Bicycle Crash Analysis

For Tippecanoe County and the Greater Lafayette Area

A Study of Bicycle and Motor Vehicle Crashes
2013 through 2017

Prepared by the Area Plan Commission of Tippecanoe County
December 2019

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Key Findings from this Report

The 2045 Metropolitan Transportation Plan: The Future of Mobility, targets improved safety of all road users with an objective to reduce both fatalities and serious injuries. It also calls for updating the Bicycle and Pedestrian Plan. The Area Plan Commission's analysis of 2013 through 2017 crash data is intended to be a key component in the updated Bicycle and Pedestrian Plan. This report's intent is to provide a better understanding of factors that are involved in bicycle-motor vehicle crashes. Specific crash attributes were extracted from the ARIES crash database, analyzed and mapped. The findings in this report should be used to inform and also influence the design and location of new bicycle facilities, the redesign of existing roadways, the development of education programs for bicyclists and motorists, and enforcement campaigns.

When Crashes Occur:

- There were 228 reported crashes that involved bicycles in Tippecanoe County from 2013 through 2017.
- An average of 46 bicyclist-vehicle crashes occurs annually in Tippecanoe County.
- Crashes are most prevalent during September & October (34.6%), on Wednesdays (18.4%) and during the late afternoon from 3:00-6:00 p.m. (26.3%).
- Crashes mostly occur on clear or cloudy days (93.0%), when the road surface is dry (89.5%) and during daylight hours (74.1%).
- Less than 1 percent of all crashes in Tippecanoe County involve a bicycle.

Injuries and fatalities:

- There was one fatality and it happened in 2013.
- Cyclists sustained an injury in three out of four crashes.

Who were Involved:

- Over 46% of the crashes involved cyclists between the ages of 16 and 24.
- Male cyclists were involved in over 85% of all the bicycle crashes.

Who Was at Fault:

- Over the five-year period, motorists were slightly more responsible in causing a crash.

Causes of Crashes:

- The most common cause of crashes when the cyclist was at fault was: failing to yield (33.0%), pedestrian action (17.5%) and Disregarding Signal/Regulatory Sign (15.5%).
- The most common cause of crashes when the motorist was at fault was: failing to yield (73.2%), Other, Driver (8.9%) and Improper Lane Usage (4.5%).

Location of Crashes:

- The location with the largest number of bicycle-vehicle crashes was in the City of Lafayette (113) and adjacent to or on the Purdue campus (63).
- The intersection of State Street and Salisbury was the intersection that had the highest number of crashes, 5.
- The corridors that had the highest number of crashes included: Salisbury Street (19), State Street in West Lafayette (17), 18th Street (14), Grant Street (14), South Street in Lafayette (11), 9th Street (12), 4th Street (10), Creasy/Brady Lane corridor (10).
- The largest number of crashes occurred at intersections (118).
- A third of all the crashes (33.3%) occurred when cyclists were riding on the sidewalk.
- Approximately a fifth of the crashes (21.9%) occurred when cyclists were riding against traffic.

Comparison to Indiana:

- The percentage of bicycle crashes in Tippecanoe County (0.8%) is higher than the percentage of bike crashes in the State of Indiana (0.5%).
- The percentage of bicycle crashes involving children 14 and younger was lower in Tippecanoe County (12.8%) when compared to all of the bicycle crashes that occurred throughout the State of Indiana (21.4%).

Introduction

The purpose of this report is to provide useful information to a wide range of audiences concerning bicycle crashes that occurred within Tippecanoe County during calendar years 2013 through 2017. While this report highlights the negative aspects of cycling, it is only done to advance the safety of all road users. Research has shown that the benefits of riding a bicycle in an urban environment far outweigh the risks.[1] This report identifies safety concerns and can be used to reduce risks to cyclists in Tippecanoe County.

This report was also developed as a critical component of a new bicycle and pedestrian plan for Tippecanoe County. A thorough understanding of the crashes that involve bicycles and pedestrians are necessary to develop beneficial infrastructure projects.

In this report, the term "fault" refers strictly to the behaviors required by statutes. It should be noted that there are extenuating circumstances that affect bicyclist behavior for both children and adults.

Children, of course, depending on age, cannot always be expected to understand the rules, and have a tendency to behave impulsively: they are often determined to complete an action once they have initiated it. Children model adult behavior when cycling, and some adults model illegal or unsafe cycling behavior. Some parents direct their children to bike against the flow of traffic, "So you can see the cars coming and get out of the way." This improper behavior often carries through to adulthood.

Many child crashes involve behaviors that can be addressed through effective education.

Few Americans truly understand proper roadway cycling practices or the true benefits of those practices compared to commonly accepted behaviors (such as cycling on the sidewalk). Adult cyclists' behavior may be colored by a distrust of motorists. Adult cyclists who ride their bicycles properly on the roadway are sometimes threatened and harassed for doing so. Such threats come from only a very small percentage of the population, but have an intense effect on many cyclists, compelling them to utilize "coping strategies" that actually place them at greater risk. Some of these coping strategies are illegal.

Cyclists are rarely cited for basic violations such as driving against traffic, running red lights and stop signs, and traveling at night without lights.

Until effective bicycling training for children is commonplace and the community understands and supports correct bicycling behavior by adults - especially motorists - attribution of "fault" will remain an incomplete portrayal of the problem.

Riding a bicycle safely with motor vehicle traffic does require certain skills, but more importantly it requires adherence to the rules of the road for vehicles and the use of key practices. Cyclists who drive properly have a much lower risk than the general population because they do not conduct high

[1] de Hartog, Jeroen Johan, et. al. "Do the Health Benefits of Cycling Outweigh the Risks?" *Environmental Health Perspectives*. 18 (2010).

risk behaviors such as cycling at night without lights, cycling while intoxicated, or generally disobeying the rules of the road.

The following practices are the most commonly implemented and should be utilized by all bicyclists:

- Traveling with the flow of traffic
- Stopping for stop signs and red lights
- Yielding when entering the roadway
- Scanning ahead for threats from cross-streets, driveways and turning vehicles
- Looking behind for and safely negotiating overtaking traffic before moving left
- Not using a right turn lane for through movements
- Yielding when changing lanes
- Turning left from the left turn lane or left-most lane
- Using reflectors, headlights and taillights at night

It should be noted that the percentages expressed in this report are based on a "snapshot" of crashes during a five-year period, and that the relative proportions of these crash types and factors will change over time. They will also differ from proportions found in other urban areas and will certainly differ from crash characteristics of more rural areas.

About the Data

The data for this report came from the Indiana State Police (ISP) Automated Reporting Information Exchange System (ARIES) database of crash reports submitted by the police departments of Lafayette, West Lafayette, Purdue University, Dayton, Battle Ground, the Tippecanoe County Sheriff, the Department of Natural Resources, and the ISP. The database contains a subset of the most important information that was submitted for each crash reported to the ARIES system. All crash reports that involved a bicycle were obtained through the ARIES website.

Glossary (Terminology)

ARIES – Automated Reporting Information Exchange System developed and maintained by the Indiana State Police. ARIES provides officers an electronic means to complete the Indiana Officer's Crash Report form. The system also allows authorized individuals access to the Indiana State Police crash records database. ARIES was formerly known as the Vehicle Crash Record System (VCRS).

Alley – Indiana Code IC 9-13-2-2.5, "Alley" means a public way in an urban district that meets the following qualifications: 1) Is open to the public for vehicular traffic; 2) Is publicly maintained; 3) Is one (1) lane wide; 4) Is designated as an alley by the local authorities on an official map of the urban district.

Bicycle – Indiana Code IC 9-13-2-14, "Bicycle" means any foot-propelled vehicle, irrespective of the number of wheels in contact with the ground.

Bicyclists or Cyclists - Used interchangeably; any person driving a bicycle. A person walking a bicycle (and not straddling it) is a pedestrian.

Bike or Bicycle Lane – A portion of a roadway which has been designated by pavement markings and, if used, signs, for the preferential or exclusive use of bicyclists. Bike lanes are generally five or more feet in width measured from the lane stripe to the face of the curb or edge of the roadway.

Crash – The term "accident" is not used in this report; it implies that an event could have been avoided by one or more parties. The vast majority of collisions between road users are due to an illegal action or error on the part of one or more parties.

Crosswalk – Indiana Code IC 9-13-2-40, "Crosswalk" means any of the following" (1) That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs, or in the absence of curbs, from the edges of the traversable roadway. (2) A part of a roadway distinctly indicated for pedestrian crossing by lines or other markings on the surface.

Driver – Any person who drives or is in actual physical control of a vehicle on a highway. Bicycles are statutorily defined as vehicles, thus cyclists are drivers.

Driveway – Indiana Code IC 9-13-2-49.1, "Driveway" means a way or place in private ownership that is used for vehicular travel by the owner and those having express or implied permission from the owner but not by other persons.

Intersection – Indiana Code IC 9-13-2-84, (a) "Intersection" means the area embraced within: (1) the prolongation or connection of the lateral curb lines, or if none, then the lateral boundary lines of the roadways of two (2) highways that join at, or approximately at, right angles; or (2) the area within which vehicles traveling upon different highways joining at any other angle may come in conflict. (b) Where a highway includes two (2) roadways at least thirty (30) feet apart, every crossing of each roadway of the divided highway by an intersection highway is regarded as a separate intersection. If the intersecting highway also includes two (2) roadways at least thirty (30) feet apart, every crossing of two (2) roadways of the intersecting highway is regarded as a separate intersection.

Motorists – Distinct from the broader term "driver" a person in control of a motor vehicle.

Paved Shoulder – A paved portion of the roadway that is to the right of the white edge line on the right side of a road. Paved shoulders are not intended for regular travel by motor vehicles, but help in recovery from run-off-the-roadway incidents and provide a space for cyclists to travel outside the regular path of motorists.

Property Damage Only Crash – A crash in which a vehicle or property is damaged and the occupant or non-motorist is not injured. A crash is required to be reported if the amount of the damage was $750 or more.

Roadway – Indiana Code IC 9-13-2-157, (a) Except as provided in subsection (b), "roadway" means that part of a highway improved, designed, or ordinarily used for vehicular travel. (b) As used in IC 9-21-12-13, "roadway" means the part of a highway that is improved, designed, or ordinarily used for vehicular travel. The term does not include the sidewalk, berm, or shoulder, even if the sidewalk, berm, or shoulder is used by persons riding bicycles or other human powered vehicles.

Sidepath – A facility adjacent to a roadway and separated from the roadway by either a curb or unpaved area. Both pedestrians and cyclists are permitted and expected to travel in either direction on such paths.

Sidewalk - Indiana Code IC 9-13-2-167, "Sidewalk" means the part of a street between the curb lines, or the lateral lines of a roadway, and the adjacent property lines intended for the use of pedestrians.

Street or Highway – Indiana Code IC 9-13-2-175, "Street" or "Highway" means the entire width between the boundary lines of every way publicly maintained when any part of the way is open to the use of the public for purposes of vehicular travel. The term includes an alley in a city or town.

Shared Use Path – A paved path intended for use by both pedestrians and bicyclists. These paths may be located in entirely separated rights-of-way or may be parallel and adjacent to roadways. Such facilities are often referred to as "trails."

Sharrow – A sharrow is a pavement marking symbol that indicates an appropriate bicycle positioning in a roadway used by motor vehicles and bicycles. Sharrows may be placed at the edge of the travel lane or at the center of the travel lane, depending on factors like on-street parking, width of travel lane, or posted speed.

Vehicle – Any vehicle whether it be an automobile or truck. It also includes motorcycles, scooters and bicycles.

When Do Crashes Occur?

By Year

Over the five years analyzed, there were 228 crashes reported that involved bicycles, **Table 1**. That is approximately 46 crashes per year. Cyclists experienced the most crashes (52) in 2013 and the fewest (39) in 2014. **Figure 1**graphically shows the number of crashes by year. While there was a significant drop in crashes between 2013 and 2014, the number of crashes steadily increased thereafter.

Injuries were reported in 75% of the crash events over the five-year period. Looking at the data by year, the percentage of crashes with injuries fluctuated from the low-60s to low-90s. 2013 was the worst year in terms of number of injuries. 90.4% of the crashes during that year resulted in an injury. It was also the year of the one fatality.

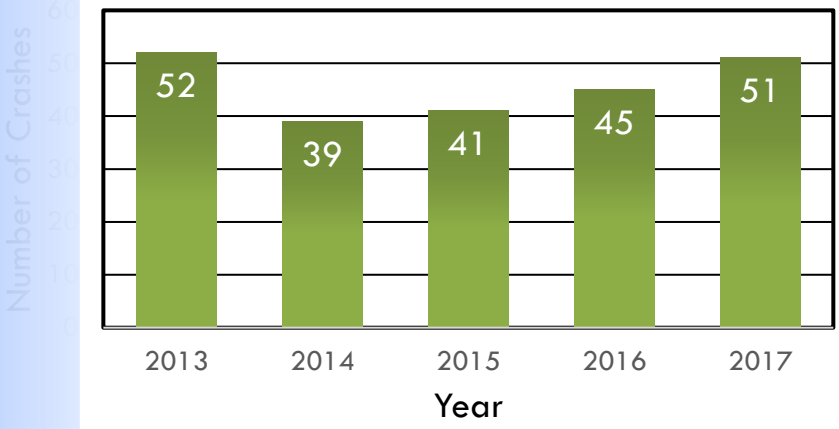
Most often, if there was an injury caused by a crash, it was the cyclist who was injured. That, however, was not necessarily the case all of the time. In 2014, 2015 and 2016, several crashes resulted in multiple injuries. Both the cyclist and motorist were injured in two crashes one each in 2014 and 2015.

There was one crash that resulted in a fatality and it occurred on May 14, 2013 on North 9th Street near Davis Ferry Park.

Table 1: Bicycle Crashes and Injuries in Tippecanoe County

Year	Total Number	Property Damage Only	% of Prop. Damage Crashes	Number of Injury Crashes	% of Injury Crashes	Number of Injured People	Fatalities
2013	52	5	9.6%	47	90.4%	47	1
2014	39	15	38.5%	24	61.5%	26	0
2015	41	8	19.5%	33	80.5%	34	0
2016	45	14	31.1%	31	68.9%	32	0
2017	51	13	25.5%	38	74.5%	38	0
Total	*228*	*55*	*24.1%*	*173*	*75.9%*	*177*	*1*

Figure 1: Number of Bicycle Crashes by Year



Annually, an average of less than 1 percent of all crashes in Tippecanoe County involved cyclists. **Table 2** compares the number of crashes involving bicycles to the total number of crashes reported in Tippecanoe County.

Table 2: Comparison of Bicycle and Total Crash Data

Year	Total # of Crashes in the County*	Bicycle Crashes	Percentage
2013	4,789	52	1.1%
2014	5,357	39	0.7%
2015	5,793	41	0.7%
2016	5,833	45	0.8%
2017	5,645	51	0.9%
Total	*27,417*	*228*	*0.8%*

** Does not include crashes on private property*

Table 3 shows crash data for the State of Indiana. Comparing the percentage of bicycle crashes in Tippecanoe County to state crash data, there is a higher percentage of bicycle crashes occurring in the county. According to the IU Public Policy Institute Indiana Crash Facts reports, one half of 1 percent of all the crashes statewide involves a bicycle.

Table 3: Bicycle Crash Data, State of Indiana (2013-2016)

Year	Total # of Crashes	# of Bicycle Crashes	State Percentage	County Percentage
2013	193,205	1, 021	0.6%	1.1%
2014	205,532	921	0.5%	0.7%
2015	216,312	953	0.5%	0.7%
2016	223,733	916	0.5%	0.8%
Total	*981,132*	*5,147*	*0.5%*	*0.8%*

Source: Indiana University Public Policy Institute, Indiana Crash Facts 2016, Figure 3.2, page 46

By Month

One would expect, intuitively, that crashes by month follow the seasons, with the majority occurring during the summer months, and the fewest during the winter months. In other words, crashes would be least prevalent in winter, increase in spring, peak in summer and then decrease in autumn.

The analysis, to a degree, supports this expectation. **Figure 2** compares the number of crashes by month to the average high monthly temperature. There are significantly fewer crashes during the winter months and the number of crashes from May through August gradually increased. However, the peak period of crashes was September and October, which lags slightly after the peak in high temperatures. The two-month peak crash period accounts for nearly 35 percent of crashes.

Figure 2: Number of Bicycle Crashes by Month Compared to Average High Temperature

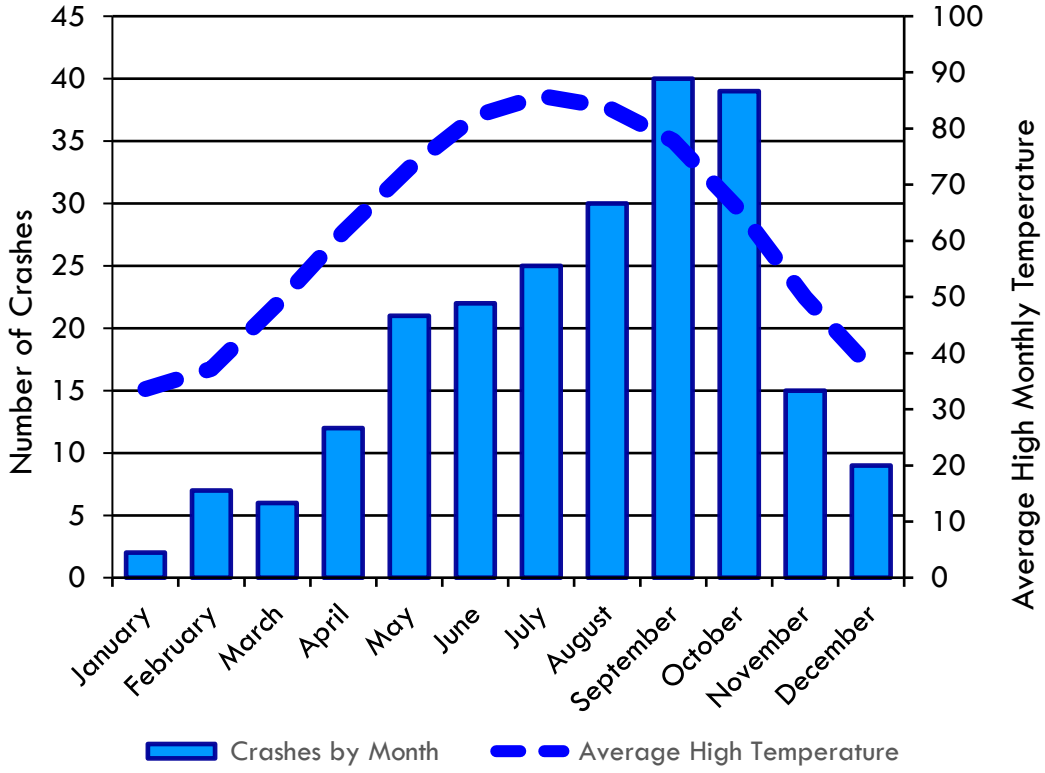


Table 4 shows the number of crashes by month for each of the five year analysis period. Peak months were typically September and October. In 2017, the peak number of crashes occurred in August.

Table 4: Bicycle Crashes by Month and Year

	2013	2014	2015	2016	2017	Total	%
January	---	1	---	1	0	2	0.9%
February	2	1	---	2	2	7	3.1%
March	2	---	1	---	3	6	2.6%
April	3	1	2	4	2	12	5.3%
May	6	3	3	4	5	21	9.2%
June	2	3	5	7	5	22	9.6%
July	7	3	8	5	2	25	11.0%
August	3	6	7	3	11	30	13.2%
September	7	11	8	8	6	40	17.5%
October	13	7	5	5	9	39	17.1%
November	5	1	2	4	3	15	6.6%
December	2	2	---	2	3	9	3.9%
Total	*52*	*39*	*41*	*45*	*51*	*228*	*100%*

Table 5 compares the number of injury crashes to the total number of bicycle crashes by month. The percentage of injuries by month varies from a low of 50 percent to a high of 90 percent. The months of January, February and December had the lowest percentages while the month of May had the highest. Of more importance is the fact that three-quarters of all bicycle crashes involved injuries.

Table 5: Comparison of the Total Number of Crashes to the Number of Injury Crashes: 2013-2017

Month	Total Crashes	Injury Crashes	Percentage
January	2	1	*50.0%*
February	7	4	*57.1%*
March	6	5	*83.3%*
April	12	10	*83.3%*
May	21	19	*90.5%*
June	22	14	*63.6%*
July	25	19	*76.0%*
August	30	25	*83.3%*
September	40	30	*75.0%*
October	39	29	*74.4%*
November	15	12	*80.0%*
December	9	5	*55.6%*
Total	*228*	*173*	*75.9%*

Figure 3 compares the total number and injury crashes by month. The gradual increase, peak, and decline of both series are nearly the same. Both trends peak during the months of September and October. The number of injuries fell from May to June but then steadily increased to the two peak months (students leave between April and May).

Figure 3: Number of Bicycle Crashes and Injury Crashes by Month

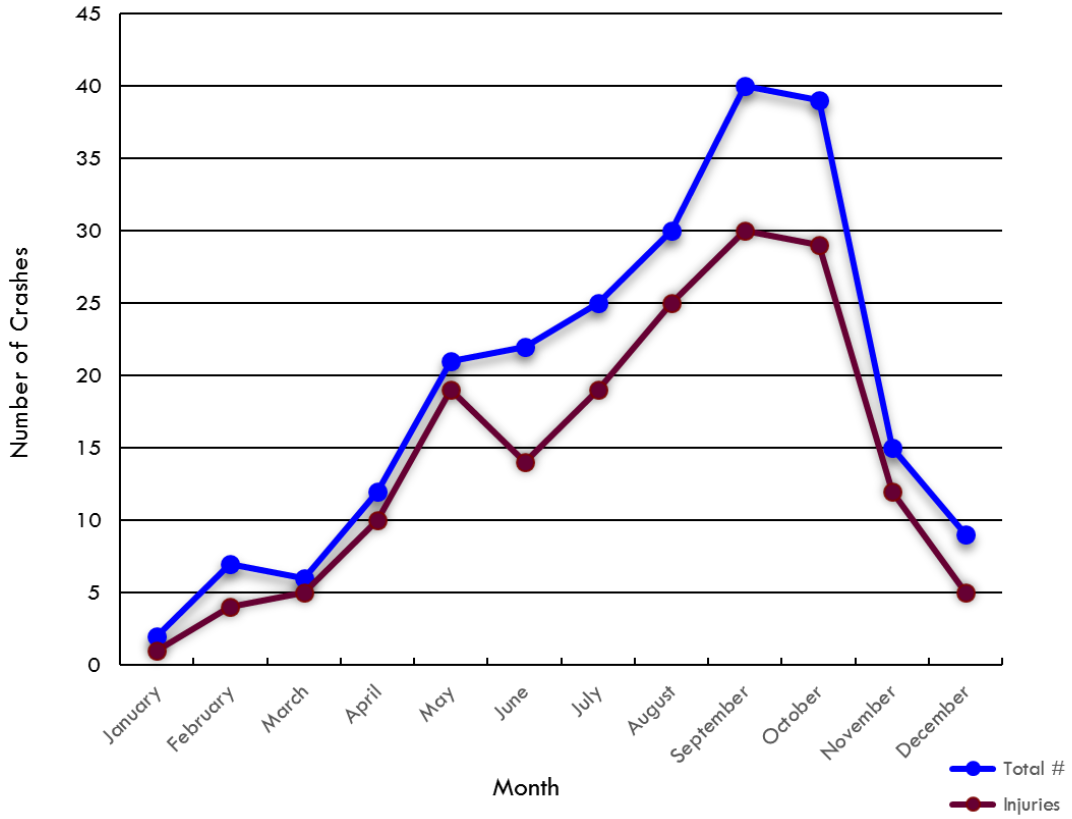


Table 6 provides a detailed look at injuries by month and by year.

Table 6: Injury Crashes by Month and by Year

	2013	2014	2015	2016	2017	Total	Percent
January	---	1	---	---	---	1	0.6%
February	2	1	---	---	1	4	2.3%
March	2	---	---	---	3	5	2.9%
April	3	1	1	3	2	10	5.8%
May	6	3	3	3	4	19	11.0%
June	2	1	3	6	2	14	8.1%
July	7	1	7	2	2	19	11.0%
August	3	5	6	3	8	25	14.5%
September	5	7	6	6	6	30	17.3%
October	13	2	5	5	4	29	16.8%
November	4	1	2	2	3	12	6.9%
December	---	1	---	1	3	5	2.9%
Total	*47*	*24*	*33*	*31*	*38*	*173*	*100%*

Tables 7, 8 and **9** look at the crash data by cyclists' age and by year. **Table 7** summarizes the data for the entire county while **Tables 8** and **9** examine the data geographically divided by the Wabash River.

Table 7 shows that nearly half of the crashes involve a bicyclist between 16 to 24 years of age. The second and third age groups that experienced the most crashes were persons under 16 years of age (37 crashes) and persons 25 to 34 years of age (27 crashes).

Table 7: Bicycle Crash by Age

	2013	2014	2015	2016	2017	Total	Percent
<16	10	5	8	7	7	37	16.2%
16-24	25	15	17	25	24	106	46.5%
25-34	9	4	4	4	6	27	11.8%
35-44	1	3	4	3	6	17	7.5%
45-54	2	1	4	2	4	13	5.7%
55-64	2	2	3	3	4	14	6.1%
65 >	1	1	1	---	---	3	1.3%
Unknown	1	8	1	1	---	11	4.8%
Total	51	39	42	45	51	228	100%

Table 8: Bicycle Crash by Age that Occurred East and South of the Wabash River

	2013	2014	2015	2016	2017	Total	Percent
<16	7	3	8	6	6	30	25.2%
16-24	12	2	4	9	8	35	29.4%
25-34	6	2	2	2	3	15	12.6%
35-44	1	2	3	3	6	15	12.6%
45-54	1	---	3	2	2	8	6.7%
55-64	1	1	2	1	3	6	5.0%
65 >	---	1	---	---	---	1	0.8%
Unknown	1	6	1	1	---	9	7.6%
Total	29	17	23	24	28	119	100%

Table 9: Bicycle Crashes by Age that Occurred West and North of the Wabash River

	2013	2014	2015	2016	2017	Total	Percent
<16	3	2	---	1	1	7	6.4%
16-24	13	13	13	16	16	71	65.1%
25-34	3	2	2	2	3	12	11.0%
35-44	---	1	1	---	---	2	1.8%
45-54	1	1	1	---	2	5	4.6%
55-64	2	2	1	2	1	8	7.3%
65 >	1	---	1	---	---	2	1.8%
Unknown	---	2	---	---	---	2	1.8%
Total	23	23	19	21	23	109	100%

Tables 8 and **9** show an interesting picture when compared to each other. Nearly a third, 29.4%, of the crashes east of the river involve a bicyclist between 16 to 24 years of age. West of the river, where Purdue University is located, that age group accounts for nearly two-thirds of bicycle crashes, 65.1%. The majority of crashes involving children younger than 16 years of age occurred east of the river.

By Day of Week

Crashes are more prevalent during the week than the weekend. The most common day is Wednesday with more than 18 percent of the crashes. The fewest crashes occurred on Sunday with 8 percent. **Table 10** and **Figure 4** present this data.

Table 10: Bicycle Crashes by Day of Week and Year

Month	2013	2014	2015	2016	2017	Total	Percent
Sunday	5	3	3	3	5	19	8.3%
Monday	8	9	7	9	4	37	16.2%
Tuesday	6	7	6	4	12	35	15.4%
Wednesday	10	4	9	6	13	42	18.4%
Thursday	7	8	8	6	9	38	16.7%
Friday	9	5	4	11	5	34	14.9%
Saturday	7	3	4	6	3	23	10.1%

Figure 4: Crashes by Day of Week

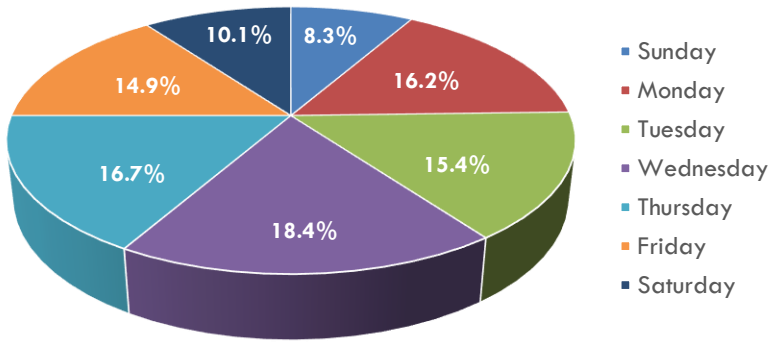


Table 11 looks at the crash data by age and by day of the week. In the youngest age group, the peak occurred on Wednesday and Friday. During the rest of the week, the number of crashes was consistent. For the age group with the highest number of crashes, 16-24, the peak occurred on

Tuesday and then tapered off toward the weekend. For those persons who are slightly older (25-34), there is a very small peak on Monday. Otherwise, the number of crashes was more evenly distributed for all the other age groups except for persons 65 and older. Only three persons in that age group were involved in a crash.

Table 11: Crashes by Age and by Day of Week

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total
<16	4	5	4	8	5	8	4	38
16-24	9	15	22	19	18	14	8	105
25-34	---	8	3	5	5	2	4	27
35-44	1	3	3	2	3	3	2	17
45-54	2	2	---	2	2	3	2	13
55-64	3	2	1	4	3	1	2	16
65 +	---	---	---	2	---	1	---	3
Unknown	1	2	2	1	2	2	1	11
Total	20	37	35	43	38	34	23	230

Note: Two crashes resulted in two bicyclists injured in each

By Time of Day

Table 12 shows when crashes occurred by time of day and year. **Figure 5** depicts the information graphically. Not surprisingly, there were very few crashes during the early morning hours. There was a small spike in the number of crashes from 7:00 to 8:00 a.m. (the morning commute.) Just before midday, the number of crashes steadily increased and then peaked between 3:00 and 6:00 p.m. (the evening commute.) A significant number of crashes between 3:00 and 4:00 was a result of eight crashes that occurred during that time in 2015. In looking more closely at the data, there was no commonality between those eight except that they were all the results of failing to yield or disregarding a stop sign or traffic signal. Another detail gleaned from the data is a third peak between 7:00 and 8:00 p.m. The number of crashes in 2013, 2015 and 2017 are consistent while the other two years were much smaller.

Looking at the morning and evening peak hour crash data by cyclists' age reveals additional information. The majority of crashes involve persons under the age of 35 for both periods. Those age groups accounted for over 81 percent of the crashes during the morning peak hour and 75 percent in the evening peak hours. Cyclists between the ages of 16 and 24 were involved over 40 percent of the time during the evening peak hours. **Table 13** shows the crash data by peak hour and by age group.

Table 12: Bicycle Crashes by Time of Day

	2013	2014	2015	2016	2017	Total	
Midnight – 1am	1	1	---	1	---	3	*1.3%*
1:00 – 2:00	---	---	---	1	---	1	*0.4%*
2:00 – 3:00	---	---	---	1	1	2	*0.9%*
3:00 – 4:00	---	1	1	---	---	2	*0.9%*
4:00 – 5:00	---	---	---	---	1	1	*0.4%*
5:00 – 6:00	1	1	---	1	---	3	*1.3%*
6:00 – 7:00	1	---	2	---	2	5	*2.2%*
7:00 – 8:00	2	---	4	4	1	11	*4.8%*
8:00 – 9:00	2	---	2	---	3	7	*3.1%*
9:00 – 10:00	2	---	1	1	---	4	*1.8%*
10:00 – 11:00	4	---	2	1	2	9	*3.9%*
11:00 – 12:00	2	3	1	2	4	12	*5.3%*
Noon – 1 pm	4	1	1	1	4	11	*4.8%*
1:00 – 2:00	2	4	1	9	1	17	*7.5%*
2:00 – 3:00	2	5	---	2	5	14	*6.1%*
3:00 – 4:00	2	3	8	4	3	20	*8.8%*
4:00 – 5:00	3	5	3	4	3	18	*7.9%*
5:00 – 6:00	4	6	5	3	4	22	*9.6%*
6:00 – 7:00	5	1	2	2	1	11	*4.8%*
7:00 – 8:00	5	3	5	1	6	20	*8.8%*
8:00 – 9:00	3	1	1	4	5	14	*6.1%*
9:00 – 10:00	1	1	1	1	2	6	*2.6%*
10:00 – 11:00	---	1	1	2	2	6	*2.6%*
11:00 – 12:00	6	2	---	---	1	9	*3.9%*
Total	52	39	41	45	51	228	

Figure 5: Bicycle Crashes by Time of Day

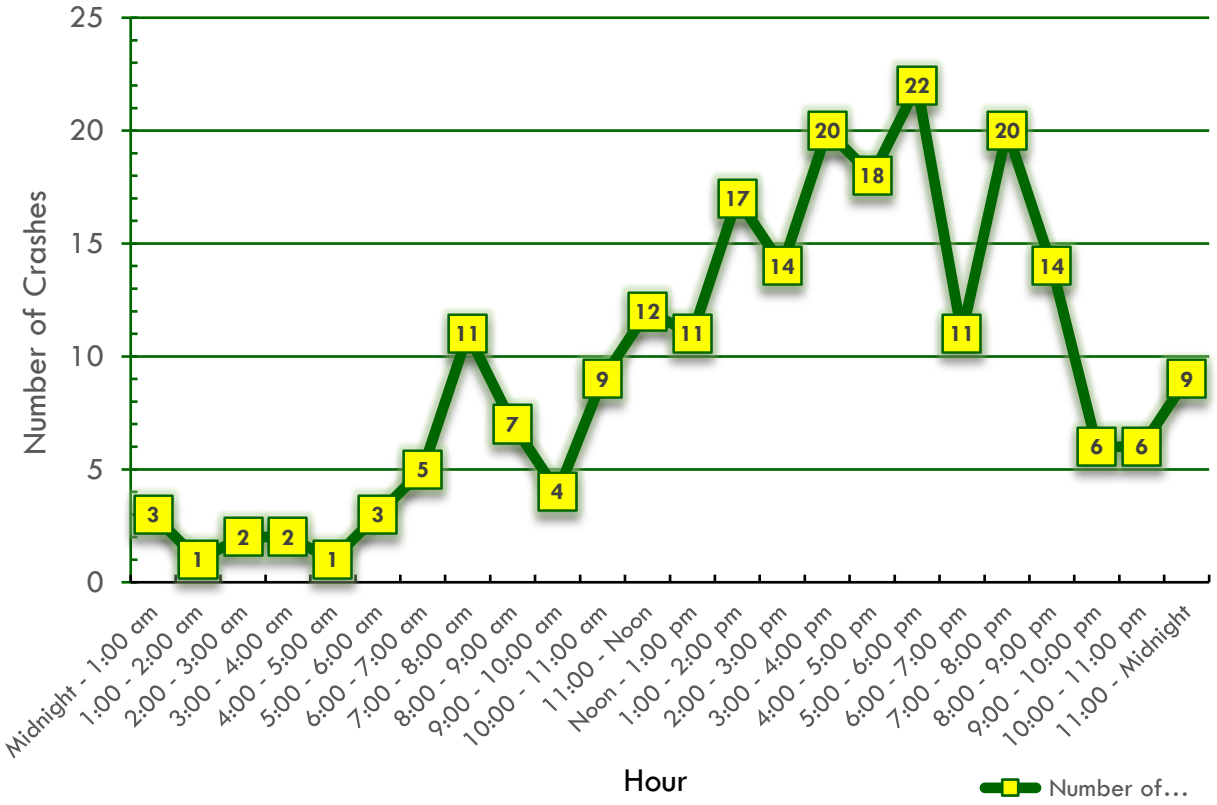


Table 13: Peak Hour Crashes by Age Group

Age	7-8 a.m.	3-6 p.m.
<16	2	12
16-24	5	26
25-34	2	7
35-44	1	3
45-54	1	6
55-64	---	2
65 +	---	1
Unknown	---	3
Total	11	60

By Environmental Conditions

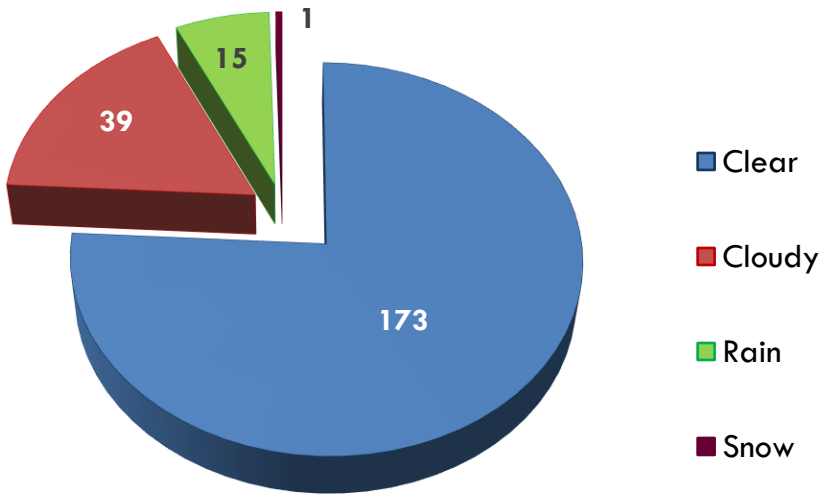
Atmospheric or Weather Conditions

Weather conditions at the time of crashes were generally favorable. Conditions were clear 75 percent of the time and cloudy 17 percent of the time. It was raining when 15 of the crashes occurred, or 6.6 percent. One crash occurred when it was snowing. **Table 14** shows the information by weather condition type and year and **Figure 6** shows the crash proportions by the four weather conditions. This shows that very few crashes can be attributed to bad weather conditions.

Table 14: Crashes by Atmospheric Conditions

Year	Clear	% of Crashes	Cloudy	% of Crashes	Rain	% of Crashes	Snow	% of Crashes
2013	39	75.0%	8	15.4%	4	7.7%	1	1.9%
2014	27	69.2%	7	17.9%	5	12.8%	0	0.0%
2015	30	73.2%	10	24.4%	1	2.4%	0	0.0%
2016	33	73.3%	9	20.0%	3	6.7%	0	0.0%
2017	44	86.3%	5	9.8%	2	3.9%	0	0.0%
Total	*173*	*75.9%*	*39*	*17.1%*	*15*	*6.6%*	*1*	*0.4%*

Figure 6: Crashes by Atmospheric Conditions



Lighting Conditions

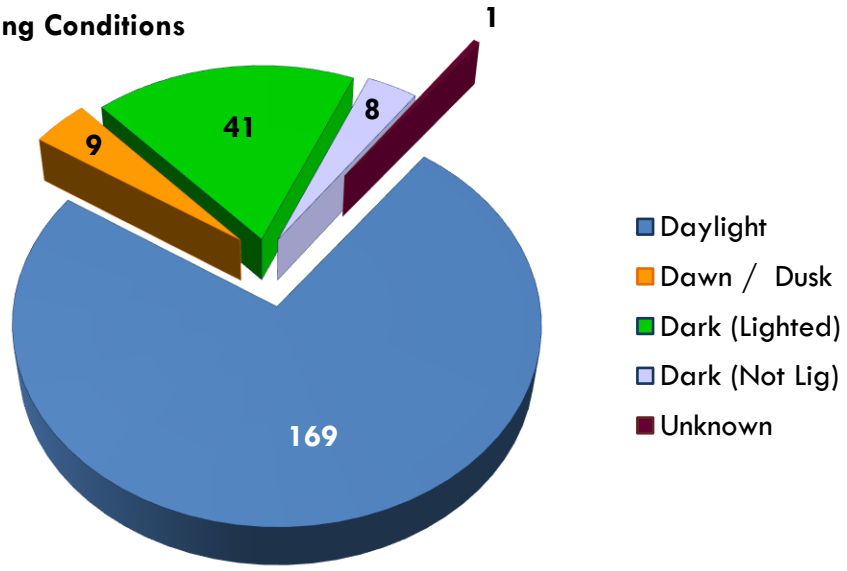
Seventy-four percent of crashes occurred during daylight hours, **Table 15**. Forty-nine crashes occurred when it was dark. Over eighty percent of those night time crashes occurred at locations that were lighted while the others occurred where there was no street lighting present. Only a small fraction, less than 4 percent, occurred at dawn or dusk. **Figure 7** shows the total number of crashes by lighting conditions.

Table 15: Crashes by Lighting Conditions

Year	Daylight	% of Crashes	Dawn / Dusk	% of Crashes	Dark (Lighted)	% of Crashes	Dark (Not Lighted)	% of Crashes
2013	36	69.2%	3	5.8%	11	21.2%	2	36%
2014	31	79.5%	1	2.6%	6	15.4%	1	2.6%
2015	33	80.5%	3	7.3%	4	9.8%	1	2.4%
2016	34	75.6%	0	0.0%	10	22.2%	1	2.2%
2017	35	68.6%	2	3.9%	10	19.6%	3	4.9%
Total	*169*	*74.1%*	*9*	*3.9%*	*41*	*18.0%*	*8*	*3.5%*

Note: One crash in 2015 had an unknown lighting condition

Figure 7: Crashes by Lighting Conditions



Road Surface Conditions

Road surface condition at the time of crashes was mostly favorable. Conditions were dry nearly 90 percent of the time and wet about 10 percent. Snow, slush or ice were present less than 1percent of the time. **Table 16** summarizes the data.

Table 16: Crashes by Road Surface Conditions

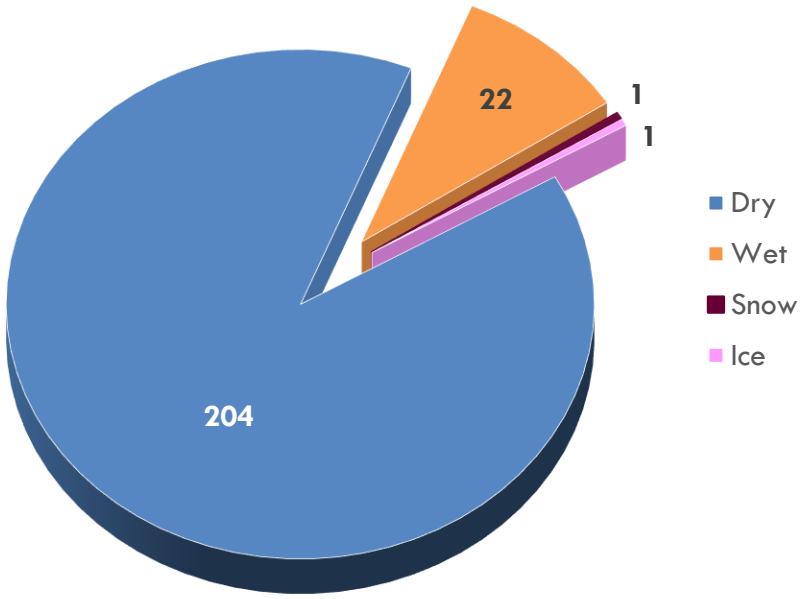
	Dry	% of Crashes	Wet	% of Crashes	Snow	% of Crashes	Ice	% of Crashes
2013	45	86.5%	7	13.5%	0	0.0%	0	0.0%
2014	32	82.1%	6	15.4%	0	0.0%	1	2.6%
2015	40	97.6%	1	2.4%	0	0.0%	0	0.0%
2016	40	88.9%	4	8.9 %	1	2.2%	0	0.0%
2017	47	92.2%	4	7.8%	0	0.0%	0	0.0%
Total	204	89.5%	22	9.6%	1	0.4%	1	0.4%

Type of Collision

The type of collision tells us what the vehicles were doing at the time of the crash. It provides information about the position of both vehicles and also their direction of travel. **Table 17** shows the data for each type of collision by year.

By far, the most frequent type of collision occurred when the cyclist hit or was hit at a right angle. This type of collision accounted for over half of the crashes. The second and third most common types of collisions occurred when one of the vehicles was turning right or left. Both of these types of collisions accounted for 17 percent of the crashes. Rear-end and same-direction sideswipe collisions accounted for 13 percent of the crashes.

Figure 8: Crashes by Road Surface Conditions



In looking at the data, overall the number of collisions by type are consistent throughout the reporting period. The only two noticeable differences are in 2013 and 2017. In 2013, there were a significant number of left turn crashes (8 of the 16) and in 2017 there were a significant number of right turn crashes (8 of the 23).

Table 17: Crashes by Type of Collision and by Year

Type of Collision	2013	2014	2015	2016	2017	Total	%
Right Angle	26	24	24	25	27	126	*55.3%*
Right Turn	4	2	5	4	8	23	*10.1%*
Left Turn	8	1	1	3	3	16	*7.0%*
Same Direction Sideswipe	2	3	3	3	5	16	*7.0%*
Rear End	4	2	4	2	3	15	*6.6%*
Head On	4	1	1	2	3	11	*4.8%*
Other – Explain in Narrative	2	3	1	3	1	10	*4.4%*
Opposite Direction Sideswipe	2	3	1	2	1	9	*3.9%*
Left/Right Turn	---	---	1	---	---	1	*0.4%*
Backing Crash	---	---	---	1	---	1	*0.4%*
Total	52	39	41	45	51	228	

Injuries and Fatalities

State and Local Comparison

Fixing America's Surface Transportation Act, or FAST Act, requires the use of data when deciding which transportation projects should be funded with federal gas tax funds. The specific program for collecting and analyzing the data is called Transportation Performance Management, or TPM. There are six specific focus areas within the TPM one of them is safety. The Safety TPM establishes targets or goals for a minimal number of crashes with fatalities, serious injuries and the number of non-motorist fatalities and serious injuries. These targets are set annually.

When looking at the non-motorist fatalities and serious injuries Safety TPM, INDOT considers bicyclists, pedestrians and occupants in animal-drawn vehicles as non-motorized. The goal is a five-year average of the combined number of fatalities and serious injuries. The draft goal for 2019 is 440 crashes and for 2020 it is 405.86 crashes. **Table 18** shows the specific details for the non-motorist safety TPM.

Table 18: Non-Motorized Fatalities & Serious Injuries, Indiana

Year	Number Non-Motorized Fatalities	Number Non-Motorized Serious Injuries	Combined Total	Five-Year Rolling Average
2012	79	301	380	373.00
2013	87	285	372	370.20
2014	94	277	367	375.20
2015	109	276	378	375.00
2016	106	280	386	376.50
2017	116	256	372	374.92
2018	140	265	405	381.51
2019	132	295	427	393.47

Source: Baseline INDOT Traffic Safety Performance Target Setting, Methodology and data decisions Draft CY 2020

Table 19 shows the number of bicycle and pedestrian fatality and serious injury crashes in Tippecanoe County from 2013 through 2017. The serious injury crashes were identified by reading each crash report and noting whether or not the cyclist/pedestrian was transported to the hospital.

Table 19: Non-Motorized Fatalities & Serious Injuries, Tippecanoe County

Year	Number Non-Motorized Fatalities	Number Non-Motorized Serious Injuries	Combined Total	Five-Year Rolling Average
2013	6	8	14	---
2014	1	5	6	---
2015	1	3	4	---
2016	0	6	6	---
2017	4	8	12	8.4

Table 20 shows a comparison of the total number of fatal crashes to the number of bicycle and pedestrian fatality crashes at the state level and for Tippecanoe County. Over 12% of the fatal crashes in Indiana from 2013 through 2016 involved a bicyclist or pedestrian. That percentage is slightly higher in Tippecanoe County over the same four-year period. The percentage for Tippecanoe County is 15.6%.

Table 20: Bicycle Crashes and Fatalities, Indiana and Tippecanoe County

Year	Total # of Fatalities in Indiana	Bike/Ped Fatalities	% Bike/Ped Fatalities	Tip. Co. Total Fatalities	Tip. Co. Bike/Ped Fatalities	% Bike/Ped Fatalities
2013	784	87	11.1%	22	6	27.3%
2014	745	94	12.6%	6	1	16.7%
2015	817	109	13.3%	18	1	5.6%
2016	829	106	12.8%	8	0	0.0%
Total	3,175	396	12.5%	*77*	12	*15.6%*

Looking at the fatality, serious injury, and injury crashes in Tippecanoe, **Figure 9** shows their locations. The only bicycle fatality was on North 9th Street just south of the Wabash River bridge. There were 9 serious injury crashes with 3 of them located on or near the Purdue campus. The remaining 6 were scattered throughout Lafayette. There were 163 crashes where an injury was reported, and they were also scattered throughout Lafayette, West Lafayette and the Purdue campus.

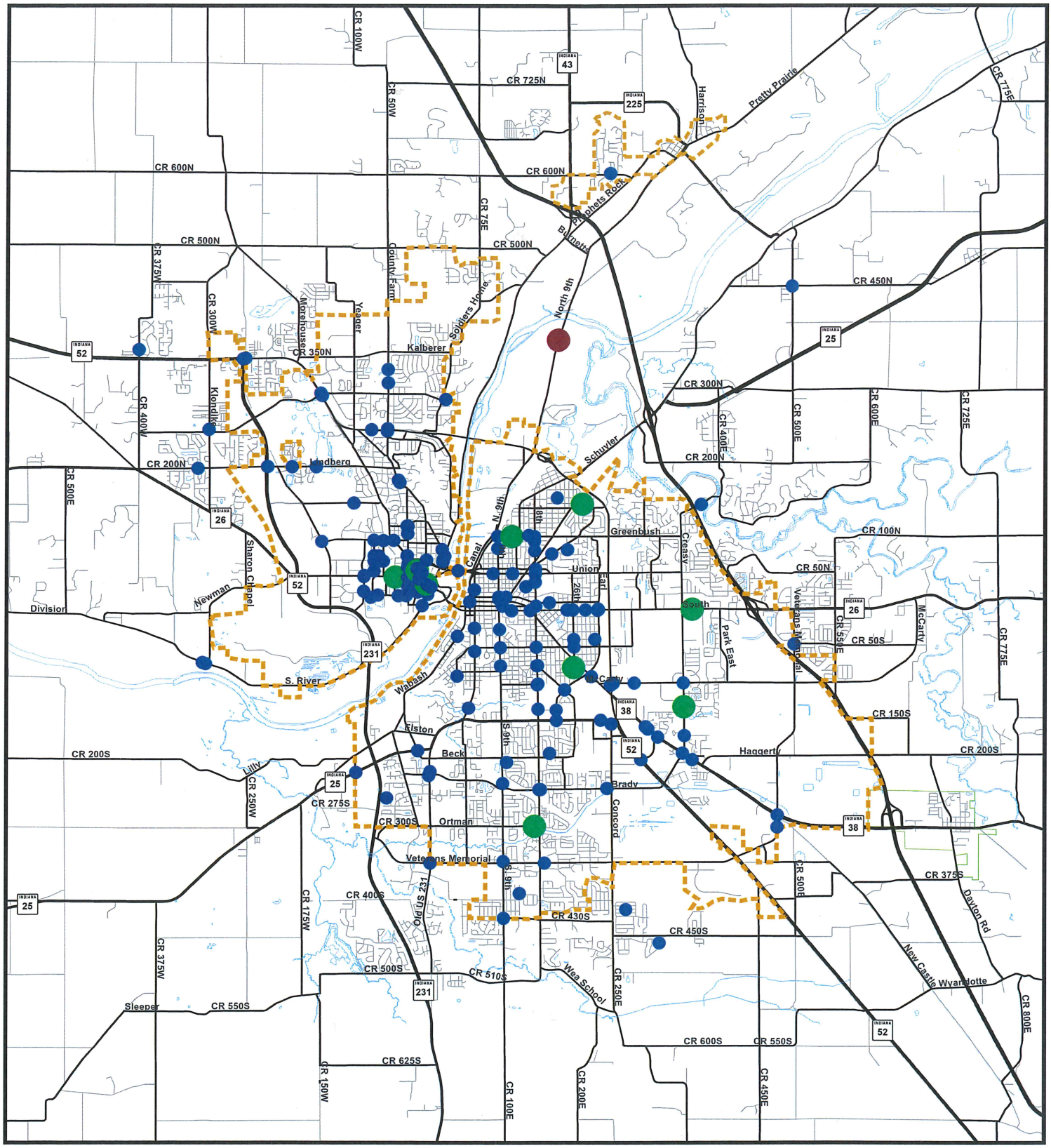
In Lafayette, there were three corridors that had a significant number of crashes. 18th Street had the most with 14 crashes. They were located between Greenbush Street and Brady Lane/Twyckenham Boulevard. There was a slight concentration at or north of Lafayette Jefferson High School. South and 9th Streets were the corridors with the second highest concentrations with 9 crashes a piece. The majority of crashes on South Street occurred between Park Avenue and Earl Avenue. The crash locations along 9th Street were scattered from Greenbush Street to Ortman Lane.

Looking at individual intersections, there were only three that had multiple crashes. The South Street and Earl Avenue intersection had the most with 3 crashes. The intersections of Central and Logan at 18th Street were tied with 2 each.

In West Lafayette, most of the crashes with an injury occurred either on or near the Purdue campus. On the Purdue campus, the State Street corridor saw the most with 11 crashes with the Grant Street corridor following with 6 crashes. Looking at West Lafayette, in its entirety and including the Purdue campus, the Salisbury (11 crashes), Grant (10 crashes), and Sagamore (7 crashes) corridors saw the most crashes with an injury. There were two intersections that each had three crashes; they were at Grant Street and Meridian and North River Road at the Harrison Bridge ramp and Quincy.

The injury crashes in Tippecanoe County were mostly close to the city limits of Lafayette and West Lafayette. There was one location where two crashes occurred; that location was just west of the intersection of South River Road and CR 300W.

Figure 9: Location of Injury, Incapacitating Injury and Fatality Crashes



Legend

- Injury
- Incapaciting Injury
- Fatality

Who Was Involved in the Crashes?

By Age of Cyclists

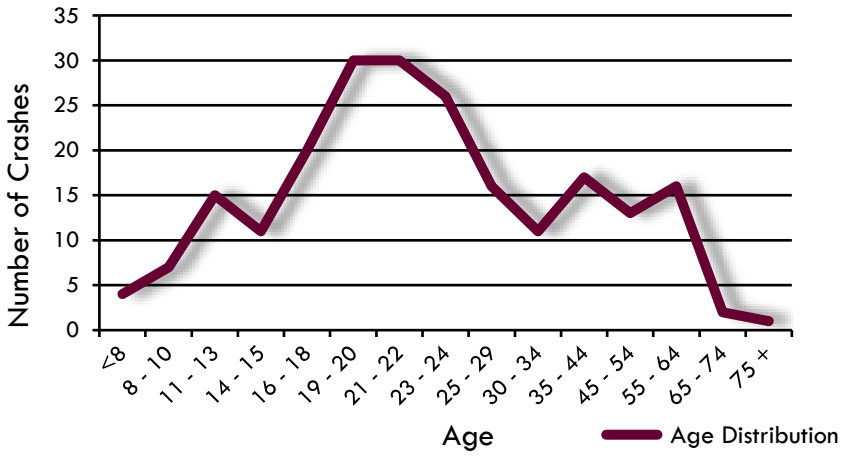
Table 21 shows that several age groups were involved in crashes more frequently than others. Sixty crashes involved persons who were either nineteen, twenty, twenty-one or twenty-two years old. If the analysis is expanded to include the age groups both younger and older, ages 16 to 24, the percentage increases to 46% of all crashes. The other age groups that were nearly equal in frequency are those persons from 11 to 13, 25 to 29, 35 to 44 and 55 to 64. Each age group accounted for roughly 7 percent of the crashes. **Figure 10** graphically shows the age distribution.

Only 11 crashes occurred involving children who are 10 or younger, or 4.5 percent of the crashes. Persons who were 65 and older were involved in 3 crashes.

Table 21: Crashes by Year and by Age Group

	2013	2014	2015	2016	2017	Total	Percent
< 8	---	1	1	2	---	4	1.7%
8-10	2	2	2	---	1	7	3.0%
11-13	5	1	2	3	4	15	6.5 %
14-15	3	1	3	2	2	11	4.8%
16-18	4	4	3	7	2	20	8.7%
19-20	7	5	5	7	6	30	13.0%
21-22	9	5	3	5	8	30	13.0%
23-24	5	1	6	6	8	26	11.3%
25-29	7	3	2	1	3	16	7.0%
30-34	2	1	2	3	3	11	4.8%
35-44	1	3	4	3	6	17	7.4%
45-54	2	1	4	2	4	13	5.7%
55-64	3	3	3	3	4	16	7.0%
65-74	---	1	1	---	---	2	0.9%
75+	1	---	---	---	---	1	0.4 %
Unknown	1	8	1	1	---	11	4.8%
	52	40	42	45	51	230	

Figure 10: Crashes by Age Group



Reviewing 2013 bicycle crash data for the entire state reveals that children between the ages of 8 and 14 years old were slightly more frequently involved in crashes than Tippecanoe County. Older teenagers and young adults, 15 to 24, were more frequently involved in crashes in Tippecanoe County than statewide. **Table 22** compares the data for the State of Indiana to that of Tippecanoe County.

In 2013, the percentage of crashes involving cyclists 45 to 54 years old was nearly the same for both Tippecanoe County and for the State (approximately 13 percent).

Table 22: Comparison to the State of Indiana, 2013

	State of Indiana (2013 Crashes)		Tippecanoe County (2013 Crashes)		Tippecanoe County (Five Year Total)	
< 8	39	*3.8%*	0	*0.0%*	4	*1.7%*
8-14	181	*17.6%*	7	*12.8%*	25	*10.9%*
15-20	195	*18.9%*	14	*25.5%*	58	*25.2%*
21-24	123	*11.9%*	14	*21.3%*	56	*24.3%*
25-34	142	*13.8%*	9	*14.9%*	27	*11.7%*
35-44	90	*8.7%*	1	*4.3%*	17	*7.4%*
45-54	132	*12.8%*	2	*12.8%*	13	*5.7%*
55-64	92	*8.9%*	3	*0.0%*	16	*7.0%*
65-74	23	*2.2%*	0	*0.0%*	2	*0.9%*
75+	14	*1.4%*	1	*0.0%*	1	*0.4%*
Unknown	0	*0.0%*	1	*8.5%*	11	*4.8%*
Total	*1,031*		*52*		*230*	

Bicycle Indiana, Bicycle Collisions in Indiana, January 2015, Issue 14-C24

Figure 11 shows the locations of crashes that involved cyclists 22 years and younger. The information was color coded to reflect approximate grade levels: elementary and younger, middle, high school and undergraduate college students.

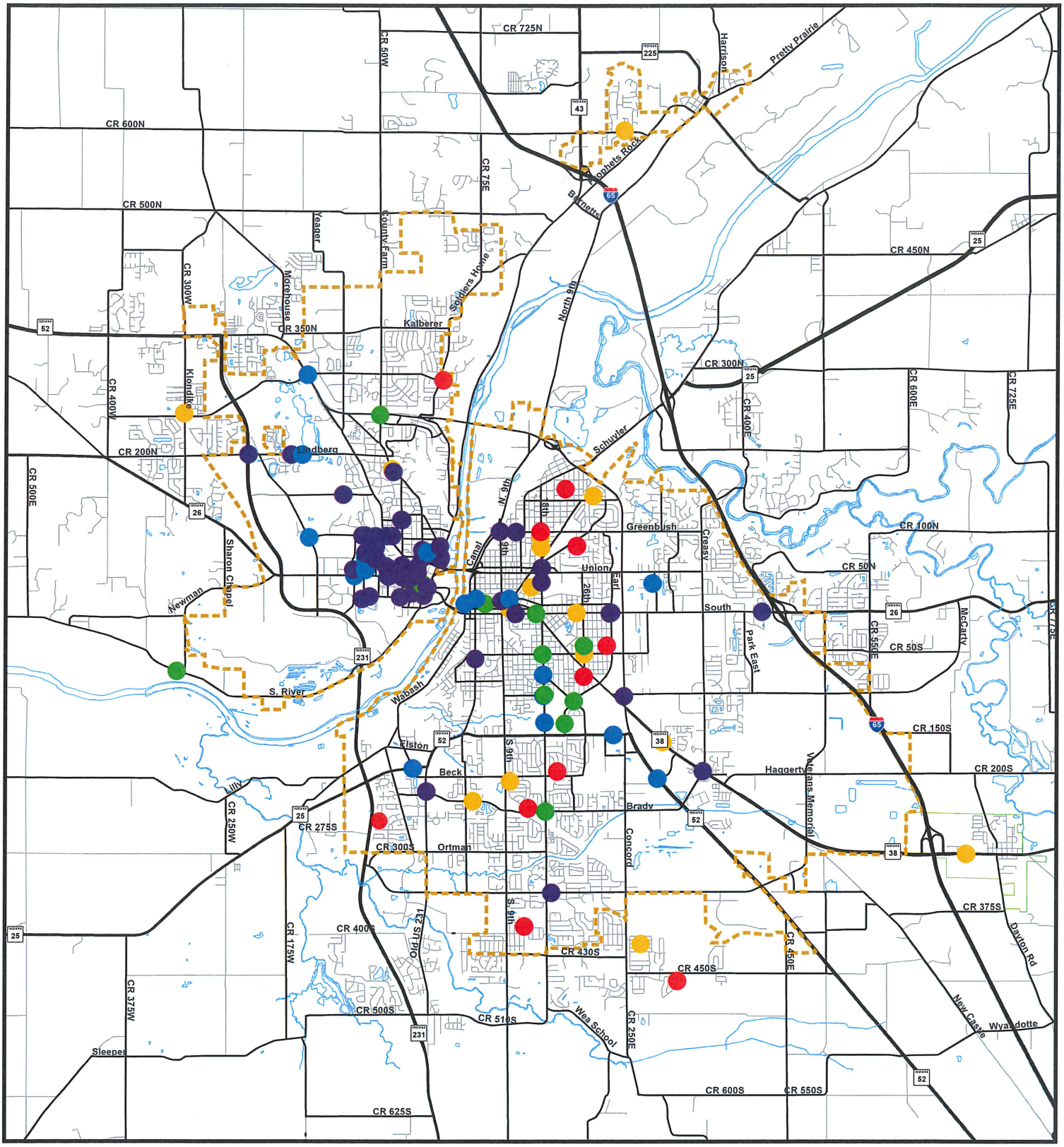
Nearly all of the crashes (10 of 11) involving children 10 and younger occurred on residential streets. The one crash that did not occur on a residential street happened at the intersection of 18th and Greenbush Streets.

Two-thirds of the crashes involving children between the ages of 11 to 13 occurred within the City of Lafayette. Seven occurred on streets designated as a minor arterial, functional classification, with two of them located on 18th Street just south of Greenbush Street, the same intersection discussed above. Three crashes were located on residential streets.

In the 16 to 18-year-old age group, 10 crashes occurred in Lafayette and 7 on or near the Purdue campus. In Lafayette, 3 crashes occurred on 18th Street near the middle school and high school, 3 were located on US 52 and 3 were located downtown. On the Purdue campus, nearly all crashes occurred on State and Russell Streets. It should also be noted that a third of the crashes involved 18-year olds.

It is no surprise that 60% of the crashes involving 19 to 22 year olds occurred on or near the Purdue campus. In West Lafayette there were several crashes at Grant and Meridian and on River Road near the Harrison Bridge ramps. Individual crash locations were on Lindberg Road and Salisbury Street. In Lafayette, the crashes were on South Street (3), 18th Street (2), Greenbush Street (2), SR 38 (1), Old US 231 (1), Veterans Memorial Parkway (1), South 4th Street (1) and 9th Street (1).

Figure 11: Bicycle Crashes Located by Age Group, 1 to 22 Years of Age



By Gender of Cyclists

Male cyclists accounted for the majority of bicycle crashes. Over 85 percent of crashes involved males versus 14 percent females. In other words, for every crash that involved a female, there were nearly six that involved a male. **Figure 12** portrays the crash data by gender. It should be noted that the information for age and/or gender was not recorded for 11 crashes.

Figure 12: Comparison of Crashes by Age Group and Sex, Cyclists

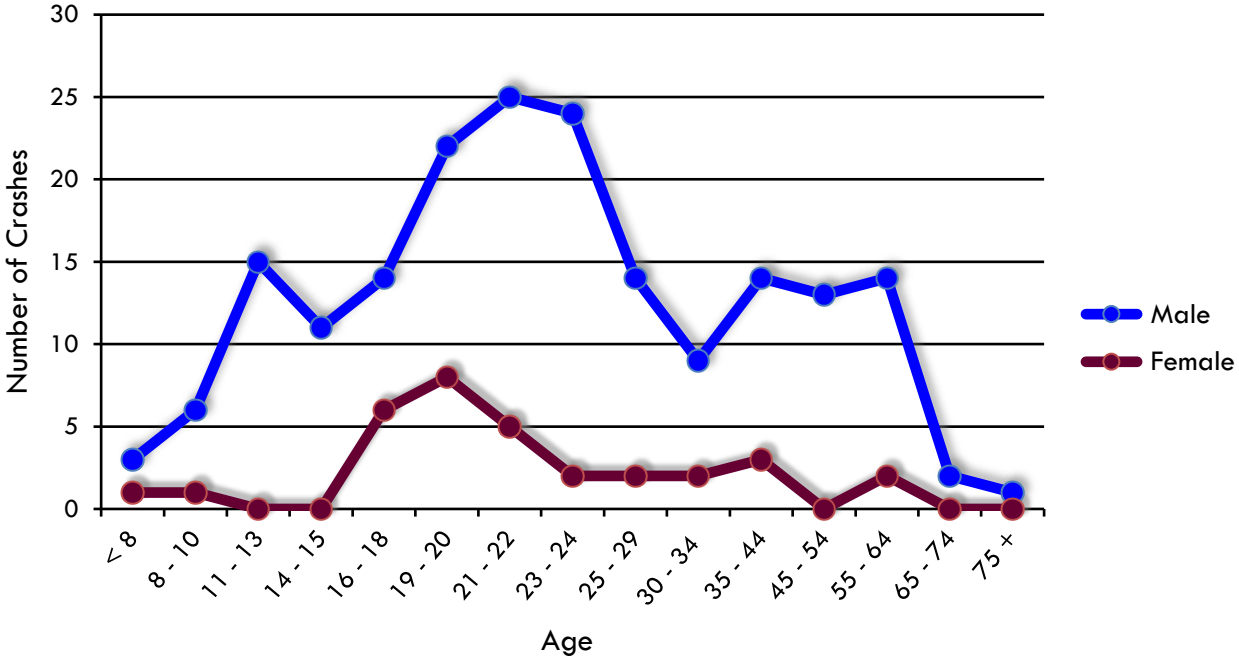


Figure 12 also shows the information by age group and **Tables 23** and **24** show the data in more detail. In looking at the data, nearly forty percent or crashes involved males from 19 to 24 years of age. **Figure 12** shows two minor peaks: 11 to 13 year olds and those between 35 to 64 years of age. Both of these minor peaks account for over 22 percent of crashes that involved male cyclists.

Figure 12 shows a concentration of crashes involve female cyclists from 16 to 22 years of age. This peak is slightly younger than for male cyclists. A quarter of all crashes involve female cyclists that were either 19 or 20 years old. Interestingly, there were five age brackets where no females were involved in a crash.

By Age and Gender of the Motor Vehicle Driver

Analysis of age and gender of motor vehicle drivers demonstrated that a greater number of females were involved in crashes. Nearly two-thirds of the crashes involved female drivers while 37 percent involved male drivers. **Figure 13** shows the crash data by gender. It should be noted that the information for age and/or gender of the vehicle driver was not recorded for 26 crashes and the motor vehicle driver was at fault in 18 of those crashes.

Figure 13 also shows the information by age group and **Tables 25** and **26** show the data in more detail. In crashes that involved females, three age groups were more frequently involved than the others: 25 to 34, 35 to 44 and 55 to 64 years old. A third of the crashes involved female drivers in these three age groups.

Table 23: Crashes by Age of Cyclists by Year, Male

Age	2013	2014	2015	2016	2017	Total	Percent
< 8	---	1	1	1	---	3	1.6%
8-10	1	2	2	---	1	6	3.2%
11-13	5	1	2	3	4	15	8.0%
14-15	3	1	3	2	2	11	5.9%
16-18	4	3	2	3	2	14	7.5%
19-20	5	3	4	7	3	22	11.8%
21-22	9	1	3	5	7	25	13.4%
23-24	5	1	5	5	8	24	12.8%
25-29	7	2	1	1	3	14	7.5%
30-34	2	1	1	2	3	9	4.8%
35-44	1	3	4	3	3	14	7.5%
45-54	2	1	4	2	4	13	7.0%
55-64	3	2	3	3	3	14	7.5%
65-74	---	1	1	---	---	2	1.1%
75+	1	---	---	---	---	1	0.5%
Total	48	23	36	37	43	187	85.4%

Table 24: Crashes by Age of Cyclists by Year, Female

Age	2013	2014	2015	2016	2017	Total	Percent
< 8	---	---	---	1	---	1	3.1%
8-10	1	---	---	---	---	1	3.1%
11-13	---	---	---	---	---	---	0.0%
14-15	---	---	---	---	---	---	0.0%
16-18	---	1	1	4	---	6	18.8%
19-20	2	2	1	---	3	8	25.0%
21-22	---	4	---	---	1	5	15.6%
23-24	---	---	1	1	---	2	6.3%
25-29	---	1	1	---	---	2	6.3%
30-34	---	---	1	1	---	2	6.3%
35-44	---	---	---	---	3	3	9.4%
45-54	---	---	---	---	---	---	0.0%
55-64	---	1	---	---	1	2	6.3%
65-74	---	---	---	---	---	---	0.0%
75+	---	---	---	---	---	---	0.0%
Total	3	9	5	7	8	32	14.6%

In crashes that involved male drivers, there were several age groups that had a larger percentage of crashes. Those age groups were 25 to 34 and 45 to 54 with 14 crashes for the first group and 12 in the second.

Figure 13: Comparison of Crashes by Age Group and Sex, Vehicle Driver

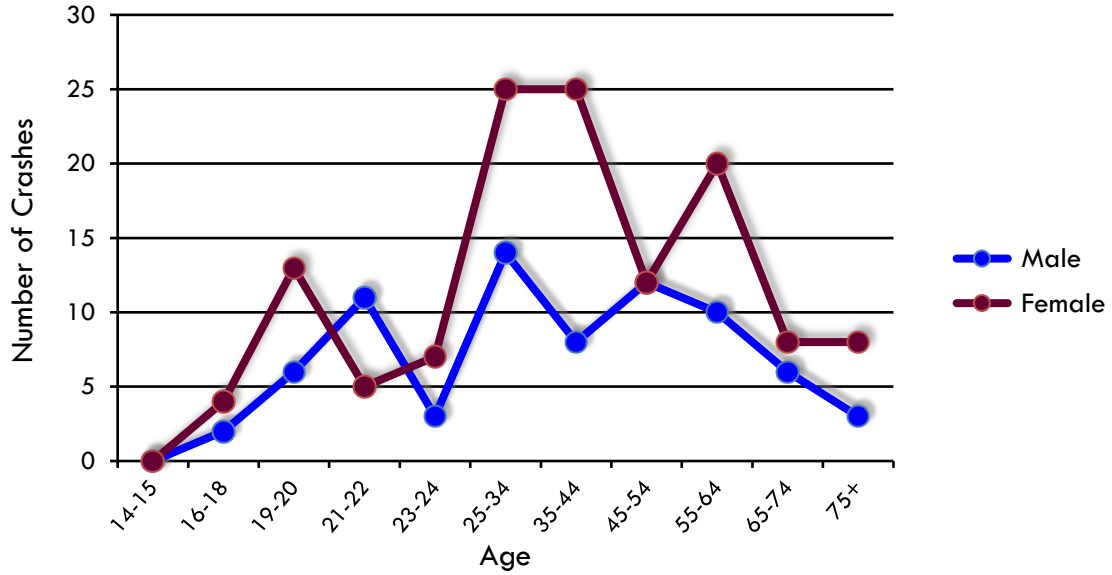


Table 25: Crash by Age of Driver by Year, Male

Age	2013	2014	2015	2016	2017	Total	Percent
14-15	---	---	---	---	---	---	*0.0%*
16-18	---	---	1	---	1	2	*2.7%*
19-20	---	1	---	4	1	6	*8.0%*
21-22	3	4	1	1	2	11	*14.7%*
23-24	---	---	---	2	1	3	*4.0%*
25-34	5	2	3	2	2	14	*18.7%*
35-44	1	---	1	2	4	8	*10.7%*
45-54	1	1	---	5	5	12	*16.0%*
55-64	1	1	2	3	3	10	*13.3%*
65-74	2	1	3	---	---	6	*8.0%*
75+	---	1	---	1	1	3	*4.0%*
Total	13	11	11	20	20	75	37.1%

Table 26: Crash by Age of Driver by Year, Female

Age	2013	2014	2015	2016	2017	Total	Percent
14-15	---	---	---	---	---	---	*0.0%*
16-18	---	---	2	1	1	4	*3.1%*
19-20	2	2	6	2	1	13	*10.2%*
21-22	1	---	---	1	3	5	*3.9%*
23-24	1	2	---	2	2	7	*5.5%*
25-34	6	3	7	5	4	25	*19.7%*
35-44	10	5	3	1	6	25	*19.7%*
45-54	5	1	1	3	2	12	*9.4%*
55-64	5	4	4	3	4	20	*15.7%*
65-74	1	2	2	1	2	8	*6.3%*
75+	3	1	1	1	2	8	6.3%
Total	34	20	26	20	27	127	62.9%

Where Did Crashes Occur?

By Location

Figure 14 shows the location of bicycle crashes throughout Tippecanoe County over the five-year study period. While the majority of crashes appear to be clustered in the heart of both cities and on the Purdue campus, crashes did occur in suburban areas and in rural Tippecanoe County.

In order to better understand and identify problematic locations such as intersections and corridors, the community was divided into four subareas. The subareas also made it easier to look at the data where there were concentrations of crashes. The sub-areas closely follow municipal boundaries except for the Purdue area. The Purdue area also includes Chauncey Village and the Levee.

Over the five years studied, nearly half of the crashes occurred in Lafayette and nearly thirty percent in the Purdue Levee area. **Table 27** shows the breakdown of crashes by area. Just over 16 percent of the crashes occurred in the remaining portion of West Lafayette and nearly 7 percent occurred in the rural portions of the county.

Table 27: Crashes by Sub-Area

	2013	2014	2015	2016	2017	Total	
PU/Levee	11	13	9	14	16	63	*27.6%*
West Lafayette	8	8	8	6	7	37	*16.2%*
Lafayette	27	14	23	24	25	113	*49.6%*
Rural Tipp. Co.	6	4	1	1	3	15	*6.6%*
	52	39	41	45	51	228	

Lafayette

Figure 15 shows the location of crashes within the City of Lafayette. There were 113 reported over the five-year period or 49.6%. With the City encompassing just over 29 square miles that equates to 3.9 crashes per square mile for the five years.

Another area of crash concentration is in and near the downtown, roughly the area bounded by Salem Street, 18th Street, Alabama and the Wabash River. Over a third of the crashes in Lafayette, 35.7%, were in this area. **Table 28** breaks down the crashes by year for the downtown area and for the remaining part of Lafayette.

Table 28: Crashes in Lafayette

	2013	2014	2015	2016	2017	Total	
Downtown Lafayette	4	3	5	6	5	23	*20.4%*
Remaining Lafayette	23	11	18	18	20	90	*79.6%*
	27	14	23	24	25	113	

Comparing the two areas, the number of crashes in the downtown area fluctuated between 3 and 6 crashes per year. The high of 6 occurred in 2016. The crashes in the remaining portion of Lafayette saw a high number in 2013 with a decrease in over half of that amount the following year. Thereafter the number of crashes remained stable.

Figure 14: Bicycle Crashes Located in Tippecanoe County, 2013-2017

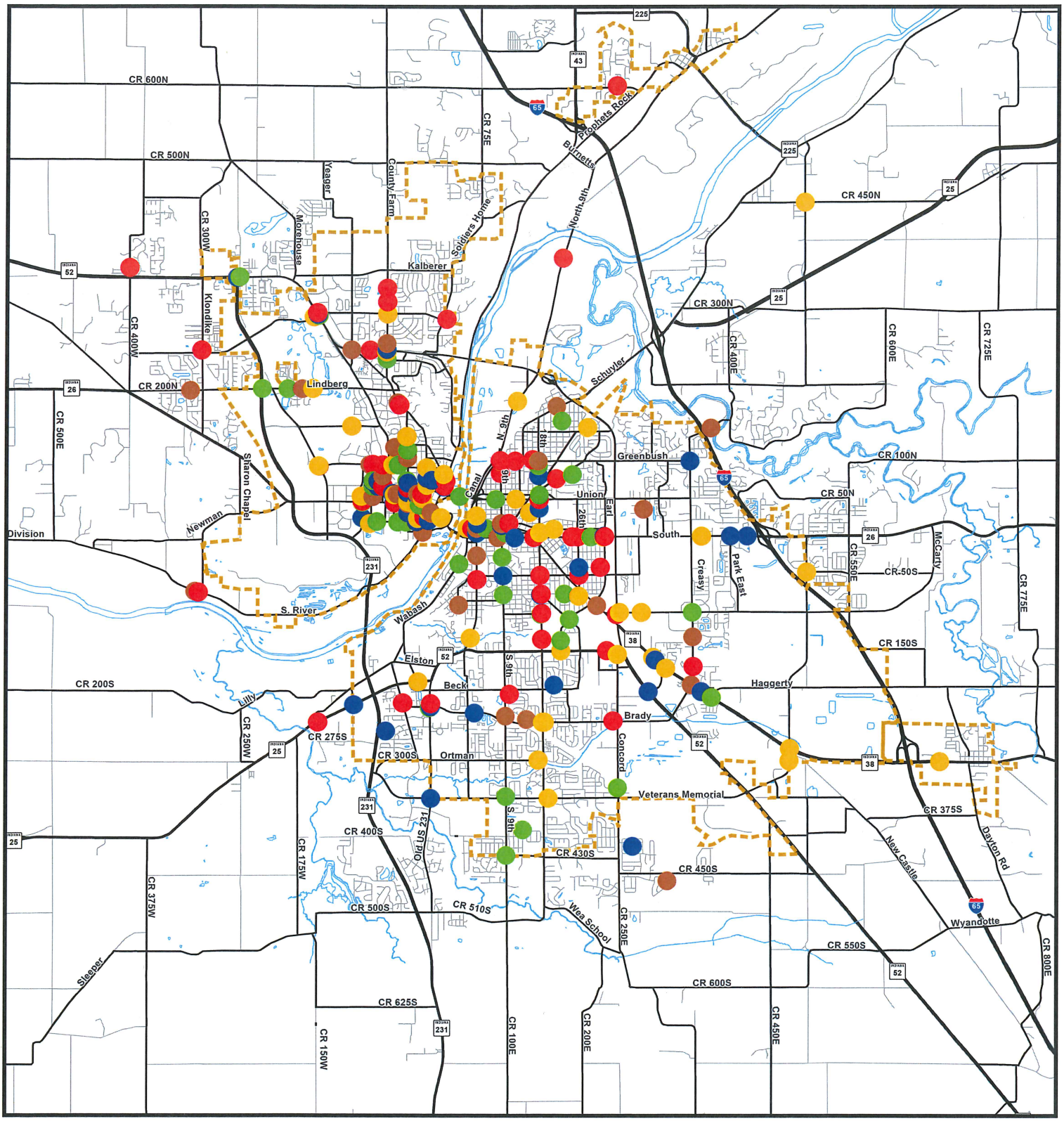
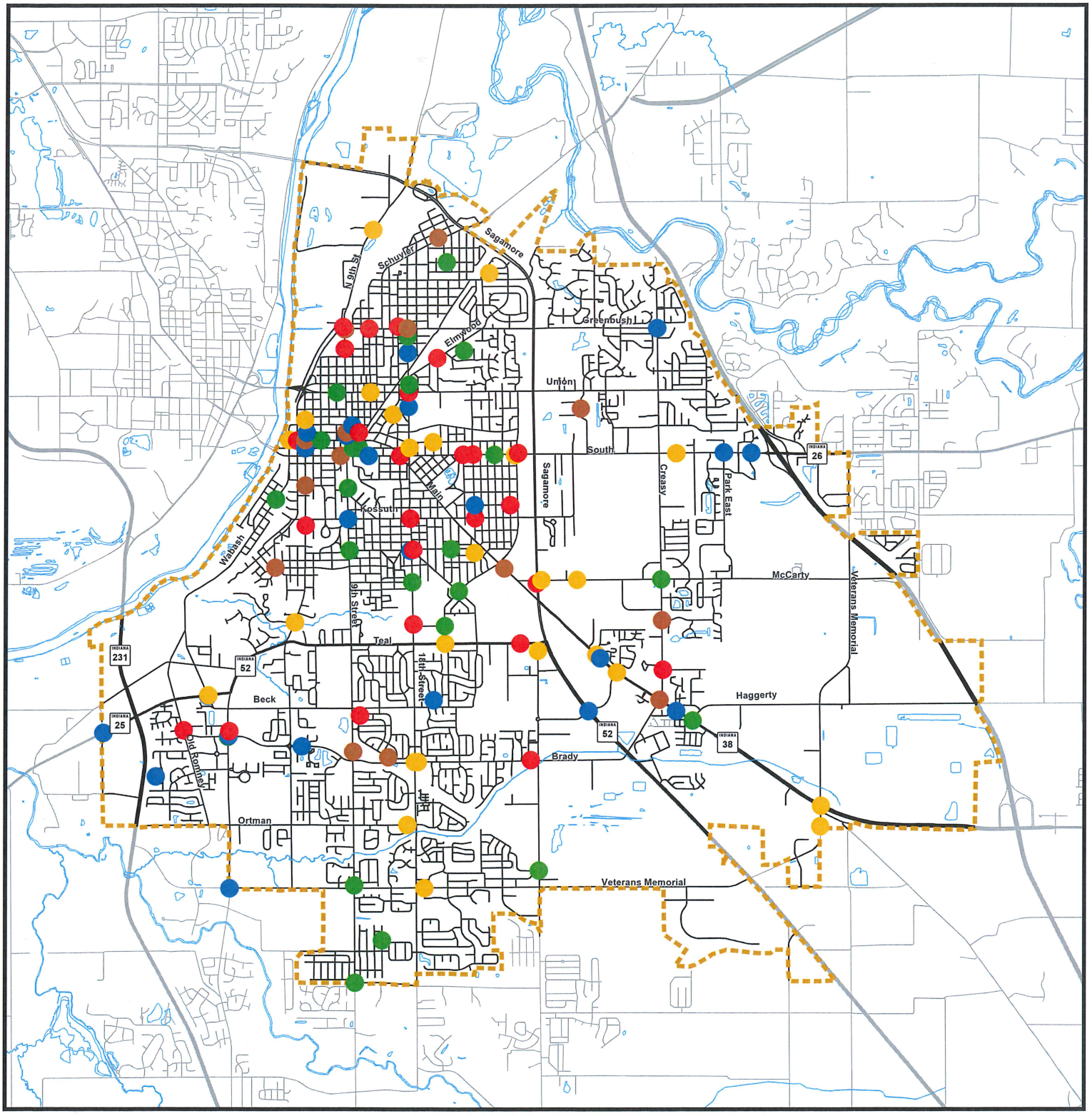


Figure 15: Bicycle Crashes Located in Lafayette



Crashes occurred on nearly all of the major roads that cross Lafayette. The following eleven corridors experienced four or more crashes over the five-year period: 18th Street (14), 9th Street (12), South Street (11), 4th Street (10), the Creasy/Brady Lane corridor (10), Greenbush (7), SR 38 (6), Ferry Street (5), Earl Avenue and 22nd Street (5), the Union/Salem corridor (4) and Main Street (4).

There were no intersections within Lafayette where there were three or more crashes reported. There were seven intersections where two crashes occurred per intersection: Greenbush and 9th Street, 9th Street and Ferry, South Street and McCarty Lane, 18th Street and Central Avenue, 18th Street and Twyckenham Boulevard, and Old US 231 and Twyckenham Boulevard.

West Lafayette Area

Outside of the Purdue campus area, there were 37 crashes involving bicycles over the five-year period in West Lafayette. Covering just over 11.3 square miles, there were 3.3 crashes per square mile. **Figure 16** shows where those crashes occurred.

There are six corridors where four or more crashes occurred. The Salisbury Street corridor had the most with 11 crashes. There were 7 crashes along the Sagamore Parkway/US 52 corridor. Grant Street and Cumberland Avenue recorded 5 crashes and there were 4 crashes apiece in the Lindberg and River Road corridors.

Looking at crashes by intersection, there were five within West Lafayette where two or more crashes were reported. Grant and Meridian and Sagamore Parkway and Cumberland were the only intersections to experience three crashes. There were four intersections where two crashes occurred at each intersection: River Road at the Harrison Bridge west-bound ramps, Sagamore Parkway and Salisbury Street, Stadium Avenue and McCormick Road and at US 52 and US 231.

Purdue Area

Even though the Purdue area, including Chauncey Village and the Levee, encompasses only 2.5 square miles, 63 crashes occurred in this area. This gives us a crash rate of 25.2 crashes per square mile. That's significantly higher than Lafayette's and West Lafayette's overall rates. Over 27 percent of all the bicycle crashes during the five-year period occurred in this area. **Figure 17** shows the location of the crashes.

Figure 17 also shows numerous crashes on State Street, especially between Grant Street and River Road. Along the entire corridor, there were 18 crashes with nearly three-quarters, or 13 occurring between Grant and River Road. Twenty percent of the crashes in the Purdue area occurred on State Street. After 2017 State Street was completely redesigned and rebuilt with bike facilities including a cycle track which should favorably affect bike crashes.

Crashes occurred on nearly all of the major roads that cross the Purdue area. Excluding State Street, the following fourteen corridors saw four or more crashes over the five-year period: Grant (9), Russell (8), Salisbury (8), Stadium (6), Northwestern (6), Memorial Mall (5), 4th Street (5), Martin Jischke (4), University (4), Chauncey (4), River Road (4), Harrison (4), Wood (4) and 3rd Street (4).

The two intersections that had the highest number of crashes were located in the Purdue area. They were State Street at Salisbury with 5 and Russell and 4th Street with 4.

Figure 16: Bicycle Crashes Located in West Lafayette

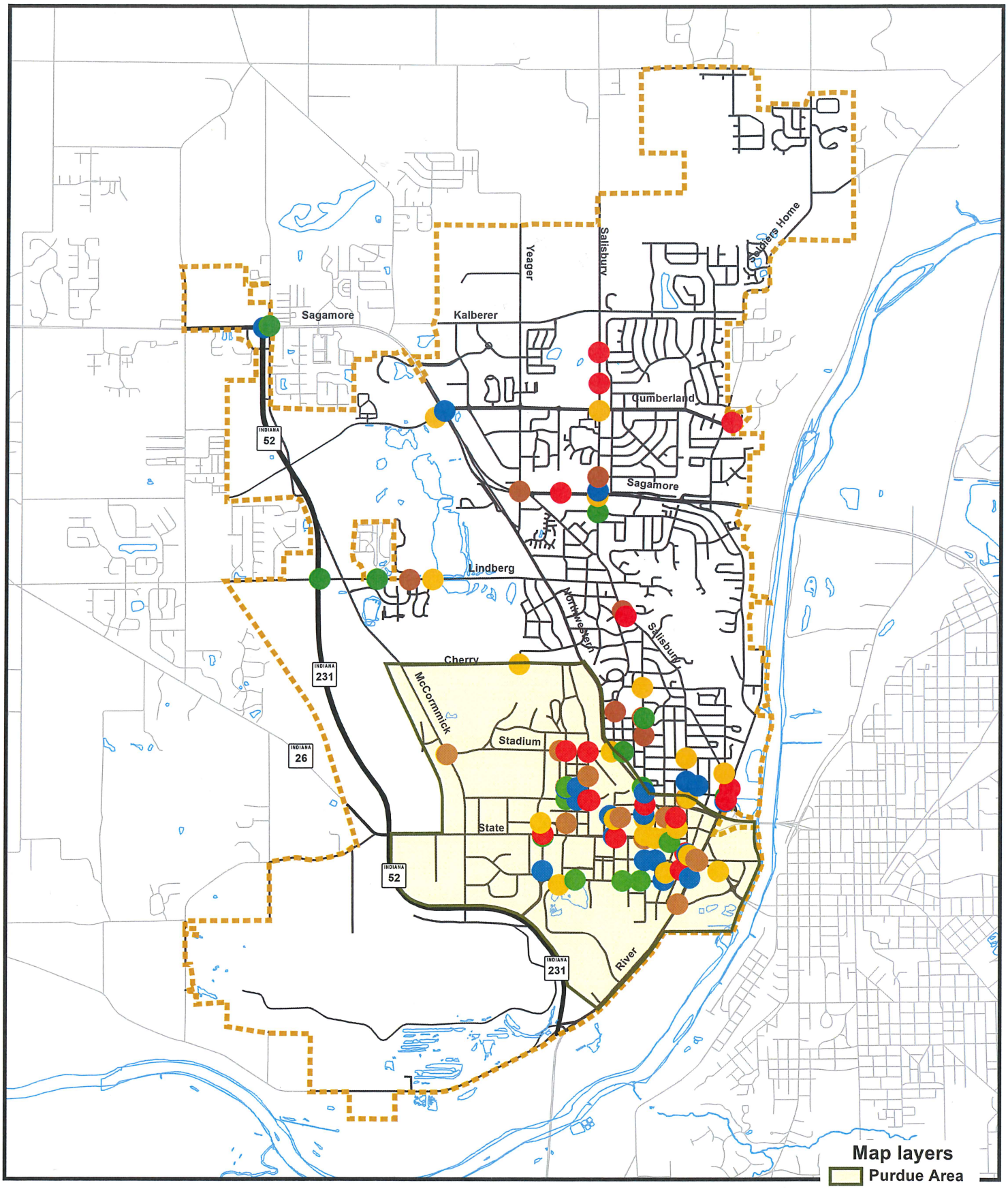
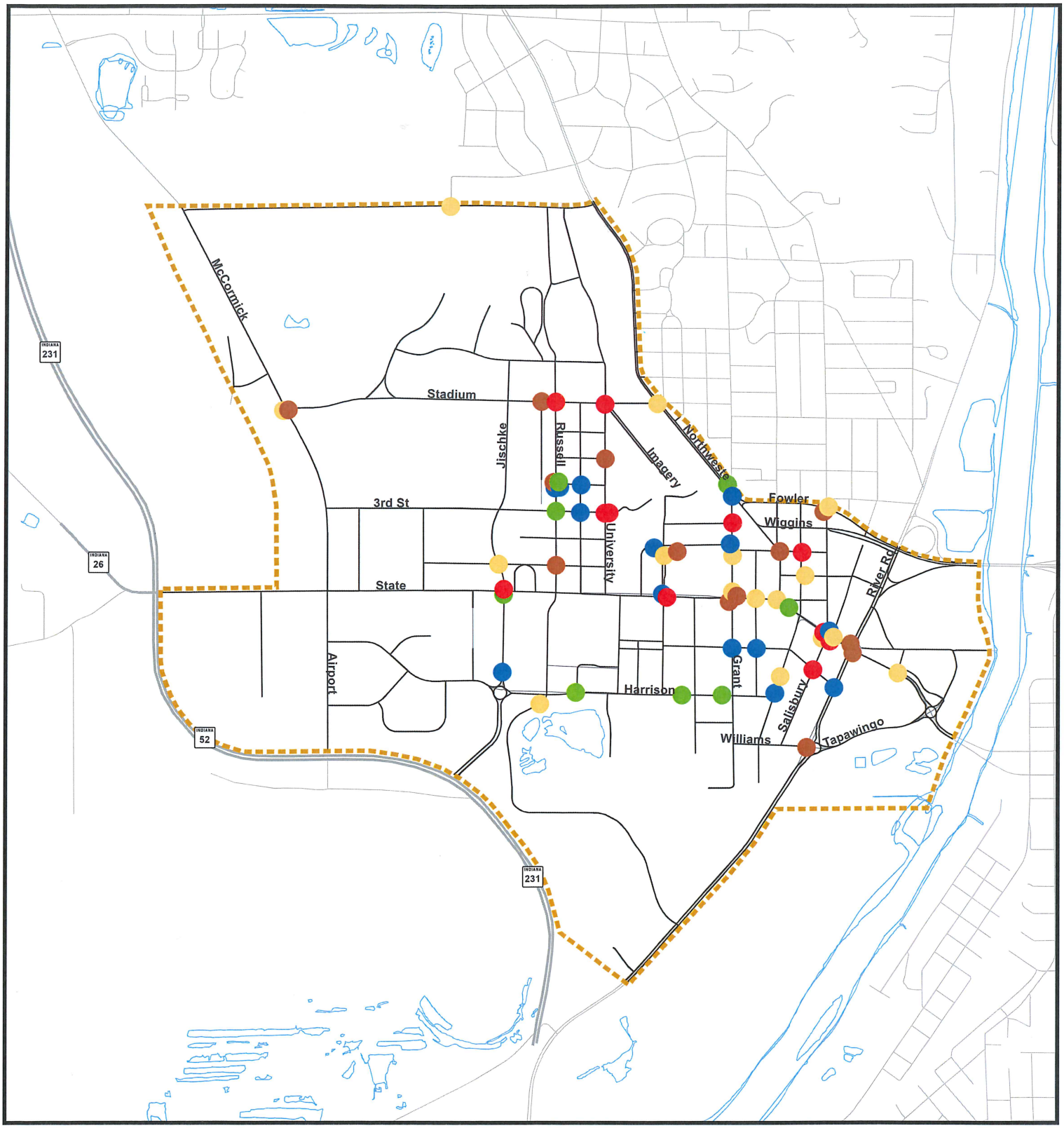


Figure 17: Bicycle Crashes Located in the Purdue Area



Excluding the two intersections just mentioned, there were an additional 8 intersections in the Purdue area that had two or more crashes per intersection. There was one intersection where three crashes were reported: South and Grant Streets.

Seven intersections had two crashes per intersection. They were: State Street at Martin Jischke, Marsteller and River Road, at University and 3rd Streets, at Stadium and McCormick Road, at Grant and Northwestern Avenue, and at Salisbury Street and Fowler Avenue.

There were no crashes reported on State Street at University, Russell or McCormick.

Rural Tippecanoe County

The number of crashes that occurred in the suburban fringe and rural portions of Tippecanoe County was substantially fewer than in both cities and the Purdue area, accounting for 15 crashes. That translates to 3.3% of all the crashes over five years. Comparing the number of crashes by square mile, the rate is extremely small. Of the 15 crashes, one did occur on the Harrison Bridge which is outside the city limits of both Lafayette and West Lafayette.

Figure 18 shows the location of the crashes. Nearly all of them, 11, occurred on either county roads that are outside of residential subdivisions (9 crashes) or state roads (2 crashes). A third of the crashes occurred west of West Lafayette with two on River Road just west of Klondike Road (CR 300W). Nearly all of the other crashes were on the fringe of the City of Lafayette except for two. One was located at the intersection of CR 450N and CR 500E and the other on North 9th Street. That location is the site of the only fatality crash in the 5-year period.

The three remaining crashes occurred in residential subdivisions and all three involved children age twelve or younger.

By Specific Location

Geographically we know where all of the crashes occur. Another way to analyze the crash data is to look at where they occurred on the roadway. For example, many of the crashes that occurred in Tippecanoe County took place at intersections. Those that had more than one crash reported have already been individually identified. This section looks at crashes that occurred on the roadway and at specific areas of the road such as in bike lanes, at driveways and alleys, on trails and sidepaths and on sharrows.

By far, the majority, 51.8%, of crashes occurred at an intersection. Looking at the data by year, the number was consistent at around 22 to 23 per year with slightly more in 2013 and 2015. **Table 29** displays this information.

The next most frequent locations were in the roadway, approximately 18 percent, and at driveways, 10 percent. While the number of crashes by year that occur on the roadway varies from 6 (2014) to 12 (2013), there is a significant fluctuation by year for crashes that occur at driveways. The number that occurred at driveways varied from a high of 9 (2017) to a low of 1 (2014). **Figure 19** shows where the roadway and driveway crashes occurred.

Figure 18: Bicycle Crashes Located in Rural Tippecanoe County

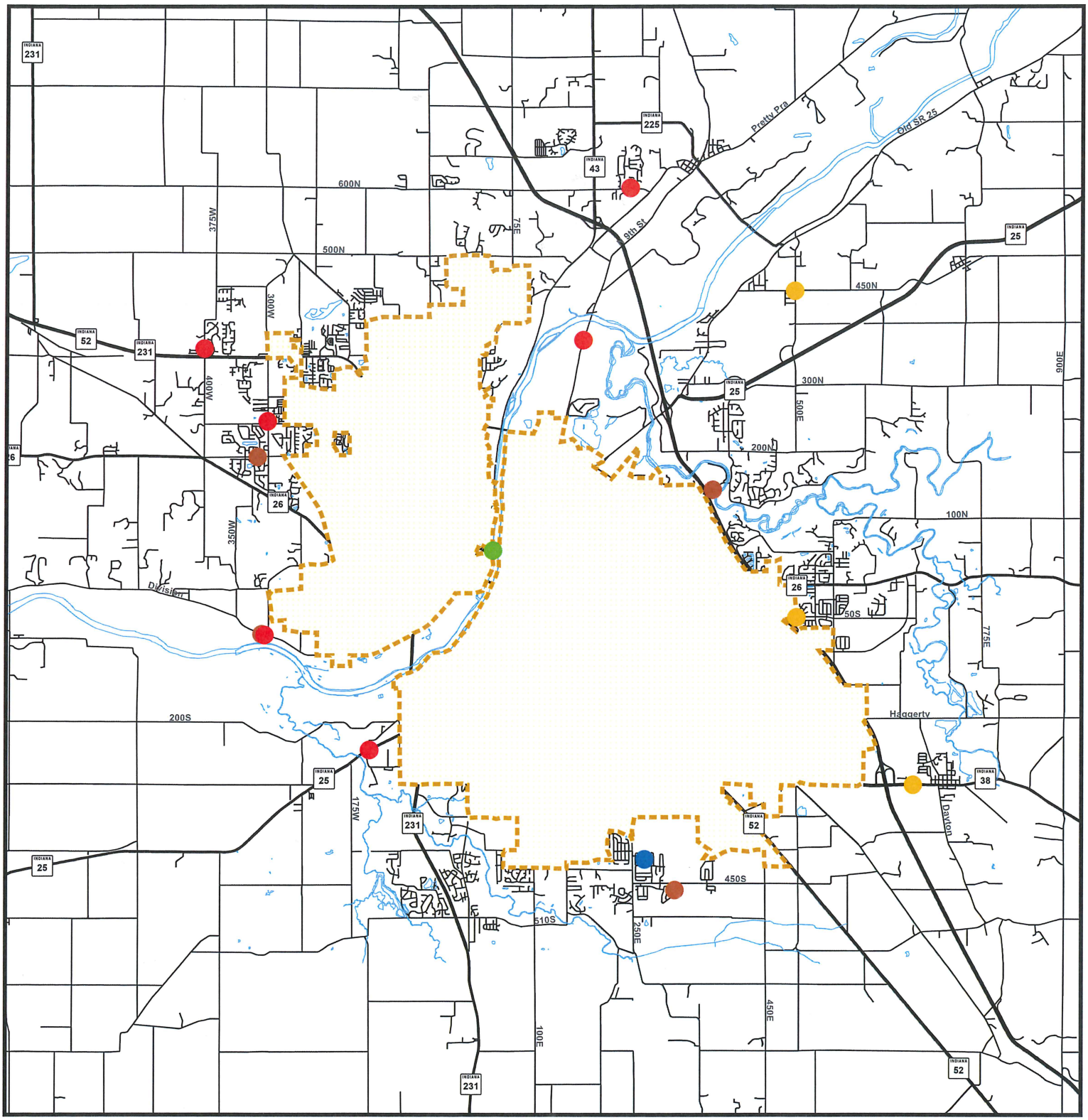
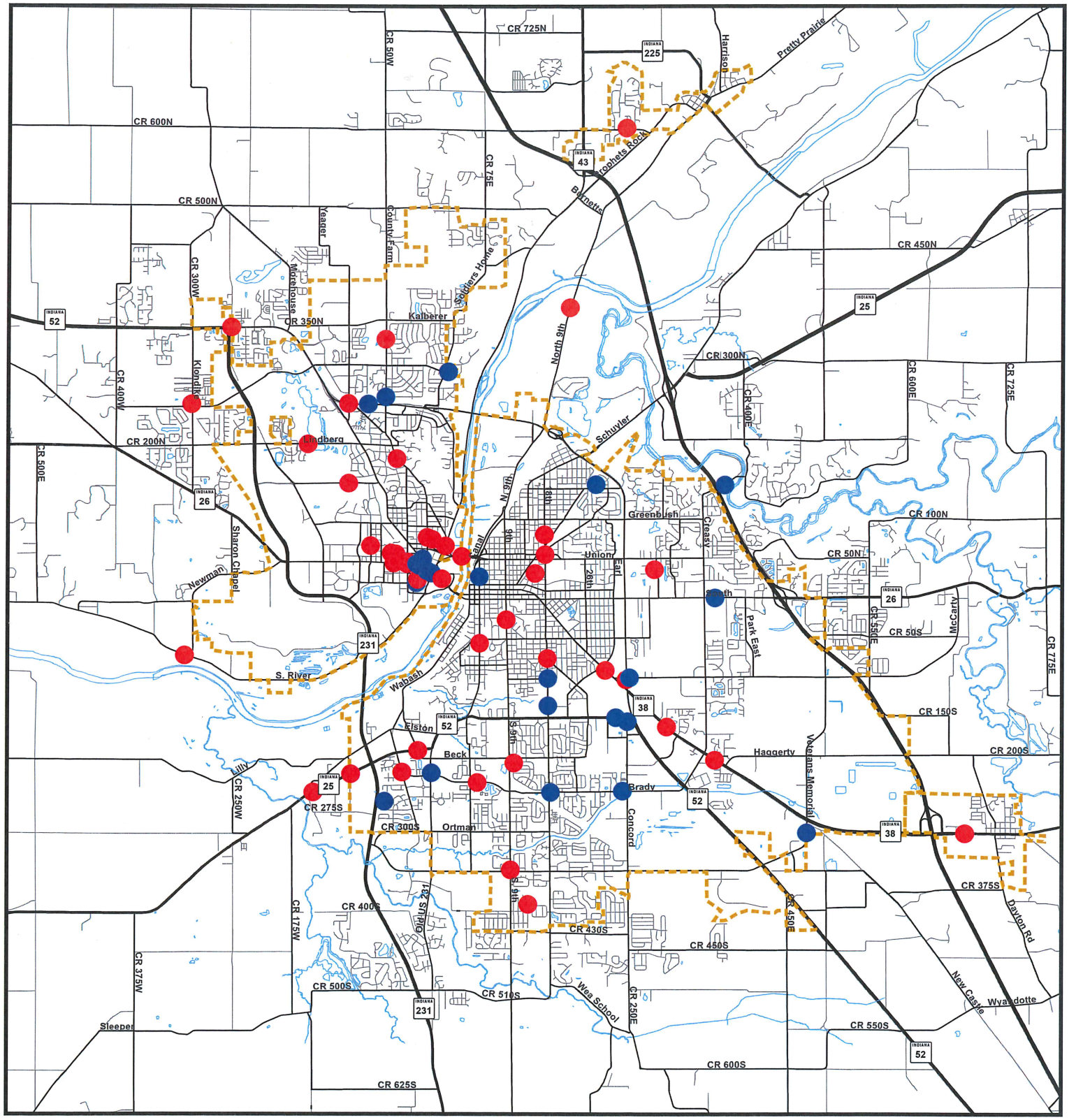


Figure 19: Bicycle Crashes that Occurred on the Roadway and at Driveways



Legend

- At Driveway
- In Roadway

There were 9 crashes relating to alleys. This includes crashes where an alley meets a road or that occurred in the alley. Three occurred in West Lafayette with two of them on Harrison Street. The other 6 crashes occurred in Lafayette; two in the downtown area.

Table 29: Crashes by Specific Location

Year	Roadway	Intersection	Driveway	Alley	Trail/ Sidepath	Bike Lane	Total
2013	12	26	8	0	4	2	52
2014	6	22	4	1	2	4	39
2015	7	25	1	3	2	3	41
2016	9	22	2	4	3	5	45
2017	8	23	9	1	6	4	51
Total	42	118	24	9	17	18	228

Both cities, as well as the county, have an established system of bike lanes, sidepaths and trails. Over the five-year period, there were 35 crashes reported at or on these facilities. That's roughly 15 percent of all the bicycle crashes. As seen in **Table 29**, the number of crashes was nearly equally divided between bike lanes and trails/sidepaths. The majority of crashes, 85.8 percent occurred in West Lafayette. There were 8 crashes on Grant Street where the bicyclists were using the bike lane. Half of them, 4, were between Northwestern and State Street. Two intersections, Grant and Meridian, and Russell and 4th Street each had two crashes. There were 5 crashes on Cumberland Avenue where the bicyclists were using the trail. Of those 5 crashes, three occurred at the intersection of Cumberland and Sagamore Parkway (SP 52). **Figure 19** shows the location where all of the bicycle crashes occurred compared to the location of all the bike lanes, sidepaths and trails in the county. **Figure 20** shows the crash locations.

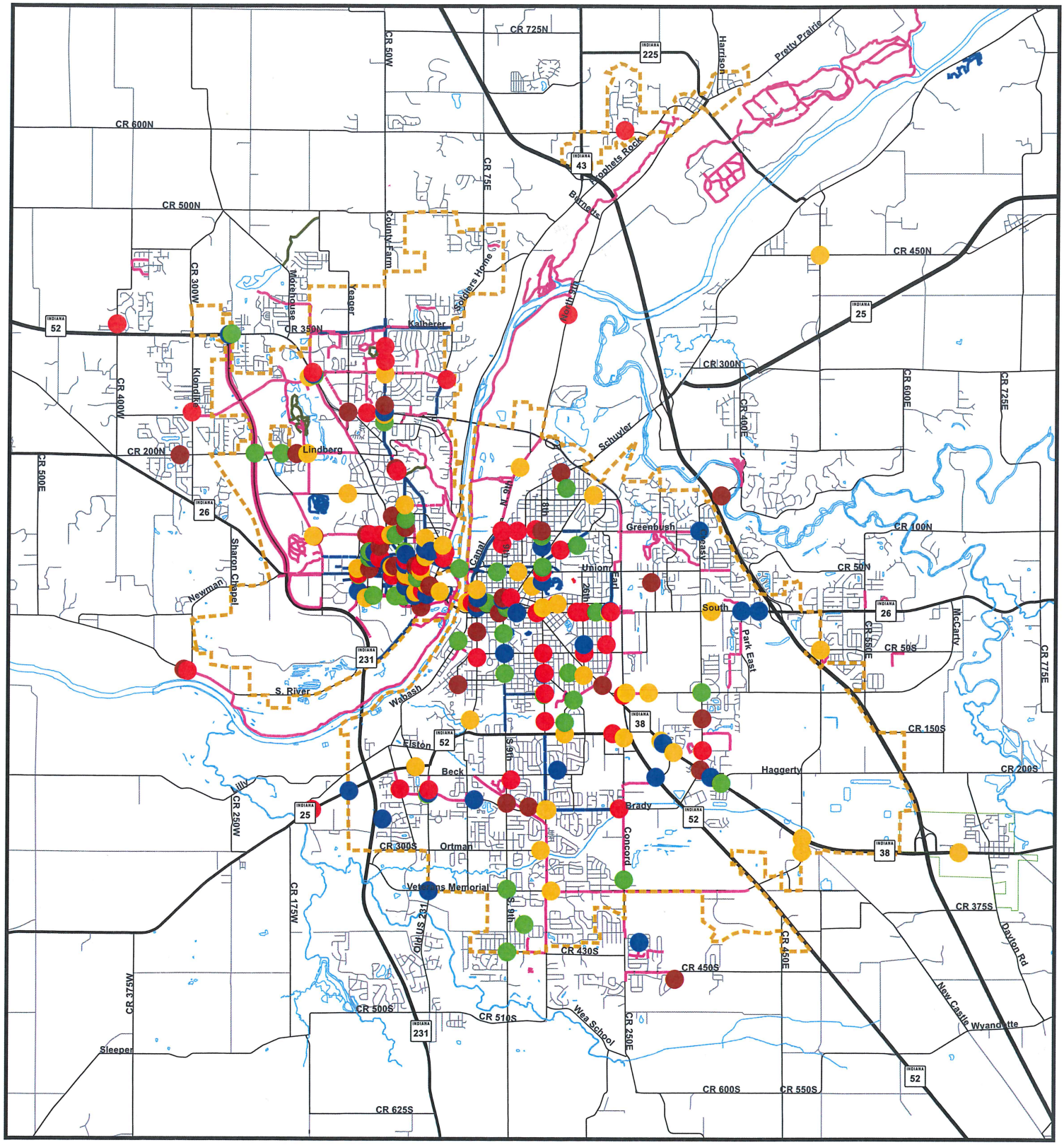
Riding on the Sidewalk and Riding Against Traffic

Riding on the Sidewalk

It is common to see bicyclists who prefer to ride on the sidewalk rather than in the roadway, bike lane or sidepath. Ordinances regulating, or allowing, cyclists the use of sidewalks vary by government agency. In Lafayette, a person may ride on the sidewalk except within the Central Business District or under certain circumstances. In West Lafayette, no one is permitted to ride on the sidewalk within a business district. Outside of a business district, no one may ride on a sidewalk unless they are fifteen or younger. On the Purdue campus, a bicycle may be ride on all designated campus drives and bike paths but may not be ride on sidewalks unless otherwise posted. Tippecanoe County and the State of Indiana have no ordinances or statutes restricting ride on sidewalks.

Table 30 shows the number of crashes that occurred where cyclists were ride on the sidewalk either right before the crash occurred or when the crash occurred. A third of all crashes, 76, involved a bicycle being ride on the sidewalk. **Figure 21** shows their locations. Most sidewalk crashes, 50, occurred in Lafayette. 20 crashes occurred on the Purdue campus. Of the remaining 6 crashes, 4 occurred in West Lafayette outside of the Purdue campus, one in the Town of Battle Ground and one occurred in the Town of Dayton.

Figure 20: Bicycle Crash Locations Compared to Existing Trails, Bike Lanes and Footpaths



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Bike Lane or Sharrow — Footpath

Trail

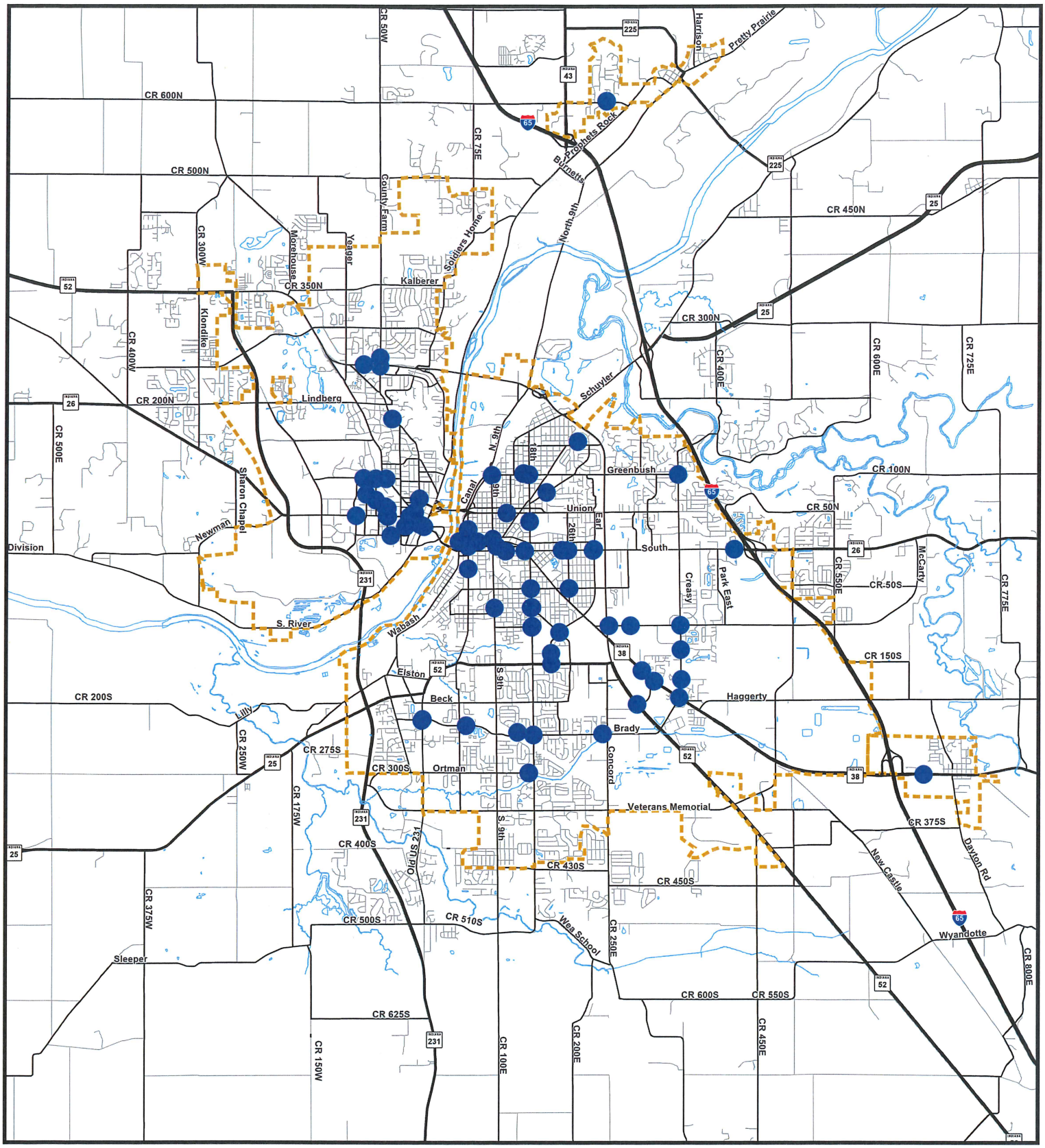
Year

2013 Crashes — 2014 Crashes

2015 Crashes — 2016 Crashes

2017 Crashes

Figure 21: Location of Crashes Where Bicycles were on/from the Sidewalk



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Crashes on/from Sidewalk

Table 30: Crashes on Sidewalks and Against Traffic

Year	Total Number	On Sidewalk	Percent	Against Traffic	Percent	Both	Percent
2013	52	19	36.5%	11	21.2%	7	13.5%
2014	39	11	28.2%	8	20.5%	4	10.3%
2015	41	11	26.8%	13	31.7%	8	19.5%
2016	45	16	35.6%	8	17.8%	6	13.3%
2017	51	19	37.3%	10	19.6%	5	9.8%
Total	228	76	33.3%	50	21.9%	30	13.2%

Looking at the crash locations on the Purdue campus and in West Lafayette, 8 crashes occurred in the State Street corridor. Six crashes occurred in the Salisbury Street corridor with three of them on or near the Purdue campus and two on or near Sagamore Parkway. Four crashes occurred on Oval Drive. There were three intersections with two crashes and they were: Salisbury Street and Fowler, State Street and Oval Drive, and State Street and River Road.

In Lafayette, the corridor with the largest number was 18th Street with 8 crashes. There were two crashes apiece at the intersections of Central and State Streets. The South Street corridor had 7 crashes with two crashes occurring at the Earl Avenue Intersection. Six crashes were located in the 4th Street/Old US 231 corridor with 4 of them downtown and the other two at the intersection of Twyckenham Boulevard. The Creasy Lane, Earl Avenue/22nd Street and Twyckenham Boulevard/Brady Lane corridors tied with 5 crashes occurring in each corridor. Roughly a quarter of the crashes, 12, occurred in the downtown area.

Riding Against Traffic

In the roadway, a cyclist is required to ride with traffic and not against it. Unfortunately, there were 50 crashes where cyclists were riding against traffic. **Figure 22** shows their locations.

Most of these crashes, 30, occurred in Lafayette and they were scattered throughout the city. The downtown area had the largest concentration with 10 crashes and Jefferson High School and Tecumseh Middle School had the second largest concentration with 5 crashes.

Looking at the crashes by corridor, 18th Street had the most with 5 crashes. The South Street corridor had 4 crashes and the 4th Street, 9th Street, and Main Street corridors each had 3 crashes.

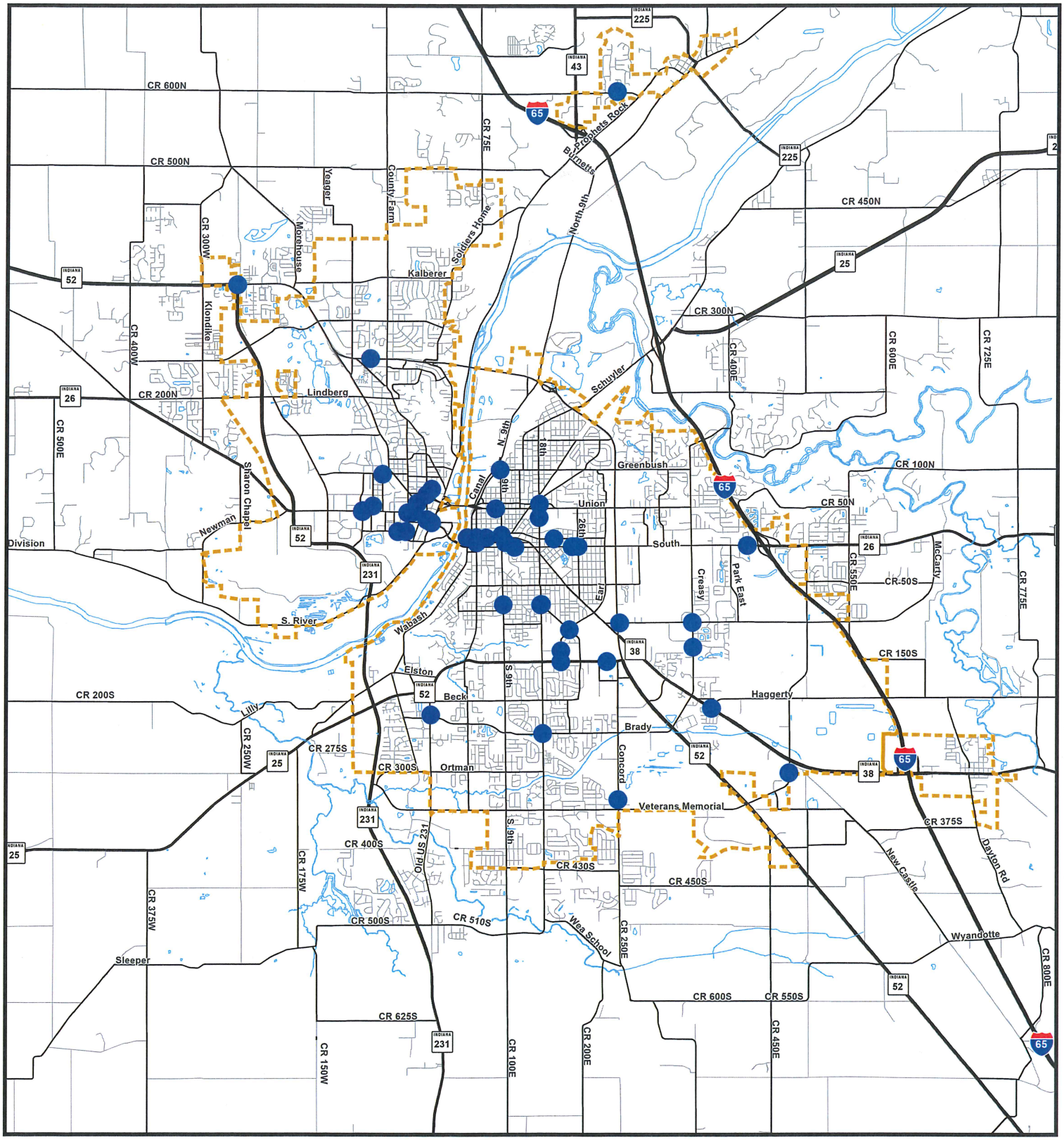
Of the 50 crashes, a third occurred on or near the Purdue campus. The majority, 9, occurred on State Street. Of those crashes, 3 occurred at the Salisbury Street intersection and four occurred at the River Road and Martin Jischke (2 apiece) intersections. Five crashes occurred in the Salisbury Street corridor with 3 occurring at River Road and the other 2 at Fowler Street.

Of the three remaining crashes, 2 occurred in the Sagamore Parkway corridor in West Lafayette and 1 occurred in the Town of Battle Ground.

Riding On the Sidewalk and Against Traffic

When riding on a sidewalk, motorists are looking for pedestrians and not expecting bicycles. Approximately 40% of cyclists who were involved in a crash while riding on the sidewalk were also traveling against traffic. Many of these crashes were located at an intersection (24). The remaining

Figure 22: Bicycle Crashes Where Bicycles were Traveling Against Traffic

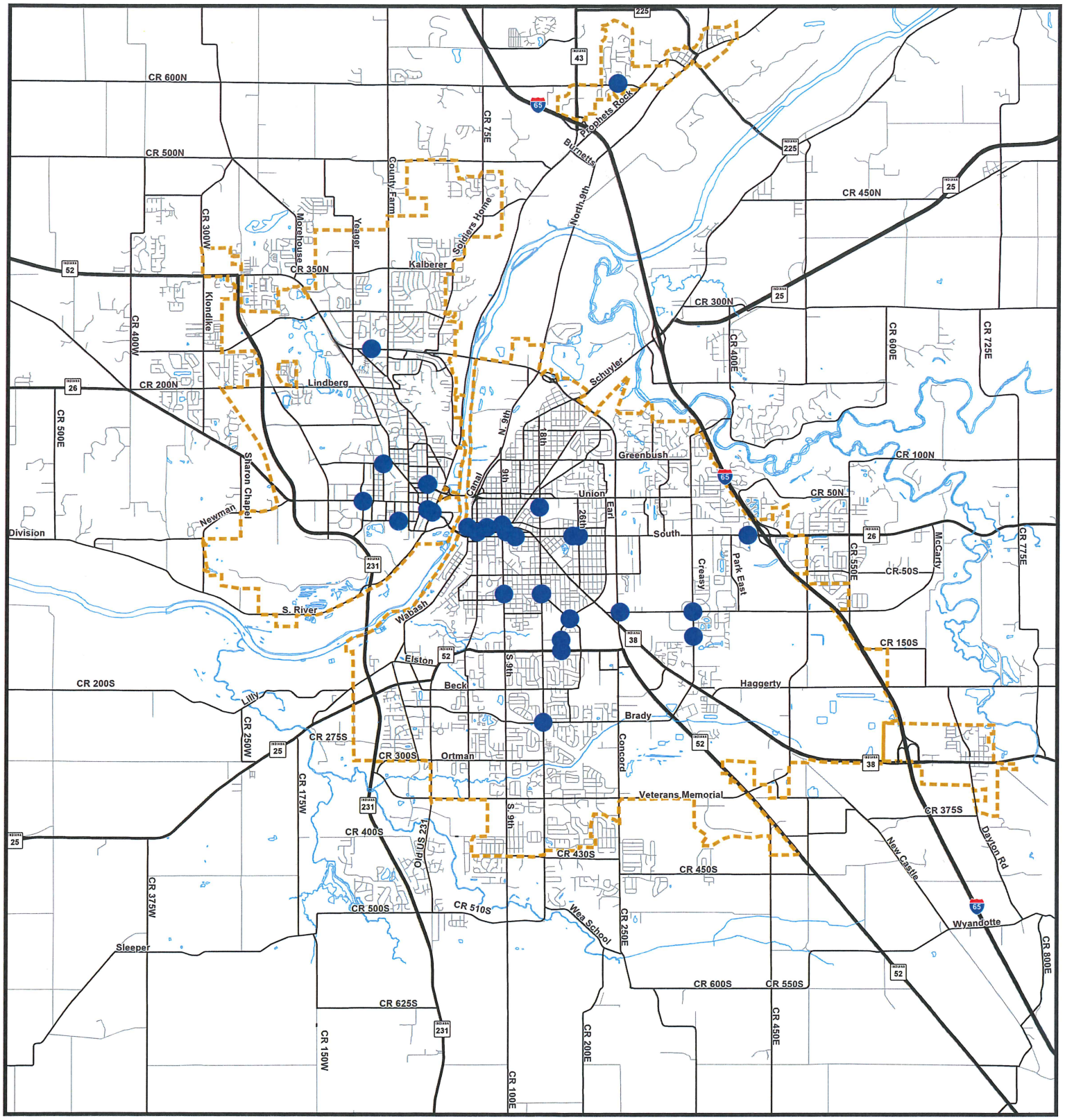


crashes occurred at a driveway (3 crashes), at an alley (2 crashes), and on the road (1 crash). **Figure 23** shows where those crashes occurred.

Many of the crashes (20) were in Lafayette with 7 occurring in the downtown area and 5 around Jefferson High School and Tecumseh Middle Schools. Of those 12 crashes, all but one occurred at an intersection.

There were 8 crashes on or near the Purdue campus. While 4 crashes occurred on State Street, 3 of them occurred at the intersections of River Road and Salisbury Street. Another 2 crashes occurred at the intersection of Salisbury Street and Fowler Avenue.

Figure 23: Bicycle Crashes Where Bicycle was Traveling on/from the Sidewalk and against Traffic



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- Crashes, on/from Sidewalk and against Traffic

Who and What are Causing the Crashes?

Who Is At Fault

A crash is a complex event, and determining fault is not always clear. To better determine who was at fault, APC staff individually reviewed each crash report. Over the five-year period, motorists were slightly more at fault than bicyclists. **Table 31** shows the yearly variation. While the fault was equally split in 2015 and bicycles slightly more at fault in 2013, motorists caused more crashes in 2014, 2016 and especially in 2017.

Table 31: Crash Data by Fault and by Year

Year	Total	Cyclists Fault	Percent	Motorists Fault	Percent	Both	Percent	Unknown	Percent
2013	52	24	*46.2%*	23	*44.2%*	5	*9.6%*	---	---
2014	39	17	*43.6%*	19	*48.7%*	3	*7.7%*	---	---
2015	41	18	*43.9%*	18	*43.9%*	4	*9.8%*	1	*2.4%*
2016	45	20	*44.4%*	22	*48.9%*	3	*6.7%*	---	---
2017	51	18	*35.3%*	30	*58.8%*	3	*5.9%*	---	---
Total	228	97	*42.5%*	112	*49.1%*	18	*7.9%*	1	*0.4%*

Primary Circumstance

Many circumstances contribute to a crash. For each crash report, law enforcement officers are allowed to specify two "Driver", one "Vehicle", and one "Environmental" contributing circumstances for each vehicle involved in the crash. For each of the vehicles, one of the four possible contributing circumstances must be listed as the primary contributing circumstance (the Primary Factor) for the crash. **Table 32** lists the primary contributing circumstances reported for all 228 crash reports.

The leading cause of crashes during the study period was "Failure to Yield Right-of-Way" with 121 incidents, or 53.1 percent. While four of the five years averaged between the upper teens and low twenties for the "Failure to Yield Right-of-Way" primary contributing circumstance, there was a significant increase in 2017 with 34 crashes.

The number of crashes due to other types of contributing circumstances are significantly less. The second leading cause was "Other" assigned to the driver and the third was pedestrian action. Nearly all the pedestrian action crashes occurred in 2013. The fourth and fifth leading causes were Disregarding Signal or Regulatory Sign and improper lane usage.

The Causes of Crashes Where the Cyclist Was at Fault

Looking at the crash data where the cyclist was at fault, the leading cause was "Failure to Yield Right-of-Way" with 32 crashes, or 33.0%. Over half of them, 18, occurred at an intersection. Another 6 occurred on the roadway and 5 occurred in or at an alley. The second and third leading causes were "Pedestrian Action" and "Disregarding Signal or Regulatory Sign" with 17 and 15 crashes respectively. Most of them occurred at an intersection; 11 and 15 each. **Table 33** shows the specific details.

Looking at where the crashes occurred, 62 occurred at an intersection while 22 occurred in the roadway. **Figure 24** shows the locations where the cyclist was at fault.

Table 32: Crash Data by Primary Factor and by Year

Primary Circumstance	2013	2014	2015	2016	2017	Total	Percent
Failure to Yield Right-of-Way	23	23	18	23	34	121	*53.1%*
Other - Driver, Explained in Narrative	6	5	6	3	4	24	*10.5%*
Pedestrian Action	20	1	---	1	1	23	*10.1%*
Disregard Signal/ Regulator Sign	---	2	5	9	3	19	*8.3%*
Improper Lane Usage	---	2	4	8	4	18	*7.9%*
Other - Environmental, Explained in Narrative	1	4	1	---	2	8	*3.5%*
Following Too Closely	---	---	3	---	---	3	*1.3%*
Wrong Way on One Way			2		1	3	*1.3%*
Unsafe Speed	1	1	---	---	---	2	*0.9%*
Left of Center	---	1	---	---	1	2	*0.9%*
Headlight Defective or Not On	1	---	---	---	---	1	*0.4%*
Improper Passing	---	---	1	---	---	1	*0.4%*
Unsafe Backing	---	---	---	1	---	1	*0.4%*
Overcorrected/Oversteering					1	1	*0.4%*
Other - Vehicle, Explained in Narrative	---	---	1	---	---	1	*0.4%*
Total	52	39	41	45	51	228	

The Causes of Crashes Where the Motorist was at Fault

The leading cause of crashes when the motorist was at fault was "Failure to Yield Right-of-Way", 82 crashes. Interestingly, the percentage of crashes from this primary contributing circumstance is significantly higher than crashes caused by bicyclists for the same contributing circumstance, 73.2% compared to 33.7%. Two-thirds of the crashes occurred at an intersection while 17 occurred at a driveway. Three of the crashes occurred at crosswalks located at 9th Street in Lafayette, Jischke Drive and Russell Street in the Purdue campus area. **Table 34** shows the breakdown by cause and location.

Dropping to a distant second and third, the next two most frequent causes were other - driver and improper lane usage. The cause, other - driver, is used by officers when the cause of the crash does not match any of the types that are available to choose from. An example would be a bicycle door accident; that is when the driver of a vehicle opens the door while the bicyclist is approaching, and the bicyclist runs into the door. There were 10 crashes listed as other - driver and they occurred at intersections, the roadway or at a driveway. There were 5 crashes listed as improper lane usage and four of them occurred at an intersection.

Similar to crashes where the bicyclist was at fault, the location where the majority of driver caused crashes occurred was at an intersection. Twenty of those crashes occurred at a driveway and 17 occurred on the roadway. **Figure 25** shows the locations where motorists were at fault.

Table 33: The Causes of Crashes Where the Cyclist Was at Fault

Cause	Number of Crashes	Percent	In Roadway	At Intersection	At Driveway	Alley
Failure to Yield	32	*33.0%*	6	18	3	*5*
Pedestrian Action	17	*17.5%*	*5*	11	1	---
Disregard Signal/ Regulator Sign	15	*15.5%*	---	15	---	---
Other - Driver	10	*10.3%*	3	6	---	1
Improper Lane Usage	9	*9.3%*	6	3	---	---
Other - Environmental	6	*6.2%*	1	4	1	---
Wrong Way / One Way	3	*3.1%*	---	1	1	1
Unsafe Speed	2	*2.1%*	---	2	---	---
Improper Passing	1	*1.0%*	---	1	---	---
Left of Center	1	*1.0%*	---	1	---	---
Over Correct / Over Steer	1	*1.0%*	1	---	---	---
Total	97		22	62	6	*7*

Table 34: The Causes of Crashes Where the Motorist Was at Fault

Cause	Number of Crashes	Percent	In Roadway	At Intersection	At Driveway	Alley	Other
Failure to Yield	82	*73.2%*	8	*54*	17	---	3
Other - Driver	10	*8.9%*	3	*5*	2	---	---
Improper Lane Usage	*5*	*4.5%*	1	4	---	---	---
Pedestrian Action	3	*2.7%*	---	3	---	---	---
Disregard Signal/ Regulator Sign	3	*2.7%*	---	3	---	---	---
Following Too Closely	3	*2.7%*	3	---	---	---	---
Improper Passing	2	*1.8%*	2	---	---	---	---
Other - Environmental	1	*0.9%*	---	1	---	---	---
Left of Center	1	*0.9%*	---	1	---	---	---
Unsafe Backing	1	*0.9%*	---	---	1	---	---
Head Light Defective	1	*0.9%*	---	1	---	---	---
Total	112		17	72	20	0	3

Figure 24: Location of Crashes Where the Bicyclist was at Fault

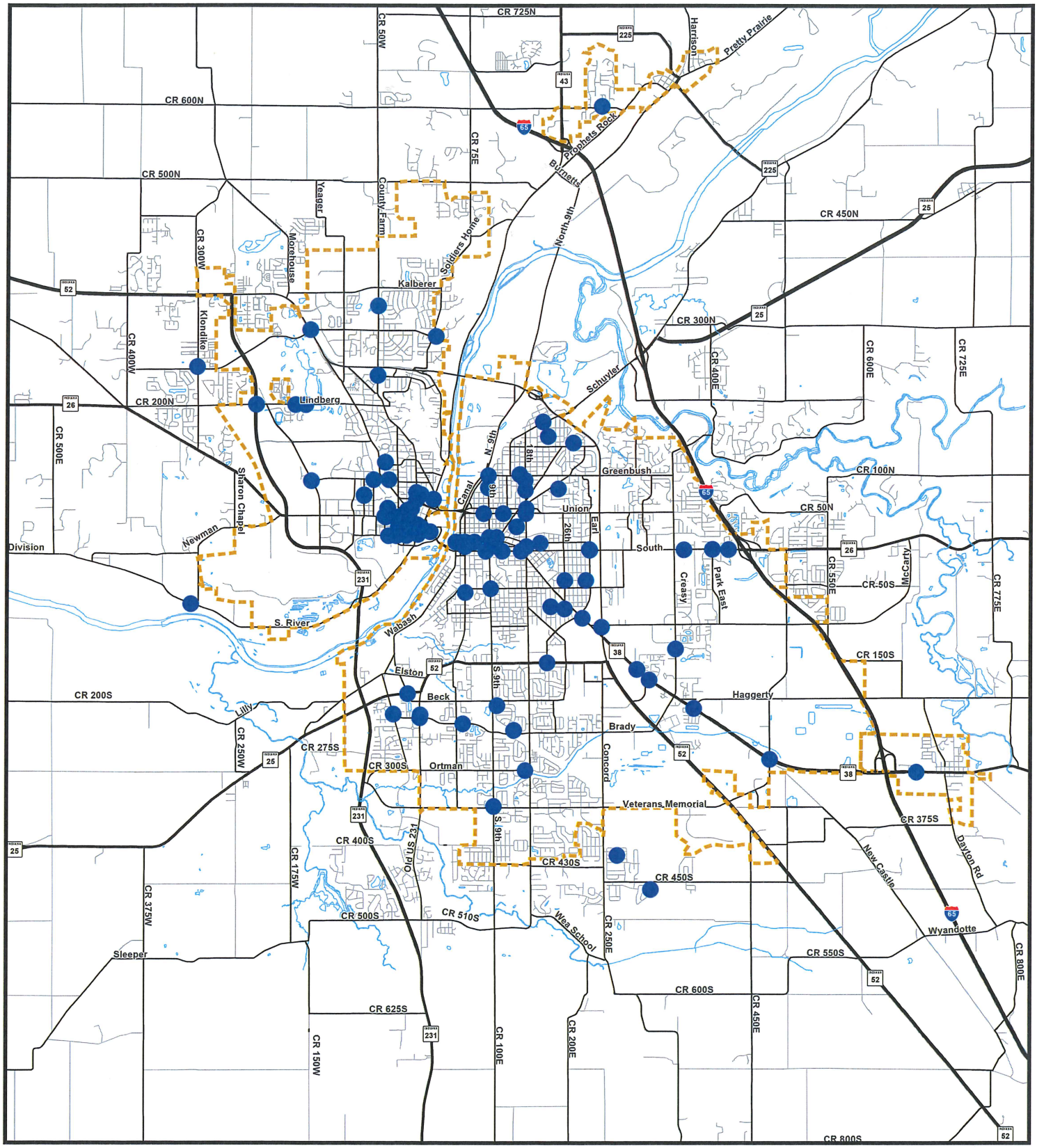
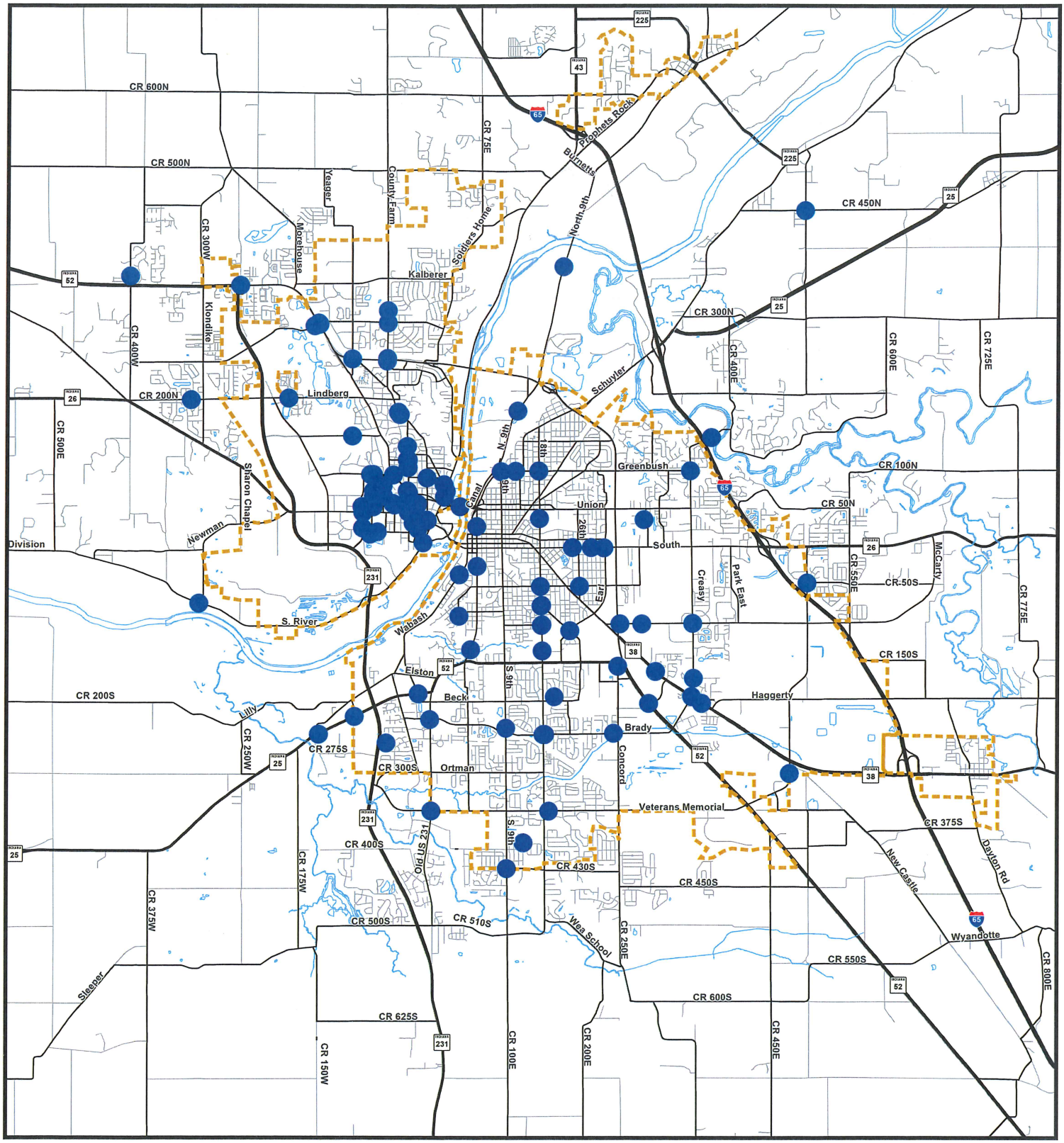
Figure 25: Location of Crashes Where the Motorist was at Fault