Level of Traffic Stress Methodology

Version 1.1

Montgomery County Planning Department

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I. Introduction

When people bicycle on roadways, they encounter varying levels of stress from traffic. A quiet residential street with a 25-mile-per-hour speed limit is considered a very low-stress environment for cyclists. But a six-lane suburban highway with a 40-mile-per-hour speed limit represents a high-stress environment for cyclists who must share the roadway with traffic. As a result, fewer people are likely to bicycle on the highway.

Level of traffic stress (LTS) is an approach that quantifies the amount of discomfort that people feel when they bicycle close to traffic. The methodology was originally developed in 2012 by the Mineta Transportation Institute and San Jose State University, but has been modified by jurisdictions over the years, including Montgomery County[1].

The LTS methodology assigns a numeric stress level to streets and trails based on attributes such as traffic speed, traffic volume, number of lanes, frequency of parking turnover, ease of intersection crossings and others.

When a street has a moderate or high level of stress, it may be a sign that bicycle infrastructure, like separated bike lanes or shared use paths, is needed to make it a place where more people will feel comfortable riding.

An analysis of over 3,500 miles of streets and trails in Montgomery County shows that while three-quarters of the network qualifies as a low-stress environment, these low stress areas form "islands of connectivity" separated by major highways and other high-speed roads. Most people are uncomfortable bicycling on high-speed roads in such environments. These low stress-tolerant groups, accounting for about 60 percent of the County's population, would be unlikely to bicycle without a network of separated bikeways and other enhancements connecting the "islands." One of the goals of the Bicycle Master Plan is to recommend ways of creating a connected bikeway system in the county that will appeal to a wider range of riders.

For a bicycle network to attract the broadest segment of the population, it must provide low-stress connectivity, defined by the methodology as "providing routes between people's origins and destinations that do not require cyclists to use links that exceed their tolerance for traffic stress, and that do not involve an undue level of detour."

[1] Mekuria, Maaza, Peter G. Furth, and Hilary Nixon, Low-Stress Bicycling and Network Connectivity, San Jose, CA: Mineta Transportation Institute, 2012.

II. Comfort Levels

The Level of Traffic Stress methodology identifies four stress levels:

- LTS 0 – None
- LTS 1 – Very Low
- LTS 2 – Low
- LTS 2.5 – Moderate Low
- LTS 3 – Moderate High
- LTS 4 – High

III. Methodology

The Level of Traffic Stress (LTS) methodology is conducted for links and intersections, as shown on the following tables. The analysis applies a “weakest link” logic, wherein the stress level is assigned based on the lowest-performing attribute of the street. For example, even if a segment has mostly low-stress characteristics, the occurrence of one higher-stress attribute (for example, frequent bike lane blockage) dictates the stress level for the segment.

Level of Traffic Stress

Link Methodology for Mixed Traffic / Priority Shared Lane Markings

Posted Speed Limit (mph)	# of Through Lanes	Mixed Traffic / Priority Shared Lane Markings					
		No Parking		Parking			
		Center Line	No Center Line	Center Line & High Parking Turnover	Center Line & Low Parking Turnover	No Center Line & High Parking Turnover	No Center Line & Low Parking Turnover
≤25	2-3	2(3[c])	1 (2[d])	2.5	2	2.5	1 (2[d])
	4-5	3	n/a	3	3	n/a	n/a
	≥6	4	n/a	4	4	n/a	n/a
30	2-3	3	2	3	3	2.5	2
	4-5	4	n/a	4	4	n/a	n/a
	≥6	4	n/a	4	4	n/a	n/a
35	2-3	4	4	4	4	n/a	n/a
	4-5						
	≥6						
40	2-3	4	4	4	4	n/a	n/a
	4-5						
	≥6						
≥45	2-3	5	5	5	5	n/a	n/a
	4-5						
	≥6						

Notes

a. Road is residential or posted speed limit is < 25 mph
b. There is a raised median
c. ADT >= 6,000 ADT
d. ADT >= 3,000 ADT
e. Buffer >= 10 feet wide
f. Road is residential
g. Hard Barrier = Jersey, Guardrail, Railing, Parking
Industrial roads: For roads that are classified as "industrial" in a master plan, the LTS is the higher of 1) the result in the segment table or 2) LTS 2.5

Level of Traffic Stress

Link Methodology for Conventional Bike Lanes

Posted Speed Limit (mph)	# of Through Lanes	Bike Lanes						
		No Parking			Parking			
		Infrequenly Obstructed		Frequently Obstructed	Infrequenly Obstructed / Low Parking Turnover			Frequently Obstructed / High Parking Turnover
		Bike Lane ≤ 5.5 ft	Bike Lane ≥ 6.0 ft		Bike Lane + Parking < 14.0 ft	Bike Lane + Parking = 14.0 - 14.5 ft	Bike Lane + Parking = 15.0 ft	
≤25	2-3	2	1	2.5	2.5 (2[a])	2	1	2.5
	4-5	2.5 (2[b])	2.5 (2[b])	2.5	3			
	≥6	3			3			
30	2-3	2	2	2.5	2.5	2	2	2.5
	4-5	2.5 (2[b])	2.5 (2[b])	2.5	3			
	≥6	3			3			
35	2-3	3			3			
	4-5							
	≥6							
40	2-3	3			n/a			
	4-5	4 (3[b])						
	≥6	4						
≥45	2-3	4			n/a			
	4-5							
	≥6							

Level of Traffic Stress

Link Methodology for Shared Use Paths (aka Sidepaths)

Posted Speed Limit (mph)	# of Through Lanes	Shared Use Path					
		No Buffer	Landscape Buffer, Crossing, Protected Intersection			Buffer = Hard Buffer (g)	Independent ROW
			Width <5 ft	Width ≥ 5 ft AND Frequent Driveways	Width ≥ 5 ft AND Driveways = Infrequent or Crossing		
≤25	2-3	2 (1[f])	2 (1f)	2 (1[f])	1	1	0
	4-5						
	≥6						
30	2-3	2 (1[f])	2 (1f)	2 (1[f])	1	1	0
	4-5						
	≥6						
35	2-3	2 (1[f])	2 (1f)	2 (1[f])	1	1	0
	4-5						
	≥6						
40	2-3	2	2	2	2 (1[e])	2 (1[e])	0
	4-5						
	≥6						
≥45	2-3	2	2	2	2 (1[e])	2 (1[e])	0
	4-5						
	≥6						

Level of Traffic Stress

Link Methodology for Separated Bike Lanes

Posted Speed Limit (mph)	# of Through Lanes	Separated Bike Lanes				
		Flex Posts	Landscape Buffer, Crossing, Protected Intersection			Buffer = Hard Barrier (g)
			Width <5 ft	Width ≥ 5 ft AND Frequent Driveways	Width ≥ 5 ft AND Driveways = Infrequent or Crossing	
≤25	2-3	1	2 (1[f])	2 (1[f])	1	1
	4-5	2				
	≥6	2.5				
30	2-3	2	2 (1[f])	2 (1[f])	1	1
	4-5	2.5				
	≥6	2.5				
35	2-3	2	2 (1[f])	2 (1[f])	1	1
	4-5	2.5				
	≥6	2.5				
40	2-3	2.5	2.5	2.5	2 (1[e])	n/a
	4-5					
	≥6					
≥45	2-3	2.5	2.5	2.5	2 (1[e])	n/a
	4-5					
	≥6					

Level of Traffic Stress

Link Methodology for Bikeable Shoulders, Neighborhood Greenways, Shared Streets

Posted Speed Limit (mph)	# of Through Lanes	Bikeable Shoulders	Neighborhood Greenway	Shared Street
≤25	2-3	2	1	1
	4-5	2.5 (2[b])		
	≥6	3		
30	2-3	2	1	1
	4-5	2.5 (2[b])		
	≥6	3		
35	2-3	3	1	1
	4-5			
	≥6			
40	2-3	3	1	1
	4-5	4 (3b)		
	≥6	4		
≥45	2-3	4	1	1
	4-5			
	≥6			

Level of Traffic Stress

Intersection Methodology

Unsignalized Intersections

LTS is the more stressful of:

1. Intersection methodology:

Posted Speed Limit on Street Being Crossed	# of Lanes of Street Being Crossed					
	No Median Refuge			Median Refuge (≥6 ft wide)		
	2 to 3	4 to 5	6+	2 to 3	4 to 5	6+
≤25	1	2	4	1	1	2
30	2	2.5	4	1	2	2.5
35	2.5	3	4	1	2.5	3
≥40	3	4	4	2	2.5	4

2. Link methodology (see previous pages)

Signalized Intersections

LTS of street is carried through the intersection.