MVRPC SAFE STREETS FOR ALL
COMPREHENSIVE SAFETY ACTION PLAN

APPENDIX B:

HIGH INJURY NETWORK ANALYSIS

MVRPC SS4A SAFETY ACTION PLAN
HIGH INJURY NETWORK ANALYSIS

Contents

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This document provides an overview of the technical approaches used to perform the High Injury Network (HIN) analysis in support of the Miami Valley Regional Planning Commission (MVRPC) Safer Streets and Roads for All (SS4A) Safety Action Plan. The High Injury Network shows high densities of fatal and serious injury crashes along roadways, weighted by distribution and severity.

High Injury Network

A sliding window-type analysis method was used to score roadway segments based on crash density and severity to identify location-specific safety performance issues. This methodology helps to pinpoint locations and patterns of high crash density across corridors, leading to data-driven insights for effective safety investments in critical locations. The sliding window approach identifies "hotter" road segments, producing a visual representation of crash densities along roadways. In the urbanized areas of the region, a window length of 0.25 miles was used to account for relatively lower speeds and shorter intersection distances. In the rural areas of the region, a window length of 0.5 miles was used to account for relatively higher speeds and more sparse networks. The delineation between rural and urban areas was determined from the Ohio Department of Transportation's Adjusted Urbanized Areas boundaries (see Figure 1).[1] Five years of crash data, 2020 to 2024, was used to conduct analyses for the motor vehicle, motorcycle, and combined travel modes. For bicyclist and pedestrian modes, a broader dataset spanning ten years, 2015 to 2024, was utilized.

[1] https://gis.dot.state.oh.us/tims/Data/Download

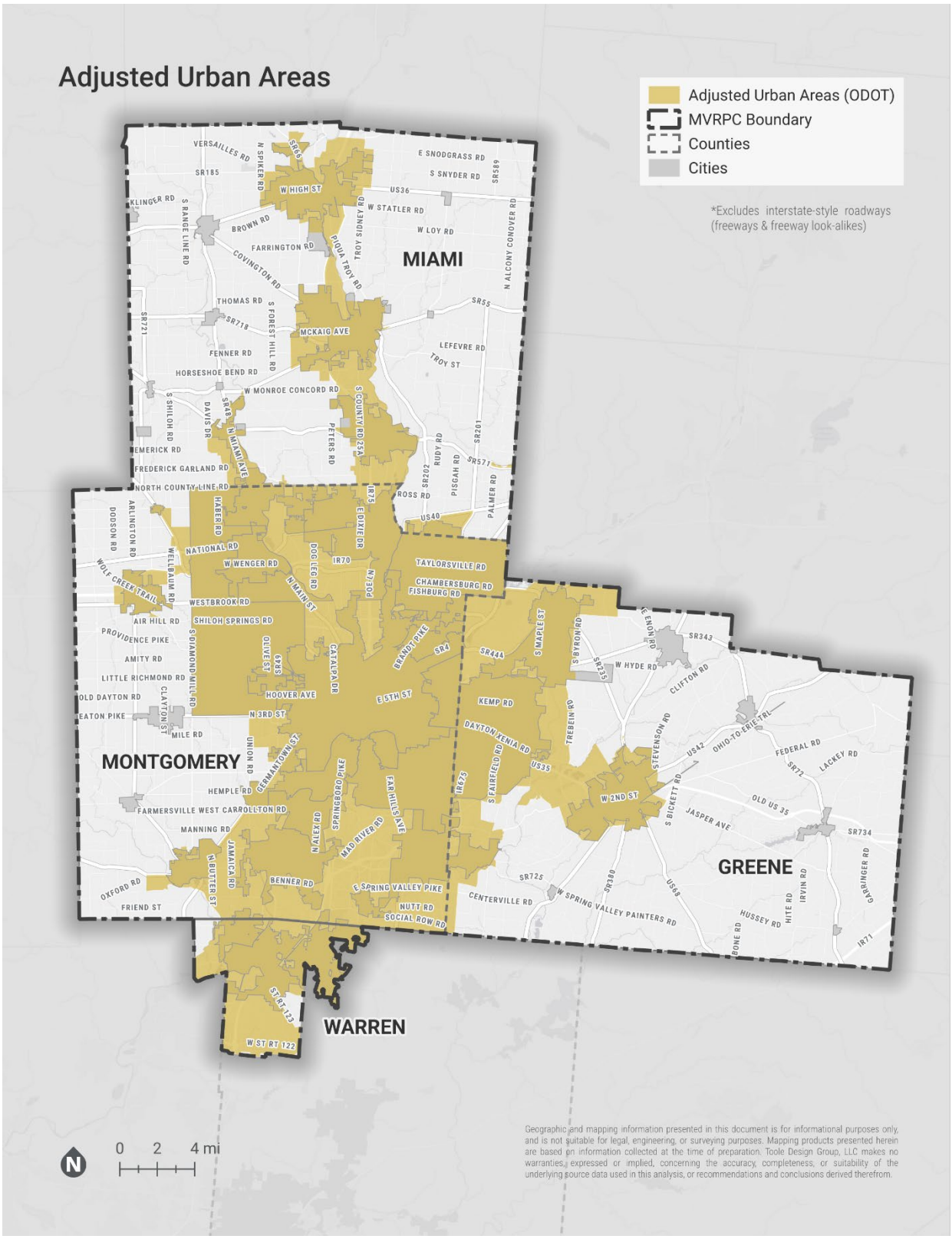


Figure 1: Rural and urban areas in the study area (areas not defined as an Adjusted Urban Area are considered rural)

Following the application of the sliding window analysis, the network was evaluated to identify locations where disproportionate levels of fatal and serious injury crashes (typically 50% or more FSI crashes) have occurred. Factors such as crash density, traffic volume, and roadway type/classification were considered when evaluating the results of the sliding window analysis to develop the final High Injury Network (HIN) so that an appropriate sampling of roadways within the region are included in the HIN. While the sliding window analysis primarily focuses on locations exhibiting high crash density and severity, it can also serve as a valuable starting point for identifying high-risk contextual factors like land use, road type, and other considerations that are indicators of or contribute to increased crash risk.

HIN maps for motor vehicle (separated into rural and urban contexts), motorcycle (separated into rural and urban contexts), pedestrian, and bicyclist crashes were produced, totaling six network maps. Additional county maps were developed to highlight results in each of the counties for readability purposes. These maps illustrate the portions of the roadway system with the highest crash densities for each road user mode. The HIN maps capture the greatest concentration of crashes across the least road miles, emphasizing segments with the most significant safety concerns. While this analysis does not directly account for land use or road type, it provides a foundation for the High Risk Network (HRN), which takes these factors into consideration. By identifying patterns in the HIN, the team can highlight potential areas for more detailed safety investigations, ensuring that investments are made where they are most needed.

Methodology

To conduct the HIN analysis, crashes were assigned to roadway segments. To focus the analysis on patterns of high severity crashes, crashes were assigned a score based on the highest severity injury in the crash. This scoring is summarized in Table 1.

Table 1: Crash Severity Scores

Severity Level	Description	Score
K	Fatal	3
A	Incapacitating Injury	3
B	Minor Injury	2
C	Possible Injury	1
O	Property Damage Only	0 (excluded from analysis)

To generalize patterns of discrete crash locations across continuous roadway corridors, a modified sliding window analysis was applied, smoothing data across adjacent segments. This approach distributes the scores assigned with each crash between the segment the crash was assigned to, as well as two segments on either side. The relative portion of the crash score to be assigned to each segment varies by its distance from the center segment and decreases linearly. This creates a pyramid-shaped distribution of each crash's scores across up to five adjacent segments, as visualized in Figure 2. These distributed crash scores were then totaled and used as the final crash score for the given segment.

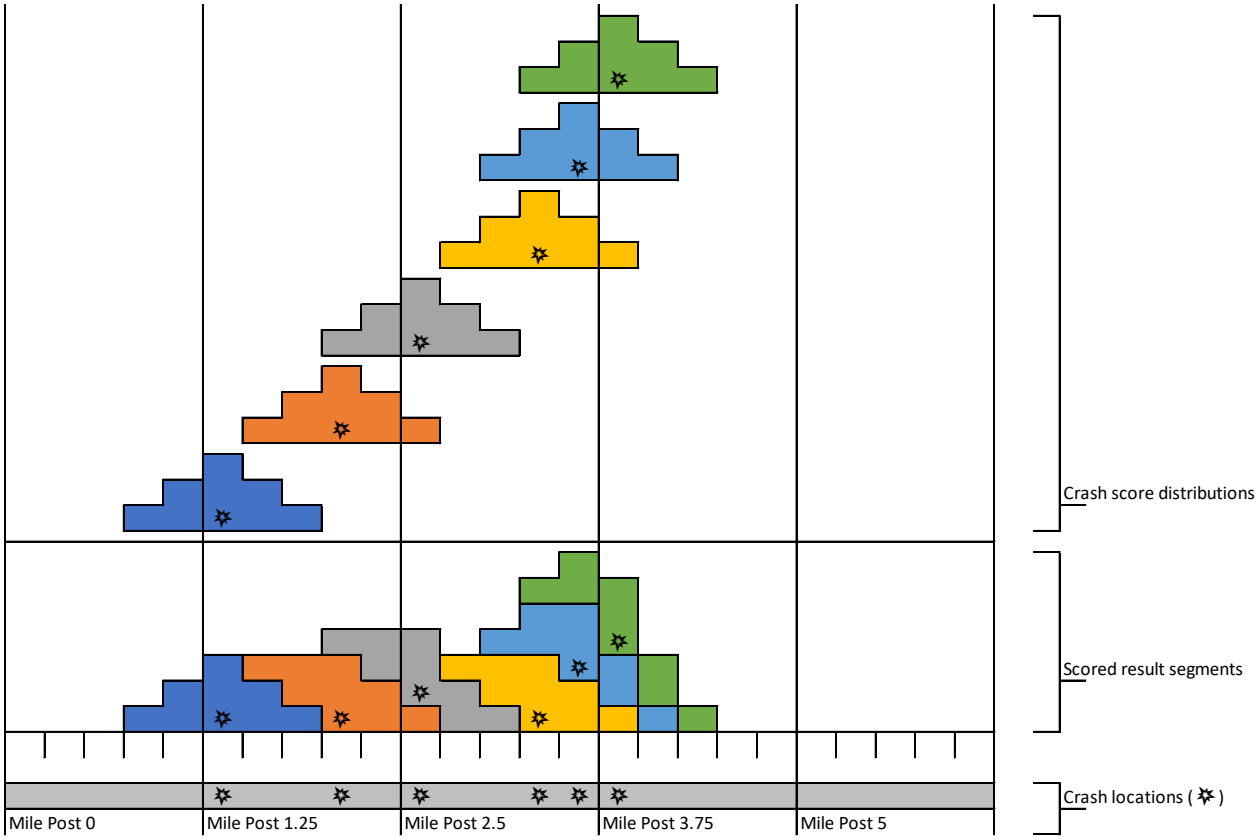


Figure 2: Sliding Window Analysis and Crash Distribution Example Schematic

After the sliding window analysis process was completed, the results were analyzed based on distributed crash scores to identify the top scoring roadway segments. A percentile ranking was computed for each segment, and the top roadway segments were selected based on the percentile score, such as selecting a fixed percentage of all top roads or based on the proportion of roads representing a target number of crashes. This selection process is visualized in Figure 3.

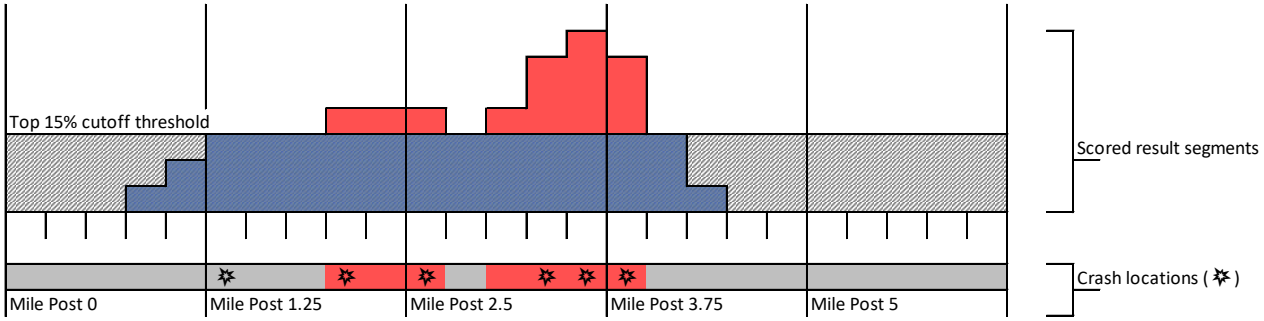


Figure 3: Percentile Ranking of Distributed Crash Scores Example

Crash Data Limitations

Local law enforcement agencies submit crash reports that provide raw crash data. While crash reports are currently the best way to obtain information about a large number of crashes, they have limitations. Crash severity may have limited accuracy because those completing reports typically don't have medical training, and victims of crashes may be unaware of internal injuries that may manifest or become apparent at a later time. The total number of crashes may be underreported due to fears, language barriers, financial concern, and more. Crash reports may not capture the effects of speed in crashes, as the first responders are typically on the scene after the crash has occurred and witnesses outside a crash are not typically interviewed about operator speed. Crashes involving motorists are more likely to be reported for insurance purposes, but crashes involving pedestrians or bicyclists only (e.g., a bicyclist hitting a fixed object) are less likely to be reported. Even when crash reports are perfect, they do not record near misses or the self-limiting behavior of travelers who don't feel safe in currently configured networks. It is useful to keep these limitations in mind when using crash data and to vet data with priority populations as part of the planning process.

High Injury Network Maps

The following pages include High Injury Network maps for the region as well as zoomed-in county-level maps (Miami, Montgomery, Greene, and part of Northern Warren County). The county-level maps represent the same data as their region-level counterparts. As such, some county maps may not have any High Injury Network segments and were included for completeness. To identify an appropriate representation of the roadway network, various network score thresholds were evaluated to determine which would capture 40%, 50%, and 60% of fatal and serious injury (FSI) crashes within the High Injury Network (HIN). Table 2 presents the results of this analysis, including the proportion of MVRPC's total roadway mileage represented in each HIN, as well as mileage by functional class—specifically, higher functional class roads (above the minor collector classification) and lower functional class roads (minor collector and below). Table 2 also includes the distribution of FSI crashes by functional classification at each threshold level. Based on this analysis, the threshold capturing 50% of FSI crashes was selected, as it offered a balanced and representative distribution across roadway functional classifications and contexts.

In addition, an analysis of the High Injury Intersections was conducted, and regional and county maps were produced as well. These maps demonstrate the top 5% of intersections based on the previous severity scoring methodology. For visual clarity, the intersections are symbolized based on the Jenks Natural Breaks method[2].

[2] Jenks Natural Breaks Explained

Table 2: High Injury Network by FSI Representation

High Injury Network Modes & Context	HIN by % of FSI Crashes	% of MVRPC Roads Miles on HIN	% of MVRPC's Higher Functional Class Miles	% of MVRPC's Lower Functional Class Miles	% of Included FSI Crashes on Higher Functional Class Roads	% of Included FSI Crashes on Lower Functional Class Roads	Threshold Network Score
All Modes (Urban Context)	**40%**	7.83%	23.58%	1.15%	89.35%	10.65%	4.72
	50%	11.29%	32.78%	2.17%	88.74%	11.26%	3.44
	60%	13.88%	37.96%	3.67%	85.98%	14.02%	2.89
All Modes (Rural Context)	**40%**	2.47%	20.91%	1.71%	43.41%	56.59%	2.00
	50%	3.37%	28.56%	2.32%	41.10%	58.90%	1.67
	60%	4.15%	32.63%	2.97%	40.00%	60.00%	1.50
Motor Vehicles (Urban Context)	**40%**	7.70%	23.52%	0.99%	90.57%	9.43%	4.11
	50%	11.04%	32.34%	2.01%	89.58%	10.42%	3.01
	60%	13.33%	37.24%	3.18%	87.72%	12.28%	2.59
Motor Vehicles (Rural Context)	**40%**	2.09%	19.64%	1.36%	44.09%	55.91%	1.89
	50%	2.60%	24.16%	1.71%	44.37%	55.63%	1.67
	60%	3.62%	30.98%	2.49%	45.31%	54.69%	1.39
Motorcycles (Urban Context)	**40%**	1.43%	3.11%	0.72%	75.57%	24.43%	1.17
	50%	2.39%	5.32%	1.14%	74.35%	25.65%	1.00
	60%	2.92%	6.59%	1.37%	73.88%	26.12%	0.88
Motorcycles (Rural Context)	**40%**	0.41%	1.74%	0.35%	21.05%	78.95%	1.28
	50%	0.61%	2.66%	0.53%	21.15%	78.85%	1.07
	60%	0.79%	3.99%	0.66%	20.34%	79.66%	0.97
Bicyclist (All Contexts)	**40%**	0.56%	1.75%	0.33%	60.76%	39.24%	0.83
	50%	0.65%	2.25%	0.34%	68.81%	31.19%	0.82
	60%	0.87%	3.02%	0.45%	70.09%	29.91%	0.17
Pedestrians (All Contexts)	**40%**	1.55%	6.15%	0.65%	79.43%	20.57%	0.84
	50%	1.57%	6.25%	0.66%	79.57%	20.43%	0.83
	60%	4.02%	17.17%	1.47%	81.61%	18.39%	0.66

MVRPC Region

All Modes HIN

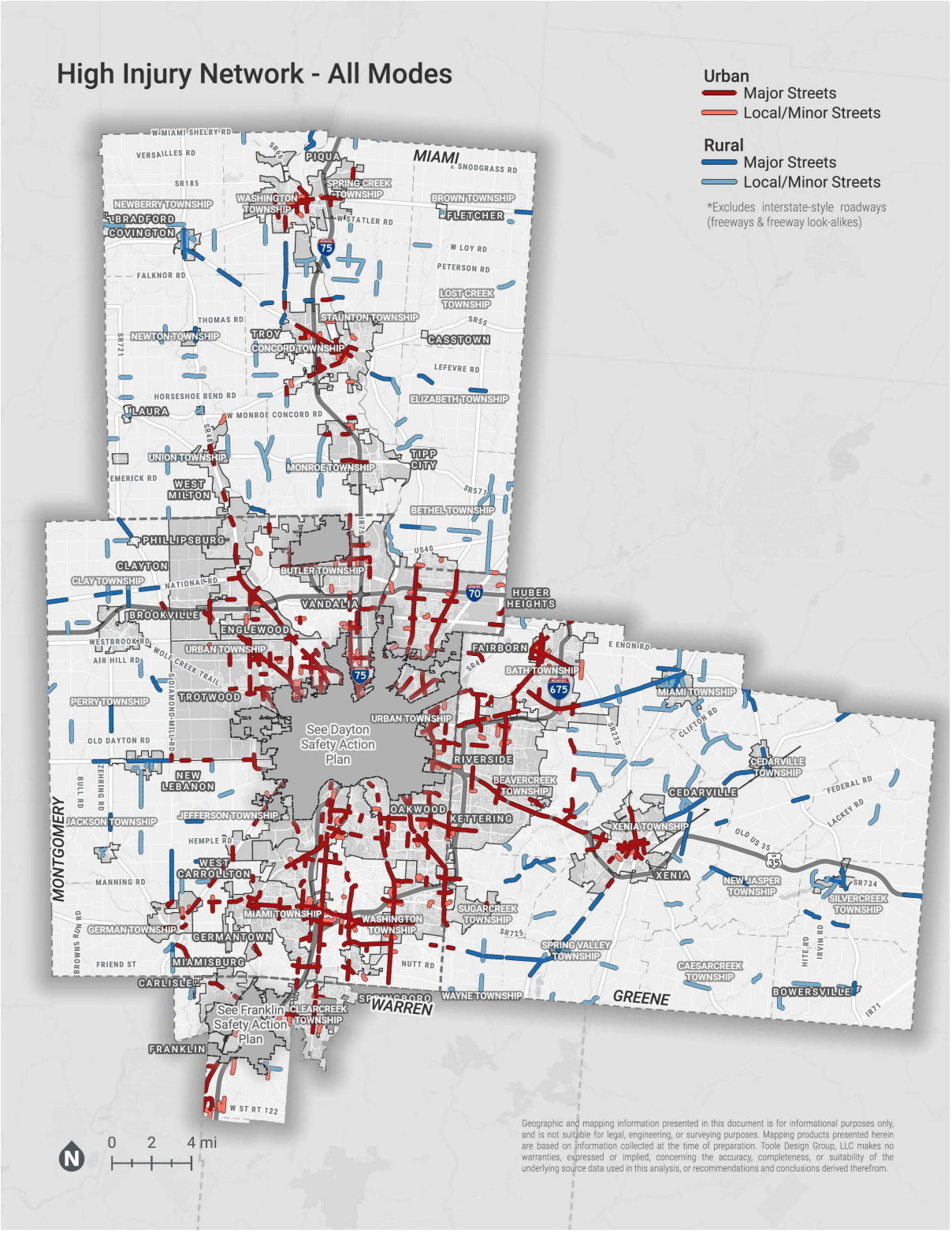


Figure 4: All Modes High Injury Network (MVRPC MPO Region)

Motor Vehicle HIN

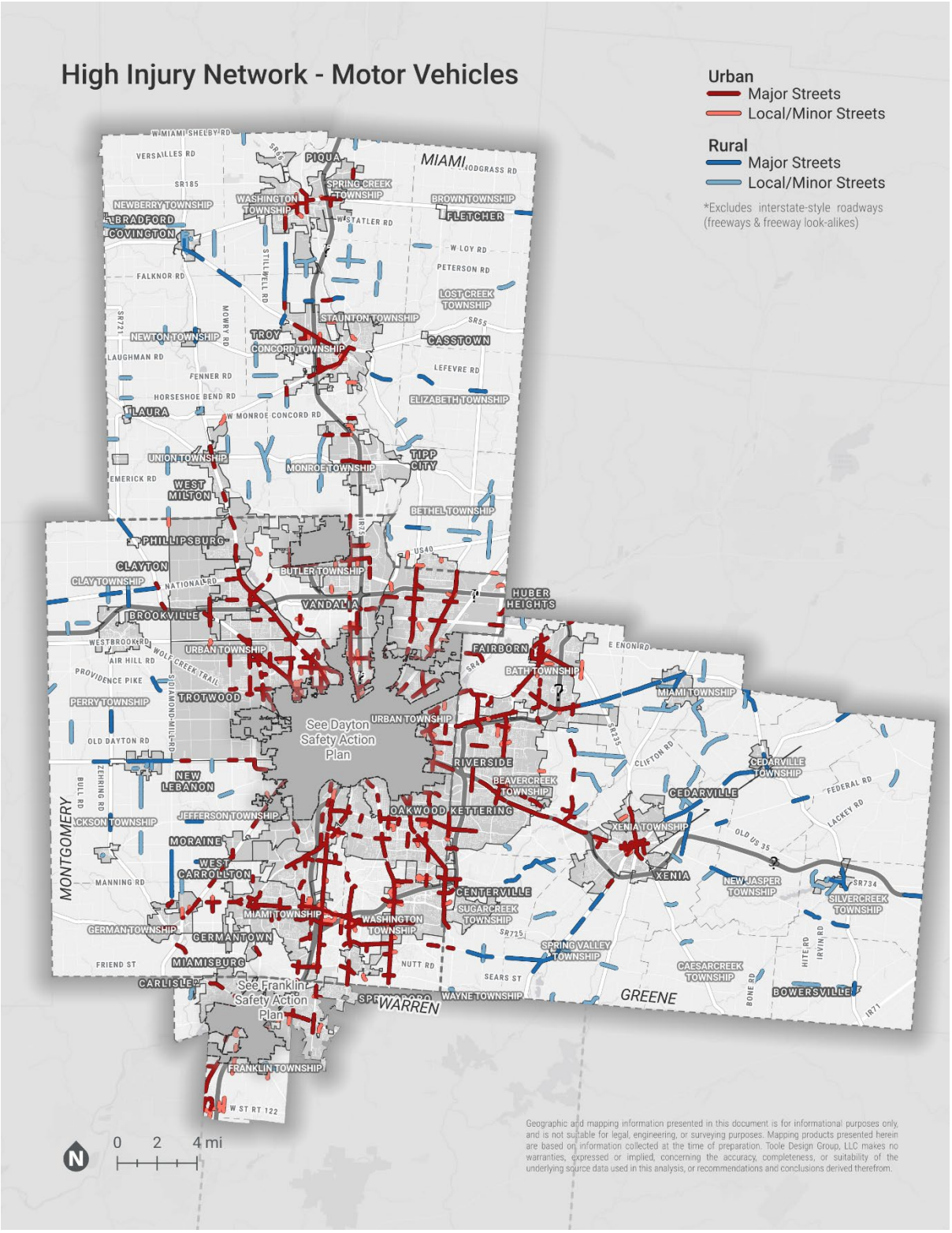


Figure 5: Motor Vehicle High Injury Network (MVRPC MPO Region)

Motorcycle HIN

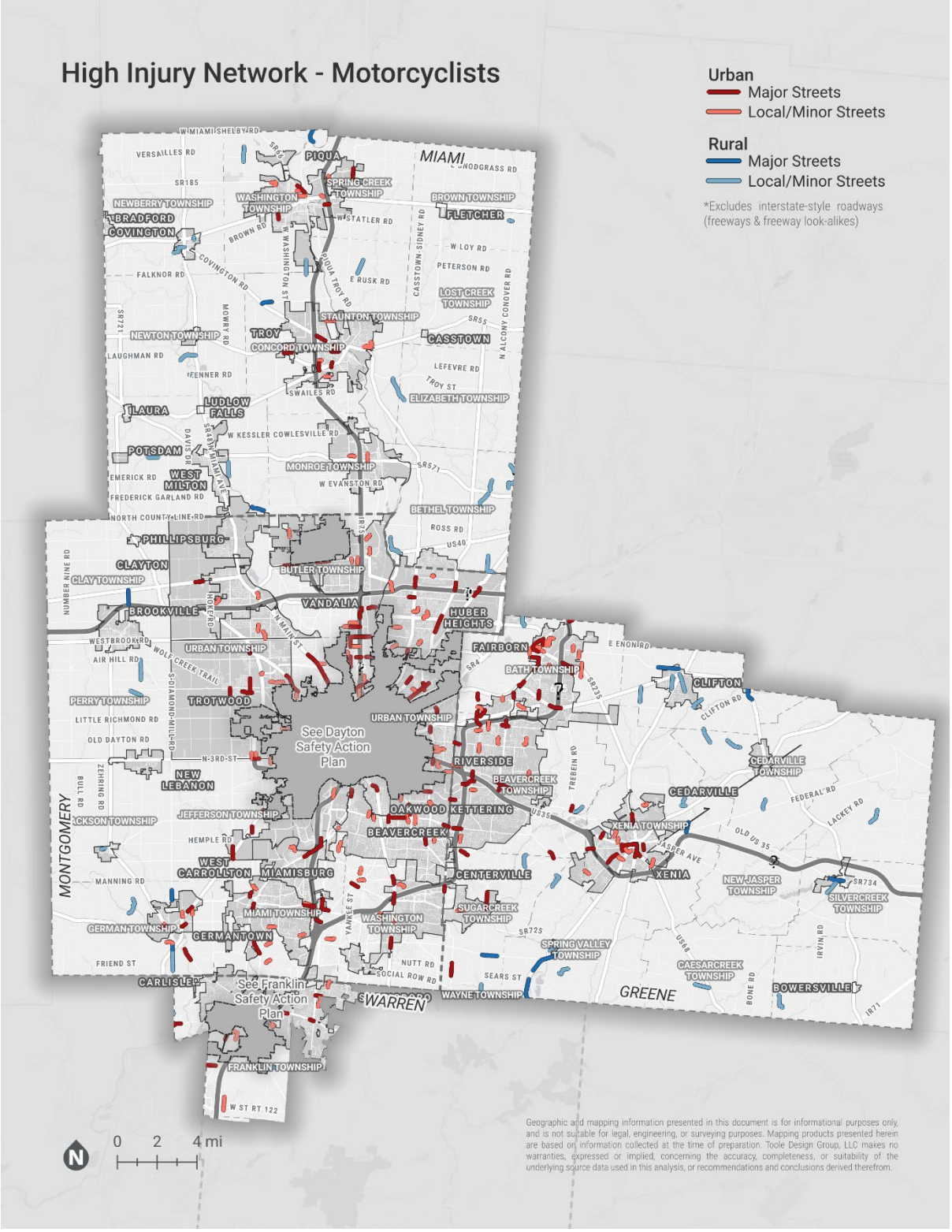


Figure 6: Motorcycle High Injury Network (MVRPC MPO Region)

Bicycle HIN

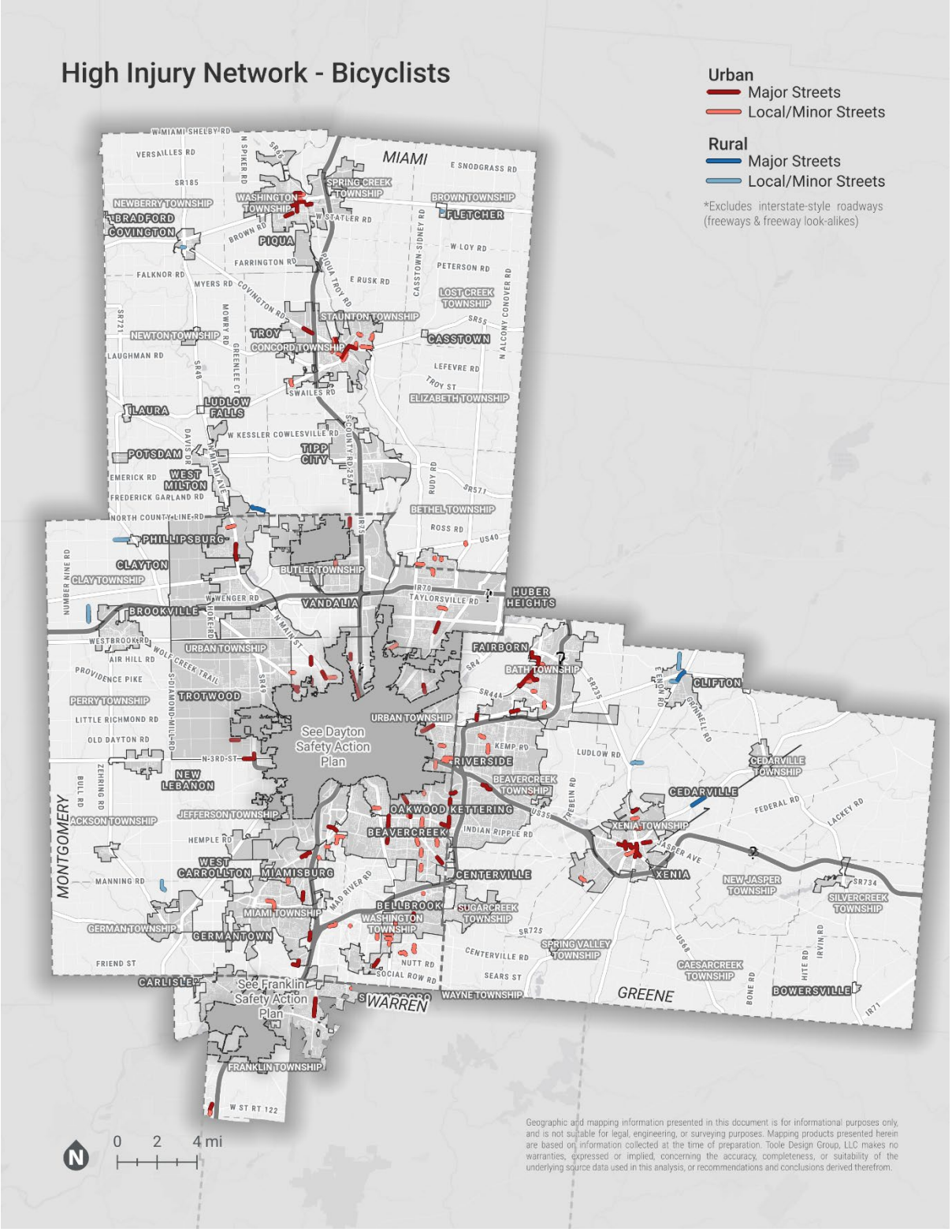


Figure 7: Bicycle High Injury Network (MVRPC MPO Region)

Pedestrian HIN

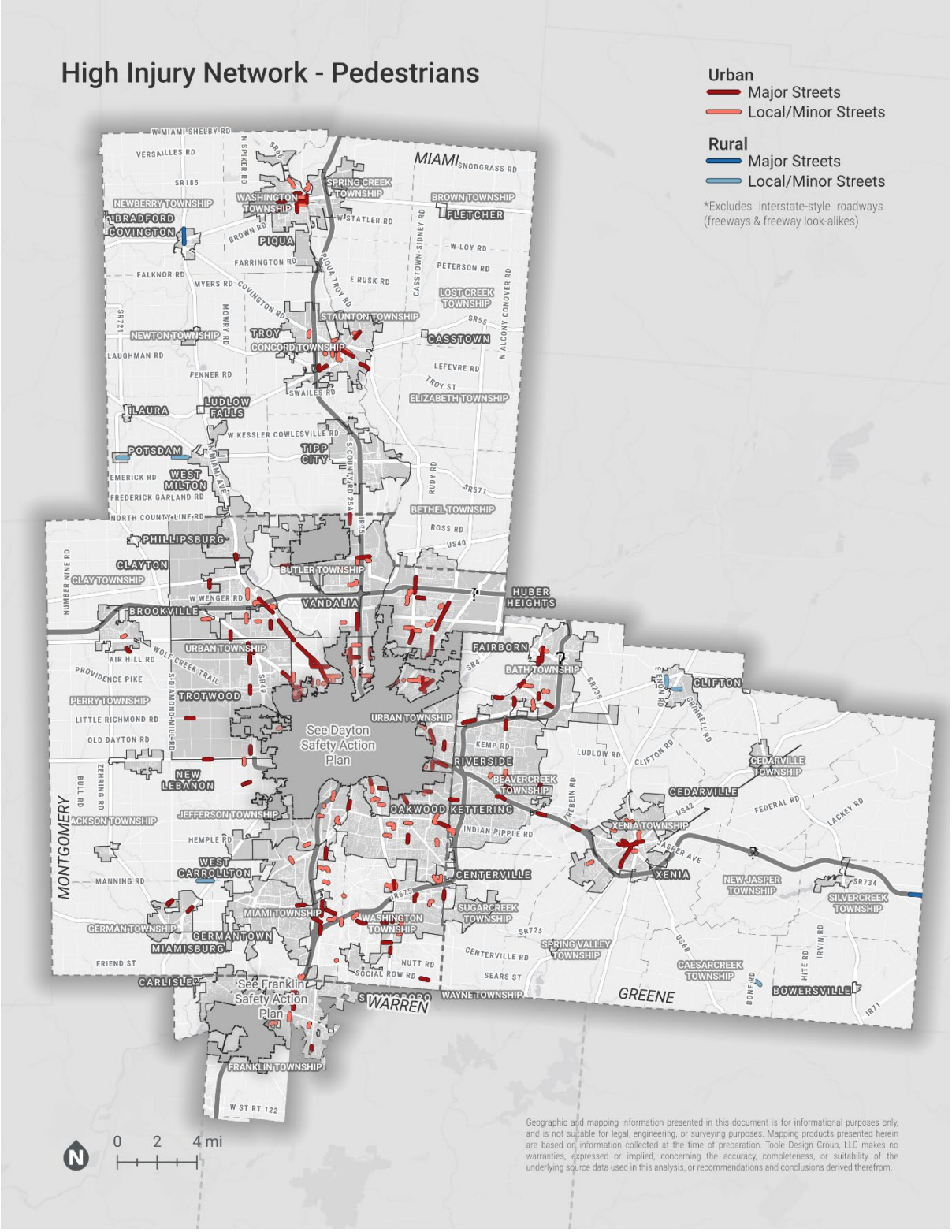


Figure 8: Pedestrian High Injury Network (MVRPC MPO Region)

Miami County

All Modes HIN

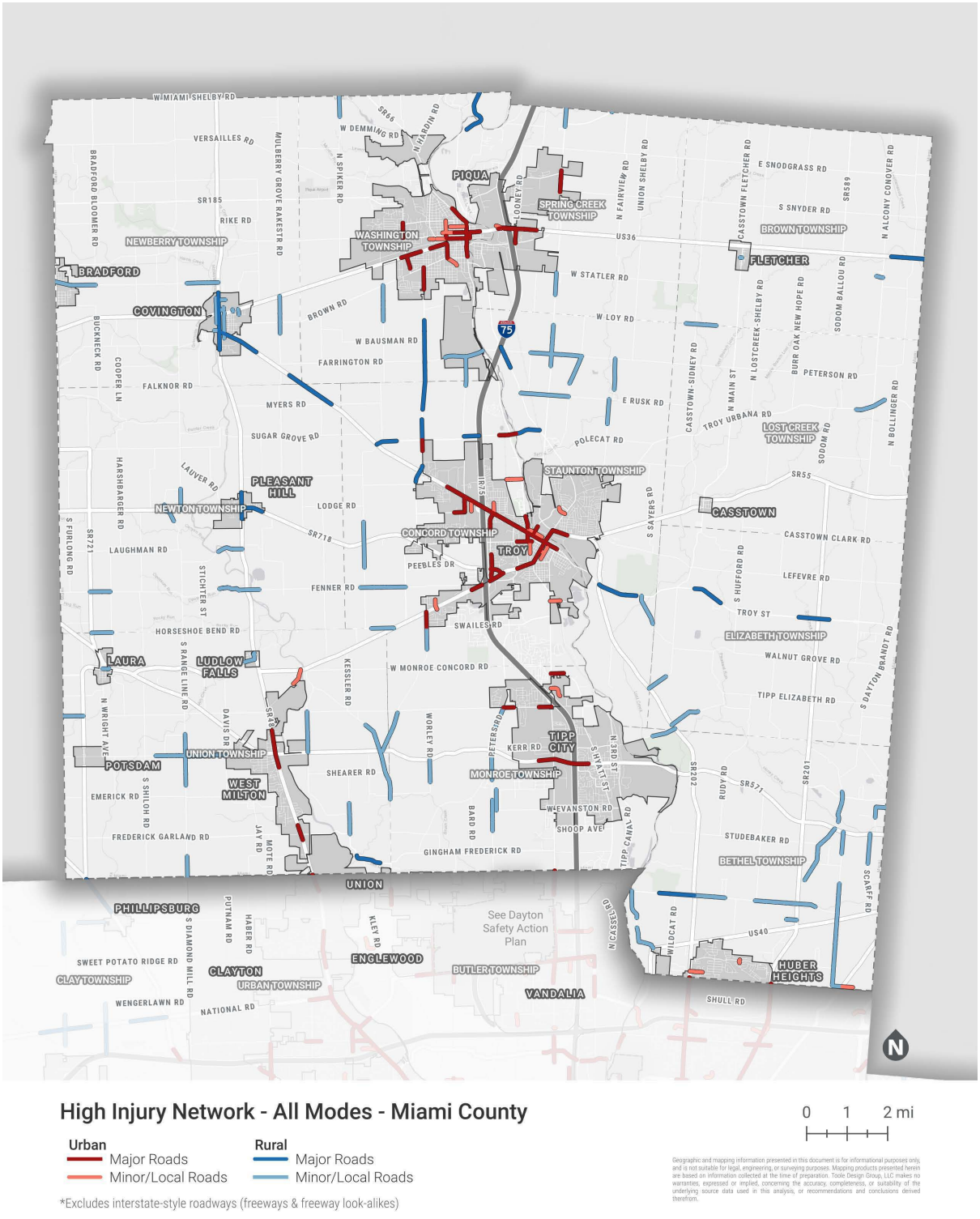


Figure 9: All Modes High Injury Network (Miami County)

Motor Vehicle HIN

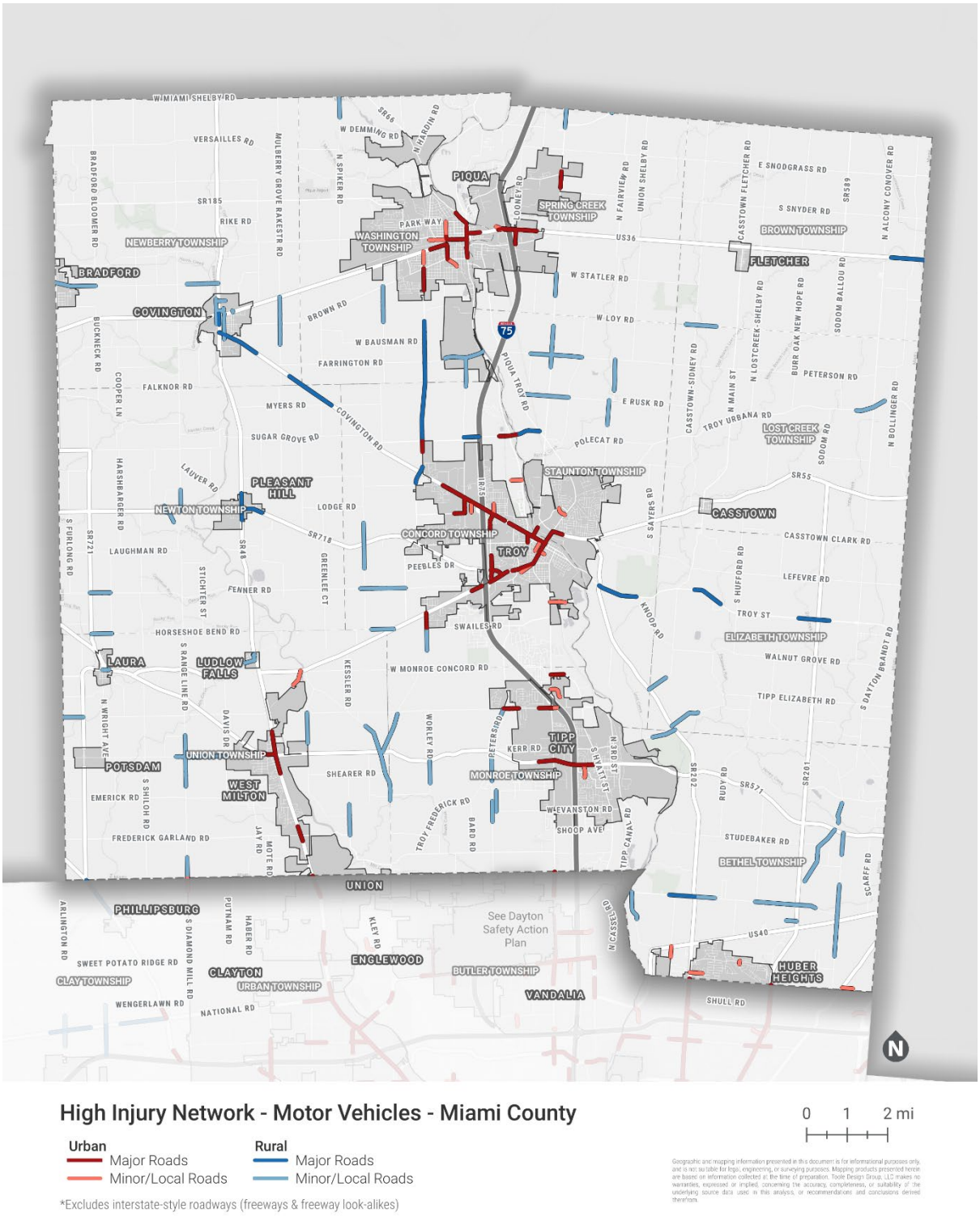


Figure 10: Motor Vehicle High Injury Network (Miami County)

Motorcycle HIN

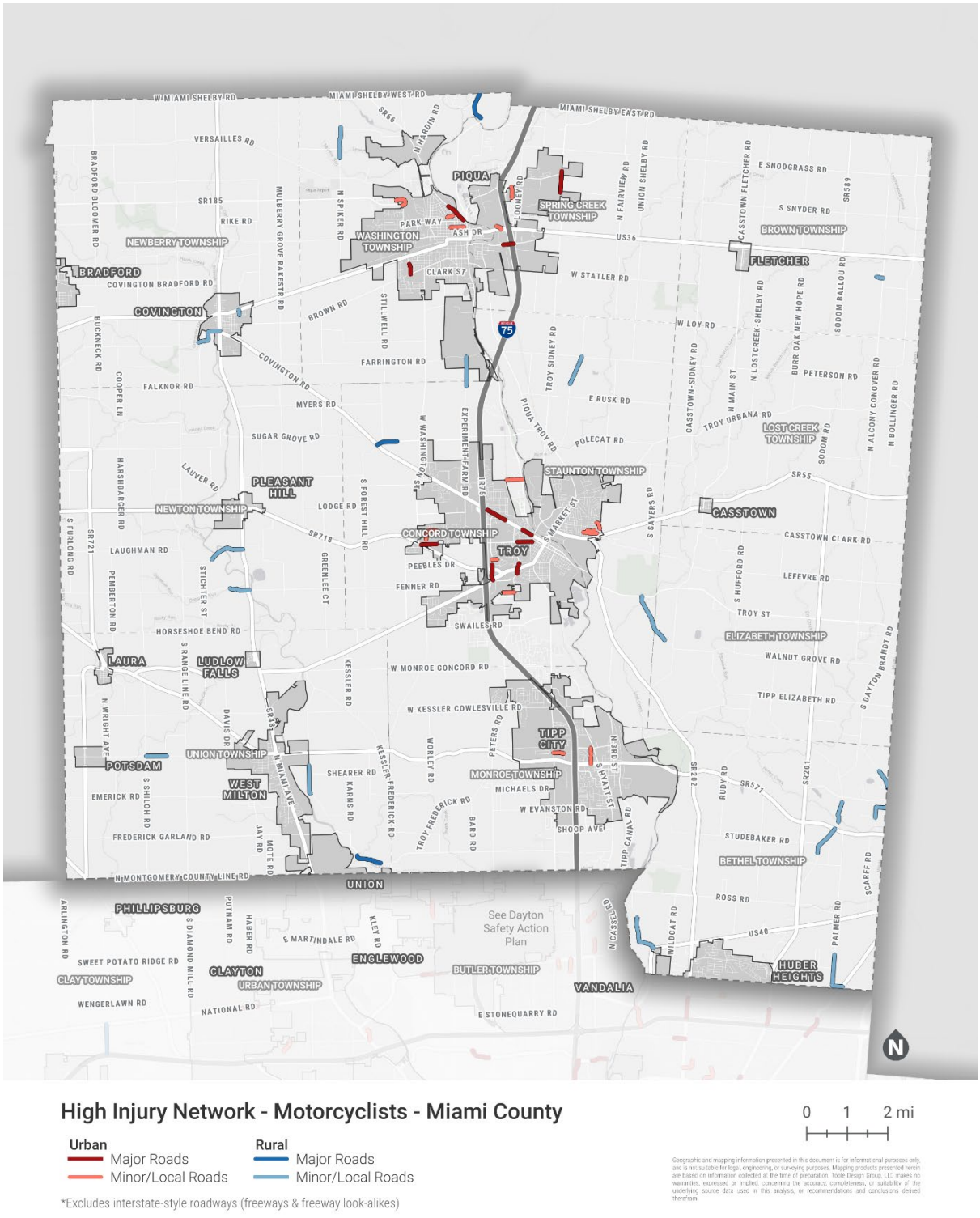


Figure 11: Motorcycle High Injury Network (Miami County)

Bicycle HIN

Figure 12: Bicycle High Injury Network (Miami County)

Pedestrian HIN

Figure 13: Pedestrian High Injury Network (Miami County)

Montgomery County

All Modes HIN

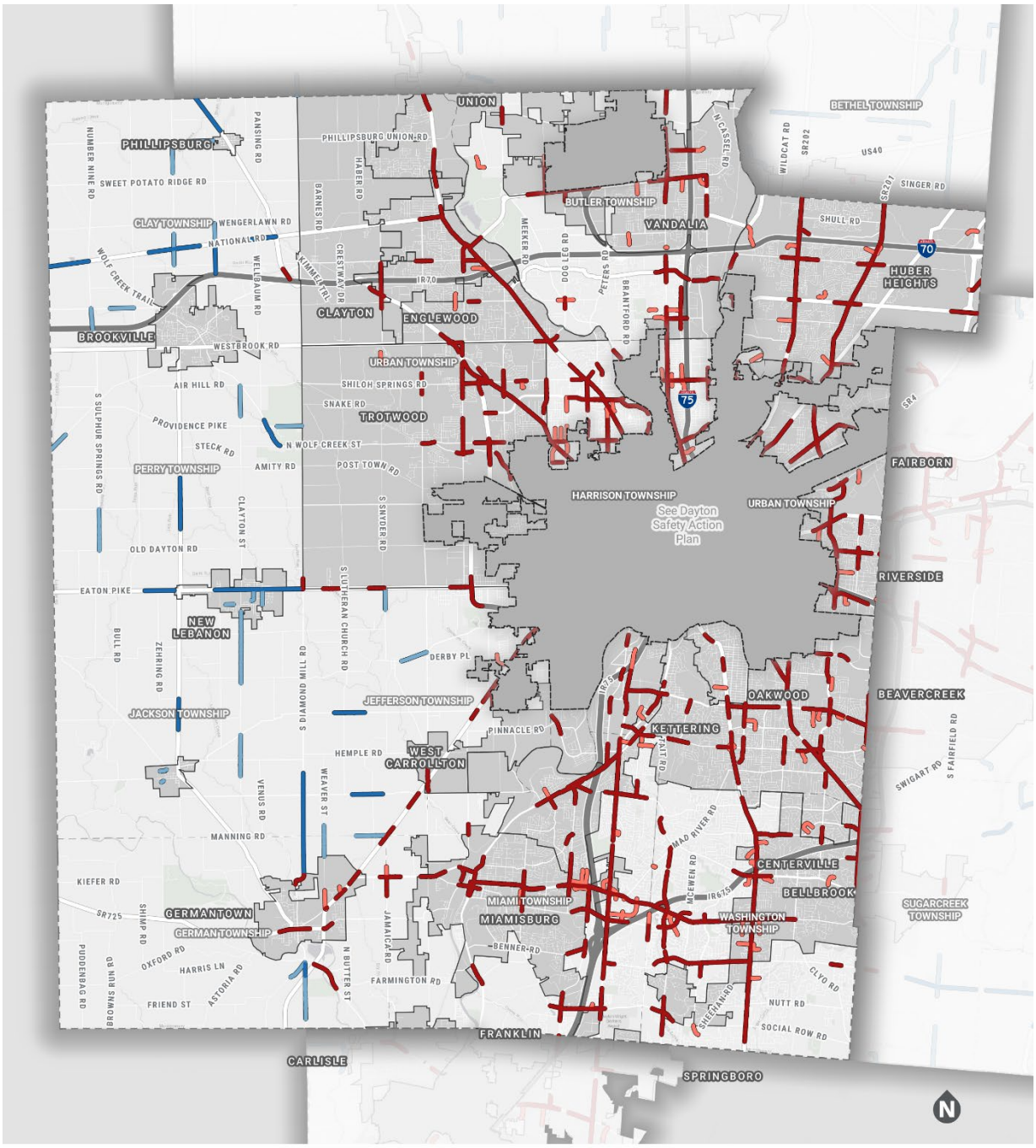


Figure 14: All Modes High Injury Network (Montgomery County)

Motor Vehicle HIN

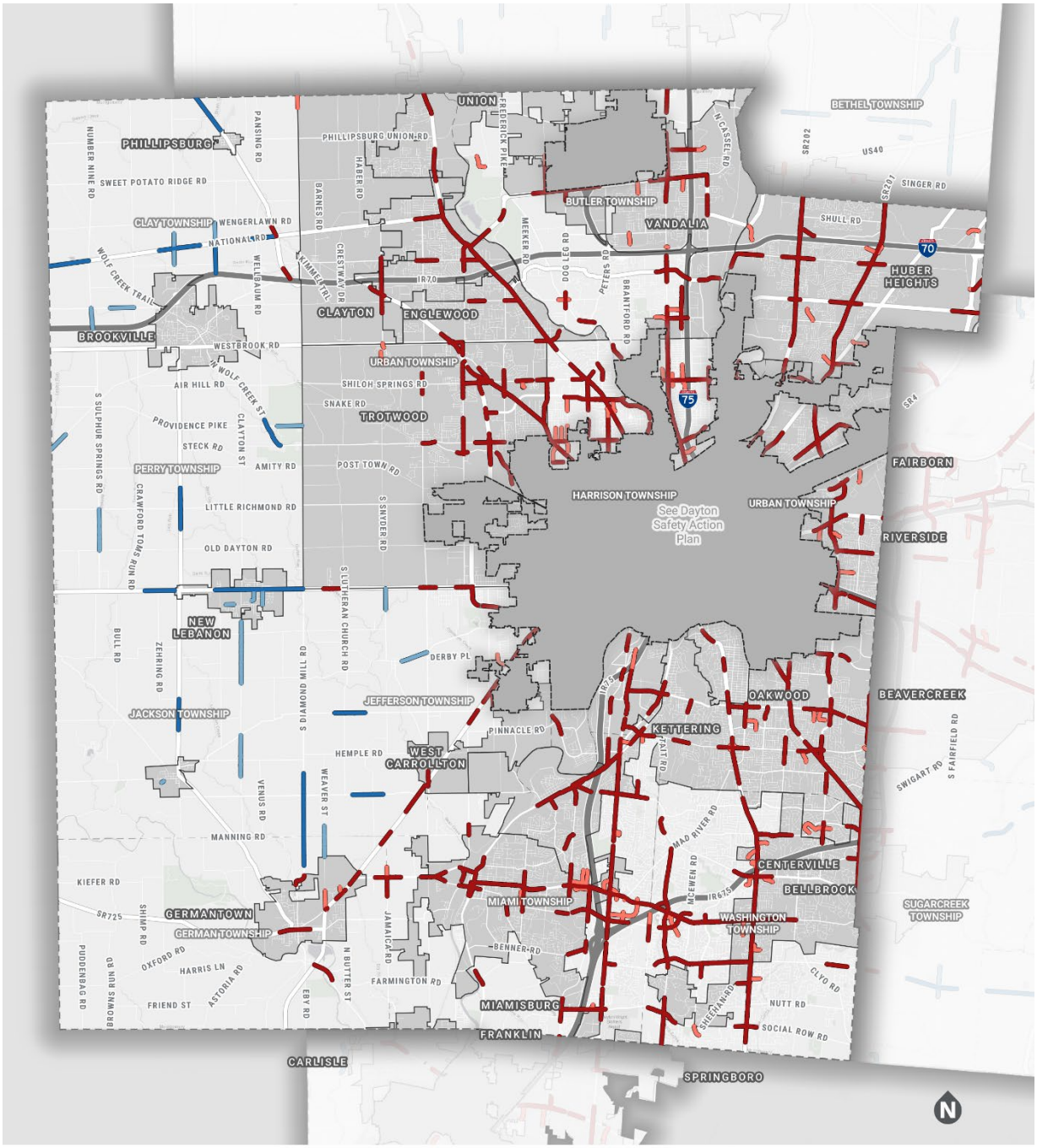


Figure 15: Motor Vehicle High Injury Network (Montgomery County)

Motorcycle HIN

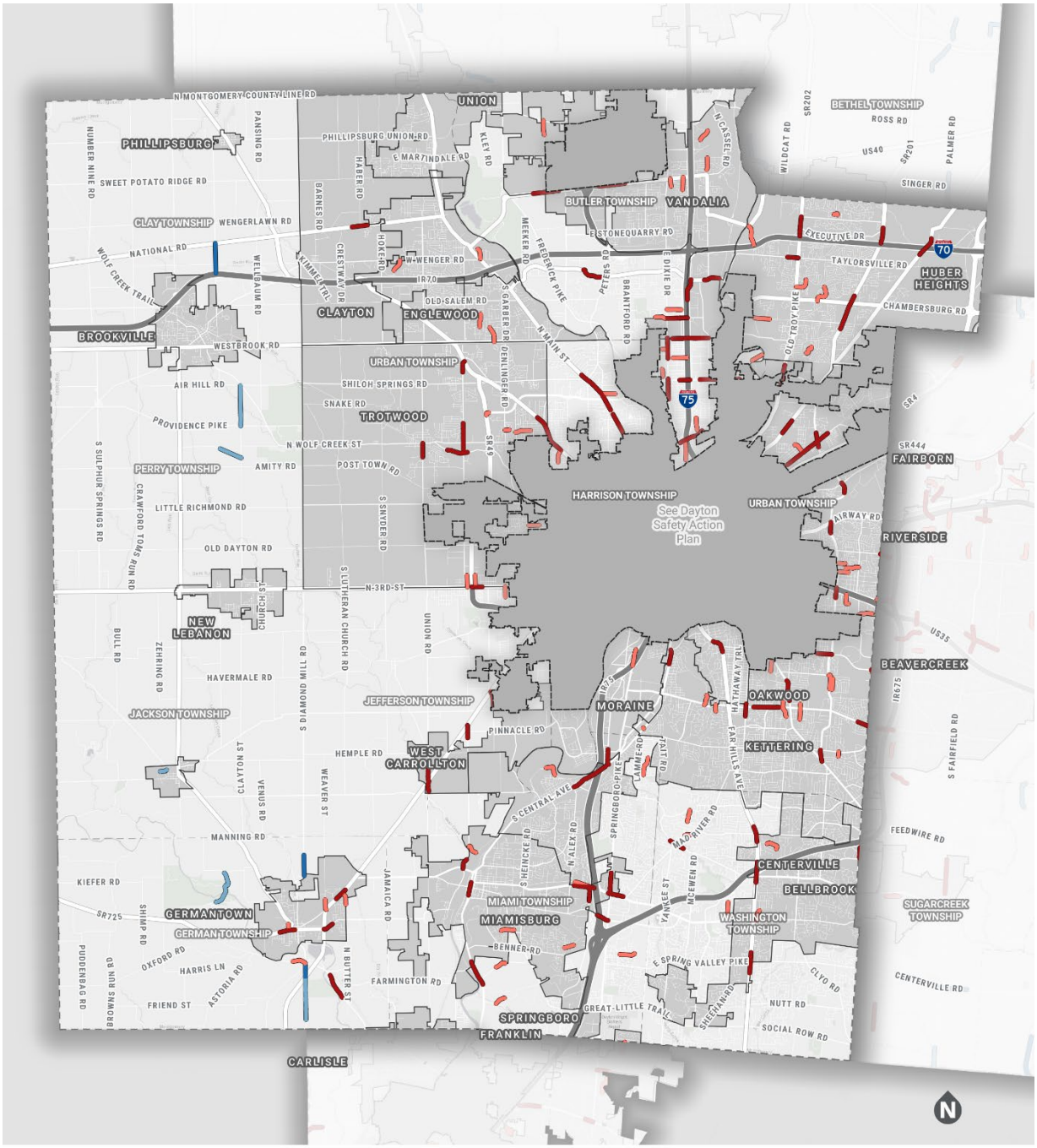


Figure 16: Motorcycle High Injury Network (Montgomery County)

Bicycle HIN

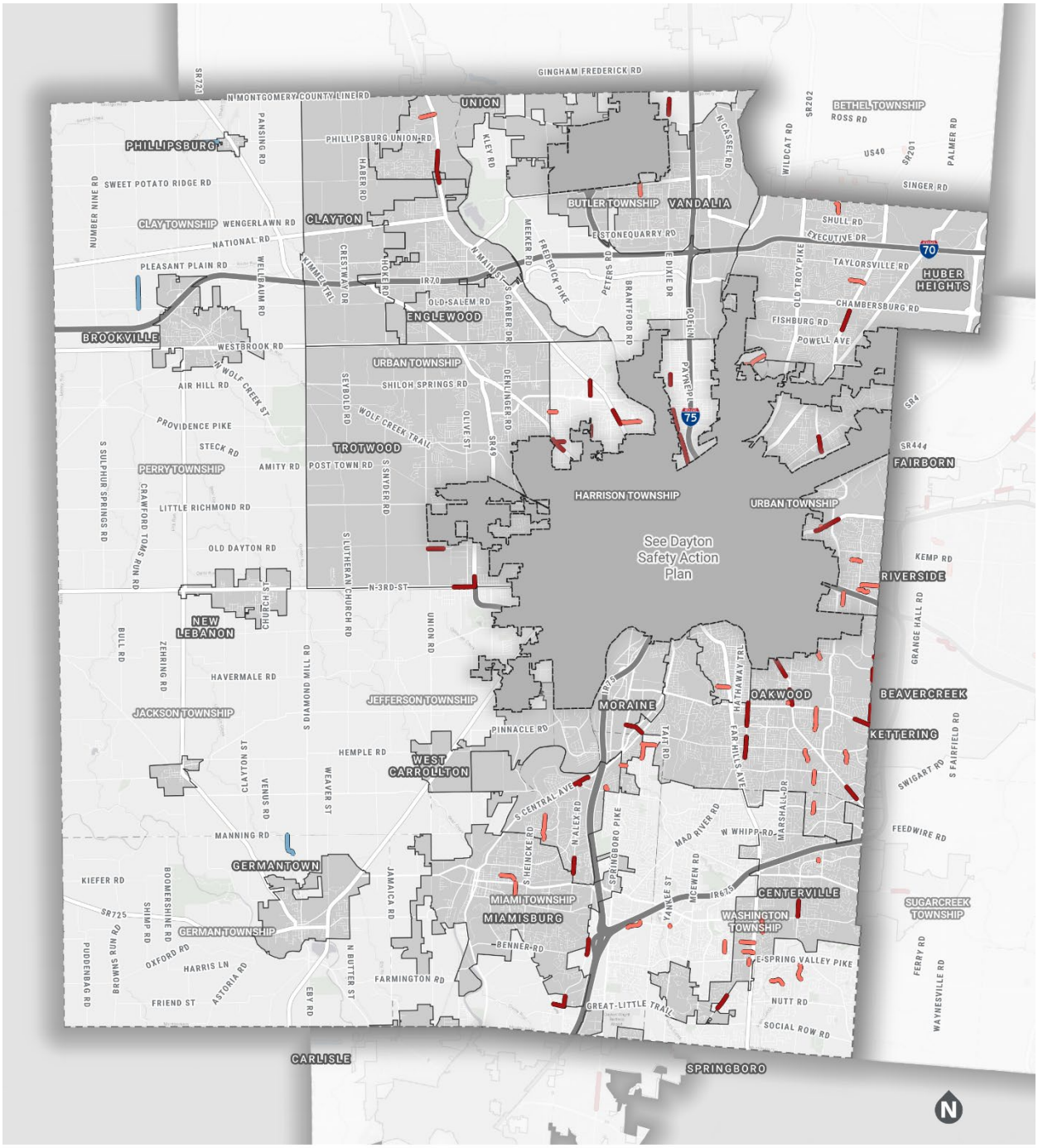


Figure 17: Bicycle High Injury Network (Montgomery County)

Pedestrian HIN

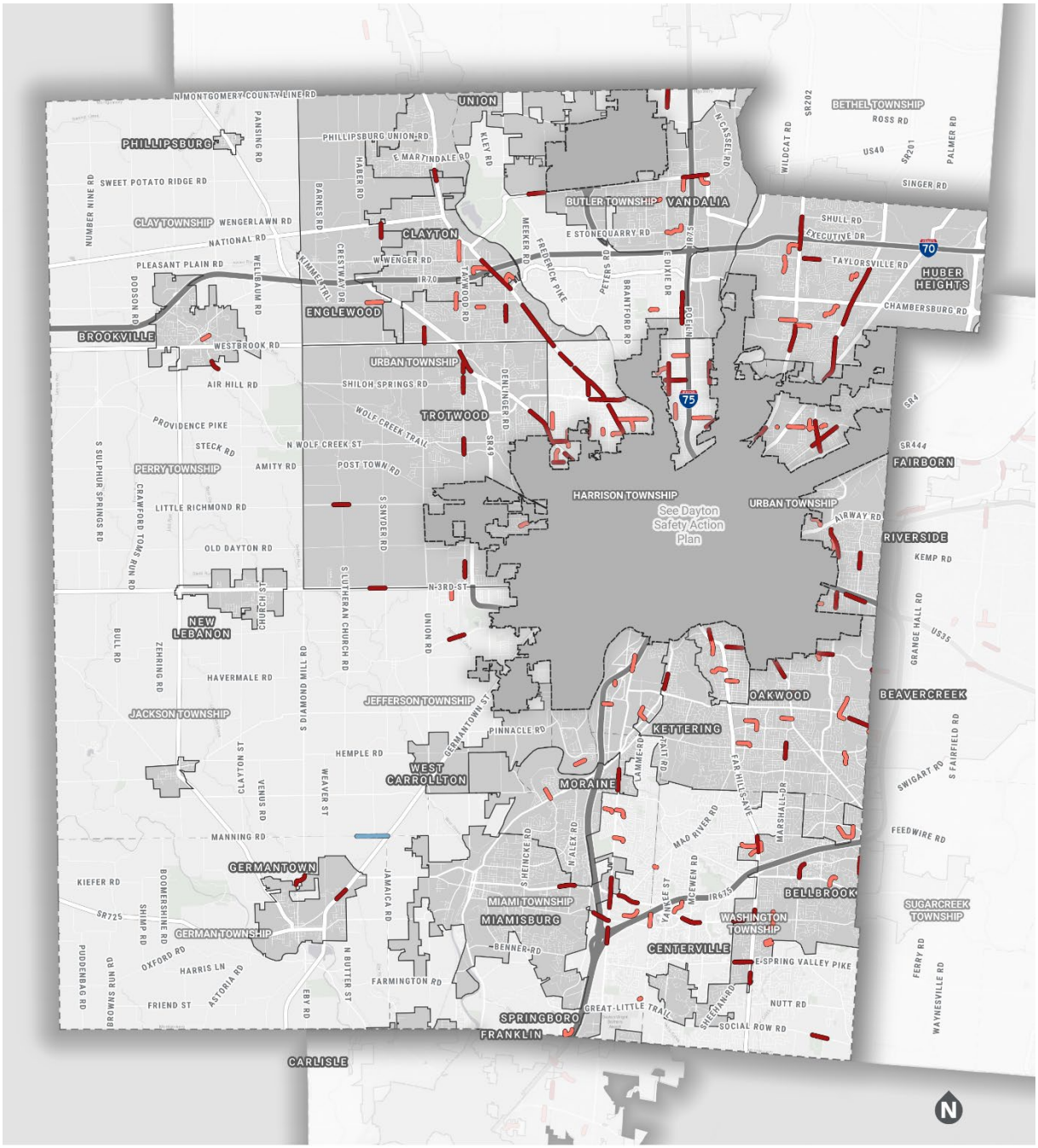


Figure 18: Pedestrian High Injury Network (Montgomery County)

Greene County

All Modes HIN

Figure 19: All Modes High Injury Network (Greene County)

Motor Vehicle HIN

Figure 5: Motor Vehicle High Injury Network (Greene County)

Motorcycle HIN

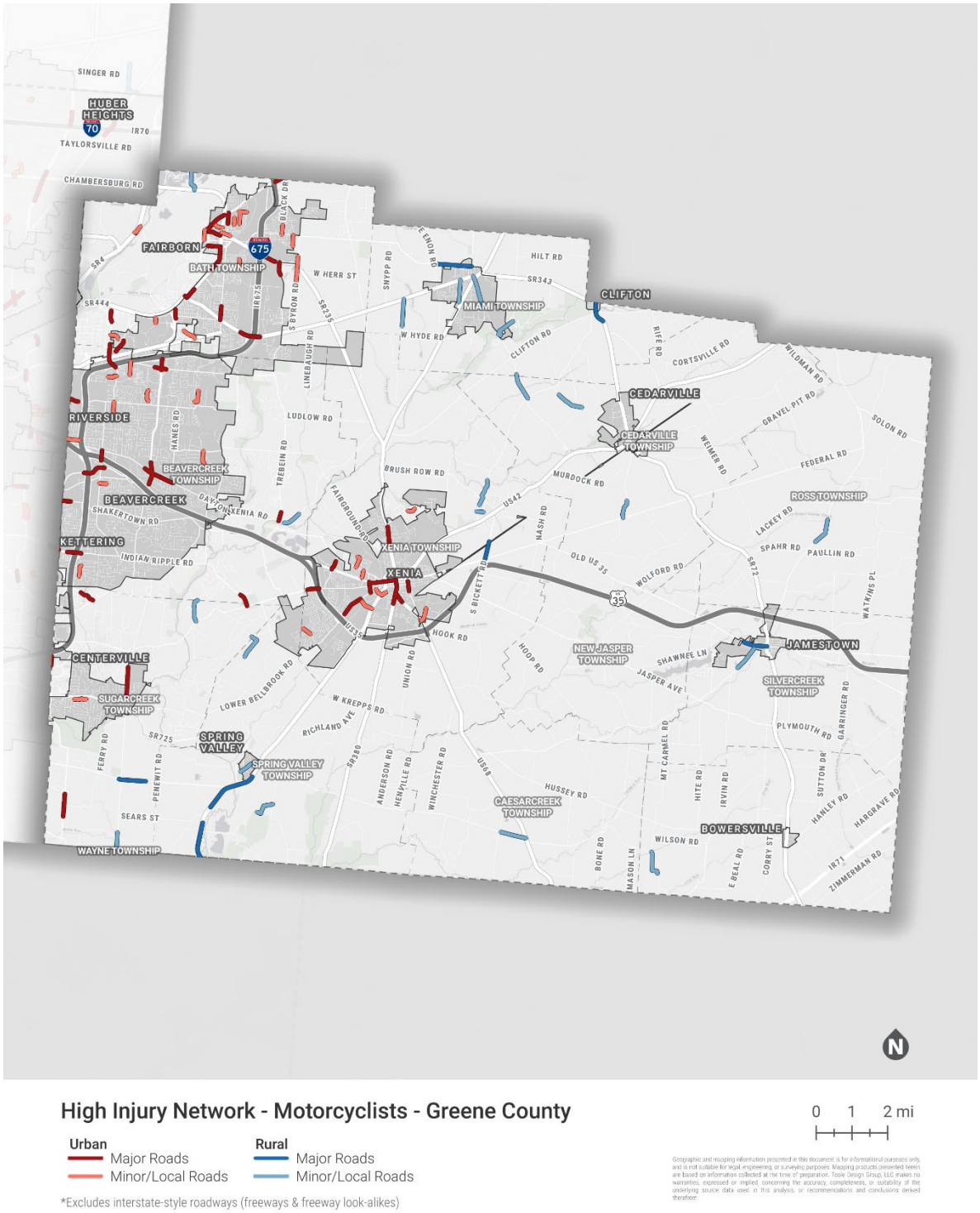


Figure 21: Motorcycle High Injury Network (Greene County)

Bicycle HIN

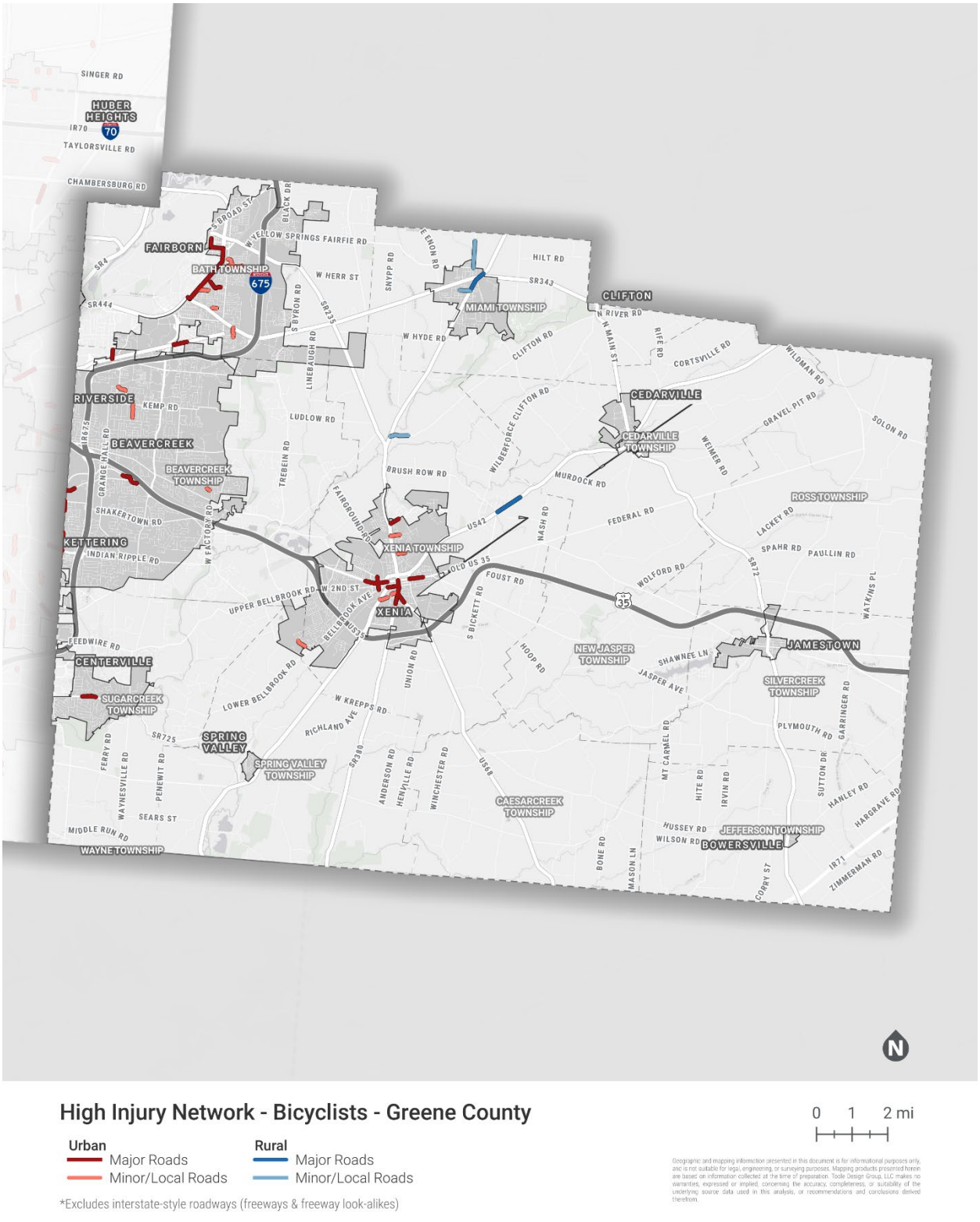


Figure 22: Bicycle High Injury Network (Greene County)

Pedestrian HIN

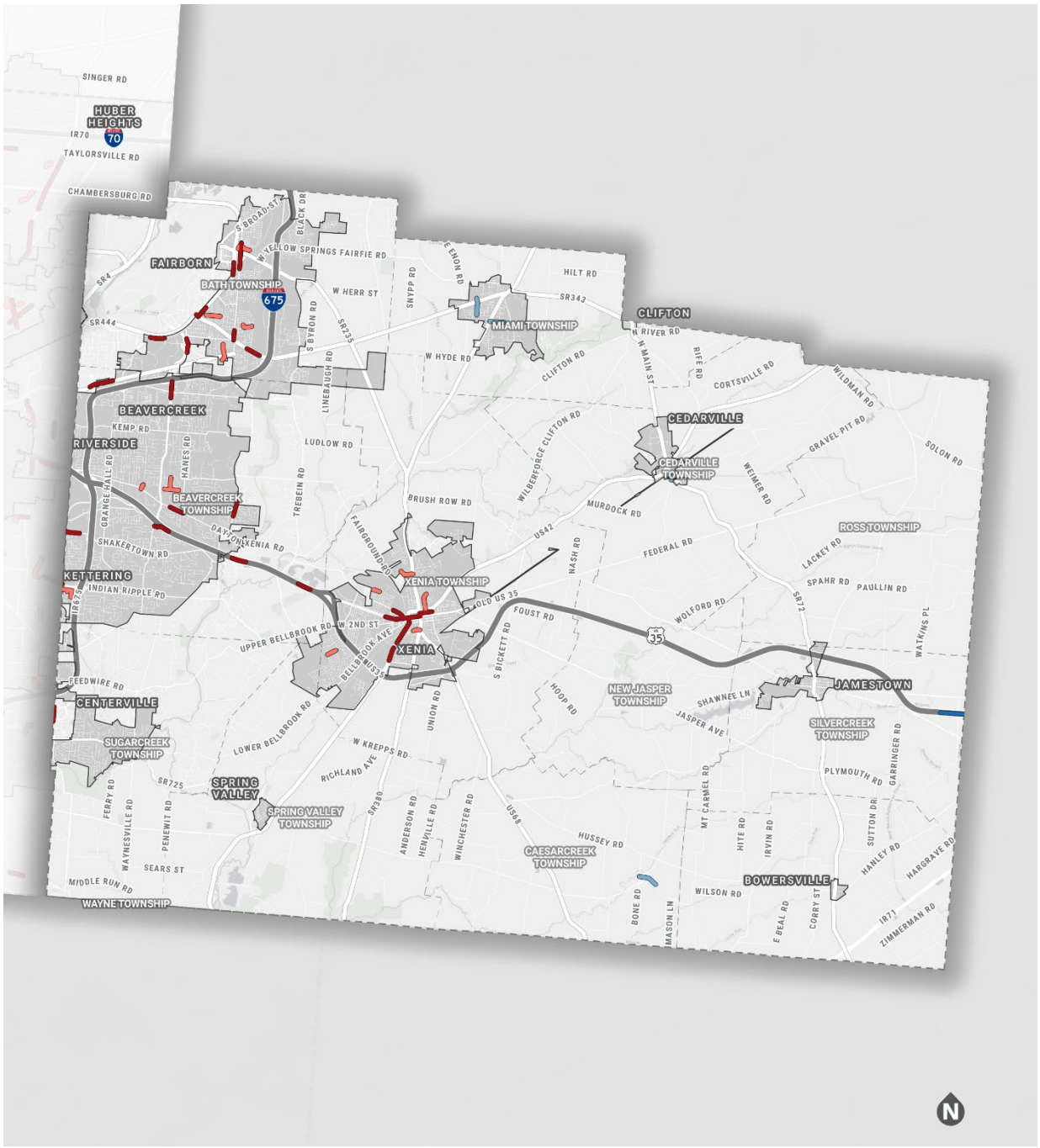


Figure 23: Pedestrian High Injury Network (Greene County)

Warren County (northern area)

All Modes HIN

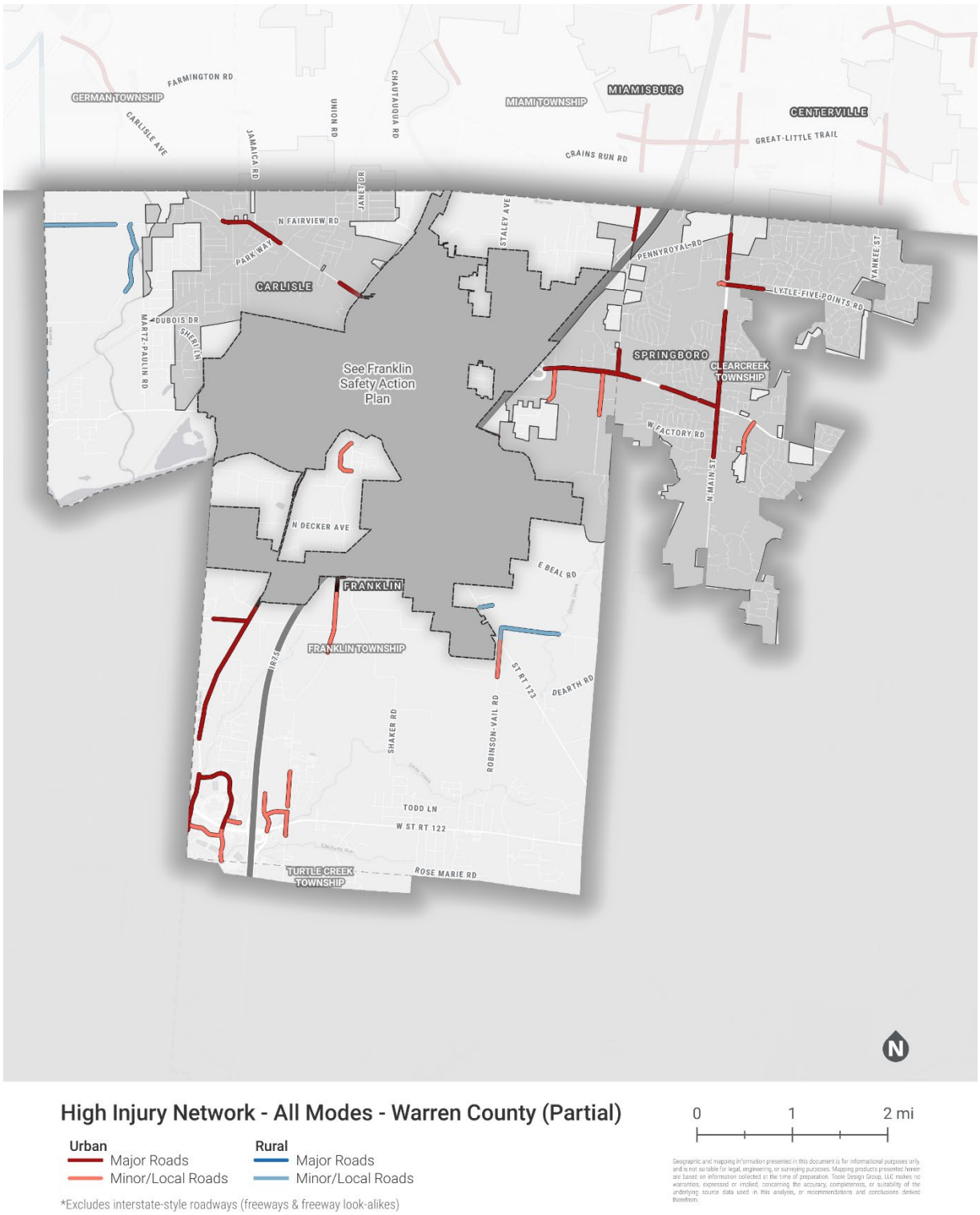


Figure 24: All Modes High Injury Network (Warren County)

Motor Vehicle HIN

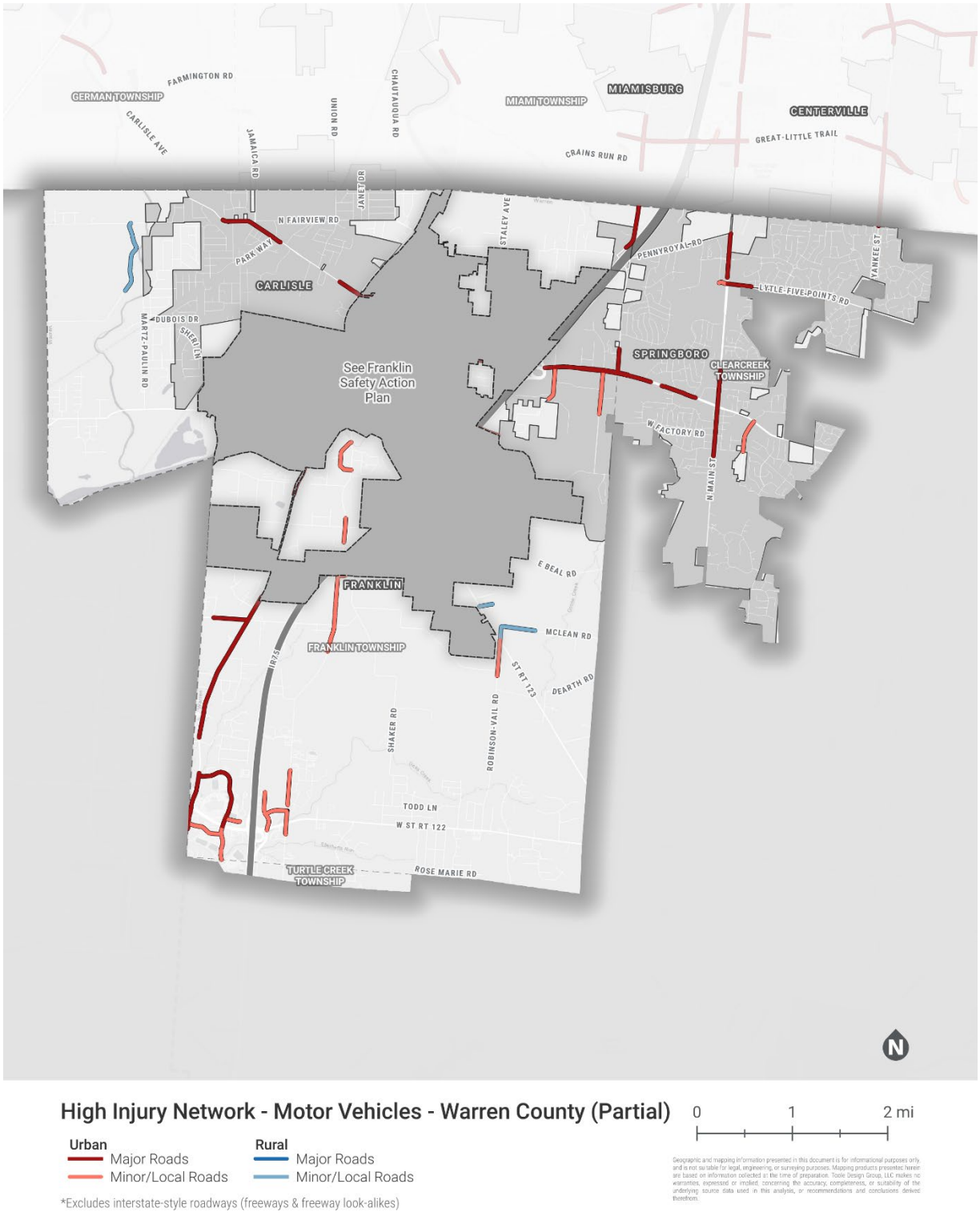


Figure 25: Motor Vehicle High Injury Network (Warren County)

Motorcyclist HIN

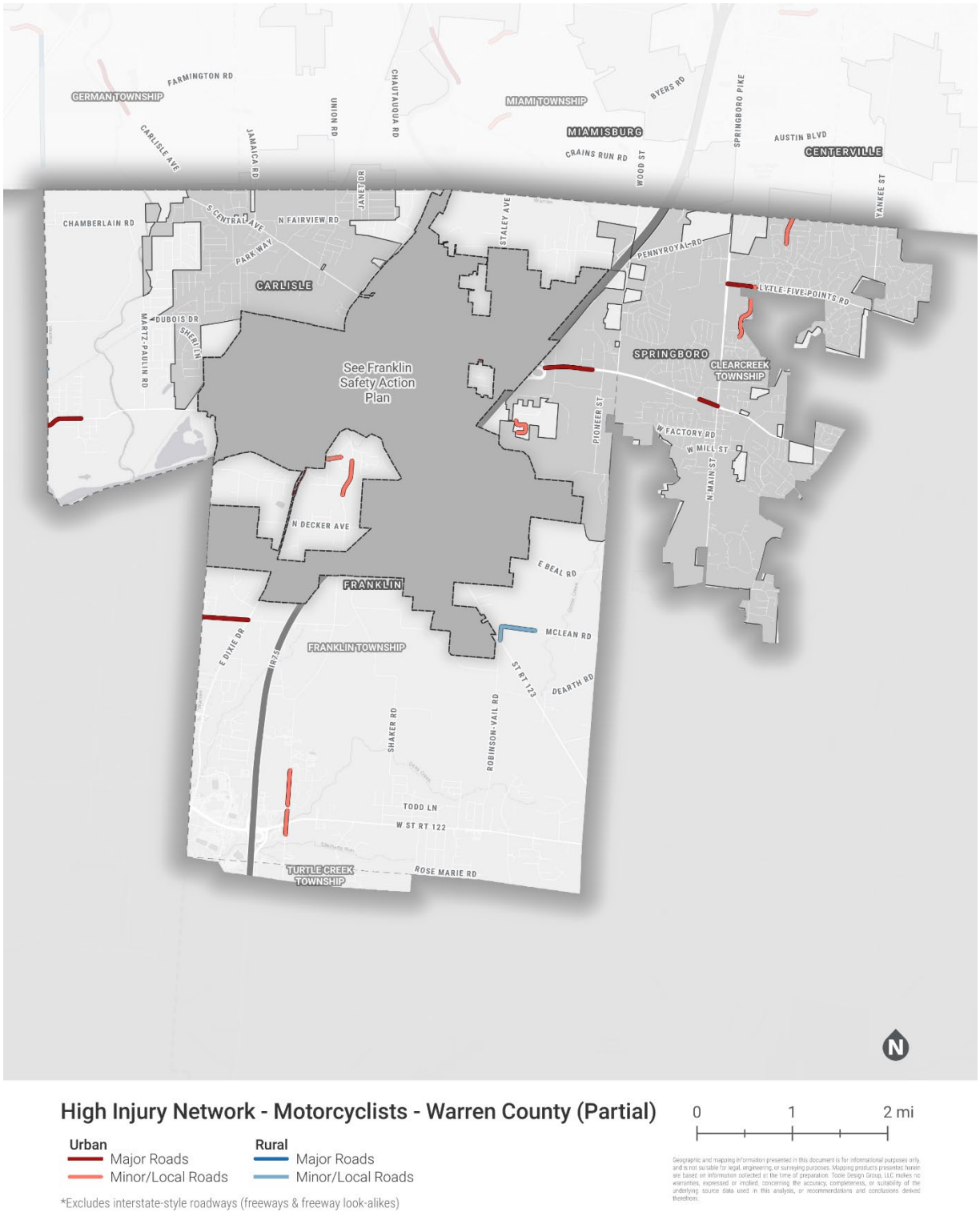
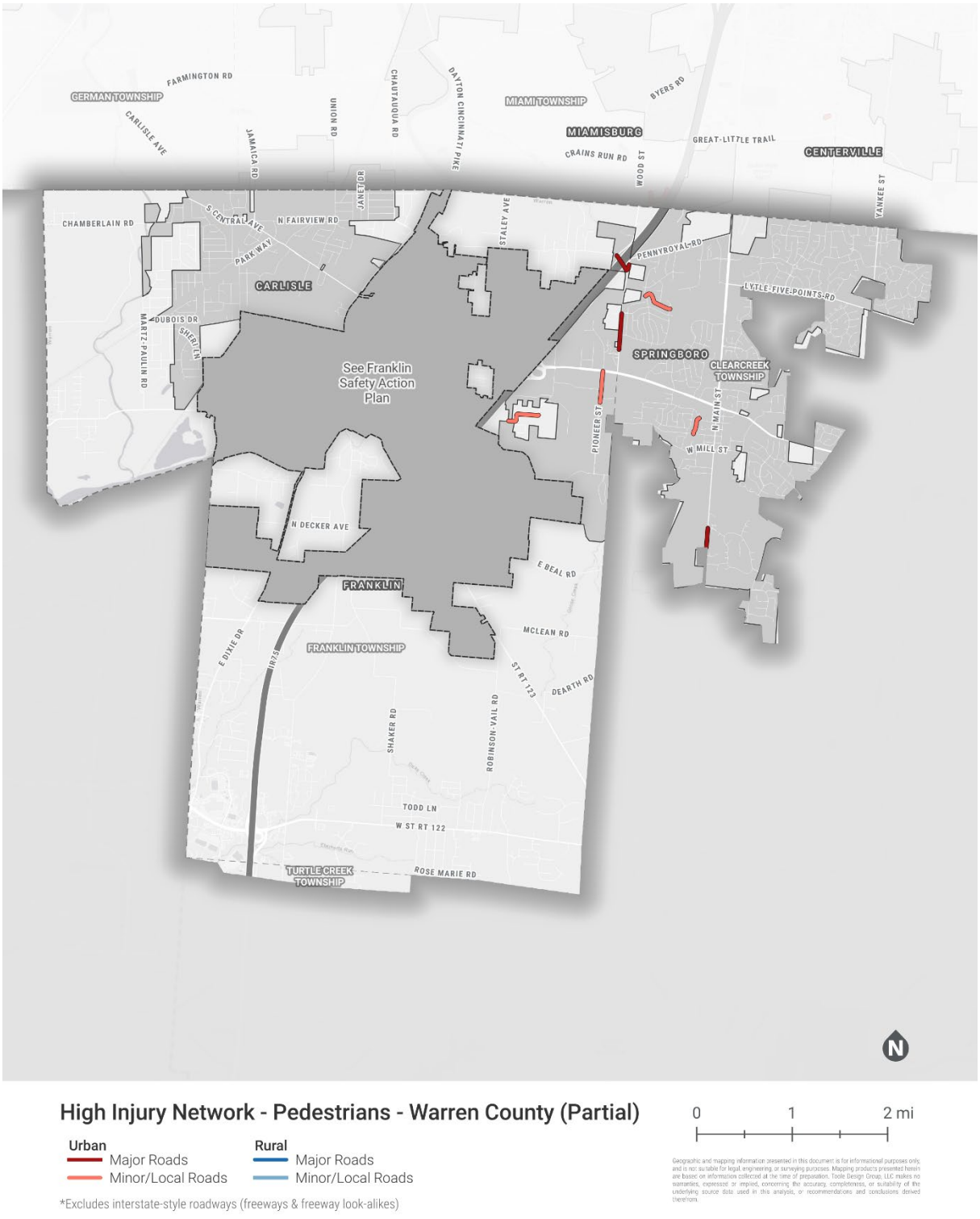


Figure 26: Motorcycle High Injury Network (Warren County)

Bicycle HIN

Figure 27: Bicycle High Injury Network (Warren County)

Pedestrian HIN



High Injury Network - Pedestrians - Warren County (Partial)

Urban
- Major Roads
- Minor/Local Roads

Rural
- Major Roads
- Minor/Local Roads

*Excludes interstate-style roadways (freeways & freeway look-alikes)

0 1 2 mi

Figure 28: Pedestrian High Injury Network (Warren County)

High Injury Intersections (All Modes)

MVRPC Region

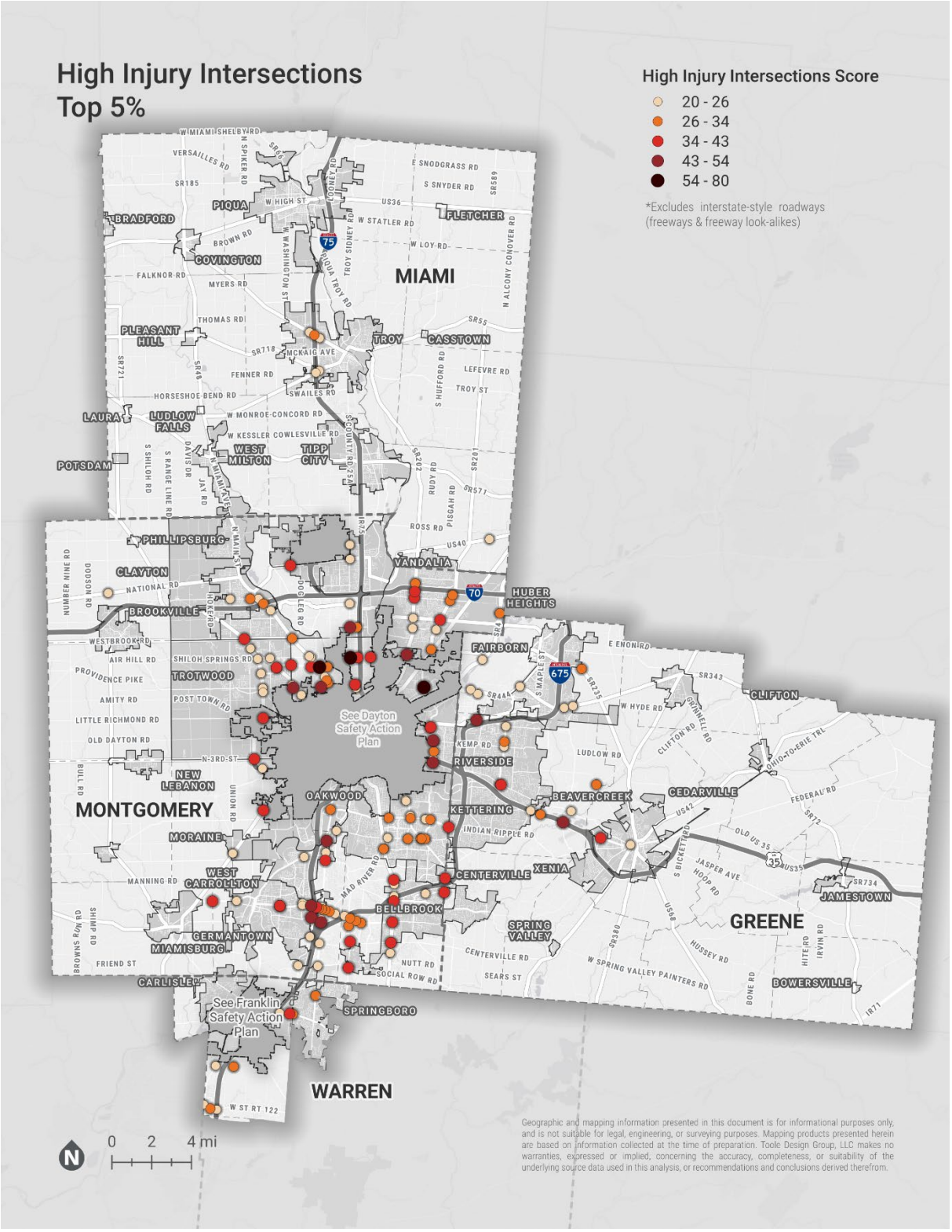


Figure 29: High Injury Intersections (MVRPC MPO Region)

Miami County

Figure 30: High Injury Intersections (Miami County)

Montgomery County

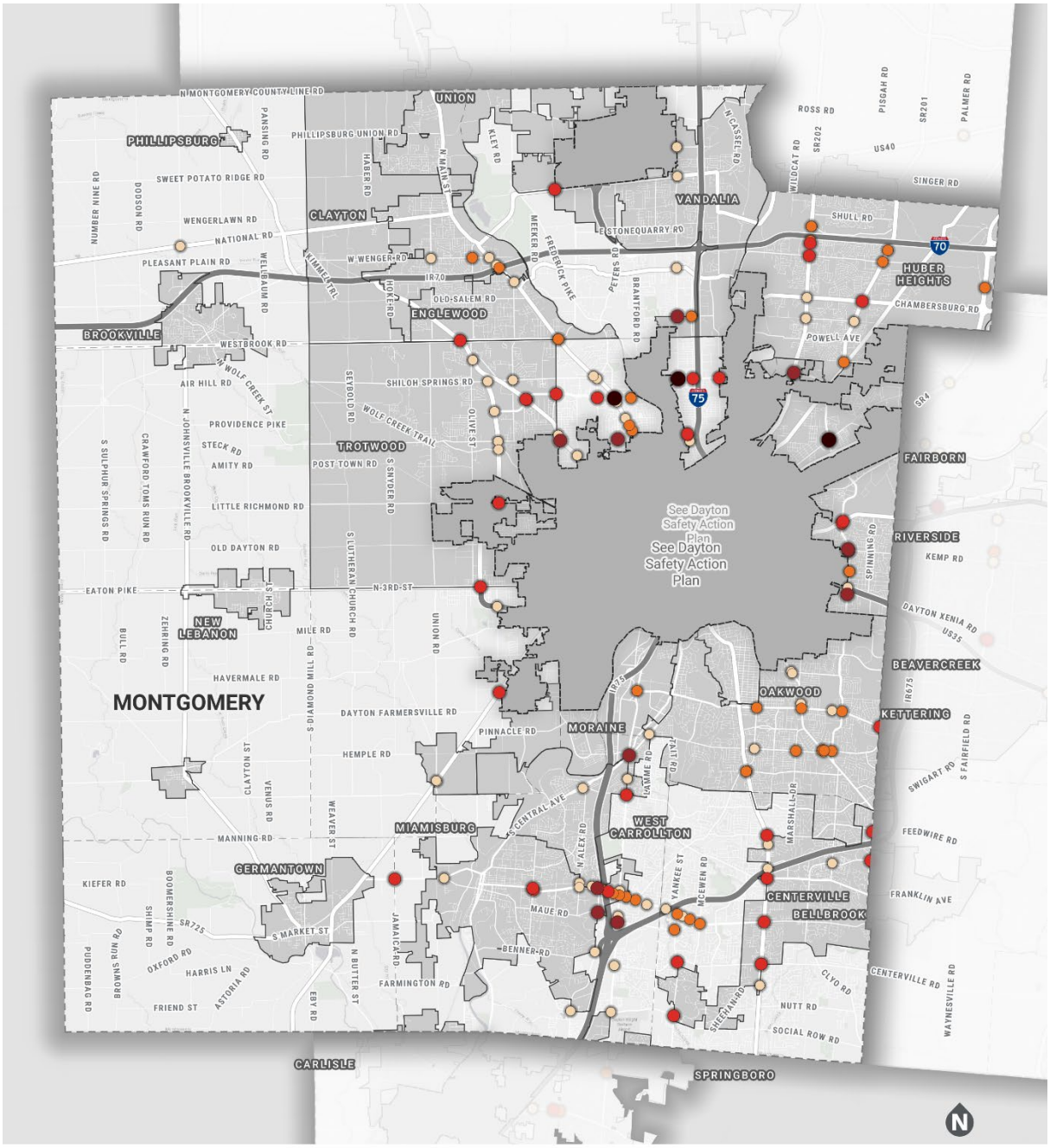
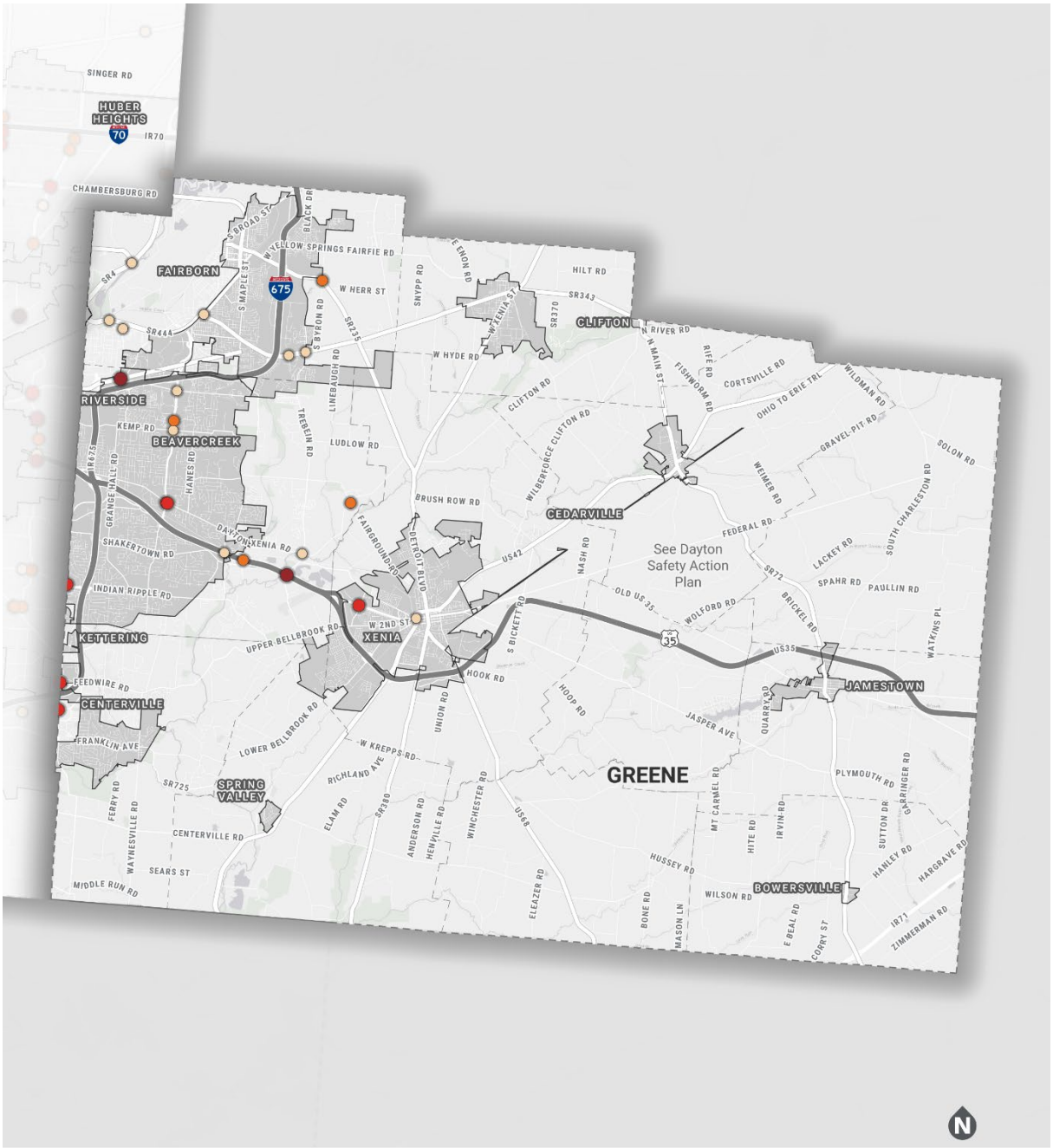


Figure 31: High Injury Intersections (Montgomery County)

Greene County



High Injury Intersections Top 5% - Greene County

High Injury Intersections Score

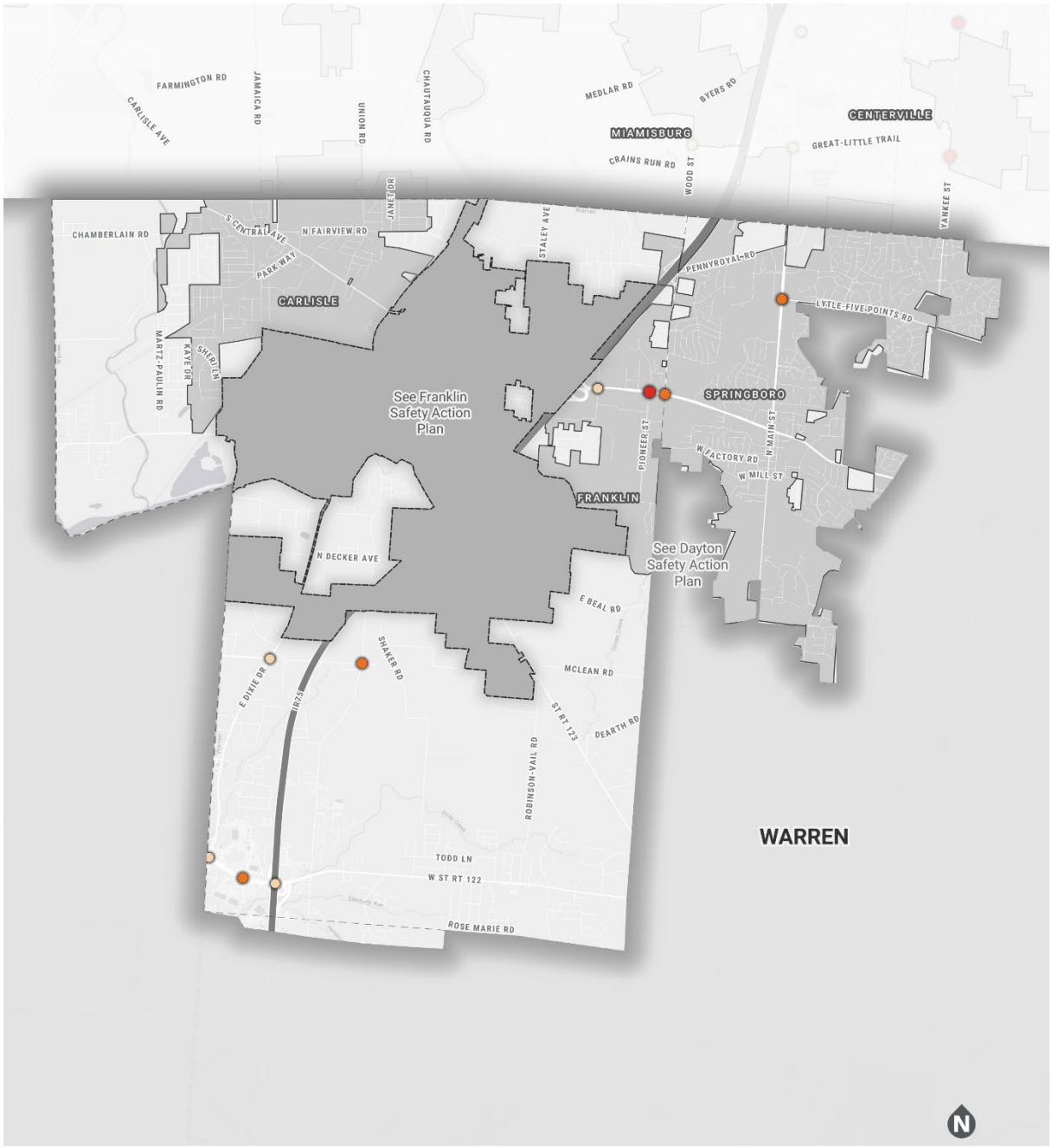
- 20 - 26
- 26 - 34
- 34 - 43
- 43 - 54
- 54 - 80

*Excludes interstate-style roadways (freeways & freeway look-alikes)

0 1 2 mi

Figure 32: High Injury Intersections (Greene County)

Warren County



High Injury Intersections Top 5% - Warren County

High Injury Intersections Score

- 20 - 26
- 26 - 34
- 34 - 43
- 43 - 54
- 54 - 80

*Excludes interstate-style roadways (freeways & freeway look-alikes)

0 1 2 mi

Figure 33: High Injury Intersections (Warren County)