Updates to Risk Factors for SHSP Emphasis Areas

Young Drivers (24 and Under)

PREPARED FOR

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Purpose & Background

The Massachusetts Department of Transportation (MassDOT) is updating the risk-based network screening maps in the IMPACT tool to incorporate recent crash data and build on lessons learned from previous analyses. This document describes the updated systemic analysis performed by VHB for younger driver crashes using crash data from 2017 through 2021. For this analysis, VHB used the default "Younger Driver" query[1] in the MassDOT IMPACT tool. The definition reads: any crash involving a driver aged 15 to 20 based on the "Age of Driver – Youngest Known" field.[2]

Note that the purpose of this report is to identify the factors most correlated with the frequency and severity of distracted younger driver involved crashes; causality was not directly investigated. As such, agencies interested in developing targeted countermeasure programs are encouraged to perform some initial investigation into causality of the target crash in their jurisdiction. This will allow the agency to develop targeted countermeasures.

Data Analysis and Focus Crash Types

To establish context, VHB first used the MassDOT IMPACT "Test of Proportions" tool[3] to summarize fatal injury (K) and suspected serious injury (A) of younger drivers' crashes. To identify overrepresented crash attributes, VHB compared KA younger driver crashes to all KA crashes in the State. Where the proportion for a given attribute is statistically larger than the proportion for the comparison group, that attribute is flagged as a potential risk factor. Statistical overrepresentation is checked by building 95 percent confidence intervals around the proportion using sampling errors. Figure 1 and Figure 2 show how the lower and upper bounds, respectively, are calculated based on the proportion of crashes (*p*) and the number of crashes in the sample (*N*). If the lower bound of young driver KA crashes is larger than the upper bound of the comparison group, the attribute was considered "overrepresented" for the data.

$$95\%\ Confidence\ Interval, Lower\ Bound\ = p - 1.96 * \sqrt{\frac{p(1-p)}{N}}$$

Figure 1. Calculation of the lower bound of the 95 percent confidence interval for the proportion of crashes with an attribute.

$$95\%\ Confidence\ Interval, Upper\ Bound\ = p + 1.96 * \sqrt{\frac{p(1-p)}{N}}$$

Figure 2. Calculation of the upper bound of the 95 percent confidence interval for the proportion of crashes with an attribute.

Table 1 summarizes notable overrepresentations found in the analysis. VHB included the following data elements in their analysis:

- Access Control.

[1] https://www.mass.gov/info-details/impact-emphasis-area-definitions

[2] MassDOT. *Impact Emphasis Area Definitions.* Available at: https://www.mass.gov/info-details/impact-emphasis-area-definitions. Accessed March, 2023.

[3] https://apps.impact.dot.state.ma.us/sat/TestofProportions

- Age of Driver – Oldest known.
- Age of Driver – Youngest Known.
- Age of Non-Motorist – Oldest Known.
- Age of Non-Motorist – Youngest Known.
- County Name.
- Crash Day of Week.
- Crash Month.
- Curb.
- Driver Contributing Circumstances.
- Driver Distracted By.
- Facility Type.
- Federal Functional Class.
- First Harmful Event.
- First Harmful Event Location.
- FMCSA Reportable.
- Functional Class.
- Jurisdiction.
- Left Shoulder Type-linked.
- Left Shoulder Width-linked.
- Light Conditions.
- Manner of Collision.
- Max Injury Severity Reported.
- Median Type.
- Operation.
- Opposite Number of Travel Lanes.
- Right Shoulder Type-linked.
- Right Shoulder Width-linked.
- Road Contributing Circumstance.
- Road Surface Condition.
- Roadway Junction Type.
- Speed Limit.
- Terrain Type.

- Total Lanes.
- Traffic Control Device Type.
- Trafficway Description.
- Urban Type.
- Weather Conditions.
- Vehicle Configuration.

Table 1. Summary of Key Overrepresentation Findings

Crash Field	Crash Attribute	Percent of Younger Driver KA Crashes	Percent of All KA Crashes
Access Control	No access control	82.20%	71.31%
County Name	MIDDLESEX	18.24%	13.18%
Curb	Both Sides	41.19%	34.05%
First Harmful Event	Collision with motor vehicle in traffic	60.75%	35.28%
Manner of Collision	Angle	31.45%	14.52%
	Rear-end	15.41%	7.41%
Federal Functional Class	Local	14.40%	10.79%
Jurisdiction	City or Town accepted road	62.96%	50.03%
Trafficway Description	Two-way, not divided	64.78%	54.23%
Median Type	None	79.12%	68.05%
Right Shoulder Type-linked	No Shoulder	49.43%	39.94%
Terrain Type	Rolling	8.24%	5.42%
Roadway Junction Type	Four-way intersection	18.87%	10.20%
	Driveway	2.26%	0.99%
	T-intersection	18.11%	10.90%
Traffic Control Device Type	Stop signs	15.09%	6.06%
	Traffic control signal	13.14%	8.69%
Driver Contributing Circumstances	Disregarded traffic signs, signals, road markings	3.50%	1.90%
	Distracted	1.63%	0.63%
	Failed to yield right of way	8.67%	3.32%
	Followed too closely	2.37%	0.52%
	Inattention	6.84%	2.65%
Driver Distracted By	External distraction (outside the vehicle)	1.54%	0.60%
	Other activity (searching, eating, personal hygiene, etc.)	2.76%	1.52%
	Not Distracted	43.72%	32.66%
Light Condition	Daylight	56.60%	46.36%
Vehicle Configuration	Passenger car	63.23%	52.31%

From a safety management perspective, it is notable that a large proportion of these crashes involved more than one motor vehicle. These incidents also correlate with more severe crashes that involved angle or rear-end collisions at four-way intersections, T-intersections, or driveways. Local streets, undivided two-way roads, streets with rolling terrain, streets with no access control, streets with no right shoulder and median, as well as streets under the jurisdiction of a city or town, have a statistically disproportionate number of crashes involving young drivers. Aggressive driving behaviors that include disregarding traffic signs, signals, road markings, distractions, failing to yield right of way, following too closely, and inattention were statistically disproportionate in these crashes. While the majority of the drivers were not distracted, there were few disproportionately distracted by external distractions outside the vehicle and other activities (searching, eating, personal hygiene, etc.).

MassDOT should consider these findings when identifying potential young driver-related countermeasures. The National Highway Traffic Safety Administration's (NHTSA) *Countermeasures that Work*[4] includes several examples of effective campaigns including Graduated Driver Licensing (GDL), learner's permit length and supervised hours, intermediate – nighttime restrictions, and intermediate – passenger restrictions. While these are notable results, they should not restrict the analysis from focusing on all young driver crashes. Ultimately, the focus crash type for this analysis is all younger driver crashes.

Crash Tree and Focus Facility Type

After concluding that the younger driver focus crash type should include all younger driver crashes, VHB developed a crash tree to identify the roadway conditions under which severe younger driver crashes tend to occur most often. Figure 3 shows the crash tree. It is evident that the majority of KA crashes related to younger drivers took place on roadways with no access control and that are in urban in urban areas. Signal-or stop-controlled four-way intersections and stop-controlled T-intersections experienced a higher proportion of such crashes. Crashes that were not at a junction, were mostly on two-way undivided roadways. Findings from the crash tree largely align with the crash proportions presented in Table 1.

[4] https://www.nhtsa.gov/book/countermeasures/countermeasures-work/young-drivers

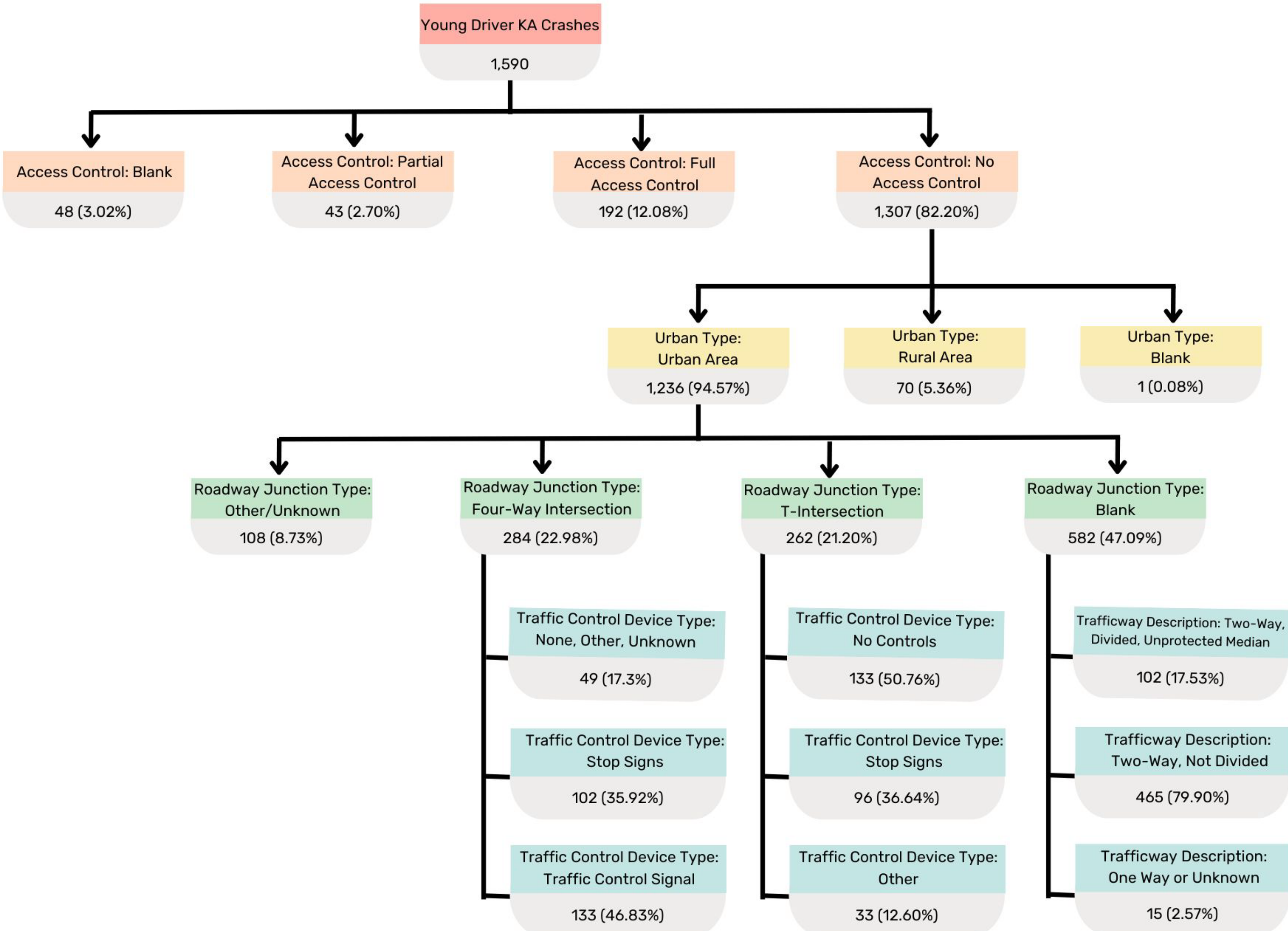

Figure 3. Crash tree summarizing KA younger driver crashes in Massachusetts.

While the analysis above points towards some potential focus for this emphasis area (e.g., intersection crashes, speeding-related crashes), younger driver crashes are best addressed directly using educational campaigns. As a result, VHB recommends performing a town-based analysis of young driver crashes. This allows for prioritization of towns for the reception of grants and encouragement for young driver safety campaigns.

Risk Factor Analysis

After identifying focus crash types and trends, VHB proceeded with the risk factor analysis. The following sections describe the methodology, data, and results of this analysis.

Methodology

Negative binomial regression is a standard approach to crash frequency modeling given that crash frequency data are typically overdispersed count data. As such, VHB used a negative binomial count regression modeling approach to identify community-level characteristics associated with higher frequencies of young driver-related KA crashes. Negative binomial regression is commonly used in transportation safety as it applies to over-dispersed count data (i.e., the variance exceeds the mean of the observed data). The dependent variable in the model is the number of young driver-related KA crashes, making a count model appropriate for the data. The functional form of the negative binomial regression model is shown in Figure 4.[5]

$$\lambda_i = e^{\beta X_i + \varepsilon_i}$$

Figure 4. Equation. Negative binomial regression functional form.

Where:

$e^{\varepsilon i}$ = gamma-distributed error term with a mean equal to one and variance equal to α.

λ_i = expected number of young driver-related KA crashes at location i.

β = vector of estimated parameters.

X_i = vector of independent variables that characterize location i and influence young driver-related KA crash frequency.

When modeling, VHB began with road exposure variables and added additional variables one at a time, monitoring the coefficients to ensure the inclusion of a variable did not result in large changes in magnitude. Additionally, VHB included variables with p-values upwards of 0.25 assuming the magnitude of the results made sense. VHB did not select a strict level of significance, as Hauer notes this could lead to misunderstanding or outright disregard for potentially noteworthy results.[6]

Data

VHB used ArcGIS to manage and integrate data for this analysis. VHB aggregated data at the city and town level. In Massachusetts, all roads and geographic areas are covered by town jurisdictions. Due to

[5] Lord, D., Mannering, F., 2010. The Statistical Analysis of Crash-Frequency Data: A Review and Assessment of Methodological Alternatives. Transp. Res. Part A Policy Pract. 44 5 , 291–305. doi:10.1016/j.tra.2010.02.001
[6] Hauer, E. (2004). The harm done by tests of significance. *Accident Analysis & Prevention*, *36*(3), 495-500.

limitations with crash data acquisition, VHB excluded the City of Boston from the analysis. MassDOT provided VHB with various sources of data, as described in the following sections.

Crash Data

VHB obtained younger driver crashes by town using the MassDOT IMPACT Test of Proportions tool. VHB then joined these totals to the town-level data set.

Roadway Data

VHB downloaded the Massachusetts statewide Road Inventory 2021 file, available at https://geo-massdot.opendata.arcgis.com/datasets/342e8400ba3340c1bf5bf2b429ad8294/about. Based on discussions with MassDOT, VHB filtered the roadway data in ArcGIS using mileage counted (equal to 1), jurisdiction (not equal to null), and facility type (less than 7) to identify unique segments that were counted for the Highway Performance Monitoring System (HPMS). Filtering the roadway inventory in this way prevented potential double-counting of mileage and VMT for divided roads and roads with overlapping route numbers. VHB aggregated the roadway data at the town-level, including summing total centerline miles and centerline miles for each Federal Functional Class.

Driver License Data

MassDOT provided driver license data by age, town, and zip code for 2021. VHB used spatial analysis to assign driver license zip codes to the relevant town, joining the driver license totals by age. Additionally, VHB calculated the proportion of drivers that fell within the Young Driver query definition for each town.

School Location Data

VHB obtained primary and secondary school location data from the Massachusetts Bureau of Geographic Information (MassGIS) open data portal (https://www.mass.gov/info-details/massgis-data-massachusetts-schools-pre-k-through-high-school).

College and University Data

VHB accessed college and university location data from the MassGIS open data portal (https://www.mass.gov/info-details/massgis-data-colleges-and-universities). Although these data contain several categories of trade schools and other atypical technical training institutions, VHB only included "Colleges, universities, and professional schools," "Fine arts schools," "Junior colleges," and "Other technical and trade schools" for the purposes of this analysis.

Citation Data

VHB obtained traffic citation count data by town for a five-year period between 2015 and 2019. These data included total citations, as well as subsets of counts for speeding-, seat belt-, impaired driving-, and distraction-related traffic citations.

Additional Data

VHB obtained several additional data sources for integration into the data set, including census and American Community Survey (ACS) data, public health data from the Massachusetts Department of Public Health (DPH), seatbelt use survey data at the county level, and environmental justice (EJ) data provided by Environmental Justice Community Block Group Data Update. Note that, regarding EJ data, the reports may change if the final layers were used but they were not available at the time the analyses were performed.

The version of Massachusetts 2020 Environmental Justice Block Group data available at the time of the analysis was a preliminary version that was later updated with a final.

Results

The following sections describe the results of the negative binomial regression modeling effort.

Variables of Interest

To account for unobserved influences due to road facilities and traffic exposure, VHB established a base model that included the natural log of the mile years (i.e., the product of five years of data and total centerline mileage in the town) – this accounts for exposure. Before including additional variables in the negative binomial, VHB developed a correlation matrix of input variables. Highly correlated variables are indicators of potential complications in the model development process. Although VHB considered all potential variables in this matrix, Table 2 shows the correlation matrix for the following 9 variables included in the final young driver model. Note the maximum correlation between any two variables is 0.49 (EJ-income indicator and average number of vehicles per household).

1. Natural log of population ages 15-24.
2. Indicator that the town is an EJ – limited English-speaking community (EJ-E).
3. Indicator that the town is not an EN – low-income community (EJ-I).
4. Average number of vehicles owned per household in the town.
5. Indicator that the proportion of centerline mileage that is Federal Functional Class interstate, freeway, or expressway[7] is greater than 0.025.
6. Indicator that the annual unbelted citations per centerline mile is greater than 1.0.
7. Indicator that the annual impaired driving citations per centerline mile is greater than 1.5.
8. Indicator that the proportion of unbelted drivers observed the residing county's seatbelt survey is less than 85 percent.
9. Proportion of licensed drivers aged 16 to 21 in the town. Elected to include 21 to include as the data were from 2021 and these drivers were likely young drivers in most of the study period.
10. Natural log of total centerline mile-years.

[7] Federal functional classes 1 and 2.

Table 2. Correlation Matrix of Input Variables.

Variable	Pop 15-24	EJ-E	Not EJ-I	# of vehicles	Fed. Funct. Class	Unbelted citations	Impaired citations	Unbelted survey	Young licensed drivers
Pop 15-24	1								
EJ-E	0.44	1							
Not EJ-I	-0.41	-0.34	1						
# of vehicles	-0.36	0.49	0.45	1					
Fed. Funct. Class	0.26	0.11	-0.17	-0.12	1				
Unbelted citations	0.42	0.33	-0.17	-0.23	0.25	1			
Impaired citations	0.12	0.14	-0.12	-0.21	0.12	0.26	1		
Unbelted survey	0.08	0.06	-0.07	0.01	0.001	0.12	0.08	1	
Young licensed drivers	-0.01	0.01	-0.03	0.02	0.02	0.09	0.002	0.05	1

Model Results

Table 3 documents the results of the final model. The natural log of the product of centerline mileage and 5 years of crash data were included in the model to offset exposure for each town. The population of persons aged 15-24 suggests that the younger persons in the town, the higher frequency of severe young driver crashes expected. The correlation between crash frequency with high proportion of interstate, freeway, and expressway centerline mileage suggests the more high-speed mileage in the town, the higher severe expected crash frequency. Additionally, the coefficients for unbelted citations, impaired driving citations, and observed unbelted occupants suggest a correlation between elevated risk-taking behavior and severe young driver crash frequency. Interestingly, while the status as an EJ-E community is positively correlated with young driver crash frequency, the status as an EJ-I community is negatively correlated (shown as the status as *not* an EJ-I community being positively correlated with crash frequency). It is possible that higher income households have more vehicles for young drivers to use, thus leading to more young driver exposure – reinforced by the positive correlation between average number of vehicles per household and young driver crash frequency. Finally, the coefficient is negative for the proportion of licensed drivers that are aged 16 to 21, suggesting that young driver crash frequency decreases as the proportion of licensed drivers aged 16 to 21 increases. First, there is a positive correlation between total young population (aged 15-24) in the town and severe young driver crash frequency. This makes sense, as there is likely additional exposure in these communities. However, this effect is somewhat offset by the negative correlation between the proportion of licensed drivers aged 15-21 (compared to all licensed drivers in the town) and severe young driver crashes. This suggests that if you increase the number of persons aged 15-21 licensed in the town, you are expected to experience fewer severe young driver crashes, as the licensed drivers may be safer than those driving on a permit or driving unlicensed as well. Results largely align with findings from the prior studies on younger involved crashes[8,9].

Table 3. Negative Binomial Count Regression Model Results.

Variable (Number)	Coefficient	Standard Error	z-value	P>|z|	95% Confidence Interval	
Natural log of population aged 15-24 in the town	0.307	0.042	7.25	<0.001	0.224	0.390
Indicator the town is an EJ-E community.	0.524	0.140	3.75	<0.001	0.250	0.797
Indicator the town is not an EJ-I community.	0.113	0.091	1.24	0.217	-0.066	0.292
Average number of vehicles per household in the town.	0.400	0.202	1.98	0.048	0.003	0.796
Indicator the proportion of centerline mileage that is interstate, freeway, or expressway is greater than 0.025.	0.150	0.080	1.86	0.063	-0.008	0.307
Indicator the annual unbelted citations per centerline mile in the town is greater than 1.0.	0.272	0.086	3.18	0.001	0.104	0.440
Indicator the annual impaired driving citations per centerline mile in the town is greater than 1.5	0.268	0.123	2.17	0.030	0.026	0.509
Percent of drivers belted in the survey is 85 percent or less.	0.324	0.143	2.27	0.023	0.044	0.605
Proportion of licensed drivers aged 16 to 21 in the town.	-2.410	1.417	-1.70	0.089	-5.188	0.368
Constant	-8.464	0.554	-15.28	<0.001	-9.550	-7.378
Natural log of the product of centerline mile length and 5 years of crash data in the town. (Offset)	1	n/a	n/a	n/a	n/a	n/a
alpha	0.147	0.031	n/a	n/a	0.097	0.222

Note: Number of observations = 349; Log likelihood = -689.88474; Pseudo R2 = 0.1165; LR chi2(9) = 181.99; Prob > chi2 = 0.0000.

[8]Factors Contributing to Crashes among Young Drivers. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4117653/

[9]Understanding the contributing factors to young driver crashes: A comparison of crash profiles of three age groups. https://www.sciencedirect.com/science/article/pii/S2666691X21000324

Conclusions and Recommendations

The purpose of this analysis is to identify town-level risk factors for fatal and serious injury young driver crashes. Instead of using the coefficients in the negative binomial regressions results from Table 3, VHB recommends that MassDOT assign risk scores between 0 and 1 based on the character of the risk factor. VHB and MassDOT made this decision to avoid overly weighting any one risk factor, especially considering potential data issues with the risk factor data which may cause biases. Table 4 summarizes the suggested risk scoring schema. Where the statistical significance of the variable was not strong (i.e., p-value < 0.05), VHB suggests a maximum risk score of 0.5 instead of 1 for the risk factor. Where a binary predictive variable was used, binary risk scores are applied. From a modeling perspective, the cutoffs for the binary variables were determined by using visual representations of the data and smaller bins to find the cutoffs which make the most sense.

Table 4. Town-level risk factors for Young Driver KA Crashes.

Risk Factor for Young Driver KA Crashes	Suggested Scoring
Natural log of population aged 15-24 in the town.	Continuous from 0 to 1 for range of values.
Indicator the town is an EJ-E community.	1 if true; 0 otherwise.
Indicator the town is not an EJ-I community.	0.5 if true; 0 otherwise.
Average number of vehicles per household in the town.	Continuous from 0 to 1 for range of values.
Indicator the proportion of centerline mileage that is interstate, freeway, or expressway is greater than 0.025.	0.5 if true; 0 otherwise.
Indicator the annual unbelted citations per centerline mile in the town is greater than 1.0.	1 if true; 0 otherwise.
Indicator the annual impaired driving citations per centerline mile in the town is greater than 1.5.	1 if true; 0 otherwise.
Percent of drivers belted in the survey is 85 percent or less.	1 if true; 0 otherwise.
Proportion of licensed drivers aged 16 to 21 in the town.	Continuous from 0.5 at the lowest proportion to 0 at the highest proportion.
Maximum potential score for a town:	**7.5**

Table 5 provides an example application of the risk factors on a hypothetical town. To provide context for these risk factor scores in relation to other emphasis areas, MassDOT can normalize the cumulative score by dividing by the total potential score for a town. This would generate a risk score out of 100 percent for each town. Under this approach, the normalized risk score for the example town is 46.3 percent (3.47 divided by 7.5).

Table 5. Example Risk Score Calculation for Young Driver Crashes.

Variable	Town Characteristic	Risk Factor	Risk Score
Natural log of population aged 15-24 in the town.	Population of 2,234	Continuous from 0 to 1 for range of values. A population of 2,234 was higher than 23 percent of towns.	0.23
Indicator the town is an EJ-E community.	Town is not an EJ-E community.	1 if true; 0 otherwise.	0
Indicator the town is not an EJ-I community.	Town is not an EJ-I community.	0.5 if true; 0 otherwise.	0.50
Average number of vehicles per household in the town.	1.45.	Continuous from 0 to 1 for range of values. An average of 1.45 was higher than 40 percent of towns.	0.40
Indicator the proportion of centerline mileage that is interstate, freeway, or expressway is greater than 0.025.	Proportion is 0.01.	0.5 if true; 0 otherwise.	0
Indicator the annual unbelted citations per centerline mile in the town is greater than 1.0.	Metric is 1.25.	1 if true; 0 otherwise.	1.0
Indicator the annual impaired driving citations per centerline mile in the town is greater than 1.5.	Metric is 1.7.	1 if true; 0 otherwise.	1.0
Percent of drivers belted in the survey is 85 percent or less.	86 percent of drivers were belted.	1 if true; 0 otherwise.	0
Proportion of licensed drivers aged 16 to 21 in the town.	Proportion is 0.20.	Continuous from 0.5 at the lowest proportion to 0 at the highest proportion.	0.34
		Total Risk Score:	3.47
		Risk Percent Score (Out of 7.5):	46.3%

Generally, the model and risk factors produce results that were expected by the VHB and MassDOT team. Several factors point toward increased young driver exposure (e.g., younger person population, income, vehicles per household), which is expected to be correlated with severe young driver crash frequency. Additionally, several factors measure the surrogate level of risk in the town, indicating an increased likelihood of risk taking behavior that is likely to be present in the young driver population (e.g., seat belt use, impaired driving citations, unbelted citations). Finally, two risk factors point toward the correlation of infrastructure and young driver crash frequency: the presence of high-speed facilities (interstate, freeway, and expressway mileage) and historically underinvested infrastructure (correlated with EJ-E community status).

MassDOT ranked the towns at both the statewide and MPO levels using the normalized risk score and the percentile score of ranking (rank kind equal to weak) function in ArcGIS. For each normalized risk score, a percentile rank for the given score was computed relative to all the normalized risk scores. If there are repeated occurrences of the same normalized risk score, then the percentile rank corresponds to values that are less than or equal to the given score. The advantage of the weak ranking approach is that it guarantees that the highest normalized score will receive a percentile rank of 100 percent. For younger driver-related crashes, normalized risk scores range from 0.14 to 0.79. The maximum value (0.79) received a percentile rank of 100 and other values received a percentile rank accordingly. For example, a town with a normalized risk score of 0.70, the calculated state percentile rank was 97.15, and fell in the primary risk town category. MassDOT then assigned risk categories using the computed ranks. For example, towns ranked in the top 5 percentile (95 through 100) were categorized as "Primary Risk Town" and towns ranked in the next 10 percentile (85 through 95) were categorized as "Secondary Risk Town"; the remaining towns were not categorized. In instances where there are large, repeated occurrences of the same normalized risk score, the percentage of segments computed for top 5% or next 10% may not be equal to 5 or 10%. This is a byproduct of the weak ranking approach.

Table 6 and Table 7 show the distribution of towns and crashes with the normalized risk score (presented as percentages) across these categories for statewide and MPO rankings, respectively. Note the goal was to see a higher proportion of target crashes for primary and secondary risk sites than proportion of towns. Similarly, Figure 5 is a map of the risk towns ranked statewide, while Figure 6 is a map of the risk towns ranked by MPO. These figures indicate the towns in the State that may deserve a higher-level of attention to reduce younger driver involved severe crashes. Note that it may be more appropriate to utilize statewide ranking for towns, particularly for the ones that are in the MPOs/RPAs with few towns, as the results for these towns may be skewed. There is a total of 18 towns in the primary risk category (top 5 percent), that captured 13.43 percent of the severe younger driver-related crashes. Similarly, there are 35 towns in the secondary risk category (next top 10 percent), which captured an additional 24.67 percent of the severe younger driver-related crashes. The towns that are in the primary risk category for younger driver-related crashes are Fall River, Chelsea, Salisbury, Woburn, Methuen, Revere, Newbury, West Bridgewater, New Bedford, Bridgewater, Raynham, Webster, Everett, Lynn, Southborough, Sturbridge, Northborough, and Foxborough. Five of these towns were under Boston Region MPO, and three of these were under Pioneer Valley Planning Commission. A higher number of secondary risk category towns for younger driver-related crashes were also under these two MPOs.

Table 6. Statewide Risk Categories.

State	Risk Category	Minimum Normalized Risk Score Percentage	Maximum Normalized Risk Score Percentage	Number of Towns	Percent of Scored State Towns	Percent of Target Crashes
MA	Primary Risk Site	67.01%	78.71%	18	5.13%	13.43%
	Secondary Risk Site	57.40%	66.50%	35	9.97%	24.67%

Table 7. Distribution of Risk Towns my MPO.

MPO	Risk Category	Minimum Normalized Risk Score Percentage	Maximum Normalized Risk Score Percentage	Number of Towns	Percent of Scored MPO Towns	Percent of Target Crashes in MPO
Berkshire Regional Planning Commission	Primary	47.03%	47.73%	2	6.25%	22.58%
	Secondary	42.85%	44.58%	3	9.38%	9.68%
Boston Region MPO	Primary	68.62%	78.71%	5	5.15%	6.84%
	Secondary	63.32%	68.43%	10	10.31%	18.48%
Cape Cod Commission	Primary	43.42%	43.42%	1	6.67%	19.64%
	Secondary	40.23%	41.86%	2	13.33%	12.50%
Central Massachusetts Regional Planning Commission	Primary	68.05%	71.74%	2	5.00%	6.67%
	Secondary	59.45%	67.60%	4	10.00%	42.00%
Franklin Regional Council of Governments	Primary	55.14%	56.64%	2	7.69%	15.00%
	Secondary	51.53%	55.04%	2	7.69%	15.00%
Martha's Vineyard Commission	Primary	47.14%	47.14%	1	14.29%	33.33%
	Secondary	37.72%	37.72%	1	14.29%	0.00%
Merrimack Valley Planning Commission	Primary	73.54%	73.54%	1	6.67%	18.82%
	Secondary	67.07%	70.26%	2	13.33%	10.59%
Montachusett Regional Planning Commission	Primary	60.34%	62.49%	2	9.09%	28.21%
	Secondary	56.07%	58.96%	2	9.09%	10.26%
Nantucket Planning and Economic Development Commission	Primary	45.13%	45.13%	1	100.00%	100.00%
	Secondary	N/A	N/A	0	0%	0%
Northern Middlesex Council of Governments	Primary	65.85%	65.85%	1	11.11%	9.86%
	Secondary	61.71%	61.71%	1	11.11%	14.08%
Pioneer Valley Planning Commission	Primary	48.76%	61.92%	3	6.98%	48.11%
	Secondary	42.60%	46.46%	4	9.30%	6.49%
Old Colony Planning Council	Primary	74.23%	74.23%	1	5.88%	3.52%
	Secondary	61.04%	74.09%	2	11.76%	12.68%
Southeastern Regional Planning and Economic Development District	Primary	75.99%	77.47%	2	7.41%	20.73%
	Secondary	59.43%	67.39%	3	11.11%	17.45%

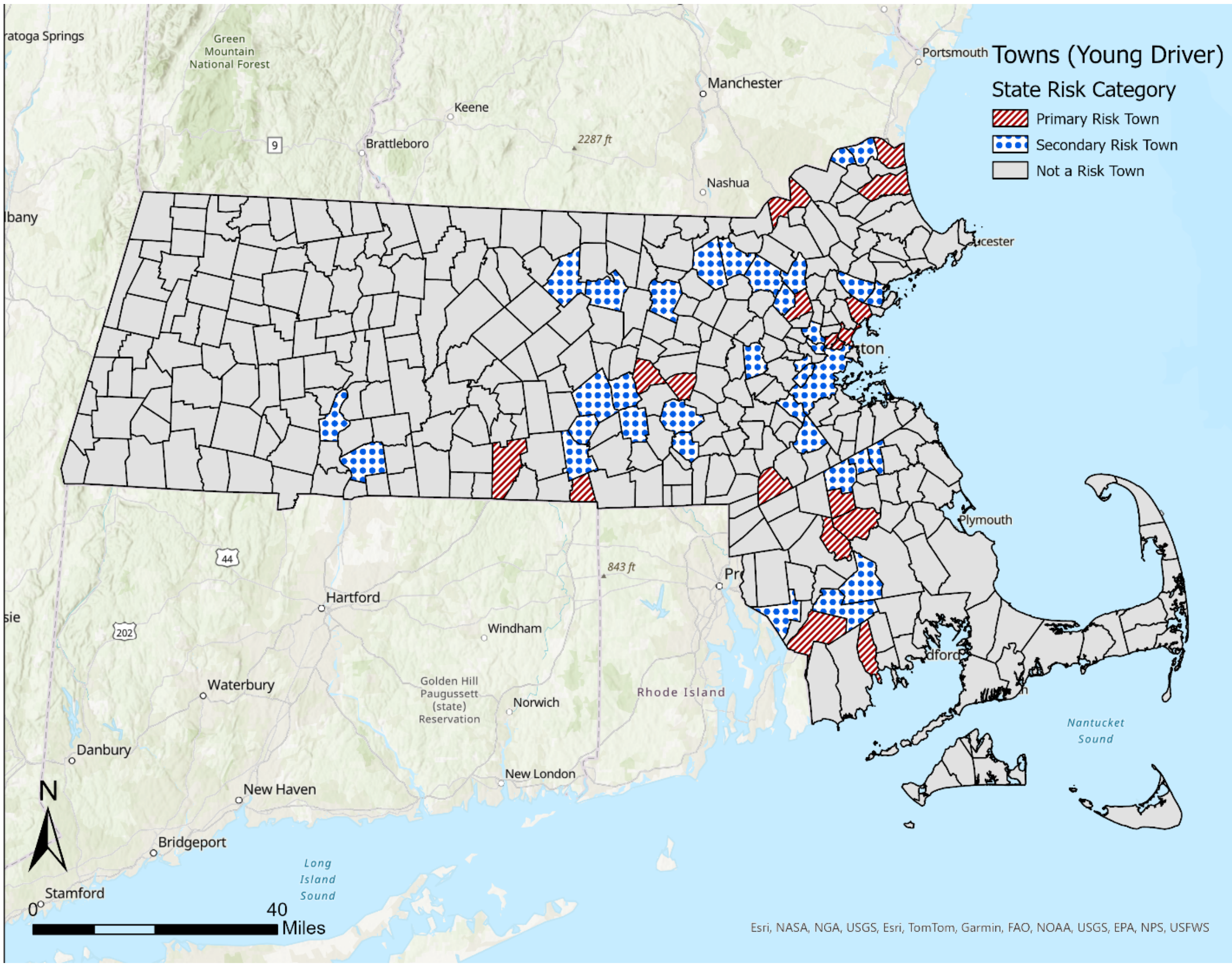

Figure 5. Map depicting the primary and secondary risk towns for severe young driver crashes, ranked statewide.

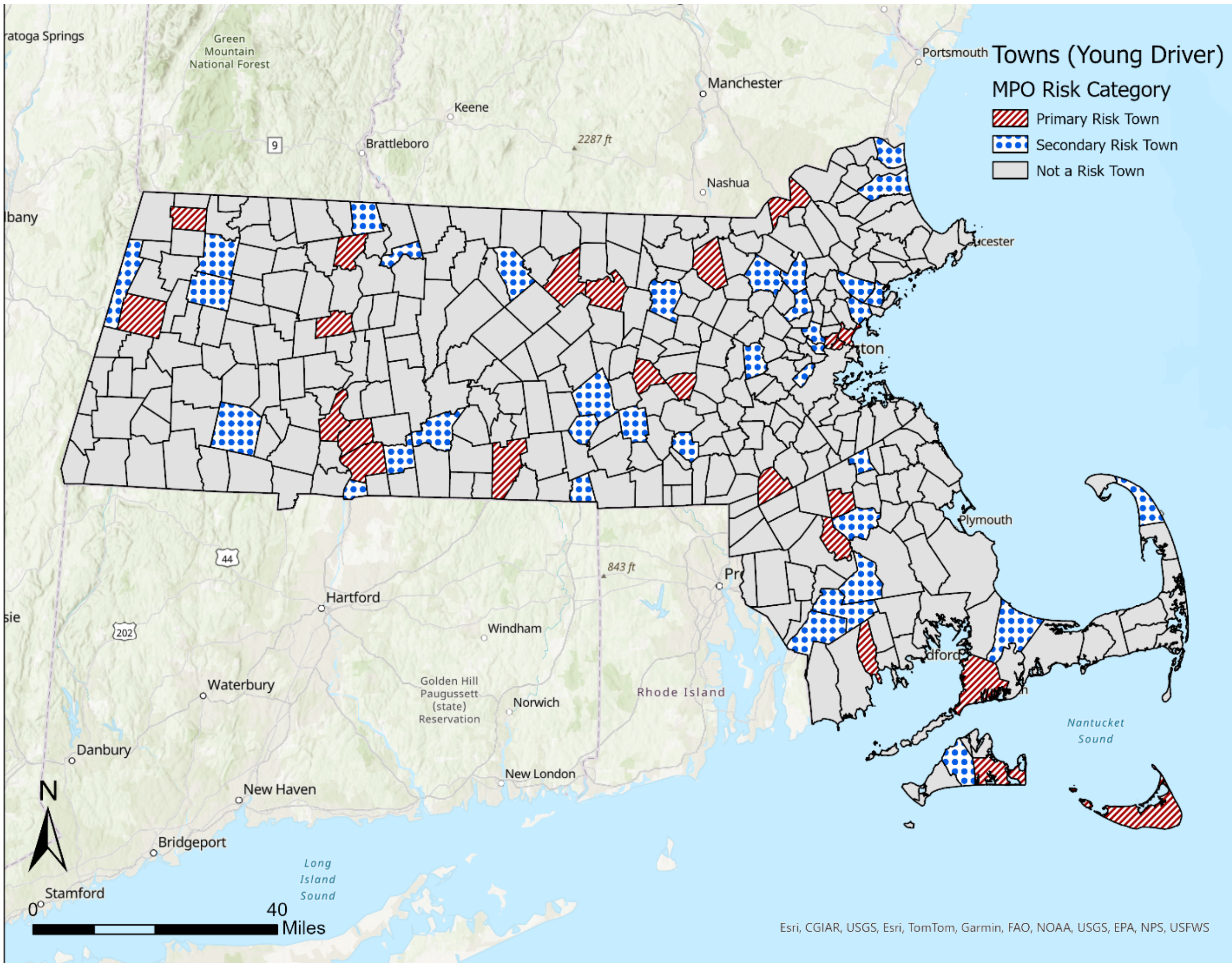

Figure 6. Map depicting the primary and secondary risk towns for severe young driver crashes, ranked by MPO.