

## Appendix 3: Bicycle Level of Traffic Stress

### Purpose

In 2018, four of New Hampshire's Metropolitan Planning Organizations (MPOs), one rural Regional Planning Commission (RPC), and Plymouth State University (PSU) partnered on an FHWA-funded pilot project to develop a shared model for evaluating Bicycle Level of Traffic Stress (BLTS) in New Hampshire. Led by Rockingham Planning Commission, the purpose of the BLTS analysis was to more accurately evaluate existing roadway conditions and needs from the perspective of a bicyclist. The BLTS results helped inform the identification and prioritization of proposed projects within the New Hampshire Department of Transportation (NHDOT) Statewide Pedestrian & Bicycle Transportation Plan, as well as the development of performance measures for tracking implementation.

### Model Development

The project team refined a BLTS model adapted from the Mineta Transportation Institute (MTI) Report 11-19 [Low-Stress Bicycling and Network Connectivity](#) (2012) and PSU graduate student Laura Getts' master thesis *Methods for Investigating and Advancing Active Transportation in New Hampshire* (2017). To tailor the BLTS analysis to the rural character of New Hampshire's road system and limited roadway attribute data, the BLTS model was divided into three integrated versions:

- **Model Version 1** – For roadways with only speed, direction, lane, and traffic data
- **Model Version 2** – For roadways with additional bikeway/shoulder width data
- **Model Version 3** – For roadways with additional bikeway/shoulder and parking width data

For a given roadway segment, the BLTS model selects the most data-intensive version based on available data. If a bikeway or bikeable shoulder is frequently blocked by motor vehicles, the project team recommended using Version 1. Version 3 was not used as part of the analysis for this project due to data limitations.

While the inputs vary among the three versions, outputs remain uniform, ranging between lowest-stress roadways (BLTS 1) and highest-stress (BLTS 4) facilities. See **Table 1** for descriptions of the BLTS output levels.

Table 1: Bicycle Level of Stress Levels (Adapted from: PSU, May 2019)

| BLTS Level                        | Description   |
|-----------------------------------|---|
| <b>BLTS 1<br/>(Lowest Stress)</b> | Roadways with strong separation between motor vehicles and bicyclists or roadways with an exceptionally low number of daily motor vehicles traveling at low speeds. Suitable to children. |
| <b>BLTS 2</b>                     | Roadways with designated bikeways, providing some physical separation from motor vehicles. Suitable to most adults.   |
| <b>BLTS 3</b>                     | Roadways with no designated bikeways, multilane traffic, and motor vehicles traveling at moderate speeds. Suitable to some adults.  |
| <b>BLTS 4</b>                     | Roadways with no designated bikeways, multilane traffic, and motor vehicles traveling at high speeds. Suitable to a limited number of adults.   |

## Data Collection

To develop a consistent baseline of input data for measuring BLTS, the project team collected and verified roadway attribute data, including posted speed limits and the presence of bikeways, on-street parking, and roadway shoulders within the partner agencies’ boundaries (see **Table 2** for a full list of BLTS model inputs). Concurrent with the FHWA project, NHDOT also collected the selected roadway attribute data for state-owned roadways in the State’s remaining four RPCs to inform the Statewide Pedestrian & Bicycle Transportation Plan. Intersections were not included in the BLTS analysis.

Table 2: BLTS Model Inputs (Adapted from: PSU, May 2019)

| Input                  | Description   | Model Versions   |
|------------------------|---|--|
| <b>Speed</b>           | The posted speed limit or prevailing traffic speed of a roadway segment | Required: 1, 2, 3  |
| <b>Direction</b>       | One-way or two-way operation direction of a roadway                     | Required: 1, 2, 3  |
| <b>Lanes</b>           | Total number of travel lanes  | Required: 1, 2, 3  |
| <b>Daily Traffic</b>   | Estimate of the average number of motor vehicles per day                | Required: 1. Required for 2 and 3 only when shoulder is <4’ wide |
| <b>Shoulder Width</b>  | Distance from the edge of pavement to the fog line                      | Optional: 2, 3   |
| <b>Bike Lane Width</b> | Width of existing bike lane or road shoulders that are ≥ 4 feet         | Required: 3<br>Optional: 1, 2                                    |
| <b>Parking Width</b>   | Width of on-street parking area   | Required: 3<br>Optional: 1, 2                                    |

## BLTS Output Levels

Because of the different inputs for the three versions of the BLTS model, the project team created three different matrices for rating roadways within the BLTS 1-4 scheme. **Table 3** shows the BLTS matrix for Version 1, **Table 4** shows the BLTS matrix for Version 2, and **Table 5** shows the BLTS matrix for Version 3. Centerline data was not available for the analysis, so the first row in Version 1 was not used. Version 3 was not used as part of the analysis for this project due to data limitations.

Table 3: BLTS Model, Version 1 (Adapted from: PSU, May 2019)

| Lanes  | Daily Traffic | Speed   |           |           |           |         |
|--|---------------|---------|-----------|-----------|-----------|---------|
|  |               | ≤20 mph | 21-25 mph | 26-30 mph | 31-35 mph | ≥36 mph |
| 2-way,<br>2 through-lane<br>road<br>with no centerline                               | 0-750         | BLTS 1  | BLTS 1    | BLTS 2    | BLTS 2    | BLTS 3  |
|  | 751-1,500     | BLTS 1  | BLTS 1    | BLTS 2    | BLTS 3    | BLTS 3  |
|  | 1,501-3,000   | BLTS 2  | BLTS 2    | BLTS 2    | BLTS 3    | BLTS 4  |
|  | >3,000        | BLTS 2  | BLTS 3    | BLTS 3    | BLTS 3    | BLTS 4  |
| 1-way, 1 through-lane road<br>or<br>2-way,<br>2 through-lane road<br>with centerline | 0-750         | BLTS 1  | BLTS 1    | BLTS 2    | BLTS 2    | BLTS 3  |
|  | 751-1,500     | BLTS 2  | BLTS 2    | BLTS 2    | BLTS 3    | BLTS 3  |
|  | 1,501-3,000   | BLTS 2  | BLTS 3    | BLTS 3    | BLTS 3    | BLTS 4  |
|  | >3,000        | BLTS 3  | BLTS 3    | BLTS 3    | BLTS 3    | BLTS 4  |
| 2-way,<br>3-4 through-lane road  | 0-8,000       | BLTS 3  | BLTS 3    | BLTS 3    | BLTS 3    | BLTS 4  |
|  | >8,000        | BLTS 3  | BLTS 3    | BLTS 4    | BLTS 4    | BLTS 4  |
| >4 through-lane road   | Any           | BLTS 3  | BLTS 3    | BLTS 4    | BLTS 4    | BLTS 4  |

Table 4: BLTS Model, Version 2 (Adapted from: PSU, May 2019)

| Lanes                            | Bikeway Width | Speed   |           |           |         |
|----------------------------------|---------------|---------|-----------|-----------|---------|
|                                  |               | ≤25 mph | 26-30 mph | 31-35 mph | ≥36 mph |
| 2-way,<br>2 through-lane<br>road | ≥6 feet       | BLTS 1  | BLTS 2    | BLTS 2    | BLTS 3  |
|                                  | 4-5 feet*     | BLTS 2  | BLTS 2    | BLTS 2    | BLTS 4  |
| 2-way,<br>3-4 through-lane road  | ≥6 feet       | BLTS 2  | BLTS 2    | BLTS 2    | BLTS 3  |
|                                  | 4-5 feet*     | BLTS 2  | BLTS 2    | BLTS 2    | BLTS 4  |
| >4 through-lane road             | Any*          | BLTS 3  | BLTS 3    | BLTS 3    | BLTS 4  |

Note \* - shoulder width of <4 feet automatically triggers the use of Model Version 1 algorithm. Therefore, Daily Traffic volume ranges are not shown in Table 4 or Table 5.

Separated bike lanes received a BLTS 1 as they are to be considered physically separated, low stress facilities.

Table 5: BLTS Model, Version 3 (Adapted from: PSU, May 2017)

|  |                         | Speed   |           |           |         |
|--|-------------------------|---------|-----------|-----------|---------|
| Lanes  | Bikeway + Parking Width | ≤25 mph | 26-30 mph | 31-35 mph | ≥36 mph |
| 1-way, 1 through-lane road                                   | ≥6 feet                 | BLTS 1  | BLTS 2    | BLTS 2    | BLTS 3  |
|  | 4-5 feet                | BLTS 2  | BLTS 2    | BLTS 2    | BLTS 4  |
| 2-way, 2 through-lane road                                   | ≥15 feet                | BLTS 1  | BLTS 2    | BLTS 3    | BLTS 3  |
|  | 12-14 feet              | BLTS 2  | BLTS 2    | BLTS 3    | BLTS 3  |
| 1-way, 2-3 through lane road or 2-way, 3-4 through-lane road | ≥15 feet                | BLTS 2  | BLTS 3    | BLTS 3    | BLTS 4  |
| Other  | Any                     | BLTS 3  | BLTS 3    | BLTS 3    | BLTS 4  |

### Data Verification

Following an initial run of the BLTS model, the project team “ground-truthed” the outputs and manually adjusted values where appropriate. In addition, the project team conducted two public input forums and developed online map application to solicit public feedback on the accuracy of the model outputs. In certain cases, some roads had missing posted speed limit data. It was agreed to move forward with the project that 30 mph would be the assumed posted speed limit in scenarios where this data was not available.

## BLTS Results

Figure 1 through Figure 7 shows the BLTS levels for all state-owned roadways in New Hampshire, and Table 6 summarizes the miles of State roadways for each BLTS level by region.

Table 6: BLTS Outputs by Regional Planning Commission

| Existing Miles (% of Total, excluding unclassified roadways) |        |           |            |            |
|--|--------|-----------|------------|------------|
| Region   | BLTS 1 | BLTS 2    | BLTS 3     | BLTS 4     |
| Central New Hampshire RPC                                    | 0 (0%) | 51 (12%)  | 176 (40%)  | 77 (17%)   |
| Lakes RPC  | 0 (0%) | 128 (19%) | 281 (42%)  | 183 (28%)  |
| Nashua RPC   | 0 (0%) | 41 (19%)  | 119 (55%)  | 56 (26%)   |
| North Country Council  | 0 (0%) | 260 (23%) | 520 (46%)  | 222 (19%)  |
| Rockingham PC  | 1 (0%) | 98 (21%)  | 221 (48%)  | 73 (16%)   |
| Southern New Hampshire PC                                    | 0 (0%) | 31 (8%)   | 161 (42%)  | 98 (26%)   |
| Southwest RPC  | 2 (0%) | 93 (18%)  | 277 (53%)  | 154 (29%)  |
| Strafford RPC  | 0 (0%) | 117 (32%) | 152 (41%)  | 101 (27%)  |
| Upper Valley Lake Sunapee RPC                                | 0 (0%) | 84 (17%)  | 223 (45%)  | 111 (22%)  |
| Statewide Total  | 3 (0%) | 902 (19%) | 2128 (45%) | 1076 (23%) |

Figure 1: BLTS Outputs, Statewide

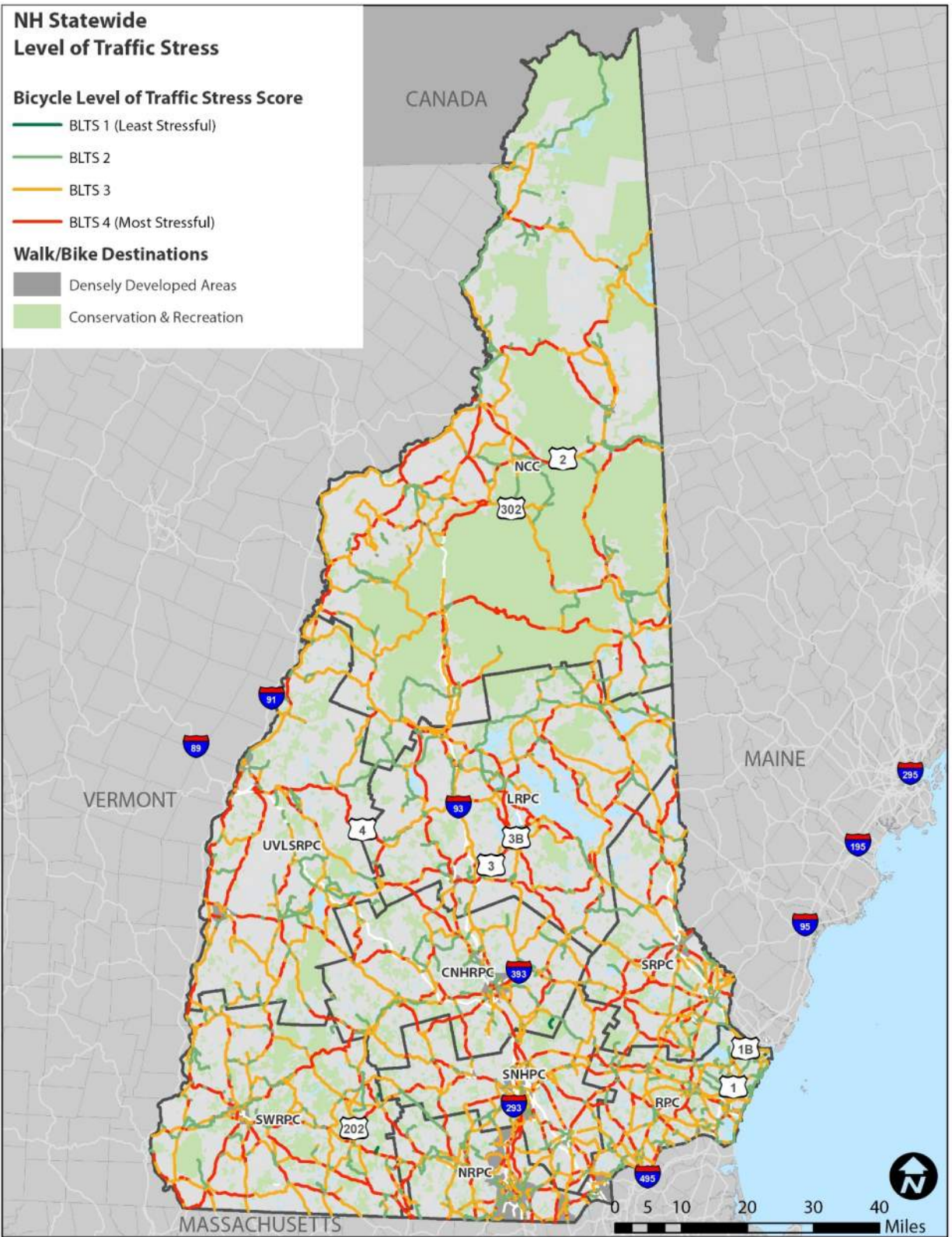


Figure 2: BLTS Outputs, North Country

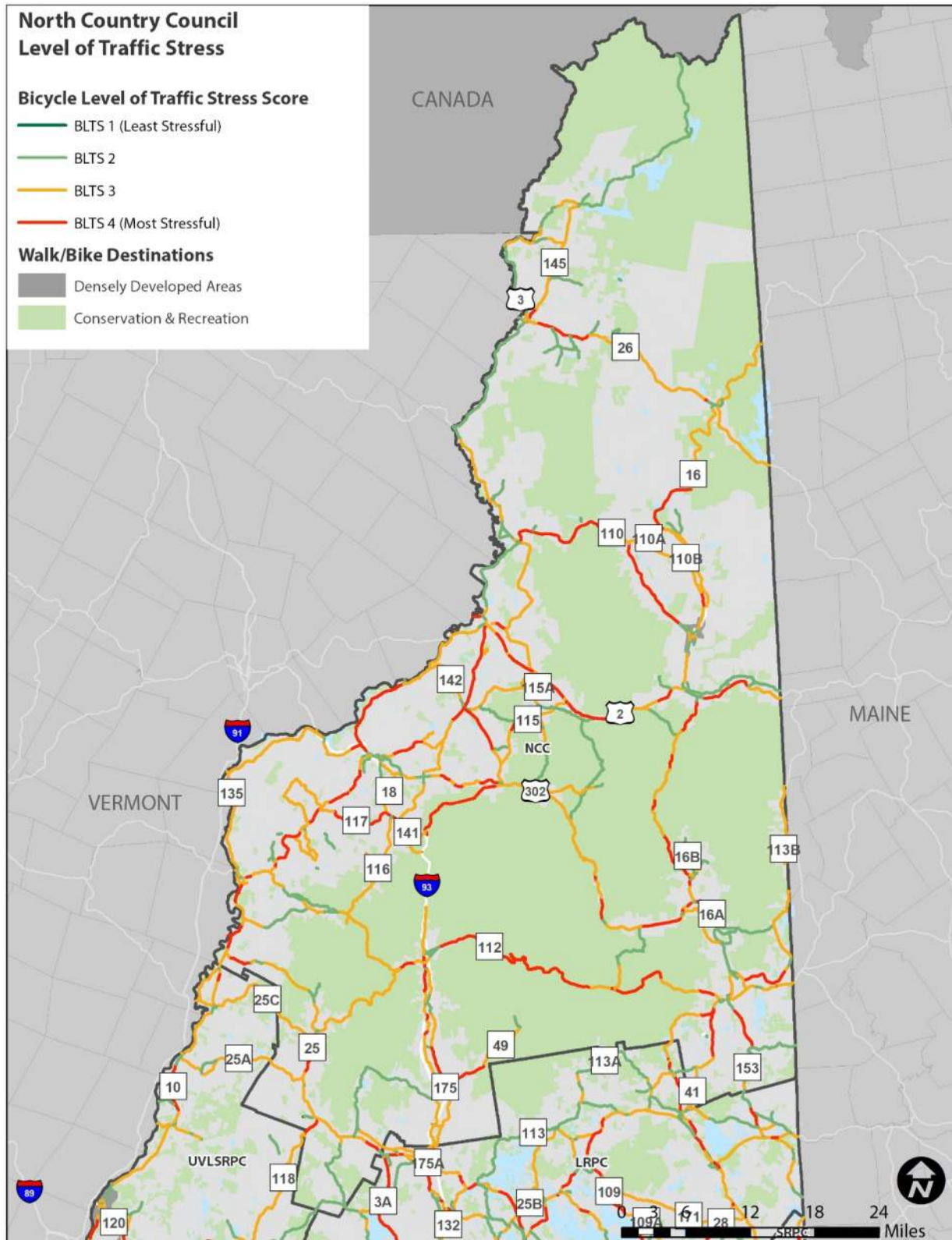


Figure 3: BLTS Outputs, Lakes Region

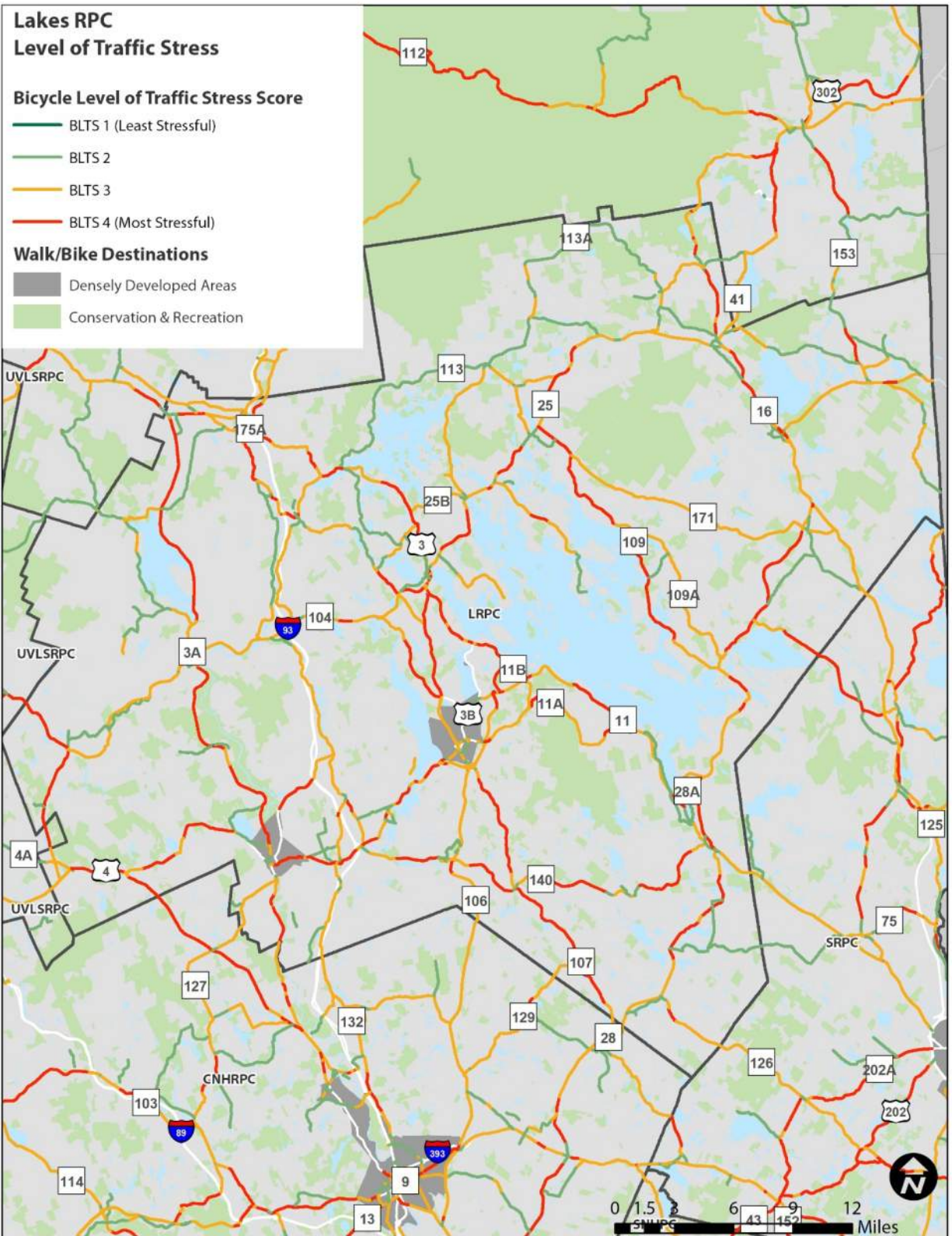




Figure 4: BLTS Outputs, Upper Valley-Lake Sunapee Region

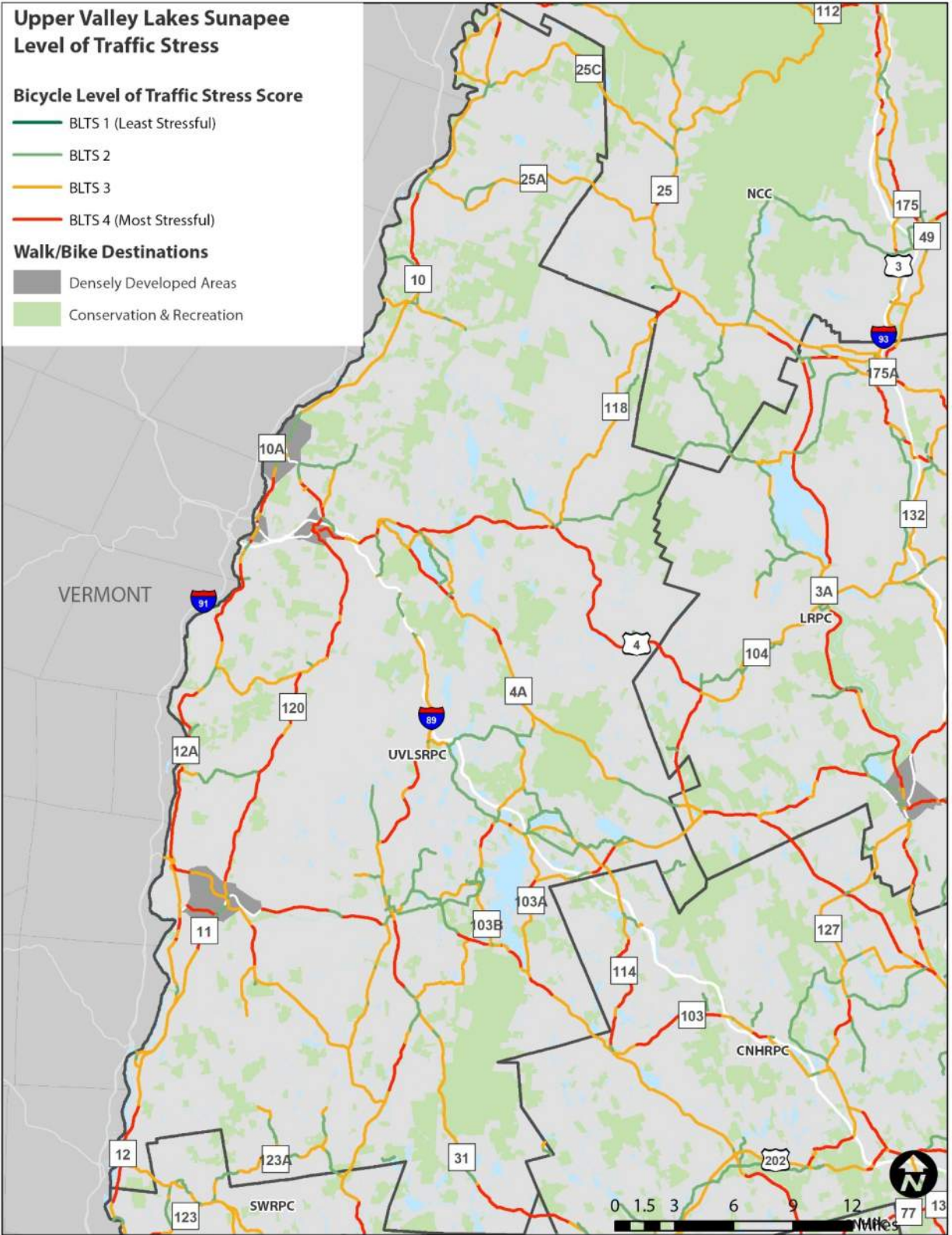


Figure 5: BLTS Outputs, Southwest Region

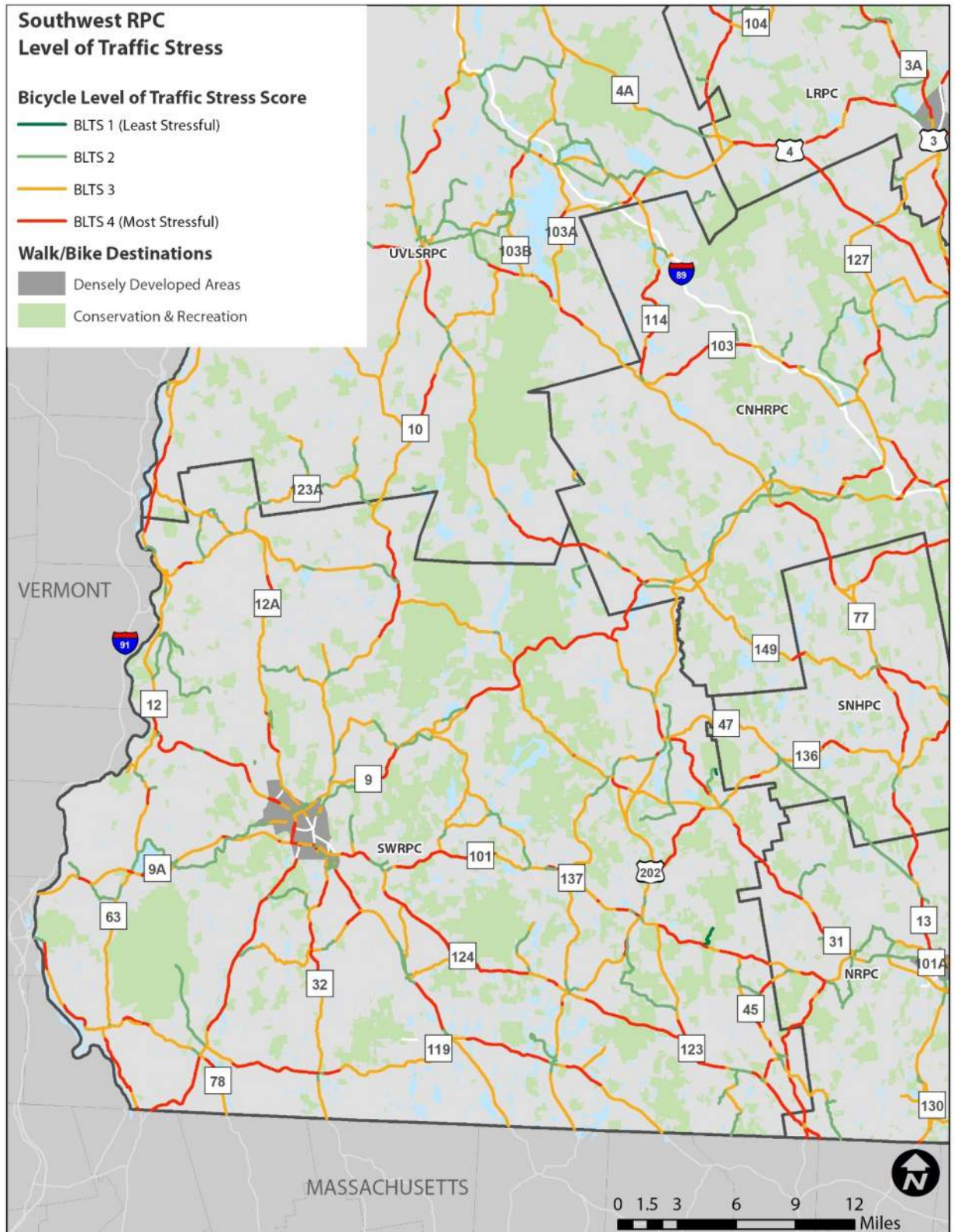


Figure 6: BLTS Outputs, Merrimack Valley

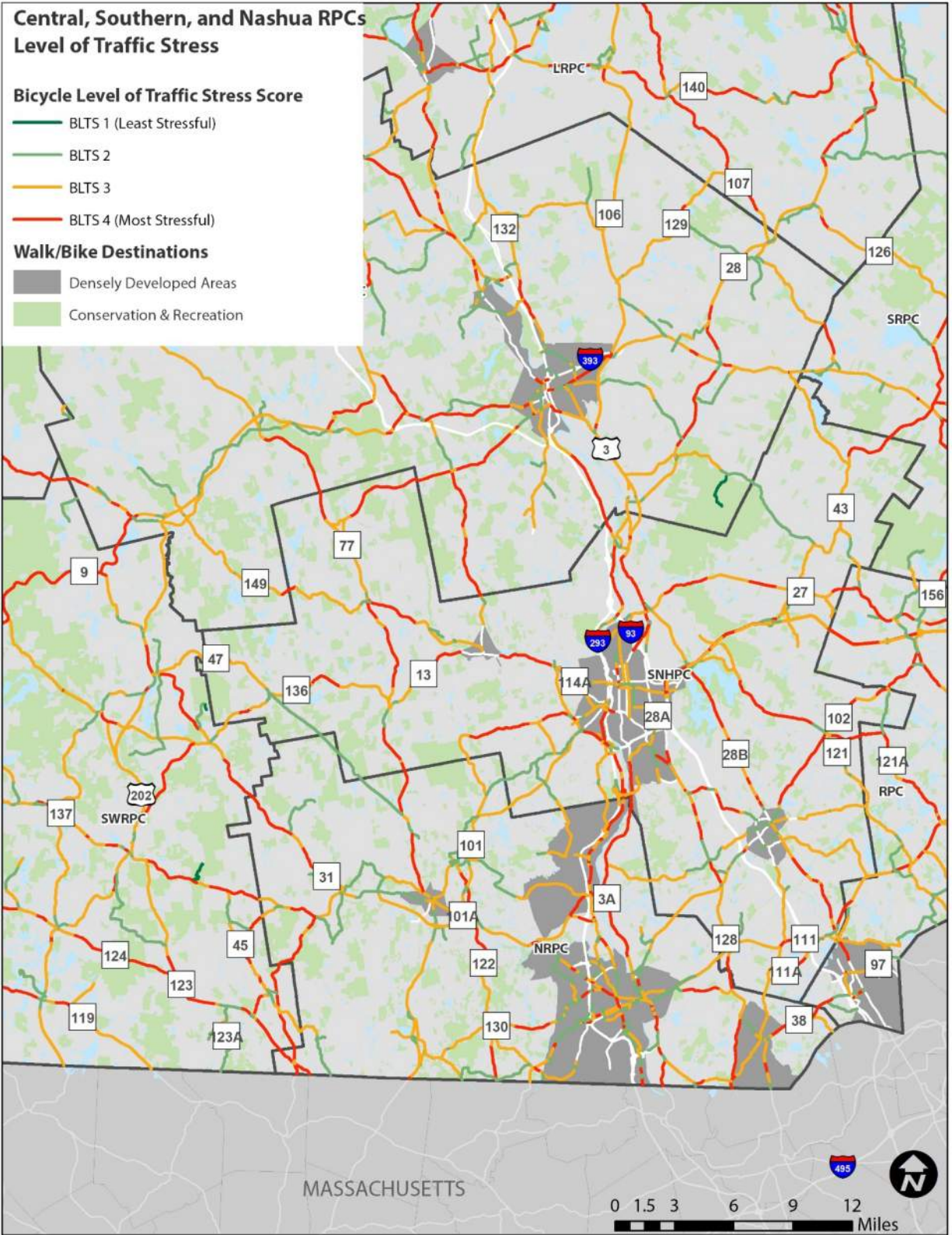
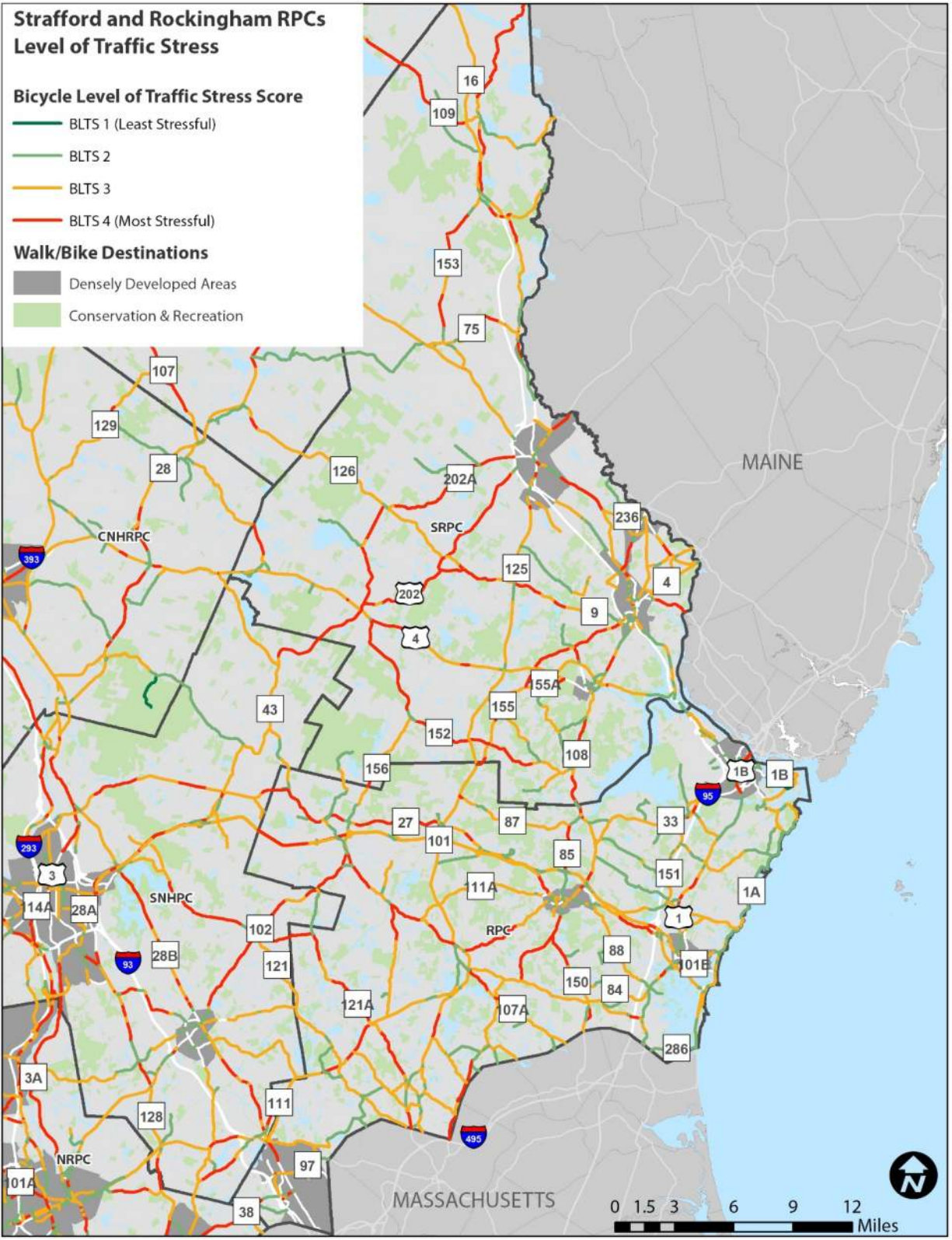


Figure 7: BLTS Outputs, Seacoast Region





## Citations

Getts, L. *Methods for Investigating and Advancing Active Transportation in New Hampshire*. Plymouth State University. Masters Thesis, Advisor: Villamagna, A. July 2017.

<<https://digitalcommons.plymouth.edu/etd/126/>>

Mekuria, M., Furth, P., and H. Nixon. *Low-Stress Bicycling and Network Connectivity*. Mineta Transportation Institute: Report 11-19. May 2012.

<<https://transweb.sjsu.edu/sites/default/files/1005-low-stress-bicycling-network-connectivity.pdf>>

Villamagna, A., L. Getts, and R. Young. *Active Transportation Accounting: Developing Metrics for Project Prioritization*. New Hampshire Department of Transportation. Project ID #26962R.

Villamagna, A. and R. Young. *Level of Traffic Stress Modeling Guide*. Plymouth State University. May 2019.