LEVEL OF TRAFFIC STRESS FOR CYCLISTS ON STATE ROADS

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Abstract

This document reports a technical analysis of right-of-way and operational conditions to characterize road segments for their bicycling comfort based on five right-of-way and operational conditions. The report includes suggestions for how to apply the findings.

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Objective

To identify the state roadways where cyclists can comfortably ride today and the roadways where improvements may be able to bring riding conditions to a comfortable level.

Methodology

Level of traffic stress (LTS) is a classification system based on cyclist comfort level. The concept was initially developed by the Mineta Transportation Institute (MTI), as described in the 2012 MTI publication Low-Stress Bicycling and Network Connectivity. LTS classification systems assign each roadway segment into four levels, with the lowest stress segments categorized as LTS 1 and the highest stress segments categorized as LTS 4, as generally summarized as follows:

LTS 1: Comfortable for people of all ages and abilities.

- Off-street trails (not included in this analysis)
- Residential streets with traffic speeds of 25 mph or less
- Bike lanes that are at least six feet wide or are physically separated from traffic

LTS 2: Comfortable for most adults.

- Residential streets with traffic speeds of up to 30 mph
- Bike lanes that are less than six feet wide

LTS 3: Comfortable for many experienced cyclists.

- Streets with no dedicated bicycle facilities and speeds of up to 30 mph
- Bike lanes adjacent to 35 mph traffic

LTS 4: Comfortable for experienced and confident cyclists.

- Two lane streets with no bike lanes and traffic speeds of 35 mph+
- Bike lanes adjacent to 40 mph traffic

For the Middle Susquehanna Regional Bicycle-Pedestrian Plan, the planning team adapted and applied this accepted methodology to the available data for state roads in the planning region.

First, using GIS, the team integrated PennDOT's road segment inventory (RMSSEG) and road segment classification (RMSADMIN) files into one regional centerline file containing the criteria for the LTS analysis: on-street parking, number of travel lanes, pavement width, average daily traffic (ADT), and speed limit.

Next, the team calculated the effective shoulder width available for bicycling, which is a key variable in determining bicycle level of traffic stress but was not available in the data set. Shoulder width was determined by first subtracting 8 feet per side of on-street parking (none/one side/both sides) from the roadway with and then subtracting 12 feet per travel lane. Any remaining width was assumed to be roadway shoulder and was divided by two for equal shoulder on each side of the roadway.

Last, each roadway segment was filtered by its traffic volume (ADT) and posted speed limit to determines its LTS value, as presented in Table 1 (page 3).

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Findings

1. 22.80 miles of LTS 1, across 372 segments, where current conditions indicate that an adult cyclist would be comfortable riding on the road segment. LST 1 segments are typically located in town settings.
2. 51.21 miles of LTS 2, across 518 segments, where at least one present factor increases stress (or decreases the comfort level) for an adult cyclist on the road segment. LST 2 segments are also commonly found in town settings as well as in rural areas.
3. 836.81 miles of LTS 3 and LTS 4, across 7230 road segments, where multiple factors influence the LTS value and improvements would likely need to be significant to reach an LTS 2 value.

Mapped Results

The planning team depicted the results of the LTS analysis, as shown in Figure 1 (page 4). The map color-codes the roadway segments by the level of traffic stress (comfort level) as follows:

- LST 1 - Green
- LST 2 - Yellow
- LST 3 - Orange
- LST 4 - Red

Note: The LST analysis estimates the comfort level bicycle riders experience on state roadways in the region based only on the five available data points. Other features and conditions, such as rider aptitude, pavement condition, type and number of intersections encountered, drainage grates, actual shoulder width, actual traffic speed, shoulder debris, terrain, weather, etc., influence the actual comfort level of bicycle riders. This analysis demonstrates which roadways have conditions that make bicycling less comfortable and enables examination of which factors contribute to that traffic stress level. Knowledge of local conditions and field views are necessary to fully assess conditions and opportunities for improved bicycling comfort.

Application to the Plan

For very low and low stress street and road segments in urban areas:

1. Retain the low stress bicycling environment. Share the analysis with PennDOT District staff and local officials for their awareness of the factors that can affect traffic stress on bicyclists.

2. Identify assess stress factors in the field and at the segment level and assess the potential to remove or reduce their impact on the bicyclist through design or operational improvement. In the short term and for individual or small groups of segments, this could be done through PennDOT Connects Technical Assistance. Communitywide, this could be performed as a bicycle audit (or bicycle and pedestrian audit).

   Based on the 2018 bicycle level of traffic stress analysis, candidates for a communitywide bicycle audit, by county, include the following with audits already completed for communities marked with an asterisk (*):

   Clinton: Lock Haven and North Bend
   Columbia: Berwick and Bloomsburg
   Lycoming: Jersey Shore*, Williamsport, South Williamsport, Montoursville, Muncy
   Montour: Danville and Riverside
   Northumberland: Milton, Northumberland*, Sunbury, Shamokin, Mt. Carmel
   Snyder: Selinsgrove
   Union: Lewisburg* and Mifflinburg

For moderate to high stress road segments in urban areas:

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1. Identify and mark low stress alternative segments, particularly for cross-town and other high bicycle traffic routes. This may require use of local streets. Bicyclists often prefer to move to an adjacent low stress street over bicycling in high stress conditions.

For moderate to high stress road segments between urban areas:

1. Evaluate alternative routes and the potential and cost to improve at least one route to LTS 2. For example, between Berwick and Bloomsburg there are two state-owned roads – US Route 11 (LTS 4) and Old Berwick Road (LTS 3). It may not be feasible to improve either road to an LTS 1 condition, however the cost to improve one to LTS 2 might be significantly higher depending on the specific stress factors involved.
2. Where costs to improve conditions are prohibitive, coordinate with transit services and planning effort to explore buses with bike racks as an alternative for intercommunity bicycle travel.

For moderate to high stress road segments in rural areas:

1. Reserve their promoted/encouraged use for special events where hazards from traffic can temporarily be halted.

Analysis of LTS on Local Roads

Using this adapted methodology, planners or bicycling advocates could gather similar data and easily calculate LTS for local roads, too. They would need to:

1. Define local road by segments
2. Determine the presence of on-street parking (none/one side/both sides)
3. Inventory the number of travel lanes
4. Measure the roadway width (pavement width)
5. Gather traffic volume and speed limits
6. Lookup the LTS value in Table 1.

If coordinated early, planners may be able to digitize the results in GIS for further analysis and data sharing.

Table 1: Bicycle Level of Traffic Stress Criteria

				Speed Limit						
Parking_Status	Lane_Count	Roadway_Width	ADT	<=20	25	30	35	40	45	50+
None	1	<=14 ft	0-750	1	1	2	2	3	3	3
			751-1500	2	2	2	3	3	3	4
			1501-3000	2	3	3	3	4	4	4
			3000+	3	3	3	3	4	4	4
		14-18	Any ADT	2	2	2	2	3	3	4
		18+	Any ADT	1	1	2	2	3	3	3
	2	<=24 ft	0-750	1	1	2	2	3	3	3
			751-1500	2	2	2	3	3	3	4
			1501-3000	2	3	3	3	4	4	4
			3000+	3	3	3	3	4	4	4
		24-32	Any ADT	2	2	2	2	3	3	4
		32+	Any ADT	1	1	2	2	3	3	3
	3	<=36 ft	0-750	1	1	2	2	3	3	3
			751-1500	2	2	2	3	3	3	4
			1501-3000	2	3	3	3	4	4	4
			3000+	3	3	3	3	4	4	4
		36-42	Any ADT	2	2	2	2	3	3	4
		42+	Any ADT	1	1	2	2	3	3	3
	4	<=48 ft	0-8000	3	3	3	3	4	4	4
			8001+	3	3	4	4	4	4	4
		48-56	0-8000	2	2	2	2	3	3	3
			8001+	2	2	2	2	3	3	3
		56+	0-8000	2	2	2	2	3	3	3
			8001+	2	2	2	2	3	3	3
One Side	1	<=24 ft	0-750	1	1	2	2	3	3	3
			751-1500	2	2	2	3	3	3	4
			1501-3000	2	3	3	3	4	4	4
			3000+	3	3	3	3	4	4	4
		24-28	Any ADT	2	2	2	2	3	3	4
		28+	Any ADT	1	1	2	2	3	3	3
	2	<=32 ft	0-750	1	1	2	2	3	3	3
			751-1500	2	2	2	3	3	3	4
			1501-3000	2	3	3	3	4	4	4
			3000+	3	3	3	3	4	4	4
		32-40	Any ADT	2	2	2	2	3	3	4
		40+	Any ADT	1	1	2	2	3	3	3
	3	<=42 ft	0-750	1	1	2	2	3	3	3
			751-1500	2	2	2	3	3	3	4
			1501-3000	2	3	3	3	4	4	4
			3000+	3	3	3	3	4	4	4
		42-50	Any ADT	2	2	2	2	3	3	4
		50+	Any ADT	1	1	2	2	3	3	3
	4	<=56 ft	0-8000	3	3	3	3	4	4	4
			8001+	3	3	4	4	4	4	4
		56-62	0-8000	2	2	2	2	3	3	3
			8001+	2	2	2	2	3	3	3
		62+	0-8000	2	2	2	2	3	3	3
			8001+	2	2	2	2	3	3	3
Both Sides	1	<=30 ft	0-750	1	1	2	2	3	3	3
			751-1500	2	2	2	3	3	3	4
			1501-3000	2	3	3	3	4	4	4
			3000+	3	3	3	3	4	4	4
		30-38	Any ADT	2	2	2	2	3	3	4
		38+	Any ADT	1	1	2	2	3	3	3
	2	<=38 ft	0-750	1	1	2	2	3	3	3
			751-1500	2	2	2	3	3	3	4
			1501-3000	2	3	3	3	4	4	4
			3000+	3	3	3	3	4	4	4
		38-46	Any ADT	2	2	2	2	3	3	4
		46+	Any ADT	1	1	2	2	3	3	3
	3	<=50 ft	0-750	1	1	2	2	3	3	3
			751-1500	2	2	2	3	3	3	4
			1501-3000	2	3	3	3	4	4	4
			3000+	3	3	3	3	4	4	4
		50-58	Any ADT	2	2	2	2	3	3	4
		58+	Any ADT	1	1	2	2	3	3	3
	4	<=62 ft	0-8000	3	3	3	3	4	4	4
			8001+	3	3	4	4	4	4	4
		62-70	0-8000	2	2	2	2	3	3	3
			8001+	2	2	2	2	3	3	3
		70+	0-8000	2	2	2	2	3	3	3
			8001+	2	2	2	2	3	3	3

Sources

- *Low-Stress Bicycling and Network Connectivity.* Research report 11-19, Mineta Transportation Institute, 2012.
- Furth, P. Northwestern University; http://www.northeastern.edu/peter.furth/research/level-of-traffic-stress/

Figure 1: Mapped Results of Bicycle Level of Traffic Stress Analysis