

Focus Crash and Facility Types for Risk Analysis

This technical memo provides a preliminary analysis of common factors among historic fatal (K) and serious injury (A) crashes within the North Carolina Capital Area Metropolitan Planning Organization (CAMPO) jurisdiction. CAMPO plays a pivotal role in addressing transportation challenges and promoting safety initiatives within its region. The data presented in this memo serve as a foundation for data-driven decision-making processes concerning road safety measures, allocation of resources, and prioritization of projects to mitigate the occurrence and severity of crashes. By examining the patterns and characteristics of fatal and serious crashes over the specified period, this memo aims to identify key areas of concern that could inform potential risk factors on the region's roads.

Data

The project team obtained crash data from the North Carolina Department of Transportation (NCDOT) for the years 2016 through 2023. This included several characteristics such as location, roadway characteristics, and crash severity, and these were reviewed to generate tables and figures explored throughout this report. The project team obtained NCDOT's route characteristics file in a geographic information systems (GIS) format. The combination of crash and roadway characteristics combined to inform this preliminary risk-based analysis.

Methodology

The scope of work for the Blueprint for Safety includes analysis of crashes occurring on the entire system of roads in the CAMPO region, with a goal of understanding historic trends and to inform a risk-based or systemic approach for identifying safety problems in the region. The systemic, or risk-based, analysis consists of three principal components:

1. Identify focus crash types
2. Identify focus facility types for focus crash types
3. Identify risk factors related to focus crashes on focus facilities

This memorandum focuses on the first 2 components of this analysis.

Focus Crash Type Approach

The project team began by reviewing focus crash types based on emphasis areas (EAs) identified in North Carolina's Strategic Highway Safety Plan (SHSP).¹ EAs considered as part of the analysis include:

- **Speed Related Crashes:** Contributing circumstances related to the driver are recorded as exceeding the posted speed limit or driving too fast for conditions.
- **Alcohol Related Crashes:** Driver is confirmed or suspected of being under the influence of alcohol.
- **Drug Related Crashes:** Driver is confirmed or suspected of being under the influence of a drug other than alcohol.
- **Distracted Driver Crashes:** Contributing circumstances related to the driver are recorded as inattention or distracted (by devices or other factors).

¹ <https://spatial.vhb.com/ncdotshsp/>

- **Animal Involved Crashes:** Crash/Collision type is recorded as an “Animal”
- **Older Driver Crashes:** Involves a driver over the age of 64.
- **Teen Driver Crashes:** Involves a driver between the ages of 15 and 19.
- **Intersection Related crashes:** Roadway feature at the crash location is an at-grade intersection.
- **Unbelted Crashes:** Driver or occupant recorded as not using a restraint.
- **Motorcycle Involved Crashes:** Vehicle type involved in crash is recorded as a motorcycle.
- **Heavy Truck Involved Crashes:** Vehicle type involved in crash is recorded as Truck/Tractor, Truck/Tractor, Tractor/Semi-Tractor, Tractor/Doubles, or Unknown Heavy Truck.
- **Pedestrian Involved Crashes:** Crash/Collision type, “vehicle” type, or person type recorded as a pedestrian.
- **Bicyclist Involved Crashes:** Crash/Collision type, “vehicle” type, or person type recorded as a bicycle.
- **Lane Departure Crashes:** Crash/Collision type recorded as running off the road, rollover/overturn, striking fixed object, sideswipe in opposite directions, or head on.

To identify focus crash types, the project team created two comparisons:

1. CAMPO fatal and serious injury (KA) crashes against total crashes.
2. CAMPO KA crashes by county against statewide KA crashes.

To identify focus crash types, the project team looked for EAs that had a greater share of KA crashes compared to total crashes. For instance, if Lane Departure accounts for 47% of KA crashes but only 18% of total crashes, then Lane Departure should be considered a priority for further risk factor development. Furthermore, comparisons at the county-level inform differences within the CAMPO jurisdiction that can inform where certain crash types are more prevalent and could be prioritized more locally.

Focus Facility Type Approach

The project team spatially joined crash data in GIS to link roadway attribute spatial values with crashes. For the purposes of this preliminary review, the project team focused on NCDOT’s route class and functional class attributes. The project team compared the proportion of crashes that occurred on a given facility type (e.g., a route classification or a functional classification) against the proportion of mileage for that facility. For instance, if 22% of pedestrian KA crashes occurred on US routes and 3% of all roads in CAMPO are US Routes, then those facilities would be a focus for further risk factor analysis.

Focus Crash Type Results

The following sections summarize the comparisons used to generate focus crash types.

CAMPO KA Crashes Relative to CAMPO Total Crashes

In Figure 1, **Lane Departure, Impaired Driving, Occupant Protection, Speed, Intersection, Motorcycle, Pedestrian, and Bicyclist** EAs are overrepresented in KA crashes compared to all crashes. For instance, Lane Departure crashes constitute 47% of KA crashes but only 18% of all crashes. These EAs are critical focal points for CAMPO, indicating the types of countermeasures, policies, and interventions that may have the most impact on improving road safety. However, these proportions vary within CAMPO. Therefore, comparing these rates at the county-level to statewide rates is critical in understanding local safety issues in CAMPO.

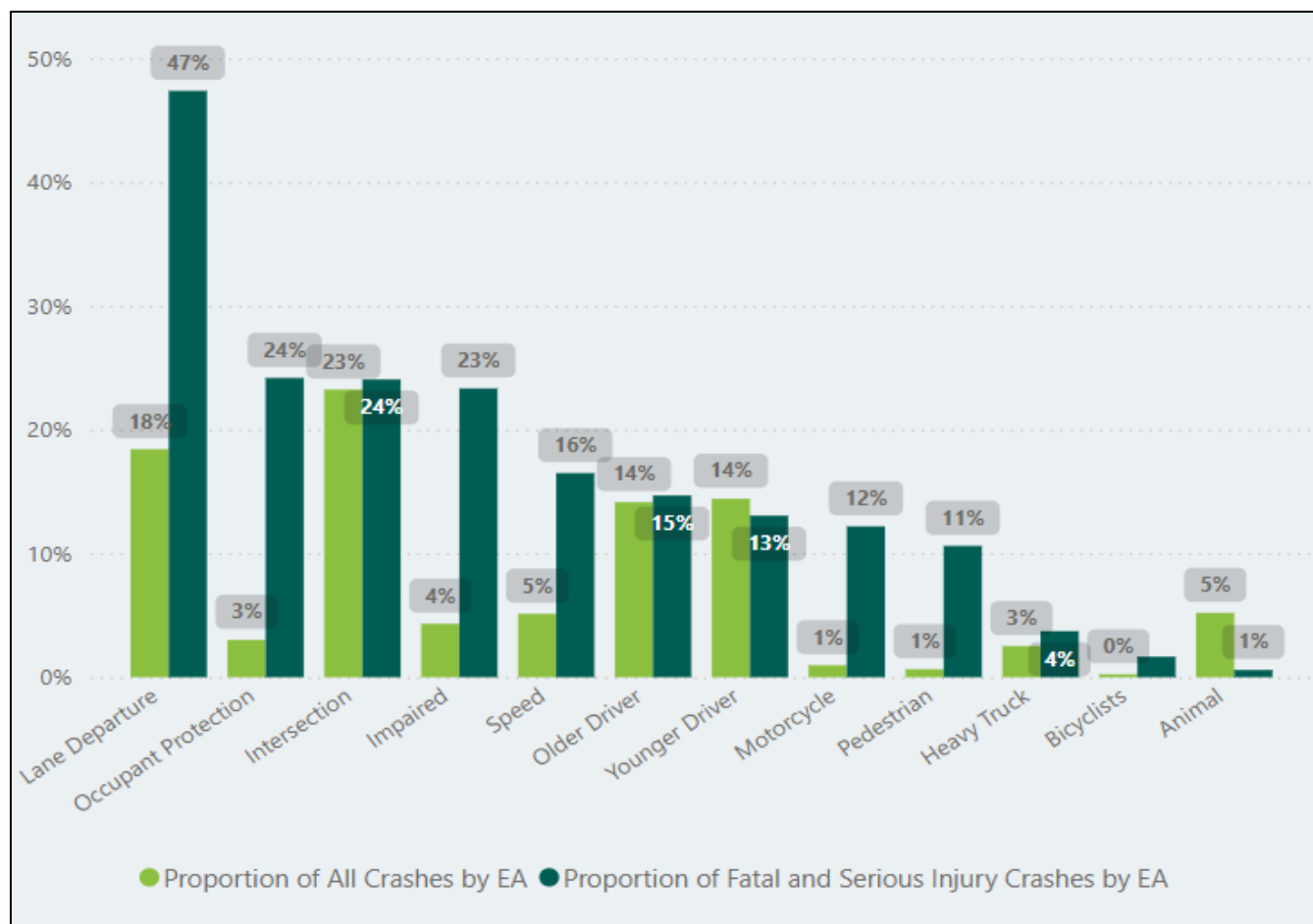


Figure 1: Comparison of Emphasis Areas (EA) in All Crashes vs. Fatal and Serious Injury Crashes

CAMPO KA Crashes Relative to State KA Crashes

If the region's proportion of KA crashes exceeded the proportion of total crashes by 1%, it was marked as a focus crash type for CAMPO. Additionally, anything with (less than) 1% difference in overrepresentation was excluded from the critical areas except for intersection and bicyclists. Intersections were kept as a focus crash type because

intersections represent a relatively large share of severe crashes. As for bicyclists, bicyclists and pedestrians are considered vulnerable road users and often have overlapping safety concerns. Figure 2 illustrates how each county's proportion of KA crashes by EA compares to the statewide proportion. Although Motorcycle crashes are not particularly overrepresented in any part of CAMPO, motorcycle crashes tend to be more severe (Figure 1) which is why they will remain in the next steps of the crash analysis.

Emphasis Area(s)	Chatham	Franklin	Granville	Harnett	Johnston	Wake	Statewide
Lane Departure	59%	62%	68%	58%	52%	38%	53%
Intersection	25%	26%	15%	22%	26%	25%	22%
Impaired Driving	16%	25%	27%	21%	26%	23%	23%
Occupant Protection	27%	29%	34%	32%	27%	19%	27%
Speed	20%	13%	23%	20%	14%	16%	18%
Motorcycle	12%	9%	8%	12%	13%	13%	14%
Pedestrian	7%	4%	5%	9%	6%	14%	10%
Bicyclists	1%	0%	1%	1%	1%	2%	2%
Animal	1%	1%	1%	1%	1%	0%	1%
Heavy Truck	4%	2%	6%	4%	7%	3%	5%
Older Driver	21%	16%	12%	15%	18%	13%	17%
Younger Driver	13%	12%	11%	13%	15%	13%	11%

Figure 2: Proportion of Fatal and Serious Injury Crashes by County and Emphasis Area Compared to Statewide Rates

Please note that crashes per county will add up to more than 100%. This is because one crash can be associated with multiple EAs. This overlap will be important in future steps of the analysis, as countermeasures for one EA could help with crashes in another EA (e.g., reducing speeds could help prevent lane departure).

Figure 3 highlights in green the EAs recommended for each county based on overrepresentation. Since Figure 1 illustrated that 8 EAs represent major contributing factors to severe crashes in CAMPO:

- Lane Departure,
- Impaired Driving,
- Occupant Protection,
- Speed,
- Intersections,
- Motorcycles,
- Pedestrians, and
- Bicyclists

These are the focus for the analysis moving forward.

Emphasis Area(s)	Chatham	Franklin	Granville	Harnett	Johnston	Wake
Lane Departure						
Intersection						
Impaired Driving						
Occupant Protection						
Speed						
Motorcycle						
Pedestrian						
Bicycle						

Figure 3: Counties with Higher Proportions of Fatal and Serious Crashes by Emphasis Area Compared to Statewide Proportion

Figure 3 helps inform the next step in the analysis by highlighting specific crash types in specific jurisdictions that can help inform the risk-based analysis. Other key conclusions include:

- **Majority of Counties:** Three out of six counties exhibit higher proportions of crashes than the state in at least five out of eight EAs, and all counties are overrepresented in at least four EAs.
- **Critical Emphasis Areas:** Intersections and Occupant Protection have the most counties (five out of six) with higher proportions than the statewide rate.
- **Urban Concerns:** Wake County, the most urban county within CAMPO, is uniquely overrepresented in Pedestrian and Bicyclist involved fatal and serious injury crashes.
- **Rural Concerns:** Lane departure tends to be overrepresented in more rural areas of the CAMPO region (i.e., outside of Wake County).

By focusing on these overrepresented EAs, CAMPO can allocate resources and develop strategies that proactively address the most pressing safety concerns in each county.

Focus Network

Based on focus crash types (i.e., EAs), the analysis then reviewed roadway types that have a disproportionately high number of KA crashes.

North Carolina Route Class

Route class refers to the signage of the route (e.g., US 70 or NC 55), and this has a correlation with road maintenance. Interstates, US Routes, NC Routes, and Secondary Routes are NCDOT maintained, while Non-System roads are not NCDOT maintained. Figure 4 compares the proportion of KA crashes and total crashes on each route classification, as well as the total mileage in the CAMPO region.

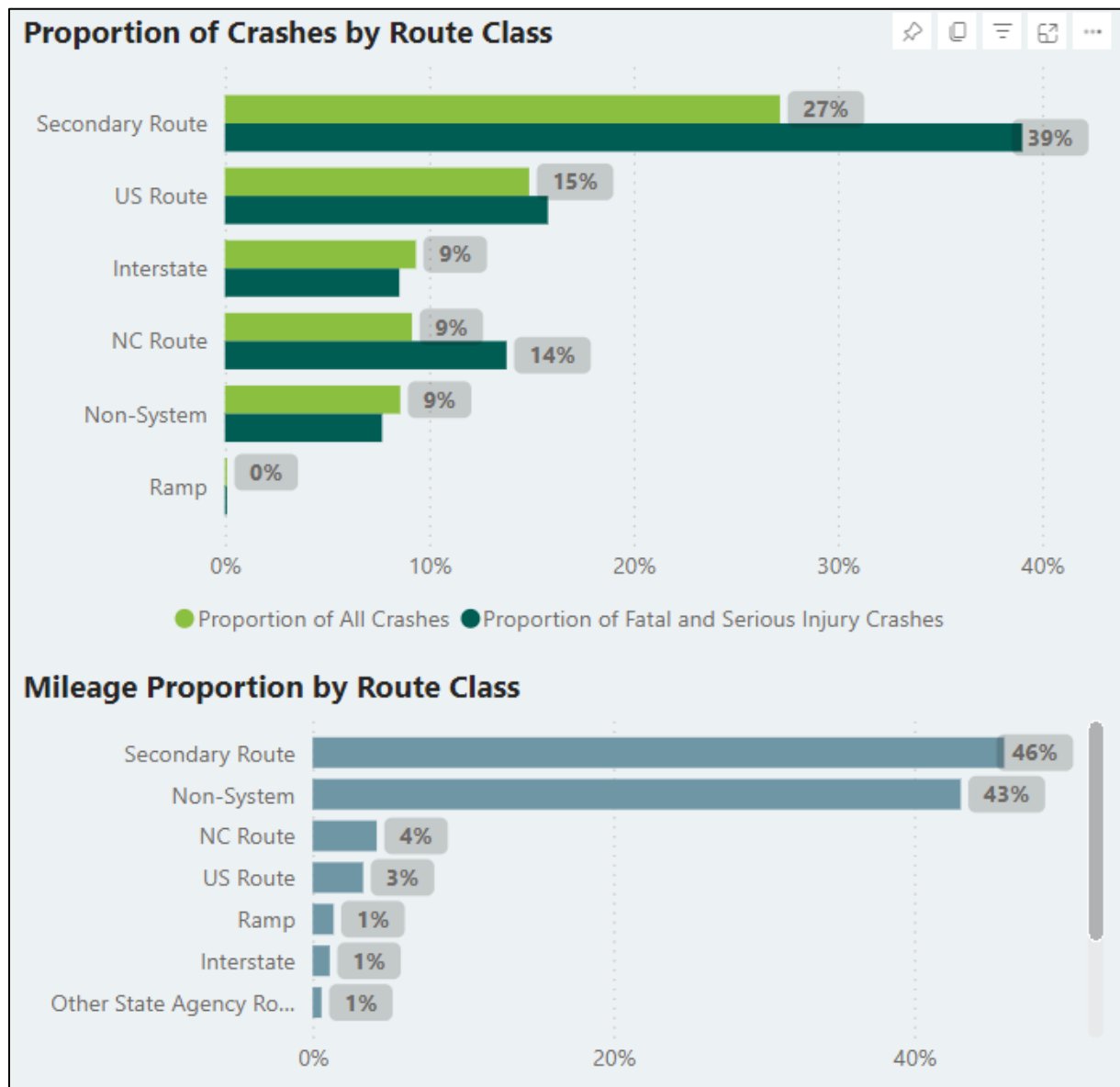


Figure 4: Disparity in Crash Distribution vs. Road Mileage by Route Class

Some key takeaways include:

- **Secondary Routes:** While they account for the majority of road mileage (46%), they are involved in a disproportionate number of KA crashes (39%) relative to total crashes (27%).
- **NC Routes:** These make up only 4% of the total road mileage but represent 14% of the KA crashes, indicating a substantial overrepresentation.
- **US Routes:** Representing just 3% of road mileage, these routes represent 16% of KA crashes, highlighting another overrepresentation.

While it's important for CAMPO to focus on Secondary Routes, as that's where the highest proportion of severe crashes occur, it is also important to focus on NC Routes and US Routes since KA crashes are overrepresented on these roads. These 3 route classes are further examined in the *Focus Network - Overrepresentation by Route Class* section.

Federal Functional Class

Functional class is a Federally mandated classification for public roads. Per the Federal Highway Administration (FHWA), “functional classification carries with it expectations about roadway design, including its speed, capacity and relationship to existing and future land use development.”² This is highly correlated with route class (i.e., a US Route will tend to be a freeway or arterial in the functional class framework), but they are not exactly the same. Figure 5 compares the proportion of KA crashes (locatable in GIS) and total crashes on each functional classification, as well as the total mileage in the CAMPO region.

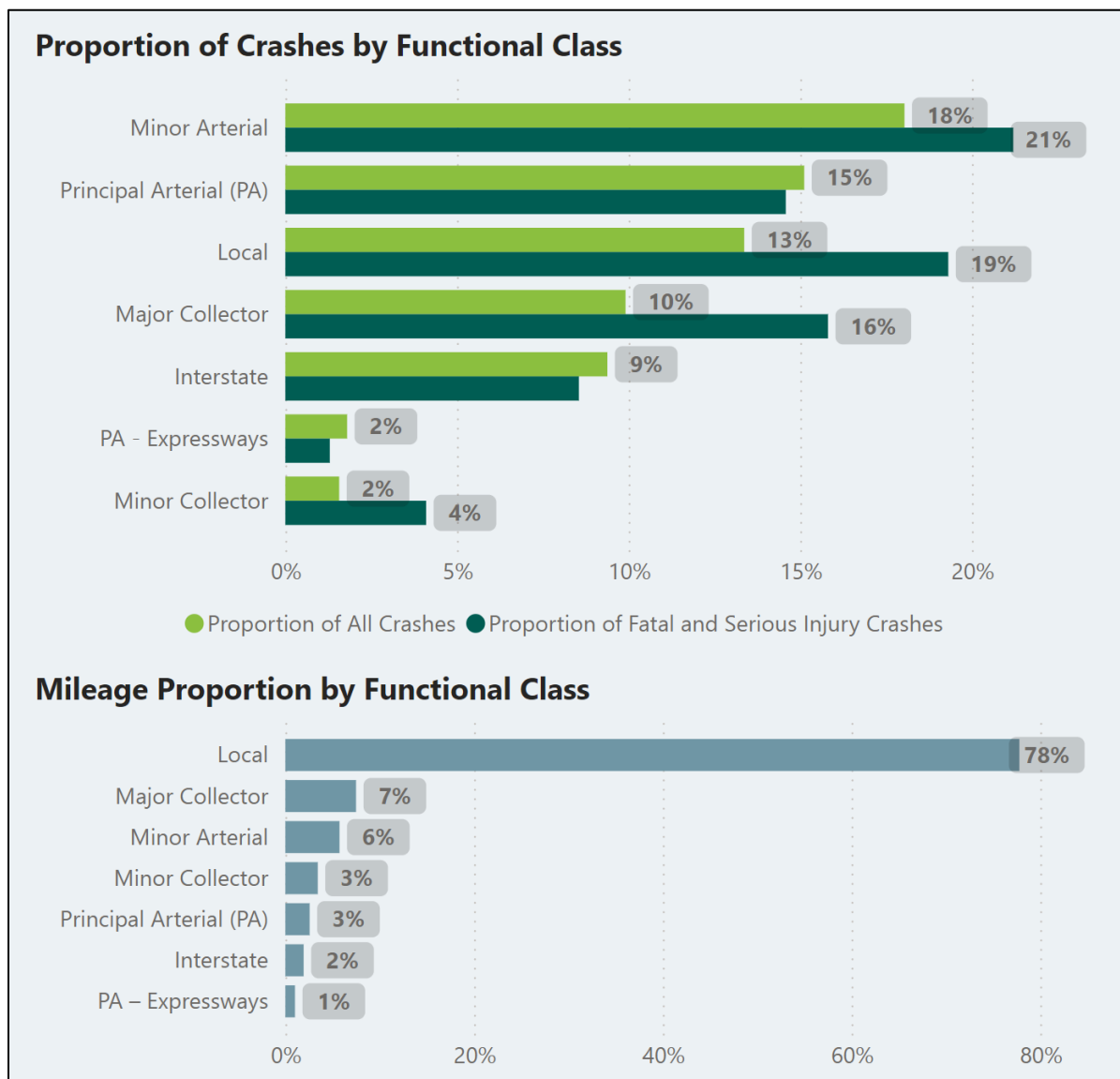


Figure 5: Disparity in Crash Distribution vs. Road Mileage by Functional Class

² <https://www.fhwa.dot.gov/planning/processes/statewide/related/hwy-functional-classification-2023.pdf>

Key takeaways include:

- **Local Roads:** Although they account for 78% of road mileage, they are involved in only 19% of KA crashes, a considerable underrepresentation.
- **Minor Arterials:** These roads represent 21% of KA crashes while comprising only 6% of the road network, indicating a significant overrepresentation.
- **Principal Arterials - Other:** These routes make up 15% of KA crashes but only 3% of road mileage, highlighting another overrepresentation.
- **Major Collectors:** These routes make up 16% of KA crashes but only 7% of road mileage, another considerable overrepresentation.
- **Interstate:** With 2% of the mileage contributing to 9% of KA crashes, interstates are also notably overrepresented. However, these facilities carry far more traffic per mile than other facilities in the region. On a per vehicle basis, these facilities are likely not substantially overrepresented.

However, due to somewhat inconsistent geolocation associated with North Carolina's crash data, the project team does not recommend using functional class as the basis for further analysis. Unlike route class, which is defined in the crash report data directly, crashes on lower functional classes (e.g., local) may be less likely to be located geospatially. Since spatial location is essential to developing the proportions in Figure 5, there is potentially a slight skewing in favor of higher functional class roads. This would bias the analysis against roads not maintained by NCDOT for safety concerns.

Overrepresented Networks

Figure 6 compares the distribution of fatal and serious injury crashes by focus crash type (i.e., EA) on the CAMPO region's road network. The 3 "Fatal and Serious Injury Crash Proportion" columns list the percentage of crashes that occur on each route class, and the "Mileage Proportion" columns list the proportion of road mileage in each class. The "Difference" columns show the difference between the two; a positive difference is indicative of key parts of the network that would be the focus for more detailed risk factors.

Emphasis Area(s)	Fatal and Serious Injury Crash Proportion			Mileage Proportion			Difference		
	US Route	NC Route	Secondary Route	US Route	NC Route	Secondary Route	US Route	NC Route	Secondary Route
Lane Departure	11%	15%	47%	3%	4%	46%	8%	11%	1%
Intersection	19%	17%	42%	3%	4%	46%	16%	13%	-4%
Impaired Driving	12%	13%	44%	3%	4%	46%	9%	9%	-2%
Occupant Protection	12%	14%	48%	3%	4%	46%	9%	10%	2%
Speed	11%	10%	45%	3%	4%	46%	8%	6%	-1%
Motorcycle	16%	12%	41%	3%	4%	46%	13%	8%	-5%
Pedestrian	22%	9%	29%	3%	4%	46%	19%	5%	-17%
Bicycle	14%	7%	51%	3%	4%	46%	11%	3%	5%

Figure 6: Disparity in Fatal and Serious Injury Crashes by Route Class and Emphasis Area

Summary of Focus Crash and Facility Types by County

Based on the results noted in the previous sections, the project team will pursue risk factor identification for the following crash types and facilities for each county in the CAMPO region (Table 1). When reviewing for specific risk factors, the project team will focus on factors that contribute to crash types on focus facilities (Figure 6) with an emphasis in counties where that crash type was overrepresented in terms of fatal and serious injury crashes (Figure 2). Examples of risk factors to be considered in the next phase of the analysis include:

- Transit presence.
- Municipal boundaries and urbanized area.
- Bicycle and pedestrian infrastructure (where present/available).
- Horizontal curvature (where present/available).
- Employment and demographic characteristics.
- Parcel density (as a proxy for land use), land use records (where available), and land cover (if needed).

Other Considerations

The county crash summaries presented at the March 2024 Stakeholder Workshop noted the "Who", "What", "When", and "Why" associated with crashes in the CAMPO planning area. Although this memorandum is primarily concerned

with the “What” and “Where” for next steps in the risk analysis, the project team plans to integrate the following considerations in the plan development:

- **When:** Crash comparisons noted considerable overrepresentation for fatal and serious injury crashes overnight (7 pm to 7am) and during weekend days (Saturday and Sunday). The project team will consider these factors when assessing potential risk by EAs, as well as strategies the Blueprint for Safety could take to focus on these temporal factors.
- **Who:** The crash summaries noted that not all communities are affected equally by transportation safety concerns. When assessing disproportionate impacts by community, the project team will consider the following:
 - Employment and population density are key indicators for safety trends. These will be reviewed as part of the risk factor analysis.
 - Race and historic disadvantage are key indicators for equitable distribution of countermeasures or community engagement. The project team will use these factors as part of plan development and implementation.



Memorandum

Table 1. Proposed Focus Crash Types and Facility Types by County.

Focus Crash Type	Lane Departure	Intersection	Impaired Driving	Occupant Protection	Speed	Motorcycle	Pedestrian	Bicycle
Focus Facility Types	<ul style="list-style-type: none">• US Route• NC Route• Secondary Route	<ul style="list-style-type: none">• US Route• NC Route	<ul style="list-style-type: none">• US Route• NC Route	<ul style="list-style-type: none">• US Route• NC Route• Secondary Route	<ul style="list-style-type: none">• US Route• NC Route	<ul style="list-style-type: none">• US Route• NC Route	<ul style="list-style-type: none">• US Route• NC Route	<ul style="list-style-type: none">• US Route• NC Route• Secondary Route
Priority Counties	<ul style="list-style-type: none">• Chatham• Franklin• Granville• Harnett	<ul style="list-style-type: none">• Chatham• Franklin• Harnett• Johnston• Wake	<ul style="list-style-type: none">• Franklin• Granville• Johnston• Wake	<ul style="list-style-type: none">• Chatham• Franklin• Granville• Harnett• Johnston	<ul style="list-style-type: none">• Chatham• Granville• Harnett	<ul style="list-style-type: none">• Chatham• Harnett• Johnston• Wake	<ul style="list-style-type: none">• Wake	<ul style="list-style-type: none">• Wake