A Traffic Operations Method for Assessing Automobile and Bicycle Shared Roadways

A Thesis Proposal
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Submitted to the Office of Graduate Studies
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

June 22, 2010

Major Subject: Civil Engineering
INTRODUCTION
A national push for bicycle consideration and demand for performance based project assessment has resulted in the need for sound technical methods for evaluating bicycle facilities. Shared roadways are bicycle facilities in which automobiles and bicycles share the traveled way. Guidance on the implementation and use of shared roadways is limited. The Oregon Department of Transportation (ODOT) has made progress in this area by developing a bicycle lane matrix and supporting context matrix; the matrices are shown in Figure 1 and Table 1.

![Figure 1 Proposed Oregon Bicycle Lane Matrix (ODOT 2009)](image)

**Table 1 Proposed Oregon Bicycle Lane Context Matrix (ODOT 2009)**

<table>
<thead>
<tr>
<th>Context</th>
<th>Need for Bike lane</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Land Use Indicators</td>
<td></td>
</tr>
<tr>
<td>Urban Center, CBD</td>
<td>Decreases</td>
</tr>
<tr>
<td>Suburban</td>
<td>Increases</td>
</tr>
<tr>
<td>Buildings at back of sidewalk</td>
<td>Decreases</td>
</tr>
<tr>
<td>Buildings set back from roadway (parking lots front street)</td>
<td>Increases</td>
</tr>
<tr>
<td>On Street Parking</td>
<td>Decreases</td>
</tr>
<tr>
<td>Short block length</td>
<td>Decreases</td>
</tr>
<tr>
<td>Long block length</td>
<td>Increases</td>
</tr>
<tr>
<td>2. Traffic speed/volume indicators</td>
<td></td>
</tr>
<tr>
<td>Signal coordination timed at higher than posted speeds</td>
<td>Increases</td>
</tr>
<tr>
<td>Signal coordination timed at lower than posted speeds</td>
<td>Decreases</td>
</tr>
<tr>
<td>Peak Hourly Traffic Volume greater than 10%</td>
<td>Increases</td>
</tr>
<tr>
<td>3. Roadway characteristics</td>
<td></td>
</tr>
<tr>
<td>Wide roadway / multiple travel lanes</td>
<td>Increases</td>
</tr>
<tr>
<td>Steep grades: uphill</td>
<td>Increases</td>
</tr>
<tr>
<td>Steep grades: downhill</td>
<td>Decreases</td>
</tr>
<tr>
<td>4. Bicycling demand indicators</td>
<td></td>
</tr>
<tr>
<td>Popular Route to School</td>
<td>Increases</td>
</tr>
<tr>
<td>Provides continuity of bike lanes, routing or trail</td>
<td>Increases</td>
</tr>
<tr>
<td>Other high-use indicators</td>
<td>Increases</td>
</tr>
</tbody>
</table>

The proposed ODOT matrices seem to be based upon engineering judgment and have not yet been sanctioned for use in practice. As shown, the ODOT matrix ignores bicycle demand when making decisions. Difficulties associated with estimating bicycle demand may be the reasoning behind this (Dill and Voros 2007). A bicycle matrix that looks at posted speed limits and
average daily traffic provides a way for making decisions without needing accurate bicycle demand estimations.

What the ODOT matrix needs is empirical backing for determining when shared roadways should not be used. The author proposes investigating automobile level of service impacts caused by bicycles on shared roadways as an empirical method for determining when shared roadways should not be used. The author proposes using microsimulation to evaluate considerations present in the Highway Capacity Manual (HCM) and multimodal level of service models (Dowling et. el. 2008). The author proposes using these findings to develop an empirically based method for evaluating shared roadways. This research proposal outlines the current problem, background, research objectives, tasks, and potential benefits of the research findings.

PROBLEM STATEMENT

Empirical methods for evaluating transportation facilities are needed as the transportation field shifts towards performance based project assessment. This shift is occurring in conjunction with a national push for bicycle consideration in transportation planning and design. Hence, there is a growing need for empirical methods for evaluating bicycle facilities.

Shared roadways are one type of bicycle facility considered by transportation agencies. Shared roadways allow bicycles and motor vehicles to operate in the same traveled way. Shared roadways are an economical way of providing bicycle facilities in urban areas with limited right-of-way. Transportation agencies that wish to consider shared roadways would benefit from an empirical methodology. An empirically supported methodology for evaluating shared roadways would be more conducive to performance based project assessment.

RESEARCH GOAL, SCOPE, AND OBJECTIVES

The purpose of this study is to develop an empirically supported methodology for determining when shared roadways are not acceptable based upon multimodal Level of Service (LOS) analysis. The author proposes using microsimulation to evaluate changes in automobile LOS that result from bicycle presence in the traveled way. The author proposes an evaluation of bicycle LOS using the model developed in National Cooperative Highway Research Program
(NCHRP) Report 616 (Dowling et. al. 2008). The results of the automobile and bicycle LOS investigations can then be used to develop an empirical method for evaluating when shared roadways should not be used. The following primary independent variables are proposed:

- Automobile speed,
- Automobile volume,
- Number of travel lanes, and
- Shared roadway type.

**Research Scope**

This research seeks to evaluate shared roadways from a traffic operations perspective. A basic assumption of this research is that a bicycle facility is desired; therefore, this research seeks to determine when shared roadways should not be used. The purpose of this research is to provide a recommendation based upon an evaluation of automobile and bicycle LOS. The author proposes only evaluating variables that can be simulated in VISSIM or variables that are included in the NCHRP bicycle LOS model.

The author proposes an investigation of two types of shared roadways: wide outside lanes and unadjusted outside lanes. Wide outside lanes allow an automobile to pass a bicycle without changing lanes. Unadjusted outside lanes require an automobile to change lanes in order to pass a bicycle.

The author proposes recording shared roadway safety considerations as part of the literature review. An empirical safety analysis is outside the scope of this research. This research assumes shared roadways are safe when developed under current guidance.

The author proposes selecting variable values and ranges based upon functional classification. For example, key variables in this study are: automobile speed, automobile volume, and number of lanes. Ranges for each of these variables will be obtained using research studies that have looked at functional classification. Urban street functional classifications that seek to balance mobility and access are the focus of this research; this means minor arterials and collectors.
Research Objectives

The author proposes to achieve the following objectives:

1. Define roadway design and traffic flow independent variables related to shared roadways,
2. Summarize safety consideration related to the defined independent variable,
3. Select and calibrate microsimulation model parameters,
4. Conduct microsimulation using the calibrated parameters to evaluate automobile level of service,
5. Evaluate the effect independent variables have on automobile level of service,
6. Evaluate the effect independent variables have on bicycle level of service, and
7. Finalize an empirical method for evaluating shared roadways using automobile and bicycle level of service findings.

BACKGROUND

This section contains background information pertaining to the study design. Further effort will be made in task one of the project to thoroughly investigate the state of understanding and practice. This section contains background information related to bicycle user characteristics, bicycle facility design, bicycle driving practices, microsimulation, and level of service analysis.

Bicycle User Characteristics

According to AASHTO’s (1999) A Guide for the Development of Bicycle Facilities there are three types of bicycle users. They are: children, amateur cyclists, and experienced cyclists. Shared roadways are intended for amateur and experienced cyclists (AASHTO 1999). In general, bicycles can operate within a width of 4 ft; however, a width of 5 ft is preferred. Bicycles on a flat surface can travel at 20 miles per hour; however, the 85th percentile speed is 14 mph. (AASHTO 1999)

Non-Designated Shared Roadways

Bicyclists will use almost any facility where they are permitted; thus, bicycles should be considered in the design of all roadways where bicycles are not prohibited (AASHTO 2004). On urban streets, wide curbed lanes can be used to provide facilities for bicycles. These types of facilities allow for bicycles and passenger vehicles to pass each other without lane change maneuvers. These types of facilities also allow bicycles to move around in the lane avoiding vehicles in driveways and other roadside obstacles.
Suggested Riding Practices
The League of American Bicyclists has the following safety tips:

- Bicycles should ride in the same direction as vehicles,
- Bicycles should obey all signs, signals, and markings,
- Bicycles should ride in the proper lanes (e.g. left turn lane when turning left), and
- Bicycles should stay to the right unless passing. (League of American Bicyclists 2010)

In cases where there is insufficient right-of-way, bicycles are encouraged to ride more towards the center of the travel lane (League of American Bicyclists 2010). This practice, of riding more towards center, may also be necessary in situations where bicycles might encounter open doors from parked cars or to increase sight line visibility at intersections. This type of riding causes additional delay to motor vehicles in the traveled way.

Microsimulation
VISSIM 5.10 is a microsimulation program capable of modeling bicycles in the traveled way. All vehicles in VISSIM are modeled individually. There are four parameter sets in VISSIM for bicycles and motor vehicles. They are: following, lane change, lateral placement, and reaction to signal control. Automobiles and bicycles can have different values for each parameter set.

This means bicycles can be simulated with different following behavior than automobiles. Effort will be made in the literature review to determine what the initial parameters should be prior to calibration. (PTV 2008)

Level of Service
Level of Service (LOS) is defined as, “a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience” (HCM 2000, pg. 2-2). This means LOS describes operating conditions and how a driver would perceive these conditions (HCM 2000). One purpose of NCHRP Report 616 was to incorporate perception into the HCM 2010 LOS models (Dowling et. el. 2008). The NCHRP Report 616 models for three of the four modes will likely be adopted in the HCM 2010. The three models likely to be adopted are: bicycle, transit, and pedestrian. The HCM 2010 automobile LOS assessment criteria for urban arterials will likely be a more formalized version of observations already included in the manual (Bonneson et. el. 2008).
**Bicycle LOS**

HCM 2000 bicycle LOS criteria for urban streets are based upon average bicycle travel speed. The LOS criteria for urban streets with bicycle lanes and an assumed bicycle free flow speed of 15 mph are: LOS A > 14 mph, LOS B > 9 to 14 mph, LOS C > 7 to 9 mph, LOS D > 5 to 7 mph, LOS E > 4 to 5 mph, LOS F < 4 mph. These values are bicycle speeds and include reductions in speed that are the result of control delay.

NCHRP Report 616 suggests two bicycle LOS models based upon user perception data (Dowling et. al. 2008). These models were constructed using user responses to varying conditions shown to them in videos. Their rating of the videos resulted in the following variables being included in both models (Dowling et. al. 2008):

- Motor vehicle volume,
- Heavy vehicle volume,
- Average motorized vehicle running speed,
- Pavement quality,
- Outside lane effective width, and
- Number of driveways plus unsignalized intersections per mile.

Lower perceived levels of service occur when the following increase: motor vehicle volume, heavy vehicle volume, average motorized vehicle running speed, and number of driveways plus unsignalized intersections per mile. Higher perceived LOS results from: Increases in pavement quality and increases in outside lane effective width. Pavement quality is based upon the FHWA’s five point pavement surface condition rating. Perceived outside width includes shoulders and bicycle lanes if present.

**Automobile LOS**

LOS for urban streets is based upon: average travel speed, urban street classification, range of free flow speeds, and typical free flow speed (HCM 2000). The current free flow ranges for an urban street class 3 with a free flow speed of 30 mph are shown in Table 2. These values are also provided as a percentage.
Table 2 HCM 2000 and NCHRP 3-79 Urban Street LOS Criteria

<table>
<thead>
<tr>
<th>Free Flow Speed</th>
<th>HCM 2000</th>
<th>HCM as Percent*</th>
<th>NCHRP 3-79*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS A</td>
<td>&gt; 30 mph</td>
<td>&gt; 100 %</td>
<td>&gt; 85 %</td>
</tr>
<tr>
<td>LOS B</td>
<td>&gt; 24 to 30 mph</td>
<td>&gt; 80 to 100 %</td>
<td>&gt; 67 to 85 %</td>
</tr>
<tr>
<td>LOS C</td>
<td>&gt; 18 to 24 mph</td>
<td>&gt; 60 to 80 %</td>
<td>&gt; 50 to 67 %</td>
</tr>
<tr>
<td>LOS D</td>
<td>&gt; 14 to 18 mph</td>
<td>&gt; 47 to 60 %</td>
<td>&gt; 40 to 50 %</td>
</tr>
<tr>
<td>LOS E</td>
<td>&gt; 10 to 14 mph</td>
<td>&gt; 33 to 47 %</td>
<td>&gt; 30 to 40 %</td>
</tr>
<tr>
<td>LOS F</td>
<td>&lt; 10 mph</td>
<td>&lt; 33 %</td>
<td>&lt; 30 %</td>
</tr>
</tbody>
</table>

*Percentages are the percent of free flow speed.

During NCHRP Project 3-79 automobile LOS criteria based upon percent below free flow speed were evaluated for inclusion in the 2010 version of the HCM (Bonneson et. el. 2008). The recommended LOS thresholds are shown in Table 2. The HCM and NCHRP methods include reductions in average travel speed resulting from control delay.

RESEARCH STUDY DESIGN

This section contains the proposed tasks needed to meet the project goals and objectives. There are eight proposed tasks. These tasks are:

- Task 1: Literature review,
- Task 2: Define roadway design and traffic flow independent variables,
- Task 3: Select and calibrate microsimulation model parameters,
- Task 4: Construct microsimulation models,
- Task 5: Conduct microsimulation,
- Task 6: Evaluate automobile level of service,
- Task 7: Evaluate bicycle level of service, and
- Task 8: Develop empirical methodology that balances automobile and bicycle level of service.

Task 1: Literature Review

The purpose of this task is to summarize the state of practice in shared roadway design and planning. The findings from this investigation will guide choices made in future tasks. Of key interest in the literature review are: present guidance on when shared roadways should not be used, typical characteristics of roadway functional classifications, multimodal Level of Service (LOS) analysis, and microsimulation of bicycle facilities.

6/22/2010
Task 2: Define Roadway Design and Traffic Flow Independent Variables

The purpose of this task is to identify roadway design and traffic flow independent variables related to shared roadways. After identifying these variables the author will select values and ranges for each independent variable. The author proposes only investigating independent variables that can be simulated in VISSIM or independent variables included in the NCHRP bicycle LOS model. Independent variables that effect automobile LOS will be used to develop microsimulation model parameters in task 3. Independent variables that effect bicycle LOS will be used to evaluate bicycle LOS in task 7. Balancing independent variables that effect both automobile and bicycle LOS will be a focus of task 8. The author will select variable ranges based upon functional classification, as indicated in the Research Scope.

Roadway design independent variables are variables related to the physical layout of the roadway. Some roadway design independent variables are:

- On street parking,
- Driveway conflicts per mile,
- Pavement condition,
- Cross street width, and
- Signalized intersection spacing.

Traffic flow independent variables are variables related to the demand and capacity of the roadway system. Some key traffic flow independent variables are:

- Traffic volume,
- Bicycle volume,
- Signal cycle length, and
- Signal green time.

Additional roadways design and traffic flow independent variables will be found as part of the literature review.

The author will need to handle each independent variable differently. Independent variables that only apply to automobile LOS will be evaluated through microsimulation. Independent variables that only apply to bicycle LOS will be evaluated using the model developed in NCHRP Report.
616. The author will attempt to evaluate variables that apply to automobile and bicycle LOS using both methods; this may not be possible for all variables.

When simulation is not possible, the author will indicate the independent variables theoretical effect on automobile LOS and state why the variable was not included in simulation. Potential reasons for not modeling a specific variable are:

- An inability to calibrate the simulation model for that variable or
- An inability of VISSIM to model the specified variable.

The author will still perform an empirical analysis of these variables in relation to bicycle LOS using the NCHRP bicycle LOS model. The author will use the theoretical summary and empirical analysis to develop a final empirical method for assessing shared roadways.

On street parking is an example of a variable that may not be simulated but is included in the NCHRP bicycle LOS model. Calibrating a model that includes on street parking is beyond the scope of this research effort. It is the intention of the author to summarize how on street parking effects automobile LOS based upon past research. The author intends to perform an empirical analysis of bicycle LOS in relation to on street parking using the NCHRP bicycle LOS model. The author will use these findings to develop a final methodology that includes this independent variable.

At the end of this task a summary of independent variables will be generated. This summary will be included in the final report. The summary will include values for use in automobile and bicycle LOS assessment. The automobile and bicycle empirical assessment techniques are explained in task 6 and task 7, respectively.

**Task 3: Select and Calibrate Microsimulation Model Parameters**

The purpose of task 3 is to select and calibrate the microsimulation model parameters in VISSIM. The author proposes using the same parameters for all simulation runs once the parameters are calibrated. Key microsimulation model parameters are:

- Vehicle speed profiles,
- Vehicle type characteristics, and
Driver behavior.

The author proposes defining speed profiles based upon standard deviation from the mean. The Institute of Transportation Engineers Traffic Engineering Handbook 6th Edition (2009) defines typical automobile standard deviation from the mean along 2 and 4 lane urban roadways. Bicycle speed profiles will be looked for as part of the literature review. The author proposes not changing speed profiles as part of model calibration.

The author proposes defining vehicle type characteristics using the AASHTO design vehicle dimensions for passenger cars and bicycles. Passenger car dimensions can be found in A Policy on Geometric Design of Highway and Streets (AASHTO 2004). Bicycle dimensions can be found in A Guide for the Development of Bicycle Facilities (AASHTO 1999). The author proposes not changing vehicle type characteristics as part of model calibration.

The author proposes defining initial driver behavior variables based upon findings of the literature review. Driver behavior variables will be the focus of model calibration. The author proposes defining driver behavior variables for automobiles and bicycles only. This means having traffic streams that do not contain heavy vehicles. The base value for heavy vehicles in the HCM is zero heavy vehicles. There are four driver behavior parameter sets in VISSIM:

- Following,
- Lane change,
- Lateral, and
- Signal control

The “following” parameter set determines how each vehicle will follow a lead vehicle. The “lane change” parameter set determines when a vehicle will change lanes. The “lateral” parameter set determines where a vehicle will position itself in the lane. The “lateral” parameter set also determines how an automobile will pass a bicycle in a wide outside lane. The “signal” parameter set defines how a vehicle will react to the amber light on a traffic signal. The author proposes calibrating each of these parameter sets as part of model calibration.
The author proposes following the calibration methods defined in the Guidelines for Applying Traffic Microsimulation Modeling Software (Dowling 2002). The author proposes noting instances when following a specific guideline is not possible as part of the final document.

The author proposes model confirmation by a professional engineer with automobile and bicycle experience as the minimum amount of calibration that will be done. This method will be used if the author is unable to find a data set that can be used to calibrate parameters in VISSIM. It is outside the scope of this research effort to collect data for model calibration.

This task will result in microsimulation parameters that will be used to conduct all simulations in task 5. These parameters will be provided as part of the final document.

**Task 4: Construct Microsimulation Models**

The purpose of task 4 is to construct microsimulation models using the independent variables defined in task 2 and the parameters calibrated in task 3. The proposed minimum number and combination of microsimulation models are shown in . The author proposes constructing microsimulation models for additional independent variables using scenario 1 and scenario 2. The author proposes: eight base models, four wide outside lane comparison models, six unadjusted outside lane models, and two models for each independent variable that can be simulated. This task will result in a model being constructed for each scenario identified.

**Task 5: Conduct Microsimulation**

The purpose of task 5 is to conduct microsimulation using the models constructed in task 4. The author proposes using the microsimulation outputs to evaluate automobile LOS in task 6. Automobile average speed is the output needed to evaluate automobile LOS using the proposed NCHRP 3-79 method.

The author proposes conducting simulation for a range of desired automobile speeds and a range of automobile volumes. The author proposes having automobile volumes that would warrant a signal as the minimum. The author proposes having automobile volumes that result in automobile LOS F as the maximum. The author proposes determining the desired speed conditions based upon functional classification, as indicated in the research scope.
Table 3 Microsimulation Model Matrix

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Wide Outside Lane</th>
<th>Unadjusted Outside Lane</th>
<th>Additional Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Lanes</td>
<td>Cycle Length</td>
<td>Green Time</td>
</tr>
<tr>
<td>Scenario 1</td>
<td>Value 1</td>
<td>Value 1</td>
<td>Value 1</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>Value 2</td>
<td>Value 1</td>
<td>Value 1</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Value 2</td>
<td>Value 1</td>
<td>Value 2</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Value 2</td>
<td>Value 2</td>
<td>Value 1</td>
</tr>
</tbody>
</table>

Notes:

- **Bold and italicized names are the base simulation models,**
- **Italicized names are comparison simulation models (comparison models include bicycle volume),**
- Number of lane, cycle length, and green time values will be selected as part of task 2,
- Automobile volume ranges will be selected as part of task 2,
- Bicycle volume 1 and volume 2 will be selected as part of task 2,
- Additional variables will be defined as part of task 2,
- An additional variable column will be added for each variable that can be simulated, and
- Additional variable simulation models will use bicycle volume 2.

6/22/2010
The author proposes selecting a number of seeds based upon the guidance found in Guidelines for Applying Traffic Microsimulation Modeling Software (Dowling 2002). A sufficient number of seeds are needed to obtain results that are reasonable. For example, we need to obtain a general every day situation that is not the result of high bicycle and vehicle volumes arriving on the system at the same time.

This task will result in a table of average vehicle speeds for each speed condition and volume simulated. These values will be used to evaluate automobile LOS in task 6.

Task 6: Evaluate Automobile LOS

The purpose of task 6 is to use the average vehicle speed values found in task 5 to evaluate automobile LOS. The author proposes using the proposed 2010 HCM method for evaluating urban street segments to do this. The proposed 2010 HCM method evaluates LOS based upon percent of free flow speed. The proposed percentages were found as part of NCHRP Project 3-79 (Bonneson et. el. 2008). The proposed LOS threshold values are shown in Table 2.

Threshold matrices are a possible method for formalizing the results of this investigation. An example of a threshold matrix is shown in Figure 2. The shaded region of the matrix indicates LOS D or lower. Regression equations are another possible method for formalizing the results. The author proposes selecting the final method based upon the results of the microsimulation and findings of the literature review.

Figure 2 Automobile LOS Threshold Matrix Example
This task will result in an evaluation of automobile LOS for each microsimulation model identified in task 4. Results will be used to develop a final empirical methodology that balances automobile and bicycle road users.

**Task 7: Evaluate Bicycle LOS**

The purpose of this task is to evaluate bicycle LOS for each microsimulation model evaluated in task 6. The author proposes evaluating bicycle LOS using the NCHRP Report 616 bicycle LOS model. The NCHRP bicycle LOS model includes variables that VISSIM may not be able to simulate or may not affect automobile LOS. The author proposes still evaluating the effect of these variables on bicycle LOS as part of this task. An important reason for doing this is to make sure all variables that are important to bicycle LOS are included in the final empirical methodology.

Bicycle LOS threshold matrices are one method for formalizing the results of this investigation. An example of a bicycle LOS threshold matrix is shown in Figure 3. The shaded region of the matrix indicates LOS D or lower. Another option would be the adoption of the NCHRP report bicycle LOS equations into the final methodology. The author proposes selecting the final method based upon the results of the microsimulation and findings of the literature review.

![Figure 3 Bicycle LOS Threshold Matrix Example](image)
This task will result in an evaluation of bicycle LOS for each microsimulation model identified in task 4. Results will be used to develop a final empirical methodology that balances automobile and bicycle road users.

**Task 8: Develop Empirical Methodology that Balances Automobile and Bicycle LOS**

The purpose of this task is to develop a final methodology that balances automobile and bicycle LOS. The author proposes a methodology that allows agencies to choose how they would like this balance to occur. Possible ways for balancing automobile and bicycle LOS are through performance measures. Possible measures are: quality of service and intensity of congestion. The HCM 2000 suggests evaluating quality of service using LOS and intensity of congestion using total delay.

The matrix shown in Figure 4 is an example of quality of service evaluation. Agencies can use a matrix such as this to evaluate when not to use shared roadways. The combined LOS threshold matrix is based upon the results of the examples shown in task 6 and task 7. The shaded region indicates a shared roadway would not be an acceptable alternative. The shaded region is LOS D or lower for automobiles and bicycles.

![Figure 4 Integrated Automobile and Bicycle LOS Threshold Matrix Example](image)

If an agency determined they are willing to permit LOS F or lower for automobiles the methodology should allow them to do so. Using the threshold matrix shown in Figure 4 the agency would only need to change the shaded region. The new matrix would show a larger non-
shaded region. This means there would be more scenarios where shared roadways would be acceptable.

This task will result in a proposed methodology for evaluating shared roadways based upon automobile and bicycle LOS. This methodology will allow agencies to balance the needs of automobiles and bicycles in a manner they see fit. The author proposes the final methodology be based upon the results of the investigation in task 6 and task 7.

**POTENTIAL BENEFITS**

Potential benefits of this research are:

- Development of an empirical method for evaluating shared roadways,
- Inclusion of passenger vehicles as stakeholders on shared roadways,
- Use of microsimulation to evaluate automobile and bicycle interactions, and
- Use of microsimulation to develop empirical project assessment methods.
REFERENCES


