

CARTS Pedestrian/Bicyclist Crash Analysis

DRAFT

Metroplan

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Executive Summary

Each year within central Arkansas an average of 140 pedestrians and 50 cyclists are involved in crashes with vehicles, resulting in an average 100 serious injuries¹ and 11 fatalities. While this is a small percent of the total number of vehicle crashes, it represents 10% of the total number of fatalities and is a major concern for pedestrians and the bicycle community. Adding to the concern is that these crashes disproportionately affect a high number of minorities and youth and are often cited as the reason why individuals are less likely to use alternative forms of transportation. As a comparison, vehicle and train crashes, which are often cited as a regional concern, average 6 crashes and 0.71 fatalities per year².

CARTS Pedestrian/Bicycle Crash Analysis

Beginning in 2004, Metroplan began incorporating pedestrian and bicycle crashes into the regional planning efforts for pedestrian and bicycle facilities. This was primarily accomplished through the GIS mapping of crashes, as reported in the Arkansas State Police Database, and review of fatal crash reports. In 2006, Metroplan staff published the first regional comprehensive analysis of pedestrian and bicycle crashes from 1995 to 2004.

The purpose of this analysis is to evaluate pedestrian/bicyclist safety within the Central Arkansas Regional Transportation Study (CARTS) area and provide a comparative assessment to the baseline initially established in the previous study. Building on the previous study, this update seeks to identify specific intersections and roadway segments with the highest number of crashes and greatest levels of safety concern. To further the investigation of pedestrian and bicycle crashes, high crash locations are intended to be independently studied to identify design issues, funding priorities and/or safety policies needed to address safety concerns and improve the safety of pedestrians and bicyclists. Ultimately, safety projects are to be selected and incorporated in the Transportation Improvement Program.

Report Format

An overview of the total, type and severity of the crash is considered first; followed with examinations by risk group, geographic area, crash condition, and spatial relationship to determine if any trends were apparent. The analysis concludes with a discussion of the potential costs of such injuries to society. Appendices are included for future intersection and corridor studies.

Results

In general, the findings were consistent with national and other regional findings with respect to risk group, area type, and crash condition.

Black males under 16 had the highest pedestrian and bicyclist crash rate. However, black males 16 and over had the highest pedestrian fatality rate. Nearly 64% of pedestrian crashes were not at intersections, contrasting with the nearly 65% of bicycle crashes occurring at intersections.

¹ Injury Severity Type 2 and 3

² FRA Highway-Rail Accident Database

Central Arkansas' fifteen year pedestrian fatality rate is lower than the national rate and the state's rate. Nearly 80% of pedestrian fatalities were not at the intersection and 57% of bicycle fatalities occurred at the intersection. Twenty-two percent of the pedestrians were crossing the roadway when killed. About 60% of pedestrian crashes occurred during dark, dawn, or dusk conditions.

Intersections identified as having the highest number of pedestrian crashes are listed in Table 3. Half of the highest pedestrian crash intersections were located in downtown Little Rock.

Table 1: Highest Pedestrian Crash Intersections

Intersection	Crashes
Markham / LaHarpe (LR)	9
6th / Broadway (LR)	8
University / Town and Country (LR)	7
Captiol / Broadway (LR)	6
McCain / JFK (NLR)	5
Magnolia / Broadway (NLR)	5
Camp Robinson / Allen (NLR)	5
Baseline / Geyer Springs (LR)	4
12th / Washington (LR)	4
7th / Broadway (LR)	4
Markham / Broadway (LR)	4
Highway 38 / S Polk (Cabot)	4

Analysis of the bicycle crashes at intersections yielded one intersection with 3 crashes (Pike Ave and Pershing Ave in North Little Rock) and 30 other intersections with 2 crashes.

Combining pedestrian and bicycle crashes, the following corridors listed in Table 4 were identified as having the highest crash rates.

Table 2: Highest Corridor Crash Rates

Corridor	Crashes	Mileage	Crash Rate
S Broadway (LR)	34	0.628	54.14
Pike Ave (NLR)	29	0.779	37.23
Camp Robinson Rd (NLR)	22	0.952	23.11
Col. Glenn / Asher Ave (LR)	47	2.736	17.18
Geyer Springs Rd (LR)	22	1.473	14.94
E Broadway St (NLR)	55	4.507	12.20
W 12th St (NLR)	24	2.036	11.79
Main St (NLR)	10	0.908	11.01
W Main St (Cabot)	22	2.071	10.62
Baseline Rd (LR)	42	4.091	10.27

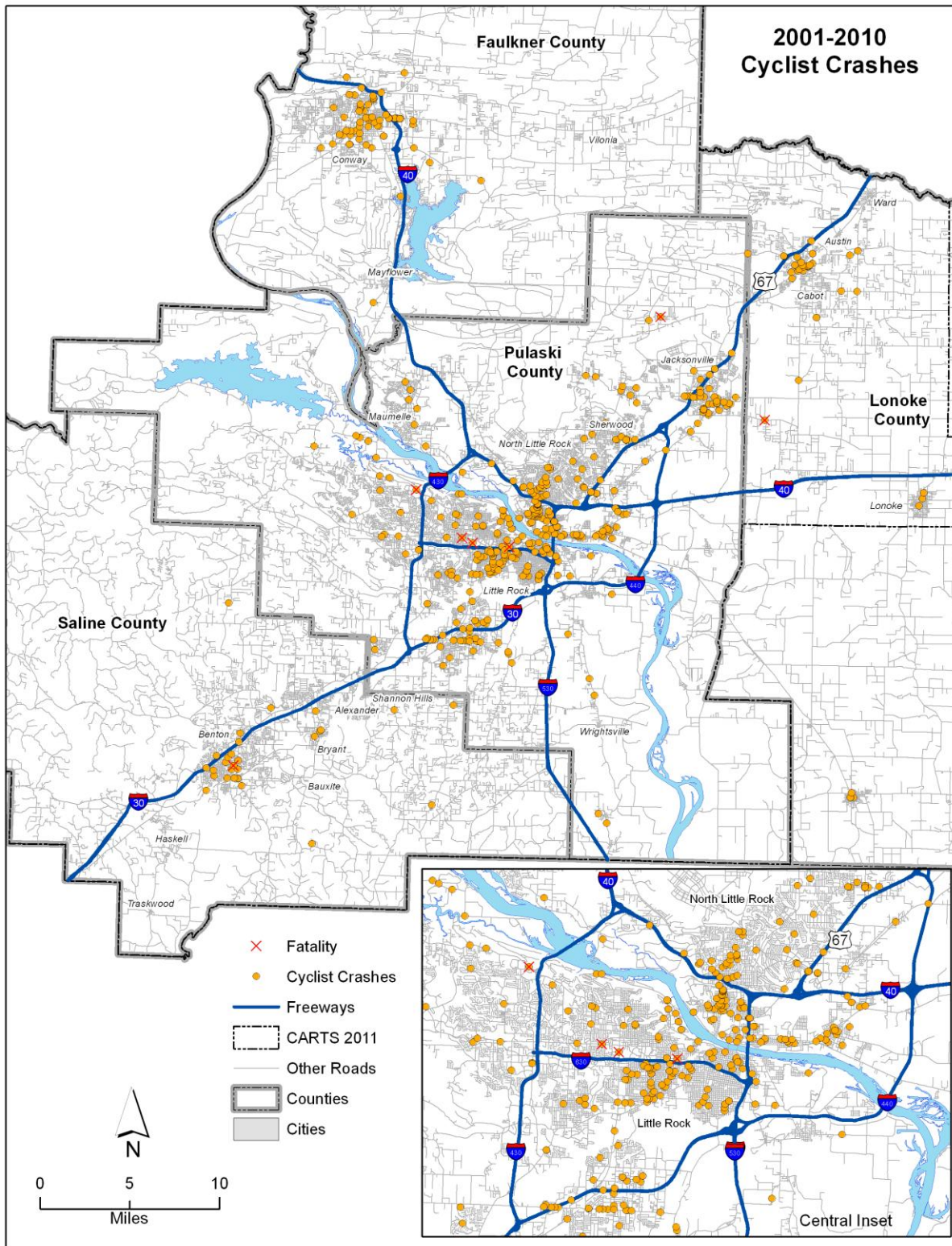


Figure 2: Bicycle Crash Clustering Analysis

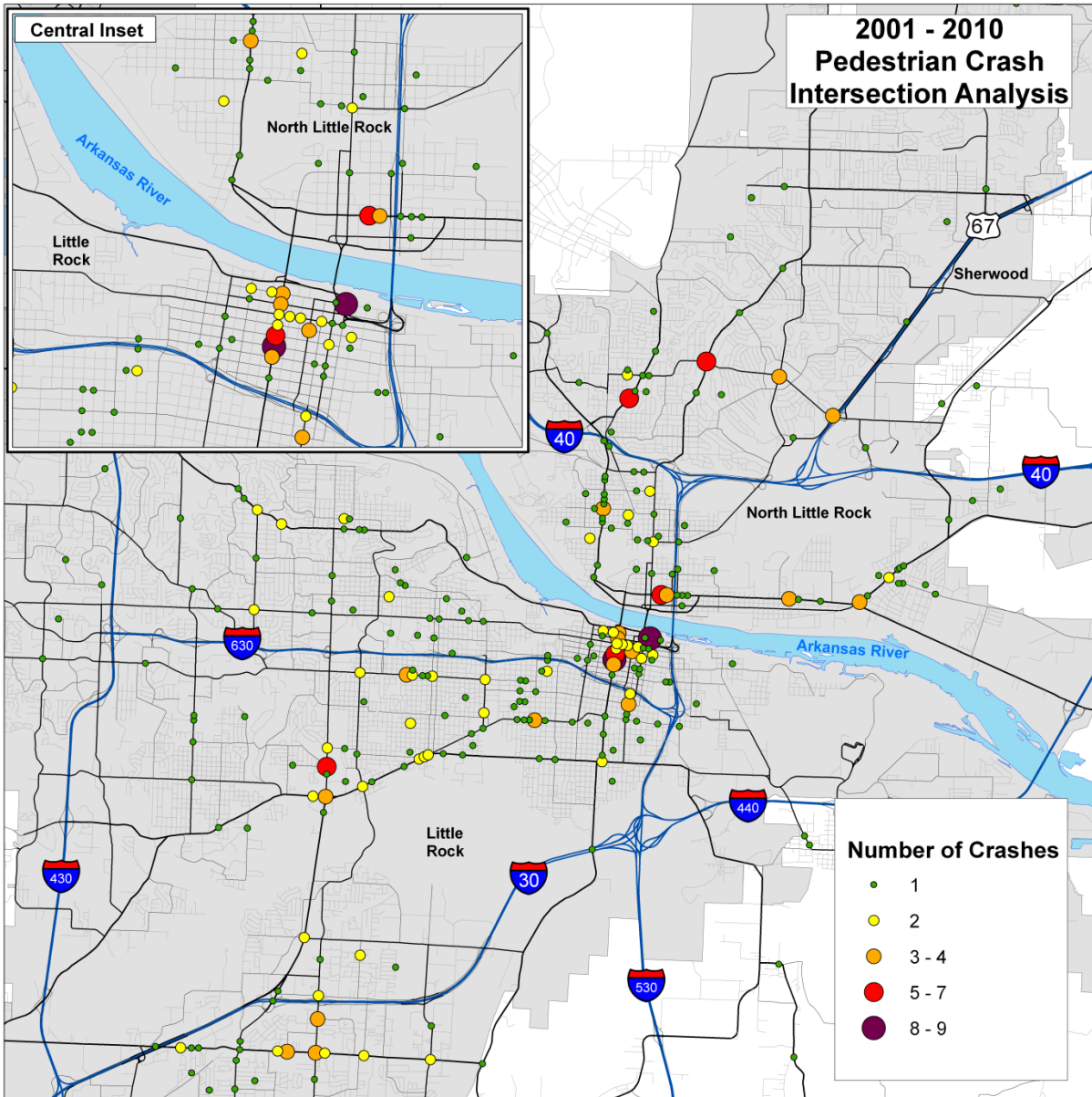


Figure 3: Pedestrian Crash Intersection Analysis

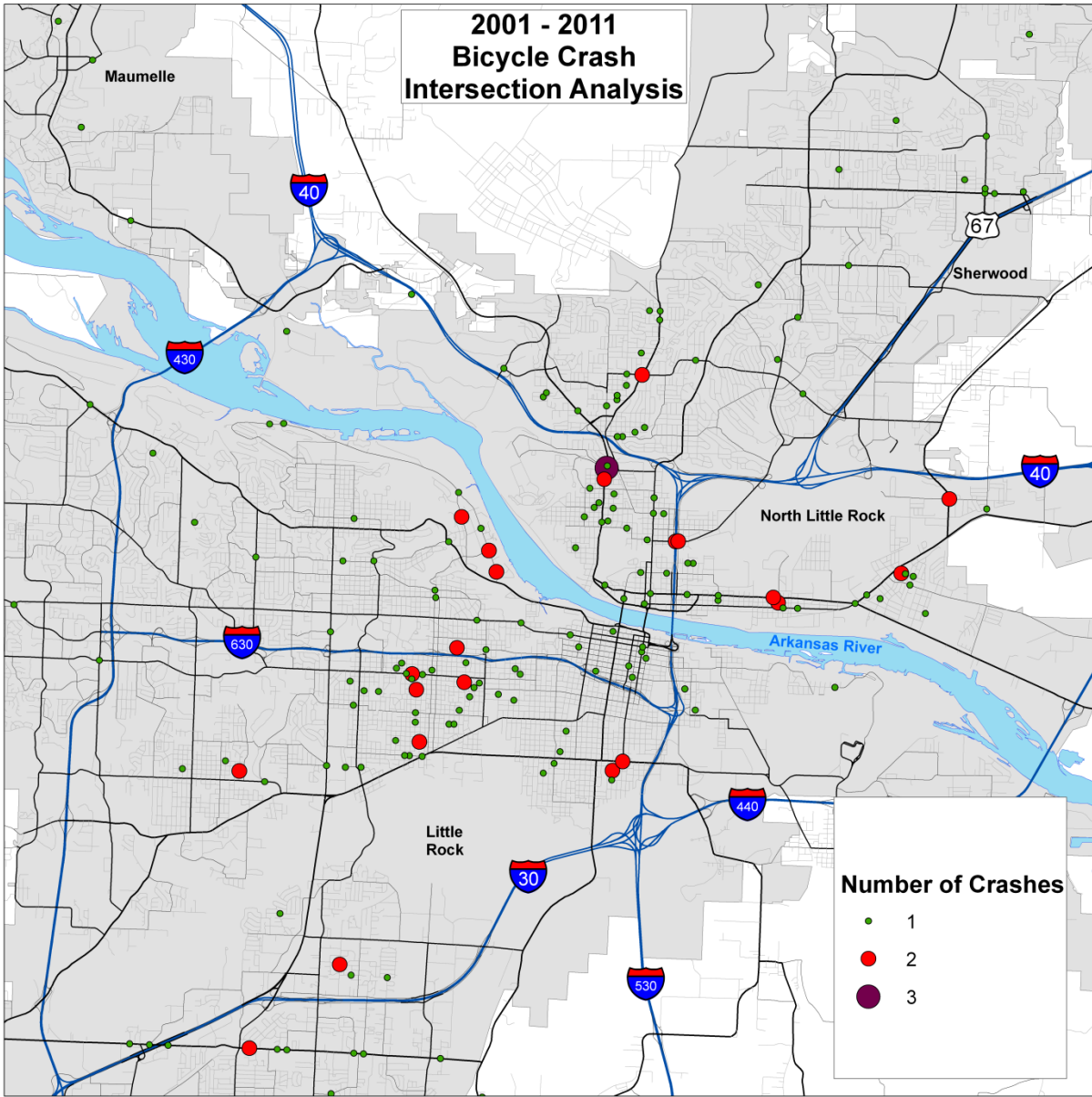


Figure 4: Bicycle Crash Intersection Analysis

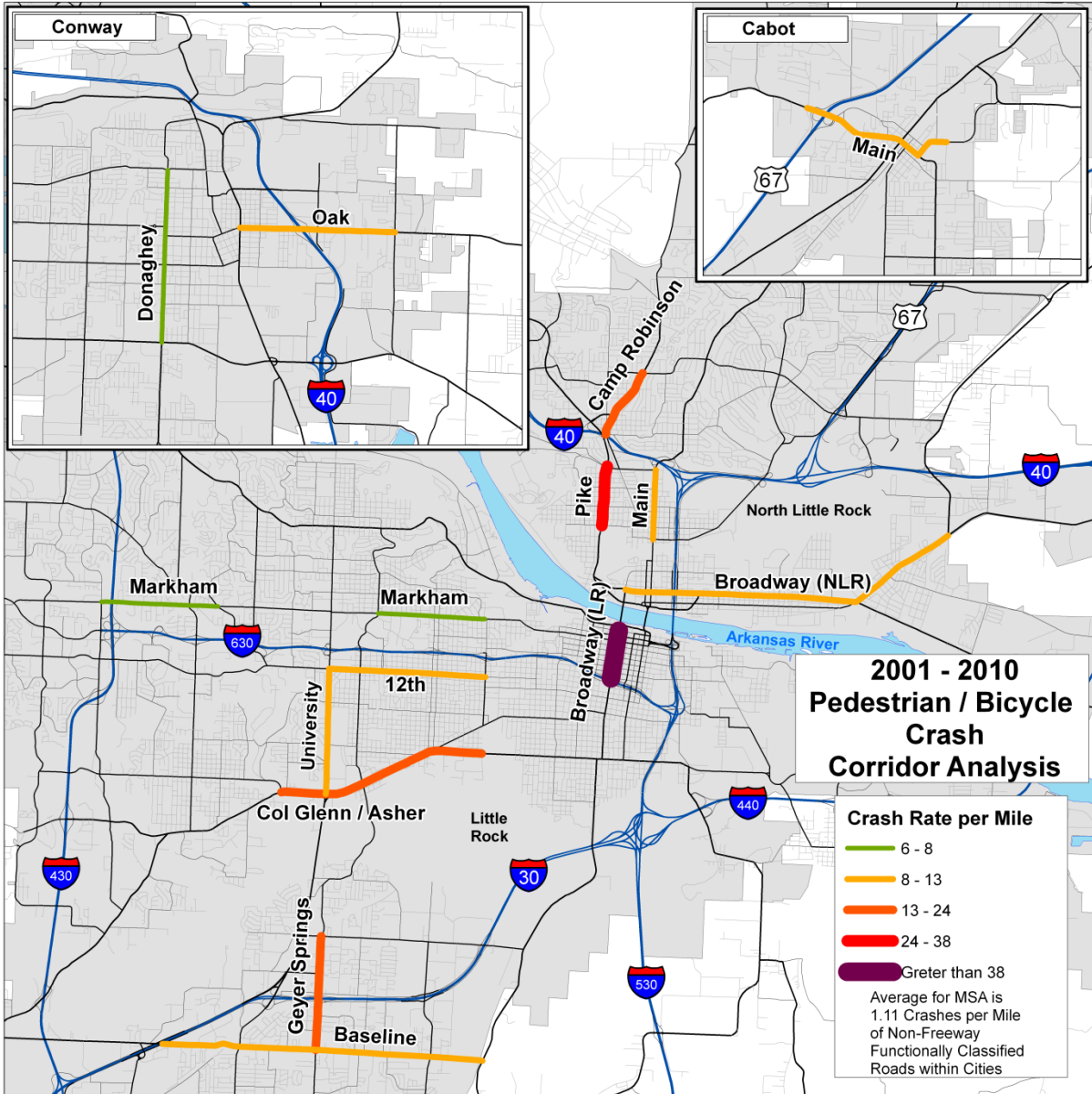


Figure 5: Pedestrian / Bicycle Corridor Crash Analysis

Overview

Using data provided by the Arkansas State Police, the number pedestrians and/or bicyclists involved in vehicular crashes were tabulated for the years 1995 to 2010 (only represents crashes that were located with GIS). These crashes were then separated for analysis because each group has unique characteristics and there were sufficient numbers of each crash type to be separated and analyzed. All available fatal crash reports were also collected and checked against crash data and reviewed carefully to garner more information that was not apparent in the crash data (e.g. pedestrian action or location, etc.).

The numbers of pedestrians and bicyclists involved in crashes are summarized by county in Table 5 and Table 6, respectively (Appendix A). The numbers of pedestrians and bicyclists involved in crashes are summarized by crash severity in Figure 6 and Figure 7, respectively. During the fifteen year period a total of 2,350 pedestrians and 805 bicyclists were involved in crashes, a combined average of 210 per year. This resulted in 155 pedestrian fatalities and 12 bicyclist fatalities, a combined average of 11 per year. Overall, there were 3,155 pedestrians or bicyclists involved in crashes.

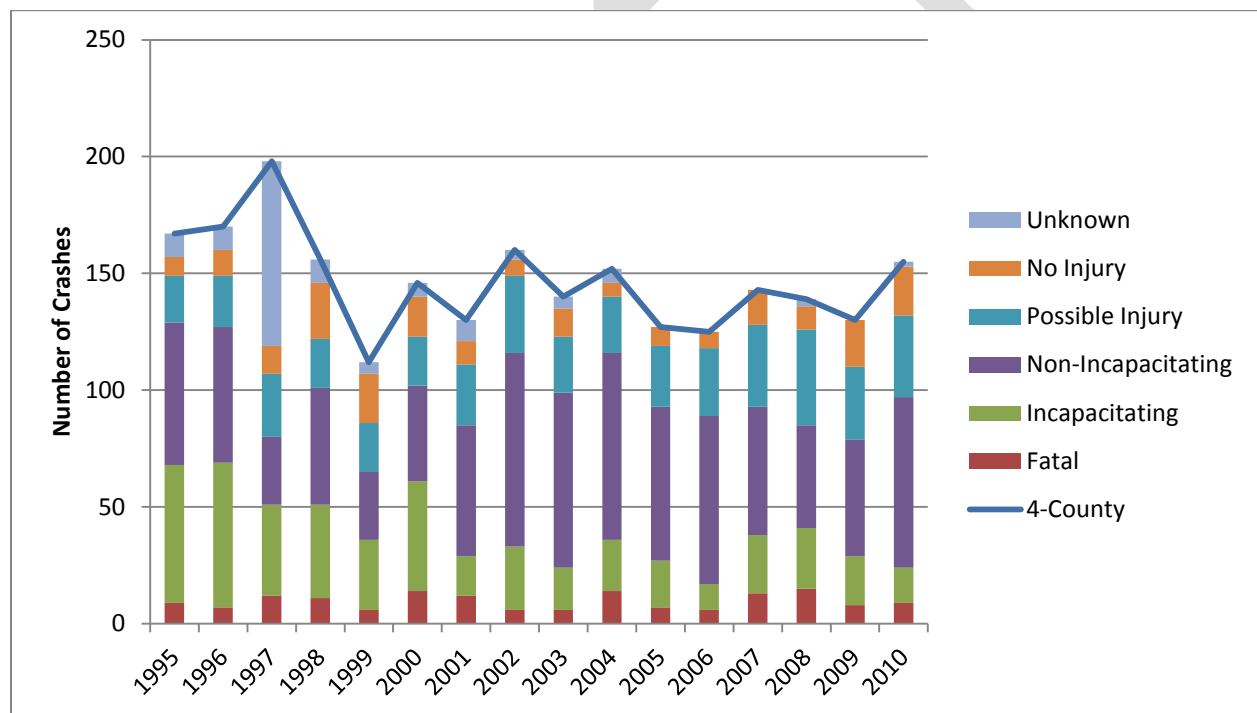


Figure 6: Number of Pedestrian Crashes 1995-2010

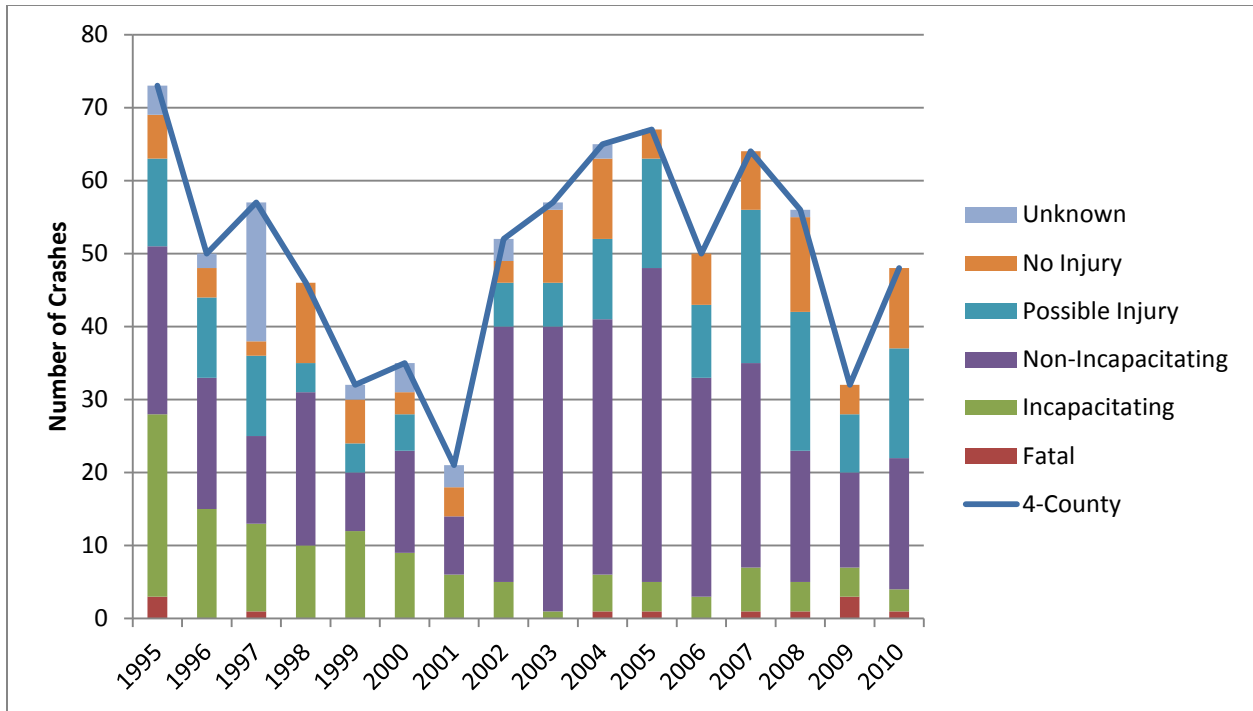


Figure 7: Number of Bicycle Crashes 1995-2010

Nearly 92% of the pedestrian crashes resulted in injuries or possible injuries. And, about 24% were either fatal or incapacitated. Similarly, about 85% of the bicycle crashes resulted in injuries or possible injuries and about 11% were either fatal or incapacitated. Approximately 24% (25) of the fatalities were alcohol or drug related.

Risk Groups

Crashes were examined by victims' age, race/origin, and sex and ten year annual average rates calculated to determine which demographic groups were at higher risk (Figure 8). Since an appropriate estimate of the number of people who walk or bike was not readily available, crash rates per population estimates for each group were calculated. Significant variations exist by age, race/origin, and sex and some general observations follow. Except for pedestrians identified as Hispanic, females had lower crash rates than their respective male counterparts. Except for Hispanic males and Asian males and females, the 16 years old and over group had lower crash rates than the under 16 population group. Overall, crash rates were significantly higher for blacks. Black males under 16 had the highest pedestrian and bicyclist crash rate.

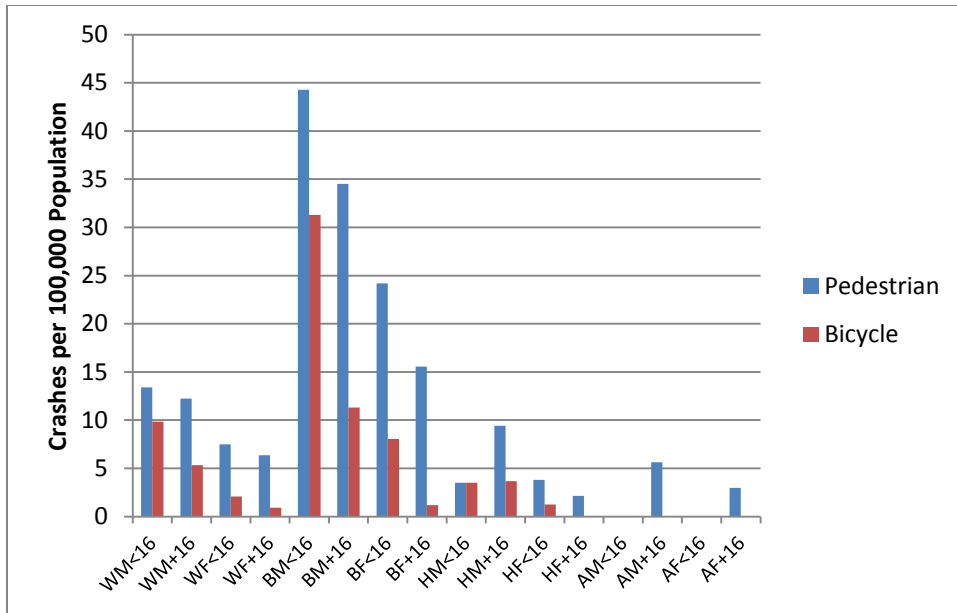


Figure 8: Pedestrian & Bicycle Crash Rate by Race, Sex, and Age 2001-2010

Similarly, Figure 9 shows that male pedestrians were more likely than females to get killed while walking, with the exception of blacks under age 16. However, it was the pedestrian ages 16 and over that were at higher risk of fatal injuries. In fact, Black males 16 and over were 2.51 times as likely to be killed while walking as white males and 2.01 times as likely as Hispanic males in the same age group. Six demographic groups had no reported fatalities. Bicyclist fatalities were not investigated due to small sample size.

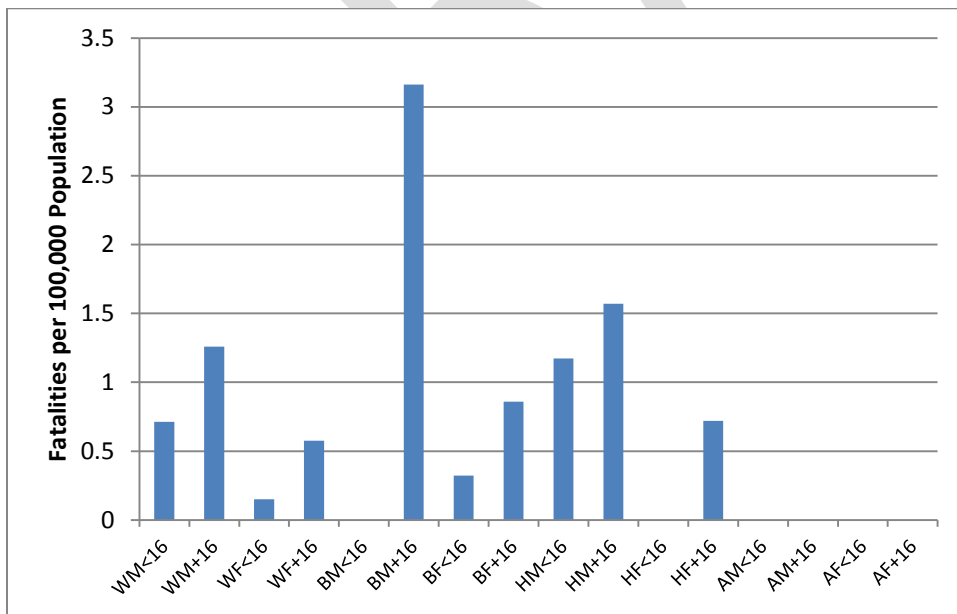


Figure 9: Pedestrian Fatality Rate by Race, Sex, and Age 2001-2010

Geographic Areas

Pedestrian/bicyclist crashes for each county and city were examined in order to develop subarea crash rates (per 100,000 population). Figure 10 shows the pedestrian crash rate by jurisdiction. North Little Rock had the highest crash rate among the cities with at least one crash and at least a population of 10,000. Maumelle had the lowest rate. This may be attributed, in part, to Maumelle's extensive off-road shared pedestrian/bicycle system, which almost universally separates motorized and non-motorized traffic. The unincorporated parts of Pulaski County, as well as the overall county (not shown), had the highest rate as compared to the other counties.

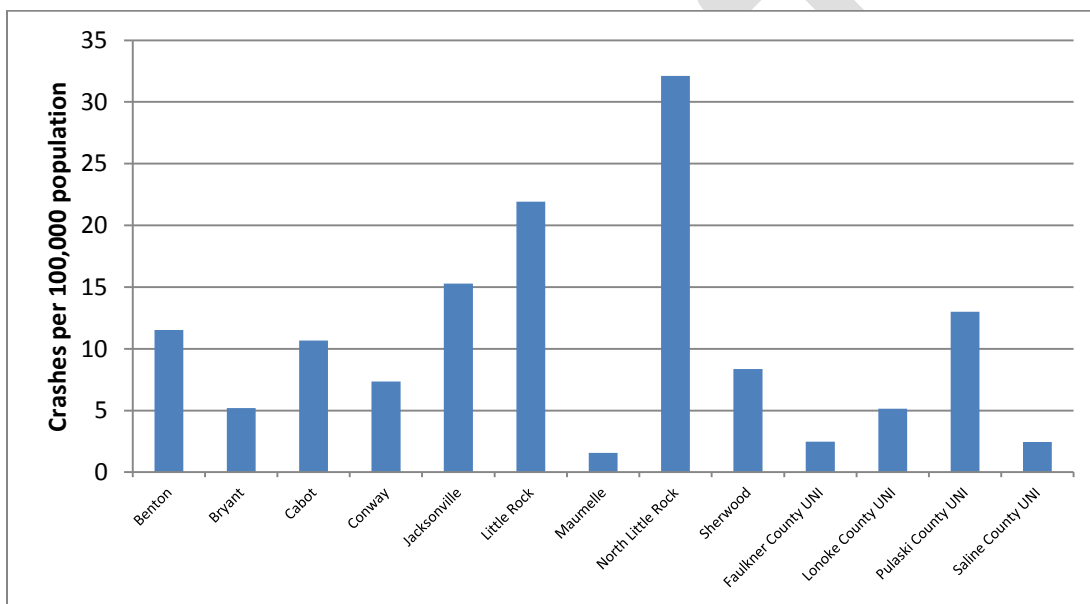


Figure 10: Pedestrian Crash Rate by Jurisdiction 2001-2010

Figure 11 shows the pedestrian fatality rate by jurisdiction. Of the cities that had at least 10,000 average population and at least one fatality, North Little Rock had the highest fatal injury rate, while Sherwood had the lowest fatality rate. Again the unincorporated parts of Pulaski County had the highest rate of all counties.

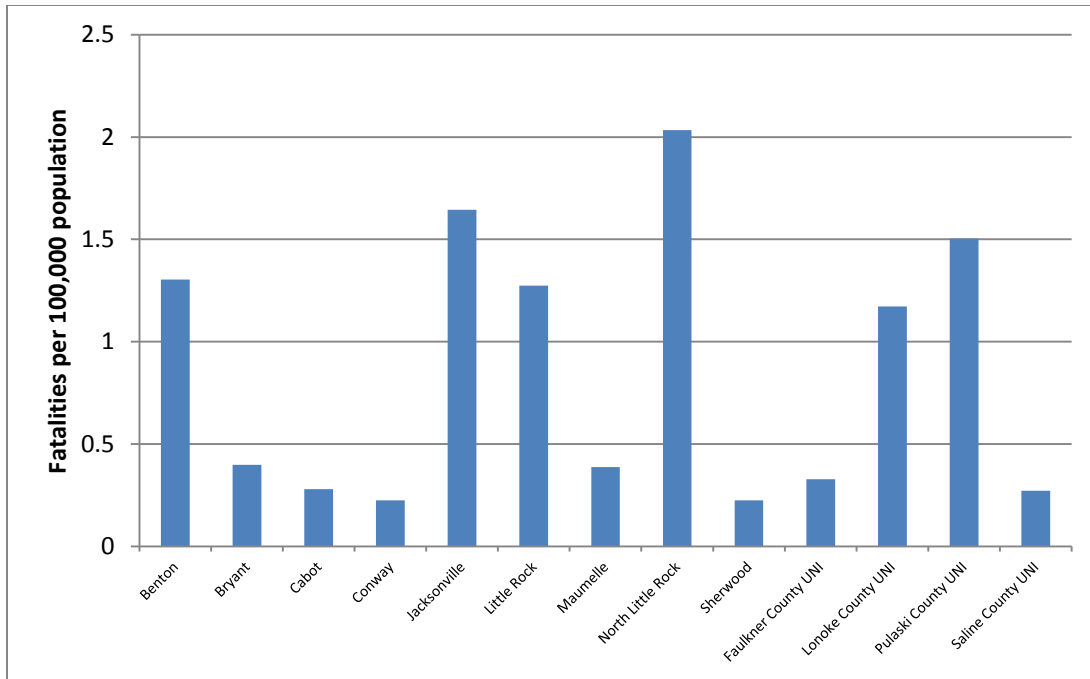


Figure 11: Pedestrian Fatality Rate by Jurisdiction 2001-2010

By comparison, the central Arkansas area's fifteen year average pedestrian fatality rate is lower than the national rate, but slightly higher than the state's rate, as shown in Figure 12. The 2000-2004 rate is higher than the national and state rate, but has since gone down and was only higher than the state rate in 2005-2010.

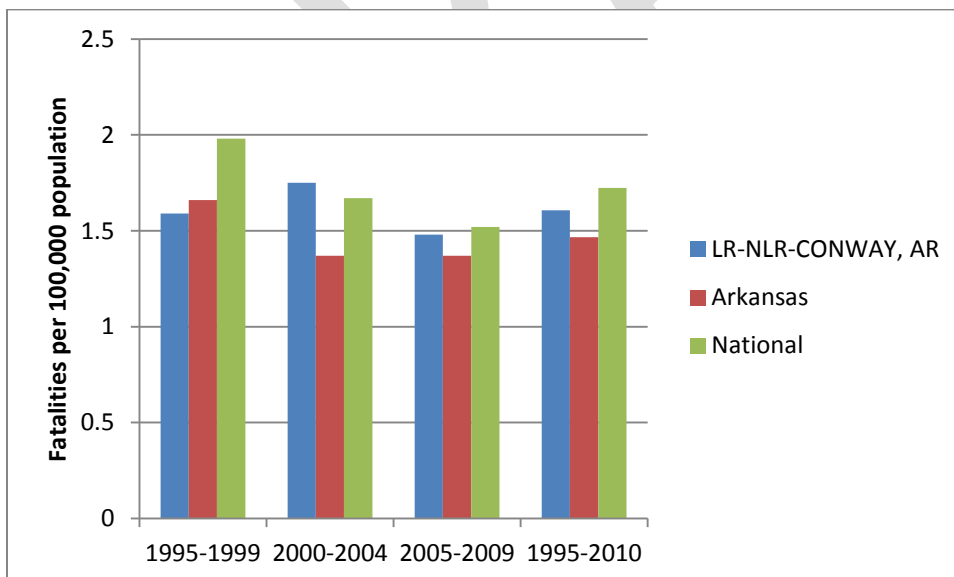


Figure 12: Comparison of Pedestrian Fatality Rates (per 100,000 population)

Figure 13 shows the bicyclist crash rate by jurisdiction. North Little Rock again had the highest bicyclist crash rates, while Bryant had the lowest bicyclist crash rates. Similarly, the unincorporated parts of

Pulaski County, as well as the overall county, had the highest rate as compared to the other counties. No bicycle fatality rates were calculated due to small sample size.

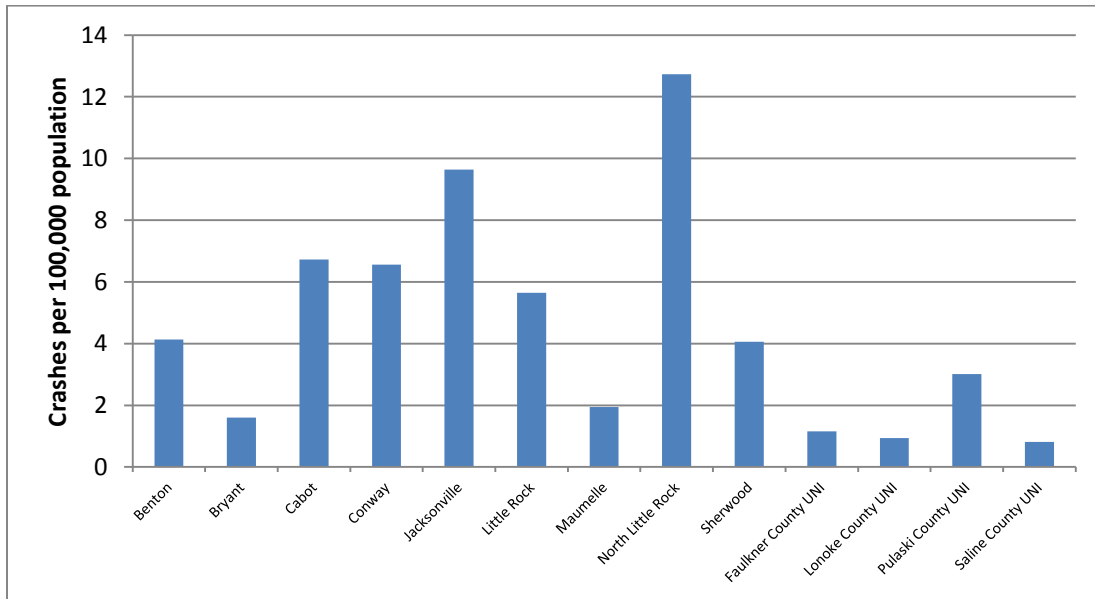


Figure 13: Bicyclist Crash Rate by Jurisdiction 2001-2010

Crash Conditions

The relation to intersection, traffic control devices, pedestrian action/location, and lighting condition fields were examined to see if there were any identifiable trends with respect to the conditions that occurred with each crash.

As Figure 14 shows, about 64% of pedestrian crashes on surface streets were not at intersections, contrasting with the nearly 65% of bicyclists crashes occurring at intersections. This trend is more pronounced with fatalities, with nearly 80% of pedestrian fatalities not at the intersection and 57% of bicycle fatalities occurring at the intersection. Of all “at intersection” crashes, about 48%, including five pedestrian fatalities and three bicyclist fatalities, were controlled by a traffic signal or pedestrian signal.

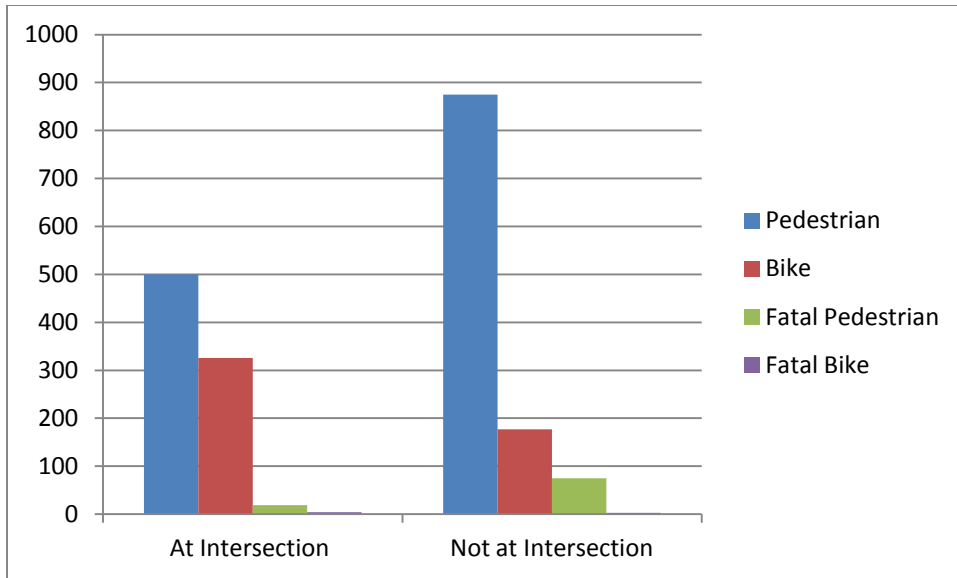


Figure 14: Pedestrian and Bicyclist Crashes and Fatalities by Relation to Intersection 2001-2010

To gain further insight into the pedestrian fatalities, the action or location of the pedestrians as described in the available crash reports was also examined. Figure 15 shows that 22% of the pedestrians were crossing the roadway as opposed to the 11% walking on the roadway when killed. Note that “other in rdwy” category included coming from behind parked cars, playing, lying, working, and standing in roadway when hit.

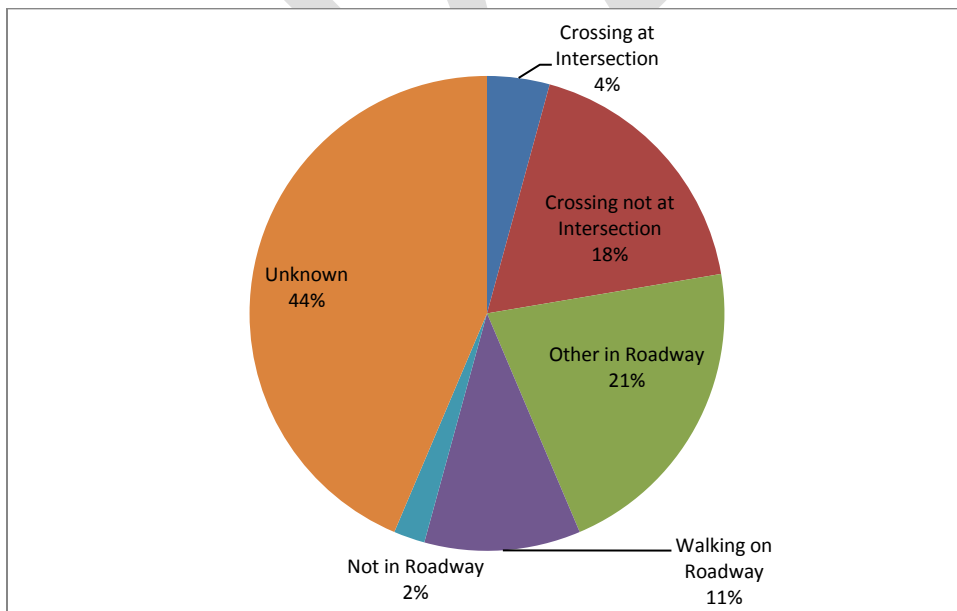


Figure 15: Action or Location of Pedestrian Fatalities 2001-2010

Figure 16 shows that about 60% of pedestrian crashes occurred during daylight, whereas nearly 61% of pedestrian fatalities occurred during dark, dawn, or dusk conditions. It also shows that nearly 76% of the bicyclist crashes occurred during daylight conditions.

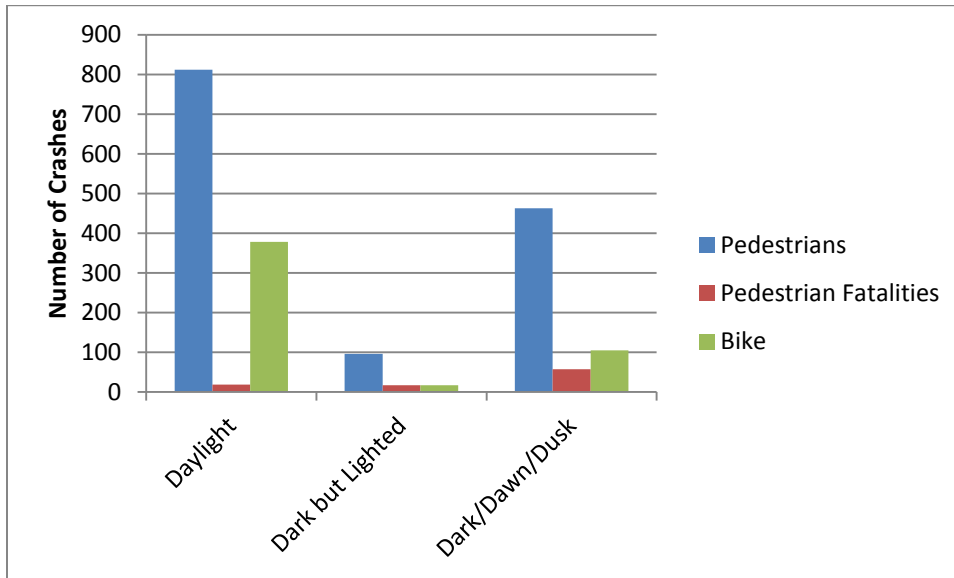


Figure 16: Pedestrian or Bicyclist Crashes by Light Condition 2001-2010

Spatial Relationships

In order to further analyze these crashes, the approximate locations of the crashes were mapped when possible (see Appendix B). Numerous geographic information systems (GIS) operations were performed on these locations to determine if any spatial patterns existed.

Crash rates by the roadways' functional classification are shown in Figure 17. With the exception of the interstate/freeway, there was a decrease in the total crash rate with lower functional classified roadways (i.e. arterials had higher crash rates than collectors and local roads).

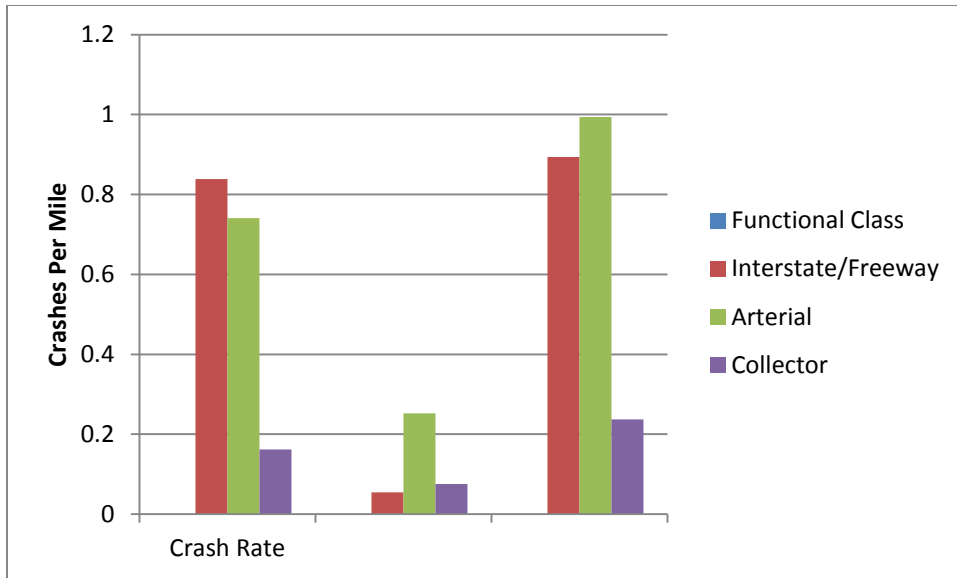


Figure 17: Crash Rate by Functional Class 2001-2010

A similar operation to the functional classification analysis was performed to determine which crashes occurred on the Regional Arterial Network (RAN). The RAN is a system of highly functioning roadways that provide feasible alternatives to the area's freeways (See Appendix A). Because a significant portion of the metropolitan planning organization's transportation funding is dedicated to improving/ implementing this system, it is imperative to look at its safety impacts on pedestrians and bicyclists, as well as motor vehicles. Approximately 37% of the pedestrian/bicyclist crashes occurred on existing parts of the RAN even though it only makes up 10% of the total roadway miles but carries 45% of the vehicle miles traveled (VMT) within the CARTS area. Figure 18 shows that nearly 70% of persons involved were injured or possibly injured, and 19% were fatal or incapacitated.

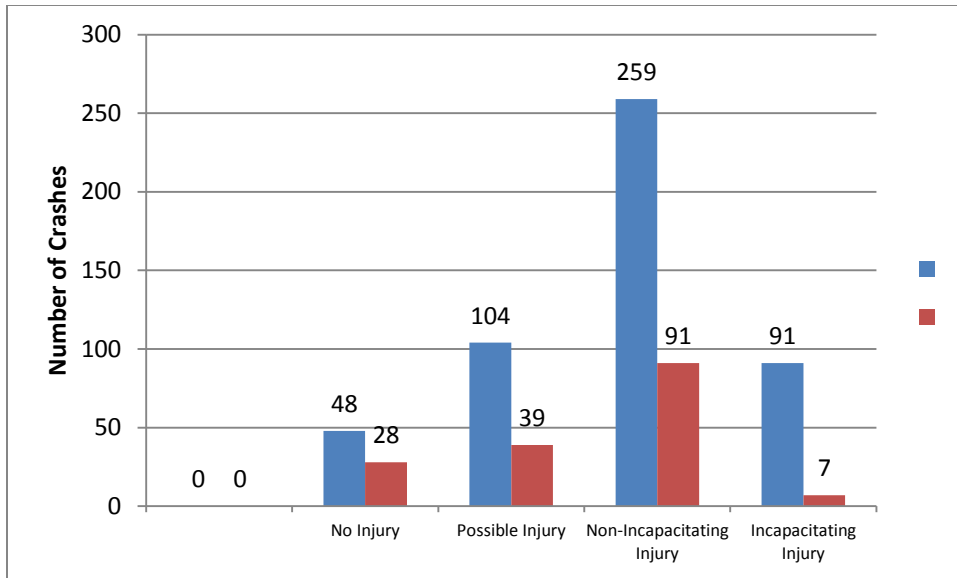


Figure 18: Pedestrian & Bicyclist Injury Severities on Regional Arterial Network 2001-2010

The presence of sidewalks was also considered in relation to non-freeway pedestrian related crashes. All known sidewalks were buffered 50 feet and intersected with these crash locations. The results show that sidewalks were only present in 47% of pedestrian related crashes between 2001 and 2010 that were mapped. Additionally, the injury severity was examined for all pedestrian crashes with and without sidewalks, which is shown in Figure 19. Crashes with fatal injuries accounted for 3% of the total crashes with sidewalks, while they accounted for nearly 11% of the total crashes without sidewalks.

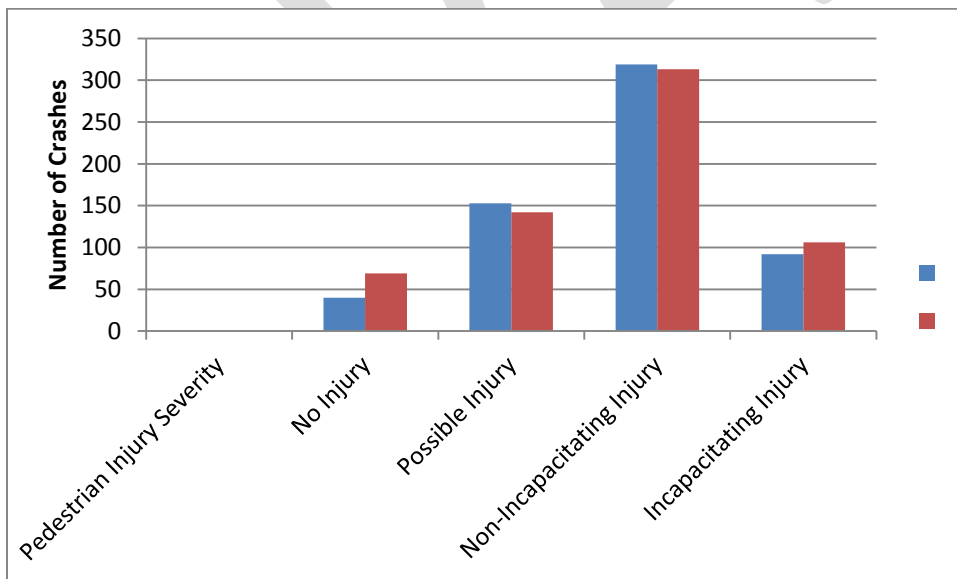


Figure 19: Sidewalk Coverage by Injury Severity 2001-2010

Crosswalk coverage was also analyzed similarly to sidewalk coverage. Crosswalks were only present in 22% of all pedestrian crashes. Again, the injury severity was examined for all pedestrian crashes with

and without sidewalks, which is shown in Figure 20. Crashes with fatal injuries accounted for nearly 2% of the total crashes with sidewalks, while they accounted for 8% of the total crashes without sidewalks.

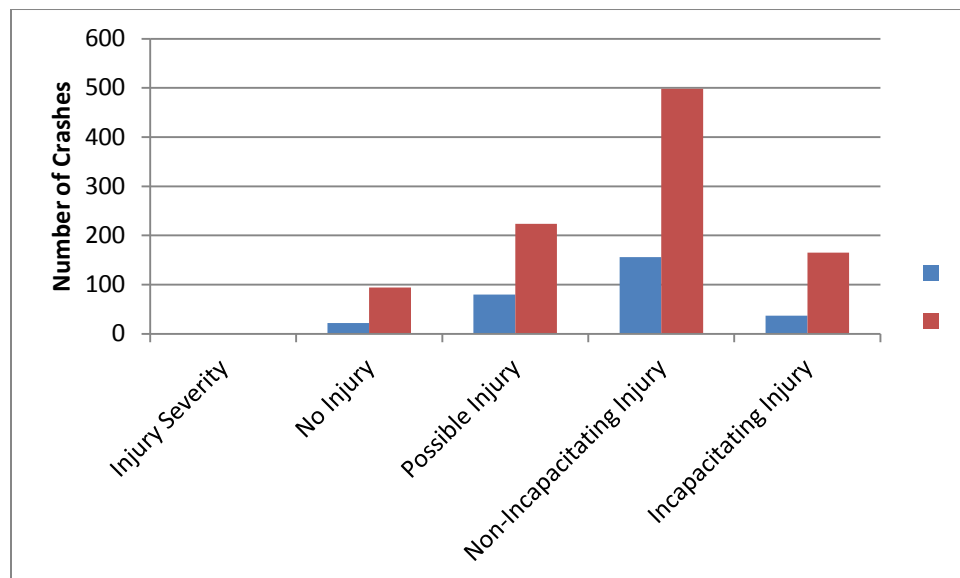


Figure 20: Crosswalk Coverage by Injury Severity 2001-2010

Speed is a major contributing factor in crashes of all types. Faster speeds increase the likelihood of a pedestrian being hit and has more serious consequences. A pedestrian hit at 40 miles per hour (mph) has an 85% chance of being killed as opposed to only 5% at 20 mph (Harkey and Zeeger 2004). Of the fatal pedestrian crashes, 11 were on roadways with a posted speed of 65 mph or greater and 14 were on roadways with a posted speed limit greater than 45 mph and less than 65 mph.

Corridor/Intersection Analysis

The crash data was also analyzed using ArcGIS to determine spatial patterns. The analysis consisted of three approaches: crash clustering, crashes at road intersections, and crashes along road corridors. Only crashes from the years 2001 to 2010 were used in the analysis.

Crash Clustering

Crash clustering was developed by using a 1000 foot search radius around each crash location and calculating the number of crashes within the vicinity. The output from this process is a raster map that shows where crashes are clustered. The crash clustering analysis was done separately for pedestrian crashes and bicycle crashes. Appendix B, Figure 23 and Figure 24, show the clustering of pedestrian crashes. The highest density of crashes occurred in downtown Little Rock. Other areas that also had concentrated crashes were: the area along Pike Avenue in North Little Rock, the area around Geyer Springs and Baseline Roads in Little Rock, areas around Asher and University Avenues in Little Rock, and the areas near 12th Street in Little Rock. Appendix B, Figure 25 shows the clustering of bicycle crashes. The highest clustering of bicycle crashes occurred along Pike Avenue in North Little Rock. Other areas that had higher crash concentrations were: areas around East Broadway in North Little Rock, areas

around the intersection of Highway 161 and Military Road in Jacksonville, areas around Oak Street east of Interstate 40 and areas along 12th Street in Little Rock.

Intersections

Appendix B, Figure 26 shows the results of the pedestrian intersection crash analysis. The highest crash pedestrian intersections are listed in the Table 3. Half of the highest pedestrian crash intersections were located in downtown Little Rock.

Table 3: Highest Pedestrian Crash Intersections

Intersection	Crashes
Markham / LaHarpe (LR)	9
6th / Broadway (LR)	8
University / Town and Country (LR)	7
Captiol / Broadway (LR)	6
McCain / JFK (NLR)	5
Magnolia / Broadway (NLR)	5
Camp Robinson / Allen (NLR)	5
Baseline / Geyer Springs (LR)	4
12th / Washington (LR)	4
7th / Broadway (LR)	4
Markham / Broadway (LR)	4
Highway 38 / S Polk (Cabot)	4

Analysis of the bicycle crashes at intersections yielded only one intersection with highest number of crashes with 3 (Pike Ave and Pershing Ave in North Little Rock) and 30 other intersections with 2 crashes. Appendix B, Figure 27 shows the results of the intersection analysis for bicycle crashes.

Corridors

Corridors were identified by intersecting the point crash data with the centerline of roadways to create a frequency of crashes per road segment. Both pedestrian and bicycle crashes were used in the corridor analysis. The minimum length of the corridors was established at a half of a mile. The crash rate for the corridors was calculated by dividing the crashes by the road mileage. Appendix B, Figure 28 shows the location of the corridors. The highest crash rate corridors are listed in Table 4.

Table 4: Highest Corridor Crash Rates

Corridor	Crashes	Mileage	Crash Rate
S Broadway (LR)	34	0.628	54.14
Pike Ave (NLR)	29	0.779	37.23
Camp Robinson Rd (NLR)	22	0.952	23.11
Col. Glenn / Asher Ave (LR)	47	2.736	17.18
Geyer Springs Rd (LR)	22	1.473	14.94
E Broadway St (NLR)	55	4.507	12.20
W 12th St (NLR)	24	2.036	11.79
Main St (NLR)	10	0.908	11.01
W Main St (Cabot)	22	2.071	10.62
Baseline Rd (LR)	42	4.091	10.27

Economic and Comprehensive Costs to Society

The economic cost is an estimate of the productivity lost and expenses incurred because of these crashes. The comprehensive cost is the economic cost plus what society is willing to pay to prevent these injuries. Typically, the latter cost is used to determine a benefit cost ratio for evaluation of possible mitigation measures (Injury Facts 2008). The estimated economic and comprehensive costs of the 104 fatalities are \$125 million (M) and \$503 M, respectively. The estimated economic and comprehensive costs of all injuries, including fatalities, are \$166 M and \$508 M, respectively.

Conclusions

Between 2001 and 2010, 1,401 pedestrians and 512 bicyclists were involved in motor vehicle crashes, a combined average of 191 per year. Of these, there were 104 fatalities, with 25 being alcohol or drug related. The following are key findings.

- Nearly 92% of the pedestrian crashes resulted in injuries or possible injuries, with 24% either fatal or incapacitated. Similarly, about 85% of the bicycle crashes resulted in injuries or possible injuries, with 11% either fatal or incapacitated.
- Black males under 16 had the highest pedestrian and bicyclist crash rate.
- Black males 16 and over had the highest pedestrian fatality rate.
- North Little Rock had the highest pedestrian and bicyclist crash rates. Whereas Maumelle had the lowest pedestrian crash rate and Bryant had the lowest bicycle crash rate. The unincorporated parts of Pulaski County were the highest among the counties.
- North Little Rock had the highest pedestrian fatality rate among cities with at least one fatality and 10,000 average population. The unincorporated parts of Pulaski County were the highest among the counties.
- The central Arkansas area's fifteen year average pedestrian fatality rate is lower than the national rate but slightly higher than the state's rate. However, between 2000 and 2004, the average pedestrian fatality rate was higher than both the national and state rates.
- Nearly 64% of pedestrian crashes on surface streets were not at intersections, contrasting with the nearly 65% of bicycle crashes occurring at intersections. This trend is more pronounced with fatalities, with nearly 80% of pedestrian fatalities not at the intersection and 57% of bicycle fatalities occurring at the intersection. Of all "at intersection" crashes, about 48%, including five pedestrian fatalities and three bicyclist fatalities, were controlled by a traffic signal or pedestrian signal.
- About 22% of the pedestrian fatalities occurred while crossing the roadway as opposed to 11% walking on the roadway.
- About 60% of pedestrians were injured during daylight, whereas nearly 61% of pedestrian fatalities occurred during dark/dawn/dusk conditions.
- There was a decrease in the crash rate with lower functional classified roadways, except for the interstates/freeways.

- 37% of the pedestrian/bicyclist crashes occurred on existing parts of the RAN. Nearly 70% were injured or possibly injured, and 19% were fatal or incapacitated.
- Sidewalks were present in 47% of all pedestrian related crashes. Crashes with fatal injuries accounted for 3% of the total crashes with sidewalks, while they accounted for nearly 11% of the total crashes without sidewalks.
- 11 pedestrians were killed on roadways with a posted speed of 65 mph or greater and 14 pedestrians were killed on roadways with a posted speed between 45 and 65 mph.
- The estimated economic and comprehensive costs of all injuries are \$166 M and \$508 M, respectively.

Recommendations

Although this analysis established a good comparison to the initial baseline, further research is still needed to investigate specific locations. It is recommended that staff, with the assistance from local jurisdictions, conduct corridor studies for the following locations:

- Broadway (LR)
 - Markham, 2nd, Capitol, 6th, 7th
- Pike Avenue (NLR)
 - Pershing
- Camp Robinson (NLR)
 - Allen
- Colonel Glenn/Asher (LR)
- Geyer Springs (LR)
 - Baseline
- W. 12th (LR)
 - Washington
- Hwy 89/Polk Street (Cabot)
- Oak Street (Conway)
- Military (Benton)
- South First Street (Jacksonville)

Furthermore, it is recommended that Metroplan staff, with the assistance from local jurisdictions, conduct intersection studies for the following locations:

- La Harpe and Markham
- University and Town & County
- Magnolia and Broadway

Additional corridor and intersection recommendations will be provided with the completion of the studies listed above.

Table 6: Number of Bicyclists Involved in Crashes 1995-2010

County	Faulkner	Lonoke	Pulaski	Saline	Total
1995	9(1)	1	56(1)	7(1)	73(3)
1996	7	1	42	0	50
1997	1	1	48(1)	7	57(1)
1998	2	2	40	2	46
1999	5	0	24	3	32
2000	6	1	25	3	35
2001	2	2	17	0	21
2002	2	4	42	4	52
2003	8	6	42	1	57
2004	7	5	50(1)	3	65(1)
2005	10	6	48(1)	3	67(1)
2006	6	3	39	2	50
2007	13	6(1)	37	8	64(1)
2008	11	4	34	7(1)	56(1)
2009	1	3	28(3)	0	32(3)
2010	7	0	40(1)	1	48(1)
Total	97(1)	45(1)	612(8)	51(2)	805(12)

Note: Fatalities are in parenthesis.

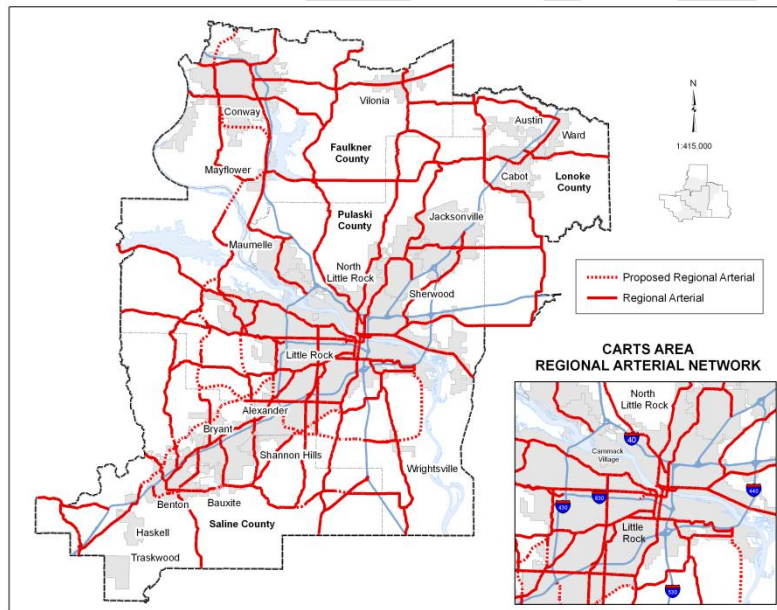


Figure 22: Regional Arterial Network

Appendix B

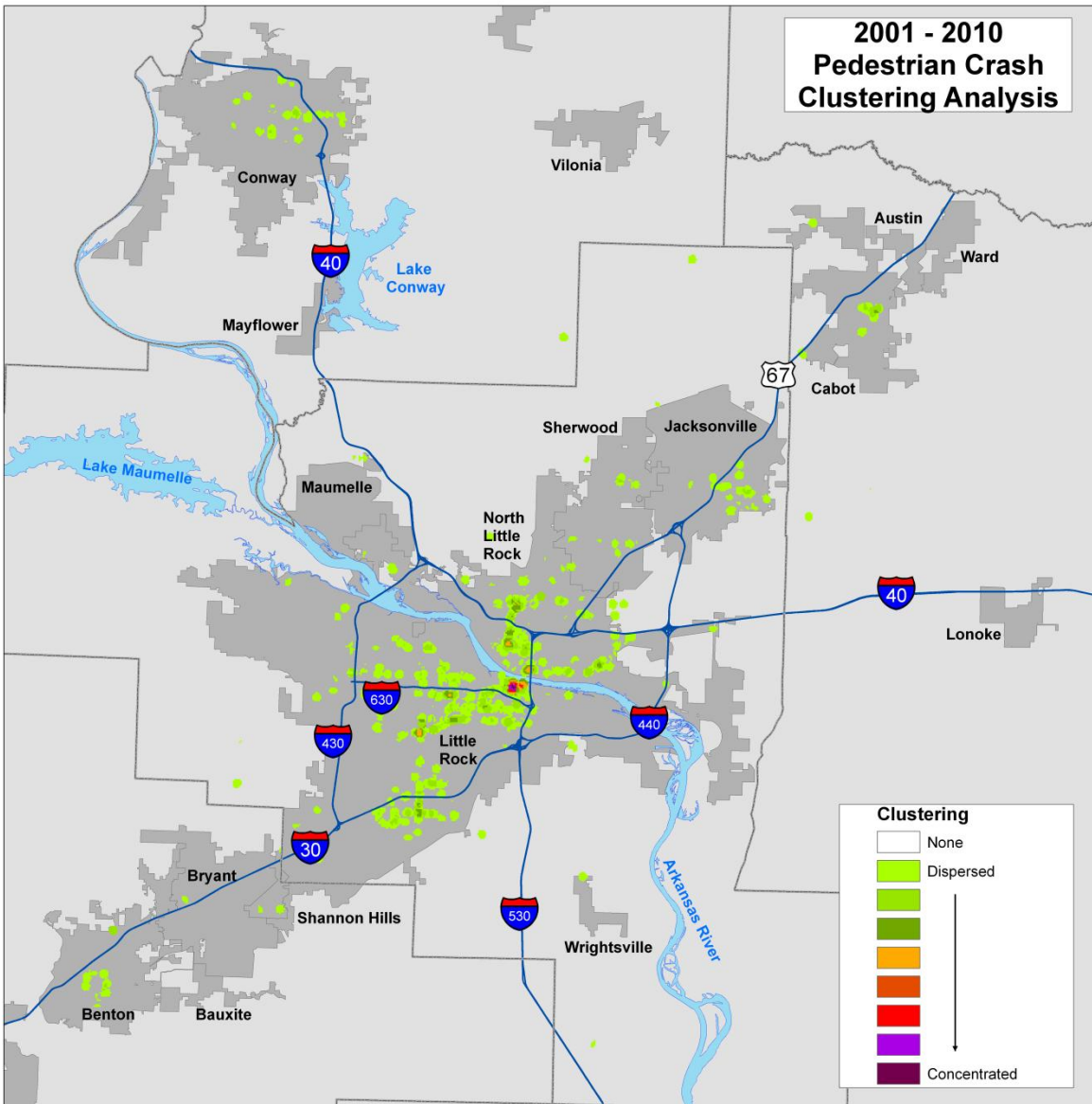


Figure 23: Pedestrian Crash Clustering Analysis

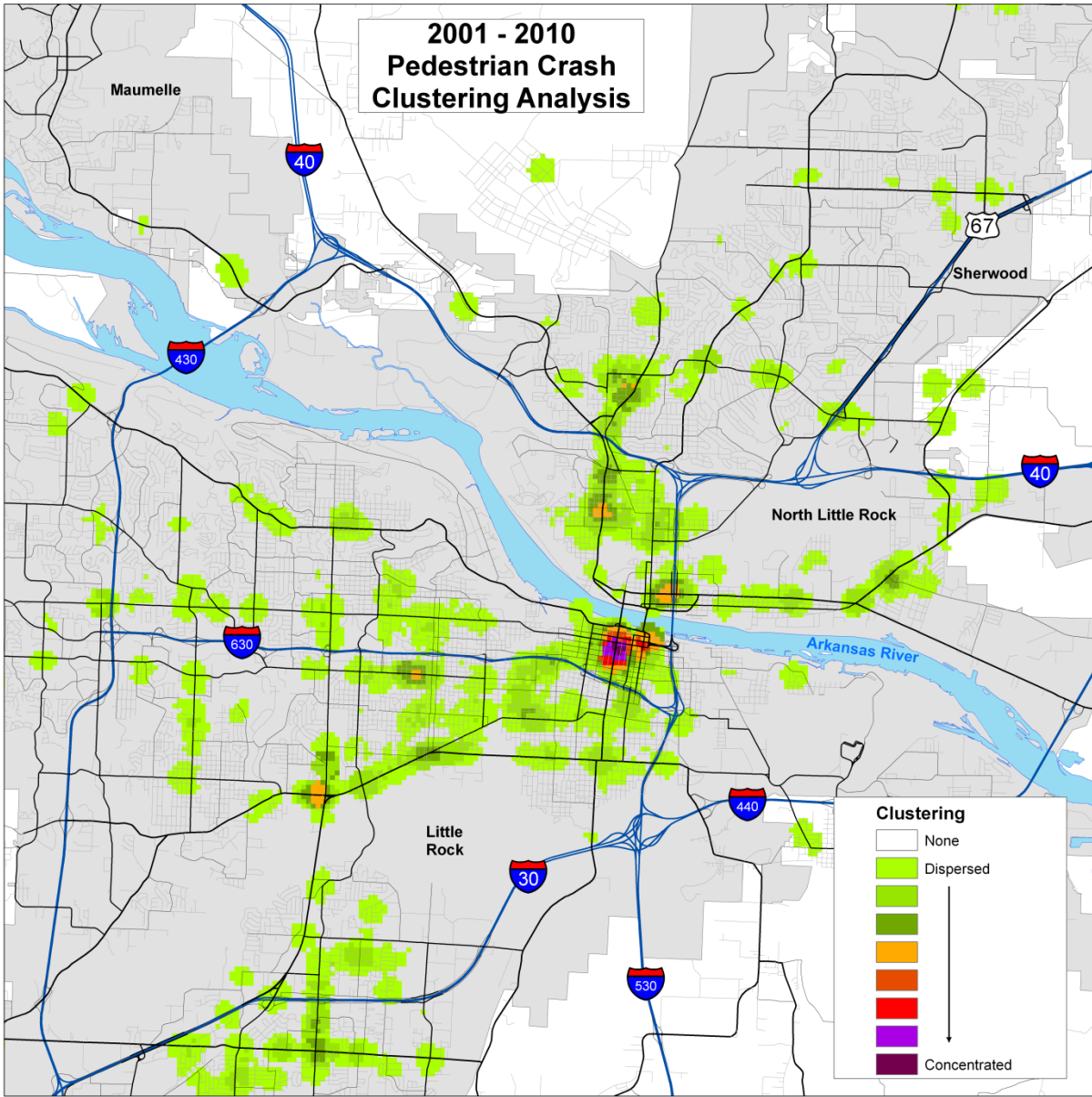


Figure 24: Pedestrian Crash Clustering Analysis (Central Area)

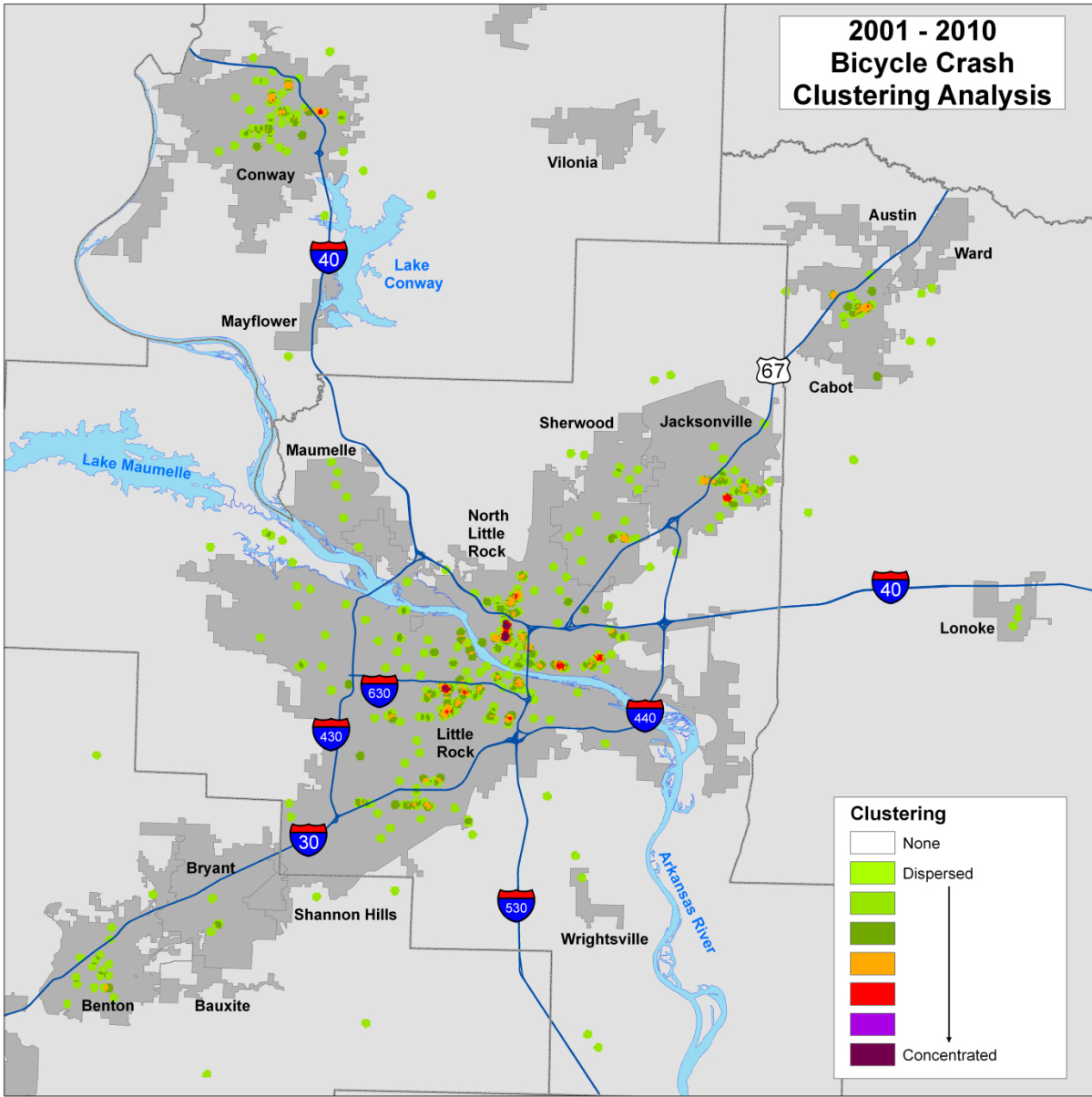


Figure 25: Bicycle Crash Clustering Analysis

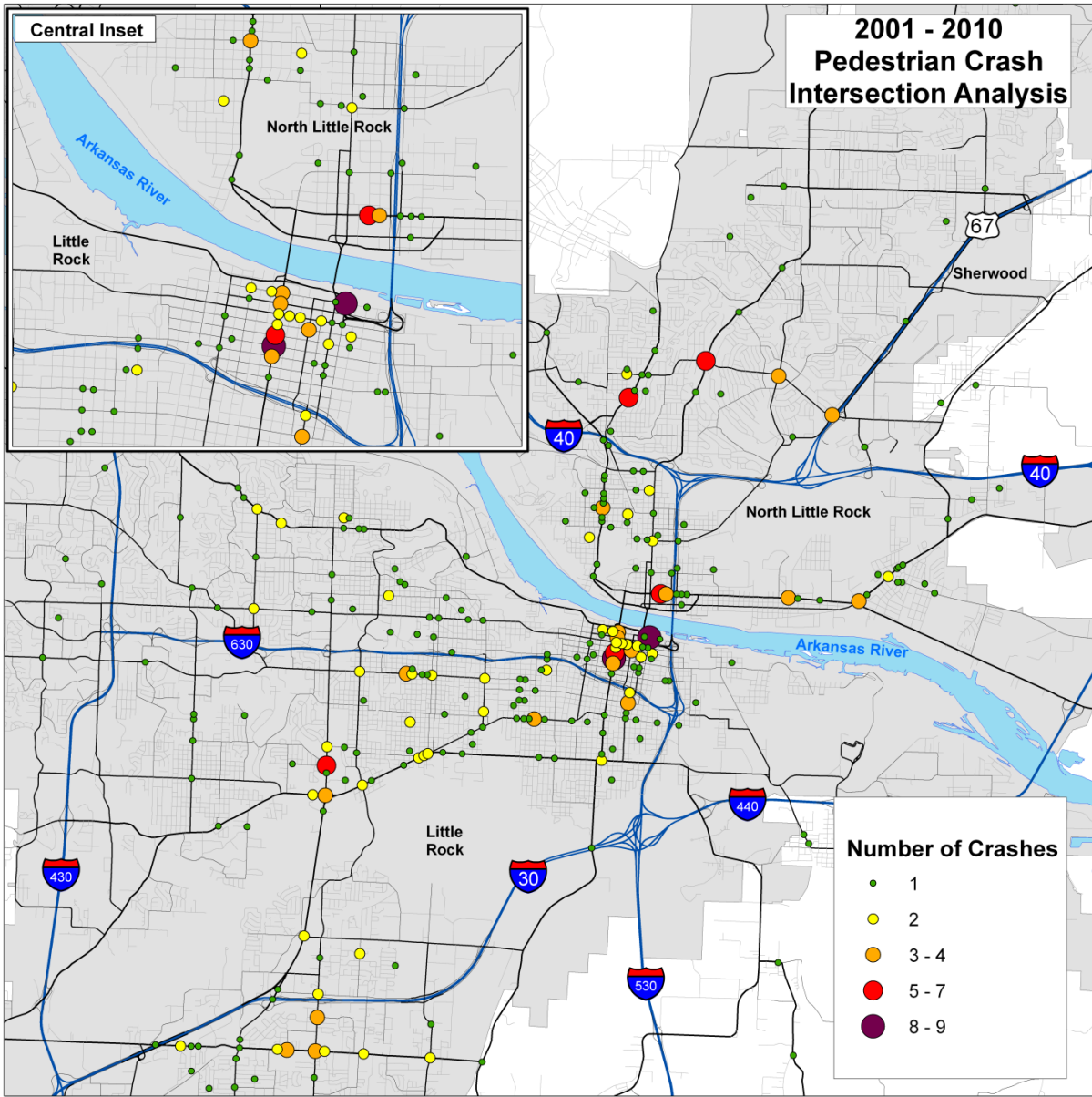


Figure 26: Pedestrian Crash Intersection Analysis

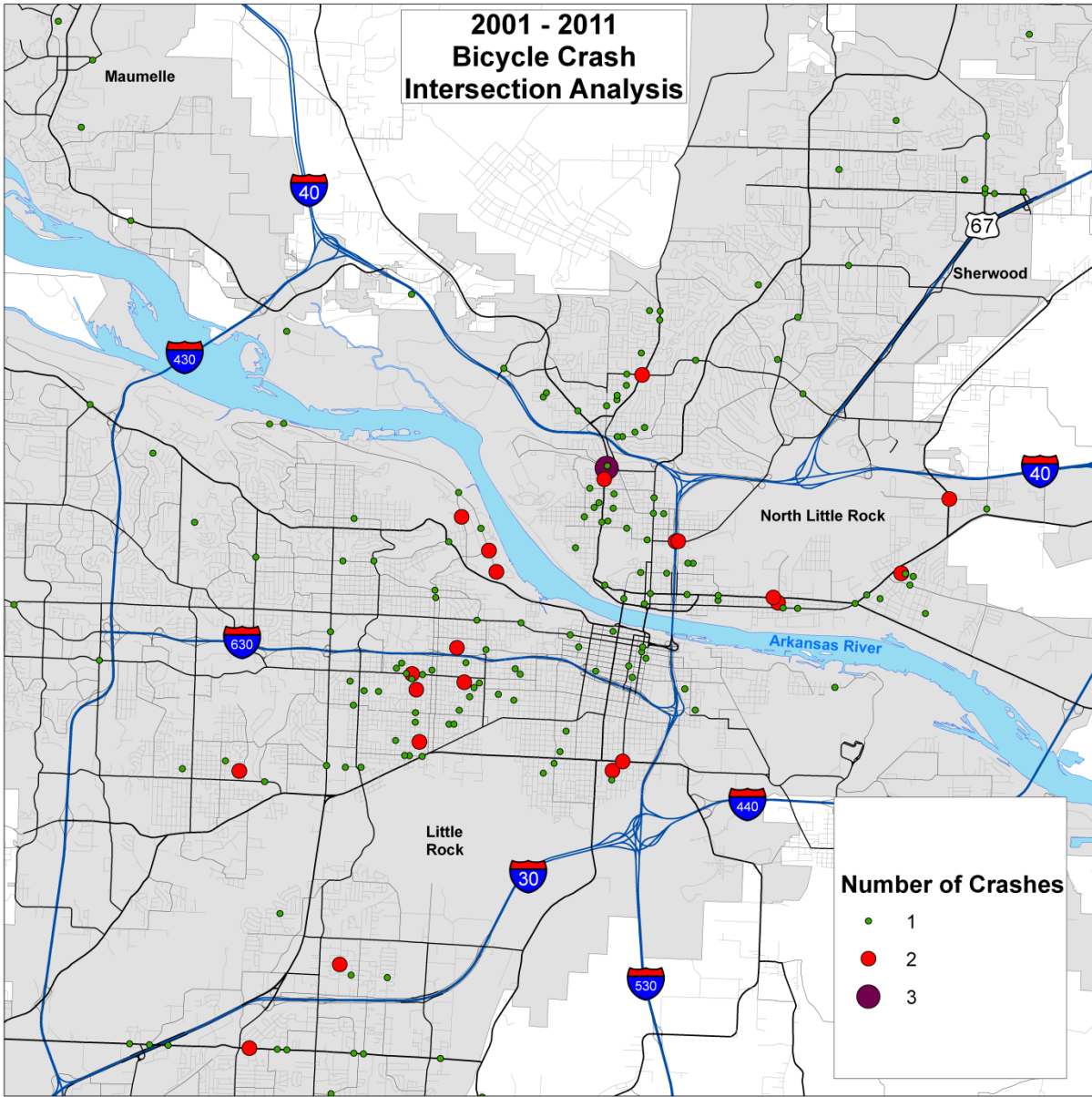


Figure 27: Bicycle Crash Intersection Analysis

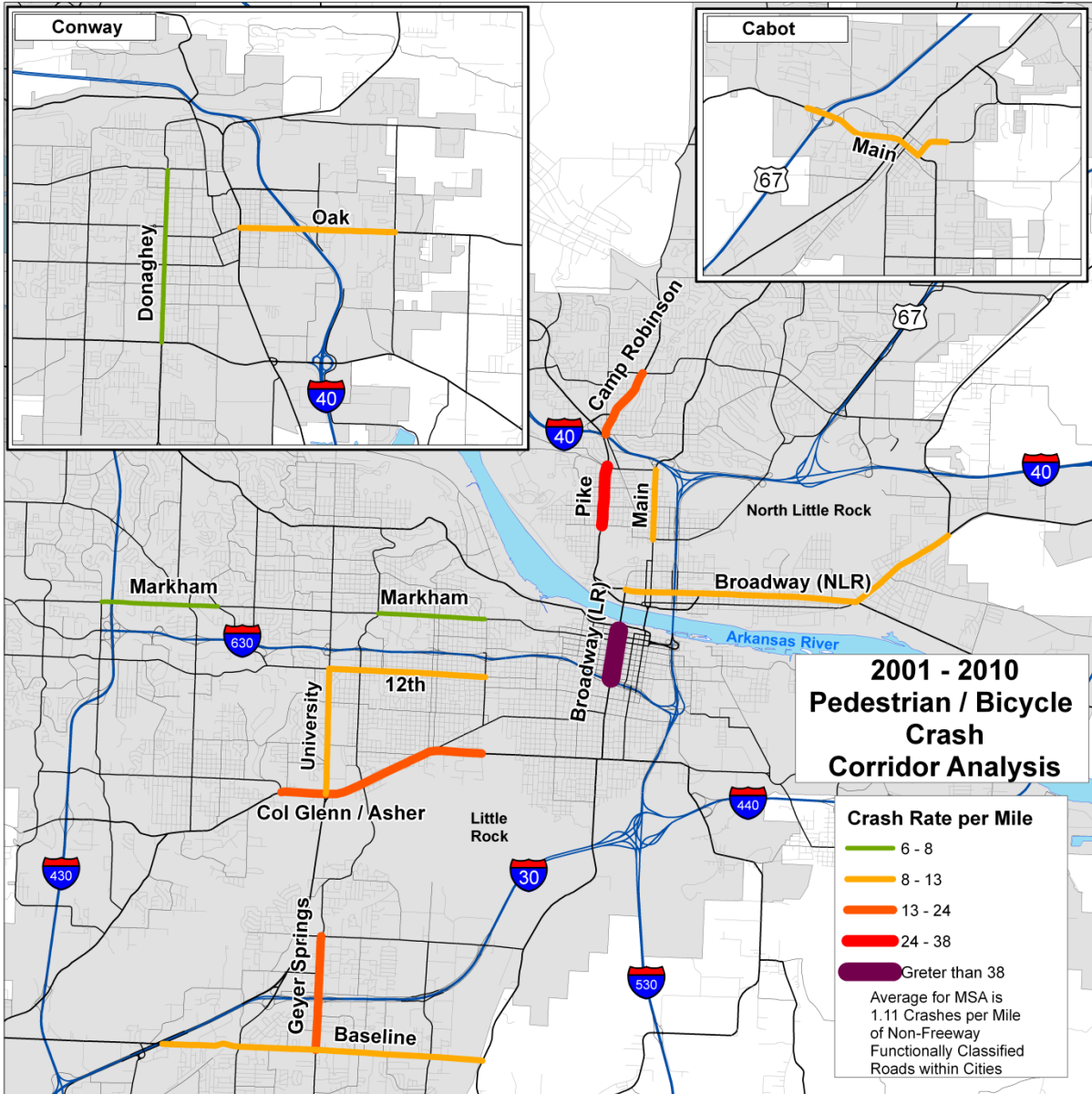


Figure 28: Pedestrian / Bicycle Corridor Crash Analysis

Appendix C

(Corridor and Intersection Studies)

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References

Harkey, D., Zeeger, C., (2004). *Pedestrian Safety Guide and Countermeasure Selection System*, FHWA-SA-04-003, Federal Highway Administration, Washington DC.

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