MassDOT IMPACT Phase II - Identification of Risk Factors for SHSP Emphasis Areas

Speeding and Aggressive Driving

PREPARED FOR

Massachusetts Department of Transportation

PREPARED BY

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Purpose & Background

The Massachusetts Department of Transportation (MassDOT) was awarded a grant by the United States Department of Transportation (USDOT) under its Safety Data Initiative (SDI) competition. MassDOT's work under this grant includes the creation of a Safety Analysis Module in their online IMPACT tool. One feature in this module will be a mapping component which will include crash-based and systemic network screening maps. As part of this work, MassDOT is identifying focus crash types, facility types, and risk factors for their Strategic Highway Safety Plan (SHSP) Emphasis Areas. This report is a precursor to the SDI project and summarizes the risk factor analysis performed for speeding-related crashes. It also describes a method to identify risk factors using binary logistic regression, which is one potential method to identify risk factors under the SDI grant. Reports for other emphasis areas describe different methods used to adapt to the needs of those areas.

Focus Crash Types

After 97 fatalities due to speeding and aggressive driving crashes between 2012 and 2016, MassDOT identified those crashes as an emphasis area in the 2018 Strategic Highway Safety Plan (SHSP)[1]. Based on discussions with MassDOT, VHB established two speeding focus crash types, described in Table 1.

Table 1. Focus crash types for speeding-related crashes.

Focus Crash Type	Method for Identification
Too Fast for Conditions	At least one entry in the Driver Contributing Circumstances field includes "Driving too fast for conditions".
Exceed Speed Limit	At least one entry in the Driver Contributing Circumstances field includes "Exceeded authorized speed limit".

Ultimately, MassDOT elected to pursue only "Exceed Speed Limit" crashes for risk factor implementation, which was further defined to only include non-intersection crashes.

Focus Facility Types

VHB used crash trees to identify focus facility types for "Exceed Speed Limit" crashes. Because of the small number of fatal (K) and incapacitating/suspected serious injury (A) crashes, VHB also included non-incapacitating/suspected minor injury (B) crashes for this analysis. This increases the sample size for the risk factor analysis. Figure 1 includes the crash tree for "Exceed Speed Limit" crashes.

[1] https://www.mass.gov/doc/massachusetts-shsp-2018/download

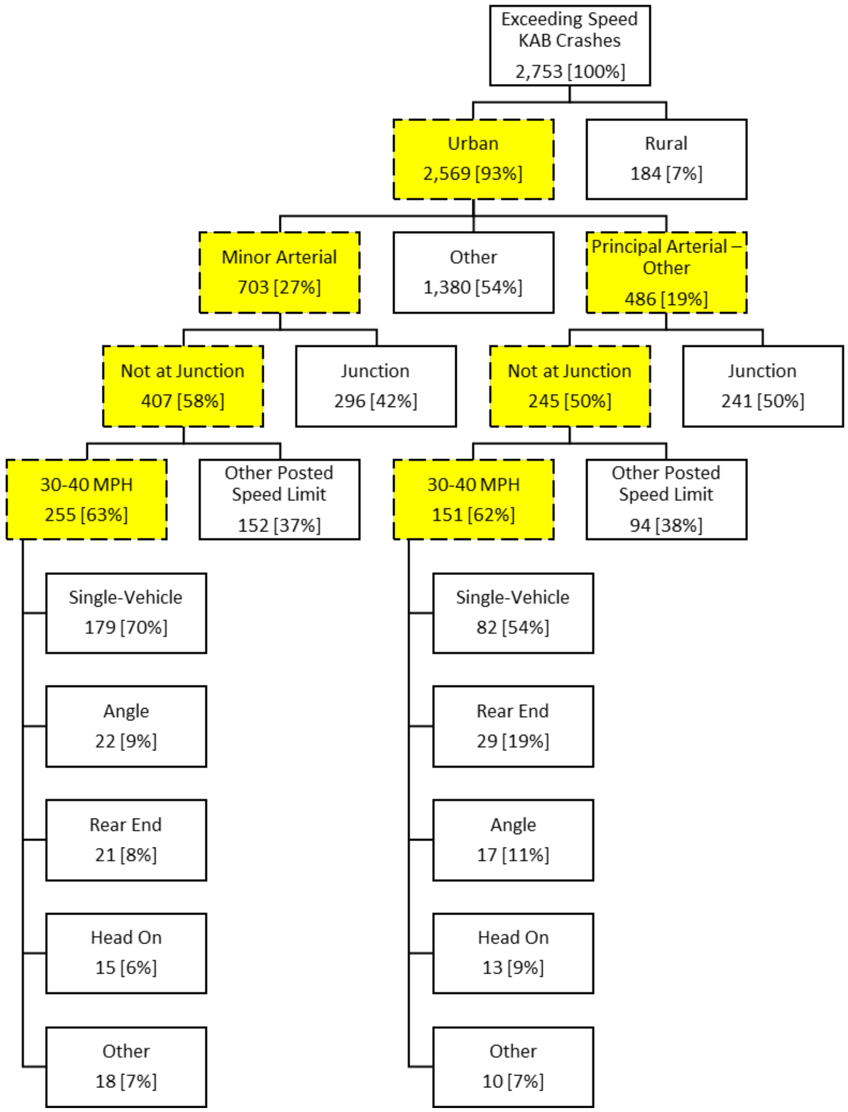

Figure 1. Crash tree to identify focus facility types for "Exceed Speed Limit" crashes.

The “exceed speed limit” crash tree shows that 93 percent of KAB “exceed speed limit” crashes occurred on urban roadways. Of those, 27 percent occurred on minor arterials while 19 percent occurred on Principal Arterials – Other roadways. These functional classes made up the two largest proportions of crashes. For minor arterials, 65 percent of crashes occurred on roads with a posted speed limit between 25 and 40 mph, while 68 percent of principal arterial – other crashes occurred on roads in that posted speed limit range. Based on this tree, VHB confirmed two focus facility types for “exceed speed limit” crashes:

1. Urban minor arterials with posted speed limit between 25 and 40 mph.
2. Urban principal arterials – other with posted speed limit between 25 and 40 mph.

Additional Crash Tree Insights

In the final rows of the crash tree, VHB included information about crash relation to junction and manner of collision. For all focus facility types, the majority of crashes were ”not at junction” (i.e., the ”RDWY_JNCT_TYPE_DESCR” field indicated as “Not at Junction”, “Driveway”, “Not Reported”, and ”Unknown”). Of those, the majority were reported as single-vehicle crashes.

Risk Factor Analysis

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

Methodology

Based on discussions with MassDOT, VHB used a modeling approach, previously used for the pedestrian and bicycle safety analysis, to identify risk factors for speeding crashes. Due to the binary nature of the crash severity outcome of interest, the project team used binary logistic regression. This probabilistic modeling technique assesses the probability that an event has occurred (i.e., a KAB speeding crash) on a given segment based on the model inputs. Agresti (2007) provides more background information on this method.[2] In this context, odds ratios for variables greater than 1.0 indicate the independent variable increases the probability of a KAB crash on the segment, while odds ratios less than 1.0 indicate a decrease in probability. With one focus crash types and two focus facility types, VHB estimated two risk factor models which are summarized in Table 2.

Table 2. Summary of risk factor analysis models.

Model Number	Crash Type	Crash Severity	Crash Relation to Junction	Facility Type	Posted Speed Limit
3	Exceed Speed Limit	KAB	Non-Intersection	Principal Arterial – Other	25-40 MPH
4	Exceed Speed Limit	KAB	Non-Intersection	Minor Arterial	25-40 MPH

When modeling, VHB added 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 was willing to include variables with p-values upwards of 0.25 assuming the magnitude of the results made sense. VHB did not want to

[2] Agresti, A. (2007). An Introduction to Categorical Data Analysis. Second Edition. John Wiley & Sons, Inc., New York.

select a strict level of significance, as Hauer noted this could lead to misunderstanding or outright disregard for potentially noteworthy results[3].

Data

VHB used ArcGIS to manage and integrate data for this analysis. MassDOT provided VHB with various sources of data, as described in the following sections. As stated in the methodology section, the binary logit model was performed at the segment level. As such, VHB tied all data to roadway inventory segments.

Crash Data

MassDOT provide statewide geolocated crash data for the years 2013 through 2017. VHB used the Spatial Join tool in ArcGIS to assign crashes to roadway segments, using the Street Name fields in the crash and roadway data to verify the match is correct. VHB processed the crash data using the Driver Contributing Circumstances field to identify "too fast for conditions" and "exceed speed limit" crashes. Additionally, VHB filtered the data using the functional class field to identify crashes occurring on minor arterials and principal arterials – other.

Roadway Data

VHB downloaded the Massachusetts statewide roadway inventory as of July 2020, available at https://massdot.maps.arcgis.com/home/item.html?id=10a2766a607345928c6a66ffb479c937. 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. The roadway inventory included an estimate of annual average daily traffic (AADT) for each segment.

One noteworthy addition VHB made to the roadway inventory data was the identification of upstream and downstream posted speed limits for each roadway inventory segment. MassDOT requested this as a potential factor to identify if changes in speed limit increase the risk of a speeding related crash. VHB identified these values using multiple steps. First, VHB sorted the roadway inventory data by route, begin milepost, and end milepost. For each roadway segment, the posted speed limit was taken from the prior roadway segment if the end milepost for that segment matched the begin milepost for the subject segment and the routes matched. The reverse process was followed to pull the posted speed limit from the next segment, the only difference being the end milepost for the subject segment matched the begin milepost for the next segment.

This method does not return an adjacent speed limit if the adjacent segment does not meet the conditions prescribed above. There are 2 scenarios where this may occur:

1. The segment is the minor approach to a t-intersection. In this case, there is no adjacent segment. For this analysis, VHB assigned a value of 0 mph for the adjacent posted speed limit.
2. The adjacent segment has a different roadway name. This change in naming convention could be due to a change in jurisdiction or the intersection of another roadway.

To address, this issue, VHB utilized various tools in ArcGIS. VHB began by calculating azimuths for each roadway inventory segment. VHB then generated a feature class of nodes at the beginning and end of

[3] Hauer, E. (2004). The harm done by tests of significance. *Accident Analysis & Prevention*, *36*(3), 495-500.

each roadway segment for which the previous method failed to identify an upstream and downstream posted speed limit. VHB then spatially joined the roadway segments to the node feature class, attaching unique segment identifiers, posted speed limit, and azimuth. VHB then calculated the difference in azimuth between the subject segment for the node and each spatially joined segment. Based on a review of the data, VHB identified 180 plus or minus 35 degrees (145 degrees to 215 degrees) as the range in azimuth difference in which a segment must fall to be identified as the adjacent upstream or downstream segment. Figure 2 provides an example of this approach, with three potential scenarios for an imagined intersection of Main Street (the subject segment), Route 1 (an intersecting roadway), and Maple Highway (a potential adjacent segment). Scenario (a) represents a situation in which the roadway continues straight through the signalized intersection with only a change in name. In this case the adjacent segment falls within the acceptable angle range based on azimuth, thus it is identified as an adjacent segment. Meanwhile, scenario (b) shows a similar situation; however, Maple highway approaches Main Street at a sharper angle than 35 degrees, thus falling outside of the acceptable angle range and not identified as an adjacent segment. Finally, scenario (c) shows a situation in which Main Street terminates at the intersection with Route 1.

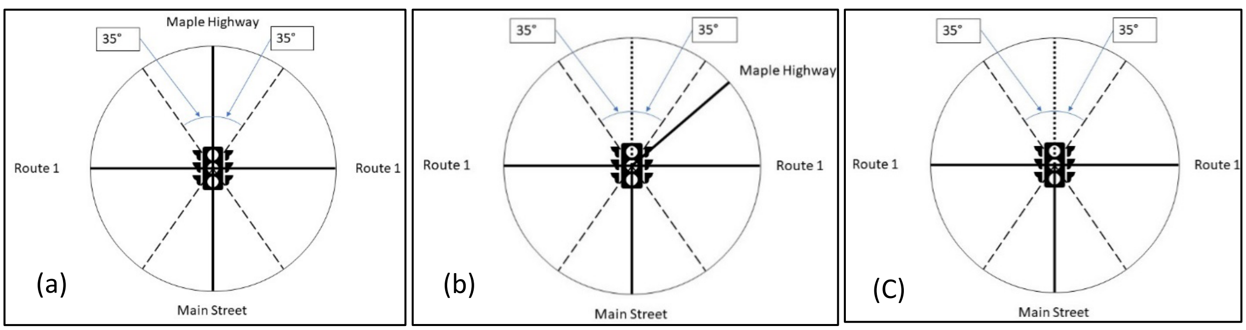

Figure 2. Visual representation of the azimuth calculations used to identify adjacent roadway segments.

Upon identifying adjacent posted speed limits for each segment, VHB calculated the maximum absolute difference in posted speed limit between adjacent segments. Equation 1 shows the math and logic used to identify this value for the subject segment. VHB used this metric for modeling.

Equation 1. Logic and math used to identify the maximum absolute difference in posted speed limit for a subject segment.

$$Maximum\ Absolute\ Difference\ in\ Posted\ Speed\ Limit = max \begin{cases} |Segment\ Posted\ Speed\ Limit - Upstream\ Posted\ Speed\ Limit| \\ |Segment\ Posted\ Speed\ Limit - Downstream\ Posted\ Speed\ Limit| \end{cases}$$

Horizontal Curve Data

MassDOT provided VHB with horizontal curve data consisting of horizontal curve radii. VHB assigned horizontal curves to roadway inventory segments using the Identity tool in ArcGIS. This allowed VHB to identify how many curves are present, and the characteristics of those curves, in each roadway segment. VHB used these data to generate a weighted average degree of curvature for each roadway segment. Degree of curvature is the measure of the change in angle for a curve over a standard distance, typically 100 feet. Equation 2 describes the degree of curvature (*D*) as a function of horizontal curve radius (*R*) in feet. Degree of curvature is preferred for modeling compared to radius because degree of curvature equal to 0 is equivalent to a tangent, and as degree of curvature increases the curve becomes sharper.

Equation 2. Degree of curvature as a function of curve radius.

$$D = \frac{5729.6}{R}$$

Equation 3 describes the method used by VHB to calculate the weighted average of degree of curvature (*WADOC*) for the segment. The average is weighted using curve length (*CL*) for *n* curves in a segment.

Equation 3. Weighted average degree of curvature for a segment.

$$WADOC = \frac{\sum_{i=1}^{n} D_i CL_i}{\sum_{i=1}^{n} CL_i}$$

Alcohol Data

MassDOT provided statewide geolocated liquor license data as of November 2019 which identifies the location of active liquor licenses. These data come from the Massachusetts Alcoholic Beverages Control Commission (ABCC). VHB used the Spatial Join tool in ArcGIS to identify the distance to the nearest licensed establishment for a roadway segment.

Driver License Data

MassDOT provided driver's license data by age and town for the years 2011 through 2015. VHB used average number of drivers at each age group for the years 2013 through 2015. VHB then calculated the proportion of young drivers (i.e., drivers aged 24 or younger) for each city or town.

Census Data

In addition to the data provided by MassDOT, VHB accessed 2010 United States Census Data and developed the following metrics to capture additional potential contributing factors at the census tract level:

- **Proportion of zero-vehicle households.** VHB derived this metric from the HOUSING CHARACTERISTICS census data table. VHB summed the number of zero-vehicle households and total households for each census tract then calculated the proportion of zero-vehicle households as the number of zero-vehicle households divided by the number of total households.
- **Proportion of non-vehicle commuters.** VHB derived this metric from the COMMUTING census data table. VHB summed the number of pedestrian, bicycle, and transit commuters and divided this by the total number of commuters to determine the proportion of non-vehicle commuters for a census tract.
- **Proportion of population under the age of 18.** VHB derived this metric from the AGE AND SEX census data table. VHB summed the number of people aged less than 18 then divided this by the total population to calculate the proportion of population under 18 for the census tract.

VHB used the Spatial Join tool in ArcGIS to assign census tract characteristics to roadway inventory segments.

Results

The following sections describe the results for each risk factor model. All models were run using segments at least 0.01 miles in length. Additionally, segment length was included as a continuous variable in all models to account for exposure. It should not be included when extracting risk factors based on the model. As part of the modeling efforts, VHB used correlation matrices to verify correlation between variables was low. There were no cases where correlation between explanatory variables exceeded 0.6.

Model 1 – Exceed Speed Limit – Principal Arterials – Other – Non-Intersection Crashes

Table 3 summarizes the binary logit regression model for "exceed speed limit" non-intersection crashes on principal arterial – other roadways. All variables (with the exception of length) are binary – meaning the variable is equal to 1 if the conditions is true for the segment and 0 otherwise. This model excludes segments for which the upstream or downstream posted speed limit was unknown (reported as 99 mph) or there was no segment present (reported as 0 mph). Additionally, this model is only for non-intersection crashes. This model includes "Maximum absolute difference in posted speed limit of 15 mph" and "Maximum absolute difference in posted speed limit of 25 mph"; however, these represent a very small portion of the sample (126 observations and 21 observations, respectively), and thus should be viewed with caution (as evidenced by the wide confidence intervals). However, their inclusion in the model has minimal effect on the odds ratios of other variables, thus VHB kept them in the final model.

Table 3. Binary logit regression model for "Exceed Speed Limit" non-intersection crashes on principal arterial - others

Variable	Odds Ratio	Standard Error	z-value	P>|z|	95% Confidence Interval	
Natural log of segment length (miles)	2.81	0.30	9.55	<0.001	2.28	3.48
AADT between 30,000 and 60,000 vehicles per day	2.63	0.53	4.78	<0.001	1.77	3.91
AADT exceeding 60,000 vehicles per day	4.06	1.92	2.97	0.003	1.61	10.25
Weighted average degree of curvature 5 or more degrees per 100 feet[4]	1.98	0.33	4.16	<0.001	1.44	2.73
Posted speed limit of 30 mph	1.28	0.23	1.38	0.167	0.90	1.81
Sidewalk present on at least one side of the segment[5]	1.75	0.39	2.53	0.011	1.13	2.70
Segment is in PVPC	1.43	0.33	1.59	0.113	0.92	2.24
Maximum absolute difference in posted speed limit of 15 mph	3.03	2.20	1.52	0.128	0.73	12.59
Maximum absolute difference in posted speed limit of 25 mph	20.61	21.54	2.90	0.004	2.66	159.8
Constant	0.05	0.02	-8.39	<0.001	0.02	0.09

Note: Number of observations = 28,804; Log likelihood = -891.99477; Pseudo R2 = 0.0751; LR chi2(10) = 144.88; Prob > chi2 < 0.0000.

The binary logit model in Table 3 consists primarily of infrastructure characteristics. The risk factors for "exceed speed limit" crashes on principal arterial – other roadways include AADT exceeding 30,000 vehicles per day, curves with a radius of 1,145 feet or sharper, a posted speed limit of 30 mph, the presence of a sidewalk on one or both sides of the roadway, and a large difference in posted speed limit between the subject segment and adjacent segments. Practically, the two maximum absolute difference in posted speed limit risk factors should be combined into one, which indicates if the maximum absolute difference in posted speed limit for the segment is at least 15 mph.

Model 2 – Exceed Speed Limit – Minor Arterials – Non-Intersection Crashes

Table 4 summarizes the binary logit regression model for "exceed speed limit" non-intersection crashes on minor arterial roadways. All variables (with the exception of length) are binary – meaning the variable is equal to 1 if the conditions is true for the segment and 0 otherwise. This model excludes segments for

[4] Equivalent to a curve radius of 1,145 feet or sharper.
[5] Compared to no sidewalk present along the roadway.

which the upstream or downstream posted speed limit was unknown (reported as 99 mph) or there was no segment present (reported as 0 mph). Additionally, this model is only for non-intersection crashes.

Table 4. Binary logit regression model for "Exceed Speed Limit" non-intersection crashes on minor arterials.

Variable	Odds Ratio	Standard Error	z-value	P>|z|	95% Confidence Interval	
Natural log of segment length (miles)	2.33	0.17	11.52	<0.001	2.02	2.69
AADT between 20,000 and 40,000 vehicles per day	1.51	0.31	1.99	0.046	1.01	2.26
Posted speed limit of 30 mph	1.34	0.17	2.33	0.020	1.05	1.72
Proportion of younger drivers in census tract between 0.15 and 0.21[6]	1.37	0.33	1.31	0.191	0.86	2.18
Weighted average degree of curvature 10 or more degrees per 100 feet[7]	1.44	0.25	2.14	0.032	1.03	2.02
Segment is in PVPC	1.45	0.24	2.27	0.023	1.05	2.00
Segment is in SRPEDD	1.80	0.34	3.11	0.002	1.24	2.60
Undivided segment	1.91	0.88	1.41	0.159	0.78	4.70
No sidewalk present on the segment[8]	1.37	0.18	2.39	0.017	1.06	1.76
Stable shoulder[9]	1.25	0.20	1.39	0.164	0.91	1.71
Constant	0.02	0.01	-7.12	<0.001	0.01	0.07

Note: Number of observations = 44,230; Log likelihood = -1595.8548; Pseudo R2 = 0.0566; LR chi2(10) = 191.33; Prob > chi2 < 0.0000.

Table 4 summarizes the binary logit model for "exceed speed limit" crashes on minor arterial roadways with a posted speed limit between 25 and 40 mph. This model includes a mix of infrastructure and census tract variables. The risk factors include AADT between 20,000 and 40,000 vehicles per day, a posted speed limit of 30 mph, roadway curvature of 573 feet or sharper, no sidewalk along the roadway, and a stable shoulder. Additionally, a high proportion of younger drivers (between 0.15 and 0.21) in the census tract is also correlated with an increased probability of a crash. VHB interprets the lack of median (undivided segment) being significant in this model as an indicator of less-forgiving roadway environments. This contrasts the result in the "too fast for conditions"; however, these results do not contradict, as this model does not include intersection crashes (while the "too fast for conditions" crashes do). Without a median, drivers who make an error while exceeding the speed limit are less likely to have a median or median

[6] Compared to less than 0.15
[7] Equivalent to a curve radius of 573 feet or sharper.
[8] As opposed to sidewalk present on one or both sides of the road
[9] As opposed to other shoulder types

barrier to allow for recovery or redirect vehicles with a less than severe crash, thus increasing the likelihood of a KAB crash on these segments.

Conclusions and Recommendations

The purpose of this report is to summarize the systemic analysis of speeding crashes on MassDOT highways. VHB and MassDOT focused on non-intersection crashes in which at least one vehicle exceeded the posted speed limit. VHB identified Minor Arterial and Principal Arterial – Other roadways with posted speed limits between 25 and 40 mph as focus facility types. To identify risk factors, VHB used binary logistic regression, identifying both infrastructure and census tract characteristics correlated with increased KAB crash probability. Table 5 summarizes the risk factors identified in this analysis.

Table 5. Summary of risk factors for non-intersection "exceed speed limit" crashes.

Exceed Speed, Principal Arterial Other	Exceed Speed, Minor Arterial
AADT between 30,000 and max AADT per day	AADT between 20,000 and 40,000 vehicles per day
Weighted average degree of curvature 5 or more degrees per 100 feet	Posted speed limit of 30 mph
Posted speed limit of 30 mph	Proportion of younger drivers in a town between 0.15 and 0.21
Sidewalk present on at least one side of the segment	Weighted average degree of curvature 10 or more degrees per 100 feet
Segment is in PVPC	Segment is in PVPC
Maximum absolute difference in posted speed limit of 15 mph or greater	Segment is in SRPEDD
	Undivided segment
	No sidewalk present on the segment
	Stable shoulder

Table 6 summarizes the recommended scoring for the risk models. These are based on the relationships between the risk factor and KAB crash frequency. The total potential risk score for principal arterial – other segments is 6 and the total for minor arterials is 8. Table 6 provides a scoring example for an example segment. Note the total risk score is 6.475 and the normalized risk score out of a potential total of 8 is 81%.

Table 6. Summary of risk factor scoring for non-intersection "exceed speed limit" crashes.

Exceed Speed, Principal Arterial Other	Risk Scoring	Exceed Speed, Minor Arterial	Risk Scoring
AADT exceeding 30,000 vehicles per day	Score = 1.1425 - 0.00000475*AADT if AADT exceeds 30,000; 0 otherwise	AADT between 20,000 and 40,000 vehicles per day	Score = 1.5 - 0.000025*AADT if AADT between 20,000 and 40,000; 0 otherwise
Weighted average degree of curvature 5 or more degrees per 100 feet	1 if degree of curvature exceeds 10; degree of curvature/10 if between 5 and 10; 0 otherwise	Posted speed limit of 30 mph	1 if true; 0 otherwise
Posted speed limit of 30 mph	1 if true; 0 otherwise	Proportion of younger drivers in a town between 0.15 and 0.21	Score = 2.25 - 8.3333*Proportion of Younger Drivers if Proportion of Younger Drivers between 0.15 and 0.21; 0 otherwise
Sidewalk present on at least one side of the segment	1 if true; 0 otherwise	Weighted average degree of curvature 10 or more degrees per 100 feet	1 if degree of curvature exceeds 15; degree of curvature * 0.1 – 0.5 if between 10 and 15; 0 otherwise
Segment is in PVPC	1 if true; 0 otherwise	Segment is in PVPC	1 if true; 0 otherwise
Maximum absolute difference in posted speed limit of 15 mph or greater	1 if true; 0 otherwise	Segment is in SRPEDD	1 if true; 0 otherwise
		Undivided segment	1 if true; 0 otherwise
		No sidewalk present on the segment	1 if true; 0 otherwise
		Stable shoulder	1 if true; 0 otherwise

Table 7. Example risk score calculations for "Exceed Speed Limit" crashes on a minor arterial segment.

Variable	Segment Characteristic	Risk Factor	Risk Score
AADT (vehicles per day)	25,000	AADT between 20,000 and 40,000 vehicles per day	0.875
Proportion of younger drivers in census tract	0.12	Proportion of younger drivers in census tract between 0.15 and 0.21	0
Divided or undivided	Undivided	Undivided segment	1
Weighted average degree of curvature (degrees per 100 feet))	11	Weighted average degree of curvature 10 or more degrees per 100 feet	0.6
Posted speed limit (mph)	30	Posted speed limit of 30 mph	1
Sidewalk (left, right, or both)	Both	No sidewalk present on the segment	1
Right Shoulder Type	Stable	Right shoulder is stable	1
RPA	SRPEDD	Segment is in PVPC or SRPEDD	1
		Total Risk Score:	6.475
		Normalized Risk Score:	81%

In order to finalize the data, MassDOT dissolved the road inventory based on the risk factor inputs to generate uniform corridors. These corridors can be used to identify targeted safety improvement projects. Additionally, MassDOT identified the closest address geospatially to the beginning and end of each corridor as reference points. The addresses include the street number, street name, and town of the address. Note these are the closest addresses geospatially, so the reference address may not be on the same street as the corridor itself, and the beginning and end reference address may be the same. MassDOT continues to provide mileposts for MassDOT routes and encourages users to use both mileposts and address points as references.

The segments were then ranked at both the Statewide and MPO levels using the normalized risk score and the percentile of score 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%. The risk categories were then determined using the computed ranks. For example, sites ranked in the top 5 percentile (95 through 100) were categorized as "Primary Risk Site," sites ranked in the next 10 percentile (85 through 95) were categorized as "Secondary Risk Site," and the remaining sites 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 used. Table 8 and 9 show the distribution of focus facility type segments with the normalized risk score (presented as percentages) across these categories for Statewide and MPO rankings, respectively.

Table 10. Statewide risk categories.

State	Risk Category	Minimum Normalized Risk Score Percentage	Maximum Normalized Risk Score Percentage	Number of Segments	Percent of Scored State Segments
MA	Primary Risk Site	42.67%	83.31%	4123	5.0%
	Secondary Risk Site	33.33%	42.67%	13314	16.1%

Table 11. MPO risk categories.

MPO	Risk Category	Minimum Normalized Risk Score Percentage	Maximum Normalized Risk Score Percentage	Number of Segments	Percent of Scored MPO Segments
Berkshire Regional Planning Commission	Primary Risk Site	33.33%	50%	514	14.59%
	Secondary Risk Site	32.56%	33.32%	15	0.43%
Boston Region MPO	Primary Risk Site	48.39%	66.67%	1466	5.01%
	Secondary Risk Site	33.33%	48.39%	5212	17.80%
Cape Cod Commission	Primary Risk Site	33.33%	50%	329	5.88%
	Secondary Risk Site	22.22%	33.33%	733	13.11%
Central Massachusetts Regional Planning Commission	Primary Risk Site	33.33%	50%	864	10.79%
	Secondary Risk Site	22.22%	33.33%	1545	19.30%
Franklin Regional Council of Governments	Primary Risk Site	33.33%	50%	148	9.10%
	Secondary Risk Site	22.22%	32.10%	209	12.85%
Martha's Vineyard Commission	Primary Risk Site	16.67%	16.67%	19	16.96%
	Secondary Risk Site	N/A	N/A	0	0%
Merrimack Valley Planning Commission	Primary Risk Site	33.33%	50%	802	16.46%
	Secondary Risk Site	N/A	N/A	0	0%
Montachusett Regional Planning Commission	Primary Risk Site	33.33%	65.71%	629	12.54%
	Secondary Risk Site	28.47%	33.32%	124	2.47%

MPO	Risk Category	Minimum Normalized Risk Score Percentage	Maximum Normalized Risk Score Percentage	Number of Segments	Percent of Scored MPO Segments
Nantucket Planning and Economic Development Commission	Primary Risk Site	11.11%	22.22%	62	71.26%
	Secondary Risk Site	N/A	N/A	0	0%
Northern Middlesex Council of Governments	Primary Risk Site	33.33%	66.56%	608	16.35%
	Secondary Risk Site	N/A	N/A	0	0%
Pioneer Valley Planning Commission	Primary Risk Site	50%	83.31%	1022	11.46%
	Secondary Risk Site	43.93%	50%	316	3.54%
Old Colony Planning Council	Primary Risk Site	33.33%	66.53%	590	12.77%
	Secondary Risk Site	31.94%	33.33%	103	2.23%
Southeastern Regional Planning and Economic Development District	Primary Risk Site	33.33%	51.38%	1409	19.93%
	Secondary Risk Site	N/A	N/A	0	0%