LOW-STRESS ACTIVE TRANSPORTATION NETWORK

DATA COLLECTION METHOD

Introduction

Creating low-stress, comfortable active transportation infrastructure is essential for attracting more people to walk, bike, or use other modes of active transportation. Among potential users, the "interested but concerned" group consists of people who would like to bike or walk more but are discouraged by safety concerns.[1] Adding low-stress bike facilities to bikeway networks can address these concerns, making active transportation a more attractive option for both commuting and recreation.

Level of Traffic Stress (LTS) is a framework that quantifies how comfortable or stressful a roadway or trail is for bicyclists based on their interaction with vehicle traffic.[2] It assigns a numeric stress level to roads and trails based on factors such as traffic speed, lane width, traffic volume, and intersection design. Low-stress active transportation facilities are essential for attracting users of all abilities, especially those who feel unsafe riding near moving vehicles.

Overview

This tool and method calculate the percent of a low-stress active transportation network that was funded by the Active Transportation Program (ATP) using the following equation:

$$Percent\ Low\ Stress\ Bicycle\ Network\ Funded\ by\ ATP\ (\%) = \frac{Total\ Length\ of\ ATP\ Funded\ Low\ Stress\ Bike\ Lanes\ Constructed\ (mi)}{Total\ Length\ of\ All\ Low\ Stress\ Bike\ Lanes\ Constructed\ (mi)}$$

The values of the numerator and denominator are derived from data about the length of the constructed bike lane segments and their levels of traffic stress. The tool also calculates the total miles of the active transportation (AT) planned and constructed (all stress levels and

[1] Four Types of Cyclists | Roger Gellar, Portland Office of Transportation

[2] Level of Traffic Stress Criteria | Peter G. Furth (northeastern.edu)

low-stress levels), the percent of low-stress AT network implemented overall (regardless of funding source), and the percent of the total constructed AT network that is low-stress.

Scoring LTS

The LTS rating ranges from 1-4 with 1 representing lowest stress and 4 representing highest stress. As motor vehicle traffic volumes increase and separation between people riding bicycles and vehicle traffic decreases, the LTS score is higher. See Appendix for specific examples of each level and how segments are assigned a score.

LTS	Description
1	Comfortable for all ages and abilities including children. Roadways have strong separation or little to no intermingling with vehicular traffic and intersection crossings are simple. Usually includes protected bike lanes, quiet neighborhood streets, or separated trails.
2	A level of traffic stress that most adults can tolerate but likely not suitable for children. Except in low speed or low volume traffic situations, people on bikes have their own place to ride that keeps them from having to interact with traffic except at formal crossings. May include physical separation from higher speed and multilane traffic.
3	Roads that involve interaction with moderate speed or multilane traffic, or close proximity to higher speed traffic. Not suitable for children or most adults who are not regular riders.
4	Tolerated by only the most experienced and able-bodied people. Not suitable for children or most adults. Involves interaction with higher speed traffic or close proximity to high-speed traffic.

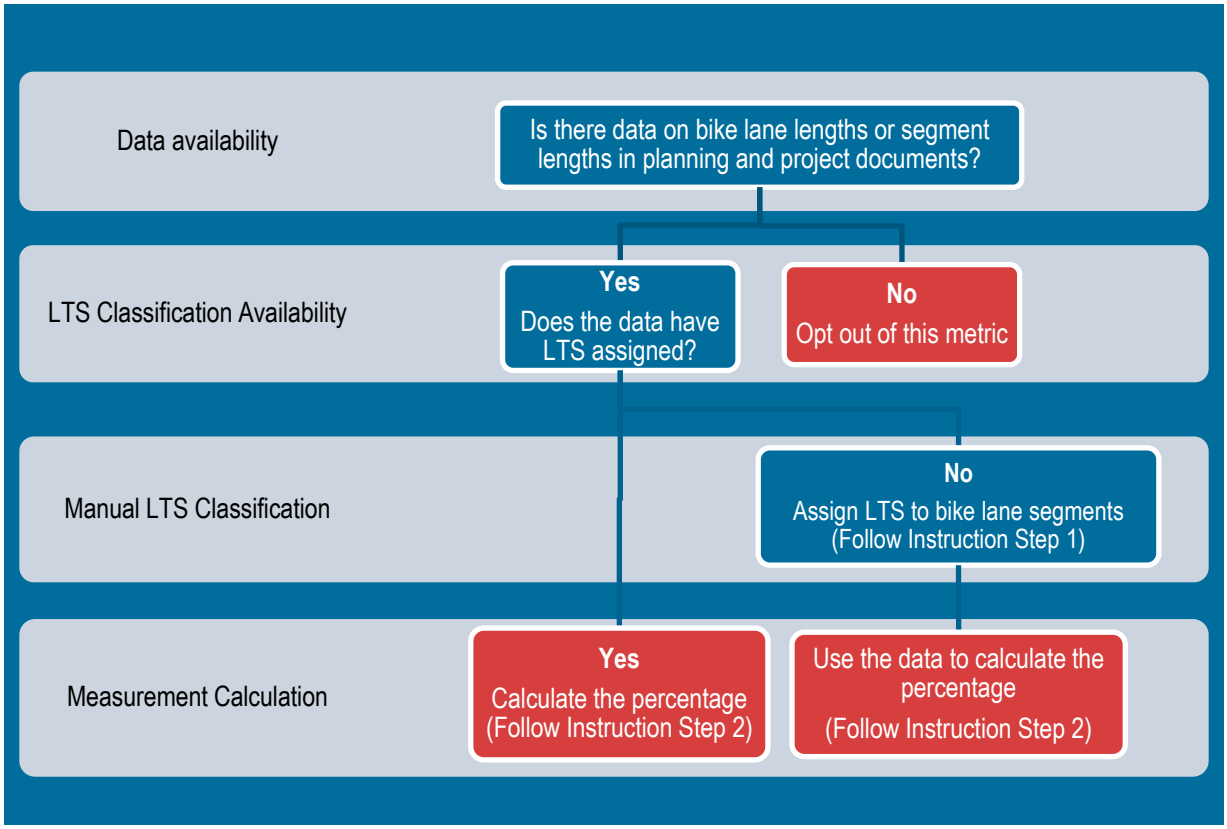
Should my project use this metric?

If the data on bike lane lengths or segment lengths are unavailable in planning or project documents, we recommend opting out of this evaluation metric.

If there is data on bike lane and segment lengths but no indication which segments have low traffic stress, then assign levels of traffic stress to bike lanes based on the bike lane and roadway context thresholds. (Start from Step 1 in Instructions section below.)

If there is data on bike lanes and segment lengths that indicate which segments have low traffic stress, use the data to calculate the percentage of low stress bicycle network. (Start from Step 2 of Instructions section below.)

See the figure below to help you understand whether the LTS metric is right for your project.



Instructions

Use the **LTS Tool Excel Sheet** to calculate the percent of LTS network implemented. The worksheet can assign an LTS score based on inputs for characteristics of the road. The README tab of the worksheet is a reference for meta data and definitions. Refer to the Appendix for specific details on LTS assignments.

1. On the 'LTS Data Input' sheet of the LTS Tool, complete Columns C-J with each segment of the planned and implemented active transportation network. Enter data on whether a segment received any funding through the Active Transportation Program, street name, starting point, ending point, planned segment length, implemented facility length, and facility type. Data may be derived from existing planning documents.
2. Assign the LTS to each planned and constructed bike facility segment:
   - *If you have the level of traffic stress data for each segment*, fill out Column B for each segment. Override the formula with "Yes" if the Level of Traffic Stress is 1 or 2, otherwise "No."

- *If you do not have traffic stress data for each segment*, the sheet will determine this. Fill out only the white-highlighted cells between Column K-X, selecting values from the drop-down menu for each segment. Refer to the "README" table in the Excel sheet for detailed descriptions of what each column in the "LTS Data Input" sheet is asking. Cells in Column B will calculate whether a given segment's LTS is low stress or not low stress based on your inputs.

3. Report data. When Step 2 is complete, the 'Report Card sheet will have calculated the sum and percentage of low-stress active transportation network planned, implemented, and implemented using ATP funds.
   - When completed, submit the LTS Excel file via Smartsheets on the Active Transportation Resource Center website.

APPENDIX

This section shows examples of different facility types and their corresponding LTS scores. Scoring follows Peter Furth's Level of Traffic Stress methodology.

Physically Separated Bikeways

LTS 1. Physically Separated Bikeways include standalone paths, cycle tracks, side paths, or segregated lanes. Physical separation may include a curb, raised medians, parking lanes, bollards, or planters.

Bike Lanes

LTS 1-4. Bike lanes can range in traffic stress levels, depending on street width (i.e., number of lanes), bicycle operating space, speed limit, and bike lane blockage. Scoring follows a "weakest link" logic, meaning over the four characteristics, the worst LTS score is the score for the entire segment.

Level of traffic stress uses the measurement of prevailing speed, or the speed at which 85% of vehicles are traveling at or below. Speed limits may be used as a proxy for prevailing speed when primary data collection is not possible. Whether using speed limit or prevailing speed, be sure to use the same input for before and after measurements.

Conventional bike lanes, advisory bike lanes, and shoulders not adjacent to a parking lane

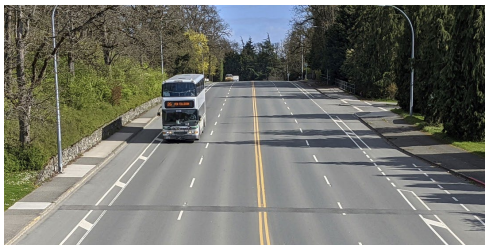
Number of lanes	Bike lane width	Prevailing Speed (mph) 0-28.5	28.5-33.5	33.5-38.5	38.5-43.5	43.5-48.5	48.5+
1 thru lane per direction or contraflow lane	6+ ft	LTS 1	LTS 1	LTS 2	LTS 3	LTS 3	LTS 3
	less than 6 ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4
2 thru lanes per direction	6+ ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	less than 6 ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 4	LTS 4
3+ lanes per direction	any width	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4

Notes
1. If bike lane is frequently blocked (as may be the case in commercial areas), or if parking is allowed in an advisory lane, use mixed traffic criteria.
2. Minimum bike lane width is 4 ft next to a curb and 3.5 ft next to a road edge or discontinuous gutter seam. For narrower bike lanes, use Mixed Traffic criteria.
3. Bike lane width includes any marked buffer next to the bike lane; also, add 2 ft if road has one thru lane per direction and a central two-way turn lane.
4. Use mixed traffic criteria if it would result in lower LTS.

Conventional bike lanes and advisory bike lanes alongside a parking lane

Number of lanes	Bike lane reach = bike + parking lane width	Prevailing Speed (mph) 0-28.5	28.5-33.5	33.5-38.5	38.5+
1 thru lane per direction or contraflow lane	15+ ft	LTS 1	LTS 2	LTS 2	LTS 3
	<15 ft	LTS 2	LTS 2	LTS 3	LTS 3
1-way multilane	15+ ft	LTS 2	LTS 3	LTS 3	LTS 3
	<15 ft	LTS 3	LTS 3	LTS 3	LTS 3
2-way, 2 lanes per direction	15+ ft	LTS 2	LTS 3	LTS 3	LTS 3
	<15 ft	LTS 3	LTS 3	LTS 3	LTS 3
other 2-way multilane	any	LTS 3	LTS 3	LTS 3	LTS 3

Notes
1. If bike lane is frequently blocked (as may be the case in commercial areas), use mixed traffic criteria.
2. Minimum bike lane reach is 12 ft. For narrower reach, use Mixed Traffic criteria.
3. Bike lane reach includes any marked buffer next to the bike lane; also, add 2 ft if road has one thru lane per direction and a central two-way turn lane.
4. Use mixed traffic criteria if it would result in lower LTS.

Bike Lane Examples	LTS	Example Image
Speed: 25 mph Parking present: No Bike lane width: 6 ft+ Number of vehicle lanes: 1 Raised median: None	1	
Speed: 30 mph Parking present: No Bike lane width: Less than 6ft Number of vehicle lanes: 2 per direction Raised median: Yes	2	
Speed: 35 mph Parking present: No Bike lane width: 6 ft+ Number of vehicle lanes: 2 lanes per direction Raised median: None	3	
Speed: 45 mph Parking present: No Bike lane width: 6ft+ Number of vehicle lanes: 4 Raised median: None	4	

Mixed Traffic

The level of stress in mixed traffic depends on the number of lanes, average daily traffic (ADT), and prevailing traffic speed. Signage, shared-lane markings, or wide outside lanes have small beneficial effects, therefore do not have a significant impact LTS rating.

Bikes in mixed traffic

		Prevailing Speed (mph)						
Number of lanes	ADT	0 - 23.5	23.5-28.5	28.5-33.5	33.5-38.5	38.5-43.5	43.5-48.5	48.5+
Unlaned 2-way street (no centerline)	0-750	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	751-1500	LTS 1	LTS 1	LTS 2	LTS 3	LTS 3	LTS 3	LTS 3
	1501-3000	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4	LTS 4
	3001+	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
2-way with 1 lane per direction and centerline, or wide* 1-way, 1-lane	0-1000	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	1001-1500	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4	LTS 4
	1501+	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
Narrow* one-way, 1-lane	0-600	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	601-1000	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4	LTS 4
	1001+	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
2 thru lanes per direction	0-8000	LTS 3	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
	8001+	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 4	LTS 4
3+ thru lanes per direction	any ADT	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 4	LTS 4

Notes * A one-way street is "narrow" if its width is less than 30 ft with parking on both sides, less than 22 ft with parking on one side, or less than 15 ft with no parking. Otherwise, it is "wide."

Mixed Traffic Examples	LTS	Example Image
Speed: 25mph Number of lanes: unlaned 2-way street Centerline: None ADT: Below 1500	1	
Speed: 25 mph Number of lanes: 2-way, 1 lane per direction Centerline: Yes ADT: 1,001-1,500	2	

Mixed Traffic Examples	LTS	Example Image
Speed: 30 mph Number of vehicle lanes: One lane per direction Centerline: Yes ADT: 1500+	3	
Speed: 35 mph Number of vehicle lanes: Two lanes per direction Centerline: Yes ADT: 8,000+	4	

Approaching Intersections in a Bike Lane with a Right Turn Lane

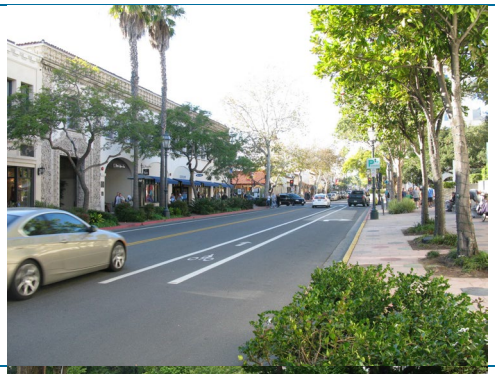
Even low-stress bikeways can become stressful if lane striping or buffers disappear at intersections, creating gaps in protection. These disruptions make the bikeway's level of stress inconsistent, and a single high-stress intersection can negatively impact the entire trip.

Configuration	Level of Traffic Stress
Single right-turn lane up to 150 ft. long, starting abruptly while the bike lane continues straight, and having an intersection angle and curb radius such that turning speed is ≤ 15 mph.	LTS ≥ 2
Single right-turn lane longer than 150 ft. starting abruptly while the bike lane continues straight, and having an intersection angle and curb radius such that turning speed is ≤ 20 mph.	LTS ≥ 3
Single right-turn lane in which the bike lane shifts to the left but the intersection angle and curb radius are such that turning speed is ≤ 15 mph.	LTS ≥ 3
Single right-turn lane with any other configuration; dual right-turn lanes; or right-turn lane along with an option (through-right) lane.	LTS = 4

Approaching Intersections in Mixed Traffic with a Right Turn Lane

Configuration	Level of Traffic Stress
Single right-turn lane with length ≤ 75 ft. and intersection angle and curb radius limit turning speed to 15 mph.	(no effect on LTS)
Single right-turn lane with length between 75 and 150 ft., and intersection angle and curb radius limit turning speed to 15 mph.	LTS ≥ 3
Otherwise.	LTS = 4

Intersection Examples	LTS	Example Image
Number of vehicle turning lanes: 1 Vehicle turning lane: Up to 150 ft long Vehicle turning speed: ≤15mph Bike lane shifts: No	2	

Number of vehicle turning lanes: 1 Vehicle turning lane: Longer than 150 ft long Vehicle turning speed: ≤15mph Bike lane shifts: No	3	
Number of vehicle turning lanes: 1 Vehicle turning lane: Up to 150 ft long Vehicle turning speed: ≤15mph Bike lane shifts: Yes	3	
Number of vehicle turning lanes: 1 Vehicle turning lane: Up to 150 ft long Vehicle turning speed: ≤15mph Bike lane shifts: N/A, bike lane ends This is an example of “Single right turn lane with any other configuration.”	4	

REFERENCES

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