level of service, and if such level of service can breach the LOS C intercept. According to Bruce Landis, no formal methodology exists at this time, but will be a topic for future research.

Additional discussion was had about whether there needs to be additional classes to deal with this issue of not being able to attain a facility LOS of A or B for bicycles. If bicyclists are comparing their arterial facility perceptions to a local or neighborhood road, then maybe there should be a separate class for those, and then the bicycle facility LOS model for arterials can be recalibrated based on additional research where bicyclists evaluate the facility conditions respective to only arterial conditions and not to more generally bicycle-friendly roadways.

Land use became a point of discussion about bicycle user perception on arterial segments. In research, users might rate two identical operational segments with varying LOS values due to varying land use conditions (e.g. nice landscaping versus dilapidated buildings).

Practical Range for LOS Values

As previously discussed, some participants mentioned that it was very difficult to obtain LOS A or B for the pedestrian or bicycle facility LOS. This issue came to light as there were some instances where the both the intersection and segment LOS were A (for pedestrian or bicycle) yet the facility LOS was C. This was of concern to a few attendees at the meeting, who complained that the inability to obtain better LOS grades for the facility would make it extremely difficult to get pedestrian or bicycle improvement projects approved. This issue is examined in more detail in the following sections. The issue of the attainability of the full spectrum of LOS values (i.e., A-F) for the NCHRP 3-70 auto LOS models was also examined since there is not a direct relationship between a single service measure and the LOS thresholds as is currently the case (i.e., HCM 2000).

Pedestrian Facility LOS

Table 2 (repeated below as Table 12) provides the ranges of index values (the numerical value that results from the various NCHRP 3-70 level of service equations) that correspond to each letter grade of LOS. It should be noted that this table is used for all modes, and in the case of multimodal, also for intersection, segment, and facility levels of service.

Table 12. NCHRP 3-70 LOS Thresholds

LOS Index Value	LOS
≤ 2.0000	A
2.0001 -2.7500	B
2.7501 -3.5000	C
3.5001 -4.2500	D
4.2501 -5.0000	E
> 5.000	F

For starters, a simple examination of the equation for pedestrian facility LOS (Eq. 22, and also Eq. 14 from earlier) reveals the potential difficulty of obtaining an A or B.

$$Facility\ LOS\ Weight = 1.6060 + 0.3180(SegLOS) + 0.2200(IntLOS) \quad [22]$$

This equation has three terms: a constant, a term that factors in the intersection LOS, and a term that factors in the segment LOS Index.

Considering just the constant value of 1.6060, there is little room for an increase in the facility LOS when factoring in the intersection and segment LOS values before reaching the upper threshold of 2.00 for LOS A. If you also consider that the absolute minimum Intersection LOS Index is 1.7806, then you are very close to 2.00 before even adding the segment LOS index. While it is technically possible to get a negative segment LOS index, such conditions are rare. In fact, even under very favorable conditions at the intersection and segment, the LOS for the facility will see a significant drop. For example, consider the following example.

EXAMPLE PEDESTRIAN FACILITY LOS CALCULATION

Segments**:** All segments in this facility are of the same length for comparison purposes. They have low vehicular traffic volumes and speed, wide lanes and shoulders, a 10-ft sidewalk, and a buffer area (see Table 13). As a result, the segment LOS is a high A.

Table 13. Pedestrian segment LOS under very favorable conditions

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/tree)	Buffer Width (ft)	Dir. Traffic Volume (veh/h)	Traffic Lanes One-Dir (lanes)	Midblock Veh. Speed (mi/h)	Ped. Seg. LOS Index
1	14	8	80%	10	3	300	2	20.0	1.06

Intersections**:** The intersections of this facility are also very pedestrian-friendly. They have low vehicular traffic volumes, low speeds, no conflicting turning cars, and low waiting time (see Table 14). The intersection LOS is A, but barely.

Table 14. Pedestrian intersection LOS under very favorable conditions

Downstream Signal	RTOR+ Perm LT (veh/h)	X-Street Volume (veh/h)	X-Street PHF (#)	X-Street Speed (mi/h)	X-Street Lanes (#)	Avg Ped. Wait at Signal (sec)	Right Turn Channel Islands (#)	Ped. Int. LOS Index
1	0	50	0.95	15	2	10.0	0	2.00

Facility: Substituting the segment and intersection LOS index values into Eq. 22, the resulting facility LOS index value is 2.38, as shown in Eq. 23. This value yields LOS B for the facility. So even under very favorable conditions, with the segment and intersection LOS both A, the facility's LOS is a mid B.

$$\textit{Facility LOS Weight} = 1.6060 + 0.3180(1.06) + 0.2200(2.00) = 2.38 \qquad [23]$$

Furthermore, if jaywalking is taken into account (as it is in most cases), the facility's LOS index value increases by a minimum of 20%, thus pushing this arterial into the LOS C range, as seen in Table 15.

Table 15. Pedestrian facility LOS under very favorable conditions

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	121	6.00	2.38	1.20	2.86	N/A	2.86	C

Note that most arterials where this type of analysis is performed will have more vehicular volume, higher speeds, and less buffer than this hypothetical scenario, effectively capping their LOS grade to a C (or maybe a D in larger cities).

Bicycle Facility LOS

The bicycle facility LOS has a lot in common with the pedestrian facility LOS, especially the inputs to the equations and the calculation procedures. It also shares the difficulty of obtaining a very good facility LOS under realistic conditions. The bicycle facility LOS formula consists of four terms: one for the segment contribution, another one for the intersections, a third one for the conflicts per mile (i.e., driveways, unsignalized intersections) and lastly a constant of 2.85.

$$BicycleFacLOS = 0.160 \times (ABSeg) + 0.011 \times (\exp(ABInt)) + 0.035 \times (Cflt) + 2.85 \qquad [24]$$

Although the constant itself is greater than the LOS B threshold (2.75), under extremely favorable conditions the segment and intersection indexes can be negative and subtract enough from the constant to bring it into the LOS A range. Under most conditions, however, the segment index will not be negative.

Example Bicycle Facility LOS Calculation

The following scenario (see Tables 16-18) illustrates the difficulty of obtaining a high bicycle LOS grade, even with a negative segment or intersection index. This facility has wide 14-ft outside lanes, a 6-ft bike lane, no driveways or unsignalized intersections, low vehicular traffic volume and speed, and no heavy vehicles. The segment and intersection LOS indexes of this scenario (–0.58 and 0.61, respectively) are equivalent to very good A's.

Table 16. Favorable segment and intersection conditions for bicycles.

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)
1	14	6	2	D	40	0.0

Table 17. Favorable traffic conditions related to bicycle LOS.

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)
1	300	0%	20.0	0%	5.0

Table 18. Bicycle LOS under realistically favorable conditions.

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	20.0	26.0	0.81	-0.58	0.61	2.78	C

The facility index drops from the constant of 2.85 to 2.78 with the help of a negative segment LOS, but not enough to improve the bicycle LOS to B.

One situation wherein the facility bicycle (and pedestrian) model may not be the most appropriate analysis tool for the non-motorized modes occurs when a facility (a combination of segments and intersections) is being tested that is not a typical arterial. Such facilities include collectors that are still part of an agency's major roadway network and roads functionally classified as arterials that have characteristics more like collectors (an example is an arterial in a central business district with low travel speeds and high signal density). Preliminary testing has indicated that the bicycle and pedestrian segment models produce more reasonable and intuitive results in such settings. Also, if an analyst is evaluating bicycling and/or walking conditions for multiple segments and intersections along a corridor but is more concerned with operations at those basic levels than the facility as a whole, the facility model may not be the best model to use. In other words, if the intent of an analysis is to test alternatives of component parts of a roadway, the respective component models should be used.

Automobile LOS

Speed Model. The two main factors in this model are the average travel speed and the segment median type. As noted on page 5, there are four different categorizations of median type, with a raised median providing the largest improvement to LOS and no median providing the largest decrease to LOS.

The speed model was exercised over a wide range of speeds, with the median type set to *raised*. The resulting LOS index values were plotted against the speeds, with the range of LOS values overlaid (see Figure 22).

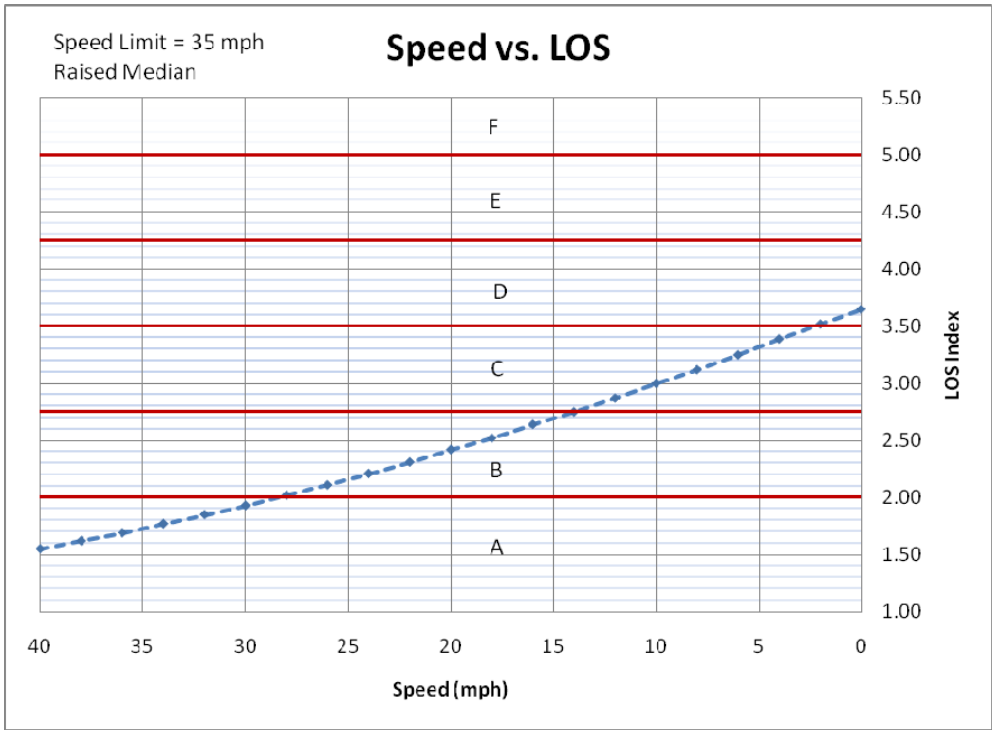

Figure 22. Relationship between average speed and LOS index (raised median).

As this figure shows, the arterial will never receive an LOS of E or F, even if its speed is below 5 mi/h, with one exception. It is possible to receive an LOS of F when the demand-to-capacity ratio exceeds 1.0. It should be pointed out that it may not even be possible to ever obtain an LOS of D—if the average speed falls below 5 mi/h, the d/c ratio may very well be in excess of 1.0 at that point. Thus, LOS C may be the lowest LOS value that can be obtained in under-saturated traffic flow conditions.

On the other hand, a similar test was performed on an arterial with no median and it was not classified as an A until the average speed exceeded the free flow speed, which is equal to the posted speed limit in this study (see Figure 23).

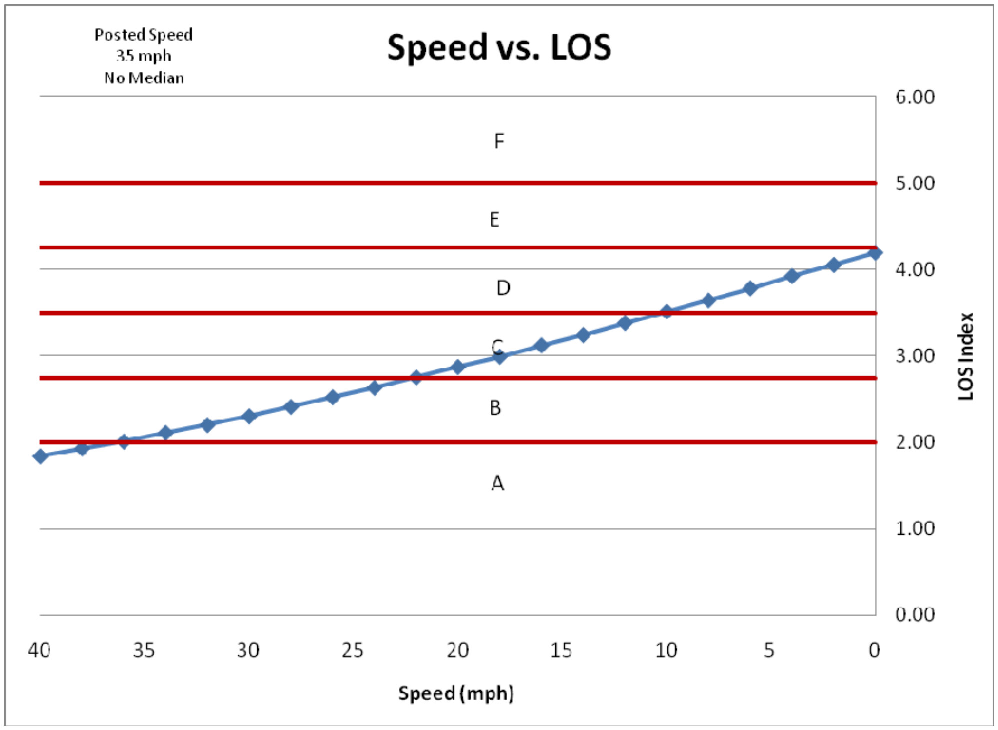

Figure 23. Relationship between average speed and LOS index (no median).

Stops Model. The two main factors in this model are stops per mile and presence of left turn lanes. The existence of a left turn lane improves the LOS of the segment by about 10% to 15%.

The stops model was exercised over a wide range of stops per mile, with the left turn lane presence set to *yes*. The resulting LOS index values were plotted against the stops/mi, with the range of LOS values overlaid (see Figure 24).

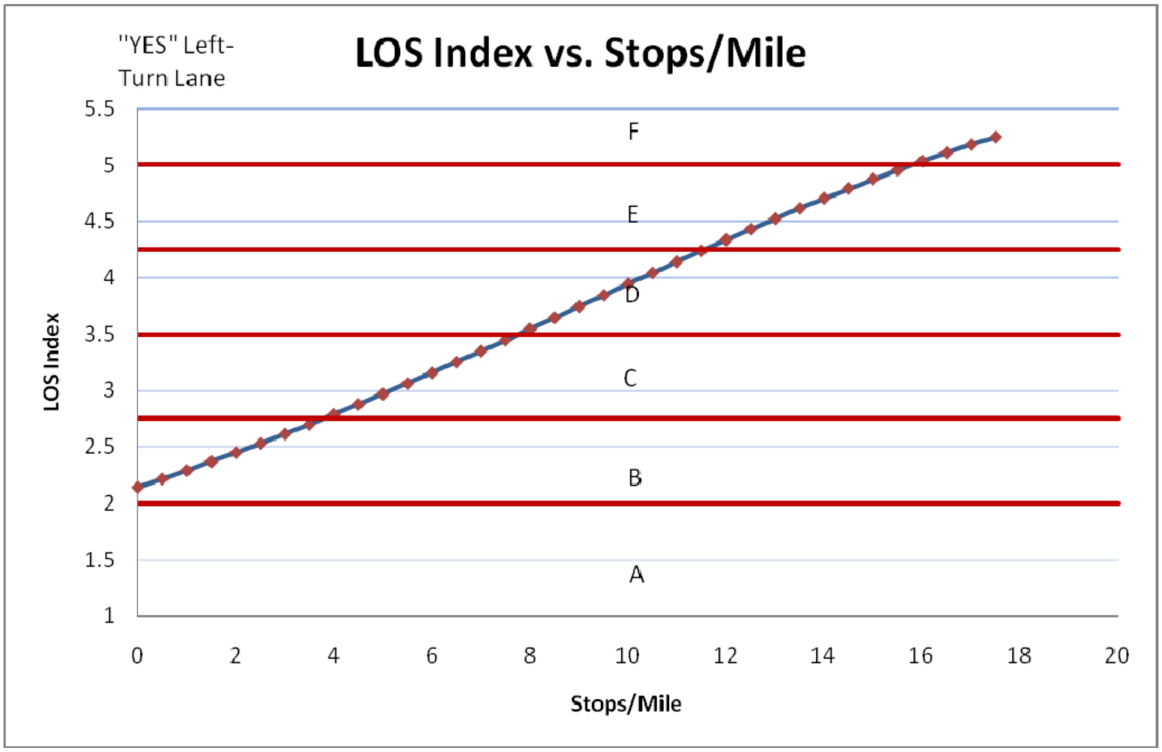

Figure 24. Relationship between Stops/Mile and LOS Indexes, with a left turn lane.

Note that LOS A cannot be achieved even with left turn lanes present and zero stops/mi. The graphic also shows that a very large number of stops/mi is needed before LOS F is reached.

In addition, a comparison between the NCHRP 3-70 speed model and the HCM 2000 method was made. As a reminder, the HCM arterial LOS is based only on average travel speed. As will be seen in the following figures, however, the HCM speed thresholds are set to yield the full range of LOS values (i.e., A-F).

In the first comparison, the median type is set to *raised* for the NCHRP 3-70 speed model as this is a very common type in urban arterials. The posted speed was set at 35 mi/h. The resulting comparison is shown in Figure 25.

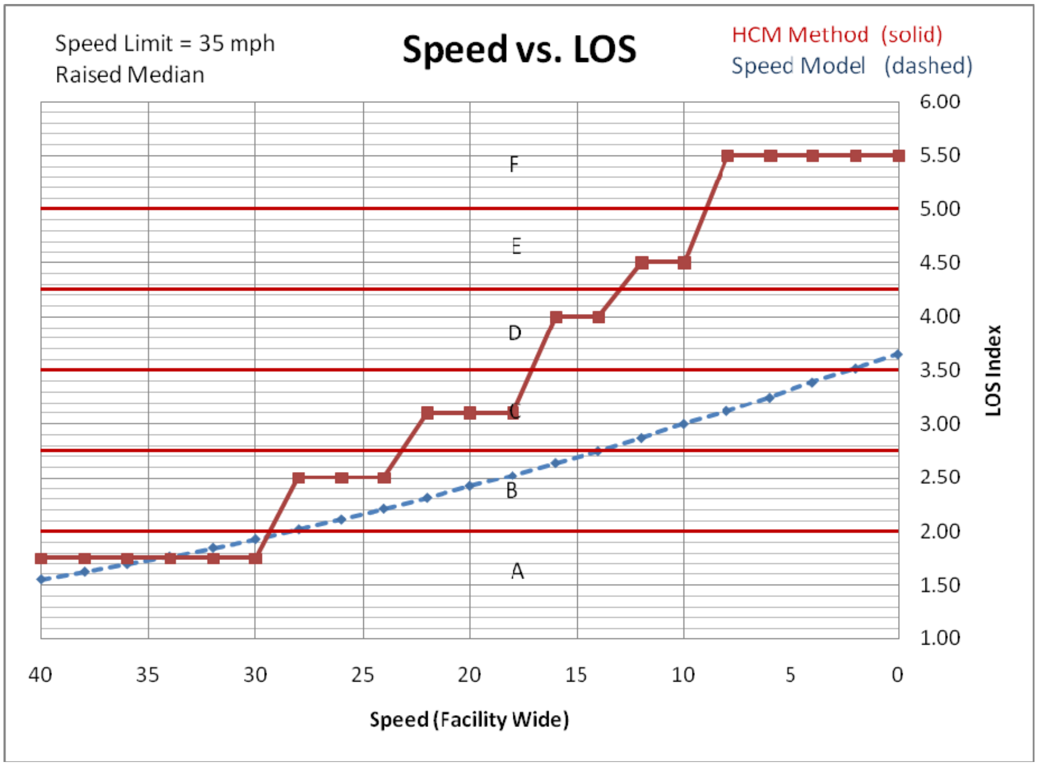

Figure 25. Comparison of HCM method and speed model (raised median).

The LOS grades from the speed model generally match those from the HCM method for speeds close to the speed limit, which is consistent with the LOS results obtained for the test arterials in the Gainesville, Tampa, and Tallahassee areas. However, as the speeds decline significantly below the posted speed limit, as would be expected under moderately congested conditions, or worse, the level of service rankings begin to deviate, with the HCM rankings being considerably worse than the NCHRP 3-70 speed model rankings. For an average speed around 5 mi/h, the LOS rankings differ by three letter grades (C vs. F).

The situation that yielded the least difference between the HCM 2000 and NCHRP 3-70 results was when the test arterial had no median (Type 0). LOS grades were fairly similar for the upper half of the speed range, with deviation, but smaller, for the lower half of the speed range (see Figure 26). In spite of this, the worst grade obtained from the speed model was only a low D.

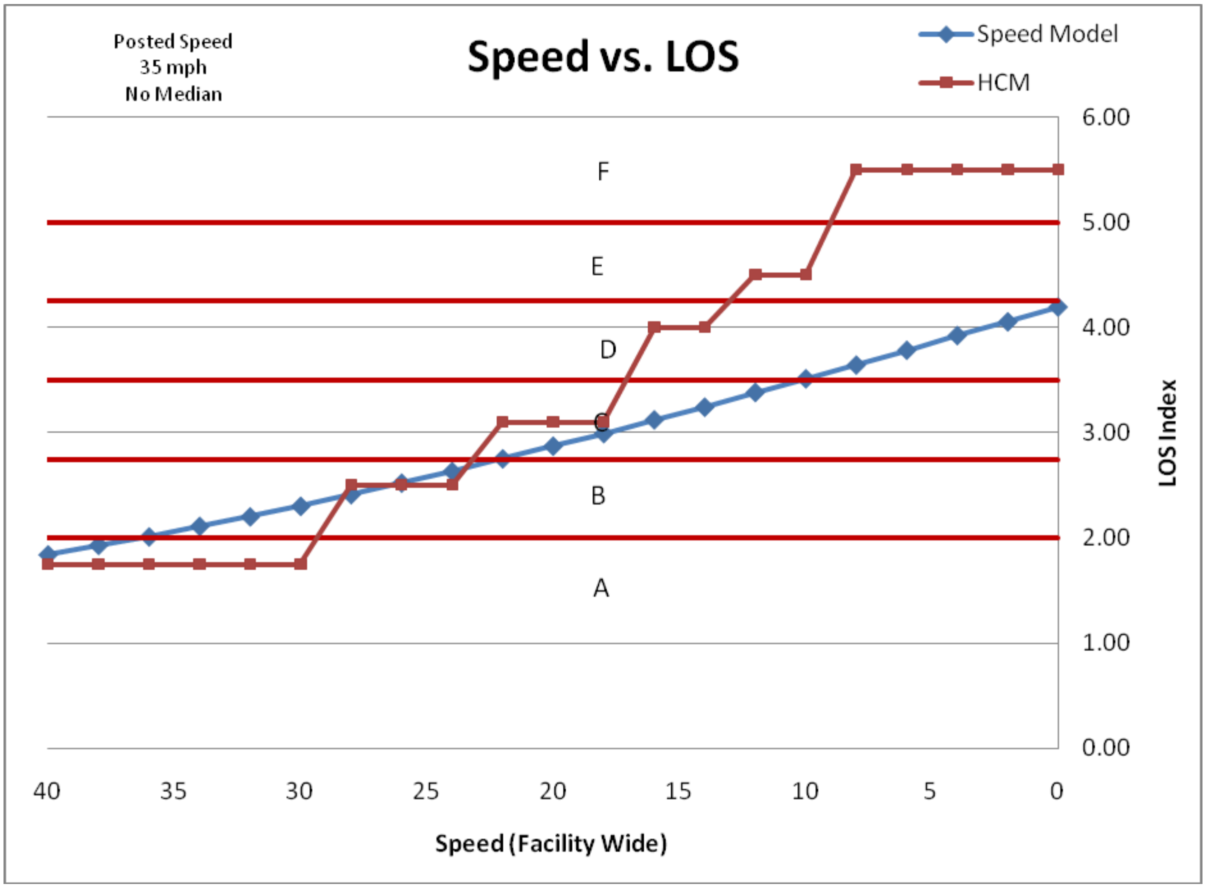

Figure 26. Comparison of HCM method and speed model (no median).

Other Questions/Issues

Participants were asked if pedestrian and bicycle facility models are needed, or are segment and intersection models sufficient.

- Participants generally agreed that the facility models should be retained to provide more flexibility in LOS applications. However, they felt the facility LOS scales needed to be revised.

Participants were asked whether they endorsed an integrated multimodal approach.

- Participants were unanimous that the multimodal approach should be advocated, feeling that all of the modes impact one another and it is important to account for those interactions in LOS analysis. This type of analysis would also allow them to examine the trade-offs in performance of one mode when changes are made to another mode. It was also recognized, however, that the automobile will always take preference and there is only so much that can be done with other modes at the expense of the auto mode.
- Discussion on the integrated multi-modal approach taken in NCHRP 3-70 spurred another related conversation. Some participants felt that the focus of the methodology on

arterial system relationships between modes was too narrow. These participants felt that the focus needs to be expanded to the corridor level.
- Despite endorsement of a multimodal analysis approach, it was acknowledged that a software implementation should allow for an auto-only LOS analysis.

Participants were asked whether they felt that they could apply the NCHRP 3-70 models 'in-house' or would need consulting support.

- Overall, agency participants felt that they could apply the NCHRP 3-70 models 'in-house', but most would need consultant assistance with data collection, as mentioned previously.

Participants were asked whether the NCHRP 3-70 methodology should be in the HCM 2010.

- Gainesville – Yes
- Tampa – Yes, but needs some refinement
- Tallahassee – Yes
- Orlando – Yes, but modification needed

Spreadsheet Tool Issues

Participants raised some general usability issues. The following recommendations were made by participants:

- Allow more flexibility with the number of segments that can be analyzed, and have the software only display the specified number of segments.
- Allow traffic volumes to be input as either AADT, peak hour two-way, or peak hour directional, so local governments can use what is consistent with their existing data collection methods.
- Incorporate an added section in the Auto LOS section of the 'mmlos' worksheet that calculates the auto speed model, instead of using the 'autolos2' worksheet that duplicates information and analysis in the Auto LOS section of the 'mmlos' worksheet.
- Where possible, adjust column widths instead of merging cells. The merged cells created a few complications when cutting and pasting data from other spreadsheets.
- Create a separate form that contains only the information to be obtained from field data collection.

CONCLUSION AND RECOMMENDATIONS

This section lists the conclusions and recommendations, by mode, resulting from this study.

General

- An integrated multimodal approach is appropriate and desirable. Public agencies believe it will be a useful addition to the HCM.
- For analysis consistency across modes, three urban street classes are recommended.

Automobile

- The evidence obtained from this project does not support a recommendation for changing from the HCM 2000 auto LOS analysis method to one of the NCHRP 3-70 models (stops or speed).
    - For the arterials tested in this project, the resulting range of LOS values was (unintentionally) confined to relatively uncongested conditions (LOS A-C). Unfortunately, participants were not able to form strong opinions about the relative accuracy of the HCM 2000 method versus the NCHRP 3-70 methods due to the similarity of LOS results for most of the arterials in this range of levels of service.
    - From the arterial LOS testing in this project, a comparison between methods for the poorer LOS conditions could not be made. However, from the testing done on the practical range of LOS values for the NCHRP 3-70 models, there is some concern about the ability of the models to predict the full range of the A-F LOS scale under practical conditions.
- It is recommended that the HCM 2000 LOS analysis methodology be retained in ARTPLAN at this time, but with a revision to the LOS threshold categorization scheme, as described at the end of this section.

Transit

- Participants were generally comfortable with the NCHRP 3-70 transit model inputs and results and supportive of its adoption in the HCM and Florida Q/LOS Handbook, but with consideration of the following recommendations:
    - Re-evaluate inclusion of on-time performance variable
    - Re-evaluate inclusion of load factor variable
    - Re-evaluate inclusion of average passenger trip length variable
    - Bus span of service should be considered as a variable in model
    - Determine if the pedestrian model adequately captures potential obstacles to bus stop access. If not, consider including in model.
    - Clarify guidance on the bus stop variable
    - Clarify guidance on average bus headway variable

Bicycle

Participants were generally comfortable with the NCHRP 3-70 facility model's FDOT segment and intersection LOS components and supportive of their adoption in the HCM and Florida

Q/LOS Handbook. They were not comfortable with the facility LOS model. The recommendations are:

- Under the NCHRP 3-70 Phase III project, test the arterials using the NCHRP Report 616 "stretched" bicycle model, which may provide a full range of LOS values under practical conditions.
  - Consider new research that could lead to the development of two or three facility models, being distinguished by roadway type (e.g., local, collector, arterial).
- Pursue research to develop a sidepath LOS methodology which will cover multi-use pathways constructed adjacent to roadways.

Pedestrian

Participants were generally comfortable with the NCHRP 3-70 facility model's FDOT segment and intersection LOS components and supportive of their adoption in the HCM and Florida Q/LOS Handbook. They were not comfortable with the composite facility LOS model. The recommendations are:

- Clarify guidance on pedestrian crossing time variable
- Under the NCHRP 3-70 Phase III project, test the arterials using the NCHRP Report 616 "stretched" pedestrian model, which may provide a full range of LOS values under practical conditions.
  - Consider new research that could lead to the development of two or three facility models, being distinguished by roadway type (e.g., local, collector, arterial).
- Pursue research to develop a sidepath LOS methodology which will cover multi-use pathways constructed adjacent to roadways.

Urban Street Classes

The HCM 2000 uses four different roadway classifications by which to stratify automobile LOS threshold values. NCHRP 3-79 does not make use of any classes. It has been recommended to consider implementing two or three classifications for the bicycle and pedestrian facility models. To better coordinate the LOS classification schemes between modes, it is recommended that the automobile, bicycle, and pedestrian modes use the same number of LOS threshold value classifications, but not exceeding three classes. For three roadway classes, the classification scheme for urban interrupted flow roadways could be one of the following options:

1) Use HCM 2000 Class II auto LOS threshold criteria and $v/c > 1.0$ check for 15 minute period
   a) Functionally classified as an "arterial" or collector
   b) < 5.0 signalized intersections per mile
   c) ≥ 40 mph posted speed limit
2) Use HCM 2000 Class IV auto LOS threshold criteria and $v/c > 1.0$ check for 15 minute period
   a) Functionally classified as an "arterial" or collector
   b) ≥ 5.0 signalized intersections per mile
   c) < 40 mph posted speed limit
3) No auto LOS criteria
   a) Functionally classified as a local street

This recommendation is not a significant change to the current HCM approach and actually helps simplify the determination of “arterial” classes by analysts. The recommendation also represents only a slight modification to the NCHRP 3-79 approach based solely off of percent free flow speed.

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Transportation Research Board. *NCHRP Report 128: Multimodal Level of Service Analysis for Urban Streets: Users Guide*. National Research Council, Washington, D.C., 2008.

J.A. Bonneson, M. Pratt, and M. Vandehey. *Predicting the Performance of Automobile Traffic on Urban Streets.* Final Report. NCHRP Project No. 3-79. Transportation Research Board, National Research Council, Washington, D.C., January 2008.

APPENDIX A: PROJECT KICK-OFF / TRAINING MEETING AGENDA

Meeting Location: University of Florida, Weil Hall, Room 513
Meeting Date: 10/2/08

10:00 – 10:15	Introductions, Purpose/Agenda of FDOT Project/Workshop (Doug and Scott)
10:15 – 10:30	Overview of NCHRP 3-70 Project (Rick and Doug)
10:30 – 11:00	Overview of Multimodal LOS Models (Rick, Bruce, Doug, and Scott)
11:00 – 11:15	General Questions/Discussion (All)
11:15 – 11:30	Introduction to MMLOS Spreadsheet (Rick and Bruce)
11:30 – 12:30	Hands on practice with spreadsheet (All, with Scott, Rick, and Bruce looking over shoulders)
12:30 – 1:30	Lunch
1:30 – 2:00	Hands on practice/refresher with ARTPLAN (Scott)
2:00 – 2:30	Data Collection Strategies & Selection of Test Arterials (Bruce, Doug, and Scott)
2:30 – 2:45	Break
2:45 – 3:45	Breakout Session: Selection of Test Arterials (Rick, Bruce, and Scott go around room giving advice to each agency on selection)
3:45 – 4:00	Next Steps, Tasks, Responsibilities, Schedule (Scott)
4:00 – 4:30	Wrap up, Set time/date for next meeting (Doug and Scott)

APPENDIX B: GAINESVILLE ARTERIAL SPREADSHEETS

Multimodal Level of Service for Urban Streets

Diagram of Urban Street

Street: Archer Road

Date: DEC 1 2008

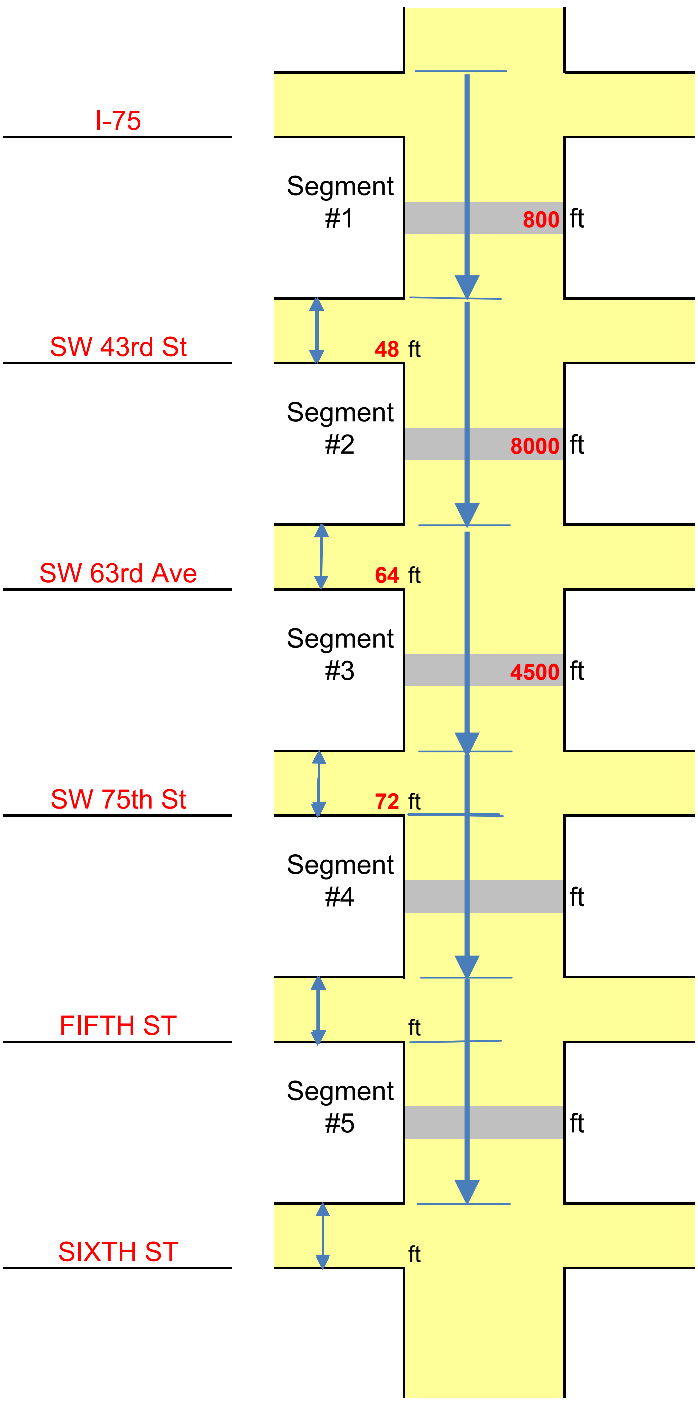
Limits: I-75 to SW 75th St

Observer: B. Perez

Analysis Direction:	WB

(Down Direction on this Sheet)

Data Entry Fields in Red



Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	3	20	350	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	45	500	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	5	35	1100	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Archer Road

Limits: I-75 to SW 75th St

Observer: B. Perez

Date: DEC 1 2008

Cross-Section #1
From: I-75 To: SW 43rd St

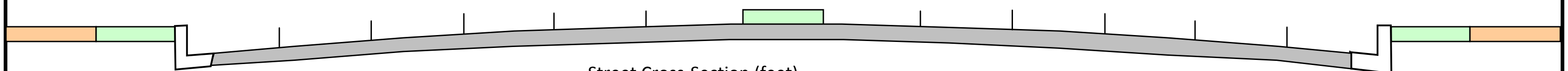
1

Ft/Tree	% Occ.
0	0%

WB

Pavement Cond:	3
Jay-Walking Calc:	NO

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	5	0	0	12	12	0		42		0	12	12	0	0	3	5

Ped Vol: 9

Cross-Section #2
From: SW 43rd St To: SW 63rd Ave

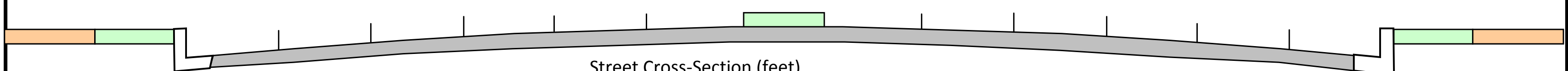
2

Ft/Tree	% Occ.
0	0%

WB

Pavement Cond:	3
Jay-Walking Calc:	NO

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	5	0	4	12	12	0		25		0	12	12	4	0	5	5

Ped Vol: 9

Cross-Section #3
From: SW 63rd Ave To: SW 75th St

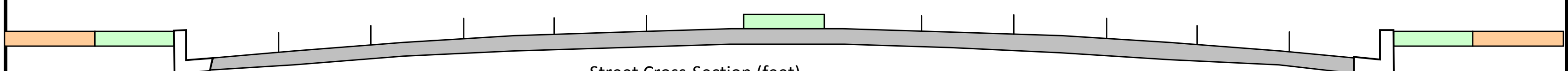
3

Ft/Tree	% Occ.
0	0%

WB

Pavement Cond:	3
Jay-Walking Calc:	NO

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	5	0	4	12	12	0		25		0	12	12	4	0	5	5

Ped Vol: 9

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Archer Road

Limits: I-75 to SW 75th St

Observer: B. Perez

Date: DEC 1 2008

Cross-Section #4
From: SW 75th St To: FIFTH ST

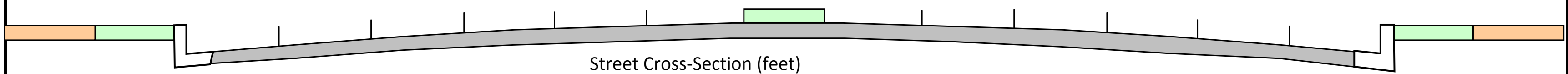
4

Ft/Tree	% Occ.
0	0%

WB

Pavement Cond:	3
Jay-Walking Calc:	NO

EB



Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
0	0	0	0	0	0	0		0		0	0	0	0	0	0	0

Ped Vol: 0

Cross-Section #5
From: FIFTH ST To: SIXTH ST

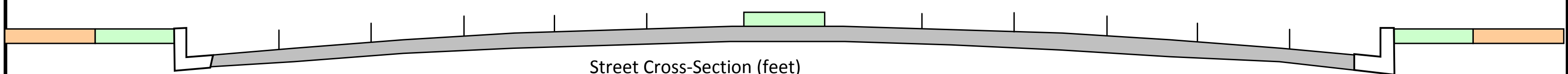
5

Ft/Tree	% Occ.
0	0%

WB

Pavement Cond:	3
Jay-Walking Calc:	No

EB



Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
0	0	0	0	0	0	0		0		0	0	0	0	0	0	0

Ped Vol: 0

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **WB**

Street: Archer Road   Date: DEC 1 2008

Limits: I-75 to SW 75th St   Observer: B. Perez

Field Survey

Segment And Downstream Signal			Speed Limit (mph)	Median Type (0-3)	Left Turn Pocket (y/n)	Drivewys Rightside (#)	Unsig. Intersects (#)
	From	To					
1	I-75	SW 43rd St	45	2	YES	0	0
2	SW 43rd St	SW 63rd Ave	45	2	YES	20	5
3	SW 63rd Ave	SW 75th St	45	2	YES	11	3
4	SW 75th St	FIFTH ST	0	0	NO	0	0
5	FIFTH ST	SIXTH ST	0	0	NO	0	0

Traffic Counts   K: 9.5   D: 55

Segment And Downstream Signal			Vol (2-wy)	Heavy Vehicle (%)	RTOR+ PermLeft veh	Left/Right Turns %	Thru Adj. Sat. (vphgl)	PHF
	From	To						
1	I-75	SW 43rd St	28000	9%	1	10%	3531	0.925
2	SW 43rd St	SW 63rd Ave	28000	9%	1	10%	3472	0.925
3	SW 63rd Ave	SW 75th St	25500	9%	35	10%	3408	0.925
4	SW 75th St	FIFTH ST	0	0%	0	0%	0	0.00
5	FIFTH ST	SIXTH ST	0	0%	0	0%	0	0.00

Arterial Traffic Performance & Signal Timing

Segment And Downstream Signal			Field Survey		Signal Timing Data			
			Mean Speed (mph)	Average Stops (#/veh)	Cycle Length (secs)	Grn/Cycle for Thru (%)	Ped Walk (sec/cyc)	Xing Ped Walk (sec/cyc)
	From	To						
1	I-75	SW 43rd St	33.49	0.00	180	72%	20	20
2	SW 43rd St	SW 63rd Ave	38.53	1.00	120	57%	20	20
3	SW 63rd Ave	SW 75th St	31.54	1.00	100	55%	20	20
4	SW 75th St	FIFTH ST	0.0	0.0	0	0%	0	0
5	FIFTH ST	SIXTH ST	0.0	0.0	0	0%	0	0

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter,
Signal data is at the downstream signal

| Route |

Data Collection Sheet - Transit

Direction: **WB**

Street: Archer Road

Date: DEC 1 2008

Limits: I-75 to SW 75th St

Observer: B. Perez

Field Survey

Segment	From	To	Bus Stop (#)	Shelters (% stops)	Benches (% stops)	CBD (yes/no)
1	I-75	SW 43rd St	1	0%	0%	NO
2	SW 43rd St	SW 63rd Ave	8	13%	100%	NO
3	SW 63rd Ave	SW 75th St	3	0%	33%	NO
4	SW 75th St	FIFTH ST	0	0%	0%	NO
5	FIFTH ST	SIXTH ST	0	0%	0%	NO

Transit Performance Data

Segment	From	To	Route #'s	Frequency (bus/hr)	Load Factor (pas/seat)	On-Time Perform. (%)	Schedule Speed (mph)
1	I-75	SW 43rd St	75	1.7	21%	70%	13
2	SW 43rd St	SW 63rd Ave	75	1.7	21%	70%	13
3	SW 63rd Ave	SW 75th St	75	1.7	21%	70%	13
4	SW 75th St	FIFTH ST					
5	FIFTH ST	SIXTH ST					

Bus is On-Time if arrives within: 5 minutes of scheduled time.

Average Passenger Trip Length: 3.35 miles

A. Compute Auto LOS and Performance

Street: **Archer Road**

Direction=	Down	WB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	28000	0.095	0.550	0.93	90%	1423	traffic
2	28000	0.095	0.55	0.93	90%	1423	traffic
3	25500	0.095	0.55	0.93	90%	1296	traffic
4	0	0.095	0.55	0.00	100%	#DIV/0!	traffic
5	0	0.095	0.55	0.00	100%	#DIV/0!	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	3531	2	0.72	5085	0.28	OK	xsec 1-3, traffic
2	3472	2	0.57	3958	0.36	OK	xsec 1-3, traffic
3	3408	2	0.55	3749	0.35	OK	xsec 1-3, traffic
4	0	0	0.00	1	#DIV/0!	#DIV/0!	xsec 4-5, traffic
5	0	0	0.00	1	#DIV/0!	#DIV/0!	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	45	800	33.5	traffic, layout
2	45	8000	38.5	traffic, layout
3	45	4500	31.5	traffic, layout
4	0	0	0.0	traffic, layout
5	0	0	0.0	traffic, layout
Total/Ave.	45.0	13300	35.5	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	0.00	YES	2	traffic
2	0.66	YES	2	traffic
3	1.17	YES	2	traffic
4	#DIV/0!	NO	0	traffic
5	#DIV/0!	NO	0	traffic
Total/Ave	0.79	0.40	2.00	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5a. Compute Auto LOS Stops Model

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
2	27.2%	41.8%	18.2%	7.5%	3.5%	1.8%	2.24	B
3	24.7%	41.5%	19.5%	8.4%	3.9%	2.1%	2.32	B
4	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Average	22.7%	40.9%	20.6%	9.1%	4.3%	2.3%	2.38	B

5b. Compute Auto LOS Speed Model

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	40.9%	40.1%	11.7%	4.2%	1.9%	1.2%	1.90	A
2	51.4%	35.3%	8.4%	2.9%	1.3%	0.8%	1.70	A
3	37.0%	41.4%	13.1%	4.9%	2.2%	1.4%	1.98	A
4	2.6%	11.6%	18.8%	22.0%	21.7%	23.3%	4.19	#DIV/0!
5	2.6%	11.6%	18.8%	22.0%	21.7%	23.3%	4.19	#DIV/0!
Average	45.2%	38.4%	10.2%	3.6%	1.6%	1.0%	1.81	A

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **Archer Road**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	5	9	8000	0.00	A	xsec1-3
2	5	9	8000.0	0.00	A	xsec1-3
3	5	9	8000.0	0.00	A	xsec1-3
4	0	0	#DIV/0!	N/A	N/A	xsec4-5
5	0	0	#DIV/0!	N/A	N/A	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	12	0	0%	0	5	1,582	2	39.2	4.36	xsec1-3
2	12	4	0%	0	5	1,582	2	41.8	4.31	xsec1-3
3	12	4	0%	0	5	1,440	2	38.3	4.01	xsec1-3
4	0	0	0%	0	0	#DIV/0!	0	0.0	#NUM!	xsec4-5
5	0	0	0%	0	0	#DIV/0!	0	0.0	#NUM!	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	1	350	0.93	20	3	71.1	0	2.32	layout, traffic
2	1	500	0.93	45	2	41.7	0	2.82	layout, traffic
3	35	1100	0.93	35	5	32.0	0	3.48	layout, traffic
4	0	0	0.00	0	0	#DIV/0!	0	#DIV/0!	layout, traffic
5	0	0	0.00	0	0	#DIV/0!	0	#DIV/0!	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	800	71.1	147	48	39.2	2,660	2.0	900	NO	layout, traffic
2	8000	41.7	1341	56	41.8	2,660	2.0	900	NO	layout, traffic
3	4500	32.0	755	56	38.3	2,423	2.0	900	NO	layout, traffic
4	0	#DIV/0!	#DIV/0!	-42	0.0	0	1.0	0	NO	layout, traffic
5	0	#DIV/0!	#DIV/0!	-25	0.0	0	1.0	0	No	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	147	6.00	3.50	1.00	3.50	0.00	3.50	D
2	900	6.00	3.60	1.00	3.60	0.00	3.60	D
3	755	6.00	3.65	1.00	3.65	0.00	3.65	D
4	#DIV/0!	#DIV/0!	#NUM!	1.00	#NUM!	N/A	#NUM!	#NUM!
5	#DIV/0!	#DIV/0!	#NUM!	1.00	#NUM!	N/A	#NUM!	#NUM!
Average							3.61	D

C. Compute Transit LOS

Street: **Archer Road**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	2	70%	0%	0%	0.21	NO	transit
2	2	70%	13%	100%	0.21	NO	transit
3	2	70%	0%	33%	0.21	NO	transit
4	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit
5	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	800	33.5	1	13.0	transit
2	8000	38.5	8	13.0	transit
3	4500	31.5	3	13.0	transit
4	0	0.0	0	#DIV/0!	transit
5	0	0.0	0	#DIV/0!	transit
Total/Ave	13300	35.5		13.0	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	1.00	4.62	0.67	0.00	5.96	0.85	1.72
2	1.00	4.62	0.67	0.11	5.85	0.86	1.72
3	1.00	4.62	0.67	0.02	5.94	0.86	1.72
4	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00
5	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	1.47	3.50	4.32	E
2	1.48	3.60	4.32	E
3	1.47	3.65	4.34	E
4	#DIV/0!	#NUM!	#DIV/0!	F
5	#DIV/0!	#NUM!	#DIV/0!	F
Average			4.33	E

D. Compute Bicycle LOS

Street: **Archer Road**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	12	0	2	D	48	0.0	xsec1-3, layout
2	12	4	2	D	64	16.5	xsec1-3, layout
3	12	4	2	D	72	16.4	xsec1-3, layout
4	0	0	0	UD	0	#DIV/0!	xsec4-5, layout
5	0	0	0	UD	0	#DIV/0!	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	1582	9%	39.2	0%	3.0	traffic, xsec1-3
2	1582	9%	41.8	0%	3.0	traffic, xsec1-3
3	1440	9%	38.3	0%	3.0	traffic, xsec1-3
4	#DIV/0!	0%	0.0	0%	3.0	traffic, xsec4-5
5	#DIV/0!	0%	0.0	0%	3.0	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent
Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	12.0	12.0	4.12	6.51	3.78	4.37	E
2	16.0	20.0	4.26	5.33	3.16	4.54	E
3	16.0	20.0	4.06	5.14	3.15	4.50	E
4	#DIV/0!	#DIV/0!	0.81	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	#DIV/0!	#DIV/0!	0.81	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Average						4.52	E

E. LOS Summary

Title: Archer Road

Direction =	Down	WB		Date:	12/1/2008	Analyst:	BOP

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Artplan Transit LOS	Bicycle LOS	Artplan Bicycle LOS	Pedestrian LOS	Artplan Pedestrian LOS
1	B	A	B	B	E	D	E	F	D	D
2	B	A	A	A	E	D	E	E	D	D
3	B	A	B	B	E	D	E	E	D	D
4	#DIV/0!	#DIV/0!	F	#DIV/0!	F		#DIV/0!		#NUM!	
5	#DIV/0!	#DIV/0!	F	#DIV/0!	F		#DIV/0!		#NUM!	
Facility	B	A	A	B	E	D	E	E	D	D

Auto Performance Measures Summary WB

Seg+Sig	Stops	FFS	Speed	%FFS
1	0.00	45.0	33.5	74.4%
2	0.66	45.0	38.5	85.6%
3	1.17	45.0	31.5	70.1%
4	#DIV/0!	0.0	0.0	#DIV/0!
5	#DIV/0!	0.0	0.0	#DIV/0!
Facility	0.79	45.0	35.5	79.0%

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

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Created: 8-Jun-07 Updated: 25-Sep-08

Multimodal Level of Service for Urban Streets

Diagram of Urban Street

Street: NW 13th St

Date: DEC 1 2008

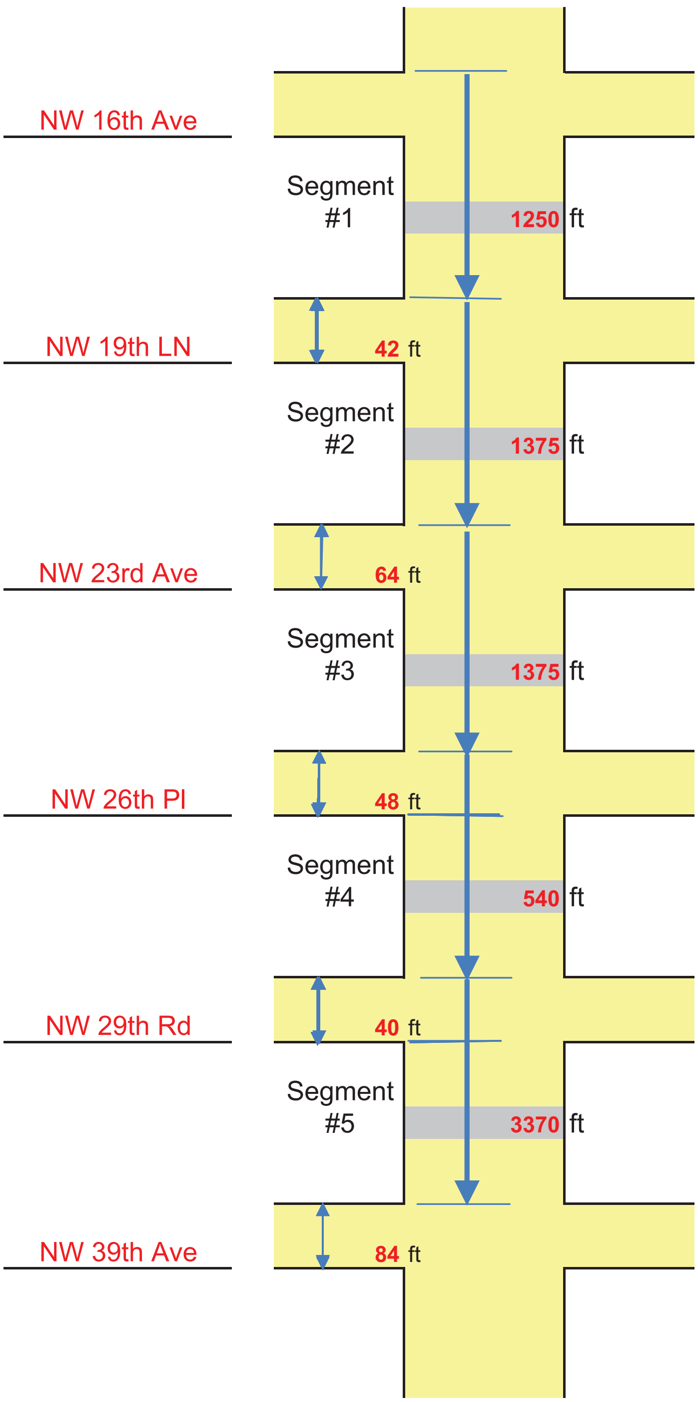
Limits: NW 16th Ave to NW 39th Ave

Observer: B. Perez

Analysis Direction:	NB

(Down Direction on this Sheet)

Data Entry Fields in Red



Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	3	20	300	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	5	30	1361	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	3	20	1165	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	3	25	775	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	5	45	2400	0

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: NW 13th St
Limits: NW 16th Ave to NW 39th Ave
Observer: B. Perez
Date: DEC 1 2008

Cross-Section #1
From: NW 16th Ave To: NW 19th LN

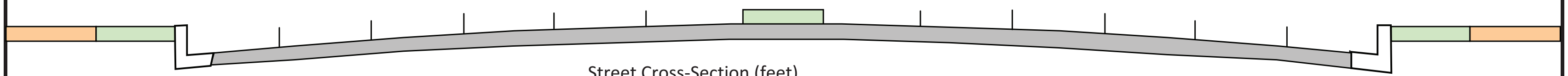
1

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	2.8
Jay-Walking Calc:	NO

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	0	14.5	11.5	0		12		0	11.5	14.5	0	0	3	5

Ped Vol: 27

Cross-Section #2
From: NW 19th LN To: NW 23rd Ave

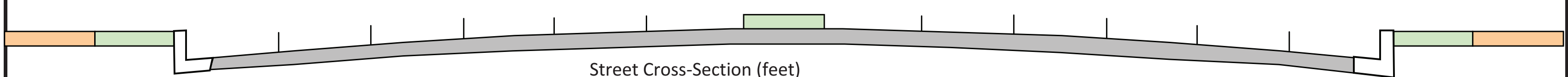
2

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	2.8
Jay-Walking Calc:	NO

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	0	14.5	11.5			12			11.5	14.5	0	0	3	5

Ped Vol: 27

Cross-Section #3
From: NW 23rd Ave To: NW 26th Pl

3

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	2.8
Jay-Walking Calc:	NO

SB

Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	4	0	6.5	13	12	0		20		0	12	13	6.5	0	4	5

Ped Vol: 27

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: NW 13th St

Limits: NW 16th Ave to NW 39th Ave

Observer: B. Perez

Date: DEC 1 2008

Cross-Section #4
From: NW 26th Pl To: NW 29th Rd

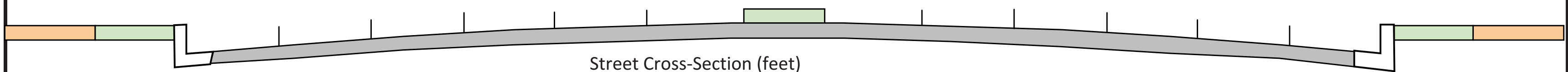
4

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	2.8
Jay-Walking Calc:	NO

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	4	0	6.5	13	12			20			12	13	6.5	0	4	5

Ped Vol: 27

Cross-Section #5
From: NW 29th Rd To: NW 39th Ave

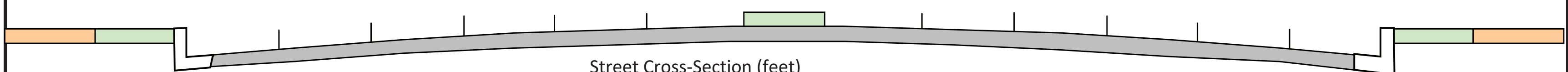
5

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	2.8
Jay-Walking Calc:	No

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	4	0	6.5	13	12			20			12	13	6.5	0	4	5

Ped Vol: 27

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **NB**

Street: NW 13th St

Date: DEC 1 2008

Limits: NW 16th Ave to NW 39th Ave

Observer: B. Perez

Field Survey

	Segment And Downstream Signal From	To	Speed Limit (mph)	Median Type (0-3)	Left Turn Pocket (y/n)	Drivewys Rightside (#)	Unsig. Intersects (#)
1	NW 16th Ave	NW 19th LN	35	2	YES	6	1
2	NW 19th LN	NW 23rd Ave	35	2	YES	7	3
3	NW 23rd Ave	NW 26th Pl	35	2	YES	4	0
4	NW 26th Pl	NW 29th Rd	35	2	YES	2	0
5	NW 29th Rd	NW 39th Ave	45	3	YES	9	8

Traffic Counts K: 9.5 D: 55

	Segment And Downstream Signal From	To	Vol (2-wy)	Heavy Vehicle (%)	RTOR+ PermLeft veh	Left/Right Turns %	Thru Adj. Sat. (vphgl)	PHF
1	NW 16th Ave	NW 19th LN	33500	4%	5	10%	3433	0.925
2	NW 19th LN	NW 23rd Ave	33500	4%	8	10%	3439	0.925
3	NW 23rd Ave	NW 26th Pl	33000	4%	10	10%	3436	0.925
4	NW 26th Pl	NW 29th Rd	33000	4%	8	10%	3439	0.925
5	NW 29th Rd	NW 39th Ave	28000	4%	35	10%	3667	0.925

Arterial Traffic Performance & Signal Timing

	Segment And Downstream Signal		Field Survey		Signal Timing Data			
	From	To	Mean Speed (mph)	Average Stops (#/veh)	Cycle Length (secs)	Grn/Cycle for Thru (%)	Ped Walk (sec/cyc)	Xing Ped Walk (sec/cyc)
1	NW 16th Ave	NW 19th LN	32.55	0.00	150	69%	20	20
2	NW 19th LN	NW 23rd Ave	15.51	1.00	150	43%	20	20
3	NW 23rd Ave	NW 26th Pl	44.14	0.00	150	53%	20	20
4	NW 26th Pl	NW 29th Rd	23.04	0.00	150	58%	20	20
5	NW 29th Rd	NW 39th Ave	32.52	0.67	150	42%	20	20

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter,
Signal data is at the downstream signal

Route

Data Collection Sheet - Transit

Direction: **NB**

Street: NW 13th St

Date: DEC 1 2008

Limits: NW 16th Ave to NW 39th Ave

Observer: B. Perez

Field Survey

Segment			Bus Stop (#)	Shelters (% stops)	Benches (% stops)	CBD (yes/no)
	From	To				
1	NW 16th Ave	NW 19th LN	2	0%	50%	YES
2	NW 19th LN	NW 23rd Ave	1	0%	0%	YES
3	NW 23rd Ave	NW 26th Pl	1	0%	100%	YES
4	NW 26th Pl	NW 29th Rd	1	0%	100%	YES
5	NW 29th Rd	NW 39th Ave	4	0%	50%	NO

Transit Performance Data

Segment			Route #'s	Frequency (bus/hr)	Load Factor (pas/seat)	On-Time Perform. (%)	Schedule Speed (mph)
	From	To					
1	NW 16th Ave	NW 19th LN	6	1	19%	75%	10
			8	2	19%	75%	10
2	NW 19th LN	NW 23rd Ave	6	1	19%	75%	10
			8	2	19%	75%	10
3	NW 23rd Ave	NW 26th Pl	6	1	19%	75%	13
			15	2	19%	75%	13
4	NW 26th Pl	NW 29th Rd	6	1	19%	72%	13
			15	2	19%	72%	13
5	NW 29th Rd	NW 39th Ave					
			6	1	19%	72%	13
			15	2	19%	72%	13

Bus is On-Time if arrives within: 5 minutes of scheduled time.

Average Passenger Trip Length: 3.35 miles

A. Compute Auto LOS and Performance

Street: **NW 13th St**

Direction=	Down	NB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	33500	0.095	0.550	0.93	90%	1703	traffic
2	33500	0.095	0.55	0.93	90%	1703	traffic
3	33000	0.095	0.55	0.93	90%	1678	traffic
4	33000	0.095	0.55	0.93	90%	1678	traffic
5	28000	0.095	0.55	0.93	90%	1423	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	3433	2	0.69	4738	0.36	OK	xsec 1-3, traffic
2	3439	2	0.43	2958	0.58	OK	xsec 1-3, traffic
3	3436	2	0.53	3642	0.46	OK	xsec 1-3, traffic
4	3439	2	0.58	3989	0.42	OK	xsec 4-5, traffic
5	3667	2	0.42	3080	0.46	OK	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	35	1250	32.6	traffic, layout
2	35	1375	15.5	traffic, layout
3	35	1375	44.1	traffic, layout
4	35	540	23.0	traffic, layout
5	45	3370	32.5	traffic, layout
Total/Ave.	39.3	7910	27.7	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	0.00	YES	2	traffic
2	3.84	YES	2	traffic
3	0.00	YES	2	traffic
4	0.00	YES	2	traffic
5	1.05	YES	3	traffic
Total/Ave	1.11	1.00	2.43	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5a. Compute Auto LOS Stops Model

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
2	14.3%	35.6%	25.3%	13.6%	7.1%	4.0%	2.76	C
3	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
4	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
5	25.3%	41.6%	19.2%	8.1%	3.8%	2.0%	2.30	B
Average	25.0%	41.5%	19.3%	8.3%	3.9%	2.1%	2.31	B

5b. Compute Auto LOS Speed Model

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	39.0%	40.8%	12.4%	4.5%	2.1%	1.3%	1.94	A
2	13.3%	35.3%	25.2%	13.7%	7.5%	5.1%	2.82	C
3	62.9%	28.4%	5.6%	1.8%	0.8%	0.5%	1.51	A
4	22.4%	41.6%	20.1%	8.8%	4.3%	2.8%	2.39	B
5	44.3%	38.8%	10.5%	3.7%	1.7%	1.0%	1.83	A
Average	31.9%	42.4%	15.3%	5.9%	2.8%	1.7%	2.10	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **NW 13th St**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	5	27	2666.66667	0.00	A	xsec1-3
2	5	27	2666.7	0.00	A	xsec1-3
3	5	27	2666.7	0.00	A	xsec1-3
4	5	27	2666.7	0.00	A	xsec4-5
5	5	27	2666.7	0.00	A	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	14.5	0	0%	0	3	1,892	2	33.8	4.51	xsec1-3
2	14.5	0	0%	0	3	1,892	2	25.3	4.31	xsec1-3
3	13	6.5	0%	0	4	1,864	2	39.6	4.49	xsec1-3
4	13	6.5	0%	0	4	1,864	2	29.0	4.20	xsec4-5
5	13	6.5	0%	0	4	1,582	2	38.8	4.10	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	5	300	0.93	20	3	56.3	0	2.28	layout, traffic
2	8	1361	0.93	30	5	56.3	0	3.54	layout, traffic
3	10	1165	0.93	20	3	56.3	0	2.90	layout, traffic
4	8	775	0.93	25	3	56.3	0	2.76	layout, traffic
5	35	2400	0.93	45	5	56.3	0	5.95	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	1250	56.3	219	52	33.8	3,183	2.0	900	NO	layout, traffic
2	1375	56.3	240	52	25.3	3,183	2.0	900	NO	layout, traffic
3	1375	56.3	240	63	39.6	3,135	2.0	900	NO	layout, traffic
4	540	56.3	101	71	29.0	3,135	2.0	900	NO	layout, traffic
5	3370	56.3	572	71	38.8	2,660	2.0	900	No	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	219	6.00	3.54	1.00	3.54	0.00	3.54	D
2	240	6.00	3.76	1.00	3.76	0.00	3.76	D
3	240	6.00	3.67	1.00	3.67	0.00	3.67	D
4	101	6.00	3.55	1.00	3.55	0.00	3.55	D
5	572	6.00	4.22	1.00	4.22	0.00	4.22	D
Average							3.89	D

C. Compute Transit LOS

Street: **NW 13th St**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	3	75%	0%	50%	0.19	YES	transit
2	3	75%	0%	0%	0.19	YES	transit
3	3	75%	0%	100%	0.19	YES	transit
4	3	72%	0%	100%	0.19	YES	transit
5	3	72%	0%	50%	0.19	NO	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	1250	32.6	2	10.0	transit
2	1375	15.5	1	10.0	transit
3	1375	44.1	1	13.0	transit
4	540	23.0	1	13.0	transit
5	3370	32.5	4	13.0	transit
Total/Ave	7910	27.7		11.8	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	1.00	6.00	0.47	0.03	6.90	0.95	2.48
2	1.00	6.00	0.47	0.00	6.93	0.94	2.48
3	1.00	4.62	0.47	0.06	5.49	1.04	2.48
4	1.00	4.62	0.59	0.06	5.73	1.02	2.48
5	1.00	4.62	0.59	0.03	5.76	0.87	2.48

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	2.35	3.54	3.01	C
2	2.34	3.76	3.05	C
3	2.57	3.67	2.70	B
4	2.53	3.55	2.74	B
5	2.15	4.22	3.41	C
Average			3.12	C

D. Compute Bicycle LOS

Street: **NW 13th St**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	15	0	2	D	42	29.6	xsec1-3, layout
2	15	0	2	D	64	38.4	xsec1-3, layout
3	13	7	2	D	48	15.4	xsec1-3, layout
4	13	7	2	D	40	19.6	xsec4-5, layout
5	13	7	2	D	84	26.6	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	1892	4%	33.8	0%	2.8	traffic, xsec1-3
2	1892	4%	25.3	0%	2.8	traffic, xsec1-3
3	1864	4%	39.6	0%	2.8	traffic, xsec1-3
4	1864	4%	29.0	0%	2.8	traffic, xsec4-5
5	1582	4%	38.8	0%	2.8	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent
Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	14.5	14.5	3.75	4.96	3.44	5.02	F
2	14.5	14.5	2.67	4.51	3.77	5.39	F
3	19.5	26.0	4.14	2.76	2.43	3.95	D
4	19.5	26.0	3.27	2.41	2.31	4.03	D
5	19.5	26.0	4.09	2.66	2.72	4.37	E
Average						4.56	E

E. LOS Summary

Title: NW 13th St

Direction =	Down	NB

Date: 12/1/2008 Analyst: BOP

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Artplan Transit LOS	Bicycle LOS	Artplan Bicycle LOS	Pedestrian LOS	Artplan Pedestrian LOS
1	B	A	A	A	C	E	F	E	D	D
2	C	C	D	D	C	E	F	E	D	D
3	B	A	A	A	B	E	D	C	D	D
4	B	B	C	C	B	E	D	C	D	D
5	B	A	B	B	C	D	E	C	D	D
Facility	B	B	C	B	C	E	E	D	D	D

Auto Performance Measures Summary NB

Seg+Sig	Stops	FFS	Speed	%FFS
1	0.00	35.0	32.6	93.0%
2	3.84	35.0	15.5	44.3%
3	0.00	35.0	44.1	126.1%
4	0.00	35.0	23.0	65.8%
5	1.05	45.0	32.5	72.3%
Facility	1.11	39.3	27.7	70.6%

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

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Created: 8-Jun-07 Updated: 25-Sep-08

Multimodal Level of Service for Urban Streets

Diagram of Urban Street

Street: Tower Road (SW 75th St)

Date: DEC 1 2008

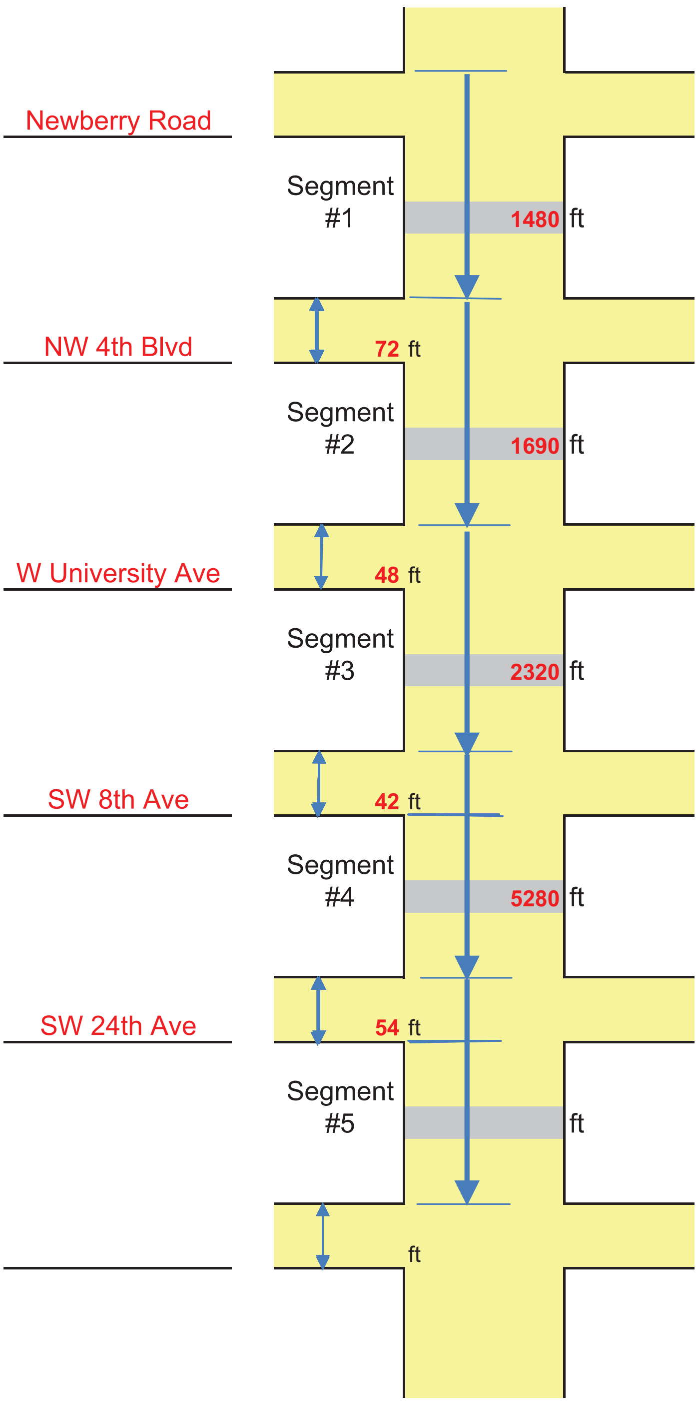
Limits: Newberry Road to SW 24th Ave

Observer: B. Perez

Analysis Direction:	SB

(Down Direction on this Sheet)

Data Entry Fields in Red



Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	4	20	665	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	3	30	530	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	3	40	650	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	4	40	900	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Tower Road (SW 75th St)

Limits: Newberry Road to SW 24th Ave

Observer: B. Perez

Date: DEC 1 2008

Cross-Section #1
From: Newberry Road To: NW 4th Blvd

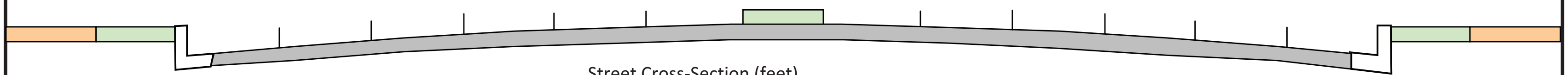
1

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	3
Jay-Walking Calc:	NO

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	2	0	0	14	12	0		13		0	12	14	0	0	2	5

Ped Vol: 8

Cross-Section #2
From: NW 4th Blvd To: W University Ave

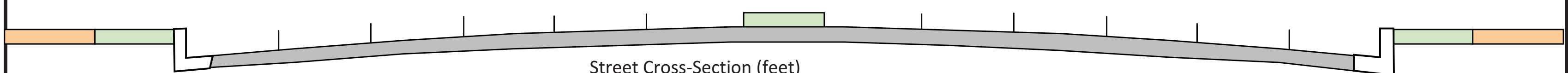
2

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	3
Jay-Walking Calc:	NO

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	2	0	0	14	12			13			12	14	0	0	2	5

Ped Vol: 8

Cross-Section #3
From: W University Ave To: SW 8th Ave

3

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	3
Jay-Walking Calc:	NO

NB

Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	5	0	4.5	11	11	0		13		0	11	11	4.5	0	5	5

Ped Vol: 8

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Tower Road (SW 75th St)

Limits: Newberry Road to SW 24th Ave

Observer: B. Perez

Date: DEC 1 2008

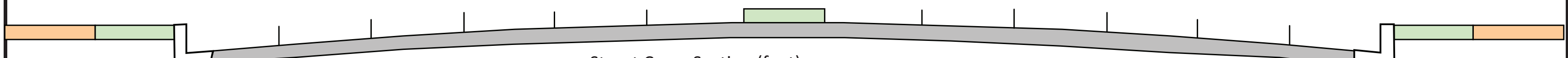
Cross-Section #4
From: SW 8th Ave To: SW 24th Ave

4

Ft/Tree	% Occ.
0	0%

Pavement Cond:	3
Jay-Walking Calc:	YES

SB **NB**


Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	32	0	0	12	0	0		0		0	0	12	0	0	0	0

Ped Vol: 9

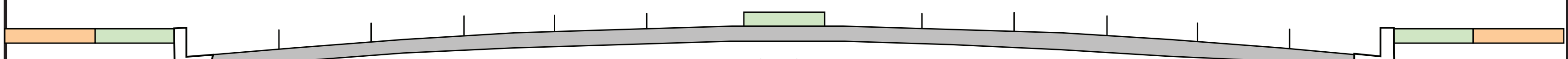
Cross-Section #5
From: SW 24th Ave To: 0

5

Ft/Tree	% Occ.
0	0%

Pavement Cond:	3
Jay-Walking Calc:	No

SB **NB**


Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
0	0	0	0	0	0	0		0		0	0	0	0	0	0	0

Ped Vol: 0

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **SB**

Street: Tower Road (SW 75th St) Date: DEC 1 2008

Limits: Newberry Road to SW 24th Ave Observer: B. Perez

Field Survey

	Segment And Downstream Signal From	To	Speed Limit (mph)	Median Type (0-3)	Left Turn Pocket (y/n)	Drivewys Rightside (#)	Unsig. Intersects (#)
1	Newberry Road	NW 4th Blvd	40	2	YES	5	0
2	NW 4th Blvd	W University Av	40	2	YES	0	0
3	W University Av	SW 8th Ave	40	2	YES	1	1
4	SW 8th Ave	SW 24th Ave	45	0	NO	0	5
5	SW 24th Ave	0	0	1	NO	0	0

Traffic Counts K: 9.5 D: 55

	Segment And Downstream Signal From	To	Vol (2-wy)	Heavy Vehicle (%)	RTOR+ PermLeft veh	Left/Right Turns %	Thru Adj. Sat. (vphgl)	PHF
1	Newberry Road	NW 4th Blvd	28595	2%	20	10%	3496	0.925
2	NW 4th Blvd	W University Av	25507	2%	11	10%	3450	0.925
3	W University Av	SW 8th Ave	20390	2%	31	10%	3257	0.925
4	SW 8th Ave	SW 24th Ave	17234	2%	33	10%	1699	0.925
5	SW 24th Ave	0	0	0%	0	0%	0	0.00

Arterial Traffic Performance & Signal Timing

	Segment And Downstream Signal		Field Survey		Signal Timing Data			
	From	To	Mean Speed (mph)	Average Stops (#/veh)	Cycle Length (secs)	Grn/Cycle for Thru (%)	Ped Walk (sec/cyc)	Xing Ped Walk (sec/cyc)
1	Newberry Road	NW 4th Blvd	23.26	0.67	100	72%	20	20
2	NW 4th Blvd	W University Av	34.47	0.50	90	70%	20	20
3	W University Av	SW 8th Ave	32.13	0.00	100	66%	20	20
4	SW 8th Ave	SW 24th Ave	29.78	1.17	90	64%	20	20
5	SW 24th Ave	0	0.0	0.0	0	0%	0	0

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter,
Signal data is at the downstream signal

| Route |

Data Collection Sheet - Transit

Direction: **SB**

Street: Tower Road (SW 75th St)

Date: DEC 1 2008

Limits: Newberry Road to SW 24th Ave

Observer: B. Perez

Field Survey

Segment	From	To	Bus Stop (#)	Shelters (% stops)	Benches (% stops)	CBD (yes/no)
1	Newberry Road	NW 4th Blvd	1	0%	100%	NO
2	NW 4th Blvd	W University Av	2	50%	100%	NO
3	W University Av	SW 8th Ave	2	50%	100%	NO
4	SW 8th Ave	SW 24th Ave	3	0%	33%	NO
5	SW 24th Ave	0	0	0%	0%	NO

Transit Performance Data

Segment	From	To	Route #'s	Frequency (bus/hr)	Load Factor (pas/seat)	On-Time Perform. (%)	Schedule Speed (mph)
1	Newberry Road	NW 4th Blvd	75	1.7	18%	70%	13
2	NW 4th Blvd	W University Av	75	1.7	18%	70%	13
3	W University Av	SW 8th Ave	75	1.7	18%	70%	13
4	SW 8th Ave	SW 24th Ave	75	1.7	18%	70%	13
5	SW 24th Ave	0					

Bus is On-Time if arrives within: 5 minutes of scheduled time.
Average Passenger Trip Length: 3.35 miles

A. Compute Auto LOS and Performance

Street: **Tower Road (SW 75th St)**

Direction=	Down	SB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	28595	0.095	0.550	0.93	90%	1454	traffic
2	25507	0.095	0.55	0.93	90%	1297	traffic
3	20390	0.095	0.55	0.93	90%	1037	traffic
4	17234	0.095	0.55	0.93	90%	876	traffic
5	0	0.095	0.55	0.00	100%	#DIV/0!	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	3496	2	0.72	5034	0.29	OK	xsec 1-3, traffic
2	3450	2	0.70	4830	0.27	OK	xsec 1-3, traffic
3	3257	2	0.66	4299	0.24	OK	xsec 1-3, traffic
4	1699	1	0.64	1087	0.81	OK	xsec 4-5, traffic
5	0	0	0.00	1	#DIV/0!	#DIV/0!	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	40	1480	23.3	traffic, layout
2	40	1690	34.5	traffic, layout
3	40	2320	32.1	traffic, layout
4	45	5280	29.8	traffic, layout
5	0	0	0.0	traffic, layout
Total/Ave.	42.5	10770	29.7	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	2.38	YES	2	traffic
2	1.56	YES	2	traffic
3	0.00	YES	2	traffic
4	1.17	NO	0	traffic
5	#DIV/0!	NO	1	traffic
Total/Ave	1.14	0.40	1.02	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5a. Compute Auto LOS Stops Model

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	19.5%	39.6%	22.4%	10.6%	5.2%	2.8%	2.51	B
2	22.9%	41.0%	20.5%	9.0%	4.3%	2.3%	2.38	B
3	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
4	18.9%	39.2%	22.8%	10.9%	5.3%	2.9%	2.53	B
5	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Average	21.2%	40.4%	21.4%	9.8%	4.7%	2.5%	2.44	B

5b. Compute Auto LOS Speed Model

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	22.7%	41.7%	19.9%	8.7%	4.3%	2.7%	2.38	B
2	42.9%	39.4%	11.0%	3.9%	1.8%	1.1%	1.85	A
3	38.2%	41.0%	12.7%	4.7%	2.1%	1.3%	1.95	A
4	24.6%	42.2%	18.9%	8.0%	3.9%	2.4%	2.32	B
5	3.2%	13.9%	20.9%	22.4%	20.0%	19.6%	4.01	#DIV/0!
Average	29.0%	42.6%	16.7%	6.7%	3.1%	2.0%	2.18	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **Tower Road (SW 75th St)**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	5	8	9000	0.00	A	xsec1-3
2	5	8	9000.0	0.00	A	xsec1-3
3	5	8	9000.0	0.00	A	xsec1-3
4	5	9	8000.0	0.00	A	xsec4-5
5	0	0	#DIV/0!	N/A	N/A	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	14	0	0%	0	2	1,615	2	31.6	4.12	xsec1-3
2	14	0	0%	0	2	1,441	2	37.2	4.05	xsec1-3
3	11	4.5	0%	0	5	1,152	2	36.1	3.59	xsec1-3
4	12	0	0%	0	32	973	1	37.4	4.65	xsec4-5
5	0	0	0%	0	0	#DIV/0!	0	0.0	#NUM!	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	20	665	0.93	20	4	32.0	0	2.56	layout, traffic
2	11	530	0.93	30	3	27.2	0	2.61	layout, traffic
3	31	650	0.93	40	3	32.0	0	3.00	layout, traffic
4	33	900	0.93	40	4	27.2	0	3.37	layout, traffic
5	0	0	0.00	0	0	#DIV/0!	0	#DIV/0!	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	1480	32.0	252	52	31.6	2,717	2.0	900	NO	layout, traffic
2	1690	27.2	286	52	37.2	2,423	2.0	900	NO	layout, traffic
3	2320	32.0	392	53	36.1	1,937	2.0	470	NO	layout, traffic
4	5280	27.2	884	11	37.4	1,637	1.0	15	YES	layout, traffic
5	0	#DIV/0!	#DIV/0!	-13	0.0	0	1.0	0	No	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	252	6.00	3.48	1.00	3.48	0.00	3.48	C
2	286	6.00	3.47	1.00	3.47	0.00	3.47	C
3	392	6.00	3.41	1.00	3.41	0.00	3.41	C
4	15	2.00	3.83	0.80	3.06	0.00	3.06	C
5	#DIV/0!	#DIV/0!	#NUM!	1.00	#NUM!	N/A	#NUM!	#NUM!
Average							3.26	C

C. Compute Transit LOS

Street: **Tower Road (SW 75th St)**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	2	70%	0%	100%	0.18	NO	transit
2	2	70%	50%	100%	0.18	NO	transit
3	2	70%	50%	100%	0.18	NO	transit
4	2	70%	0%	33%	0.18	NO	transit
5	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	1480	23.3	1	13.0	transit
2	1690	34.5	2	13.0	transit
3	2320	32.1	2	13.0	transit
4	5280	29.8	3	13.0	transit
5	0	0.0	0	#DIV/0!	transit
Total/Ave	10770	29.7		13.0	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	1.00	4.62	0.67	0.06	5.90	0.86	1.72
2	1.00	4.62	0.67	0.25	5.70	0.87	1.72
3	1.00	4.62	0.67	0.25	5.70	0.87	1.72
4	1.00	4.62	0.67	0.02	5.94	0.86	1.72
5	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	1.48	3.48	4.31	E
2	1.49	3.47	4.28	E
3	1.49	3.41	4.27	E
4	1.47	3.06	4.25	E
5	#DIV/0!	#NUM!	#DIV/0!	F
Average			4.27	E

D. Compute Bicycle LOS

Street: **Tower Road (SW 75th St)**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	14	0	2	D	72	17.8	xsec1-3, layout
2	14	0	2	D	48	0.0	xsec1-3, layout
3	11	5	2	D	42	4.6	xsec1-3, layout
4	12	0	1	UD	54	5.0	xsec4-5, layout
5	0	0	0	UD	0	#DIV/0!	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	1615	2%	31.6	0%	3.0	traffic, xsec1-3
2	1441	2%	37.2	0%	3.0	traffic, xsec1-3
3	1152	2%	36.1	0%	3.0	traffic, xsec1-3
4	973	2%	37.4	0%	3.0	traffic, xsec4-5
5	#DIV/0!	0%	0.0	0%	3.0	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent
Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	14.0	14.0	3.56	4.35	3.75	4.64	E
2	14.0	14.0	4.00	4.42	3.21	3.83	D
3	15.5	20.0	3.92	3.27	2.53	3.67	D
4	12.0	12.0	4.01	4.84	4.21	4.54	E
5	#DIV/0!	#DIV/0!	0.81	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Average						4.25	E

E. LOS Summary

Title: Tower Road (SW 75th St)

Direction =	Down	SB

Date: 12/1/2008 Analyst: BOP

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Artplan Transit LOS	Bicycle LOS	Artplan Bicycle LOS	Pedestrian LOS	Artplan Pedestrian LOS
1	B	B	C	C	E	E	E	D	C	D
2	B	A	B	A	E	E	D	D	C	D
3	B	A	B	B	E	E	D	C	C	C
4	B	B	B	C	E	E	E	E	C	D
5	#DIV/0!	#DIV/0!	F	#DIV/0!	F		#DIV/0!		#NUM!	
Facility	B	B	B	B	E	E	E	D	C	D

Auto Performance Measures Summary SB

Seg+Sig	Stops	FFS	Speed	%FFS
1	2.38	40.0	23.3	58.1%
2	1.56	40.0	34.5	86.2%
3	0.00	40.0	32.1	80.3%
4	1.17	45.0	29.8	66.2%
5	#DIV/0!	0.0	0.0	#DIV/0!
Facility	1.14	42.5	29.7	70.1%

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

Created: 8-Jun-07 Updated: 25-Sep-08

Multimodal Level of Service for Urban Streets

Diagram of Urban Street

Street: W University Ave

Date: DEC 1 2008

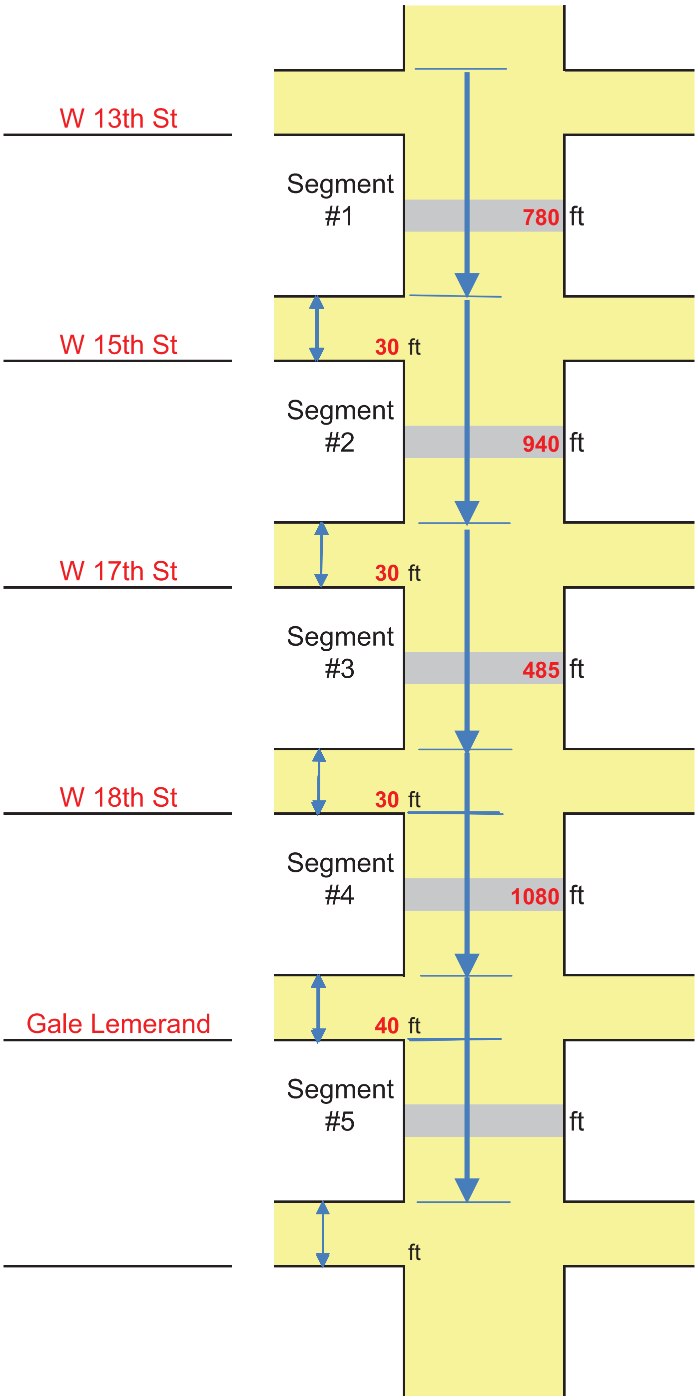
Limits: W. 13th Street to Gale Lemerand Drive

Observer: B. Perez

Analysis Direction:	WB

(Down Direction on this Sheet)

Data Entry Fields in Red



Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	2	25	170	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	25	1040	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	25	330	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	3	20	530	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: W University Ave

Limits: W. 13th Street to Gale Lemerand Drive

Observer: B. Perez

Date: DEC 1 2008

Cross-Section #1
From: W 13th St To: W 15th St

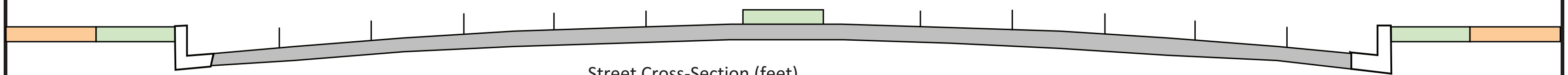
1

Ft/Tree	% Occ.
0	0%

WB

Pavement Cond:	2.8
Jay-Walking Calc:	NO

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
7.5	2	0	0	12	11	0		16		0	11	12	0	0	2	5

Ped Vol: 67

Cross-Section #2
From: W 15th St To: W 17th St

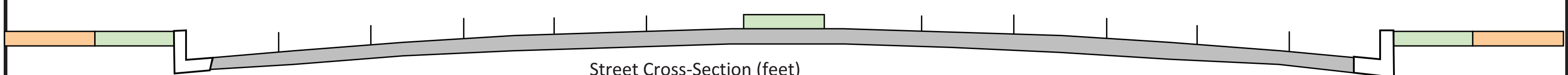
2

Ft/Tree	% Occ.
0	100%

WB

Pavement Cond:	2.8
Jay-Walking Calc:	NO

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
7.5	2	7	0	11	11			11			11	11	0	0	2	5

Ped Vol: 67

Cross-Section #3
From: W 17th St To: W 18th St

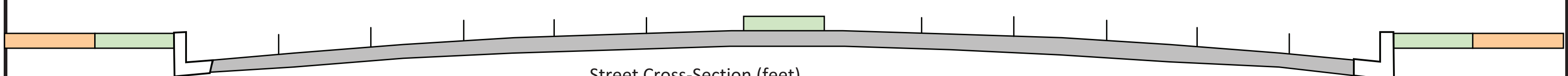
3

Ft/Tree	% Occ.
0	100%

WB

Pavement Cond:	2.8
Jay-Walking Calc:	NO

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
7.5	2	7	0	11	11	0		11		0	11	11	0	0	2	7.5

Ped Vol: 67

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: W University Ave

Limits: W. 13th Street to Gale Lemerand Drive

Observer: B. Perez

Date: DEC 1 2008

Cross-Section #4
From: W 18th St To: Gale Lemerand

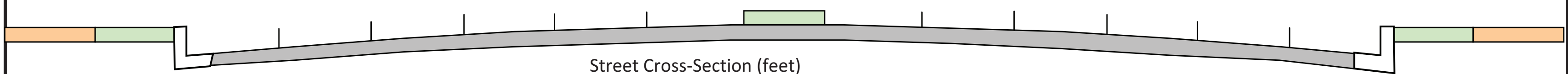
4

Ft/Tree	% Occ.
0	0%

WB

Pavement Cond:	2.8
Jay-Walking Calc:	NO

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
7.5	2	0	0	17	11	0		10		0	11	11	0	0	2	7.5

Ped Vol: 9

Cross-Section #5
From: Gale Lemerand To: 0

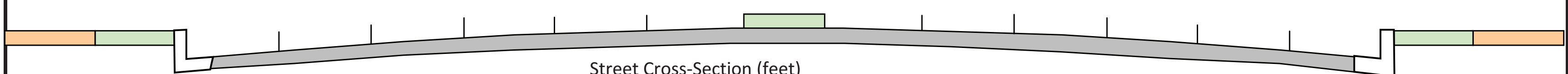
5

Ft/Tree	% Occ.
0	0%

WB

Pavement Cond:	3
Jay-Walking Calc:	No

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
0	0	0	0	0	0	0		0		0	0	0	0	0	0	0

Ped Vol: 0

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **WB**

Street: W University Ave

Date: DEC 1 2008

Limits: 13th Street to Gale Lemerand Dr

Observer: B. Perez

Field Survey

	Segment And Downstream Signal From	To	Speed Limit (mph)	Median Type (0-3)	Left Turn Pocket (y/n)	Drivewys Rightside (#)	Unsig. Intersects (#)
1	W 13th St	W 15th St	30	2	NO	1	1
2	W 15th St	W 17th St	30	2	YES	2	1
3	W 17th St	W 18th St	30	2	YES	0	0
4	W 18th St	Gale Lemerand	30	2	NO	1	1
5	Gale Lemerand	0	0	1	NO	0	0

Traffic Counts K: 9.5 D: 55

	Segment And Downstream Signal From	To	Vol (2-wy)	Heavy Vehicle (%)	RTOR+ PermLeft veh	Left/Right Turns %	Thru Adj. Sat. (vphgl)	PHF
1	W 13th St	W 15th St	30500	1%	0	10%	3400	0.925
2	W 15th St	W 17th St	30500	1%	13	10%	3412	0.925
3	W 17th St	W 18th St	30500	1%	6	10%	3412	0.925
4	W 18th St	Gale Lemerand	30500	1%	15	10%	3424	0.925
5	Gale Lemerand	0	0	0%	0	0%	0	0.00

Arterial Traffic Performance & Signal Timing

	Segment And Downstream Signal From	To	Field Survey: Mean Speed (mph)	Field Survey: Average Stops (#/veh)	Signal Timing Data: Cycle Length (secs)	Signal Timing Data: Grn/Cycle for Thru (%)	Signal Timing Data: Ped Walk (sec/cyc)	Signal Timing Data: Xing Ped Walk (sec/cyc)
1	W 13th St	W 15th St	15.53	0.50	150	82%	25	25
2	W 15th St	W 17th St	16.50	0.33	150	52%	25	25
3	W 17th St	W 18th St	28.07	0.00	150	68%	25	25
4	W 18th St	Gale Lemerand	20.50	0.33	150	70%	25	25
5	Gale Lemerand	0	0.0	0.0	0	0%	0	0

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter,
Signal data is at the downstream signal

| Route |

Data Collection Sheet - Transit

Direction: **WB**

Street: W University Ave

Date: DEC 1 2008

Limits: W. 13th Street to Gale Lemerand Drive

Observer: B. Perez

Field Survey

Segment	From	To	Bus Stop (#)	Shelters (% stops)	Benches (% stops)	CBD (yes/no)
1	W 13th St	W 15th St	1	100%	100%	YES
2	W 15th St	W 17th St	2	0%	50%	YES
3	W 17th St	W 18th St	1	0%	0%	YES
4	W 18th St	Gale Lemerand	2	50%	100%	YES
5	Gale Lemerand	0	0	0%	0%	NO

Transit Performance Data

Segment	From	To	Route #'s	Frequency (bus/hr)	Load Factor (pas/seat)	On-Time Perform. (%)	Schedule Speed (mph)
1	W 13th St	W 15th St	5	3	37%	60%	10
2	W 15th St	W 17th St	5	3	37%	60%	10
3	W 17th St	W 18th St	5	3	37%	60%	10
			34	3.33	50%	60%	10
4	W 18th St	Gale Lemerand	5	3	37%	60%	10
			34	3.33	50%	60%	10
5	Gale Lemerand	0					

Bus is On-Time if arrives within: 5 minutes of scheduled time.

Average Passenger Trip Length: 3.35 miles

A. Compute Auto LOS and Performance

Street: **W University Ave**

Direction=	Down	WB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	30500	0.095	0.550	0.93	90%	1551	traffic
2	30500	0.095	0.55	0.93	90%	1551	traffic
3	30500	0.095	0.55	0.93	90%	1551	traffic
4	30500	0.095	0.55	0.93	90%	1551	traffic
5	0	0.095	0.55	0.00	100%	#DIV/0!	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	3400	2	0.82	5576	0.28	OK	xsec 1-3, traffic
2	3412	2	0.52	3548	0.44	OK	xsec 1-3, traffic
3	3412	2	0.68	4640	0.33	OK	xsec 1-3, traffic
4	3424	2	0.70	4794	0.32	OK	xsec 4-5, traffic
5	0	0	0.00	1	#DIV/0!	#DIV/0!	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	30	780	15.5	traffic, layout
2	30	940	16.5	traffic, layout
3	30	485	28.1	traffic, layout
4	30	1080	20.5	traffic, layout
5	0	0	0.0	traffic, layout
Total/Ave.	30.0	3285	18.5	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	3.38	NO	2	traffic
2	1.87	YES	2	traffic
3	0.00	YES	2	traffic
4	1.63	NO	2	traffic
5	#DIV/0!	NO	1	traffic
Total/Ave	1.87	0.40	2.00	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5a. Compute Auto LOS Stops Model

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	11.7%	32.5%	26.5%	15.7%	8.6%	5.0%	2.92	C
2	21.6%	40.5%	21.2%	9.6%	4.6%	2.5%	2.43	B
3	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
4	17.2%	38.1%	23.8%	11.8%	5.9%	3.3%	2.61	B
5	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Average	18.3%	38.8%	23.1%	11.2%	5.5%	3.0%	2.56	B

5b. Compute Auto LOS Speed Model

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	13.3%	35.3%	25.2%	13.7%	7.5%	5.0%	2.82	C
2	14.3%	36.4%	24.7%	13.0%	7.0%	4.7%	2.76	C
3	30.5%	42.5%	15.9%	6.3%	2.9%	1.8%	2.14	B
4	18.9%	40.1%	22.1%	10.4%	5.2%	3.4%	2.53	B
5	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#DIV/0!
Average	16.5%	38.4%	23.4%	11.6%	6.0%	4.0%	2.64	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **W University Ave**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	7.5	67	1611.9403	0.00	A	xsec1-3
2	7.5	67	1611.9	0.00	A	xsec1-3
3	7.5	67	1611.9	0.00	A	xsec1-3
4	7.5	9	12000.0	0.00	A	xsec4-5
5	0	0	#DIV/0!	N/A	N/A	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	12	0	0%	0	2	1,723	2	22.8	3.95	xsec1-3
2	11	7	100%	0	2	1,723	2	23.3	3.78	xsec1-3
3	11	7	100%	0	2	1,723	2	29.0	3.91	xsec1-3
4	17	0	0%	0	2	1,723	2	25.3	3.85	xsec4-5
5	0	0	0%	0	0	#DIV/0!	0	0.0	#NUM!	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	0	170	0.93	25	2	52.1	0	2.19	layout, traffic
2	13	1040	0.93	25	2	52.1	0	2.97	layout, traffic
3	6	330	0.93	25	2	52.1	0	2.34	layout, traffic
4	15	530	0.93	20	3	52.1	0	2.45	layout, traffic
5	0	0	0.00	0	0	#DIV/0!	0	#DIV/0!	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	780	52.1	139	46	22.8	2,898	2.0	900	NO	layout, traffic
2	940	52.1	166	44	23.3	2,898	2.0	900	NO	layout, traffic
3	485	52.1	90	44	29.0	2,898	2.0	900	NO	layout, traffic
4	1080	52.1	189	44	25.3	2,898	2.0	900	NO	layout, traffic
5	0	#DIV/0!	#DIV/0!	-11	0.0	0	1.0	0	No	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	139	6.00	3.34	1.00	3.34	0.00	3.34	C
2	166	6.00	3.46	1.00	3.46	0.00	3.46	C
3	90	6.00	3.36	1.00	3.36	0.00	3.36	C
4	189	6.00	3.37	1.00	3.37	0.00	3.37	C
5	#DIV/0!	#DIV/0!	#NUM!	1.00	#NUM!	N/A	#NUM!	#NUM!
Average							3.39	C

C. Compute Transit LOS

Street: **W University Ave**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	3	60%	100%	100%	0.37	YES	transit
2	3	60%	0%	50%	0.37	YES	transit
3	6	60%	0%	0%	0.44	YES	transit
4	6	60%	50%	100%	0.44	YES	transit
5	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	780	15.5	1	10.0	transit
2	940	16.5	2	10.0	transit
3	485	28.1	1	10.0	transit
4	1080	20.5	2	10.0	transit
5	0	0.0	0	#DIV/0!	transit
Total/Ave	3285	18.5		10.0	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	1.00	6.00	1.19	0.45	7.94	0.89	2.48
2	1.00	6.00	1.19	0.03	8.36	0.88	2.48
3	1.00	6.00	1.19	0.00	8.39	0.88	3.19
4	1.00	6.00	1.19	0.25	8.13	0.89	3.19
5	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	2.22	3.34	3.17	C
2	2.17	3.46	3.26	C
3	2.79	3.36	2.32	B
4	2.83	3.37	2.27	B
5	#DIV/0!	#NUM!	#DIV/0!	F
Average			2.77	C

D. Compute Bicycle LOS

Street: **W University Ave**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	12	0	2	D	30	13.5	xsec1-3, layout
2	11	7	2	D	30	16.9	xsec1-3, layout
3	11	7	2	D	30	0.0	xsec1-3, layout
4	17	0	2	D	40	9.8	xsec4-5, layout
5	0	0	0	UD	0	#DIV/0!	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	1723	1%	22.8	0%	2.8	traffic, xsec1-3
2	1723	1%	23.3	100%	2.8	traffic, xsec1-3
3	1723	1%	29.0	100%	2.8	traffic, xsec1-3
4	1723	1%	25.3	0%	2.8	traffic, xsec4-5
5	#DIV/0!	0%	0.0	0%	3.0	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent
Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	12.0	12.0	1.95	4.23	3.63	4.42	E
2	18.0	11.0	2.13	4.39	2.35	4.26	E
3	18.0	11.0	3.28	4.68	2.35	3.71	D
4	17.0	17.0	2.67	3.69	2.71	3.95	D
5	#DIV/0!	#DIV/0!	0.81	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Average						4.11	D

E. LOS Summary

Title: W University Ave

Direction =	Down	WB

Date: 12/1/2008 Analyst: BOP

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Artplan Transit LOS	Bicycle LOS	Artplan Bicycle LOS	Pedestrian LOS	Artplan Pedestrian LOS
1	C	C	C	C	C	D	E	D	C	D
2	B	C	C	C	C	C	E	D	C	D
3	B	B	A	A	B	C	D	D	C	D
4	B	B	B	B	B	D	D	D	C	D
5	#DIV/0!	#DIV/0!	F	#DIV/0!	F		#DIV/0!		#NUM!	
Facility	B	B	C	C	C	D	D	D	C	D

Auto Performance Measures Summary WB

Seg+Sig	Stops	FFS	Speed	%FFS
1	3.38	30.0	15.5	51.8%
2	1.87	30.0	16.5	55.0%
3	0.00	30.0	28.1	93.6%
4	1.63	30.0	20.5	68.3%
5	#DIV/0!	0.0	0.0	#DIV/0!
Facility	1.87	30.0	18.5	61.8%

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

Spreadsheet is made available "As-Is" for TRB internal review.
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Spreadsheet is unsupported.
Spreadsheet does not have data entry error checking.
Created: 8-Jun-07 Updated: 25-Sep-08

APPENDIX C: TAMPA ARTERIAL SPREADSHEETS

Multimodal Level of Service for Urban Streets

Diagram of Uban Street

Street: US 41

Date: Oct. 14, 2008

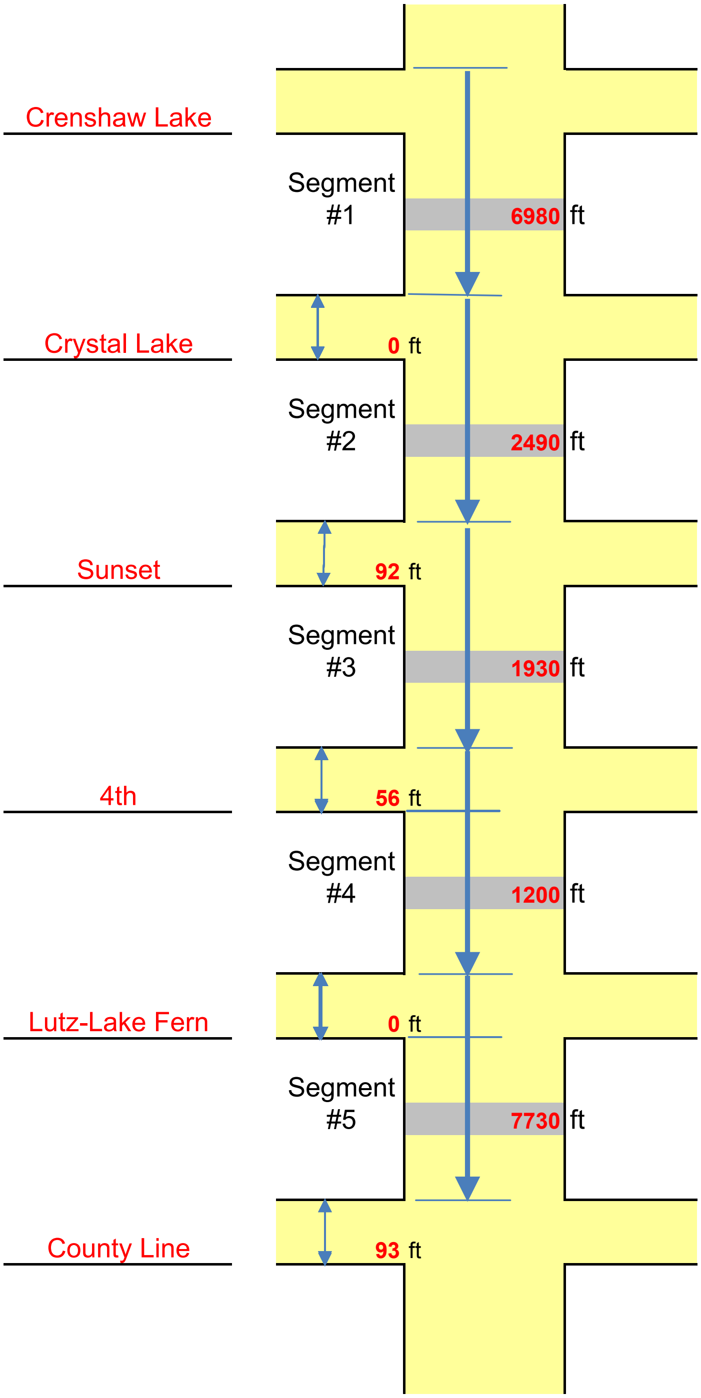
Limits: Crenshaw Lake to County Line

Observer: PSM

Analysis Direction:	NB

(Down Direction on this Sheet)

Data Entry Fields in Red



Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	0	0	0	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	4	40	680	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	35	60	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	0	0	0	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	3	40	844	0

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: US 41

Limits: Crenshaw Lake to County Line

Cross-Section #1

Observer: PSM

Date: Oct. 14, 2008

From: Crenshaw Lake To: Crystal Lake

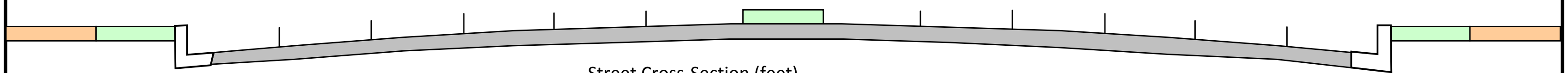
1

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	4
Jay-Walking Calc:	YES

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
0	0	0	4	12	12	12		21		12	12	13.5	0	0	3	5

Ped Vol: 0

Cross-Section #2

From: Crystal Lake To: Sunset

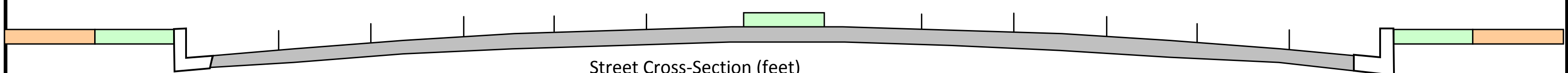
2

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	4
Jay-Walking Calc:	YES

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	0	13.5	12	12		21		12	12	12	4	0	0	0

Ped Vol: 5

Cross-Section #3

From: Sunset To: 4th

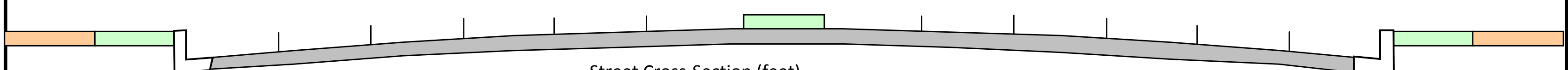
3

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	4
Jay-Walking Calc:	YES

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	0	13.5	12	12		21		12	12	12	0	0	0	0

Ped Vol: 5

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: US 41

Limits: Crenshaw Lake to County Line

Observer: PSM

Date: Oct. 14, 2008

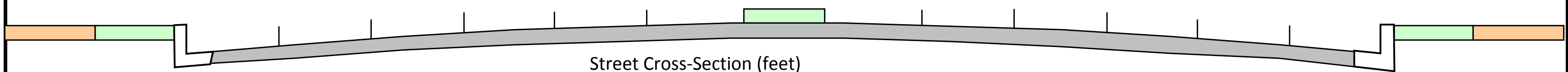
Cross-Section #4
From: 4th To: Lutz-Lake Fern

4

Ft/Tree	% Occ.
0	0%

Pavement Cond:	4
Jay-Walking Calc:	YES

NB **SB**



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	0	13.5	12	12		21		11.5	12.5	13.5	0	0	0	0

Ped Vol: 5

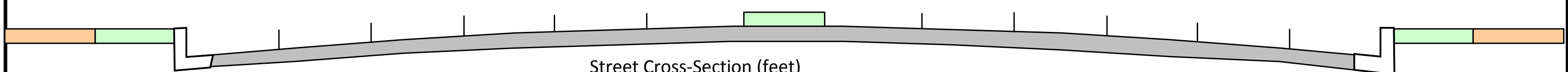
Cross-Section #5
From: Lutz-Lake Fern To: County Line

5

Ft/Tree	% Occ.
0	0%

Pavement Cond:	4
Jay-Walking Calc:	YES

NB **SB**



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	0	13.5	12	12		21		11.5	12.5	13.5	0	0	0	0

Ped Vol: 5

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **NB**

Street: US 41

Date: Oct. 14, 2008

Limits: Crenshaw Lake to County Line

Observer: PSM

Field Survey

	Segment And Downstream Signal From	To	Speed Limit (mph)	Median Type (0-3)	Left Turn Pocket (y/n)	Drivewys Rightside (#)	Unsig. Intersects (#)
1	Crenshaw Lake	Crystal Lake	50	3	YES	2	4
2	Crystal Lake	Sunset	45	3	YES	9	1
3	Sunset	4th	45	3	YES	1	0
4	4th	Lutz-Lake Ferr	45	3	YES	3	2
5	Lutz-Lake Ferr	County Line	50	3	YES	14	5

Traffic Counts K: 9.52 D: 56.79

	Segment And Downstream Signal From	To	Vol (2-wy)	Heavy Vehicle (%)	RTOR+ PermLeft veh	Left/Right Turns %	Thru Adj. Sat. (vphgl)	PHF
1	Crenshaw Lake	Crystal Lake	45500	5%	0	9%	4383	0.92
2	Crystal Lake	Sunset	46000	5%	28	18%	5009	0.92
3	Sunset	4th	38100	5%	0	1%	4383	0.92
4	4th	Lutz-Lake Ferr	38100	5%	0	14%	5424	0.92
5	Lutz-Lake Ferr	County Line	35500	5%	10	17%	4383	0.92

Arterial Traffic Performance & Signal Timing

	Segment And Downstream Signal		Field Survey		Signal Timing Data			
	From	To	Mean Speed (mph)	Average Stops (#/veh)	Cycle Length (secs)	Grn/Cycle for Thru (%)	Ped Walk (sec/cyc)	Xing Ped Walk (sec/cyc)
1	Crenshaw Lake	Crystal Lake	50.0	0.3	90	76%	68	7
2	Crystal Lake	Sunset	47.0	0.0	90	83%	90	7
3	Sunset	4th	48.0	0.0	90	60%	7	7
4	4th	Lutz-Lake Ferr	42.0	0.3	90	88%	7	7
5	Lutz-Lake Ferr	County Line	46.0	0.3	90	83%	90	7

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter, H(
Signal data is at the downstream signal

| Route |
Data Collection Sheet - Transit

Direction: **NB**

Street: US 41

Date: Oct. 14, 2008

Limits: Crenshaw Lake to County Line

Observer: PSM

Field Survey

Segment			Bus Stop	Shelters	Benches	CBD
	From	To	(#)	(% stops)	(% stops)	(yes/no)
1	Crenshaw Lake	Crystal Lake	1	0%	0%	NO
2	Crystal Lake	Sunset	0	0%	0%	NO
3	Sunset	4th	0	0%	0%	NO
4	4th	Lutz-Lake Fern	0	0%	0%	NO
5	Lutz-Lake Fern	County Line	0	0%	0%	NO

Transit Performance Data

Segment			Route	Frequency	Load Factor	On-Time Perform.	Schedule Speed
	From	To	#'s	(bus/hr)	(pas/seat)	(%)	(mph)
1	Crenshaw Lake	Crystal Lake	20X	1	30%	90%	22
2	Crystal Lake	Sunset					
3	Sunset	4th					
4	4th	Lutz-Lake Fern					
5	Lutz-Lake Fern	County Line					

Bus is On-Time if arrives within: 5 minutes of scheduled time.
Average Passenger Trip Length: 13 miles

A. Compute Auto LOS and Performance

Street: **US 41**

Direction=	Down	NB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	45500	0.095	0.568	0.92	91%	2433	traffic
2	46000	0.095	0.57	0.92	82%	2217	traffic
3	38100	0.095	0.57	0.92	99%	2217	traffic
4	38100	0.095	0.57	0.92	86%	1926	traffic
5	35500	0.095	0.57	0.92	83%	1732	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	4383	3	0.76	9993	0.24	OK	xsec 1-3, traffic
2	5009	3	0.83	12472	0.18	OK	xsec 1-3, traffic
3	4383	3	0.60	7889	0.28	OK	xsec 1-3, traffic
4	5424	3	0.88	14319	0.13	OK	xsec 4-5, traffic
5	4383	3	0.83	10914	0.16	OK	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	50	6980	50.0	traffic, layout
2	45	2490	47.0	traffic, layout
3	45	1930	48.0	traffic, layout
4	45	1200	42.0	traffic, layout
5	50	7730	46.0	traffic, layout
Total/Ave.	48.6	20330	47.3	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	0.23	YES	3	traffic
2	0.00	YES	3	traffic
3	0.00	YES	3	traffic
4	1.32	YES	3	traffic
5	0.20	YES	3	traffic
Total/Ave	0.23	1.00	3.00	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	29.4%	41.9%	17.1%	6.9%	3.1%	1.6%	2.17	B
2	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
3	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
4	24.0%	41.3%	19.9%	8.6%	4.1%	2.2%	2.34	B
5	29.5%	41.9%	17.0%	6.8%	3.1%	1.6%	2.17	B
Average	29.4%	41.9%	17.1%	6.9%	3.1%	1.6%	2.17	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **US 41**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	0	0	#DIV/0!	N/A	N/A	xsec1-3
2	5	5	14400.0	0.00	A	xsec1-3
3	5	5	14400.0	0.00	A	xsec1-3
4	5	5	14400.0	0.00	A	xsec4-5
5	5	5	14400.0	0.00	A	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	12	4	0%	0	0	2,674	3	50.0	5.96	xsec1-3
2	13.5	0	0%	0	3	2,703	3	46.0	4.83	xsec1-3
3	13.5	0	0%	0	3	2,239	3	46.5	4.45	xsec1-3
4	13.5	0	0%	0	3	2,239	3	43.5	4.34	xsec4-5
5	13.5	0	0%	0	3	2,086	3	48.0	4.37	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	0	0	0.92	0	0	2.7	0	1.82	layout, traffic
2	28	680	0.92	40	4	0.0	0	2.92	layout, traffic
3	0	60	0.92	35	2	38.3	0	2.10	layout, traffic
4	0	0	0.92	0	0	38.3	0	1.93	layout, traffic
5	10	844	0.92	40	3	0.0	0	3.11	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	6980	38.3	1171	78	50.0	4,332	2.0	900	YES	layout, traffic
2	2490	38.3	423	78	46.0	4,379	2.0	900	YES	layout, traffic
3	1930	38.3	330	74	46.5	3,627	2.0	900	YES	layout, traffic
4	1200	38.3	208	75	43.5	3,627	2.0	900	YES	layout, traffic
5	7730	38.3	1296	75	48.0	3,380	2.0	900	YES	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	900	6.00	3.90	1.20	4.68	N/A	4.68	E
2	423	6.00	3.79	1.20	4.54	0.00	4.54	E
3	330	6.00	3.48	1.20	4.18	0.00	4.18	D
4	208	6.00	3.41	1.20	4.09	0.00	4.09	D
5	900	6.00	3.68	1.20	4.42	0.00	4.42	E
Average							4.48	E

C. Compute Transit LOS

Street: **US 41**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	1	90%	0%	0%	0.30	NO	transit
2	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit
3	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit
4	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit
5	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	6980	50.0	1	22.0	transit
2	2490	47.0	0	#DIV/0!	transit
3	1930	48.0	0	#DIV/0!	transit
4	1200	42.0	0	#DIV/0!	transit
5	7730	46.0	0	#DIV/0!	transit
Total/Ave	20330	47.3		#DIV/0!	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	1.00	2.73	0.02	0.00	2.77	1.16	0.95
2	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00
3	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00
4	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00
5	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	1.10	4.68	5.05	F
2	#DIV/0!	4.54	#DIV/0!	F
3	#DIV/0!	4.18	#DIV/0!	F
4	#DIV/0!	4.09	#DIV/0!	F
5	#DIV/0!	4.42	#DIV/0!	F
Average			#DIV/0!	F

D. Compute Bicycle LOS

Street: **US 41**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	12	4	3	D	0	4.5	xsec1-3, layout
2	14	0	3	D	92	21.2	xsec1-3, layout
3	14	0	3	D	56	2.7	xsec1-3, layout
4	14	0	3	D	0	22.0	xsec4-5, layout
5	14	0	3	D	93	13.0	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	2674	5%	50.0	0%	4.0	traffic, xsec1-3
2	2703	5%	46.0	0%	4.0	traffic, xsec1-3
3	2239	5%	46.5	0%	4.0	traffic, xsec1-3
4	2239	5%	43.5	0%	4.0	traffic, xsec4-5
5	2086	5%	48.0	0%	4.0	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent
Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	16.0	20.0	4.62	4.13	2.38	3.79	D
2	13.5	13.5	4.46	5.15	4.34	5.26	F
3	13.5	13.5	4.48	5.07	3.50	4.12	D
4	13.5	13.5	4.35	5.00	2.64	4.58	E
5	13.5	13.5	4.54	5.06	3.97	4.70	E
Average						4.39	E

E. LOS Summary

Title: US 41

Direction =	Down	NB	Date:	9/28/2008	Analyst:	AEN

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	A	A	A	F	D	E
2	B	A	A	A	F	F	E
3	B	A	A	A	F	D	D
4	B	A	A	A	F	E	D
5	B	A	A	A	F	E	E
Facility	B	A	A	A	F	E	E

Auto Performance Measures Summary NB

Seg+Sig	Stops	FFS	Speed	%FFS
1	0.23	50.0	50.0	100.0%
2	0.00	45.0	47.0	104.4%
3	0.00	45.0	48.0	106.7%
4	1.32	45.0	42.0	93.3%
5	0.20	50.0	46.0	92.0%
Facility	0.23	48.6	47.3	97.4%

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

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Spreadsheet is unsupported.
Spreadsheet does not have data entry error checking.
Created: 8-Jun-07 Updated: 25-Sep-08

Street: **US 41**
(This sheet generates the LOS results for "results")

Direction= **Down** **NB**

Leave Blank Cells Alone. Have Eqns

A. Compute Auto LOS and Performance

1. Compute Eastbound Hourly Demand (v)

Segment	Weekday ADT (vpd)	Peak Factor k (#)	Dir. Factor d (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)
1	45500	0.10	0.57	0.92	91%	2433
2	46000	0.10	0.57	0.92	82%	2217
3	38100	0.10	0.57	0.92	99%	2217
4	38100	0.10	0.57	0.92	86%	1926
5	35500	0.10	0.57	0.92	83%	1732

2. Compute Eastbound Hourly Capacity and V/C

Segment	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	V/c	V/c Check
1	4383	3	0.76	9993	0.24	OK
2	5009	3	0.83	12472	0.18	OK
3	4383	3	0.60	7889	0.28	OK
4	5424	3	0.88	14319	0.13	OK
5	4383	3	0.83	10914	0.16	OK

Adjusted Sat. Flows computed per Chapter 16, Signalized Intersections.

3. Compute Mean Through Speed

Segment	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)
1	50	6980	50.0
2	45	2490	47.0
3	45	1930	48.0
4	45	1200	42.0
5	50	7730	46.0
Total/Ave.	48.6	20330	47.3

4. Compute Stops & % Left Lane

Segment	Average Speed (mph)	Median Type
1	50.0	3.0
2	47.0	3.0
3	48.0	3.0
4	42.0	3.0
5	46.0	3.0
Total/Ave	47.3	3.00

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	77.6%	18.0%	2.9%	0.9%	0.4%	0.2%	1.29	A
2	72.9%	21.4%	3.7%	1.2%	0.5%	0.3%	1.36	A
3	74.5%	20.2%	3.4%	1.1%	0.5%	0.3%	1.34	A
4	63.8%	27.8%	5.4%	1.8%	0.8%	0.5%	1.49	A
5	71.2%	22.7%	4.0%	1.3%	0.6%	0.3%	1.38	A
Average	73.4%	21.0%	3.6%	1.1%	0.5%	0.3%	1.35	A

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

Multimodal Level of Service for Urban Streets

Diagram of Uban Street

Street: Himes Avenue

Date: Oct. 21, 2008

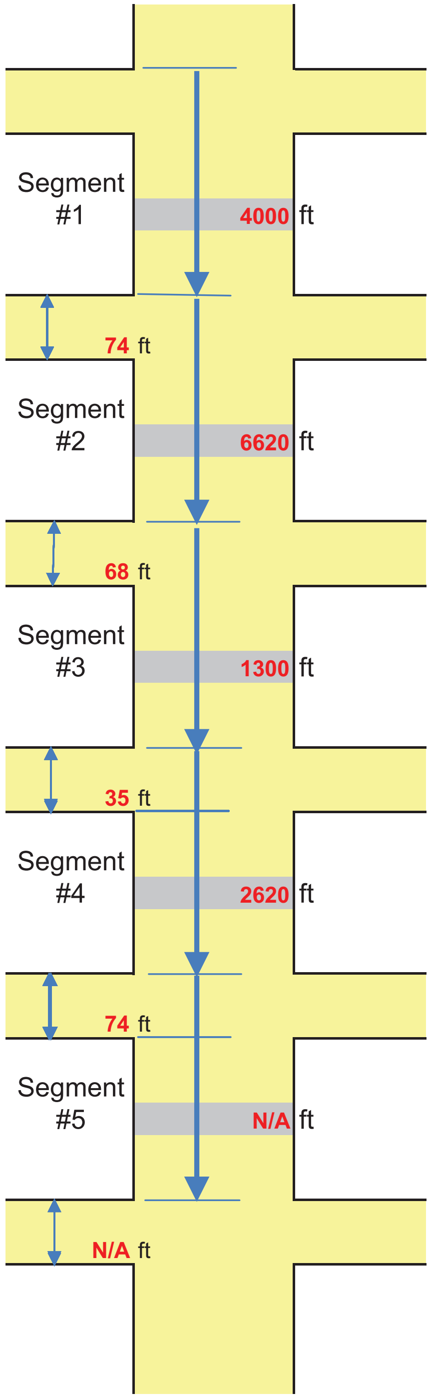
Limits: Hillsborough to Busch

Observer: PSM & GT

Analysis Direction:	NB

(Down Direction on this Sheet)

Data Entry Fields in Red



Hillsborough

Lambright

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	4	40	936	0

Waters

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	4	45	2160	0

Humphrey

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	30	104	0

Busch

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	4	45	2364	0

N/A

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
N/A	N/A	N/A	N/A	N/A

Multimodal Level of Service for Urban Streets

Street Cross-Section Data

Street: Himes Avenue

Limits:

Observer:

Cross-Section #1

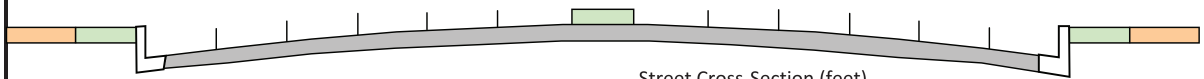
From: Hillsborough To: Lambright

1

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	3.5
Jay-Walking Calc:	YES



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane
4	7	0	0	10.5				0			

Ped Vol: 20

Cross-Section #2

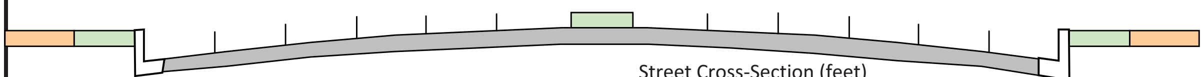
From: Lambright To: Waters

2

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	3.5
Jay-Walking Calc:	YES



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane
0	0	0	0	10.5				0			

Ped Vol: 20

Cross-Section #3

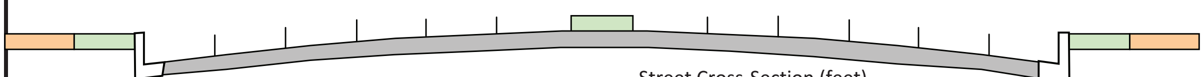
From: Waters To: Humphrey

3

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	3.5
Jay-Walking Calc:	YES



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane
0	0	0	0	10				0	12		

Ped Vol: 20

Multimodal Level of Service for Urban Streets

Street Cross-Section Data | Street: Himes Avenue | Limits:

Cross-Section #4 | Observer:

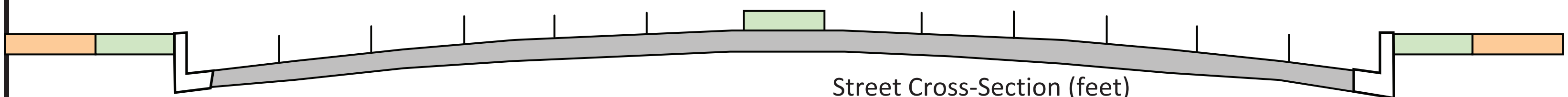
From: Humphrey | To: Busch

4

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	3.5
Jay-Walking Calc:	YES



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane
5	10	0	0	10				9			

Ped Vol: 20

Cross-Section #5

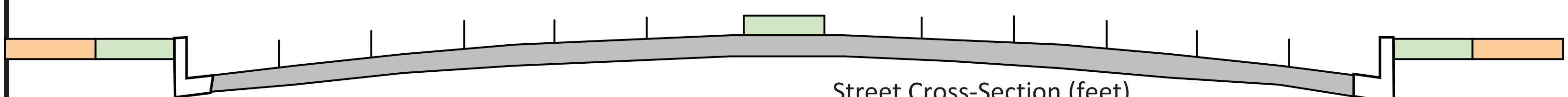
From: Busch | To: N/A

5

Ft/Tree	% Occ.
N/A	N/A

NB

Pavement Cond:	N/A
Jay-Walking Calc:	N/A



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Ped Vol: N/A

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Street: Himes Avenue

Limits: Hillsborough to Busch

Field Survey

Segment And Downstream Signal			Speed Limit (mph)	Median Type (0-3)	Left Turn Pocket (y/n)
	From	To			
1	Hillsborough	Lambright	30	0	NO
2	Lambright	Waters	30	0	YES
3	Waters	Humphrey	35	0	YES
4	Humphrey	Busch	35	2	YES
5	Busch	N/A	N/A	N/A	N/A

Traffic Counts K: 9.65

Segment And Downstream Signal			Vol (2-wy)	Heavy Vehicle (%)	RTOR+ PermLeft veh
	From	To			
1	Hillsborough	Lambright	13210	2%	36
2	Lambright	Waters	13210	2%	44
3	Waters	Humphrey	13210	2%	8
4	Humphrey	Busch	13210	2%	6
5	Busch	N/A	N/A	N/A	N/A

Arterial Traffic Performance & Signal Timing

Segment And Downstream Signal			Field Survey		Signal Timing Data
			Mean Speed (mph)	Average Stops (#/veh)	Cycle Length (secs)
	From	To			
1	Hillsborough	Lambright	17.6	1.7	110
2	Lambright	Waters	20.9	1.3	120
3	Waters	Humphrey	30.8	0.0	71
4	Humphrey	Busch	13.2	1.3	180
5	Busch	N/A	N/A	N/A	N/A

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized I
Signal data is at the downstream signal

| Route |

Data Collection Sheet - Transit

Street: Himes Avenue

Limits: Hillsborough to Busch

Field Survey

Segment	From	To	Bus Stop (#)	Shelters (% stops)	Benches (% stops)
1	Hillsborough	Lambright	4	0%	75%
2	Lambright	Waters	8	0%	100%
3	Waters	Humphrey	2	0%	100%
4	Humphrey	Busch	4	0%	100%
5	Busch	N/A	N/A	N/A	N/A

Transit Performance Data

Segment	From	To	Route #'s	Frequency (bus/hr)	Load Factor (pas/seat)
1	Hillsborough	Lambright	36	2	30%
2	Lambright	Waters	36	2	30%
3	Waters	Humphrey	36	2	30%
4	Humphrey	Busch	36	2	30%
5	Busch	N/A	36	2	30%

Bus is On-Time if arrives within: 5 minutes of scheduled time.
Average Passenger Trip Length: 5 miles

A. Compute Auto LOS and Performance

Street: **Himes Avenue**

Direction=	Down	NB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	13210	0.097	1.000	#REF!	#REF!	#REF!	traffic
2	13210	0.097	1.00	#REF!	#REF!	#REF!	traffic
3	13210	0.097	1.00	#REF!	#REF!	#REF!	traffic
4	13210	0.097	1.00	#REF!	#REF!	#REF!	traffic
5	N/A	0.097	1.00	#REF!	#REF!	#VALUE!	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	#REF!	1	#REF!	#REF!	#REF!	#REF!	xsec 1-3, traffic
2	#REF!	1	#REF!	#REF!	#REF!	#REF!	xsec 1-3, traffic
3	#REF!	1	#REF!	#REF!	#REF!	#REF!	xsec 1-3, traffic
4	#REF!	1	#REF!	#REF!	#REF!	#REF!	xsec 4-5, traffic
5	#REF!	0	#REF!	#REF!	#VALUE!	#VALUE!	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	30	4000	17.6	traffic, layout
2	30	6620	20.9	traffic, layout
3	35	1300	30.8	traffic, layout
4	35	2620	13.2	traffic, layout
5	N/A	N/A	N/A	traffic, layout
Total/Ave.	31.3	14540	#VALUE!	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	2.24	NO	0	traffic
2	1.04	YES	0	traffic
3	0.00	YES	0	traffic
4	2.62	YES	2	traffic
5	#VALUE!	N/A	N/A	traffic
Total/Ave	#VALUE!	0.60	0.36	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment &	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F	Weight.	Auto
4	18.5%	39.0%	23.0%	11.0%	5.5%	3.0%	2.55	#REF!
5	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#REF!

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **Himes Avenue**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	4	20	2880	0.00	A	xsec1-3
2	0	20	#DIV/0!	N/A	N/A	xsec1-3
3	0	20	#DIV/0!	N/A	N/A	xsec1-3
4	5	20	3600.0	0.00	A	xsec4-5
5	N/A	N/A	#VALUE!	#VALUE!	#VALUE!	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	10.5	0	0%	0	7	#REF!	1	23.8	#REF!	xsec1-3
2	10.5	0	0%	0	0	#REF!	1	25.5	#REF!	xsec1-3
3	10	0	0%	0	0	#REF!	1	32.9	#REF!	xsec1-3
4	10	0	0%	0	10	#REF!	1	24.1	#REF!	xsec4-5
5	N/A	0	N/A	N/A	N/A	#VALUE!	0	#DIV/0!	#VALUE!	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	36	936	#REF!	40	4	#REF!	0	#REF!	layout, traffic
2	44	2160	#REF!	45	4	#REF!	0	#REF!	layout, traffic
3	8	104	#REF!	30	2	#REF!	0	#REF!	layout, traffic
4	6	2364	#REF!	45	4	#REF!	0	#REF!	layout, traffic
5	N/A	N/A	#REF!	N/A	N/A	#VALUE!	N/A	#VALUE!	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	4000	#REF!	#REF!	11	23.8	1,275	1.0	9	YES	layout, traffic
2	6620	#REF!	#REF!	11	25.5	1,275	1.0	9	YES	layout, traffic
3	1300	#REF!	#REF!	22	32.9	1,275	1.0	35	YES	layout, traffic
4	2620	#REF!	#REF!	19	24.1	1,275	2.0	22	YES	layout, traffic
5	N/A	#VALUE!	#VALUE!	0	#DIV/0!	#VALUE!	2.0	#VALUE!	N/A	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	#REF!	#REF!	#REF!	#REF!	#REF!	0.00	#REF!	#REF!
2	#REF!	#REF!	#REF!	#REF!	#REF!	N/A	#REF!	#REF!
3	#REF!	#REF!	#REF!	#REF!	#REF!	N/A	#REF!	#REF!
4	#REF!	#REF!	#REF!	#REF!	#REF!	0.00	#REF!	#REF!
5	#VALUE!	#VALUE!	#VALUE!	1.00	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average							#REF!	#REF!

C. Compute Transit LOS

Street: **Himes Avenue**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	2	#REF!	0%	75%	#VALUE!	#REF!	transit
2	2	#REF!	0%	100%	#VALUE!	#REF!	transit
3	2	#REF!	0%	100%	#VALUE!	#REF!	transit
4	2	#REF!	0%	100%	#VALUE!	#REF!	transit
5	2	#REF!	N/A	N/A	#VALUE!	#REF!	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	4000	17.6	4	#REF!	transit
2	6620	20.9	8	#REF!	transit
3	1300	30.8	2	#REF!	transit
4	2620	13.2	4	#REF!	transit
5	N/A	N/A	N/A	#REF!	transit
Total/Ave	14540	#VALUE!		#REF!	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	#VALUE!	#REF!	#REF!	0.03	#VALUE!	#REF!	1.95
2	#VALUE!	#REF!	#REF!	0.04	#VALUE!	#REF!	1.95
3	#VALUE!	#REF!	#REF!	0.04	#VALUE!	#REF!	1.95
4	#VALUE!	#REF!	#REF!	0.04	#VALUE!	#REF!	1.95
5	#VALUE!	#REF!	#REF!	#VALUE!	#VALUE!	#REF!	1.95

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	#REF!	#REF!	#REF!	F
2	#REF!	#REF!	#REF!	F
3	#REF!	#REF!	#REF!	F
4	#REF!	#REF!	#REF!	F
5	#REF!	#VALUE!	#REF!	F
Average			#REF!	F

D. Compute Bicycle LOS

Street: **Himes Avenue**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	11	0	1	UD	74	#REF!	xsec1-3, layout
2	11	0	1	UD	68	#REF!	xsec1-3, layout
3	10	0	1	UD	35	#REF!	xsec1-3, layout
4	10	0	1	D	74	#REF!	xsec4-5, layout
5	N/A	0	0	D	N/A	#REF!	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	#REF!	2%	23.8	0%	3.5	traffic, xsec1-3
2	#REF!	2%	25.5	0%	3.5	traffic, xsec1-3
3	#REF!	2%	32.9	0%	3.5	traffic, xsec1-3
4	#REF!	2%	24.1	0%	3.5	traffic, xsec4-5
5	#VALUE!	N/A	#DIV/0!	N/A	N/A	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	#REF!	#REF!	2.31	#REF!	#REF!	#REF!	#REF!
2	#REF!	#REF!	2.71	#REF!	#REF!	#REF!	#REF!
3	#REF!	#REF!	3.67	#REF!	#REF!	#REF!	#REF!
4	#REF!	#REF!	2.39	#REF!	#REF!	#REF!	#REF!
5	#VALUE!	#VALUE!	#DIV/0!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average						#REF!	#REF!

E. LOS Summary

Title: Himes Avenue

Direction =	Down	NB	Date:	9/28/2008	Analyst:	AEN

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	#REF!	#REF!	#REF!	#REF!	F	#REF!	#REF!
2	#REF!	#REF!	#REF!	#REF!	F	#REF!	#REF!
3	#REF!	#REF!	#REF!	#REF!	F	#REF!	#REF!
4	#REF!	#REF!	#REF!	#REF!	F	#REF!	#REF!
5	#VALUE!	#VALUE!	#REF!	#VALUE!	F	#VALUE!	#VALUE!
Facility	#REF!	#REF!	#VALUE!	#VALUE!	F	#REF!	#REF!

Auto Performance Measures Summary NB

Seg+Sig	Stops	FFS	Speed	%FFS
1	2.24	30.0	17.6	58.7%
2	1.04	30.0	20.9	69.7%
3	0.00	35.0	30.8	88.0%
4	2.62	35.0	13.2	37.7%
5	#VALUE!	N/A	N/A	#VALUE!
Facility	#VALUE!	31.3	#VALUE!	#VALUE!

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

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No warranty as to accuracy or suitability for use.
Spreadsheet is unsupported.
Spreadsheet does not have data entry error checking.
Created: 8-Jun-07 Updated: 25-Sep-08

Street: **Himes Avenue**
(This sheet generates the LOS results for "results")

Direction=	Down	NB

Leave Blank Cells Alone. Have Eqns

A. Compute Auto LOS and Performance

1. Compute Eastbound Hourly Demand (v)

Segment	Weekday ADT (vpd)	Peak Factor k (#)	Dir. Factor d (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)
1	13210	0.10	1.00	#REF!	#REF!	#REF!
2	13210	0.10	1.00	#REF!	#REF!	#REF!
3	13210	0.10	1.00	#REF!	#REF!	#REF!
4	13210	0.10	1.00	#REF!	#REF!	#REF!
5	N/A	0.10	1.00	#REF!	#REF!	#VALUE!

2. Compute Eastbound Hourly Capacity and V/C

Segment	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	V/c	V/c Check
1	#REF!	1	#REF!	#REF!	#REF!	#REF!
2	#REF!	1	#REF!	#REF!	#REF!	#REF!
3	#REF!	1	#REF!	#REF!	#REF!	#REF!
4	#REF!	1	#REF!	#REF!	#REF!	#REF!
5	#REF!	0	#REF!	#REF!	#VALUE!	#VALUE!

Adjusted Sat. Flows computed per Chapter 16, Signalized Intersections.

3. Compute Mean Through Speed

Segment	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)
1	30	4000	17.6
2	30	6620	20.9
3	35	1300	30.8
4	35	2620	13.2
5	N/A	N/A	N/A
Total/Ave.	31.3	14540	#VALUE!

4. Compute Stops & % Left Lane

Segment	Average Speed (mph)	Median Type
1	17.6	0.0
2	20.9	0.0
3	30.8	0.0
4	13.2	2.0
5	N/A	N/A
Total/Ave	#VALUE!	0.36

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

3	26.3%	42.5%	18.0%	7.5%	3.6%	2.2%	2.26	#REF!
4	11.2%	32.6%	26.1%	15.4%	8.7%	6.1%	2.96	#REF!
5	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#REF!

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

Multimodal Level of Service for Urban Streets

Diagram of Uban Street

Street: Kennedy Boulevard

Date: Nov. 18, 2008

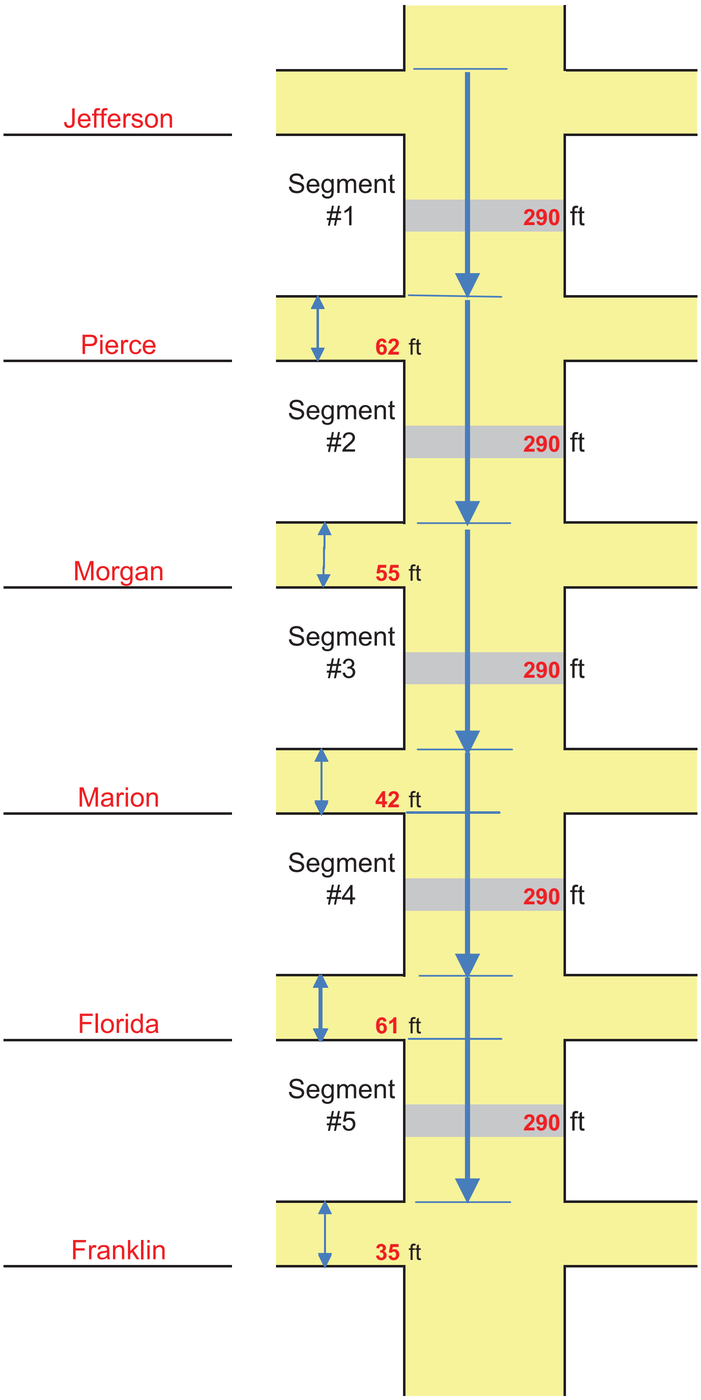
Limits: Jefferson to Franklin

Observer: PSM

Analysis Direction:	WB

(Down Direction on this Sheet)

Data Entry Fields in Red



Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	4	30	320	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	4	30	276	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	30	24	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	4	35	960	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	30	8	0

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Kennedy Boulevard
Limits: Jefferson to Franklin

Observer: PSM
Date: Nov. 18, 2008

Cross-Section #1
From: Jefferson To: Pierce

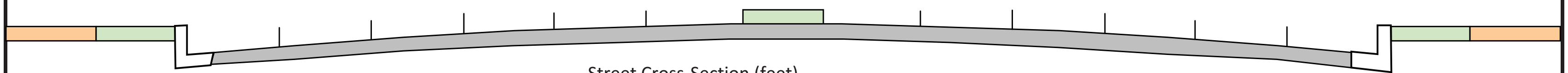
1

Ft/Tree	% Occ.
0	100%

WB

Pavement Cond:	4.5
Jay-Walking Calc:	YES

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
8	4	7	0	10	10	10	10	0							4	8

Ped Vol: 40

Cross-Section #2
From: Pierce To: Morgan

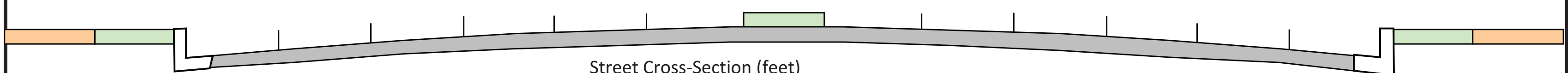
2

Ft/Tree	% Occ.
75	100%

WB

Pavement Cond:	4.5
Jay-Walking Calc:	YES

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
6	6	7	0	10	10	10	10	0							6	6

Ped Vol: 40

Cross-Section #3
From: Morgan To: Marion

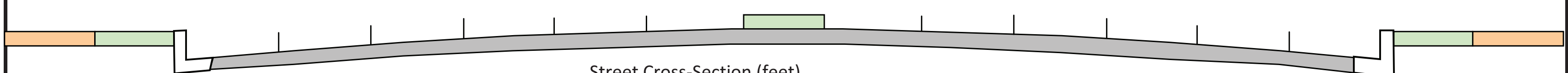
3

Ft/Tree	% Occ.
50	100%

WB

Pavement Cond:	4.5
Jay-Walking Calc:	YES

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
6	6	7	0	10	10	10	10	0							6	6

Ped Vol: 40

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Kennedy Boulevard

Limits: Jefferson to Franklin

Observer: PSM

Date: Nov. 18, 2008

Cross-Section #4
From: Marion To: Florida

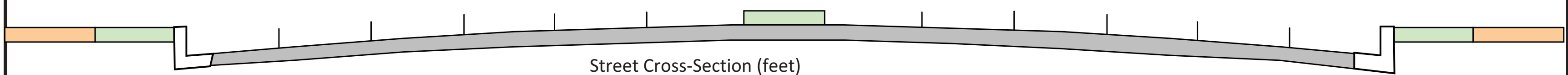
4

Ft/Tree	% Occ.
30	100%

WB

Pavement Cond:	4.5
Jay-Walking Calc:	YES

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
6	6	7	0	10	10	10	10	0							6	6

Ped Vol: 40

Cross-Section #5
From: Florida To: Franklin

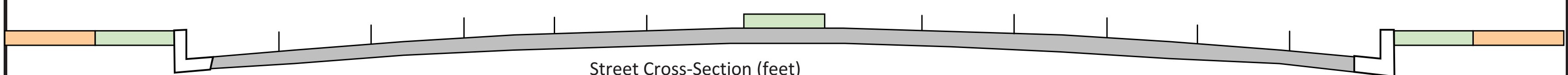
5

Ft/Tree	% Occ.
75	100%

WB

Pavement Cond:	4.5
Jay-Walking Calc:	YES

EB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
6	6	7	0	10	10	10	10	0							6	6

Ped Vol: 40

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **WB**

Street: Kennedy Boulevard

Date: Nov. 18, 2008

Limits: Jefferson to Franklin

Observer: PSM

Field Survey

Segment And Downstream Signal			Speed Limit	Median Type	Left Turn Pocket	Drivewys Rightside	Unsig. Intersects
	From	To	(mph)	(0-3)	(y/n)	(#)	(#)
1	Jefferson	Pierce	30	1	NO	0	0
2	Pierce	Morgan	30	1	NO	0	0
3	Morgan	Marion	30	1	NO	0	0
4	Marion	Florida	30	1	NO	0	0
5	Florida	Franklin	30	1	NO	0	0

Traffic Counts K: 9.52 D: 100

Segment And Downstream Signal			Vol	Heavy Vehicle	RTOR+ PermLeft	Left/Right Turns	Thru Adj. Sat.	PHF
	From	To	(2-wy)	(%)	veh	%	(vphgl)	
1	Jefferson	Pierce	18500	2%	1	3%	5858	0.92
2	Pierce	Morgan	18500	2%	5	7%	5821	0.92
3	Morgan	Marion	18500	2%	0	0%	5865	0.92
4	Marion	Florida	18500	2%	0	19%	5695	0.92
5	Florida	Franklin	18500	2%	0	0%	5865	0.92

Arterial Traffic Performance & Signal Timing

Segment And Downstream Signal			Field Survey		Signal Timing Data			
			Mean Speed	Average Stops	Cycle Length	Grn/Cycle for Thru	Ped Walk	Xing Ped Walk
	From	To	(mph)	(#/veh)	(secs)	(%)	(sec/cyc)	(sec/cyc)
1	Jefferson	Pierce	22.9	0.0	90	50%	30	22
2	Pierce	Morgan	24.7	0.0	100	55%	37	27
3	Morgan	Marion	24.7	0.0	100	40%	22	40
4	Marion	Florida	31.2	0.0	100	40%	22	42
5	Florida	Franklin	28.3	0.0	100	60%	41	17

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter, H(
Signal data is at the downstream signal

| Route |

Data Collection Sheet - Transit

Direction: **WB**

Street: Kennedy Boulevard

Date: Nov. 18, 2008

Limits: Jefferson to Franklin

Observer: PSM

Field Survey

Segment			Bus Stop	Shelters	Benches	CBD
	From	To	(#)	(% stops)	(% stops)	(yes/no)
1	Jefferson	Pierce	0	0%	0%	YES
2	Pierce	Morgan	1	0%	0%	YES
3	Morgan	Marion	0	0%	0%	YES
4	Marion	Florida	1	100%	100%	YES
5	Florida	Franklin	0	0%	0%	YES

Transit Performance Data

Segment			Route #'s	Frequency (bus/hr)	Load Factor (pas/seat)	On-Time Perform. (%)	Schedule Speed (mph)
	From	To					
1	Jefferson	Pierce	46	1	25%	90%	11
			1	2	75%	90%	17
			2	2	50%	90%	16
			4	1	50%	90%	6
2	Pierce	Morgan	46	1	25%	90%	11
			1	2	75%	90%	17
			2	2	50%	90%	16
			4	1	50%	90%	6
3	Morgan	Marion	46	1	25%	90%	11
			1	2	75%	90%	17
			2	2	50%	90%	16
			4	1	50%	90%	6
4	Marion	Florida	46	1	25%	90%	11
			1	2	75%	90%	17
			2	2	50%	90%	16
			4	1	50%	90%	6
5	Florida	Franklin	46	1	25%	90%	11
			1	2	75%	90%	17
			2	2	50%	90%	16
			4	1	50%	90%	6

Bus is On-Time if arrives within: 5 minutes of scheduled time.

Average Passenger Trip Length: 5 miles

A. Compute Auto LOS and Performance

Street: **Kennedy Boulevard**

Direction=	Down	WB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	18500	0.095	1.000	0.92	97%	1857	traffic
2	18500	0.095	1.00	0.92	93%	1780	traffic
3	18500	0.095	1.00	0.92	100%	1914	traffic
4	18500	0.095	1.00	0.92	81%	1551	traffic
5	18500	0.095	1.00	0.92	100%	1914	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	5858	3	0.50	8787	0.21	OK	xsec 1-3, traffic
2	5821	3	0.55	9605	0.19	OK	xsec 1-3, traffic
3	5865	3	0.40	7038	0.27	OK	xsec 1-3, traffic
4	5695	3	0.40	6834	0.23	OK	xsec 4-5, traffic
5	5865	3	0.60	10557	0.18	OK	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	30	290	22.9	traffic, layout
2	30	290	24.7	traffic, layout
3	30	290	24.7	traffic, layout
4	30	290	31.2	traffic, layout
5	30	290	28.3	traffic, layout
Total/Ave.	30.0	1450	26.0	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	0.00	NO	1	traffic
2	0.00	NO	1	traffic
3	0.00	NO	1	traffic
4	0.00	NO	1	traffic
5	0.00	NO	1	traffic
Total/Ave	0.00	0.00	1.00	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	23.8%	41.3%	20.0%	8.7%	4.1%	2.2%	2.34	B
2	23.8%	41.3%	20.0%	8.7%	4.1%	2.2%	2.34	B
3	23.8%	41.3%	20.0%	8.7%	4.1%	2.2%	2.34	B
4	23.8%	41.3%	20.0%	8.7%	4.1%	2.2%	2.34	B
5	23.8%	41.3%	20.0%	8.7%	4.1%	2.2%	2.34	B
Average	23.8%	41.3%	20.0%	8.7%	4.1%	2.2%	2.34	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **Kennedy Boulevard**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	8	40	2880	0.00	A	xsec1-3
2	6	40	2160.0	0.00	A	xsec1-3
3	6	40	2160.0	0.00	A	xsec1-3
4	6	40	2160.0	0.00	A	xsec4-5
5	6	40	2160.0	0.00	A	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	10	7	100%	0	4	1,914	3	26.5	3.29	xsec1-3
2	10	7	100%	75	6	1,914	3	27.4	3.07	xsec1-3
3	10	7	100%	50	6	1,914	3	27.4	2.98	xsec1-3
4	10	7	100%	30	6	1,914	3	30.6	2.92	xsec4-5
5	10	7	100%	75	6	1,914	3	29.2	3.11	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	1	320	0.92	30	4	20.0	0	2.38	layout, traffic
2	5	276	0.92	30	4	19.8	0	2.34	layout, traffic
3	0	24	0.92	30	2	30.4	0	2.04	layout, traffic
4	0	960	0.92	35	4	30.4	0	3.24	layout, traffic
5	0	8	0.92	30	2	17.4	0	2.00	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	290	25.7	52	40	26.5	1,761	1.0	895	YES	layout, traffic
2	290	26.6	52	40	27.4	1,761	1.0	888	YES	layout, traffic
3	290	18.0	50	40	27.4	1,761	1.0	888	YES	layout, traffic
4	290	16.8	50	40	30.6	1,761	1.0	867	YES	layout, traffic
5	290	34.4	54	40	29.2	1,761	1.0	876	YES	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	52	5.00	3.18	1.20	3.81	0.00	3.81	D
2	52	5.00	3.10	1.20	3.72	0.00	3.72	D
3	50	5.00	3.00	1.20	3.60	0.00	3.60	D
4	50	5.00	3.25	1.20	3.90	0.00	3.90	D
5	54	5.00	3.04	1.20	3.64	0.00	3.64	D
Average							3.73	D

C. Compute Transit LOS

Street: **Kennedy Boulevard**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	6	90%	0%	0%	0.54	YES	transit
2	6	90%	0%	0%	0.54	YES	transit
3	6	90%	0%	0%	0.54	YES	transit
4	6	90%	100%	100%	0.54	YES	transit
5	6	90%	0%	0%	0.54	YES	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	290	22.9	0	13.8	transit
2	290	24.7	1	13.8	transit
3	290	24.7	0	13.8	transit
4	290	31.2	1	13.8	transit
5	290	28.3	0	13.8	transit
Total/Ave	1450	26.0		13.8	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	1.00	4.34	0.05	0.00	4.44	1.13	3.15
2	1.00	4.34	0.05	0.00	4.44	1.13	3.15
3	1.00	4.34	0.05	0.00	4.44	1.13	3.15
4	1.00	4.34	0.05	0.30	4.14	1.16	3.15
5	1.00	4.34	0.05	0.00	4.44	1.13	3.15

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	3.55	3.81	1.25	A
2	3.55	3.72	1.23	A
3	3.55	3.60	1.21	A
4	3.65	3.90	1.11	A
5	3.55	3.64	1.22	A
Average			1.20	A

D. Compute Bicycle LOS

Street: **Kennedy Boulevard**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	10	7	3	UD	62	0.0	xsec1-3, layout
2	10	7	3	UD	55	0.0	xsec1-3, layout
3	10	7	3	UD	42	0.0	xsec1-3, layout
4	10	7	3	UD	61	0.0	xsec4-5, layout
5	10	7	3	UD	35	0.0	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	1914	2%	26.5	100%	4.5	traffic, xsec1-3
2	1914	2%	27.4	100%	4.5	traffic, xsec1-3
3	1914	2%	27.4	100%	4.5	traffic, xsec1-3
4	1914	2%	30.6	100%	4.5	traffic, xsec4-5
5	1914	2%	29.2	100%	4.5	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent
Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	17.0	10.0	2.90	4.09	2.64	3.66	D
2	17.0	10.0	3.04	4.13	2.53	3.65	D
3	17.0	10.0	3.04	4.13	2.33	3.62	D
4	17.0	10.0	3.45	4.25	2.62	3.68	D
5	17.0	10.0	3.29	4.20	2.22	3.62	D
Average						3.65	D

E. LOS Summary

Title: Kennedy Boulevard

Direction =	Down	WB	Date:	9/28/2008	Analyst:	AEN

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	B	B	B	A	D	D
2	B	B	B	B	A	D	D
3	B	B	B	B	A	D	D
4	B	B	A	A	A	D	D
5	B	B	A	A	A	D	D
Facility	B	B	A	A	A	D	D

Auto Performance Measures Summary WB

Seg+Sig	Stops	FFS	Speed	%FFS
1	0.00	30.0	22.9	76.3%
2	0.00	30.0	24.7	82.3%
3	0.00	30.0	24.7	82.3%
4	0.00	30.0	31.2	104.0%
5	0.00	30.0	28.3	94.3%
Facility	0.00	30.0	26.0	86.8%

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

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Spreadsheet does not have data entry error checking.
Created: 8-Jun-07 Updated: 25-Sep-08

Street: **Kennedy Boulevard**
(This sheet generates the LOS results for "results")

Direction=	Down	WB

Leave Blank Cells Alone. Have Eqns

A. Compute Auto LOS and Performance

1. Compute Eastbound Hourly Demand (v)

Segment	Weekday ADT (vpd)	Peak Factor k (#)	Dir. Factor d (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)
1	18500	0.10	1.00	0.92	97%	1857
2	18500	0.10	1.00	0.92	93%	1780
3	18500	0.10	1.00	0.92	100%	1914
4	18500	0.10	1.00	0.92	81%	1551
5	18500	0.10	1.00	0.92	100%	1914

2. Compute Eastbound Hourly Capacity and V/C

Segment	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	V/c	V/c Check
1	5858	3	0.50	8787	0.21	OK
2	5821	3	0.55	9605	0.19	OK
3	5865	3	0.40	7038	0.27	OK
4	5695	3	0.40	6834	0.23	OK
5	5865	3	0.60	10557	0.18	OK

Adjusted Sat. Flows computed per Chapter 16, Signalized Intersections.

3. Compute Mean Through Speed

Segment	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)
1	30	290	22.9
2	30	290	24.7
3	30	290	24.7
4	30	290	31.2
5	30	290	28.3
Total/Ave.	30.0	1450	26.0

4. Compute Stops & % Left Lane

Segment	Average Speed (mph)	Median Type
1	22.9	1.0
2	24.7	1.0
3	24.7	1.0
4	31.2	1.0
5	28.3	1.0
Total/Ave	26.0	1.00

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	18.6%	39.9%	22.2%	10.5%	5.3%	3.4%	2.54	B
2	21.0%	41.1%	20.9%	9.4%	4.6%	3.0%	2.44	B
3	21.0%	41.1%	20.9%	9.4%	4.6%	3.0%	2.44	B
4	31.4%	42.5%	15.5%	6.1%	2.8%	1.7%	2.12	B
5	26.4%	42.5%	17.9%	7.4%	3.5%	2.2%	2.26	B
Average	22.9%	41.8%	19.8%	8.6%	4.2%	2.7%	2.37	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

Multimodal Level of Service for Urban Streets

Diagram of Uban Street

Street: Nebraska Avenue

Date: Nov. 17, 2008

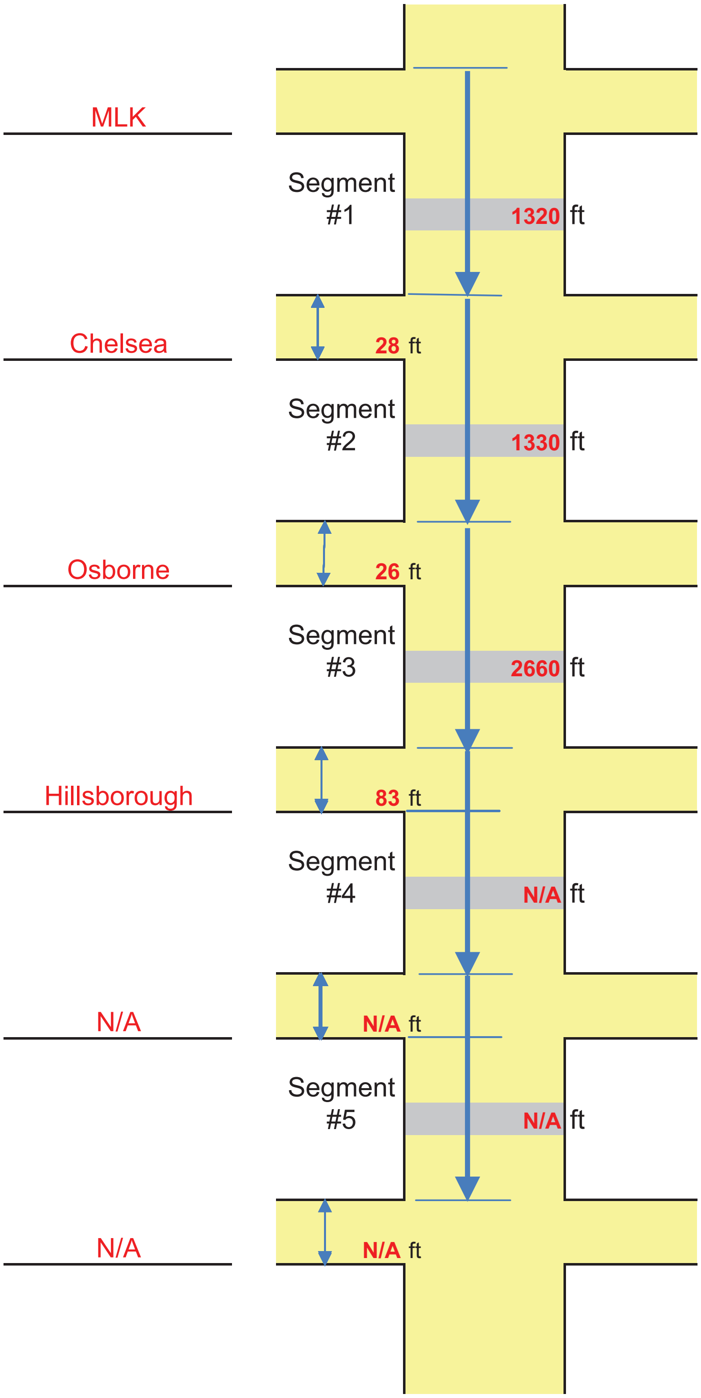
Limits: MLK to Hillsborough

Observer: PSM

Analysis Direction:	NB

(Down Direction on this Sheet)

Data Entry Fields in Red



Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	2	25	100	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	30	328	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	7	45	2732	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
N/A	N/A	N/A	N/A	N/A

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
N/A	N/A	N/A	N/A	N/A

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Nebraska Avenue

Limits: MLK to Hillsborough

Observer: PSM

Date: Nov. 17, 2008

Cross-Section #1

From: MLK To: Chelsea

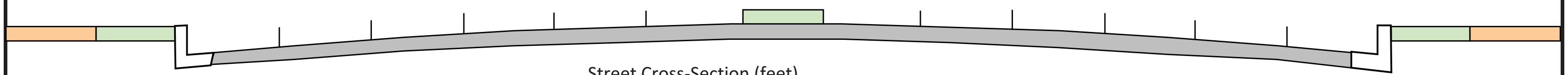
1

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	5
Jay-Walking Calc:	YES

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
6	8	12	0	12				0					12	0	8	6

Ped Vol: 20

Cross-Section #2

From: Chelsea To: Osborne

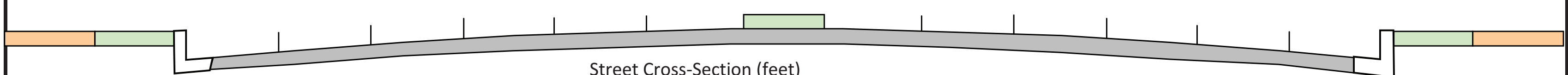
2

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	5
Jay-Walking Calc:	YES

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
6	8	0	5	11.5				14				11.5	8	0	8	6

Ped Vol: 20

Cross-Section #3

From: Osborne To: Hillsborough

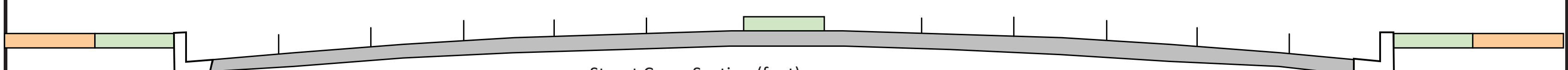
3

Ft/Tree	% Occ.
0	0%

NB

Pavement Cond:	5
Jay-Walking Calc:	YES

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	8	0	4	11.5				10.5				11.5	3	0	0	6

Ped Vol: 20

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Nebraska Avenue

Limits: MLK to Hillsborough

Cross-Section #4

Observer: PSM

Date: Nov. 17, 2008

From: Hillsborough To: N/A

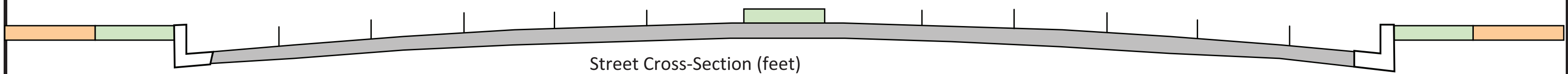
4

Ft/Tree	% Occ.
N/A	N/A

NB

Pavement Cond:	N/A
Jay-Walking Calc:	N/A

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Ped Vol: N/A

Cross-Section #5

From: N/A To: N/A

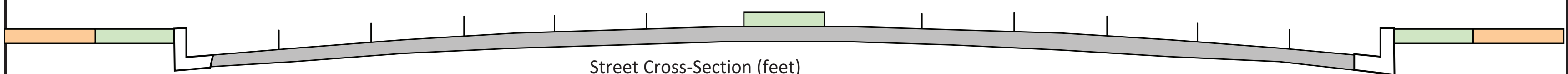
5

Ft/Tree	% Occ.
N/A	N/A

NB

Pavement Cond:	N/A
Jay-Walking Calc:	N/A

SB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Ped Vol: N/A

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **NB**

Street: Nebraska Avenue

Date: Nov. 17, 2008

Limits: MLK to Hillsborough

Observer: PSM

Field Survey

	Segment And Downstream Signal From	To	Speed Limit (mph)	Median Type (0-3)	Left Turn Pocket (y/n)	Drivewys Rightside (#)	Unsig. Intersects (#)
1	MLK	Chelsea	35	2	YES	6	3
2	Chelsea	Osborne	35	2	YES	5	3
3	Osborne	Hillsborough	35	2	YES	12	7
4	Hillsborough	N/A	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Traffic Counts

K: 9.52

D: 56.79

	Segment And Downstream Signal From	To	Vol (2-wy)	Heavy Vehicle (%)	RTOR+ PermLeft veh	Left/Right Turns %	Thru Adj. Sat. (vphgl)	PHF
1	MLK	Chelsea	16800	4%	7	10%	1805	0.92
2	Chelsea	Osborne	16800	4%	12	4%	1823	0.92
3	Osborne	Hillsborough	16800	4%	13	40%	3141	0.92
4	Hillsborough	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Arterial Traffic Performance & Signal Timing

	Segment And Downstream Signal		Field Survey		Signal Timing Data			
	From	To	Mean Speed (mph)	Average Stops (#/veh)	Cycle Length (secs)	Grn/Cycle for Thru (%)	Ped Walk (sec/cyc)	Xing Ped Walk (sec/cyc)
1	MLK	Chelsea	23.4	0.5	100	78%	65	5
2	Chelsea	Osborne	15.8	1.0	100	64%	65	5
3	Osborne	Hillsborough	14.2	1.3	150	25%	5	80
4	Hillsborough	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter, H(
Signal data is at the downstream signal

Route

Data Collection Sheet - Transit

Direction: **NB**

Street: Nebraska Avenue

Date: Nov. 17, 2008

Limits: MLK to Hillsborough

Observer: PSM

Field Survey

Segment			Bus Stop (#)	Shelters (% stops)	Benches (% stops)	CBD (yes/no)
	From	To				
1	MLK	Chelsea	2	0%	100%	NO
2	Chelsea	Osborne	1	0%	100%	NO
3	Osborne	Hillsborough	5	20%	100%	NO
4	Hillsborough	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A	N/A

Transit Performance Data

Segment			Route #'s	Frequency (bus/hr)	Load Factor (pas/seat)	On-Time Perform. (%)	Schedule Speed (mph)
	From	To					
1	MLK	Chelsea	2	4	75%	70%	12
2	Chelsea	Osborne	2	4	75%	70%	12
3	Osborne	Hillsborough	2	4	75%	70%	12
4	Hillsborough	N/A					
5	N/A	N/A					

Bus is On-Time if arrives within: 5 minutes of scheduled time.

Average Passenger Trip Length: 6 miles

A. Compute Auto LOS and Performance

Street: **Nebraska Avenue**

Direction=	Down	NB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	16800	0.095	0.568	0.92	90%	889	traffic
2	16800	0.095	0.57	0.92	96%	948	traffic
3	16800	0.095	0.57	0.92	60%	592	traffic
4	N/A	0.095	0.57	N/A	#VALUE!	#VALUE!	traffic
5	N/A	0.095	0.57	N/A	#VALUE!	#VALUE!	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	1805	1	0.78	1408	0.63	OK	xsec 1-3, traffic
2	1823	1	0.64	1167	0.81	OK	xsec 1-3, traffic
3	3141	1	0.25	785	0.75	OK	xsec 1-3, traffic
4	N/A	0	N/A	#VALUE!	#VALUE!	#VALUE!	xsec 4-5, traffic
5	N/A	0	N/A	#VALUE!	#VALUE!	#VALUE!	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	35	1320	23.4	traffic, layout
2	35	1330	15.8	traffic, layout
3	35	2660	14.2	traffic, layout
4	N/A	N/A	N/A	traffic, layout
5	N/A	N/A	N/A	traffic, layout
Total/Ave.	35.0	5310	#VALUE!	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	2.00	YES	2	traffic
2	3.97	YES	2	traffic
3	2.58	YES	2	traffic
4	#VALUE!	N/A	N/A	traffic
5	#VALUE!	N/A	N/A	traffic
Total/Ave	#VALUE!	0.40	2.00	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	21.0%	40.3%	21.5%	9.8%	4.7%	2.6%	2.45	B
2	13.9%	35.1%	25.5%	13.9%	7.3%	4.1%	2.78	C
3	18.7%	39.1%	22.9%	11.0%	5.4%	2.9%	2.54	B
4	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
5	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **Nebraska Avenue**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	6	20	4320	0.00	A	xsec1-3
2	6	20	4320.0	0.00	A	xsec1-3
3	5	20	3600.0	0.00	A	xsec1-3
4	N/A	N/A	#VALUE!	#VALUE!	#VALUE!	xsec4-5
5	N/A	N/A	#VALUE!	#VALUE!	#VALUE!	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	12	12	0%	0	8	987	1	29.2	4.05	xsec1-3
2	11.5	5	0%	0	8	987	1	25.4	4.17	xsec1-3
3	11.5	4	0%	0	8	987	1	24.6	4.26	xsec1-3
4	N/A	0	N/A	N/A	N/A	#VALUE!	0	#DIV/0!	#VALUE!	xsec4-5
5	N/A	0	N/A	N/A	N/A	#VALUE!	0	#DIV/0!	#VALUE!	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	7	100	0.92	25	2	6.1	0	2.05	layout, traffic
2	12	328	0.92	30	2	6.1	0	2.32	layout, traffic
3	13	2732	0.92	45	7	70.1	0	6.50	layout, traffic
4	N/A	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!	layout, traffic
5	N/A	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	1320	45.1	230	24	29.2	1,599	1.0	84	YES	layout, traffic
2	1330	45.1	232	36	25.4	1,599	2.0	95	YES	layout, traffic
3	2660	16.3	444	30	24.6	1,599	2.0	64	YES	layout, traffic
4	N/A	#VALUE!	#VALUE!	0	#DIV/0!	#VALUE!	2.0	#VALUE!	N/A	layout, traffic
5	N/A	#VALUE!	#VALUE!	-14	#DIV/0!	#VALUE!	2.0	#VALUE!	N/A	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	84	6.00	3.34	1.20	4.01	0.00	4.01	D
2	95	6.00	3.44	1.20	4.13	0.00	4.13	D
3	64	6.00	4.39	1.20	5.27	0.00	5.27	F
4	#VALUE!	#VALUE!	#VALUE!	1.00	#VALUE!	#VALUE!	#VALUE!	#VALUE!
5	#VALUE!	#VALUE!	#VALUE!	1.00	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average							#VALUE!	#VALUE!

C. Compute Transit LOS

Street: **Nebraska Avenue**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	4	70%	0%	100%	0.75	NO	transit
2	4	70%	0%	100%	0.75	NO	transit
3	4	70%	20%	100%	0.75	NO	transit
4	0	#DIV/0!	N/A	N/A	#DIV/0!	N/A	transit
5	0	#DIV/0!	N/A	N/A	#DIV/0!	N/A	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	1320	23.4	2	12.0	transit
2	1330	15.8	1	12.0	transit
3	2660	14.2	5	12.0	transit
4	N/A	N/A	N/A	#DIV/0!	transit
5	N/A	N/A	N/A	#DIV/0!	transit
Total/Ave	5310	#VALUE!		#VALUE!	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	1.00	5.00	0.38	0.03	5.72	0.87	2.79
2	1.00	5.00	0.38	0.03	5.72	0.87	2.79
3	1.00	5.00	0.38	0.08	5.67	0.87	2.79
4	#DIV/0!	#DIV/0!	#DIV/0!	#VALUE!	#DIV/0!	#DIV/0!	0.00
5	#DIV/0!	#DIV/0!	#DIV/0!	#VALUE!	#DIV/0!	#DIV/0!	0.00

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	2.43	4.01	2.96	C
2	2.43	4.13	2.98	C
3	2.43	5.27	3.14	C
4	#DIV/0!	#VALUE!	#DIV/0!	F
5	#DIV/0!	#VALUE!	#DIV/0!	F
Average			#DIV/0!	F

D. Compute Bicycle LOS

Street: **Nebraska Avenue**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	12	12	1	UD	28	36.0	xsec1-3, layout
2	12	5	1	D	26	31.8	xsec1-3, layout
3	12	4	1	D	83	37.7	xsec1-3, layout
4	N/A	0	0	D	N/A	#VALUE!	xsec4-5, layout
5	N/A	0	0	D	N/A	#VALUE!	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	987	4%	29.2	0%	5.0	traffic, xsec1-3
2	987	4%	25.4	0%	5.0	traffic, xsec1-3
3	987	4%	24.6	0%	5.0	traffic, xsec1-3
4	#VALUE!	N/A	#DIV/0!	N/A	N/A	traffic, xsec4-5
5	#VALUE!	N/A	#DIV/0!	N/A	N/A	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	24.0	36.0	3.30	-1.26	1.27	3.95	D
2	16.5	21.5	2.70	2.67	2.85	4.58	E
3	15.5	19.5	2.52	3.01	3.94	5.22	F
4	#VALUE!	#VALUE!	#DIV/0!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
5	#VALUE!	#VALUE!	#DIV/0!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average						#VALUE!	#VALUE!

E. LOS Summary

Title: Nebraska Avenue

Direction =	Down	NB	Date:	9/28/2008	Analyst:	AEN

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	B	C	C	C	D	D
2	C	C	D	D	C	E	D
3	B	C	D	D	C	F	F
4	#VALUE!	#VALUE!	#N/A	#VALUE!	F	#VALUE!	#VALUE!
5	#VALUE!	#VALUE!	#N/A	#VALUE!	F	#VALUE!	#VALUE!
Facility	#VALUE!	#VALUE!	#VALUE!	#VALUE!	F	#VALUE!	#VALUE!

Auto Performance Measures Summary NB

Seg+Sig	Stops	FFS	Speed	%FFS
1	2.00	35.0	23.4	66.9%
2	3.97	35.0	15.8	45.1%
3	2.58	35.0	14.2	40.6%
4	#VALUE!	N/A	N/A	#VALUE!
5	#VALUE!	N/A	N/A	#VALUE!
Facility	#VALUE!	35.0	#VALUE!	#VALUE!

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

Spreadsheet is made available "As-Is" for TRB internal review.
No warranty as to accuracy or suitability for use.
Spreadsheet is unsupported.
Spreadsheet does not have data entry error checking.
Created: 8-Jun-07 Updated: 25-Sep-08

Street: **Nebraska Avenue**
(This sheet generates the LOS results for "results")

Direction=	**Down**	**NB**

Leave Blank Cells Alone. Have Eqns

A. Compute Auto LOS and Performance

1. Compute Eastbound Hourly Demand (v)

Segment	Weekday ADT (vpd)	Peak Factor k (#)	Dir. Factor d (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)
1	16800	0.10	0.57	0.92	90%	889
2	16800	0.10	0.57	0.92	96%	948
3	16800	0.10	0.57	0.92	60%	592
4	N/A	0.10	0.57	N/A	#VALUE!	#VALUE!
5	N/A	0.10	0.57	N/A	#VALUE!	#VALUE!

2. Compute Eastbound Hourly Capacity and V/C

Segment	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	V/c	V/c Check
1	1805	1	0.78	1408	0.63	OK
2	1823	1	0.64	1167	0.81	OK
3	3141	1	0.25	785	0.75	OK
4	N/A	0	N/A	#VALUE!	#VALUE!	#VALUE!
5	N/A	0	N/A	#VALUE!	#VALUE!	#VALUE!

Adjusted Sat. Flows computed per Chapter 16, Signalized Intersections.

3. Compute Mean Through Speed

Segment	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)
1	35	1320	23.4
2	35	1330	15.8
3	35	2660	14.2
4	N/A	N/A	N/A
5	N/A	N/A	N/A
Total/Ave.	35.0	5310	#VALUE!

4. Compute Stops & % Left Lane

Segment	Average Speed (mph)	Median Type
1	23.4	2.0
2	15.8	2.0
3	14.2	2.0
4	N/A	N/A
5	N/A	N/A
Total/Ave	#VALUE!	2.00

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	22.9%	41.8%	19.8%	8.6%	4.2%	2.7%	2.37	B
2	13.6%	35.6%	25.0%	13.5%	7.3%	4.9%	2.80	C
3	12.1%	33.8%	25.7%	14.6%	8.2%	5.6%	2.90	C
4	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
5	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

APPENDIX D: TALLAHASSEE ARTERIAL SPREADSHEETS

Multimodal Level of Service for Urban Streets

Diagram of Uban Street

Street: Appleyard Drive

Date: Oct. 21, 2008

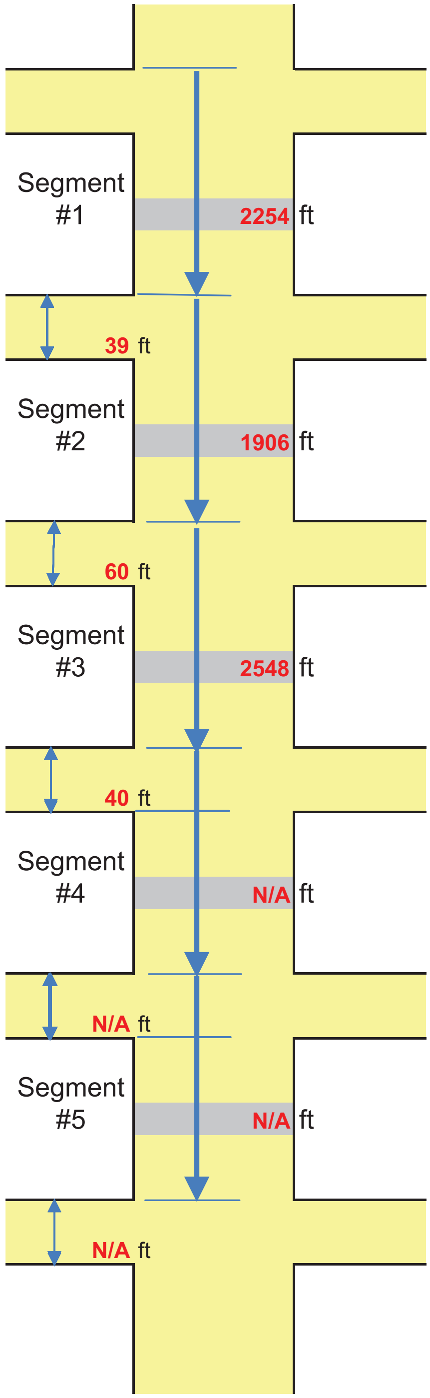
Limits: Tennessee to Jackson Bluff

Observer: Cherie Horne

Analysis Direction:	SB

(Down Direction on this Sheet)

Data Entry Fields in Red



Tennessee

TCC

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	3	15	254	0

Pensacola

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	6	45	1384	0

Jackson Bluff

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
STOP	3	35	949	0

N/A

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
N/A	N/A	N/A	N/A	N/A

N/A

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
N/A	N/A	N/A	N/A	N/A

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Appleyard Drive

Limits: Tennessee to Jackson Bluff

Observer: Cherie Horne

Date: Oct. 21, 2008

Cross-Section #1
From: Tennessee To: TCC

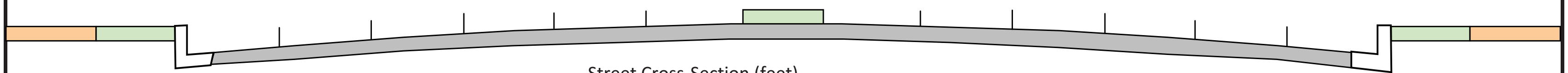
1

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	4
Jay-Walking Calc:	NO

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	4	12	12	0		20		0	12	12	4	0	3	5

Ped Vol: 20

Cross-Section #2
From: TCC To: Pensacola

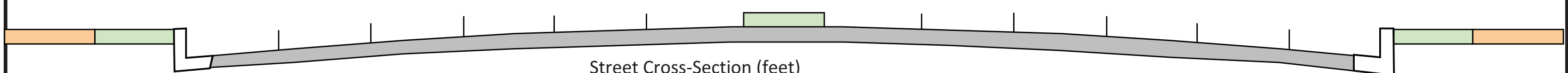
2

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	4
Jay-Walking Calc:	NO

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	4	12	12	0		20		0	12	12	4	0	3	5

Ped Vol: 6

Cross-Section #3
From: Pensacola To: Jackson Bluff

3

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	4
Jay-Walking Calc:	NO

NB

Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	4	12	12	0		20		0	12	12	4	0	3	5

Ped Vol: 6

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Appleyard Drive

Limits: Tennessee to Jackson Bluff

Observer: Cherie Horne

Date: Oct. 21, 2008

Cross-Section #4
From: Jackson Bluff To: N/A

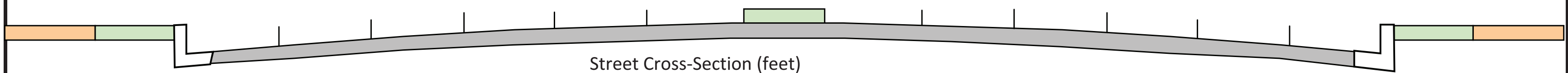
4

Ft/Tree	% Occ.
N/A	N/A

SB

Pavement Cond:	N/A
Jay-Walking Calc:	N/A

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A

Ped Vol: N/A

Cross-Section #5
From: N/A To: N/A

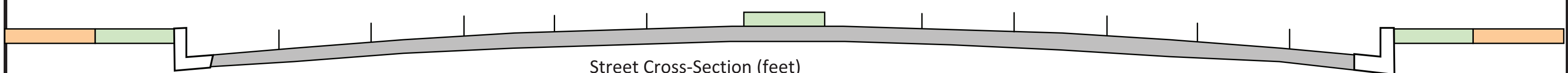
5

Ft/Tree	% Occ.
N/A	N/A

SB

Pavement Cond:	N/A
Jay-Walking Calc:	N/A

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A

Ped Vol: N/A

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **SB**

Street: Appleyard Drive

Date: Oct. 21, 2008

Limits: Tennessee to Jackson Bluff

Observer: Cherie Horne

Field Survey

	Segment And Downstream Signal From	To	Speed Limit (mph)	Median Type (0-3)	Left Turn Pocket (y/n)	Drivewys Rightside (#)	Unsig. Intersects (#)
1	Tennessee	TCC	35	3	YES	3	2
2	TCC	Pensacola	35	3	YES	2	1
3	Pensacola	Jackson Bluff	40	3	YES	6	4
4	Jackson Bluff	N/A	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Traffic Counts K: N/A D: N/A

	Segment And Downstream Signal From	To	Vol (2-wy)	Heavy Vehicle (%)	RTOR+ PermLeft veh	Left/Right Turns %	Thru Adj. Sat. (vphgl)	PHF
1	Tennessee	TCC	946	3%	6	20%	1882	0.93
2	TCC	Pensacola	818	3%	2	45%	1787	0.93
3	Pensacola	Jackson Bluff	617	3%	247	40%	1787	0.93
4	Jackson Bluff	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Arterial Traffic Performance & Signal Timing

	Segment And Downstream Signal		Field Survey		Signal Timing Data			
	From	To	Mean Speed (mph)	Average Stops (#/veh)	Cycle Length (secs)	Grn/Cycle for Thru (%)	Ped Walk (sec/cyc)	Xing Ped Walk (sec/cyc)
1	Tennessee	TCC	31.5	0.5	100	42%	7	7
2	TCC	Pensacola	31.5	0.7	120	42%	7	7
3	Pensacola	Jackson Bluff	36.0	0.1	180	45%	7	7
4	Jackson Bluff	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter, H(
Signal data is at the downstream signal

| Route |

Data Collection Sheet - Transit

Direction: **SB**

Street: Appleyard Drive

Date: Oct. 21, 2008

Limits: Tennessee to Jackson Bluff

Observer: Cherie Horne

Field Survey

Segment			Bus Stop (#)	Shelters (% stops)	Benches (% stops)	CBD (yes/no)
	From	To				
1	Tennessee	TCC	1	0%	0%	NO
2	TCC	Pensacola	2	1%	0%	NO
3	Pensacola	Jackson Bluff	2	2%	0%	NO
4	Jackson Bluff	N/A				
5	N/A	N/A				

Transit Performance Data

Segment			Route #'s	Frequency (bus/hr)	Load Factor (pas/seat)	On-Time Perform. (%)	Schedule Speed (mph)
	From	To					
1	Tennessee	TCC	24	2	127%	50%	12
2	TCC	Pensacola	3	2	28%	0%	12
			23	2	23%	50%	12
3	Pensacola	Jackson Bluff	23	2	34%	100%	12
4	Jackson Bluff	N/A					
5	N/A	N/A					

Bus is On-Time if arrives within: 5 minutes of scheduled time.

Average Passenger Trip Length: 4 miles

A. Compute Auto LOS and Performance

Street: **Appleyard Drive**

Direction=	Down	SB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	946	1.000	1.000	0.93	80%	814	traffic
2	818	1.000	1.00	0.93	55%	484	traffic
3	617	1.000	1.00	0.93	60%	398	traffic
4	N/A	1.000	1.00	N/A	#VALUE!	#VALUE!	traffic
5	N/A	1.000	1.00	N/A	#VALUE!	#VALUE!	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	1882	2	0.42	1581	0.51	OK	xsec 1-3, traffic
2	1787	2	0.42	1501	0.32	OK	xsec 1-3, traffic
3	1787	2	0.45	1608	0.25	OK	xsec 1-3, traffic
4	N/A	0	N/A	#VALUE!	#VALUE!	#VALUE!	xsec 4-5, traffic
5	N/A	0	N/A	#VALUE!	#VALUE!	#VALUE!	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	35	2254	31.5	traffic, layout
2	35	1906	31.5	traffic, layout
3	40	2548	36.0	traffic, layout
4	N/A	N/A	N/A	traffic, layout
5	N/A	N/A	N/A	traffic, layout
Total/Ave.	36.9	6708	#VALUE!	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	1.17	YES	3	traffic
2	1.94	YES	3	traffic
3	0.21	YES	3	traffic
4	#VALUE!	N/A	N/A	traffic
5	#VALUE!	N/A	N/A	traffic
Total/Ave	#VALUE!	0.40	3.00	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	24.7%	41.5%	19.5%	8.4%	3.9%	2.1%	2.32	B
2	21.3%	40.4%	21.4%	9.7%	4.7%	2.5%	2.44	B
3	29.5%	41.9%	17.0%	6.8%	3.1%	1.6%	2.17	B
4	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
5	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **Appleyard Drive**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	5	20	3600	0.00	A	xsec1-3
2	5	6	12000.0	0.00	A	xsec1-3
3	5	6	12000.0	0.00	A	xsec1-3
4	N/A	N/A	#VALUE!	#VALUE!	#VALUE!	xsec4-5
5	N/A	N/A	#VALUE!	#VALUE!	#VALUE!	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	12	4	0%	0	3	1,017	2	33.3	3.31	xsec1-3
2	12	4	0%	0	3	880	2	33.3	3.14	xsec1-3
3	12	4	0%	0	3	663	2	38.0	2.99	xsec1-3
4	N/A	0	N/A	N/A	N/A	#VALUE!	0	#DIV/0!	#VALUE!	xsec4-5
5	N/A	0	N/A	N/A	N/A	#VALUE!	0	#DIV/0!	#VALUE!	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	6	254	0.93	15	3	43.2	0	2.19	layout, traffic
2	2	1384	0.93	45	6	53.2	0	4.29	layout, traffic
3	247	949	0.93	35	3	83.1	0	3.62	layout, traffic
4	N/A	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!	layout, traffic
5	N/A	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	2254	43.2	385	56	33.3	946	2.0	99	NO	layout, traffic
2	1906	53.2	329	56	33.3	818	2.0	79	NO	layout, traffic
3	2548	83.1	444	56	38.0	617	2.0	55	NO	layout, traffic
4	N/A	#VALUE!	#VALUE!	-20	#DIV/0!	#VALUE!	2.0	#VALUE!	N/A	layout, traffic
5	N/A	#VALUE!	#VALUE!	-20	#DIV/0!	#VALUE!	2.0	#VALUE!	N/A	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	99	6.00	3.14	1.00	3.14	0.00	3.14	C
2	79	6.00	3.55	1.00	3.55	0.00	3.55	D
3	55	5.00	3.35	1.00	3.35	0.00	3.35	C
4	#VALUE!	#VALUE!	#VALUE!	1.00	#VALUE!	#VALUE!	#VALUE!	#VALUE!
5	#VALUE!	#VALUE!	#VALUE!	1.00	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average							#VALUE!	#VALUE!

C. Compute Transit LOS

Street: **Appleyard Drive**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	2	50%	0%	0%	1.27	NO	transit
2	4	25%	1%	0%	0.26	NO	transit
3	2	100%	2%	0%	0.34	NO	transit
4	0	#DIV/0!	0%	0%	#DIV/0!	0%	transit
5	0	#DIV/0!	0%	0%	#DIV/0!	0%	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	2254	31.5	1	12.0	transit
2	1906	31.5	2	12.0	transit
3	2548	36.0	2	12.0	transit
4	N/A	N/A	0	#DIV/0!	transit
5	N/A	N/A	0	#DIV/0!	transit
Total/Ave	6708	#VALUE!		#VALUE!	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	1.73	5.00	1.56	0.00	11.76	0.67	1.95
2	1.00	5.00	3.52	0.00	12.03	0.67	2.79
3	1.00	5.00	0.00	0.01	4.99	0.92	1.95
4	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00
5	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	1.31	3.14	4.51	E
2	1.86	3.55	3.74	D
3	1.79	3.35	3.82	D
4	#DIV/0!	#VALUE!	#DIV/0!	F
5	#DIV/0!	#VALUE!	#DIV/0!	F
Average			#DIV/0!	F

D. Compute Bicycle LOS

Street: **Appleyard Drive**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	12	4	2	D	39	11.7	xsec1-3, layout
2	12	4	2	D	60	8.3	xsec1-3, layout
3	12	4	2	D	40	20.7	xsec1-3, layout
4	N/A	0	0	D	N/A	#VALUE!	xsec4-5, layout
5	N/A	0	0	D	N/A	#VALUE!	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	1017	3%	33.3	0%	4.0	traffic, xsec1-3
2	880	3%	33.3	0%	4.0	traffic, xsec1-3
3	663	3%	38.0	0%	4.0	traffic, xsec1-3
4	#VALUE!	N/A	#DIV/0!	N/A	N/A	traffic, xsec4-5
5	#VALUE!	N/A	#DIV/0!	N/A	N/A	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent
Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	16.0	20.0	3.70	2.99	2.25	3.84	D
2	16.0	20.0	3.70	2.91	2.44	3.73	D
3	16.0	20.0	4.05	2.89	1.93	4.11	D
4	#VALUE!	#VALUE!	#DIV/0!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
5	#VALUE!	#VALUE!	#DIV/0!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average						#VALUE!	#VALUE!

E. LOS Summary

Title: Appleyard Drive

Direction =	Down	SB	Date:	9/28/2008	Analyst:	AEN

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	A	A	A	E	D	C
2	B	A	A	A	D	D	D
3	B	A	A	A	D	D	C
4	#VALUE!	#VALUE!	#N/A	#VALUE!	F	#VALUE!	#VALUE!
5	#VALUE!	#VALUE!	#N/A	#VALUE!	F	#VALUE!	#VALUE!
Facility	#VALUE!	#VALUE!	#VALUE!	#VALUE!	F	#VALUE!	#VALUE!

Auto Performance Measures Summary SB

Seg+Sig	Stops	FFS	Speed	%FFS
1	1.17	35.0	31.5	90.0%
2	1.94	35.0	31.5	90.0%
3	0.21	40.0	36.0	90.0%
4	#VALUE!	N/A	N/A	#VALUE!
5	#VALUE!	N/A	N/A	#VALUE!
Facility	#VALUE!	36.9	#VALUE!	#VALUE!

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

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No warranty as to accuracy or suitability for use.
Spreadsheet is unsupported.
Spreadsheet does not have data entry error checking.
Created: 8-Jun-07 Updated: 25-Sep-08

Street: **Appleyard Drive**
(This sheet generates the LOS results for "results")

Direction=	**Down**	**SB**

Leave Blank Cells Alone. Have Eqns

A. Compute Auto LOS and Performance

1. Compute Eastbound Hourly Demand (v)

Segment	Weekday ADT (vpd)	Peak Factor k (#)	Dir. Factor d (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)
1	946	1.00	1.00	0.93	80%	814
2	818	1.00	1.00	0.93	55%	484
3	617	1.00	1.00	0.93	60%	398
4	N/A	1.00	1.00	N/A	#VALUE!	#VALUE!
5	N/A	1.00	1.00	N/A	#VALUE!	#VALUE!

2. Compute Eastbound Hourly Capacity and V/C

Segment	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	V/c	V/c Check
1	1882	2	0.42	1581	0.51	OK
2	1787	2	0.42	1501	0.32	OK
3	1787	2	0.45	1608	0.25	OK
4	N/A	0	N/A	#VALUE!	#VALUE!	#VALUE!
5	N/A	0	N/A	#VALUE!	#VALUE!	#VALUE!

Adjusted Sat. Flows computed per Chapter 16, Signalized Intersections.

3. Compute Mean Through Speed

Segment	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)
1	35	2254	31.5
2	35	1906	31.5
3	40	2548	36.0
4	N/A	N/A	N/A
5	N/A	N/A	N/A
Total/Ave.	36.9	6708	#VALUE!

4. Compute Stops & % Left Lane

Segment	Average Speed (mph)	Median Type
1	31.5	3.0
2	31.5	3.0
3	36.0	3.0
4	N/A	N/A
5	N/A	N/A
Total/Ave	#VALUE!	3.00

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	42.2%	39.6%	11.2%	4.0%	1.8%	1.1%	1.87	A
2	42.2%	39.6%	11.2%	4.0%	1.8%	1.1%	1.87	A
3	51.6%	35.2%	8.3%	2.8%	1.3%	0.8%	1.69	A
4	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
5	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

Multimodal Level of Service for Urban Streets

Diagram of Uban Street

Street: Capital Circle Southeast

Date: Oct. 21, 2008

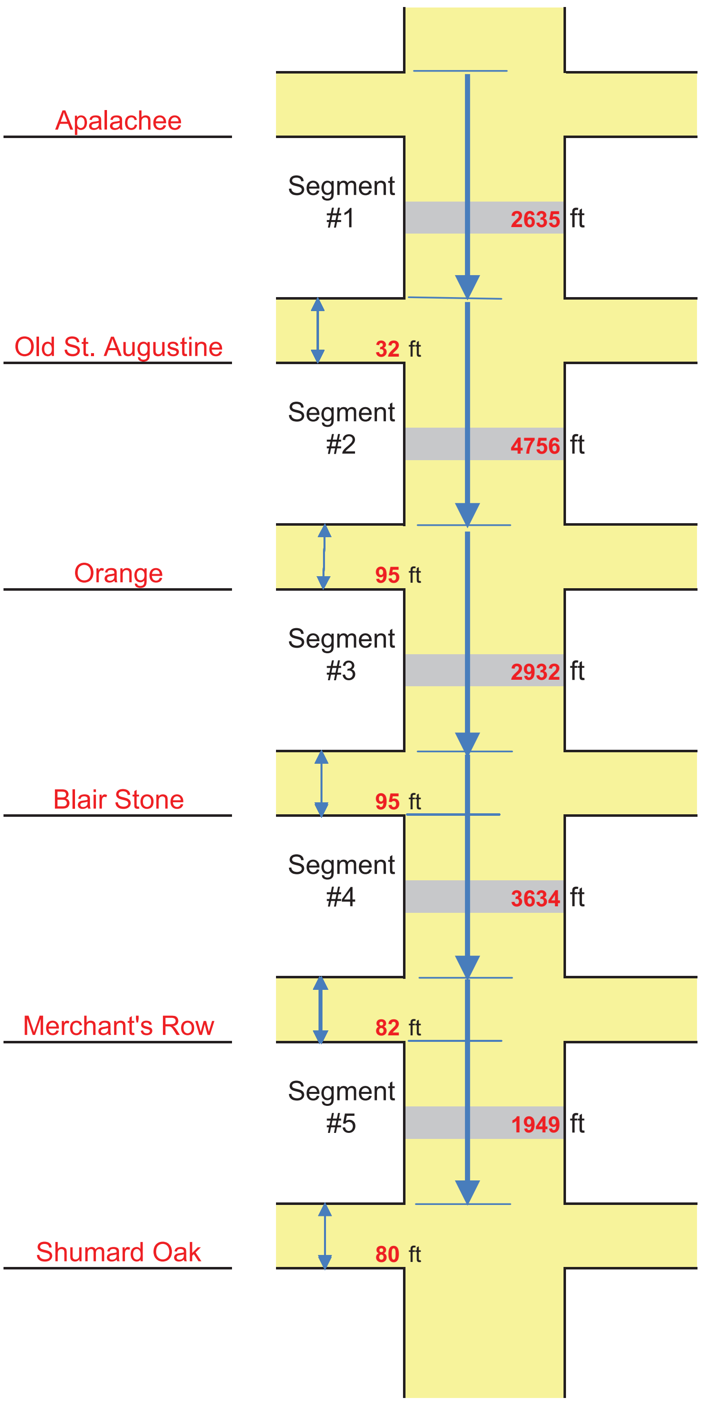
Limits: Apalachee to Shumard Oak

Observer: Cherie Horne

Analysis Direction:	SB

(Down Direction on this Sheet)

Data Entry Fields in Red



Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	3	35	446	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	7	40	1624	1

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	7	35	1523	1

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	6	35	646	1

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	6	30	400	0

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Capital Circle Southeast

Limits: Apalachee to Shumard Oak

Observer: Cherie Horne

Date: Oct. 21, 2008

Cross-Section #1
From: Apalachee To: Old St. Augustine

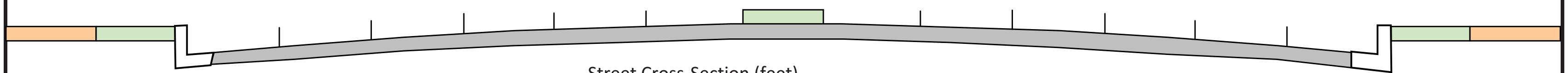
1

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:
Jay-Walking Calc:

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3.5	0	4	12	12	12	30.5	12	12	12	4	0	3	5		

Ped Vol: 10

Cross-Section #2
From: Old St. Augustine To: Orange

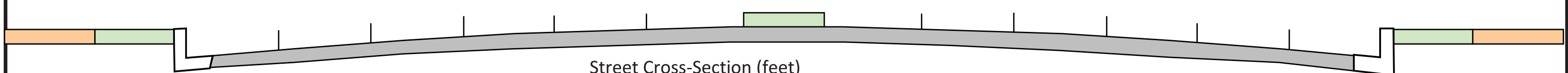
2

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:
Jay-Walking Calc:

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3.5	0	4	12	12	12	30	12	12	12	4	0	3	5		

Ped Vol: 5

Cross-Section #3
From: Orange To: Blair Stone

3

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:
Jay-Walking Calc:

NB

Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	6	0	4	12	12	12	36	12	12	12	4	0	15	10		

Ped Vol: 5

Multimodal Level of Service for Urban Streets

Street Cross-Section Data

Street: Capital Circle Southeast

Limits: Apalachee to Shumard Oak

Observer: Cherie Horne

Date: Oct. 21, 2008

Cross-Section #4

From: Blair Stone To: Merchant's Row

4

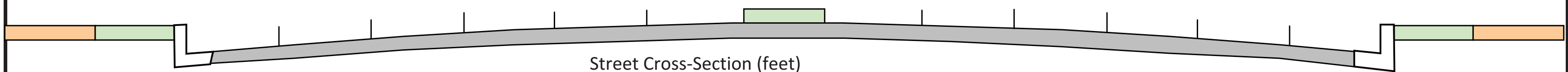
Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:

Jay-Walking Calc:

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	6	0	4	12	12	12	36	12	12	12	4	0	15	10		

Ped Vol: 10

Cross-Section #5

From: Merchant's Row To: Shumard Oak

5

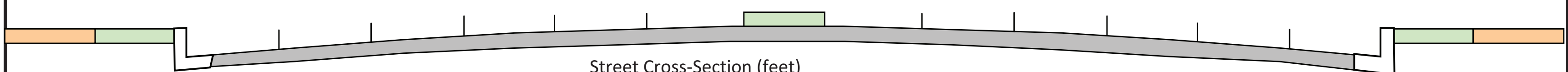
Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:

Jay-Walking Calc:

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	6	0	4	12	12	12	36	12	12	12	4	0	15	10		

Ped Vol: 10

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **SB**

Street: Capital Circle Southeast

Date: Oct. 21, 2008

Limits: Apalachee to Shumard Oak

Observer: Cherie Horne

Field Survey

	Segment And Downstream Signal		Speed Limit	Median Type	Left Turn Pocket	Drivewys Rightside	Unsig. Intersects
	From	To	(mph)	(0-3)	(y/n)	(#)	(#)
1	Apalachee	)ld St. Augustin	45	3	YES	7	0
2	)ld St. Augustin	Orange	45	3	YES	10	1
3	Orange	Blair Stone	45	3	YES	4	1
4	Blair Stone	Merchant's Rov	45	3	YES	1	1
5	Merchant's Rov	Shumard Oak	45	3	YES	2	0

Traffic Counts K: N/A D: N/A

	Segment And Downstream Signal		Vol	Heavy Vehicle	RTOR+ PermLeft	Left/Right Turns	Thru Adj. Sat.	PHF
	From	To	(2-wy)	(%)	veh	%	(vphgl)	
1	Apalachee	)ld St. Augustin	1007	9%	3	5%	1569	0.93
2	)ld St. Augustin	Orange	1137	9%	11	16%	1569	0.93
3	Orange	Blair Stone	974	9%	5	23%	1569	0.93
4	Blair Stone	Merchant's Rov	1623	9%	5	10%	1569	0.93
5	Merchant's Rov	Shumard Oak	380	9%	0	55%	1569	0.93

Arterial Traffic Performance & Signal Timing

	Segment And Downstream Signal		Field Survey		Signal Timing Data			
			Mean Speed	Average Stops	Cycle Length	Grn/Cycle for Thru	Ped Walk	Xing Ped Walk
	From	To	(mph)	(#/veh)	(secs)	(%)	(sec/cyc)	(sec/cyc)
1	Apalachee	)ld St. Augustin	38.7	0.0	160	60%	5	5
2	)ld St. Augustin	Orange	49.4	0.3	130	55%	6	6
3	Orange	Blair Stone	23.6	0.7	130	33%	6	5
4	Blair Stone	Merchant's Rov	36.0	0.3	130	68%	6	5
5	Merchant's Rov	Shumard Oak	42.8	0.0	130	68%	0	5

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter, H(
Signal data is at the downstream signal

| Route |

Data Collection Sheet - Transit

Direction: **SB**

Street: Capital Circle Southeast

Date: Oct. 21, 2008

Limits: Apalachee to Shumard Oak

Observer: Cherie Horne

Field Survey

Segment			Bus Stop (#)	Shelters (% stops)	Benches (% stops)	CBD (yes/no)
	From	To				
1	Apalachee	Old St. Augustin	0	0%	0%	NO
2	Old St. Augustin	Orange	0	0%	0%	NO
3	Orange	Blair Stone	0	0%	0%	NO
4	Blair Stone	Merchant's Row	1	0%	0%	NO
5	Merchant's Row	Shumard Oak	0	0%	0%	NO

Transit Performance Data

Segment			Route #'s	Frequency (bus/hr)	Load Factor (pas/seat)	On-Time Perform. (%)	Schedule Speed (mph)
	From	To					
1	Apalachee	Old St. Augustin					
2	Old St. Augustin	Orange					
3	Orange	Blair Stone	80X	2	1%	100%	20
4	Blair Stone	Merchant's Row	80X	2	1%	100%	20
5	Merchant's Row	Shumard Oak					

Bus is On-Time if arrives within: 5 minutes of scheduled time.

Average Passenger Trip Length: 6 miles

A. Compute Auto LOS and Performance

Street: **Capital Circle Southeast**

Direction=	Down	SB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	1007	1.000	1.000	0.93	95%	1029	traffic
2	1137	1.000	1.00	0.93	84%	1027	traffic
3	974	1.000	1.00	0.93	77%	806	traffic
4	1623	1.000	1.00	0.93	90%	1571	traffic
5	380	1.000	1.00	0.93	45%	184	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	1569	6	0.60	5648	0.18	OK	xsec 1-3, traffic
2	1569	6	0.55	5178	0.20	OK	xsec 1-3, traffic
3	1569	6	0.33	3107	0.26	OK	xsec 1-3, traffic
4	1569	6	0.68	6402	0.25	OK	xsec 4-5, traffic
5	1569	6	0.68	6402	0.03	OK	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	45	2635	38.7	traffic, layout
2	45	4756	49.4	traffic, layout
3	45	2932	23.6	traffic, layout
4	45	3634	36.0	traffic, layout
5	45	1949	42.8	traffic, layout
Total/Ave.	45.0	15906	36.6	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	0.00	YES	3	traffic
2	0.33	YES	3	traffic
3	1.26	YES	3	traffic
4	0.44	YES	3	traffic
5	0.00	YES	3	traffic
Total/Ave	0.43	1.00	3.00	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
2	28.9%	41.9%	17.3%	7.0%	3.2%	1.7%	2.19	B
3	24.3%	41.4%	19.7%	8.5%	4.0%	2.1%	2.33	B
4	28.3%	41.9%	17.6%	7.2%	3.3%	1.7%	2.20	B
5	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
Average	28.3%	41.9%	17.6%	7.2%	3.3%	1.7%	2.20	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **Capital Circle Southeast**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	5	10	7200	0.00	A	xsec1-3
2	5	5	14400.0	0.00	A	xsec1-3
3	5	5	14400.0	0.00	A	xsec1-3
4	5	10	7200.0	0.00	A	xsec4-5
5	5	10	7200.0	0.00	A	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	12	4	0%	0	3.5	1,083	6	41.9	2.73	xsec1-3
2	12	4	0%	0	3.5	1,223	6	47.2	2.98	xsec1-3
3	12	4	0%	0	6	1,047	6	34.3	2.48	xsec1-3
4	12	4	0%	0	6	1,745	6	40.5	2.97	xsec4-5
5	12	4	0%	0	6	409	6	43.9	2.51	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	3	446	0.93	35	3	75.1	0	2.62	layout, traffic
2	11	1624	0.93	40	7	59.1	1	4.60	layout, traffic
3	5	1523	0.93	35	7	59.1	1	4.19	layout, traffic
4	5	646	0.93	35	6	59.1	1	3.10	layout, traffic
5	0	400	0.93	30	6	65.0	0	2.54	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	2635	75.1	457	102	41.9	1,007	2.0	643	0	layout, traffic
2	4756	59.1	806	101	47.2	1,137	2.0	900	0	layout, traffic
3	2932	60.1	503	119	34.3	974	2.0	900	0	layout, traffic
4	3634	60.1	620	119	40.5	1,623	2.0	900	0	layout, traffic
5	1949	60.1	339	119	43.9	380	2.0	136	0	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	457	6.00	3.05	1.00	3.05	0.00	3.05	C
2	806	6.00	3.57	1.00	3.57	0.00	3.57	D
3	503	6.00	3.32	1.00	3.32	0.00	3.32	C
4	620	6.00	3.23	1.00	3.23	0.00	3.23	C
5	136	6.00	2.96	1.00	2.96	0.00	2.96	C
Average							3.29	C

C. Compute Transit LOS

Street: **Capital Circle Southeast**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit
2	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit
3	2	100%	0%	0%	0.01	NO	transit
4	2	100%	0%	0%	0.01	NO	transit
5	0	#DIV/0!	0%	0%	#DIV/0!	NO	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	2635	38.7	0	#DIV/0!	transit
2	4756	49.4	0	#DIV/0!	transit
3	2932	23.6	0	20.0	transit
4	3634	36.0	1	20.0	transit
5	1949	42.8	0	#DIV/0!	transit
Total/Ave	15906	36.6		#DIV/0!	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00
2	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00
3	1.00	3.00	0.00	0.00	3.00	1.12	1.95
4	1.00	3.00	0.00	0.00	3.00	1.12	1.95
5	#DIV/0!	#DIV/0!	#DIV/0!	0.00	#DIV/0!	#DIV/0!	0.00

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	#DIV/0!	3.05	#DIV/0!	F
2	#DIV/0!	3.57	#DIV/0!	F
3	2.19	3.32	3.21	C
4	2.19	3.23	3.20	C
5	#DIV/0!	2.96	#DIV/0!	F
Average			#DIV/0!	F

D. Compute Bicycle LOS

Street: **Capital Circle Southeast**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	12	4	6	D	32	14.0	xsec1-3, layout
2	12	4	6	D	95	12.2	xsec1-3, layout
3	12	4	6	D	95	9.0	xsec1-3, layout
4	12	4	6	D	82	2.9	xsec4-5, layout
5	12	4	6	D	80	5.4	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	1083	9%	41.9	0%	0.0	traffic, xsec1-3
2	1223	9%	47.2	0%	0.0	traffic, xsec1-3
3	1047	9%	34.3	0%	0.0	traffic, xsec1-3
4	1745	9%	40.5	0%	0.0	traffic, xsec4-5
5	409	9%	43.9	0%	0.0	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent
Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	16.0	20.0	4.26	#DIV/0!	1.53	#DIV/0!	#DIV/0!
2	16.0	20.0	4.51	#DIV/0!	2.54	#DIV/0!	#DIV/0!
3	16.0	20.0	3.79	#DIV/0!	2.48	#DIV/0!	#DIV/0!
4	16.0	20.0	4.19	#DIV/0!	2.50	#DIV/0!	#DIV/0!
5	16.0	20.0	4.36	#DIV/0!	2.05	#DIV/0!	#DIV/0!
Average						#DIV/0!	#DIV/0!

E. LOS Summary

Title: Capital Circle Southeast

Direction =	Down	SB	Date:	9/28/2008	Analyst:	AEN

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	A	A	A	F	#DIV/0!	C
2	B	A	A	A	F	#DIV/0!	D
3	B	B	C	C	C	#DIV/0!	C
4	B	A	A	B	C	#DIV/0!	C
5	B	A	A	A	F	#DIV/0!	C
Facility	B	A	A	B	F	#DIV/0!	C

Auto Performance Measures Summary SB

Seg+Sig	Stops	FFS	Speed	%FFS
1	0.00	45.0	38.7	86.0%
2	0.33	45.0	49.4	109.8%
3	1.26	45.0	23.6	52.4%
4	0.44	45.0	36.0	80.0%
5	0.00	45.0	42.8	95.1%
Facility	0.43	45.0	36.6	81.2%

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

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Spreadsheet does not have data entry error checking.
Created: 8-Jun-07 Updated: 25-Sep-08

Street: **Capital Circle Southeast**
(This sheet generates the LOS results for "results")

Direction= **Down** **SB**

Leave Blank Cells Alone. Have Eqns

A. Compute Auto LOS and Performance

1. Compute Eastbound Hourly Demand (v)

Segment	Weekday ADT (vpd)	Peak Factor k (#)	Dir. Factor d (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)
1	1007	1.00	1.00	0.93	95%	1029
2	1137	1.00	1.00	0.93	84%	1027
3	974	1.00	1.00	0.93	77%	806
4	1623	1.00	1.00	0.93	90%	1571
5	380	1.00	1.00	0.93	45%	184

2. Compute Eastbound Hourly Capacity and V/C

Segment	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	V/c	V/c Check
1	1569	6	0.60	5648	0.18	OK
2	1569	6	0.55	5178	0.20	OK
3	1569	6	0.33	3107	0.26	OK
4	1569	6	0.68	6402	0.25	OK
5	1569	6	0.68	6402	0.03	OK

Adjusted Sat. Flows computed per Chapter 16, Signalized Intersections.

3. Compute Mean Through Speed

Segment	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)
1	45	2635	38.7
2	45	4756	49.4
3	45	2932	23.6
4	45	3634	36.0
5	45	1949	42.8
Total/Ave.	45.0	15906	36.6

4. Compute Stops & % Left Lane

Segment	Average Speed (mph)	Median Type
1	38.7	3.0
2	49.4	3.0
3	23.6	3.0
4	36.0	3.0
5	42.8	3.0
Total/Ave	36.6	3.00

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	57.2%	32.0%	6.9%	2.3%	1.0%	0.6%	1.60	A
2	76.7%	18.6%	3.1%	1.0%	0.4%	0.2%	1.31	A
3	27.3%	42.6%	17.5%	7.1%	3.4%	2.1%	2.23	B
4	51.6%	35.2%	8.3%	2.8%	1.3%	0.8%	1.69	A
5	65.4%	26.7%	5.1%	1.7%	0.7%	0.4%	1.47	A
Average	52.8%	34.6%	8.0%	2.7%	1.2%	0.7%	1.67	A

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

Multimodal Level of Service for Urban Streets

Diagram of Uban Street

Street: Macomb Street

Date: Oct. 21, 2008

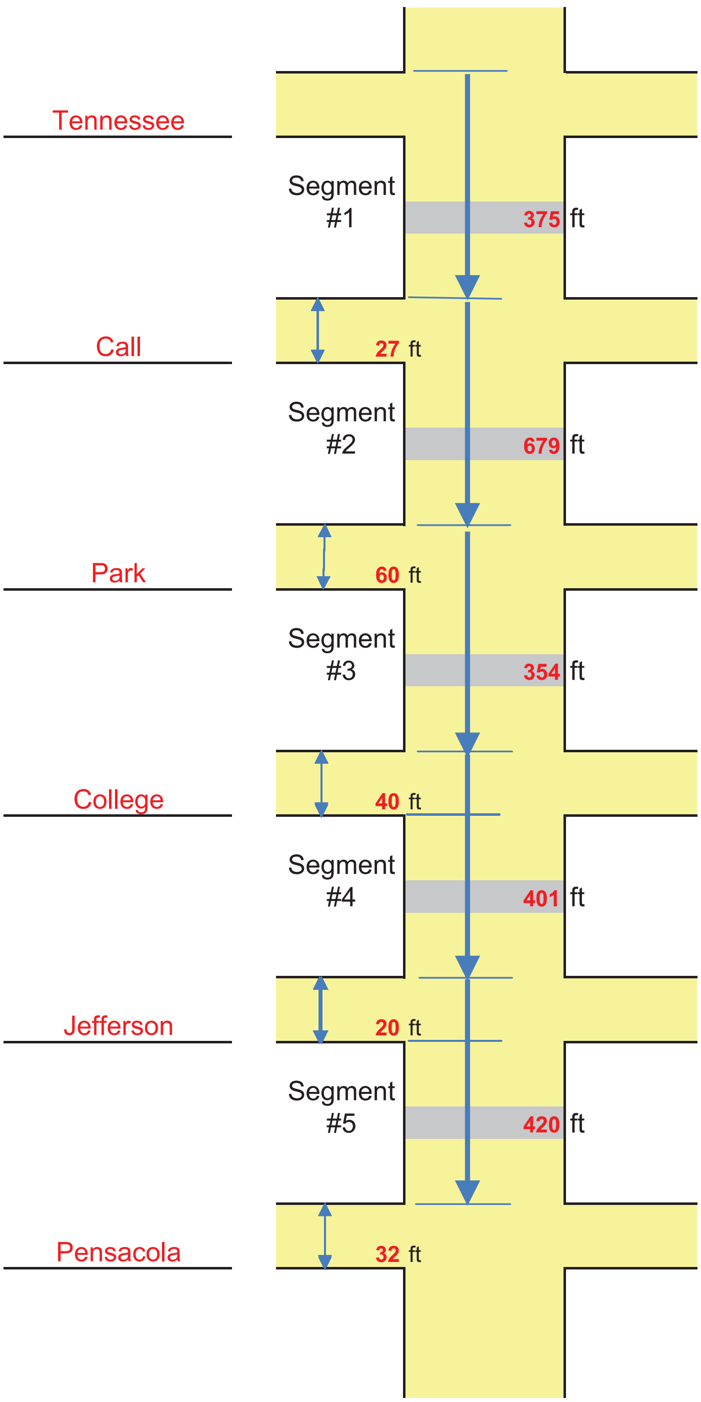
Limits: Tennessee to Pensacola

Observer: Cherie Horne

Analysis Direction:	SB

(Down Direction on this Sheet)

Data Entry Fields in Red



Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	2	30	186	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	25	72	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	30	224	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	30	258	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	30	640	0

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Macomb Street

Limits: Tennessee to Pensacola

Observer: Cherie Horne

Date: Oct. 21, 2008

Cross-Section #1
From: Tennessee To: Call

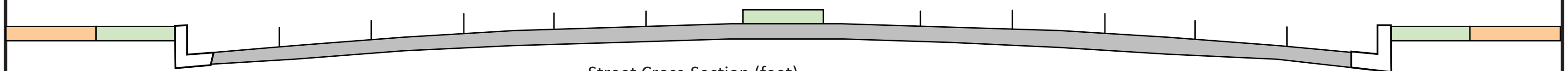
1

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	4
Jay-Walking Calc:	NO

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	0	0	0	12	11	0		10		0	11	12	0	0	0	6

Ped Vol: 12

Cross-Section #2
From: Call To: Park

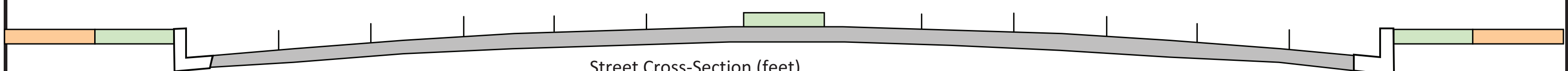
2

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	4
Jay-Walking Calc:	NO

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	0	0	0	12	11	0		10		0	11	12	0	0	0	6

Ped Vol: 2

Cross-Section #3
From: Park To: College

3

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	4
Jay-Walking Calc:	NO

NB

Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	2	0	4	12	12	0		10		0	12	12	0	0	0	6

Ped Vol: 2

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: Macomb Street

Limits: Tennessee to Pensacola

Observer: Cherie Horne

Date: Oct. 21, 2008

Cross-Section #4
From: College To: Jefferson

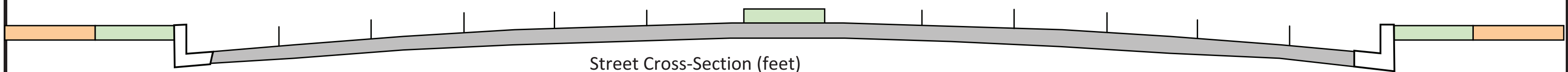
4

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	4
Jay-Walking Calc:	NO

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	0	12	12	0		10		0	12	12	0	0	0	5

Ped Vol: 2

Cross-Section #5
From: Jefferson To: Pensacola

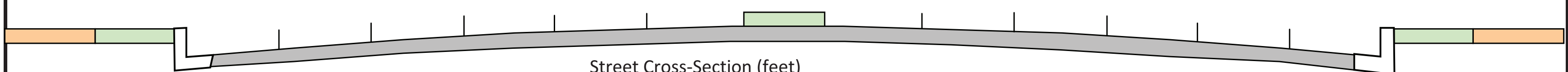
5

Ft/Tree	% Occ.
0	0%

SB

Pavement Cond:	4
Jay-Walking Calc:	NO

NB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	3	0	0	12	12	0		10		0	12	12	0	0	2	5

Ped Vol: 4

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **SB**

Street: Macomb Street

Date: Oct. 21, 2008

Limits: Tennessee to Pensacola

Observer: Cherie Horne

Field Survey

	Segment And Downstream Signal From	To	Speed Limit (mph)	Median Type (0-3)	Left Turn Pocket (y/n)	Drivewys Rightside (#)	Unsig. Intersects (#)
1	Tennessee	Call	30	2	YES	1	0
2	Call	Park	30	3	NO	0	1
3	Park	College	30	3	YES	1	0
4	College	Jefferson	30	2	YES	2	0
5	Jefferson	Pensacola	30	2	NO	1	0

Traffic Counts K: N/A D: N/A

	Segment And Downstream Signal From	To	Vol (2-wy)	Heavy Vehicle (%)	RTOR+ PermLeft veh	Left/Right Turns %	Thru Adj. Sat. (vphgl)	PHF
1	Tennessee	Call	880	3%	10	11%	1787	0.93
2	Call	Park	791	3%	10	7%	1505	0.93
3	Park	College	764	3%	8	11%	1787	0.93
4	College	Jefferson	790	3%	12	26%	1787	0.93
5	Jefferson	Pensacola	661	3%	4	21%	1787	0.93

Arterial Traffic Performance & Signal Timing

	Segment And Downstream Signal		Field Survey		Signal Timing Data			
	From	To	Mean Speed (mph)	Average Stops (#/veh)	Cycle Length (secs)	Grn/Cycle for Thru (%)	Ped Walk (sec/cyc)	Xing Ped Walk (sec/cyc)
1	Tennessee	Call	22.5	0.0	70	26%	17	6
2	Call	Park	29.5	0.0	70	37%	23	6
3	Park	College	25.0	0.0	70	28%	21	5
4	College	Jefferson	32.8	0.3	70	30%	23	5
5	Jefferson	Pensacola	20.4	0.3	70	20%	5	5

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter, H(
Signal data is at the downstream signal

Route

Data Collection Sheet - Transit

Direction: **SB**

Street: Macomb Street

Date: Oct. 21, 2008

Limits: Tennessee to Pensacola

Observer: Cherie Horne

Field Survey

Segment			Bus Stop (#)	Shelters (% stops)	Benches (% stops)	CBD (yes/no)
	From	To				
1	Tennessee	Call	0	0%	0%	YES
2	Call	Park	0	0%	0%	YES
3	Park	College	0	0%	0%	YES
4	College	Jefferson	0	0%	0%	YES
5	Jefferson	Pensacola	0	0%	0%	YES

Transit Performance Data

Segment			Route #'s	Frequency (bus/hr)	Load Factor (pas/seat)	On-Time Perform. (%)	Schedule Speed (mph)
	From	To					
1	Tennessee	Call					
2	Call	Park					
3	Park	College					
4	College	Jefferson					
5	Jefferson	Pensacola					

Bus is On-Time if arrives within: 5 minutes of scheduled time.

Average Passenger Trip Length: 0 miles

A. Compute Auto LOS and Performance

Street: **Macomb Street**

Direction=	Down	SB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	880	1.000	1.000	0.93	89%	842	traffic
2	791	1.000	1.00	0.93	93%	791	traffic
3	764	1.000	1.00	0.93	89%	731	traffic
4	790	1.000	1.00	0.93	74%	629	traffic
5	661	1.000	1.00	0.93	79%	561	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	1787	2	0.26	929	0.91	OK	xsec 1-3, traffic
2	1505	2	0.37	1114	0.71	OK	xsec 1-3, traffic
3	1787	2	0.28	1001	0.73	OK	xsec 1-3, traffic
4	1787	2	0.30	1072	0.59	OK	xsec 4-5, traffic
5	1787	2	0.20	715	0.79	OK	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	30	375	22.5	traffic, layout
2	30	679	29.5	traffic, layout
3	30	354	25.0	traffic, layout
4	30	401	32.8	traffic, layout
5	30	420	20.4	traffic, layout
Total/Ave.	30.0	2229	25.7	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	0.00	YES	2	traffic
2	0.00	NO	3	traffic
3	0.00	YES	3	traffic
4	3.95	YES	2	traffic
5	3.77	NO	2	traffic
Total/Ave	1.42	0.40	2.46	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
2	23.8%	41.3%	20.0%	8.7%	4.1%	2.2%	2.34	B
3	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
4	14.0%	35.2%	25.5%	13.9%	7.3%	4.1%	2.78	C
5	14.5%	35.8%	25.2%	13.5%	7.0%	3.9%	2.75	B
Average	20.0%	39.9%	22.1%	10.3%	5.0%	2.7%	2.48	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **Macomb Street**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	5	12	6000	0.00	A	xsec1-3
2	5	2	36000.0	0.00	A	xsec1-3
3	5	2	36000.0	0.00	A	xsec1-3
4	5	2	36000.0	0.00	A	xsec4-5
5	5	4	18000.0	0.00	A	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	12	0	0%	0	0	946	2	26.3	3.19	xsec1-3
2	12	0	0%	0	0	851	2	29.8	3.15	xsec1-3
3	12	4	0%	0	2	822	2	27.5	2.92	xsec1-3
4	12	0	0%	0	3	849	2	31.4	3.19	xsec4-5
5	12	0	0%	0	3	711	2	25.2	2.87	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	10	186	0.93	30	2	20.1	0	2.21	layout, traffic
2	10	72	0.93	25	2	15.8	0	2.07	layout, traffic
3	8	224	0.93	30	2	17.2	0	2.24	layout, traffic
4	12	258	0.93	30	2	15.8	0	2.28	layout, traffic
5	4	640	0.93	30	2	30.2	0	2.69	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	375	29.3	69	46	26.3	880	2.0	60	NO	layout, traffic
2	679	29.3	119	46	29.8	791	2.0	52	NO	layout, traffic
3	354	30.2	66	52	27.5	764	2.0	63	NO	layout, traffic
4	401	30.2	73	48	31.4	790	2.0	56	NO	layout, traffic
5	420	30.2	77	48	25.2	661	2.0	46	NO	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	60	5.00	3.11	1.00	3.11	0.00	3.11	C
2	52	5.00	3.06	1.00	3.06	0.00	3.06	C
3	63	6.00	3.03	1.00	3.03	0.00	3.03	C
4	56	5.00	3.12	1.00	3.12	0.00	3.12	C
5	46	5.00	3.11	1.00	3.11	0.00	3.11	C
Average							3.08	C

C. Compute Transit LOS

Street: **Macomb Street**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	0	#DIV/0!	0%	0%	#DIV/0!	YES	transit
2	0	#DIV/0!	0%	0%	#DIV/0!	YES	transit
3	0	#DIV/0!	0%	0%	#DIV/0!	YES	transit
4	0	#DIV/0!	0%	0%	#DIV/0!	YES	transit
5	0	#DIV/0!	0%	0%	#DIV/0!	YES	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	375	22.5	0	#DIV/0!	transit
2	679	29.5	0	#DIV/0!	transit
3	354	25.0	0	#DIV/0!	transit
4	401	32.8	0	#DIV/0!	transit
5	420	20.4	0	#DIV/0!	transit
Total/Ave	2229	25.7		#DIV/0!	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00
2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00
3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00
4	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00
5	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.00

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	#DIV/0!	3.11	#DIV/0!	F
2	#DIV/0!	3.06	#DIV/0!	F
3	#DIV/0!	3.03	#DIV/0!	F
4	#DIV/0!	3.12	#DIV/0!	F
5	#DIV/0!	3.11	#DIV/0!	F
Average			#DIV/0!	F

D. Compute Bicycle LOS

Street: **Macomb Street**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	12	0	2	D	27	14.1	xsec1-3, layout
2	12	0	2	D	60	7.8	xsec1-3, layout
3	12	4	2	D	40	14.9	xsec1-3, layout
4	12	0	2	D	20	26.3	xsec4-5, layout
5	12	0	2	D	32	12.6	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	946	3%	26.3	0%	4.0	traffic, xsec1-3
2	851	3%	29.8	0%	4.0	traffic, xsec1-3
3	822	3%	27.5	0%	4.0	traffic, xsec1-3
4	849	3%	31.4	0%	4.0	traffic, xsec4-5
5	711	3%	25.2	0%	4.0	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent
Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	12.0	12.0	2.86	3.94	2.85	4.16	D
2	12.0	12.0	3.36	4.06	3.27	4.06	D
3	16.0	20.0	3.07	2.66	2.08	3.89	D
4	12.0	12.0	3.54	4.12	2.66	4.59	E
5	12.0	12.0	2.66	3.73	2.71	4.05	D
Average						4.14	D

E. LOS Summary

Title: Macomb Street

Direction =	Down	SB	Date:	9/28/2008	Analyst:	AEN

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	B	B	B	F	D	C
2	B	A	A	A	F	D	C
3	B	B	A	B	F	D	C
4	C	A	A	A	F	E	C
5	B	B	B	B	F	D	C
Facility	B	B	A	A	F	D	C

Auto Performance Measures Summary SB

Seg+Sig	Stops	FFS	Speed	%FFS
1	0.00	30.0	22.5	75.0%
2	0.00	30.0	29.5	98.3%
3	0.00	30.0	25.0	83.3%
4	3.95	30.0	32.8	109.3%
5	3.77	30.0	20.4	68.0%
Facility	1.42	30.0	25.7	85.7%

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

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Spreadsheet does not have data entry error checking.
Created: 8-Jun-07 Updated: 25-Sep-08

Street: **Macomb Street**
(This sheet generates the LOS results for "results")

Direction=	Down	SB

Leave Blank Cells Alone. Have Eqns

A. Compute Auto LOS and Performance

1. Compute Eastbound Hourly Demand (v)

Segment	Weekday ADT (vpd)	Peak Factor k (#)	Dir. Factor d (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)
1	880	1.00	1.00	0.93	89%	842
2	791	1.00	1.00	0.93	93%	791
3	764	1.00	1.00	0.93	89%	731
4	790	1.00	1.00	0.93	74%	629
5	661	1.00	1.00	0.93	79%	561

2. Compute Eastbound Hourly Capacity and V/C

Segment	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	V/c	V/c Check
1	1787	2	0.26	929	0.91	OK
2	1505	2	0.37	1114	0.71	OK
3	1787	2	0.28	1001	0.73	OK
4	1787	2	0.30	1072	0.59	OK
5	1787	2	0.20	715	0.79	OK

Adjusted Sat. Flows computed per Chapter 16, Signalized Intersections.

3. Compute Mean Through Speed

Segment	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)
1	30	375	22.5
2	30	679	29.5
3	30	354	25.0
4	30	401	32.8
5	30	420	20.4
Total/Ave.	30.0	2229	25.7

4. Compute Stops & % Left Lane

Segment	Average Speed (mph)	Median Type
1	22.5	2.0
2	29.5	3.0
3	25.0	3.0
4	32.8	2.0
5	20.4	2.0
Total/Ave	25.7	2.46

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	21.6%	41.4%	20.5%	9.1%	4.5%	2.9%	2.42	B
2	38.2%	41.0%	12.7%	4.7%	2.1%	1.3%	1.95	A
3	29.7%	42.6%	16.3%	6.5%	3.0%	1.9%	2.16	B
4	39.5%	40.6%	12.2%	4.4%	2.0%	1.2%	1.92	A
5	18.7%	40.0%	22.2%	10.4%	5.3%	3.4%	2.54	B
Average	28.5%	42.6%	16.9%	6.8%	3.2%	2.0%	2.20	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

Multimodal Level of Service for Urban Streets

Diagram of Uban Street

Street: West Tennessee Street

Date: Oct. 21, 2008

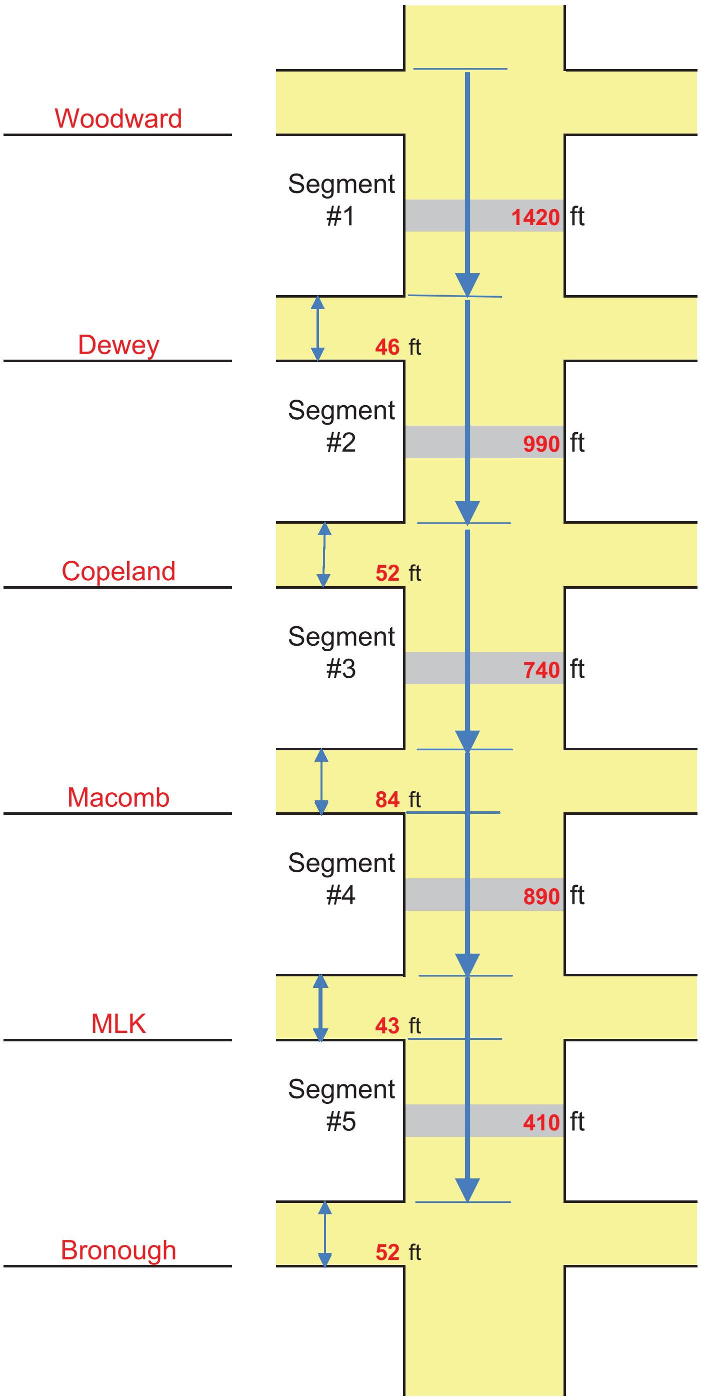
Limits: Woodward to Bronough

Observer: Cherie Horne

Analysis Direction:	EB

(Down Direction on this Sheet)

Data Entry Fields in Red



Intersect. Control	X-Street Lanes	X-Street Speed	X-Street 2-W vph	Right Turn Isl.
SIGNAL	3	30	675	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	4	30	457	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	5	30	1000	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	2	30	170	0

Intersect. Control	X-Street Lanes	X-Street Speed	X-Street Vph	Right Turn Isl.
SIGNAL	3	30	1692	0

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: West Tennessee Street
Limits: Woodward to Bronough

Cross-Section #1
From: Woodward To: Dewey
Observer: Cherie Horne
Date: Oct. 21, 2008

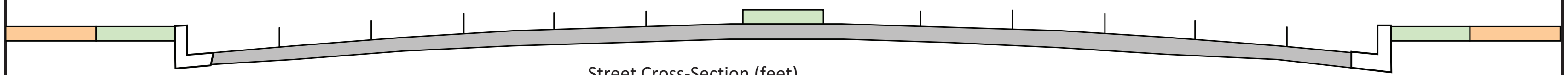
1

Ft/Tree	% Occ.
0	0%

EB

Pavement Cond:	4
Jay-Walking Calc:	NO

WB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	2	0	0	12	12	12		12		12	12	12	0	0	2	5

Ped Vol: 30

Cross-Section #2
From: Dewey To: Copeland

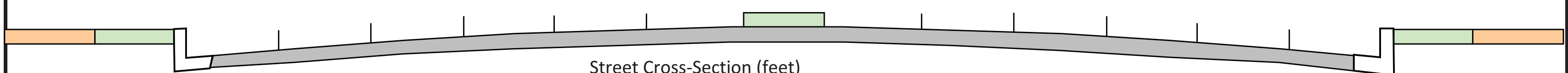
2

Ft/Tree	% Occ.
0	0%

EB

Pavement Cond:	4
Jay-Walking Calc:	NO

WB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	0	0	0	11	11	11		11		11	11	11	0	0	0	5

Ped Vol: 30

Cross-Section #3
From: Copeland To: Macomb

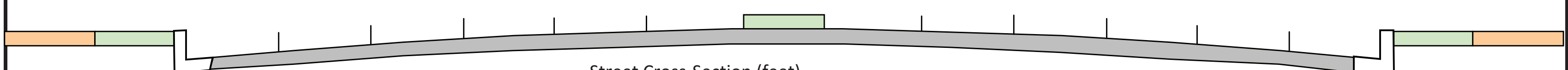
3

Ft/Tree	% Occ.
0	0%

EB

Pavement Cond:	4
Jay-Walking Calc:	NO

WB



Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	0	0	0	11	11	11		11		11	11	11	0	0	0	5

Ped Vol: 30

Multimodal Level of Service for Urban Streets
Street Cross-Section Data

Street: West Tennessee Street

Limits: Woodward to Bronough

Observer: Cherie Horne

Date: Oct. 21, 2008

Cross-Section #4
From: Macomb To: MLK

4

Ft/Tree	% Occ.
0	0%

EB

Pavement Cond:	4
Jay-Walking Calc:	NO

WB

Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	0	0	0	11	11	11		11		11	11	11	0	0	0	5

Ped Vol: 30

Cross-Section #5
From: MLK To: Bronough

5

Ft/Tree	% Occ.
0	0%

EB

Pavement Cond:	4
Jay-Walking Calc:	NO

WB

Street Cross-Section (feet)

Sidewalk	Buffer	Shoulder Parking	Bike Ln	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Median	Trav. Lane	Trav. Lane	Trav. Lane	Trav. Lane	Bike Ln	Shoulder Parking	Buffer	Sidewalk
5	0	0	0	11	11	11		11		11	11	11	0	0	0	5

Ped Vol: 30

Urban Street Multimodal Level of Service
Data Collection Sheet - Vehicle Traffic

Direction: **EB**

Street: West Tennessee Street

Date: Oct. 21, 2008

Limits: Woodward to Bronough

Observer: Cherie Horne

Field Survey

	Segment And Downstream Signal From	To	Speed Limit (mph)	Median Type (0-3)	Left Turn Pocket (y/n)	Drivewys Rightside (#)	Unsig. Intersects (#)
1	Woodward	Dewey	35	3	YES	0	0
2	Dewey	Copeland	30	0	YES	10	1
3	Copeland	Macomb	30	0	YES	1	0
4	Macomb	MLK	30	0	YES	8	0
5	MLK	Bronough	30	0	NO	0	0

Traffic Counts K: N/A D: N/A

	Segment And Downstream Signal From	To	Vol (2-wy)	Heavy Vehicle (%)	RTOR+ PermLeft veh	Left/Right Turns %	Thru Adj. Sat. (vphgl)	PHF
1	Woodward	Dewey	1471	3%	0	3%	1693	0.93
2	Dewey	Copeland	1571	3%	3	10%	1619	0.93
3	Copeland	Macomb	1466	3%	3	9%	1619	0.93
4	Macomb	MLK	1453	3%	1	4%	1619	0.93
5	MLK	Bronough	1329	3%	4	11%	1619	0.93

Arterial Traffic Performance & Signal Timing

	Segment And Downstream Signal		Field Survey		Signal Timing Data			
	From	To	Mean Speed (mph)	Average Stops (#/veh)	Cycle Length (secs)	Grn/Cycle for Thru (%)	Ped Walk (sec/cyc)	Xing Ped Walk (sec/cyc)
1	Woodward	Dewey	29.8	0.0	140	70%	63	6
2	Dewey	Copeland	16.4	1.0	140	79%	72	6
3	Copeland	Macomb	11.9	0.7	140	55%	41	6
4	Macomb	MLK	29.0	0.7	140	97%	87	6
5	MLK	Bronough	19.1	0.0	140	59%	49	7

Notes: Median = 0 if None, 1 if one-way st., 2 if Painted or TWLTL, 3 if Raised
Heavy Vehicles = Buses plus trucks plus recreational vehicles
Thru Adusted Saturation Flow rates computed per Signalized Intersections Chapter, H(
Signal data is at the downstream signal

| Route |

Data Collection Sheet - Transit

Direction: **EB**

Street: West Tennessee Street

Date: Oct. 21, 2008

Limits: Woodward to Bronough

Observer: Cherie Horne

Field Survey

Segment			Bus Stop	Shelters	Benches	CBD
	From	To	(#)	(% stops)	(% stops)	(yes/no)
1	Woodward	Dewey	1	1%	0%	YES
2	Dewey	Copeland	1	0%	0%	YES
3	Copeland	Macomb	1	0%	0%	YES
4	Macomb	MLK	1	0%	0%	YES
5	MLK	Bronough	1	0%	0%	YES

Transit Performance Data

Segment			Route	Frequency	Load Factor	On-Time Perform.	Schedule Speed
	From	To	#'s	(bus/hr)	(pas/seat)	(%)	(mph)
1	Woodward	Dewey	1	1	19%	100%	12
			17	1	31%	100%	12
			21	1	67%	100%	12
			24	2	10%	100%	12
2	Dewey	Copeland	1	1	25%	100%	12
			17	1	16%	100%	12
			21	1	87%	100%	12
			24	2	40%	100%	12
3	Copeland	Macomb	1	1	56%	100%	12
			17	1	16%	100%	12
			21	1	87%	100%	12
			24	2	93%	100%	12
4	Macomb	MLK	1	1	56%	100%	12
			6	1	47%	100%	12
			13	3	34%	100%	12
			17	1	25%	100%	12
5	MLK	Bronough	21	1	67%	100%	12
			24	2	94%	100%	12
			1	1	63%	100%	12
			6	1	47%	50%	12

Bus is On-Time if arrives within:	17
Average Passenger Trip Length:	21

A. Compute Auto LOS and Performance

Street: **West Tennessee Street**

Direction=	Down	EB

1. Compute Eastbound Hourly Demand (v)

Segment & Downstream Signal	AADT (vpd)	Peak Factor K (#)	Dir. Factor D (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)	from:
1	1471	1.000	1.000	0.93	97%	1534	traffic
2	1571	1.000	1.00	0.93	90%	1520	traffic
3	1466	1.000	1.00	0.93	91%	1434	traffic
4	1453	1.000	1.00	0.93	96%	1500	traffic
5	1329	1.000	1.00	0.93	89%	1272	traffic

2. Compute Eastbound Hourly Capacity and V/C

Segment & Downstream Signal	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	v/c	v/c Check	from:
1	1693	3	0.70	3555	0.43	OK	xsec 1-3, traffic
2	1619	3	0.79	3837	0.40	OK	xsec 1-3, traffic
3	1619	3	0.55	2671	0.54	OK	xsec 1-3, traffic
4	1619	3	0.97	4711	0.32	OK	xsec 4-5, traffic
5	1619	3	0.59	2866	0.44	OK	xsec 4-5, traffic

3. Mean Through Speed (including delay at downstream signal)

Segment & Downstream Signal	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)	from:
1	35	1420	29.8	traffic, layout
2	30	990	16.4	traffic, layout
3	30	740	11.9	traffic, layout
4	30	890	29.0	traffic, layout
5	30	410	19.1	traffic, layout
Total/Ave.	31.6	4450	20.0	

4. Compute Stops & % Left Lane

Segment & Downstream Signal	Stops Per Mile (stps/mi)	Left Trn Ln (YES/NO)	Median Type	from:
1	0.00	YES	3	traffic
2	5.33	YES	0	traffic
3	4.99	YES	0	traffic
4	4.15	YES	0	traffic
5	0.00	NO	0	traffic
Total/Ave	2.85	0.60	0.96	

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment & Signal	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
2	10.3%	30.3%	27.0%	17.0%	9.7%	5.7%	3.03	C
3	11.1%	31.5%	26.8%	16.2%	9.1%	5.3%	2.97	C
4	13.4%	34.5%	25.8%	14.3%	7.6%	4.3%	2.81	C
5	30.6%	41.8%	16.5%	6.6%	3.0%	1.6%	2.14	B
Average	15.8%	37.0%	24.6%	12.7%	6.5%	3.6%	2.68	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

B. Pedestrian LOS

Street: **West Tennessee Street**

1. Compute Pedestrian Density LOS

Seg.	Sidewalk Width (ft)	Ped Flow (pph)	Space Per Ped (ft^2/ped)	Ped. Density LOS #	Ped. Density LOS	from
1	5	30	2400	0.00	A	xsec1-3
2	5	30	2400.0	0.00	A	xsec1-3
3	5	30	2400.0	0.00	A	xsec1-3
4	5	30	2400.0	0.00	A	xsec4-5
5	5	30	2400.0	0.00	A	xsec4-5

Density LOS Lookup

ft^2/ped	LOS
0	A
300	B
420	C
600	D
900	E
1380	F

2. Compute Pedestrian Segment LOS

Seg.	Outside Lane (ft)	Bike Ln + Park/Shldr (ft)	On-Street Parking Occ (%)	Barrier (ft/Tree)	Buffer Width (ft)	Dir. Traffic Volume (vph)	Traf. Lanes One-Dir (lanes)	Midblock Veh. Speed (mph)	Ped. Seg. LOS #	from
1	12	0	0%	0	2	1,582	3	32.4	3.47	xsec1-3
2	11	0	0%	0	0	1,689	3	23.2	3.40	xsec1-3
3	11	0	0%	0	0	1,576	3	21.0	3.26	xsec1-3
4	11	0	0%	0	0	1,562	3	29.5	3.42	xsec4-5
5	11	0	0%	0	0	1,429	3	24.6	3.20	xsec4-5

Midblock traffic speed = average of auto free-flow speed, and mean auto speed with intersection delay.

3. Compute Pedestrian Intersection LOS

Downstream Signal	RTOR+ Perm LT (vph)	X-Street Volume (vph)	X-Street PHF (#)	X-Street Speed (mph)	X-Street Lanes (#)	Ave Ped. Wait At Signal (sec)	Right Turn Channel Islands (#)	Ped. Intersect LOS #	from
1	0	675	0.93	30	3	21.2	0	2.73	layout, traffic
2	3	457	0.93	30	4	16.5	0	2.52	layout, traffic
3	3	1000	0.93	30	5	35.0	0	3.13	layout, traffic
4	1	170	0.93	30	2	10.0	0	2.15	layout, traffic
5	4	1692	0.93	30	3	29.6	0	3.82	layout, traffic

Pedestrian Delay computed per Chapter 18 method (eqn 18-5, HCM 2000).

4. Compute Roadway Crossing Difficulty Factor (RCDF)

Seg.	Signal Spacing (ft)	Cross St. Ped Wait (secs/cycle)	Divert Delay (sec)	Arterial X Distance (ft)	Midblock Veh Speed (mph)	Vehicle Vol 2-Dir (vph)	Number of stages to Cross	Wait To X (max=900) (sec)	J-Walking Calculation (Yes/No)	from
1	1420	64.1	251	72	32.4	1,471	2.0	599	NO	layout, traffic
2	990	64.1	180	66	23.2	1,571	2.0	554	NO	layout, traffic
3	740	64.1	138	66	21.0	1,466	2.0	450	NO	layout, traffic
4	890	64.1	163	65	29.5	1,453	2.0	400	NO	layout, traffic
5	410	63.2	83	66	24.6	1,329	2.0	332	NO	layout, traffic

5. Compute Pedestrian Facility LOS

Segment & Downstream Signal	Min. Wait,Divert (sec)	Crossing LOS (#)	No Cross LOS (#)	RCDF (#)	Ped. NDLOS (#)	Ped. Density LOS #	Ped. Fac. LOS (#)	Ped. Facility LOS
1	251	6.00	3.31	1.00	3.31	0.00	3.31	C
2	180	6.00	3.24	1.00	3.24	0.00	3.24	C
3	138	6.00	3.33	1.00	3.33	0.00	3.33	C
4	163	6.00	3.17	1.00	3.17	0.00	3.17	C
5	83	6.00	3.46	1.00	3.46	0.00	3.46	C
Average							3.28	C

C. Compute Transit LOS

Street: **West Tennessee Street**

1. Input Data

Segment	Transit Frequency (bus/h)	On-Time Performance (%)	Stops with Shelter (%)	Stops with Bench (%)	Pk Load Factor (p/seat)	Central Busi. District (Yes/No)	from
1	5	100%	1%	0%	0.27	YES	transit
2	5	100%	0%	0%	0.41	YES	transit
3	5	100%	0%	0%	0.69	YES	transit
4	6	100%	0%	0%	0.39	YES	transit
5	5	90%	0%	0%	0.73	YES	transit

2. Compute Mean Bus Speed

Segment	Length (ft)	Auto Spd (mph)	Bus Stops (#)	Ave Bus (mph)	from
1	1420	29.8	1	12.0	transit
2	990	16.4	1	12.0	transit
3	740	11.9	1	12.0	transit
4	890	29.0	1	12.0	transit
5	410	19.1	1	12.0	transit
Total/Ave	4450	20.0		12.0	

3. Compute Transit Perceived Travel Time and Headway Factors

Segment	a1 factor	IVTTR min/mi	EWTTR min/mi	ATR min/mi	PTTR	Fptt	Fh
1	1.00	5.00	0.00	0.00	5.00	1.08	3.00
2	1.00	5.00	0.00	0.00	5.00	1.08	3.00
3	1.00	5.00	0.00	0.00	5.00	1.08	3.00
4	1.00	5.00	0.00	0.00	5.00	1.08	3.15
5	1.00	5.00	0.14	0.00	5.28	1.05	3.00

IVTTR = In-Vehicle Travel Time Rate
EWTTR = Equivalent Wait Travel Time Rate
ATR = Amenity Time Rate
PTTR = Perceived Travel Time Rate
Fptt = Perceived Travel Time Factor
Fh = Headway Factor

4. Compute Transit LOS

Segment	Wait/Ride Score	Ped LOS	LOS Score	Transit LOS
1	3.23	3.31	1.65	A
2	3.23	3.24	1.64	A
3	3.23	3.33	1.66	A
4	3.39	3.17	1.39	A
5	3.16	3.46	1.78	A
Average			1.61	A

D. Compute Bicycle LOS

Street: **West Tennessee Street**

1. Geometric Input Data

Segment & Downstream Signal	Outside Lane Width (ft)	Bike/Shldr Lane Width (ft)	Through Lanes (lanes)	Divided/ Undivided (D/UD)	Sig. Int Cross-Dist (ft)	Unsig.Conf Per Mile (conf/mi)	from
1	12	0	3	D	46	0.0	xsec1-3, layout
2	11	0	3	D	52	58.7	xsec1-3, layout
3	11	0	3	D	84	7.1	xsec1-3, layout
4	11	0	3	D	43	47.5	xsec4-5, layout
5	11	0	3	D	52	0.0	xsec4-5, layout

2. Performance and Other Input Data

Segment & Downstream Signal	Traffic Volume (vph)	Heavy Vehicle (%)	Midblock Traffic Spd (mph)	On-Street Parking (%)	Pavement Rating (#)	from
1	1582	3%	32.4	0%	4.0	traffic, xsec1-3
2	1689	3%	23.2	0%	4.0	traffic, xsec1-3
3	1576	3%	21.0	0%	4.0	traffic, xsec1-3
4	1562	3%	29.5	0%	4.0	traffic, xsec4-5
5	1429	3%	24.6	0%	4.0	traffic, xsec4-5

Pavement Rating: 1=Poor, 5=Excellent
Midblock traffic speed = average of auto free-flow speed, and mean auto speed with inte

3. Compute Bicycle LOS

Segment & Downstream Signal	Prelim. Eff. Width (Wv)	Effective Width (We)	Speed Factor (#)	Segment LOS (#)	Intersect LOS (#)	Bicycle Score (#)	Bicycle LOS
1	12.0	12.0	3.63	4.26	3.25	3.81	D
2	11.0	11.0	2.11	3.89	3.62	5.94	F
3	11.0	11.0	0.81	3.41	4.04	4.27	E
4	11.0	11.0	3.33	4.27	3.40	5.52	F
5	11.0	11.0	2.51	3.94	3.46	3.83	D
Average						4.71	E

E. LOS Summary

Title: West Tennessee Street

Direction =	Down	EB	Date:	9/28/2008	Analyst:	AEN

Segment & Downstream Signal	Auto Stops LOS #1	Auto Speed LOS #2	Auto HCM LOS #3	Auto NCHRP 379 LOS #4	Transit LOS	Bicycle LOS	Pedestrian LOS
1	B	A	B	A	A	D	C
2	C	C	C	C	A	F	C
3	C	C	D	E	A	E	C
4	C	B	A	A	A	F	C
5	B	C	B	C	A	D	C
Facility	B	B	B	C	A	E	C

Auto Performance Measures Summary EB

Seg+Sig	Stops	FFS	Speed	%FFS
1	0.00	35.0	29.8	85.1%
2	5.33	30.0	16.4	54.7%
3	4.99	30.0	11.9	39.7%
4	4.15	30.0	29.0	96.7%
5	0.00	30.0	19.1	63.7%
Facility	2.85	31.6	20.0	63.3%

Spreadsheet created by: R.Dowling of Dowling Associates, Inc.
Under contract to:
Transportation Research Board
NCHRP 3-70 Multimodal Level of Service For Urban Streets

Spreadsheet is made available "As-Is" for TRB internal review.
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Spreadsheet is unsupported.
Spreadsheet does not have data entry error checking.
Created: 8-Jun-07 Updated: 25-Sep-08

Street: **West Tennessee Street**
(This sheet generates the LOS results for "results")

Direction= | **Down** | **EB**

Leave Blank Cells Alone. Have Eqns

A. Compute Auto LOS and Performance

1. Compute Eastbound Hourly Demand (v)

Segment	Weekday ADT (vpd)	Peak Factor k (#)	Dir. Factor d (#)	Pk.Hr.Fac. PHF (#)	Thru Traffic (%)	Demand v (vph)
1	1471	1.00	1.00	0.93	97%	1534
2	1571	1.00	1.00	0.93	90%	1520
3	1466	1.00	1.00	0.93	91%	1434
4	1453	1.00	1.00	0.93	96%	1500
5	1329	1.00	1.00	0.93	89%	1272

2. Compute Eastbound Hourly Capacity and V/C

Segment	Adjusted Saturation (vphgl)	Thru Lanes One-Dir. (#)	Thru (g/C) (#)	Capacity (vph)	V/c	V/c Check
1	1693	3	0.70	3555	0.43	OK
2	1619	3	0.79	3837	0.40	OK
3	1619	3	0.55	2671	0.54	OK
4	1619	3	0.97	4711	0.32	OK
5	1619	3	0.59	2866	0.44	OK

Adjusted Sat. Flows computed per Chapter 16, Signalized Intersections.

3. Compute Mean Through Speed

Segment	Free Speed (mph)	Segment Length (ft)	Average Speed (mph)
1	35	1420	29.8
2	30	990	16.4
3	30	740	11.9
4	30	890	29.0
5	30	410	19.1
Total/Ave.	31.6	4450	20.0

4. Compute Stops & % Left Lane

Segment	Average Speed (mph)	Median Type
1	29.8	3.0
2	16.4	0.0
3	11.9	0.0
4	29.0	0.0
5	19.1	0.0
Total/Ave	20.0	0.96

Median Types
0 = none
1 = one-way st
2= TWLTL
3 = Raised

5. Compute Auto LOS

Segment	LOS A (%)	LOS B (%)	LOS C (%)	LOS D (%)	LOS E (%)	LOS F (%)	Weight. Ave.	Auto LOS
1	38.8%	40.9%	12.5%	4.6%	2.1%	1.3%	1.94	A
2	9.6%	30.0%	26.5%	16.8%	10.0%	7.1%	3.09	C
3	6.8%	24.2%	26.2%	19.7%	13.1%	10.1%	3.38	C
4	23.4%	42.0%	19.5%	8.4%	4.1%	2.6%	2.36	B
5	11.8%	33.4%	25.9%	14.9%	8.4%	5.8%	2.92	C
Average	15.1%	37.2%	24.2%	12.5%	6.6%	4.4%	2.71	B

LOS:	A	B	C	D	E	F
weights:	1	2	3	4	5	6

APPENDIX E: PARTICIPANT SURVEY

Florida Multimodal Arterial LOS Questions for 12/11/08 Meeting

1. After the initial training workshop, how well did you feel that you understood the inputs and calculations of NCHRP 3-70 models (auto, ped, bike, and bus)?

☐ Did not understand at all ☐ Partially understood ☐ Mostly understood ☐ Perfectly understood

If your answer to the previous question was something other than 'perfectly understood', was there anything that could have been done differently within the same time frame of the training session that would have increased your level of understanding?

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2. After completing your analyses, how well did you feel that you understood the inputs and calculations of the NCHRP 3-70 models?

☐ Did not understand at all ☐ Partially understood ☐ Mostly understood ☐ Perfectly understood

If your answer to the previous question was something other than 'perfectly understood', what inhibited your ability to perfectly understand the inputs and calculations of the NCHRP 3-70 models (e.g., insufficient documentation, insufficient support from research team, insufficient personal technical background, difficulties with spreadsheet implementation, etc.)?

____

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3. For each of the data items below, rank the difficulty of collecting or obtaining accurate estimates of each one on a scale of 1-10 (with 1 being very easy and 10 being very difficult). Additionally, if you feel that it would be acceptable to use a default value (based on a statewide average) for the data item, check the box next to it.

Roadway Data	Traffic Data
____ Number of lanes ☐	____ Daily/hourly counts ☐
____ Outside lane width ☐	____ K factor/D factor ☐
____ Presence of turn lanes ☐	____ % heavy vehicles ☐
____ Presence and type of median ☐	____ peak hour factor ☐
____ Posted Speeds ☐	____ % turns at signalized intersections ☐
____ Presence of bike lane ☐	____ Right turn on red/permitted lefts ☐
____ Presence of sidewalk ☐	____ Free flow speed ☐
____ Driveways/unsignalized intersections☐	____ Average travel speed ☐
	____ Number of stops ☐

Signal Data	Transit Data
____ Cycle length ☐	____ Frequency ☐
____ Green times ☐	____ Schedule speed ☐
____ Arrival type ☐	____ On-Time Performance ☐
____ Adjusted saturation flow rate ☐	____ Load Factor ☐
____ Pedestrian crossing times ☐	____ Location and type of transit stops ☐

4. Were there any specific compromises (in your opinion) that you made with the collection of any of these data items that you feel would be acceptable in all situations? If so, please describe.

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5. Are there any specific data values you used in your analyses that you feel may be significantly affecting the accuracy of the obtained LOS results? If so, please explain.

____

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____

6. For each of the following modes and models, rank how well the LOS results from your analyses match with your own personal perceptions of the LOS. Use a scale of 1-6 (with 1 indicating the worst match and 6 indicating a perfect match). For example, if the calculated LOS for one of your arterials was 'A' and your perception of the LOS is 'F', then rank this situation as a '1'.

Mode/Model	Arterial 1	Arterial 2	Arterial 3	Arterial 4
Auto				
Stops and left turn bay				
Average travel speed and median				
Existing HCM method (arterial class and average travel speed)				
Slightly revised HCM method (% of free flow speed with no arterial class)				
Transit				
Bike				
Pedestrian				

7. For model LOS results (by arterial) that differed significantly from your personal perception of LOS, please explain why you feel your perceived LOS values are better or worse than the model estimated LOS.

____

____

____

____

8. If you are familiar with the current HCM (2000) method for assessing automobile LOS on urban arterials, how would you compare:

The ease/difficulty of applying the methods

- ☐ The HCM method is much easier to apply than the NCHRP 3-70 method
- ☐ The HCM is slightly easier to apply than the NCHRP 3-70 method
- ☐ They are about the same ease/difficulty to apply
- ☐ The NCHRP 3-70 method is slightly easier to apply than the HCM method
- ☐ The NCHRP 3-70 method is much easier to apply than the HCM method

The accuracy of the results

- ☐ The HCM method is much more accurate than the NCHRP 3-70 method
- ☐ The HCM is slightly more accurate than the NCHRP 3-70 method
- ☐ They are about the same accuracy
- ☐ The NCHRP 3-70 method is slightly more accurate than the HCM method
- ☐ The NCHRP 3-70 method is much more accurate than the HCM method

9. If you are familiar with the ARTPLAN 2007 methods for assessing multimodal LOS on urban arterials, how would you compare

The ease/difficulty of applying the methods

- ☐ The ARTPLAN method is much easier to apply than the NCHRP 3-70 method
- ☐ The ARTPLAN is slightly easier to apply than the NCHRP 3-70 method
- ☐ They are about the same ease/difficulty to apply
- ☐ The NCHRP 3-70 method is slightly easier to apply than the ARTPLAN method
- ☐ The NCHRP 3-70 method is much easier to apply than the ARTPLAN method

The accuracy of the results

- ☐ The ARTPLAN method is much more accurate than the NCHRP 3-70 method
- ☐ The ARTPLAN is slightly more accurate than the NCHRP 3-70 method
- ☐ They are about the same accuracy
- ☐ The NCHRP 3-70 method is slightly more accurate than the ARTPLAN method
- ☐ The NCHRP 3-70 method is much more accurate than the ARTPLAN method

10. Is a simultaneous multimodal approach to analyze an arterial desirable or is it better to have each mode addressed in separate studies?

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____

11. Would you recommend it for inclusion in the next update of the Highway Capacity Manual (Yes or No)? If your answer is no, please explain why not.

____

____

____

12. Can you/your agency perform the MMLOS work directly or would you need consultant services?

____

____

____

If you have suggestions for improvements to the MMLOS spreadsheet tool, please bring a printout of the sheets with markups and/or notes.

Thanks!

APPENDIX F: SURVEY RESPONSES

After the initial training workshop, how well did you feel that you understood the inputs and calculations of NCHRP 3-70 models (auto, ped, bike, and bus)?	Did not understand at all	Partially understood	Mostly understood	Perfectly understood	If your answer to the previous question was something other than 'perfectly understood', was there anything that could have been done differently within the same time frame of the training session that would have increased your level of understanding?	After completing your analyses, how well did you feel that you understood the inputs and calculations of the NCHRP 3-70 models?	Did not understand at all	Partially understood	Mostly understood	Perfectly understood	If your answer to the previous question was something other than 'perfectly understood', what inhibited your ability to perfectly understand the inputs and calculations of the NCHRP 3-70 models (e.g., insufficient documentation, insufficient support from research team, insufficient personal technical background, difficulties with spreadsheet implementation, etc.)?	**Roadway Data**	Number of lanes	Outside lane width	Presence of turn lanes	Presence and type of median	Posted Speeds	Presence of bike lane	Presence of sidewalk	Driveways/unsignalized intersections	**Traffic Data**	Daily/hourly counts	K factor/D factor	% heavy vehicles	peak hour factor	% turns at signalized intersections	Right turn on red/permitted lefts	Free flow speed	Average travel speed	Number of stops	**Signal Data**	Cycle length
			x		No, excellent training, looked forward to applying with our own data.				x		I "understood" but not having computed the calculations before, takes practice.		1	2	1	2	1	1	1	5		2	2	2	2	2	5	6	6	3		3
			x		Probably not--It is important to have someone to call once getting into the data gathering and input because some things don't make sense until you do it. In that vein, maybe a simple walk through exercise with actual data entry would help.				x		Perfectly understood once talking with support team staff. Need to allow for input of peak data instead of just AADT.		1	4	1	1	1	1	1	1		8	**1**	**4**	**1**	**6**	**6**	8	8	8		3
			x		I don't think so. There was not much time.					x	--	b	1	--	2	4	--	3	3	--		--	--	--	--	--	--	--	--	--		--
			x		--					x	--	e	x	x	x	x	x	x	x	--		x	x	x	x	x	x	--	--	--		x
			x		We were required to work on the Auto aspect of these models. Therefore we have concentrated on Auto related inputs and calculations. We felt that we have good understanding of the Autos inputs and calculations. However, with the model inputs and calculations for other modes, i.e., Pedestrian, Bike and Transit, we did not work with directly, and therefore have no comment on.				x		As mentioned earlier our work efforts were concentrated only on Auto aspect of the models, therefore we don't have any experience with the other travel modes included in these models.		2	2	2	2	2	2	2			3	3	3	3	3	4	5	5	8		3

bolded numbers indicate data item for which the use of a default value would be acceptable
b "did not collect data item for blank values"
c "unknown term"
e only defaults were indicated, no rankings were given

Green times	Arrival type	Adjusted saturation flow rate	Pedestrian crossing times	**Transit Data**	Frequency	Schedule speed	On-Time Performance	Load Factor	Location and type of transit stops	Were there any specific compromises (in your opinion) that you made with the collection of any of these data items that you feel would be acceptable in all situations? If so, please describe.	Are there any specific data values you used in your analyses that you feel may be significantly affecting the accuracy of the obtained LOS results? If so, please explain.	**Arterial 1**	Stops and left turn bay	Average travel speed and median	Existing HCM method	% FFS	Transit	Bike	Pedestrian	**Arterial 2**	Stops and left turn bay	Average travel speed and median	Existing HCM method	% FFS	Transit	Bike	Pedestrian	**Arterial 3**	Stops and left turn bay	Average travel speed and median	Existing HCM method	% FFS	Transit	Bike	Pedestrian	**Arterial 4**	Stops and left turn bay	Average travel speed and median	Existing HCM method	% FFS
3	--	6	4		--	--	--	--	--	--	--		2	4	4	4	5	5	5		5	5	4	4	6	2	2		6	5	5	5	5	5	5		4	4	3	3
3	3	3	3		2	2	6	8	3	Estimating RTOR and Permitted lefts	Time of data collection – times got faster near the end of peak		6	6	6	6	6	6	6		4	4	4	4	2	6	6		4	5	6	6	6	2	3		6	6	6	6
--	--	--	--		1	c	9	8	1	No	On time performance. It should be done on a route or system wide basis. Not good for individual stops! Frequency should be "real", not an average (6 buses leaving once would be averaged as a 10-min headway.)		NA	NA	NA	NA	1	1	1		NA	NA	NA	NA	1	4	3		NA	NA	NA	NA	3	1	2		NA	NA	NA	NA
x	x	x	--		x	--	x	x	x	NA	No	Archer	6	6	6	6	6	6	6	NW 13th	4	4	4	5	6	6	6	Tower	3	4	3	4	6	4	6	Univ.	3	4	4	5
3	6	4	NA		NA	NA	NA	NA	NA	NCHRP 3-70 models are setup for five segments in each corridor. It should be readily adaptable for more or less than five segments.	No		2	2	4	5	NA	NA	NA		3	3	6	6	NA	NA	NA		3	2	6	5	NA	NA	NA		NA	NA	NA	NA

Transit	Bike	Pedestrian	For model LOS results (by arterial) that differed significantly from your personal perception of LOS, please explain why you feel your perceived LOS values are better or worse than the model estimated LOS.	**The ease/difficulty of applying the methods**	The HCM method is much easier to apply than the NCHRP 3-70 method	The HCM is slightly easier to apply than the NCHRP 3-70 method	They are about the same ease/difficulty to apply	The NCHRP 3-70 method is slightly easier to apply than the HCM method	The NCHRP 3-70 method is much easier to apply than the HCM method	**The accuracy of the results**	The HCM method is much more accurate than the NCHRP 3-70 method	The HCM is slightly more accurate than the NCHRP 3-70 method	They are about the same accuracy	The NCHRP 3-70 method is slightly more accurate than the HCM method	The NCHRP 3-70 method is much more accurate than the HCM method	**The ease/difficulty of applying the methods**	The ARTPLAN method is much easier to apply than the NCHRP 3-70 method	The ARTPLAN is slightly easier to apply than the NCHRP 3-70 method	They are about the same ease/difficulty to apply	The NCHRP 3-70 method is slightly easier to apply than the ARTPLAN method	The NCHRP 3-70 method is much easier to apply than the ARTPLAN method	**The accuracy of the results**	The ARTPLAN method is much more accurate than the NCHRP 3-70 method	The ARTPLAN is slightly more accurate than the NCHRP 3-70 method	They are about the same accuracy	The NCHRP 3-70 method is slightly more accurate than the ARTPLAN method
2	2	2	The auto LOS from the model seemed to assign a better LOS than perceived. I hope this is only from the "impatience" factor! Demonstrates the need to shift focus to improvement to the other modes which may have much less cost (than adding MV lanes or turning movement changes) and the auto LOS will still be acceptable.		--	--	--	--	--		--	--	--	--	--		x									x
--	2	3	The bike scores seemed worse than expected.		--	--	--	--	--		--	--	--	--	--		x					a				
2	2	2	For bicycle artierial 2, the speed is not high, there are bike lanes and it is a relatively safe and attractive environment.	d						d						d						d				
6	3	6	Auto LOS on NW 13th is worse; Bike LOS on University Ave is worse				x					x					x									x
NA	NA	NA	The perceived LOS Values were found to be consistent with the HCS, ARTPLAN and SYNCHRO calculations.			x							x					x							x	

a "Haven't compared these segments because don't have ARTPLAN data for all of them'

d "Not familiar"

The NCHRP 3-70 method is much more accurate than the ARTPLAN method	Is a simultaneous multimodal approach to analyze an arterial desirable or is it better to have each mode addressed in separate studies?	Would you recommend it for inclusion in the next update of the Highway Capacity Manual (Yes or No)? If your answer is no, please explain why not.	Can you/your agency perform the MMLOS work directly or would you need consultant services?
	I prefer the holistic approach – more palatable to road engineers/designers if one mode (auto!) is not neglected.	Yes! After more refining, should be widely accepted.	If data collection is needed, may have to use consultant, if data already on hand, input and analysis should be no problem.
	Together – policy decisions will benefit from having unified model	Yes	Yes, although if staffing levels are low, may require new people for consultant to gather some field data.
	Desirable	Yes	The load factor would require outside assistance, because of the need for observers. None of the other data collection (bike/ped/transit) was outside the capabilities of our office.
	Yes	Yes	Work directly, but may need assistance for data collection
	Depending upon the area type and facility type, simultaneous multimodal approach is desirable.	Yes	This new MMLOS methodology should follow the procedures we presently use, i.e., consultant services. Primarily due to data collection requirements rather than ease of use of the modeling application.