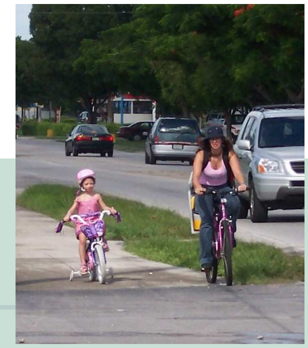
CAMBRIDGE SYSTEMATICS

Bicycle Safety Program Plan



prepared for

Miami-Dade Metropolitan Planning Organization

prepared by

Cambridge Systematics, Inc.

with

Sprinkle Consultants, Inc.

March 2006

report

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Executive Summary

The Miami-Dade Metropolitan Planning Organization (MPO) developed a Geographic Information Systems (GIS) database of reported traffic crashes involving bicycles for the years 1996 to 2002. The database contains over 4,500 crash records obtained from the Florida Department of Highway Safety and Motor Vehicles, Florida Highway Patrol and County and municipal police departments, and includes spatial information on the location of each crash, as well as other crash characteristics of the bicyclist, driver, and roadway.

The objective of this study was to use software developed for the Federal Highway Administration (FHWA) to identify common crash types occurring at locations throughout the County, and develop countermeasures to address the physical conditions and bicyclist or driver behaviors at these locations to enhance safety for cyclists throughout Miami Dade County in the future. This software – called the Pedestrian and Bicycle Crash Analysis Tool (PBCAT) – was used to allocate one of 73 districts and defined "crash types" to the crash reports for further analysis using GIS software.

A study advisory committee was identified at the outset of this project to help guide the analysis, provide input based on local experience, and carefully review the findings of the study. The committee was comprised of representatives of 10 local agencies that work within the bicycle safety arena – including the County, police departments, hospitals and transportation agencies and the local bicycle advocacy group – and met three times during the nine-month study to review progress and provide comments and suggestions.

A number of approaches was taken to evaluate the seven years of crash data. Geographic analysis was used to identify areas where high densities of crashes were occurring. The crash types were consolidated into nine subgroups and used with GIS to identify locations where common crash types occurred. And finally, a focused geographic cluster analysis was used to identify hotspot locations that experienced a high incidence of bicycle crashes.

The study team visited a total of 22 crash hotspots throughout the County to carefully review site conditions with reference to the individual crash reports, and developed engineering and programmatic countermeasures for implementation to enhance bicycle safety in Miami-Dade County. Bicycle activity was noted at each of the locations visited – during the relatively short period the study team was at each site – clearly indicating the extent to which this mode of transportation is a critical element of mobility for so many county residents.

The study found that physical treatments were applicable in approximately 50 percent of the high crash locations identified, and that education and enforcement programs – aimed at both cyclists and drivers – would be needed in combination with engineering treatments at those locations, as well as at the remaining locations identified in the hotspot analysis, to address the safety issues. A series of engineering treatments and countermeasures is presented in this report for specific sites identified through the analysis. Educational and enforcement programs are also outlined as relevant to specific community areas.

Behaviors that contributed to the bicycle crashes commonly included:

- Failure to adhere to signals and traffic control signs (both cyclists and drivers),
- Riding against traffic,
- Riding on sidewalks,
- Riding at night without lights, and
- Failure to yield to bicyclists (and pedestrians).

Implementation of the physical, educational, and enforcement countermeasures should be the shared responsibility of County and local governments, schools, and local community organizations representing the people that are so affected by bicycle crashes. Addressing the dangerous behaviors of cyclists will go a long way to enhance safety for this mode of transportation in Miami-Dade County.

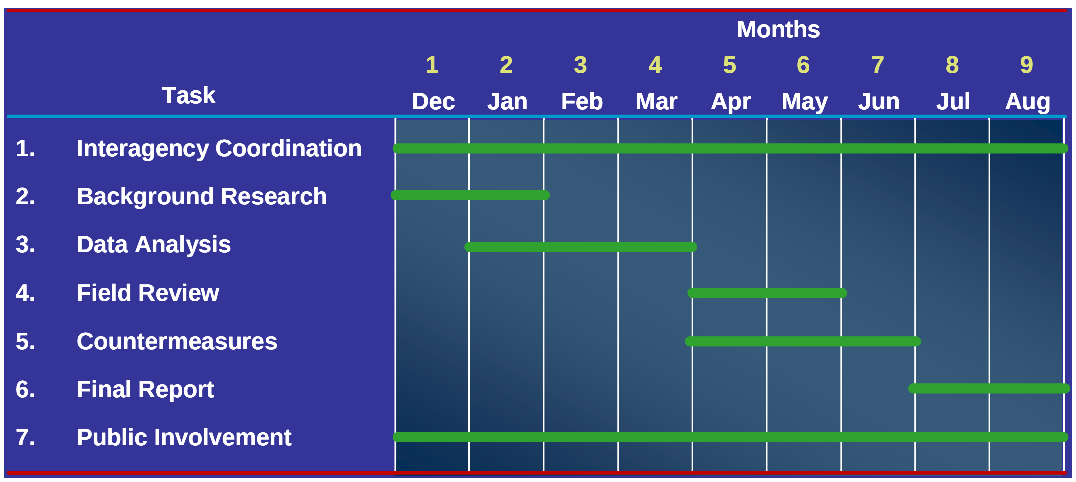
1.0 Introduction

1.1 Study Objectives and Schedule

The Miami-Dade County MPO developed a geographically-referenced database of bicycle related traffic crashes for the seven-year period from 1996 to 2002. The objective of this study was to use GIS and other tools to analyze this database of over 5,000 crashes to identify recurring conditions and causes, and identify a comprehensive set of countermeasures for implementation to enhance safety for bicyclists on the roads throughout the County.

The individual tasks included in the study are shown together with the study schedule in Figure 1.1.

Figure 1-1 Study Tasks and Schedule



1.2 Study Advisory Committee

At the outset of this study, a study advisory committee was formed to help steer and advise the work progress, and to bring to the project the many years of experience of several local professionals working in the safety arena. This committee was made up of MPO and consultant staff, and representatives of the following organizations:

- MPO Bicycle/Pedestrian Advisory Committee,
- Miami Children's Hospital,
- University of Miami School of Medicine,
- FDOT D6 Traffic Operations,
- Miami-Dade County Public Works,

- Miami-Dade County Public Schools,
- Miami-Dade Police,
- City of Miami Police,
- City of Miami Beach Police, and
- Miami Beach Bicycle Center.

The study advisory committee convened three times during the study to review the project objectives and proposed approach, then to review initial findings and provide input on what the data analysis was indicating, and finally to review the recommendations of the study team and provide final input on the recommended implementation actions from the study. These meetings took place in February, May, and August 2005.

2.0 Crash Data Analysis

In the United States in 2004, 725 bicyclists were killed and an additional 41,000 bicyclists were injured in collisions with motor vehicles. In Florida, there were 119 bicyclist fatalities and 4,820 injuries, while in Miami Dade County, 6 bicyclists were killed and 508 were injured.

In Florida, almost half of the fatalities and 60% of the injuries during 2004 happened in the seven largest counties:

Table 2-1 Florida Bicycle Crash Statistics - 2004

County	Fatalities	Injuries	Population
Pinellas	13	398	943,640
Hillsborough	10	401	1,108,435
Orange	8	283	1,013,937
Palm Beach	8	380	1,242,270
Broward	6	672	1,723,131
Duval	6	230	840,474
Miami-Dade	6	508	2,379,818
TOTAL	57	2872	

Rather than absolute numbers, it is more useful to look at the crash rate or number of crashes per 100,000 persons to get a more balanced picture of the bicycle crash problem. Larger counties tend to have a larger number of all kinds of traffic crashes. Dividing the number of crashes by population gives numbers that are more comparable between different places.

Figure 2-1 shows the trend in bicycle crash rates for Miami-Dade, Broward, Palm Beach, Hillsborough, Orange, Pinellas and Duval counties between 1990 and 2004. The crash rate is calculated by dividing the number of reported bicycle fatalities and injuries by the county population and multiplying by 100,000.

Figure 2-1 Bicycle Crash Injury Rates in Florida

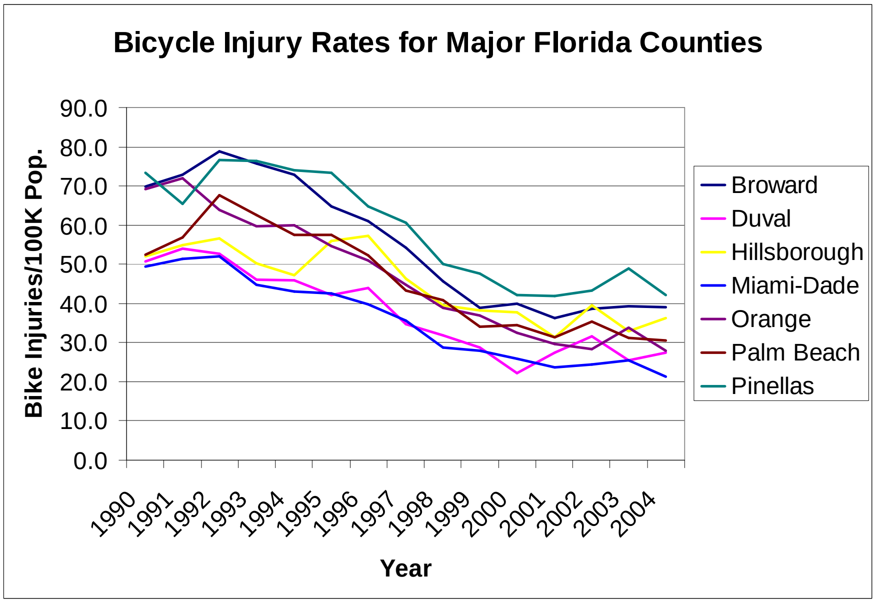
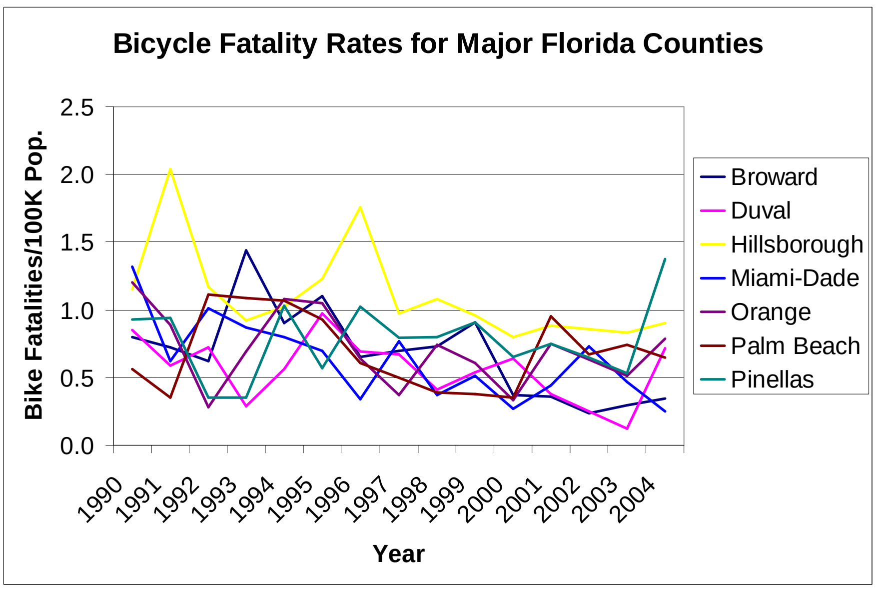


Figure 2-2 Bicycle Crash Fatality Rates in Florida



The trend for bicycle traffic injuries is generally downward while the rate for fatalities is more flat. Miami-Dade County has had some of the lowest bicyclist injury and fatality rates within Florida for the last 15 years.

Calculating per-capita crash rates balances large and small counties but does not account for differences in the amount of bicycling that takes place in different counties. A place where more people are bicycling more often may also have more bicycle traffic crashes.

All data noted above pertain to **reported** crashes. However, many bicycle-motor vehicle crashes go unreported, particularly those when the bicyclist is not injured or received minor injuries. A 1990's FHWA study of hospital data pertaining to bicyclists who were treated for injuries was conducted at eight hospitals in New York, California, and North Carolina and found that 40-60 percent of bicycle-motor vehicle crashes went unreported[1]. This indicates that the true number of bicycle crashes involving automobiles could be double the number that is recorded.

In addition, many bicycle crashes do not involve a motor vehicle or happen off-road (for example, a cyclist may fall off his/her bicycle while riding in a parking lot). Indeed, about 67 percent of bicycle injury events in emergency rooms did not involve a motor vehicle and 31 percent of bicyclist injury events occurred in non-roadway locations[2]. This indicates that the total number of bicycle crash events could be three times the number of all auto-bike crashes, or six times the number of reported bicycle crashes. Therefore, the anticipated benefits from bicycle safety improvements can be expected to be far higher than those indicated using only reported crashes.

2.1 Crash Database Analysis

Analysis of the GIS database of Miami-Dade bicycle-related crashes for the years 1996 to 2002 focused on a number of approaches:

1) a general analysis of all crashes in the database to identify common themes related to severity of injuries, age and race of cyclist, time of day and lighting conditions,
2) geospatial analysis relying on location information for each crash which sought to identify areas of high crash density, or crash clusters; and
3) crash-typing which sought to identify crashes of similar types in common locations.

Figure 2-3 shows the distribution of bicyclist age in all bicycle crashes. It is evident that there is a peak in the 15- to 20-year old group, tapering off and increasing again in the 40- to 55-age group. This is similar to profiles from other communities and likely indicative of the high activity rates in youth/high school cyclists, and similarly for middle-age cyclists who return to cycling after a decade or two of being automobile focused.

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[1] http://www.tfhrc.gov/safety/pedbike/research/99078/chapter6.htm

[2] http://www.tfhrc.gov/safety/pedbike/research/99078/chapter7.htm

The distribution of ages among fatal crashes is shown in Figure 2-4. This graph has a quite different shape than the distribution for all crashes, with a peak in the 45- to 54-age group. This is likely as a result of the location of crashes involving these riders – on higher-speed suburban streets where they were training, commuting, or otherwise riding longer distances. Younger riders tend to make shorter trips on lower speed roads, where injuries tend to be less severe.

Figure 2-5 shows the distribution of ages for serious or incapacitating injuries. The peak occurs in the 15- to 24-age group, corresponding to the first peak in the overall age distribution. There is a far lower proportion of serious injuries in the 45- to 54-age group, indicating the likelihood of these older riders being killed in serious higher-speed crashes.

Younger bicyclists are over-represented relative to the population and older bicyclists are under-represented relative to the population. However, older bicyclists are greatly over-represented in crashes that result in serious injury or death. This points to the need for adult safety education.

Figure 2-3 Age Distribution – All Crashes

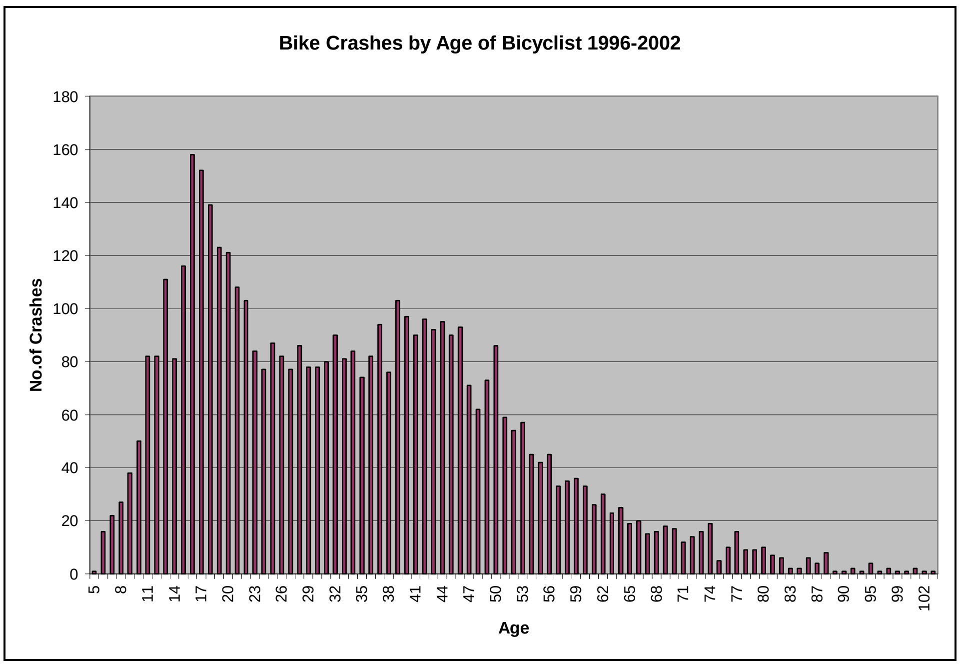


Figure 2-4 Age Distribution – Fatalities

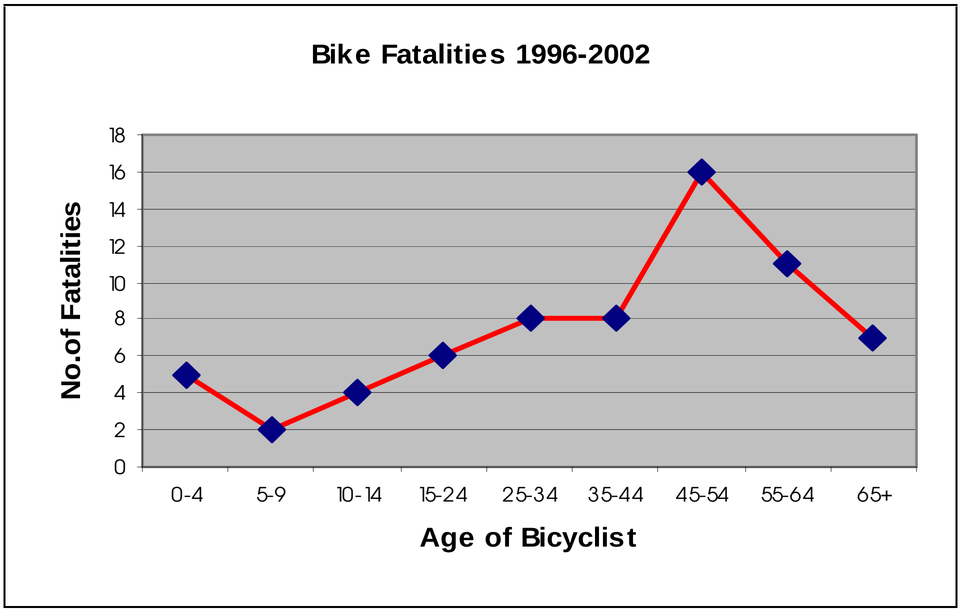


Figure 2-5 Age Distribution – Incapacitating Injuries

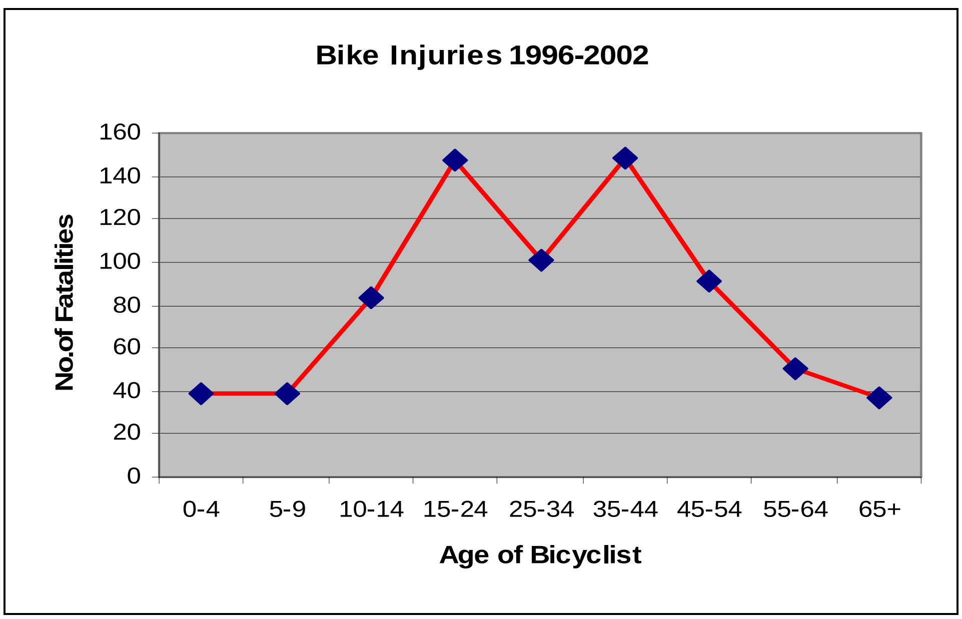
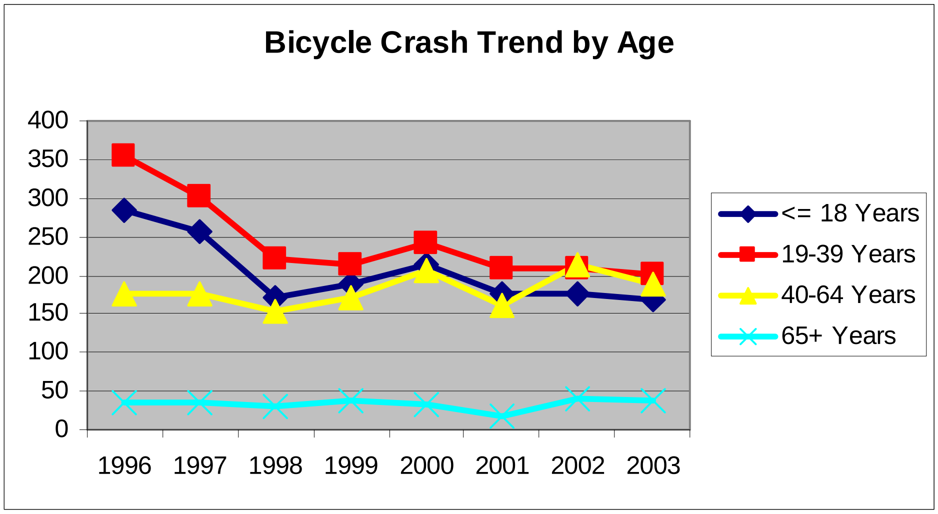


Figure 2-6 shows the trends in bicycle crashes for different age groups. It is evident from the data that the trend is downward for the under 40 age groups, but remains flat for older age groups.

Figure 2-6 Bicycle Crash Trend by Age Group



Race also plays a part in the data analysis of bicycle crashes for Miami-Dade County. Figure 2-7 shows the trends in bicycle crashes for different races/ethnic groups for Miami-Dade County for the period 1996 through 2003. Data indicate a reduction in the number of crashes for White and Black cyclists, but little or no reduction for Hispanics. Figure 2-8 shows the number of crashes broken up by both race and age of the cyclist. This graphic shows young Black riders involved in a large number of crashes, while Whites account for a great number of the crashes of middle aged cyclists.

Figure 2-7 Bicycle Crash Trend by Race

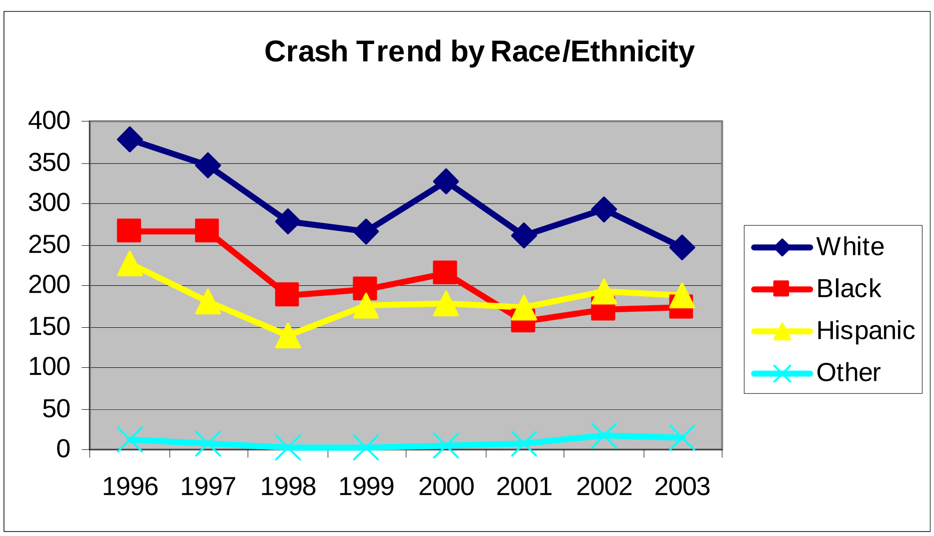
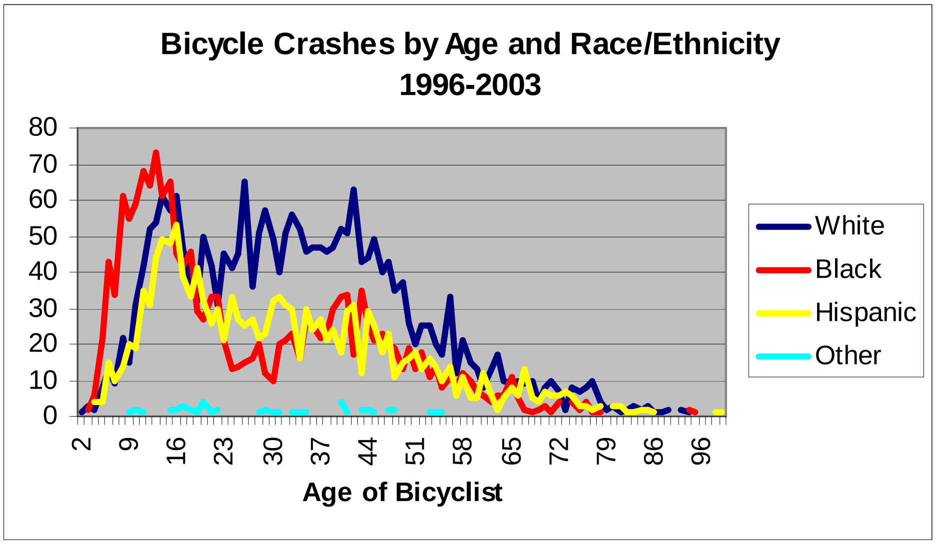


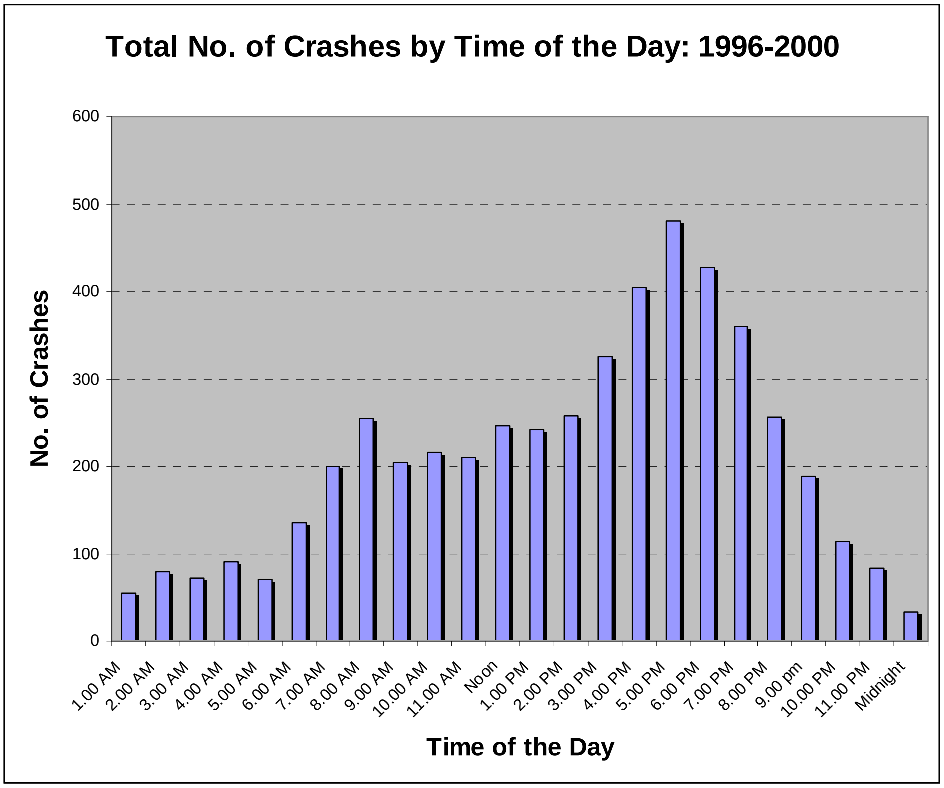
Figure 2-8 Bicycle Crashes by Age and Race



Another analysis of these crashes focused on the time of day of the crash, with results shown in Figure 2-9. It is clear that a peak occurs in the late afternoon – between 3:00 p.m. and 8:00 p.m., when people are using their bicycles after school or work, in the dark during the winter months. There is a far lower secondary peak occurring between 7:00 a.m. and 9:00 am.

Figure 2-14 shows the location of crashes occurring outside of daylight hours – with the symbols indicating whether the crash occurred in lighted conditions, or where no street lights were present. There is an almost 5:1 ratio of lighted versus unlit conditions, reflecting a fairly good level of street lighting infrastructure in Miami-Dade County.

Figure 2-9 Time Distribution of Crashes



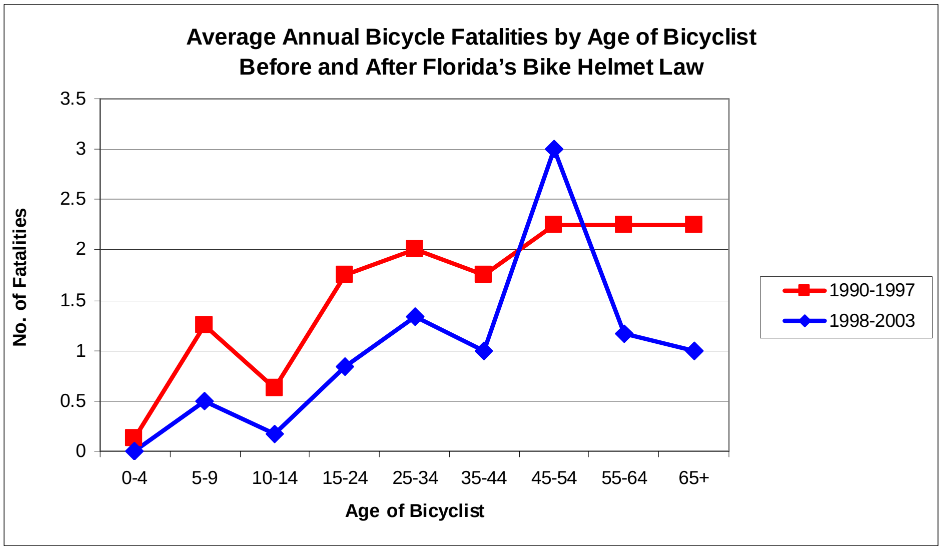
A high-level overall review of all bicycle crashes indicated that many were related to the following behaviors:

- Wrong-way riding,
- Unsafe intersection crossing,
- Use of busy streets – where alternate routes exist, and
- Night time riding without lights.

Addressing these behaviors will be an important part of improving safety for bicyclists.

It is widely acknowledged that head injuries – for crashes of all types – tend to be the most severe in nature. In 1997, Florida enacted a compulsory helmet law for school age children. Figure 2-10 shows the impact of that law on bicycle fatalities in Miami-Dade County.

Figure 2-10 Impact of Helmet Law



It is evident that fatalities dropped following the introduction of the helmet law for all age groups except the 45-54 age group. Data indicate that injuries also decreased following the law's introduction for all ages under 45. This hopefully points to a wider awareness of helmets in the majority of age groups, but also indicates a need for safety education amongst adult cyclists.

2.2 Geographic Crash Analysis

Initial geographic crash analysis considered all of Miami-Dade County and sought to identify spatial trends in the data related to bicycle crashes. A series of figures shows geographic representations of all crashes for the seven-year period, together with other statistics on the crashes and people involved in them.

Figure 2-11 shows the location of all approximately 5,000 crashes in the database for Miami-Dade County. It is evident that there are concentrations of crashes in areas where high bicycling activity is expected – for example in the dense residential areas on Miami Beach, the Liberty City area, and North Miami. It is also evident that bicycle crashes are occurring all over the County – without exception. Clearly, people are using bicycles throughout the County, and are involved in crashes in all areas. It is also clear that safety programs should be established in all areas in the County to have the full effect on minimizing the number of crashes.

The inset graphic shows the distribution of crashes for each year in the period. A decreasing trend is apparent, although increases were evident in 1999, 2000, and 2002.

Fatal and incapacitating injury crashes are shown in Figure 2-12. The graphic shows a high incidence of fatal and serious injury in many of the same areas as the high numbers of crashes are occurring; however, there is an over-representation of fatal and serious crashes in the lower-density suburban areas in southern and western parts of the County where automobile speeds tend to be higher, leading to greater injury severity.

The inset graphic indicates the distribution of crash types for the seven-year period. Fatalities account for approximately three percent of crashes, while incapacitating injuries represent another 14 percent.

Figure 2-11 Bicycle Crash Locations

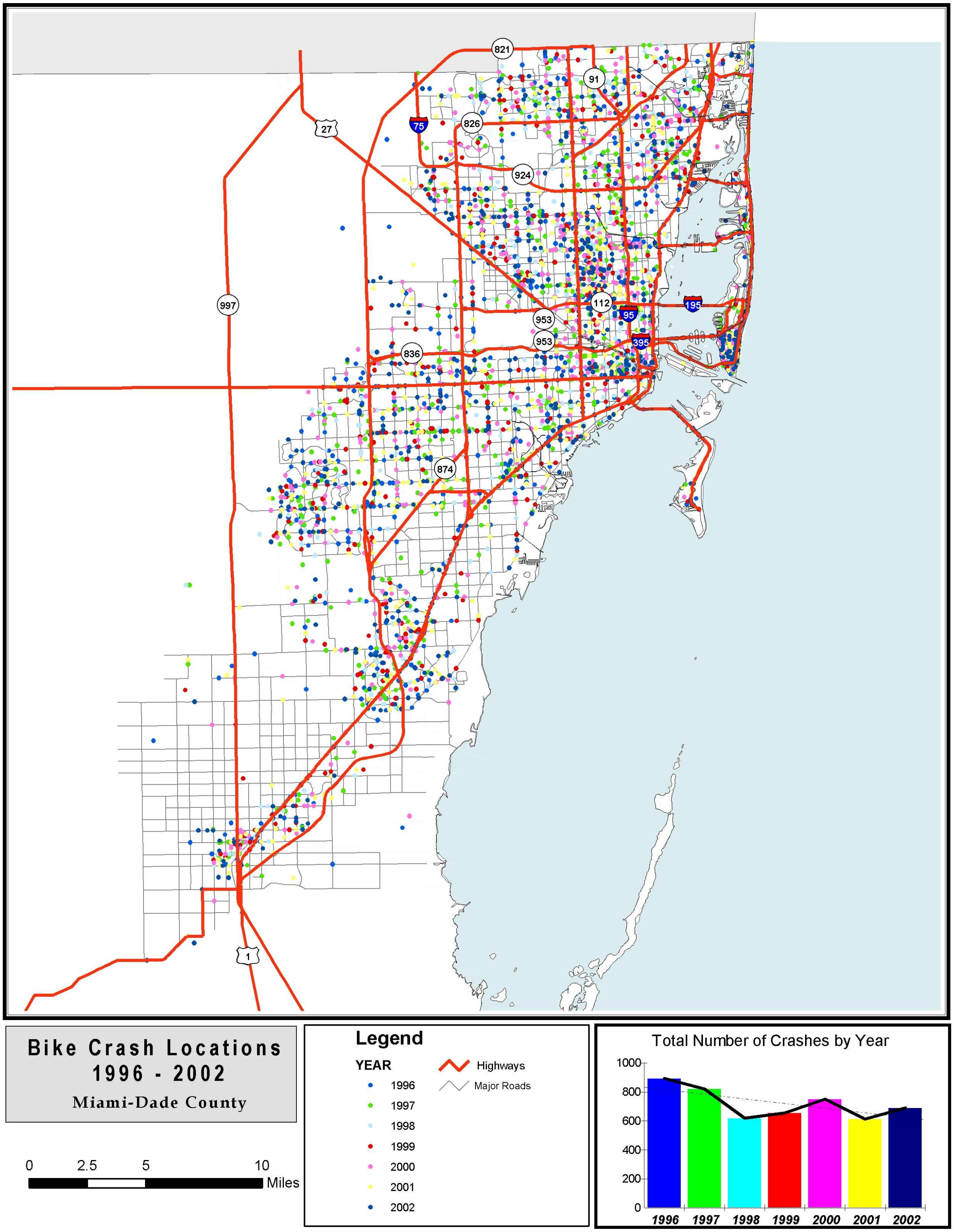


Figure 2-12 Bicycle Fatalities and Incapacitating Injuries

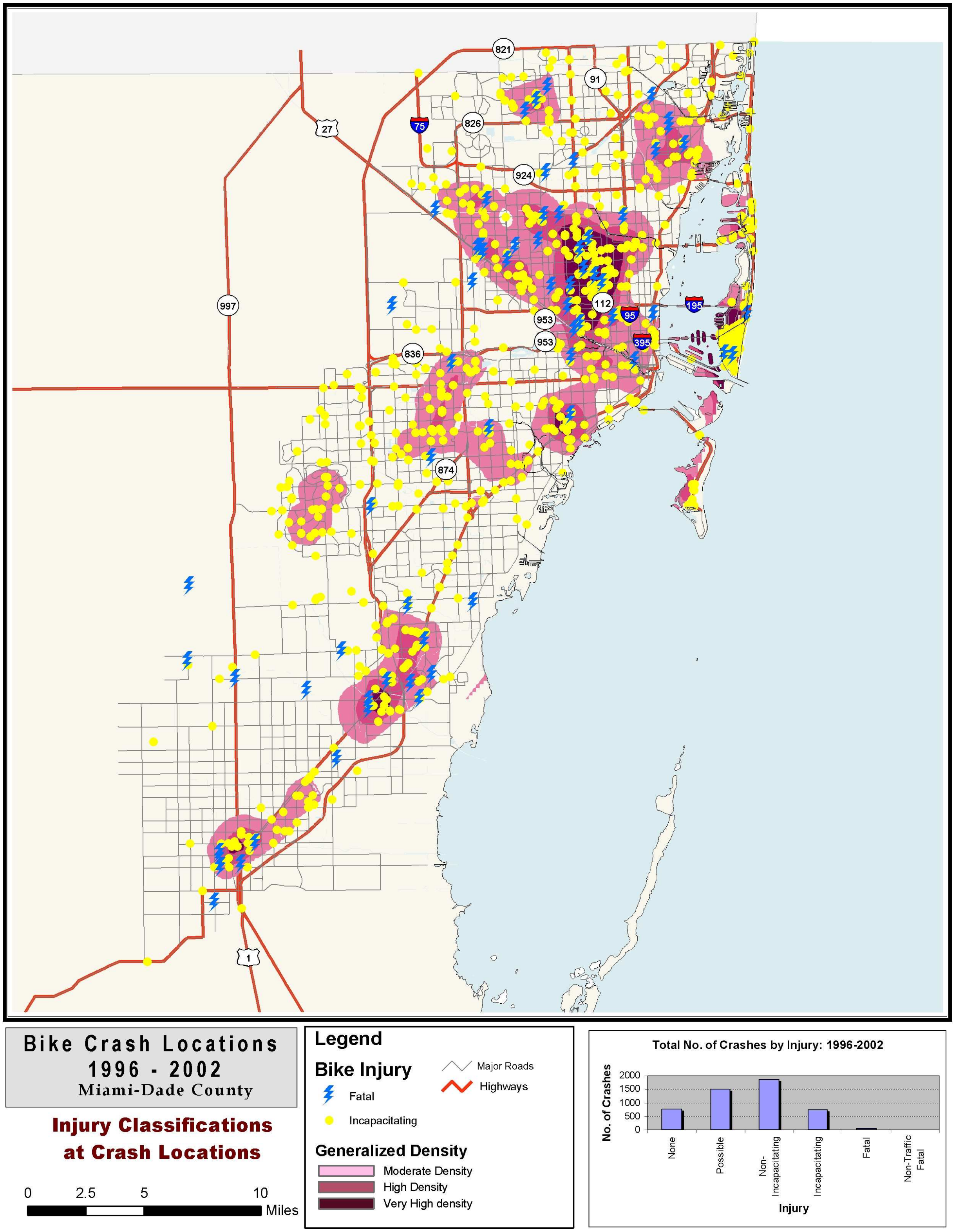
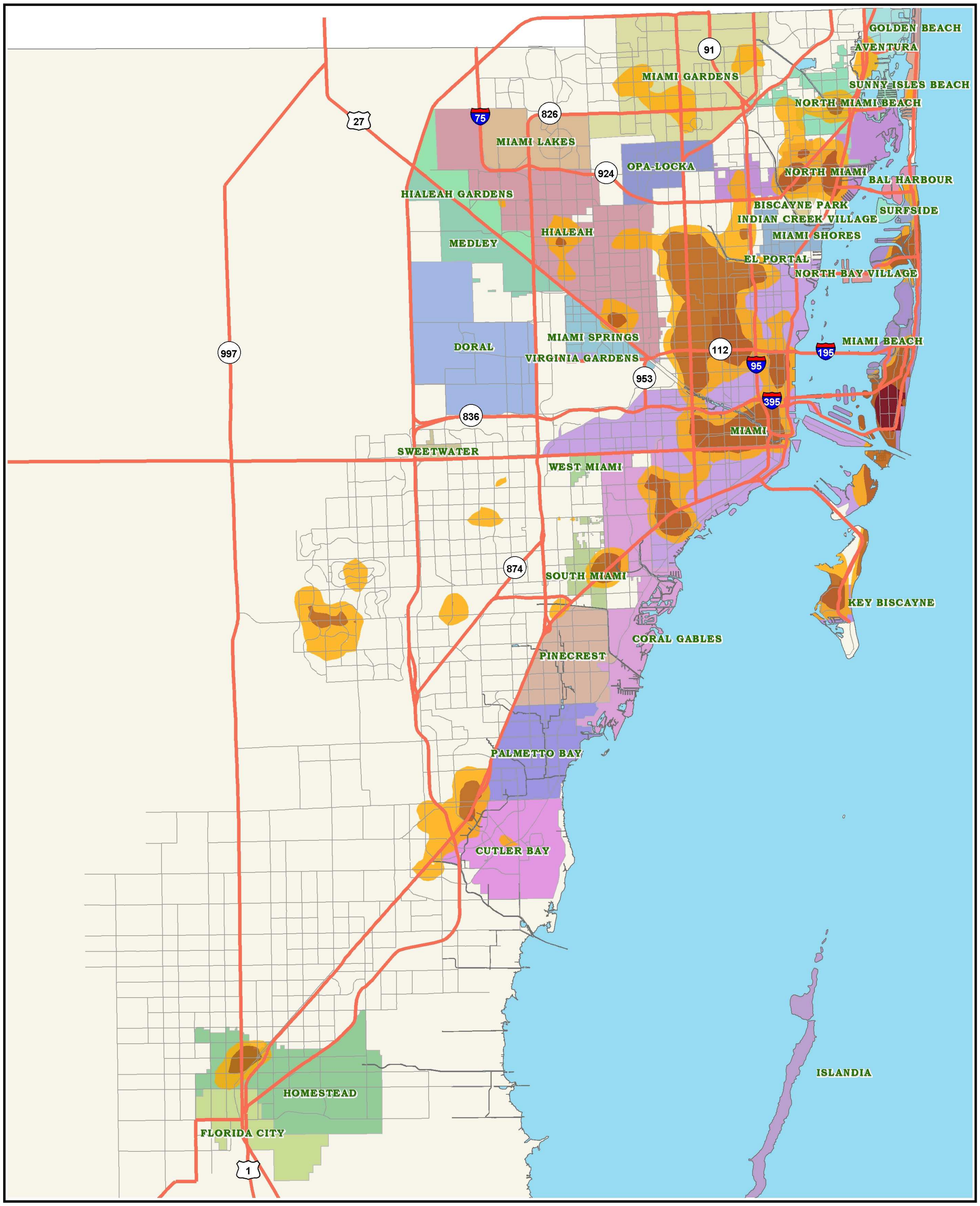


Figure 2-13 shows the results of a crash density analysis (with darker regions indicating the highest densities) performed using GIS software. Once again, the results are not unexpected, with the highest densities of crashes occurring in the most populated areas of the County, particularly the north central county and barrier island communities. However, there is somewhat of an over-representation of the southern areas along U.S. 1 and in Homestead and Florida City, where there is a high number of lower-wage jobs, and a corresponding number of people who are dependent on bicycle transportation.

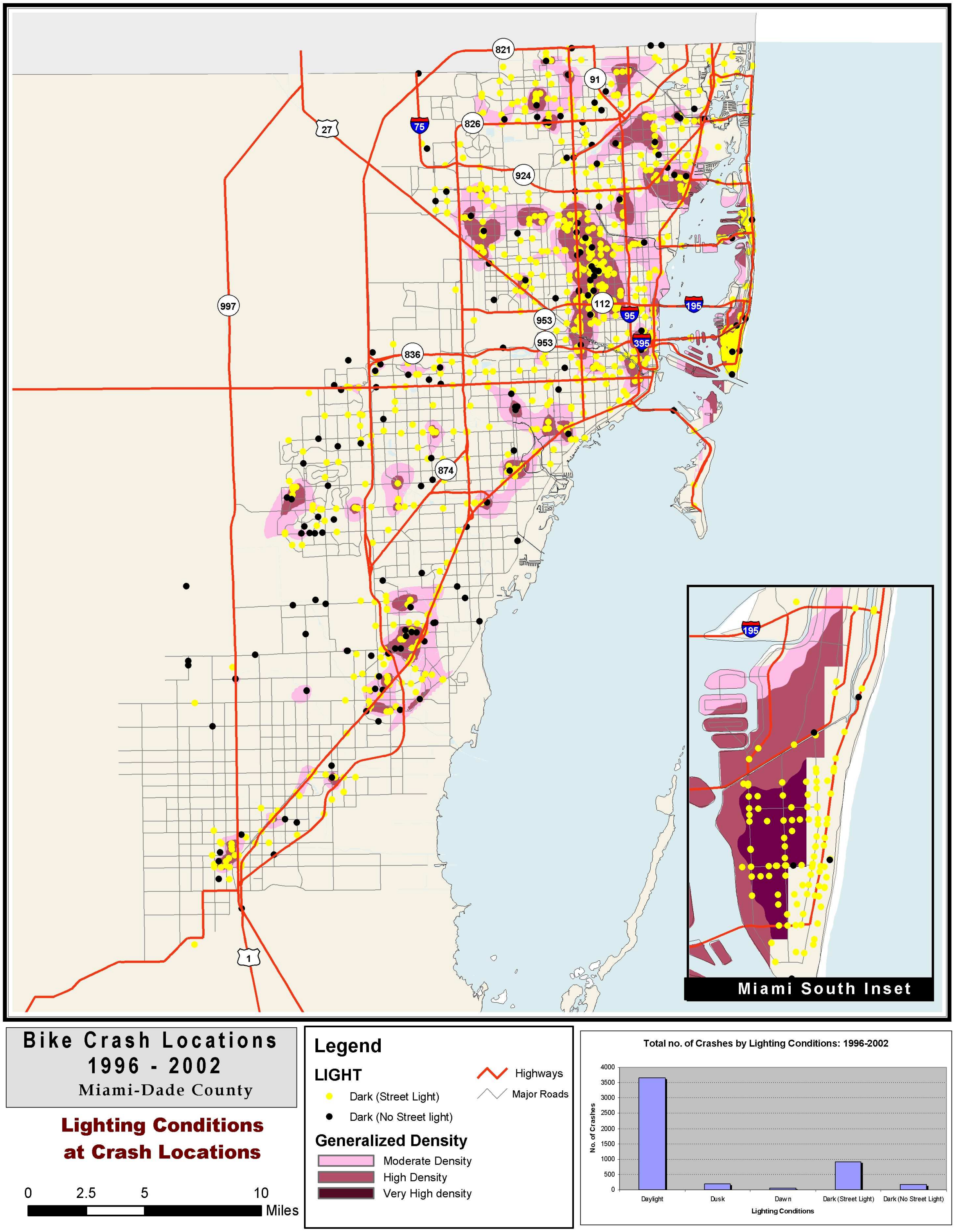
Figure 2-13 Crash Density Map



MIAMI-DADE COUNTY

Crash Densities 1996-2002

Figure 2-14 Location by Lighting Conditions



2.3 CRASH-TYPE ANALYSIS

Miami-Dade County provided hard-copy police crash reports to Sprinkle Consulting, Inc. for use in the analysis. PBCAT was used to assign a crash type to each crash. The user inputs information from the police crash report into a series of screens. The logic incorporated into the development of the software determines the sequence of screens. At the end of the process, PBCAT assigns one of 73 bicyclist crash types. PBCAT saves the user's responses to each screen and the resulting crash type into a Microsoft Access database. PBCAT contains limited analysis capabilities, so the database was exported into Microsoft Excel for in-depth analysis.

It is important to note that crash typing does not actually provide specific information for any particular crash. Rather, the method allows the analyst to look at crash trends to determine general intervention type countermeasures.

The Appendix to this report contains an example of police crash reports, and a series of screen captures which illustrate the use of PBCAT to determine the crash type for a specific bicycle crash.

Cyclist Behavior

The PBCAT analysis revealed many of the crashes were the result of poor bicyclists' judgment resulting in unsafe behaviors. The most common example of these behaviors is a bicyclist turning into a motorist's path. This crash type is difficult to address because it is frequently caused by poor judgment on the part of the bicyclists. An educational campaign suggesting people use better judgment would not be an effective approach to reducing these crashes because people already feel they have good judgment.

Another example of poor bicyclist behavior is simply choosing an inadequate gap to cross the street, usually in the daytime and frequently within 100 feet of a signalized crosswalk. Technically, if the adjacent intersections on both sides of the crossing are signalized, this behavior is illegal. However, most often at least one adjacent intersection is unsignalized, so the behavior is not illegal; meaning that law enforcement can have little impact on these crashes.

An educational campaign targeting this behavior would also have very limited effect. Those crossing the street believe they have an adequate gap or they would not ride into the travel lanes. In short, people believe they are behaving reasonably and safely.

Although poor bicyclist judgment resulted in many of the crashes, there were also many crashes that countermeasures may be able to reduce. The specific intersections, crash types, and potential countermeasures for these crashes are discussed in Section 4.0.

2.4 Crash Type Cluster Analysis

With a database of crash types created from the crash reports, a combined crash-typing and geographical analysis was performed using GIS software to identify locations where crashes of common types were occurring within a small area – where engineering treatments might be implemented to address the safety concerns.

Consolidated Crash Types

Given the 73 different crash types identified in PBCAT, it was necessary to consolidate the types into a more manageable number of categories. Crashes were first sorted into intersection- and segment-related crashes, and then into the nine categories shown in Table 2-2.

Table 2-2 Consolidated Crash Types

Intersection Crash	Segment Crash
Intersection control	Intersection control
Turning conflict	Turning conflict
Driveway conflict	Driveway conflict
Loss of control	Loss of control
Head-on	Head-on
Alcohol	Alcohol
	Parking conflict
	Overtaking
	Other

For intersections, a 600-foot cluster distance was analyzed, and returned a small number of locations where crashes of a common kind were occurring, however the 600-foot radius was large enough to include five or six intersections. This made it very difficult to direct analysis toward a specific location where improvements might be evaluated. A smaller cluster distance failed to identify locations with common crash types.

The segment analysis identified ten corridors with eight or more crashes of a similar types, but several of these corridors were more than three miles in length.

Nevertheless, the crash types – and the bicyclist and motorist behaviors that contributed to them – were identified for a number of community areas in the County. They are presented in Table 2-3. This analysis identified educational and enforcement approaches, as well as some physical treatments, that specific local communities can pursue to enhance bicyclist safety in their area. More information on these elements is presented later in the report.

Table 2-3 Crash Types by Community

Location	Type	Facing Traffic?*	Possible Treatment
Miami Beach South	• Motorist drive out • Bicyclist ride out • Bicyclist left turn	N	• Pavement control markings • Sight distance • Parking setback
Key Biscayne	• Motorist drive out • Bicyclist left turn	N	• Bicycle lanes • Education, enforcement
Little Havana	• Motorist drive through • Bicyclist ride out	Y	• Education, enforcement • Lighting
Hialeah	• Bicyclist ride through • Motorist ride out	Y	• Education, enforcement • Lane markings
West Kendall	• Bicycle failed to clear • Motorist drive out	Y	• Signal timing • Education

*Y indicates more than 50 percent of bicycles were facing traffic.

More information on local area education and enforcement programs is provided in the recommendations in Section 4. While this analysis approach identified areas where common behaviors and crash types were occurring, it did not identify spot locations where local engineering treatments could be expected to return meaningful safety improvements. To do this, a more focused geographic analysis was pursued.

Crash data indicated that bicycles riding against traffic accounted for more than 50 percent of the crashes in three of these five locations. A large proportion of against-traffic riders are also riding on the sidewalk, often because they perceive this to be safer – particularly on high-volume streets. This condition was witnessed at many locations during the crash site visits.

Riding a bike on the sidewalk is more hazardous than riding on the street because sidewalks are not designed as bikeways. Cyclists will encounter slower-moving pedestrians and automobiles can appear at every driveway and intersection. Cycling on sidewalks increases the chances of a collision by as much as two times over the likelihood of cyclists experiencing a crash in the street (*Risk Factors for Bicycle-Motor Vehicle Collisions at Intersections*; Wachtel and

Lewiston, 1993). This is because sidewalk cyclists have to deal with potential conflicts with cars at every intersection and every driveway. When cyclists are on the sidewalk, they often surprise motorists. Before entering intersections, motorists look for cross traffic approaching from their left and don't expect high-speed traffic on sidewalks. Drivers especially don't expect traffic to be coming from their right-which is the clear zone into which they are turning. But half of sidewalk cyclists - and all wrong way cyclists - are coming from the right, so it's very easy for a driver to turn directly into their path.

Sidewalk cyclists also have to deal with curbs, which slow them and can cause unanticipated behavior and falls.

When cyclists are in the street, on the other hand, they are part of the normal traffic flow and are easier to see. Their behavior, when they are following the rules for vehicles, is predictable, which contributes to their safety.

2.5 Geographic Crash Cluster Analysis

A focused crash cluster analysis was conducted to identify hot-spot locations where high numbers of bicycle-related crashes occurred, regardless of the assigned crash type. A density value is calculated for an area of crashes, and reflected in the color intensity on a map created as previously shown in Figure 2-13. The database can then be used to extract specific metrics for a defined area of crashes. This procedure was followed to identify areas with high density of crashes and associated statistics as shown in Table 2-4.

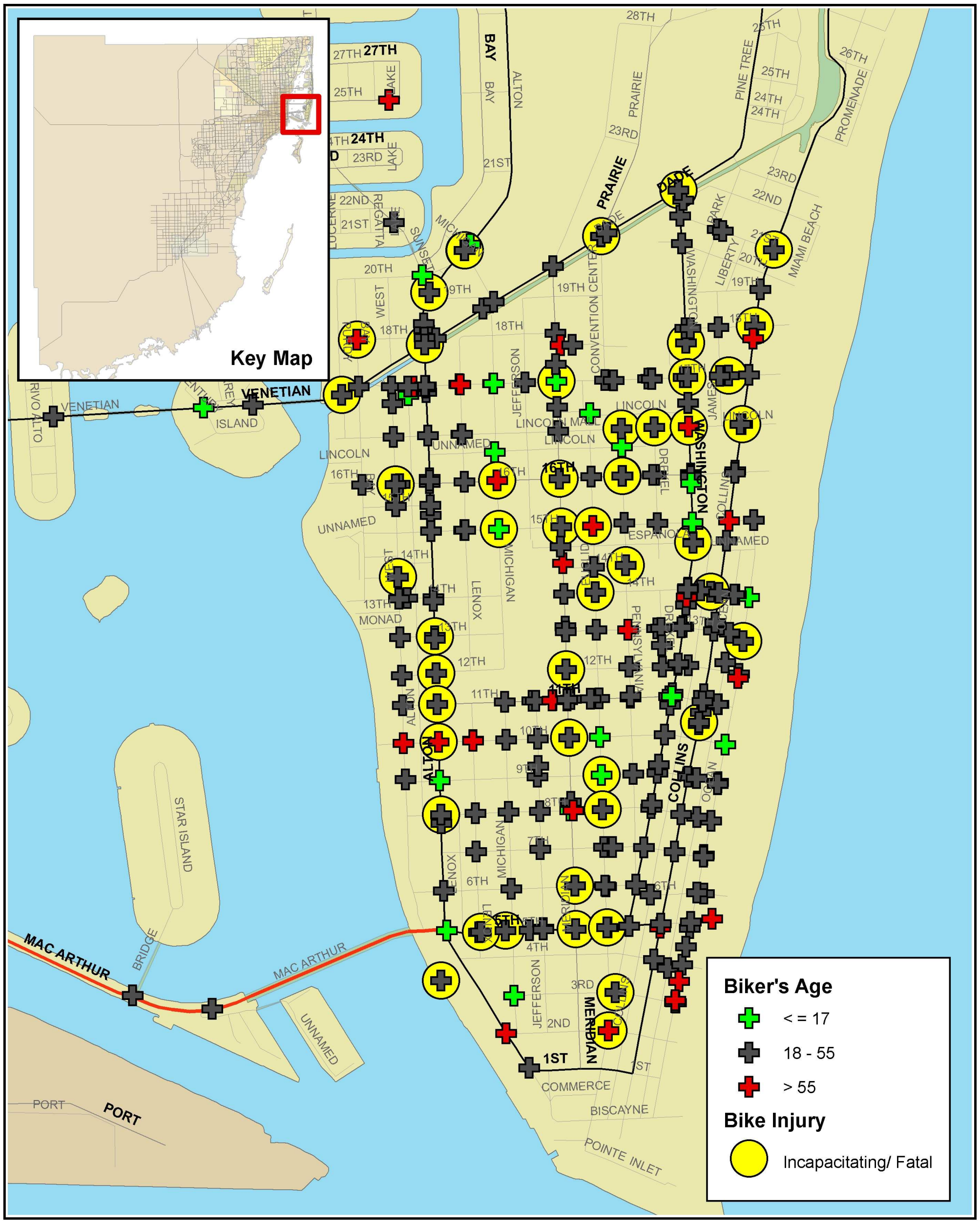
Table 2-4 Crash Density Areas 1996-2003

City	Location	# Crashes	Fatalities	Incapacitating	% Under 17	Light: Dark?	Drink/ Drug
Miami Beach South	South Beach	446	2	55	9%	26%	21
Miami Dade North	Liberty City, 62nd St	223	6	34	41%	26%	5
Miami Dade South	Perrine, Palmetto Estates	100	1	14	26%	21%	12
North Miami	City of N Miami	74	1	10	28%	23%	1
Miami Beach North	79th Street	71	0	11	21%	21%	4
Miami Central	SW 8th Street	67	1	6	33%	15%	3
Key Biscayne	Key Biscayne	51	1	10	39%	4%	0
Coral Gables	Coral Gables	50	0	13	30%	16%	4
Miami Dade West	SW 147 Av/ Kendall Dr	36	0	4	36%	8%	0

Two of these high density locations – South Beach and the Liberty City area – are shown in Figure 2-15 and Figure 2-16.

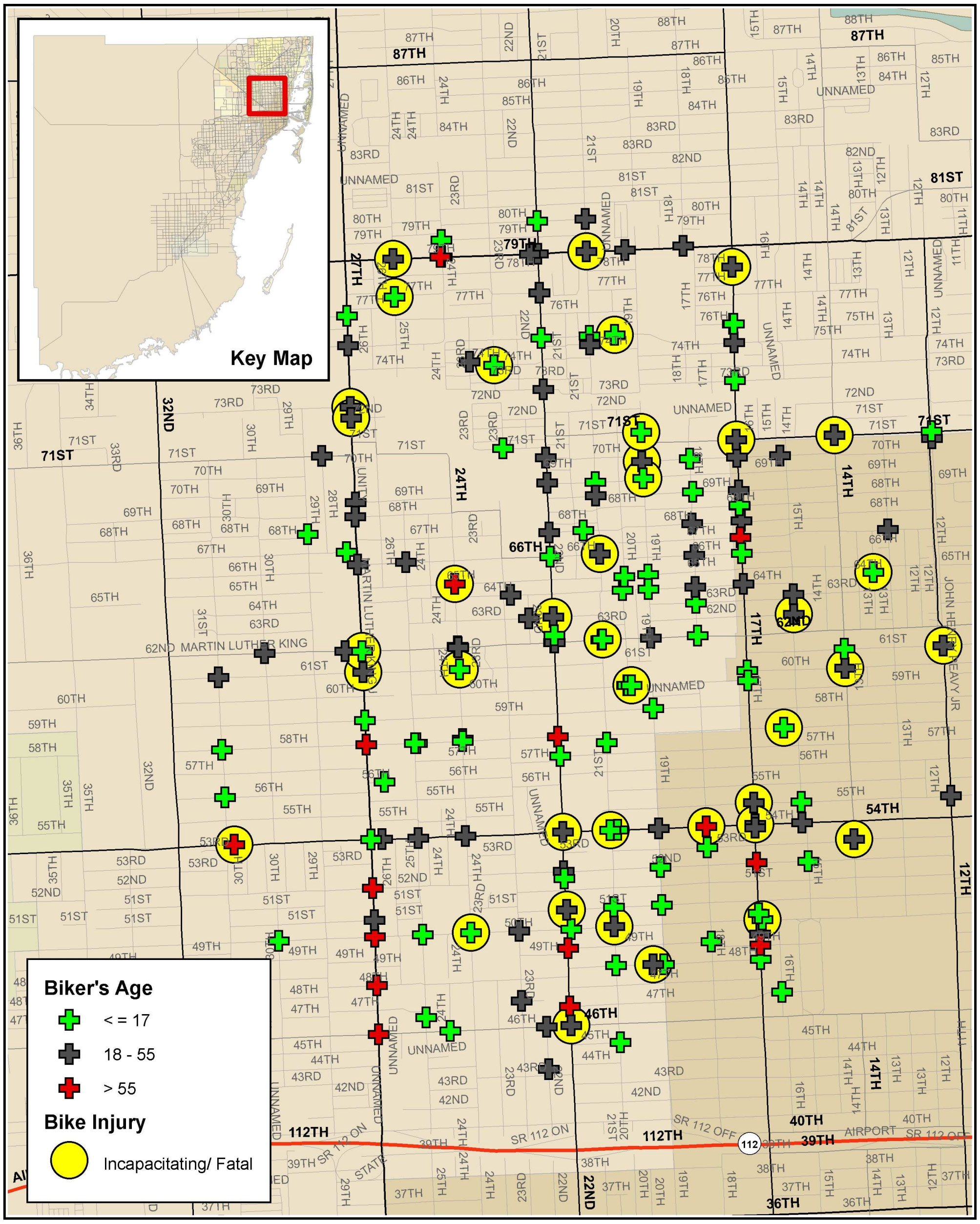
As shown in Table 2-4, the South Beach area of Miami Beach was the largest density area of crashes, with 446 recorded in seven years, including two fatalities and 55 incapacitating bicycle crashes. A high percentage occurred at night and this area saw by far the highest incidence of alcohol- or drug-related crashes. By contrast, the Liberty City area has half as many crashes, but three times the number of fatalities, meaning the rate of fatalities was six times that in South Beach. The rate of incapacitating injuries was also 24 percent higher in Liberty City. The incidence of young bicyclists (under 17) involved in crashes was far higher in the Liberty City area, but the incidence of alcohol- or drug-related crashes was lower. The percent of night-time crashes was the same as for South Beach, but was higher than other areas in the County.

Figure 2-15 South Beach Crash Density Area



Region 7 - Biker's Age Group

Figure 2-16 Liberty City Crash Density Area



Region 8 - Biker's Age Group

Intersection Crash Clusters

A refined geographic analysis was undertaken, using a reduced cluster distance of 100 feet. This distance is consistent with identifying spot locations where engineering or other treatments could be effective in addressing the safety issues identified from individual crash reports.

The majority of the crash clusters were located within the bicycle crash areas showing in Table 2-4, with a number of those areas containing the spot locations with the highest incidence of bicycle-related crashes for the seven years of data.

Top Crash Locations Identified

The top 22 crash hotspots are identified in Table 2-5. The top 12 locations experienced seven or more reported bicycle crashes in the seven-year period from 1996 through 2002. Eight of these locations are found on the barrier islands, with the remaining four on the mainland – two in the Liberty City area, and two in the South County area.

Table 2-5 Top-Ranked Bicycle Crash Hotspots

Rank	Location	# Crashes
1	Crandon Boulevard at Harbor Drive	13
2	Alton Road at 17th Street	11
3	Alton Road at 15th Street	9
4	Euclid Avenue at 5th Street	9
5	NW 27th Avenue at NW 79th Street	9
6	Meridian Avenue at 11th Street	8
7	NW 22nd Avenue at NW 62nd Street	8
8	Washington Avenue at 17th Street	8
9	Washington Avenue at Espanola Way	8
10	E Bay Road at NE 71st Street	7
11	S Dixie Hwy at SW 184th Street	7
12	Washington Avenue at 16th Street	7
13	Alton Road at 11th Street	6
14	Dickinson Ave at 71st Street	6

Table 2-4 Top-Ranked Bicycle Crash Hotspots (continued)

Rank	Location	# Crashes
15	Jefferson Ave at 5th Street	6
16	W Dixie Hwy at NE 135th Street	6
17	NE 6th Ave at W Dixie Highway	6
18	NW 46th Street at NW 22nd Avenue	6
19	SW 104th Street at SW 147th Avenue	6
20	SW Franjo Rd at Cutler Ridge Drive	6
21	Washington Avenue at 13th Street	6
22	Washington Avenue at 14th Street	6

The top seven South Beach area crash hotspots (that experienced seven or more crashes) are shown in Figure 2-17.

Figure 2-17 South Beach Crash Hotspots

The next 10 locations shown in Table 2-5 each experienced six reported bicycle crashes during the seven-year period. Five of these lay on the barrier island, with the remaining five on the mainland – three in the northeast part of the County, and two in the south county area.

The study team prepared to visit each of these 22 locations during two days in July 2005 to verify information shown in the crash reports and identify safety conditions that could be improved through this comprehensive safety program plan. The crash site evaluations are detailed in the next section.

2.6 CRASH SITE EVALUATIONS

The study team visited each of the 22 bicycle crash hotspot locations on Monday and Tuesday, July 18 and 19, 2005, to verify information shown in the crash reports and identify safety conditions that could be improved through this comprehensive safety program plan. The visits included a member of the Miami-Dade MPO staff, in addition to two consultant team members.

Photographs were taken to document conditions for comparison with crash reports. . A number of the crash reports were available at the site visits, and the remainder of the reports reviewed following the site visits. Bicycle activity was noted and photographed in all locations, confirming the expectation that these high-crash locations were all relatively high-exposure locations experiencing a high level of bicycle activity. The following conditions were observed at each location:

- Site visit conditions observed:
  - Land use/activity;
  - Behavior;
  - Bicycle facilities – signage, lanes;
  - Lighting;
  - Sight distance obstruction;
  - Turn radius;
  - Pavement markings; and
  - Parking setback.

Based on these observations, a range of potential countermeasures – as described in the next section - was considered for each identified safety hazard location

3.0 Potential Safety Countermeasures

A broad range of potential countermeasures was considered for addressing the safety concerns at locations identified through the data analysis task. These can be broadly categorized into two categories:

- Safety programs – encompassing educational and enforcement countermeasures , and
- Engineering Treatments

3.1 Safety Programs

Safety programs are a vital part of an overall bicycle safety strategy for any community. Cyclists of all ages and backgrounds should be informed on how to safely use their vehicles in their environment, and how to interact with others on the roads – be they on bicycles, on foot, or in motor vehicles. And to complement the information, enforcement programs are needed to discourage those who neglect their responsibilities on the road.

Educational Countermeasures

While many people automatically associate education programs with school children, statistics indicate that 72 percent of over 5,000 bicycle crashes in Miami-Dade County involved adults, with the remainder attributed to school-age children. The proportion of serious and fatal crashes experienced by adults is even higher. While schools in Miami-Dade County have several ongoing education programs aimed at road users, there are very few programs aimed at improving safety amongst adult and senior cyclists who are becoming an increasingly large fraction of the population locally.

Typical cyclist education programs that may be considered for the County are described below[3].

- Children
    - Toddlers – safe and aware passengers
    - Juniors – beginner cyclists having fun off the streets
    - Middle school – biking as a way to get around

[3] FHWA Bicycle Safety Education Resource Center

  - High school – remembering the rules
- Adults – using bikes for more than recreation
- Seniors –reducing the stress of increased traffic
- Motorists – bicycles are vehicles with rights too

The Florida Department of Transportation's Pedestrian and Bicycle Program serves as a clearinghouse for information concerning safety and design. The office is also responsible for the *Florida School Crossing Guard Program* and the *Florida Traffic and Bicycle Safety Education Program* which provides information about curriculum and training for school and community bike and pedestrian safety instruction, and about the statewide initiative for *Safe Ways to School*. The safety education program has been in effect since 1982 and has a mission to "prevent injuries to children from bicycle and pedestrian crashes by training them with the knowledge and skills needed to be competent and safe in traffic." The program is unique in the country in that it has received a continuous funding source from the Department. This program has a large impact on school age children in Miami-Dade County, but, although it includes a Community Workshop component for adults, this has less impact than the school programs. This is an area that the County should focus on for bicycle safety enhancement.

Educational countermeasures can also be implemented through a Bicycle Ambassadors program. Bicycle Ambassadors are typically citizen volunteers who perform public outreach and education. Typically operating as teams of at least two cyclists, they generate interest in bicycling and promote bicycling safety to both cyclists and motorists. Bike Ambassadors talk face-to-face and give demonstrations to kids, teens, and adults by participating in existing community events, and running special Ambassador programs in neighborhoods. The Ambassadors also work with communities to identify and address local transportation safety concerns. In some cases they hand out gift certificates to cyclists who are behaving safely. Cities and organizations throughout the United States sponsor Bicycle Ambassadors. Examples include the Cascade Bicycle Club (Seattle[4]), Mayor Daley's Bicycling Ambassadors (Chicago[5]), and Bucky's Ambassadors (University of Wisconsin-Madison[6]).

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[4] http://www.cbcef.org/ambassadors.html

Many more educational programs are summarized in FHWA's Good Practices Guide for Bicycle Safety Education[7]. This document also provides suggestions on how communities can develop and evaluate their own educational programs.

Enforcement Countermeasures

Enforcement programs directed towards bicyclists face many challenges, and are frequently avoided by law enforcement agencies for some or all of the following reasons:

- They tend to be controversial,
- They often targets disadvantaged groups,
- They are expensive, and
- They tend to have limited success.

Sporadic enforcement will not result in significant improvements to cyclist safety behavior and will likely result in resentment of law enforcement personnel. The effort to enforce the traffic laws as they relate to bicycle safety should be addressed in an overall, countywide, coordinated, bicycle enforcement campaign that includes local community input – be it from church groups, neighborhood associations or major employers.

On the University of Florida campus, bicyclists who violate traffic laws are subject to the same fines as motorist violators: $118.50 for a moving violation, $74.50 for a non-moving violation, and $46.50 for a violation specific to bicycle operation (http://police.ufl.edu/csd/community_bsep.htm). Bicyclists who have received citations have a one-time option of attending the University's Bicycle Traffic Safety School. This program lasts 90 minutes and covers topics including bicycle crash statistics, laws and definitions, parking rules, riding techniques, safety equipment, and bicycle security.

The National Highway Traffic Safety Administration (NHTSA) offers two courses for law enforcement officers[8]. First, "Community Bicycle Safety for Law Enforcement" gives officers background on bicycling safety and covers working with communities to encourage bicycling and bicycling safety. Second, "A Law Officer's Good Practices Guide to Bicycle Safety and Enforcement" focuses on laws pertaining to cyclists.

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[5] http://www.bicyclingambassadors.org

[6] http://www2.fpm.wisc.edu/trans/Ambassadors

[7] http://www.bicyclinginfo.org/ee/bestguidedoc.pdf

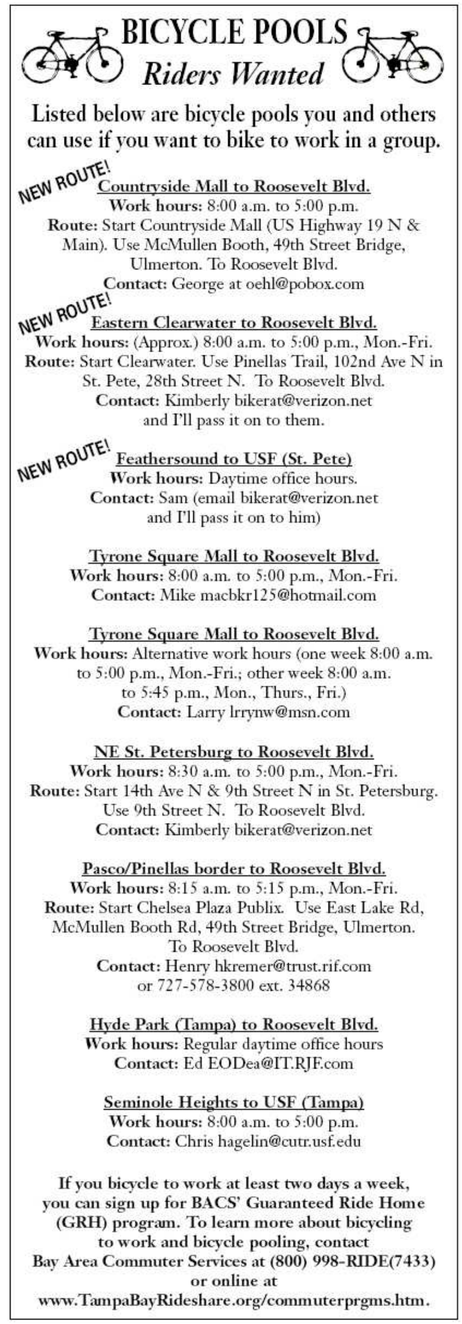
[8] http://www.bicyclinginfo.org/ee/enforce_officer03.htm

The International Police Mountain Bike Association (IPMBA) offers several courses for police officers, including instructor certification, basic and advanced bicycle officers, and crowd control[9].

Encouragement

Encouragement of bicycling is an important part of creating a bicycle-friendly community and enhancing safety.

While provision of good bicycle facilities is a critical part of this strategy, Bikepools are another great method for encouraging safe bicycling. Tampa's bikepool program is based upon general origins and destinations in the community[10]. Communities like Boulder, CO have promoted worksite based bikepools. North Carolina has a statewide ride match program for bicyclists[11]. Many other urban areas also have ridepool or ridematch programs; these include Denver, CO and Arlington, VA. One critical feature these programs all share is a Guaranteed Ride Home program for individuals who agree to bike to work a minimum number of days per week. South Florida Commuter Services currently has an emergency ride home program and website to match potential carpoolers[12] which could possibly be expanded to include a bikepool match list.



BICYCLE POOLS

Riders Wanted

Listed below are bicycle pools you and others can use if you want to bike to work in a group.

NEW ROUTE! **Countryside Mall to Roosevelt Blvd.**
Work hours: 8:00 a.m. to 5:00 p.m.
Route: Start Countryside Mall (US Highway 19 N & Main). Use McMullen Booth, 49th Street Bridge, Ulmerton. To Roosevelt Blvd.
Contact: George at oehl@pobox.com

NEW ROUTE! **Eastern Clearwater to Roosevelt Blvd.**
Work hours: (Approx.) 8:00 a.m. to 5:00 p.m., Mon.-Fri.
Route: Start Clearwater. Use Pinellas Trail, 102nd Ave N in St. Pete, 28th Street N. To Roosevelt Blvd.
Contact: Kimberly bikerat@verizon.net and I'll pass it on to them.

NEW ROUTE! **Feathersound to USF (St. Pete)**
Work hours: Daytime office hours.
Contact: Sam (email bikerat@verizon.net and I'll pass it on to him)

Tyrone Square Mall to Roosevelt Blvd.
Work hours: 8:00 a.m. to 5:00 p.m., Mon.-Fri.
Contact: Mike macbkr125@hotmail.com

Tyrone Square Mall to Roosevelt Blvd.
Work hours: Alternative work hours (one week 8:00 a.m. to 5:00 p.m., Mon.-Fri.; other week 8:00 a.m. to 5:45 p.m., Mon., Thurs., Fri.)
Contact: Larry lrrynw@msn.com

NE St. Petersburg to Roosevelt Blvd.
Work hours: 8:30 a.m. to 5:00 p.m., Mon.-Fri.
Route: Start 14th Ave N & 9th Street N in St. Petersburg. Use 9th Street N. To Roosevelt Blvd.
Contact: Kimberly bikerat@verizon.net

Pasco/Pinellas border to Roosevelt Blvd.
Work hours: 8:15 a.m. to 5:15 p.m., Mon.-Fri.
Route: Start Chelsea Plaza Publix. Use East Lake Rd, McMullen Booth Rd, 49th Street Bridge, Ulmerton. To Roosevelt Blvd.
Contact: Henry hkremer@trust.rif.com or 727-578-3800 ext. 34868

Hyde Park (Tampa) to Roosevelt Blvd.
Work hours: Regular daytime office hours
Contact: Ed EODea@IT.RJF.com

Seminole Heights to USF (Tampa)
Work hours: 8:00 a.m. to 5:00 p.m.
Contact: Chris hagelin@cutr.usf.edu

If you bicycle to work at least two days a week, you can sign up for BACS' Guaranteed Ride Home (GRH) program. To learn more about bicycling to work and bicycle pooling, contact Bay Area Commuter Services at (800) 998-RIDE(7433) or online at www.TampaBayRideshare.org/commuterprgms.htm.

Transit systems throughout the United States have bikes on transit programs. These enable a cyclist to ride his/her bike for part of the journey and utilize transit for part of the journey. Miami-Dade Transit allows cyclists to bring their bikes on board buses, Metrorail, and

9 http://www.ipmba.org/instructors.htm

10 http://www.TampaBayRideshare.org/commuterprgms.htm

11 http://www.sharetheridenc.org/

12 www.1800234ride.com/index.html

Metromover[13]. Permits are required to bring bikes on board Metrorail. In addition, cyclists can rent lockers at selected Metrorail stations[14]. Tri-Rail allows cyclists to bring their bikes on board commuter trains; permits are required[15].

3.2 ENGINEERING TREATMENTS

Although bicyclists do well when riding legally and sharing roadways with motorists, many bicyclists do not feel comfortable when riding on roadways, especially those with high speeds and high volumes. These bicyclists may behave in an unsafe manner (riding against traffic, on the sidewalk, cutting through parking lots) unless additional facilities are provided. Thus, good quality roadway design and comfortable bicycle facilities should be provided to encourage safe bicycling behavior.

High-Speed Roadways

The following should be considered on high-speed roadways:

- Bike lanes – Bike lanes have been found to improve the predictability of both motorists and bicyclists. In addition, when properly designed and installed at intersections, bike lanes have been shown to improve compliance with traffic control devices and properly position cyclists for through or turning movements. While as yet unconfirmed through extensive research, these results suggest that bicycle lanes will reduce bicycle / motor vehicle crashes.
- Shared-use lane symbols - Where there is insufficient space to provide a bike lane, the shared lane symbol is an option to consider. This pavement marking has been shown to reduce riding against traffic, reduce sidewalk riding, increase bicyclists' separation to the curb, and increase motorists' separation to bicyclists. While not all the results are statistically significant this is a promising treatment nonetheless. It is currently being installed and evaluated in numerous communities around the country.
- Signing of alternative routes – If there is no practical treatment which can be applied to a high volume, high speed roadway, and an alternative low-volume, low-speed route is available, this alternative route should be considered for route signage. Route signage should provide information

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13 http://www.co.miami-dade.fl.us/transit/bikes.asp

14 http://www.co.miami-dade.fl.us/transit/bikerail.asp

15 http://www.tri-rail.com/rider_info/bike_permit.htm

that is useful to cyclists such as destinations along the route and connections to other routes.

- Sidepaths – If right-of-way is available, visibility is good, and conflicts with driveways are minimal, a pathway adjacent to the roadway may be an appropriate treatment to provide for bicyclists along a busy roadway.

Lower-Speed Roadways

Many low-speed, low-volume facilities (usually residential streets) do not require special treatments. However, on collectors or roadways with moderate volumes, special treatments may improve the conditions for cyclists:

- Bike lanes – These are usually not needed on residential roadways but may be desirable on collector roads.
- Shared-use lane symbols – adjacent to on-street parking
- Appropriate signs
- Traffic calming treatments: curb extensions, mini-circles, contrasting shoulders, speed pillows (these are speed humps with a passage for bicyclists), chicanes, and choke points

Some additional potential engineering treatments were identified that may improve bicycling safety conditions at locations throughout Miami-Dade County, and were considered for the locations identified in this study.

- Pavement surface treatments
- Lighting enhancements
- Drainage improvements
- Access control
- Advance bicycle stop bar
- Bicycle signal/detector
- No right-turn, or yield to pedestrians in crosswalk SIGNS

Based on the detailed crash location site reviews and an evaluation of the several programmatic and engineering treatments available to treat individual safety conditions, a number of targeted recommendations were made for Miami-Dade County as detailed in the following section.

4.0 Recommended Safety Countermeasures

This section addresses the programmatic and engineering countermeasures that are recommended for implementation in Miami-Dade County as a product of this bicycle safety study.

4.1 Summary of Crash Site Countermeasures

The table below provides a brief summary of countermeasures identified for each location identified through the data analysis.

Table 4-1 Summary of Crash Site Countermeasures

Rank	Location	# Crashes	Potential Treatments Recommended
1	Crandon Boulevard at Harbor Drive	13	Bike box
2	Alton Road at 17^{th} Street	11	Shared lane; education
3	Alton Road at 15^{th} Street	9	Shared Lane; education
4	Euclid Avenue at 5^{th} Street	9	Enforcement
5	NW 27^{th} Avenue at NW 79^{th} Street	9	Enforcement
6	Meridian Avenue at 11^{th} Street	8	Education; enforcement
7	NW 22^{nd} Avenue at NW 62^{nd} Street	8	Enforcement; education
8	Washington Avenue at 17^{th} Street	8	Shared lane
9	Washington Avenue at Espanola Way	8	Signs, education
10	E Bay Road at NE 71^{st} Street	7	Sign evaluation; education
11	S Dixie Hwy at SW 184^{th} Street	7	Signs; education
12	Washington Avenue at 16^{th} Street	7	Shared lane
13	Alton Road at 11^{th} Street	6	Shared lane; Education
14	Dickinson Ave at 71^{st} Street	6	Signs; education
15	Jefferson Ave at 5^{th} Street	6	Signs; education
16	W Dixie Hwy at NE 135^{th} Street	6	Education, signs
17	NE 6^{th} Ave at W Dixie Highway	6	Enforcement
18	NW 46^{th} Street at NW 22^{nd} Avenue	6	Enforcement; education
19	SW 104^{th} Street at SW 147^{th} Avenue	6	Education; enforcement
20	SW Franjo Rd at Cutler Ridge Drive	6	Sidepath improvements; education
21	Washington Avenue at 13^{th} Street	6	Shared lane
22	Washington Avenue at 14^{th} Street	6	Signs; education

As shown in this table, engineering treatments were identified for 11 of the 22 top-ranked crash locations in Miami-Dade County – or 50 percent of the list. This is due to the random and nonrecurring nature of crashes at the remaining 11 locations – where no common crash type or engineering countermeasure could be identified. For these locations – as is indicated in the table – education and enforcement are recommended as countermeasures most likely to lead to enhanced safety for bicyclists.

4.2 Data Collection and Monitoring

As a result of the data analysis conducted for this study, it is recommended that the MPO continue with the annual collection of bicycle crash information, and with geo-coding the data for use in effective mapping and geo-spatial analysis. This will facilitate effective monitoring of crash rates and hot spots.

4.3 Countywide Treatments

There are several reoccurring themes among the countermeasures identified for the site-specific crash problems. These include engineering, educational, and enforcement countermeasures. Each of these needs a bit more discussion in the context of countywide implementation.

Education

As shown in Table 4-1, site-specific engineering treatments were identified for only 50 percent of the locations. This is due to the random nature of crashes at the remaining 11 locations – where no common crash type was identified. For these locations – as is indicated in the table – education and enforcement areas recommended as countermeasures most likely to lead to enhanced safety for bicyclists.

Educational countermeasures will have a greater effect if they are implemented across the County to achieve a degree of uniformity of information. Consequently, we recommend a broad application of these campaigns with greater saturation within the high crash areas.

- **The Dangers of Riding Against Traffic and**
- **Motorist Yield to Sidewalk Traffic.**

Riding against traffic, either on the sidewalk or on the roadway is a common practice in Miami-Dade County. According to the PBCAT analysis, it is also a fairly frequent (36 percent of all crashes) characteristic of bicycle crashes in Miami-Dade County. We realize, however, that sidewalk riding will continue because many people simply are not comfortable riding bikes on the roadway with motor vehicles. Additionally, we cannot expect cyclists to cross a multilane roadway to get to a sidewalk so they can ride in the same direction as cars in the adjacent travel lane. Thus, it is imperative that cyclists who chose to ride on the sidewalk be aware of the hazards associated with this practice. We recommend driver- and cyclist-targeted campaigns with graphics representing Miami-Dade County; this representation would include location, demographics, and language. It is also important to target motorists with these campaigns to make the driver aware that they need to scan for traffic on the sidewalk. To maximize the potential for reducing crashes, these campaigns must be run concurrently.

- **Riding at Night Without Lights.**

Bicyclists operating at night without lights are nearly invisible to motorists – until it is too late. Even if a bicycle is properly fitted with reflectors, motorists coming from a side street will not see the cyclists until it is too late for the driver to react. Even if bicyclists choose to ride at night without lights, they must be made aware of the dangers they face in the dark. We have had the opportunity to review as yet unpublished research papers which show that a minimal (time) amount of exposure to conspicuity issues results in a much increased appreciation of how well motorists can see pedestrians at night. We recommend applying potential increase in awareness to the Miami-Dade bicycle crash problem. Informational posters showing sight distances for various colors of clothing and illustrating the limitations of reflectors may provide cyclists (and pedestrians) the information they need to make better choices when choosing gaps to cross the road or when anticipating driver behaviors at driveways and intersections.

Enforcement

Similarly, enforcement countermeasures will have a greater effect if they are implemented across the County, largely to avoid any implication of unfair targeting of communities. Particular behaviors to be targeted should be determined at the outset of the law enforcement campaign. We recommend the following behaviors be targeted:

1. Riding at night without lights,
2. Violating traffic signals, and
3. Riding against traffic on the roadway

These three behaviors were chosen for two reasons. First, they represent particularly hazardous behaviors which result in many crashes. Secondly, and very importantly, the enforcement of these behaviors is easy to justify to the public. When coupled with (and in fact preceded by) a large scale education campaign, the public will understand the importance of the campaign and consequently will accept the enforcement activity.

Engineering

Quick Response Program As an outcome of the analysis completed for this study, it is recommended that the County implement a program for quickly responding to public calls or complaints relating to unsafe bicycling conditions at specific locations. This may include a common communication channel so all issues are routed through a single database and/or small staff group, and a funding and cooperating mechanism so that Public Works or other County departments may be available to evaluate and correct any physical safety hazard that is identified. Such a program would benefit from data collecting, geo-coding and monitoring recommended in Section 4.2 which could help identify or verify crash hot spots.

Intersection signage. Signs such as the *NO RIGHT ON RED when Pedestrians Present* or the *Left Turning Vehicles Yield to Peds* signs are currently being evaluated for their effectiveness in reducing pedestrian conflicts and crashes. If these signs are found to be effective for reducing pedestrian conflicts, it is reasonable to expect that these signs would also reduce the conflicts between motorists and bicyclists riding on the sidewalk (or on a sidepath). However, even if these signs are found to be effective tools in reducing crashes, they should be used sparingly and only where there is a documented problem and relatively constant pedestrian/bicycle use of the intersection. The overuse of signs, or the use of the signs where pedestrians and/or cyclists are not using the crosswalks, dilutes the signs' ability to command the attention of motorists, and eventually result in the signs being just background visual clutter.

Blank out (or internally illuminated) signs, because they are real-time traffic control devices, can continue to be effective at intersections because they are only activated when there is a potential conflict. If motorists see an illuminated YIELD TO PEDS sign next to a permissive left-turn signal, the motorists will know there is a pedestrian crossing the conflicting crosswalk at that time. This "real-time" aspect of blank out signs allows for them to be placed at locations where conflicts are not frequent or constant enough to make a static sign appropriate.

Shared Lane Symbol. The Shared Lane Symbol has the potential to reduce several different types of crashes and is being used in several jurisdictions across the country. Because cyclists tend to center over the symbol, it may be useful for reducing dooring crashes. Additionally, a similar treatment has been found to reduce wrong way riding and riding on the sidewalk, and to improve bicyclists' position in the travel lanes. Consequently, this treatment may actually reduce the incidence of motorist-failure-to-yield-to-the-bicyclist crashes and overtaking crashes. This treatment is experimental and has not been approved by the FHWA. Therefore, we recommend a Request to Experiment be submitted to the FHWA prior to implementation. An evaluation plan must accompany this Request to Experiment and this must include measures of effectiveness. The following measures of effectiveness are suggested:

- Separation between parked cars and bicyclists,
- Percent bicyclists riding on the sidewalk,
- Percent bicyclists riding against traffic,

- Motorists' understanding of the symbol, and
- Bicyclists' understanding of the symbol.

Due to the experimental nature of this treatment, it is not recommended for use throughout the County, although, with a successful test outcome, that may be possible in the future.

Bike Box. This treatment may be a unique application in Miami-Dade County and there have been no previous local evaluations of this type of application.

As with the Shared Lane Symbol, this is an experimental treatment and would require a Request to Experiment and an evaluation plan. We suggest the following measures of effectiveness:

- Reduction in conflicts,
- Number and percent of bicyclists using the box,
- Motorists' understanding of the box, and
- Bicyclists' understanding of the box.

4.4 Local Area Treatments

It may be appropriate to implement more focused educational programs in areas of the County which experience particular bicyclist behaviors and crash types. Based on the geographic crash data analysis task findings, a summary of potential educational program focus areas for different communities in Miami-Dade County is provided in Table 4-2.

Table 4-2 Summary of Educational Elements by Local Area

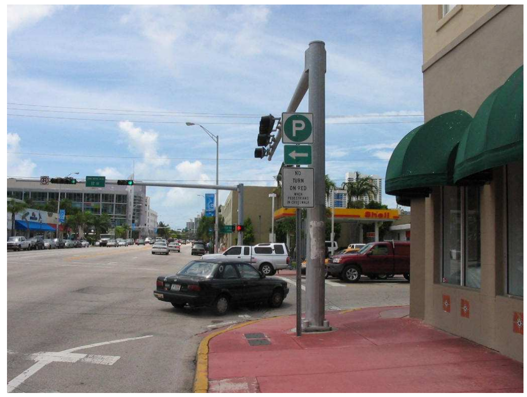
Community	Obey Rules, Ride w/Traffic	Lights	Drink/ Drugs	Youth	Senior
Miami Beach – South	◆	◆	◆		
Miami Beach – North		◆			◆
Liberty City	◆	◆			
Key Biscayne				◆	◆
Cutler Ridge/Perrine				◆	◆

These programs should be coordinated through local community organizations including schools, churches, neighborhood and community groups, and at commercial establishments that generate significant bicycle trips, or are active with cyclists – like bike shops.

4.5 CRASH SITE ENGINEERING TREATMENTS

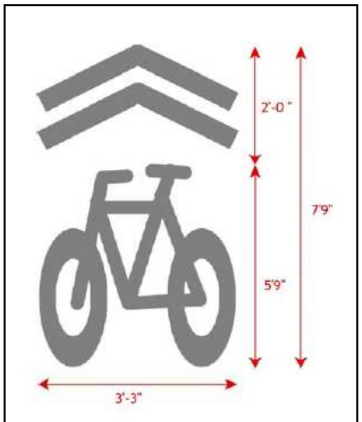
Bay Road at 71st Street. Two of the crashes that occurred at this location involved left-turning motorists hitting bicyclists in the crosswalks. Two sets of signs have been installed at this intersection; both have been circled in the picture on the right. The first is mounted on the signal mast arm to warn left-turning motorist to yield to pedestrians within the crosswalk. The second is mounted on the right side of the roadway and prohibits turning right on red when pedestrians are present. These signs have only recently been installed and are being evaluated as part of a FHWA project to determine their effectiveness on reducing conflicts and crashes occurring in the crosswalks. We recommend this evaluation be completed prior to installing any additional treatments. If evaluations show these signs to be ineffective, blank-out signs (discussed below) may serve to further raise motorists' awareness of bicyclists (and pedestrians) crossing in the crosswalks.

An education campaign directed at motorists may also reduce the turning motorist crashes at this intersection (and others). The posters shown above are part of a multimedia campaign package developed by the FHWA to combat pedestrian crashes. This campaign includes video and radio public service announcements, brochures, posters, bus backs, and interior bus cards. The multilingual materials are free and are directed at both motorists and pedestrians.



Alton and 17th. Three of the crashes that occurred at Alton and 17th involved motorists hitting bicyclists riding against traffic either on the roadway or on the sidewalk.

Riding against traffic is a major contributing cause to many bicycle crashes – particularly on the sidewalk. This is because motorists frequently do not look for traffic on the sidewalk, and only rarely look for traffic coming contra-flow to the normal traffic stream (for instance, a right-turning motorist will rarely look to his right before making a turn).



Bike-and-chevron marking

From an engineering standpoint, it would be desirable to have bicyclists ride with traffic and within the roadway. A variation of the experimental shared lane symbol shown at the right[16] has been shown to reduce bicyclists riding on the sidewalk and increase riding with traffic. More recent research has shown this symbol to be more understandable to motorists and bicyclists[17]. Consequently, this treatment may help reduce bicycle crashes near this intersection. Special approval is required from the State Department of Transportation to implement such an experimental treatment.

While the above-noted treatment may have a positive impact on bicyclists' safety near Alton and 17th, we feel there may be resistance to riding in the roadway by some cyclists in this specific area.

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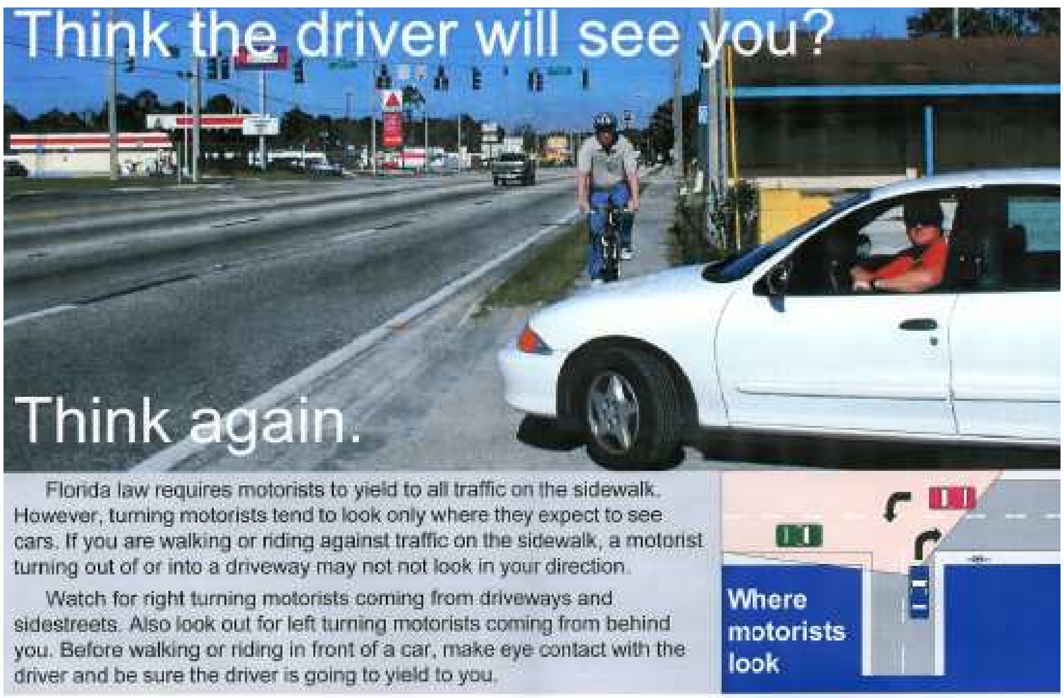
16 Florida Department of Transportation and UNC-HSRC, *Evaluation of the Shared Lane Arrow*, December, 1999.

17 San Francisco Department of Planning and Traffic and Alta Planning+Design, *San Francisco's Shared Lane Pavement Markings: Improving Bicycle Safety*, Final Report, February 2004.

Consequently, an educational campaign to inform bicyclists of the hazards associated with riding against traffic and on the sidewalk would likely have a greater safety impact. The goal of such a campaign would be to teach bicyclists that motorists are not looking for traffic on the sidewalk, and that they must take greater responsibility for their own safety when riding on the sidewalk. An example of what an informational poster might look like for this campaign is provided below.

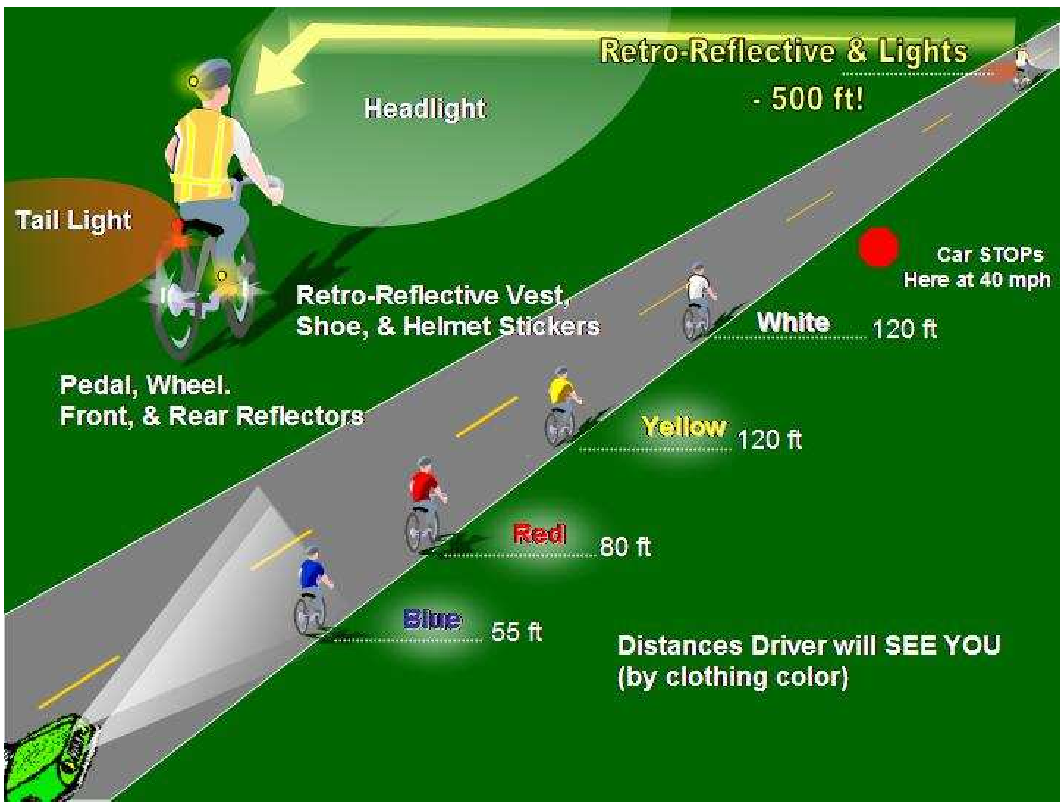
In addition to riding against traffic, riding at night without lights appears to have contributed to two of the bicycle crashes at Alton and 17^{th}. This is a crash cause for which enforcement is a potential solution. Riding a bicycle without lights at night is a violation of Florida Statutes.[18] Because this is a significant contributing cause to bicycle crashes in Miami-Dade County, an enforcement campaign targeting riding without lights near this intersection could be part of a countywide effort.



Crashes resulting from riding at night without lights can also be targeted through educational efforts. All bicycles sold in Florida are required to be provided with reflectors, and many people riding bicycles may believe the reflector

[18] 316.2065(8) Every bicycle in use between sunset and sunrise shall be equipped with a lamp on the front exhibiting a white light visible from a distance of at least 500 feet to the front and a lamp and reflector on the rear each exhibiting a red light visible from a distance of 600 feet to the rear. A bicycle or its rider may be equipped with lights or reflectors in addition to those required by this section.

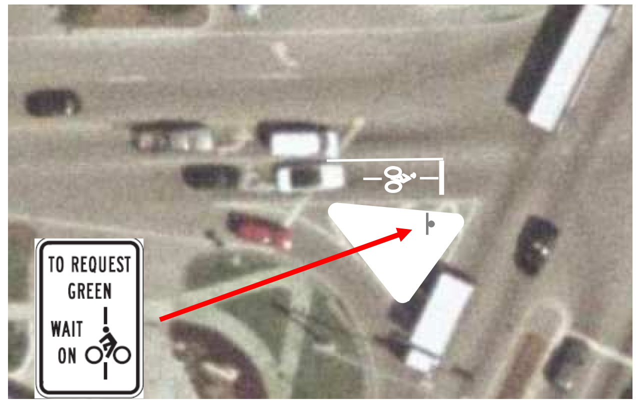
system that comes on a bicycle is adequate to ensure their visibility to motorists. While this is a reasonable assumption if the bicycle is approaching from within a motorist's headlamp cone of illumination, it is not true for when the bicycle is approaching the motorist on a perpendicular travel path. Consequently, a two-part educational effort should be made. The first part would be composed of an educational campaign emphasizing the importance of retro-reflectivity and lighting. A draft graphic for a poster campaign is provided below[19]. A second portion of the effort would educate bicyclists on the limitations of a reflectivity- (or retro-reflectivity) based system and underscore the need for bicycle lighting. Such a campaign would likely include graphics showing the visibility of a cyclist about to cross a motorist's path at night.



Alton Road and 13th Street and Alton Road and 11th Street. The crash types described above continue along this entire section of Alton Road. This suggests countermeasures should be applied along this entire corridor section.

[19] Adapted from FHWA document FHWA-SA-0-011, an educational poster for pedestrians promoting the use of retro-reflective materials.

Crandon and Harbor Drive. The west approach to the Harbor Drive at Crandon intersection includes a right-turn lane, a left-turn lane, and a shared through–left lane. The through-movement is relatively rare and (apparently) cyclists do not watch for it to occur. There were several crashes at this location that involved a left-turning bicyclist being hit by a through motorist. One potential solution for this is an experimental treatment called a bike box. In this location, a bike box would allow bicyclists at the intersection to position themselves in front of motorists waiting behind the stop bar. This position makes it clear to the motorist that the cyclist is turning and prevents the motorists from believing they can overtake the cyclist. An example of what this treatment might look like is provided to the right.



This treatment has difficulties associated with it however. The location of the pedestrian crossing at this location requires that the vehicle stop bar be moved back to accommodate the bicycle box. Given the typical driver behavior in this region, it is expected that moving the stop bar back to provide space for a bike box would lead to a high violation rate and could lead to less safe conditions for bicyclists. At the same time, the County is working with the Village of Key Biscayne to design an improvement at this location that would provide a bicycle lane between the right-turn lane and the left/through lane. While this is not an ideal solution, it is expected that the treatment would enhance the level of recognition for bicycles and should have an impact on improving safety.

NW 27th Avenue and NW 79th Street. The primary cause of crashes at this intersection appears to be violation of traffic signals. Consequently, an enforcement campaign that addresses signal violations by both motorists and bicyclists is suggested for this intersection area.

NW 22nd Avenue and 62nd Street. The crash review for this location found that bicyclists' behavior – crossing midblock and choosing an insufficient gap – was the primary cause of crashes. As stated previously, this type of crash does not lend itself to intervention or engineering countermeasures. Enforcement and education programs aimed at cyclists are recommended.

S. Dixie Highway and 184th Street. Two cyclists at this location were hit by motorists failing to yield to bicyclists riding in the crosswalk. As discussed previously, this suggests several different countermeasures. First, YIELD TO PEDS IN CROSSWALK signage, such as those at Bay and 71st, may increase motorist awareness of individuals riding (or walking) in the crosswalks. If, however, the evaluations of these signs show little or no impact on motorist behavior, blank out signs are an alternative treatment which have been shown to reduce conflicts.[20] Example applications of these internally illuminated signs, superimposed on the Alton/17th intersection, are shown below.

Educational countermeasures include *yield to pedestrians* campaigns, such as the FHWA campaign described above, aimed at motorists and sidewalk riding hazard awareness campaigns (again, as discussed above) aimed at cyclists.

Washington Avenue and Espanola Way. The behavior of motorists failing to yield to bicyclists in the crosswalk behavior was also responsible for crashes at the Washington Avenue and Espanola Way intersection. Treatments and campaigns such as those described for the S. Dixie Highway/184th Street intersection should be considered at this location as well.

A *dooring* crash also occurred near this intersection. *Dooring* crashes occur when a motorist in a parking lane opens his/her door into the path of an overtaking cyclist. This type of crash typically results in serious injuries for the cyclists. There are two basic causes for this crash type: the primary cause being that the motorist failed to properly scan prior to opening the car door, and the other that the cyclist was riding too close to the parked cars. One treatment which may reduce the potential for this type of crash is the shared lane symbol placed on the roadway at a location which encourages the cyclist to ride a safe distance from parked cars.

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[20] FDOT and UNC-HSRC, *The Effects of NO TURN ON RED/YIELD TO PEDS Variable Message Signs on Motorist and Pedestrian Behavior*, November 2000.

Washington Avenue and 16th Street and Washington Avenue and 13th Street. The same crash types that occurred at Washington and Espanola Way continue along the corridor. Consequently, the same countermeasures should be implemented consistently along this section of Washington Avenue.

An example of the Shared Lane Symbol as it would be applied near 16th Street is provided at the right.

Euclid Avenue and 5th Street. Enforcement-based countermeasures will be needed to prevent the crash types occurring in the area of this intersection. Bicyclist violation of traffic controls, including STOP signs and signals, was responsible for several crashes. Riding without lights at night also contributed to the crashes at this location. The night riding without lights enforcement campaign should be supplemented with an educational campaign described above.

Meridian Avenue and 11th Street. Bicycle riding at night without lights was a significant factor in crashes at this location. Again, enforcement and educational campaigns aimed at bicyclists who ride at night without lights should be implemented in this area.

West Dixie Highway and 6th Avenue. Bicyclists' violations of signals were the primary causes of crashes at this intersection. Consequently, an enforcement campaign targeted at bicyclists running red lights should be implemented in this area.

West Dixie Highway and NE 135th Street. Sidewalk riding contributed to the crashes near this intersection. The motorist signing and the sidewalk riding hazards awareness programs discussed above should help reduce this crash type.

5th Street and Jefferson Avenue. As with the previous intersection, sidewalk riding contributed to the crashes near this intersection. The motorist signing and the sidewalk riding hazards awareness programs discussed above should help reduce this crash type. Riding without lights also contributed to one crash at this intersection.

NW 22nd Avenue and 46th Street. As described with other intersections discussed, bicyclists' violations of signals were the primary causes of crashes at this intersection. Consequently, an enforcement campaign targeted at bicyclists running red lights should be implemented in this area.

SW 147th Avenue and SW 104th Street. Crashes at this intersection included several bicyclists' signal violations, a cyclist riding at night without lights, and bicyclists choosing inadequate gaps when crossing away from the intersection. Each of these crash types could be addressed with the respective countermeasures discussed previously.

71st Street and Dickenson Avenue. Similar to several other intersections, sidewalk riding was a contributing factor for the crashes at this location. Signing and educational efforts would be appropriate at this location.

Old Cutler and Franjo Road. Motorists' failure to yield to cyclists on the sidepath contributed to the crashes at this location. Old Cutler has a sidepath for cyclists located adjacent to the roadway on the east side at this location. While this arrangement may not cause problems for cyclists riding with traffic, effectively functioning as a wide shoulder, it can create operational problems for cyclists riding against traffic. A primary concern with this configuration is that it requires that cyclists traveling against traffic pass motorists in the adjacent lane on the left, in violation of Florida Statutes[21] and expected traffic behavior. As discussed previously, riding against traffic puts cyclists in a location approaching intersections or driveways where motorists are not expecting or looking for traffic.

If a sidepath is to be used at this location, it should be reconfigured to be separated from the roadway. Additionally, educational efforts designed to increase motorist yielding and make bicyclists aware of the hazards of riding against traffic on a sidepath (as with a sidewalk) should be implemented.

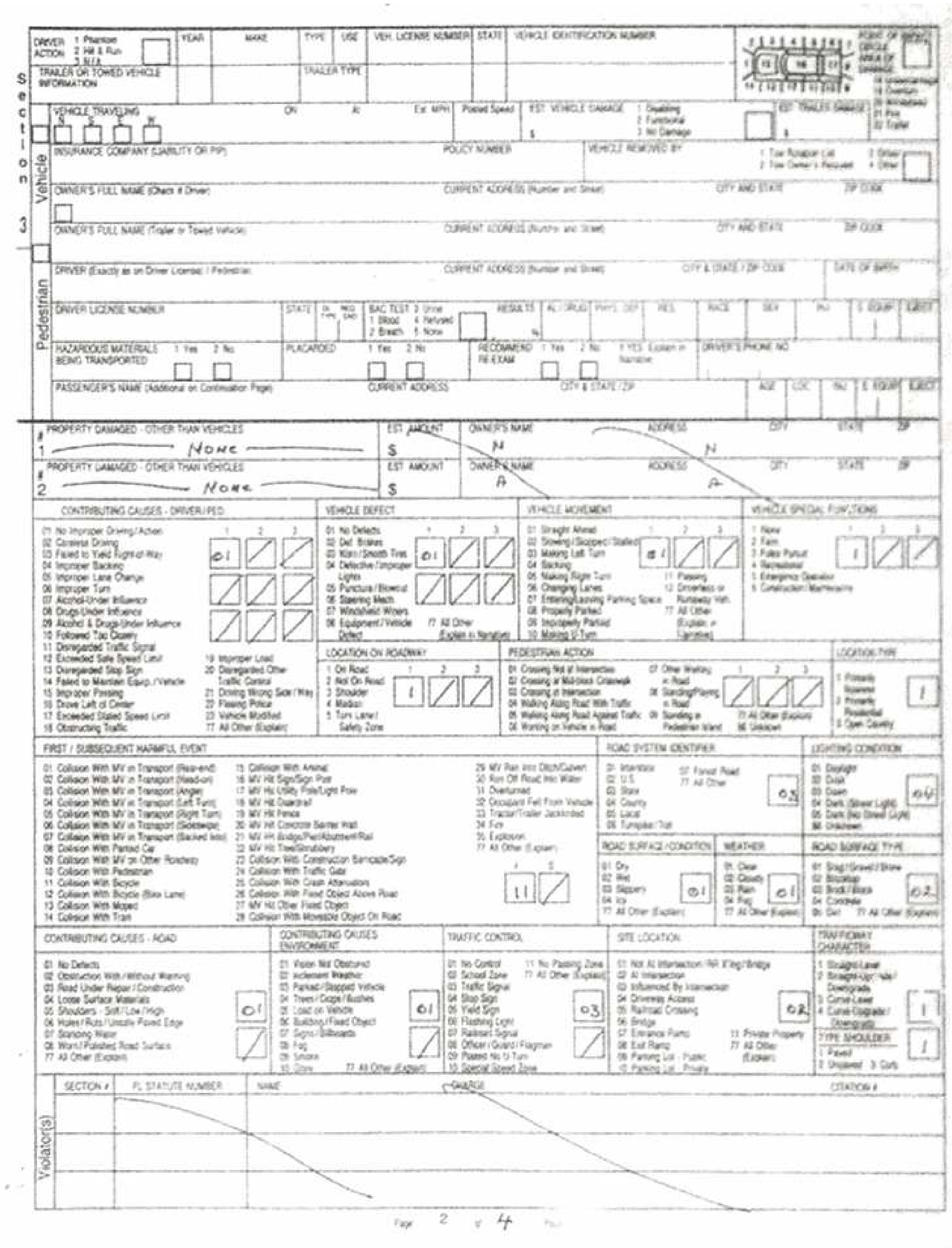
[21] 316.082(1) Drivers of vehicles proceeding in opposite directions shall pass each other to the right.

5.0 Appendix

In the 1970s, manual methods for typing pedestrian and bicycle crashes were developed by the National Highway Traffic Safety Administration (NHTSA) to better define the sequence of events and precipitating actions leading to bicycle- and pedestrian-motor vehicle crashes.

In the 1990s, the methodologies were applied to over 8,000 pedestrian and bicycle crashes from six states. The results provided a representative summary of the distribution of crash types experienced by pedestrians and bicyclists. This method has evolved over time and was refined during development of the PBCAT by the FHWA. PBCAT is a software product for state and local pedestrian and bicycle coordinators, planners, and engineers to better understand crashes involving pedestrians or bicyclists.

The following sequences of document scans and screen captures illustrate the use of PBCAT to determine the crash type for a specific bicycle crash. A police crash report appears on the next two pages, followed by screens presented by PBCAT software Version 2.0 (released in 2005) to the user.


DRIVER ACTION 1 Phantom 2 Hit & Run 3 N/A | YEAR | MAKE | TYPE | USE | VEH. LICENSE NUMBER | STATE | VEHICLE IDENTIFICATION NUMBER | POINT OF IMPACT CIRCLE AREA OF DAMAGE

TRAILER OR TOWED VEHICLE INFORMATION | TRAILER TYPE

VEHICLE TRAVELING N S E W | ON | AT | EST. MPH | POSTED SPEED | EST. VEHICLE DAMAGE $ | 1 Disabling 2 Functional 3 No Damage | EST. TRAILER DAMAGE $

INSURANCE COMPANY (LIABILITY OR PIP) | POLICY NUMBER | VEHICLE REMOVED BY | 1 Tow Rotation List 2 Tow Owner's Request 3 Other 4 Other

OWNER'S FULL NAME (Check if Driver) | CURRENT ADDRESS (Number and Street) | CITY AND STATE | ZIP CODE

OWNER'S FULL NAME (Trailer or Towed Vehicle) | CURRENT ADDRESS (Number and Street) | CITY AND STATE | ZIP CODE

DRIVER (Exactly as on Driver License) / Pedestrian | CURRENT ADDRESS (Number and Street) | CITY & STATE / ZIP CODE | DATE OF BIRTH

DRIVER LICENSE NUMBER | STATE | BAC TEST 1 Blood 2 Breath 3 Urine 4 Refused 5 None | RESULTS | RACE | SEX | INJ | S. EQUIP | EJECT

HAZARDOUS MATERIALS BEING TRANSPORTED 1 Yes 2 No | PLACARDED 1 Yes 2 No | RECOMMEND RE-EXAM 1 Yes 2 No | DRIVER'S PHONE NO.

PASSENGER'S NAME (Additional on Continuation Page) | CURRENT ADDRESS | CITY & STATE / ZIP | AGE | LOC | INJ | S. EQUIP | EJECT

Section 3 — Vehicle / Pedestrian

1 PROPERTY DAMAGED - OTHER THAN VEHICLES: None | EST. AMOUNT $ | OWNER'S NAME: N | ADDRESS: N | CITY | STATE | ZIP

2 PROPERTY DAMAGED - OTHER THAN VEHICLES: None | EST. AMOUNT $ | OWNER'S NAME: A | ADDRESS: A | CITY | STATE | ZIP

CONTRIBUTING CAUSES - DRIVER/PED: 01 | VEHICLE DEFECT: 01 | VEHICLE MOVEMENT: 01 | VEHICLE SPECIAL FUNCTIONS: 1

LOCATION ON ROADWAY: 1 | PEDESTRIAN ACTION | LOCATION TYPE: 1

FIRST / SUBSEQUENT HARMFUL EVENT: 11 | ROAD SYSTEM IDENTIFIER: 03 | LIGHTING CONDITION: 04

ROAD SURFACE CONDITION: 01 | WEATHER: 01 | ROAD SURFACE TYPE: 02

CONTRIBUTING CAUSES - ROAD: 01 | CONTRIBUTING CAUSES ENVIRONMENT: 01 | TRAFFIC CONTROL: 03 | SITE LOCATION: 02 | TRAFFICWAY CHARACTER: 1 | TYPE SHOULDER: 1

Violator(s): SECTION # | FL STATUTE NUMBER | NAME | CHARGE | CITATION #

Page 2 of 4

FLORIDA TRAFFIC CRASH REPORT HIT & RUN 1-233
LONG FORM
MAIL TO: DEPT. OF HIGHWAY SAFETY & MOTOR VEHICLES
TRAFFIC CRASH RECORDS
TALLAHASSEE, FLORIDA 32399-0500

DO NOT WRITE IN THIS SPACE
12073385713

Time & Location

DATE OF CRASH	TIME OF CRASH	TIME OFFICER NOTIFIED	TIME OFFICER ARRIVED	INVEST. AGENCY REPORT NUMBER	HSMV CRASH REPORT NUMBER
06 08 01	9:15 PM	9:17 PM	9:20 PM	01- 21759	58089

COUNTY / CITY CODE: 01-80
CITY OR TOWN: North Miami (Check if in City or Town) ☒
COUNTY: Miami-
AT NODE NO. / FEET / MILES / FROM NODE NO. / NEXT NODE NO.
NO. OF LANES: 4 — 1 DIVIDED 2 UNDIVIDED: 2
ON STREET, ROAD OR HIGHWAY: N.E. 135 St
AT INTERSECTION OF: N.E. 9 Ave

Section 1 — Vehicle / Pedestrian

DRIVER ACTION (1 Phantom 2 Hit & Run 3 N/A): 3
YEAR: / MAKE: HUFFY TYPE: 09 USE: 01 VEH. LICENSE NUMBER: — NONE — STATE: /
VEHICLE IDENTIFICATION NUMBER: B99H006788
TRAILER OR TOWED VEHICLE INFORMATION / TRAILER TYPE
VEHICLE TRAVELING: N ☒ ON: N.E. 9 Ave — AT: Est. MPH: 15 MPH Posted Speed: 30
EST. VEHICLE DAMAGE: $ 250.00 (1 Disabling 2 Functional 3 No Damage): 1
EST. TRAILER DAMAGE: $
INSURANCE COMPANY (LIABILITY OR PIP): UNKNOWN POLICY NUMBER
VEHICLE REMOVED BY: Impounded (1 Tow Rotation List 2 Tow Owner's Request)
OWNER'S FULL NAME (Check if Driver) ☒ CURRENT ADDRESS (Number and Street) CITY AND STATE ZIP
OWNER'S FULL NAME (Trailer or Towed Vehicle) CURRENT ADDRESS (Number and Street) CITY AND STATE ZIP
DRIVER (Exactly as on Driver License) / Pedestrian: Jeff Alexandez — CURRENT ADDRESS (Number and Street): 13390 N.E. 7 Ave - #40? — CITY & STATE / ZIP CODE: No. Miami Fl - 33161 — DATE 10/
[redacted]
BAC TEST (1 Blood 2 Breath 3 Urine 4 Refused 5 None): 5 RESULTS AL/DRUG PHYS. DEF RES RACE: 2 SEX: 1 INJ.: 4
HAZARDOUS MATERIALS BEING TRANSPORTED ☒ PLACARDED ☒ RE-EXAM ☒ — If YES, Explain in Narrative — DRIVER'S PHONE NO.
PASSENGER'S NAME (Additional on Continuation Page): None CURRENT ADDRESS CITY & STATE / ZIP AGE LOC. INJ.

Section 2 — Vehicle / Pedestrian

DRIVER ACTION (1 Phantom 2 Hit & Run 3 N/A) YEAR MAKE TYPE USE VEH. LICENSE NUMBER STATE VEHICLE IDENTIFICATION NUMBER
TRAILER OR TOWED VEHICLE INFORMATION TRAILER TYPE
VEHICLE TRAVELING N S E W ON AT Est. MPH Posted Speed EST. VEHICLE DAMAGE $ (1 Disabling 2 Functional 3 No Damage) EST. TRAILER DAMAGE $
INSURANCE COMPANY (LIABILITY OR PIP) POLICY NUMBER VEHICLE REMOVED BY (1 Tow Rotation List 2 Tow Owner's Request)
OWNER'S FULL NAME (Check if Driver) CURRENT ADDRESS (Number and Street) CITY AND STATE ZIP
OWNER'S FULL NAME (Trailer or Towed Vehicle) CURRENT ADDRESS (Number and Street) CITY AND STATE ZIP
DRIVER (Exactly as on Driver License) / Pedestrian CURRENT ADDRESS (Number and Street) CITY & STATE / ZIP CODE DATE
DRIVER LICENSE NUMBER STATE DL TYPE REQ. END. BAC TEST (1 Blood 2 Breath 3 Urine 4 Refused 5 None) RESULTS AL/DRUG PHYS. DEF RES RACE SEX INJ.
HAZARDOUS MATERIALS BEING TRANSPORTED (1 Yes 2 No) PLACARDED (1 Yes 2 No) RECOMMEND RE-EXAM (1 Yes 2 No) If YES, Explain in Narrative DRIVER'S PHONE NO.
PASSENGER'S NAME (Additional on Continuation Page) CURRENT ADDRESS CITY & STATE / ZIP AGE LOC. INJ.

Code Information

VEHICLE TYPE	VEHICLE USE	TRAILER TYPE	RESIDENCE (Driver Only)	PHYSICAL DEFECTS	ALCOHOL / DRUG USE
01 Automobile; 02 Passenger Van; 03 Pickup/Light Truck (2 rear tires); 04 Medium Truck (4 rear tires); 05 Heavy Truck (2 or more rear axles); 06 Truck Tractor (Cab); 07 Motor Home (RV); 08 Bus; 09 Bicycle; 10 Motorcycle; 11 Moped; 12 All Terrain Vehicle; 13 Train; 77 Other	01 Private Transportation; 02 Commercial Passengers; 03 Commercial Cargo; 04 Public Transportation; 05 Public School Bus; 06 Private School Bus; 07 Ambulance; 08 Law Enforcement; 09 Fire/Rescue; 10 Military; 11 Other Government; 77 Other	01 Single Semi Trailer; 02 Tandem Semi Trailer(s); 03 Tank Trailer; 04 Saddle Mount / Flatbed; 05 Boat Trailer; 06 Utility Trailer; 07 House Trailer; 08 Pole Trailer; 09 Towed Vehicle; 77 Other	1 County of Crash; 2 Elsewhere in State; 3 Non-Resident of State; 4 Foreign; 5 Unknown. DL TYPE: 1 A 2 B 3 C 4 D/Chauffeur 5 E/Operator 6 E/Oper-Rest 7 None. RACE: 1 White 2 Black 3 Hispanic 4 Other. REQUIRED ENDORSEMENTS: 1 Yes 2 No 3 NR. SEX: 1 Male 2 Female	1 No Defects Known; 2 Eyesight Defect; 3 Fatigue / Asleep; 4 Hearing Defect; 5 Illness; 6 Seizure, Epilepsy, Blackout; 7 Other Physical Defect. INJURY SEVERITY: 1 None; 2 Possible; 3 Non-Incapacitating; 4 Incapacitating; 5 Fatal (Within 90 Days); 6 Non-Traffic Fatality	1 Not Drinking or Using Drugs; 2 Alcohol - Under Influence; 3 Drugs - Under Influence; 4 Alcohol & Drugs - Under Influence; 5 Had Been Drinking; 6 Pending BAC Test Result. SAFETY EQUIPMENT IN USE: 1 Not In Use; 2 Seat Belt / Shoulder Harness; 3 Child Restraint; 4 Air Bag; 5 Safety Helmet; 6 Eye Protection

HSMV 90003 (Rev. 5/99)

Page 1 of 4 Pages

In Service : 1014S P — Grid # 310 Z

RIDA TRAFFIC CRASH REPORT

NARRATIVE / DIAGRAM

TO DEPT. OF HIGHWAY SAFETY & MOTOR VEHICLES
TRAFFIC CRASH RECORDS
TALLAHASSEE, FLORIDA 32399-0500

DO NOT WRITE IN THIS SPACE 12073385714

ME EMS OTIFIED	TIME EMS ARRIVED	COUNTY / CITY CODE	DATE OF CRASH	INVEST. AGENCY REPORT NUMBER	HSMV CRASH REPORT NUMBER
9:17 AM ☐ PM ☒	9:19 AM ☐ PM ☒	01-80	06-08-01	01-21759	58089965

NARRATIVE / ADDITIONAL PASSENGERS

- Bicyclist was Traveling North Bound on N.E. 6 Ave.
According To Eye witnesses, A Red Vehicle operated by unknown
river, Ran The Red light East Bound on N.E. 135 St, Struck
Bicycle, And left The Accident Scene East bound on N.E.
St. Toward Unk. Directions. –

PASSENGER NAME	ADDRESS	CITY & STATE	ZIP	Age	Loc.	Inj.	Safety Equip.	Eject
							I	
							I	
							I	
							I	
							I	
							I	

[redacted]

ME | ADDRESS | CITY & STATE | ZIP
RIA ANNESSE, – 632 N.E. 151 St – Miami FL – 33162

EN BY - NAME: ue #19 — 1 Physician or Nurse 2 Paramedic or EMT 3 Police Officer 4 Certified 1st Aider 5 Other: 2 — INJURED TAKEN TO: JMH. Trauma — BY - NAME: Air Rescue #1

1 YES 2 NO: 1 — WHERE? — IS INVESTIGATION COMPLETE? 1 YES 2 NO: 2 — WHY? Hit & Run — DATE OF REPORT: 06/08/01 — PHOTOS TAKEN? 1 YES 2 NO: 2 — 3 INVEST. AGENCY — 4 OTHER

R - RANK & SIGNATURE — ID / BADGE NUMBER: 43 — DEPARTMENT: North. Miami P.D. – 06 — FHP ☐ SO ☐ CPD ☒ OTHER ☐

ev 1/95) S

Page 3 of 4 Pages

01-21759

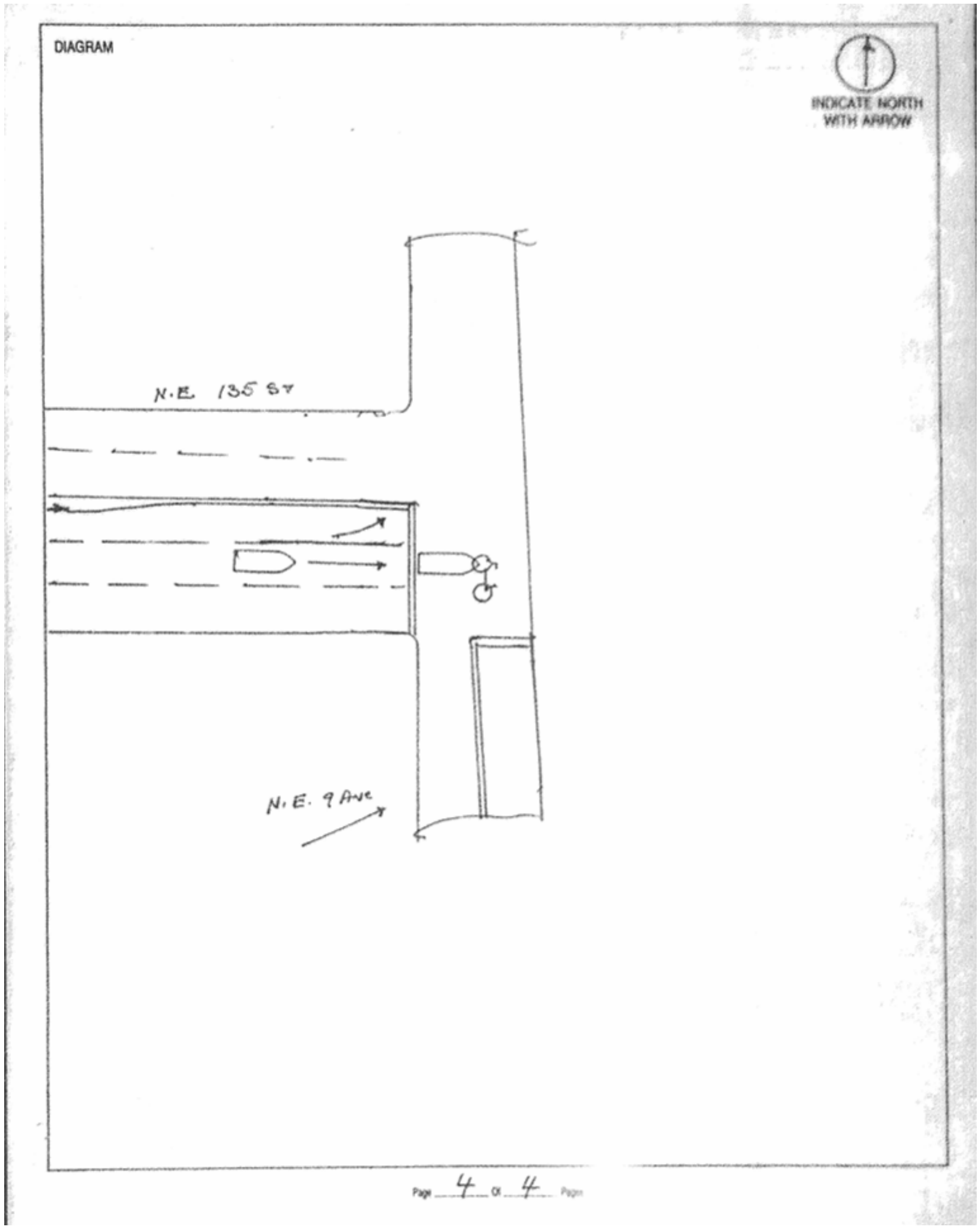
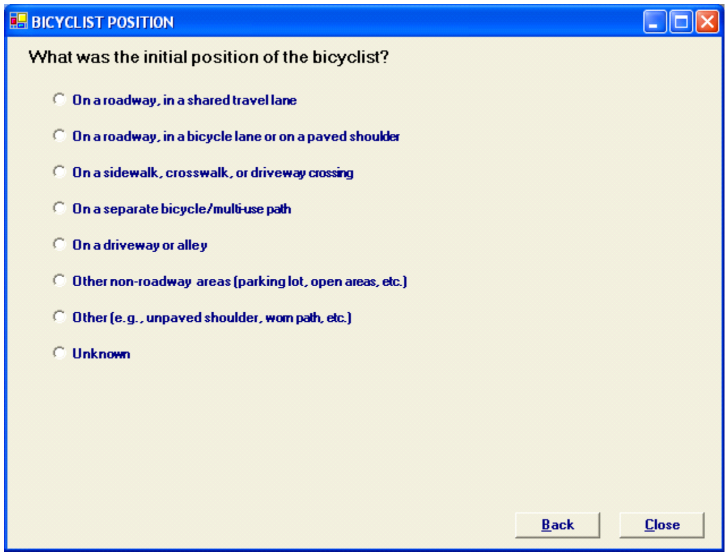
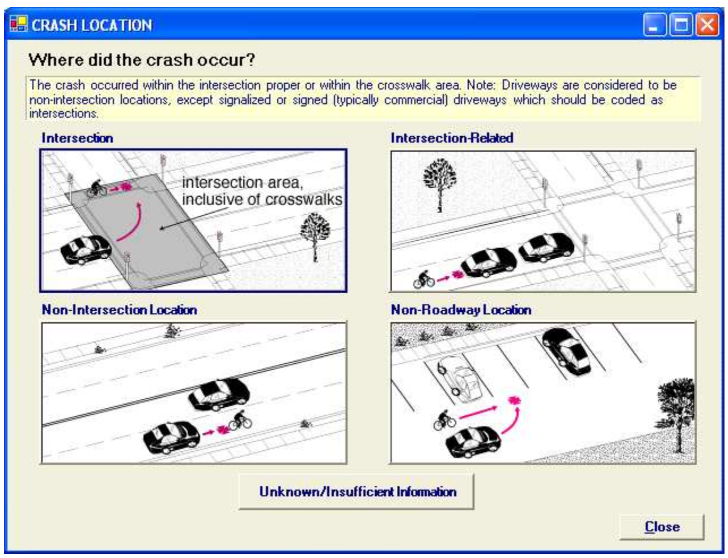


DIAGRAM
INDICATE NORTH WITH ARROW
N.E 135 ST
N.E. 9 Ave
Page 4 of 4 Pages



The narrative (page 3 of the police crash report) and the crash diagram (page 4 of the police crash report) indicate that the crash occurred within the intersection.

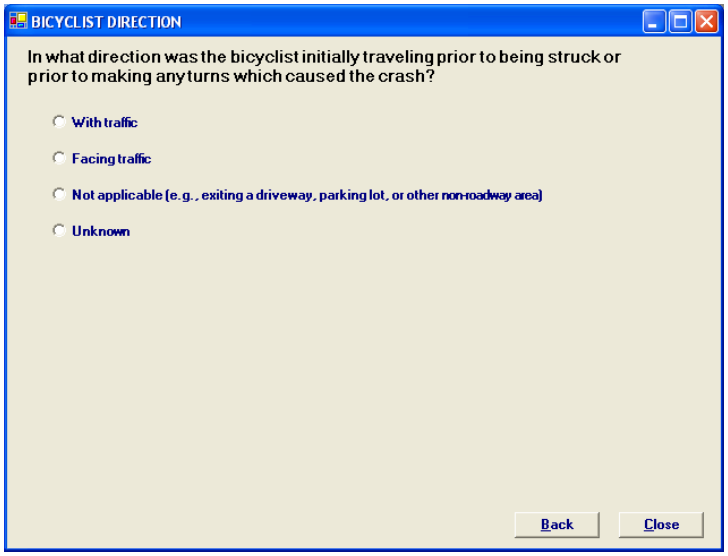
Click on "Intersection."



The narrative and the diagram indicate that the bicyclist was in the roadway.

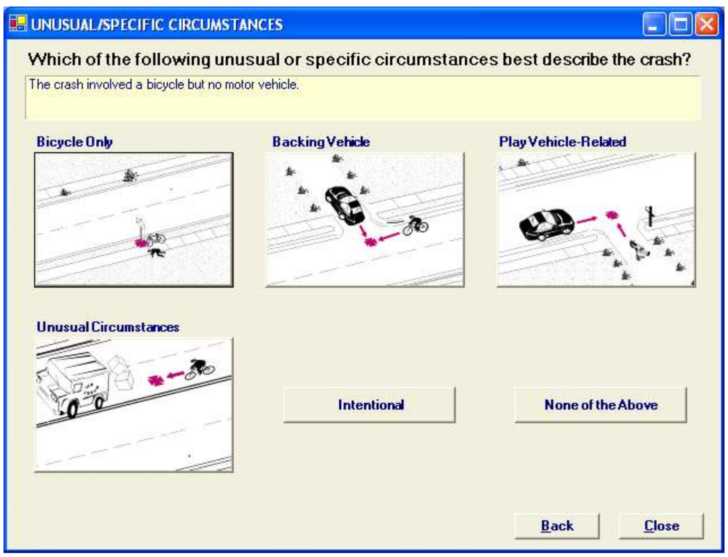
The narrative does not mention a bicycle lane or paved shoulder. The diagram does not depict a bicycle lane or paved shoulder.

Click on "On a roadway, in a shared travel lane."



The diagram indicates that the bicyclist was traveling with traffic.

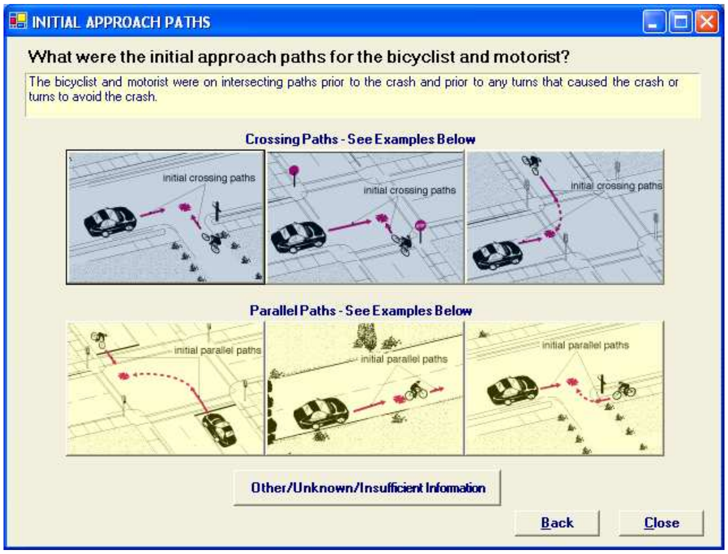
Click on "With traffic."



When the cursor is moved over the box illustrating a circumstance (such as "Bicycle Only"), a description of that circumstance appears (such as "The crash involved a bicycle but no motor vehicle.")

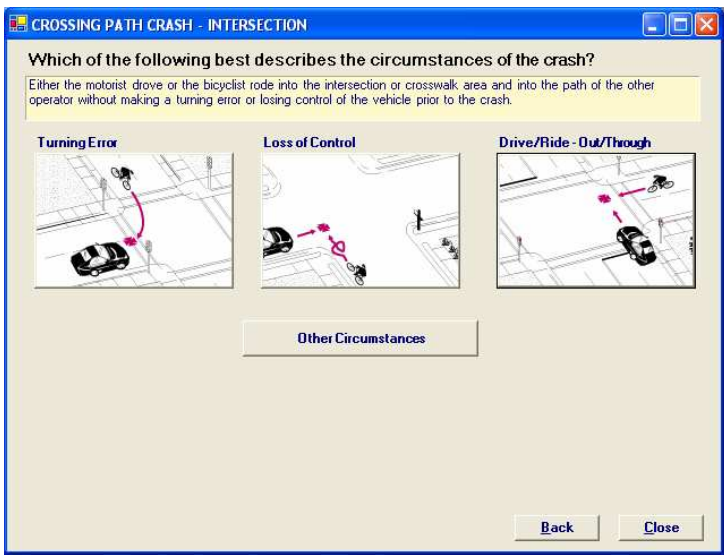
None of these circumstances apply.

Click on "None of the Above."

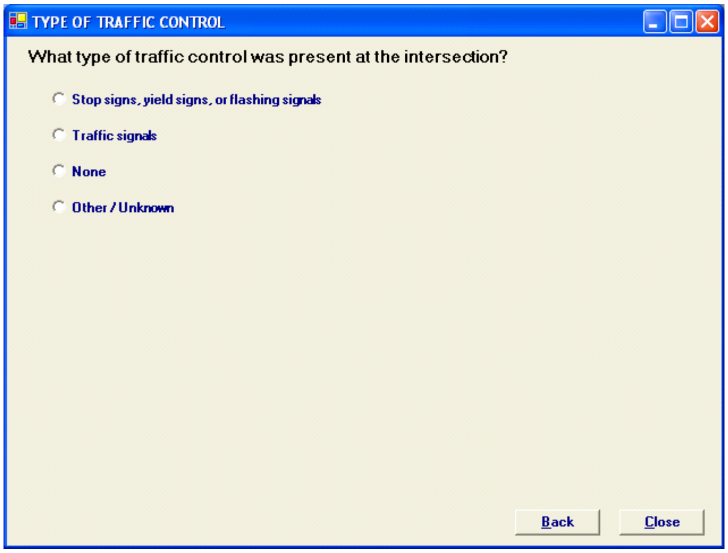


The crash diagram shows that the bicyclist and the motorist were on crossing paths.

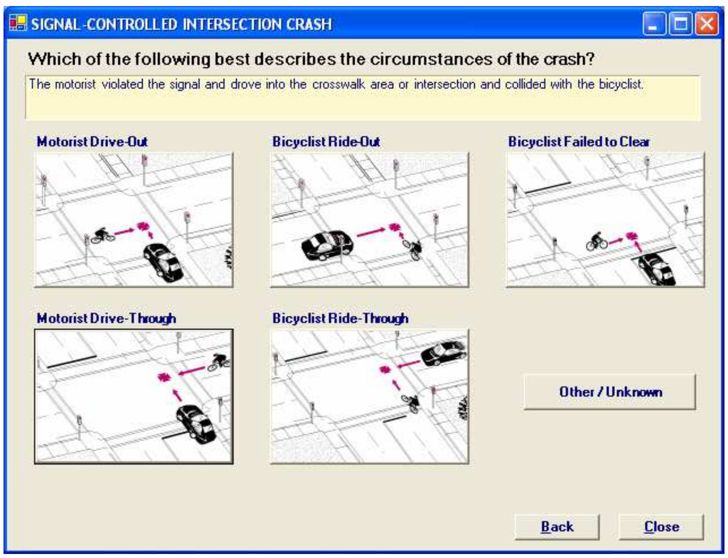
Click on "Crossing Paths."



Click on "Drive/Ride-Out/Through."

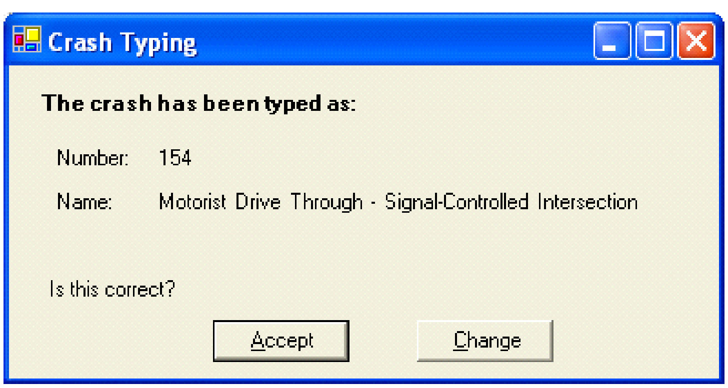


"Traffic Control" is shown on page 2 of the police crash report. The code "03" indicates that a traffic signal is present. Click on "Traffic signals."



The narrative mentions that the driver ran a red light.

Click on "Motorist Drive-Through."



PBCAT has assigned crash type 154, Motorist Drive Through – Signal-Controlled Intersection for this crash. If this is correct, click on" Accept."