HILLSBOROUGH COUNTY MPO
2035 LONG RANGE TRANSPORTATION PLAN

SAFETY TECHNICAL REPORT

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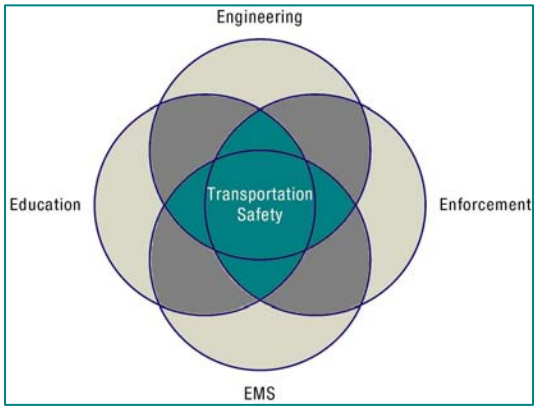
INTRODUCTION

Transportation safety is a vital part to the overall health and well being of the residents of Hillsborough County. Safety is defined by the United States Department of Transportation as *freedom from harm resulting from unintentional acts or circumstances*. The primary goal of transportation safety planning is to improve safety by supporting efforts to develop policies, programs, and projects related to pedestrians, bicyclists, transit users, truckers and motorists on the roadways and highways of Hillsborough County.

The goals, objectives and policies related directly to safety in the 2035 Long Range Transportation Plan (LRTP) are intended to improve the safety of the transportation system within Hillsborough County through the four E's - **Engineering**, **Education**, **Enforcement**, and **Emergency Services**. The benefits realized from an effective safety program include safer roadways and intersections, reduced fatalities and injuries, improved mobility, and improved air quality.



Source: Transportation Planner's Safety Desk Reference

The purpose of this Technical Report is to develop the foundation for the Safety Element of the 2035 Long Range Transportation Plan (LRTP) through the analysis of motor vehicle crashes on the MPO Major Road Network, and presentation of various strategies and countermeasures to improve safety.

Specifically, the report is presented in four major components:

- **Transportation Safety Overview**
- **MPO Crash Profile and Analysis**
- **Safety Improvement Methods**
- **Safety Improvement Recommendations**

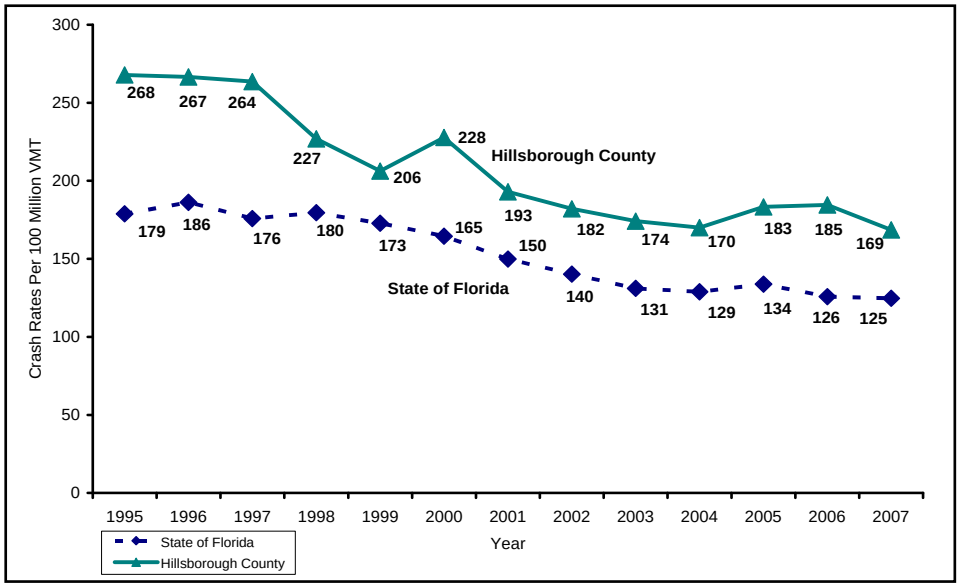
1.0 TRANSPORTATION SAFETY OVERVIEW

1.1 BACKGROUND

Motor vehicle crashes and fatalities have a major impact on the safety and well being of motorists, pedestrians and bicyclists using the transportation system. According to the National Highway Transportation Safety Administration (NHTSA), in 2007 over 41,000 people were killed and nearly 2.5 million were injured in crashes across the nation. In the state of Florida, over 3,200 people were killed and over 212,000 injured. In Hillsborough County, 183 people were killed and over 20,000 were injured. Crashes have a major impact on the safety and well being of all motorists and pedestrians using the transportation system.

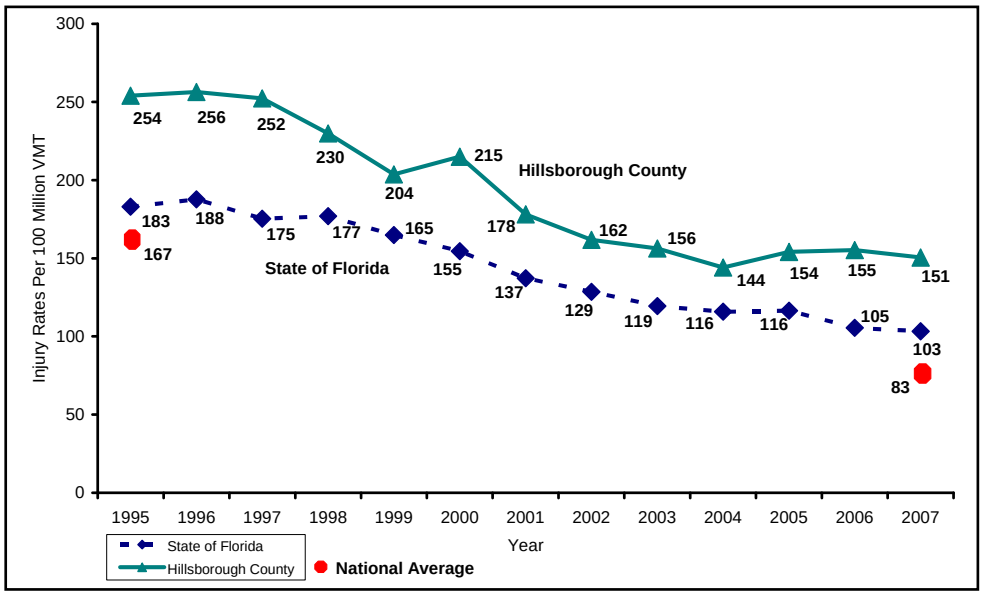
As displayed in Figures 1.1, 1.2 and 1.3, from 1995 to 2007, Hillsborough County experienced a steady decline in crash rates per 100 million vehicle miles traveled (VMT). However, the County has remained consistently above the statewide average. The same historical trend has also been prevalent during the same time period for injury crashes. The comparison between the County to the statewide average for fatalities, however, reveals a different trend. Since 2001, Hillsborough County has experienced a shift in fatalities below the statewide average, and in 2007, for the first time in this 12-year period, dropped below the national average (1.37).

Figure 1.1: State of Florida vs. Hillsborough County Crash Rates Per 100 Million VMT, 1995 to 2007*



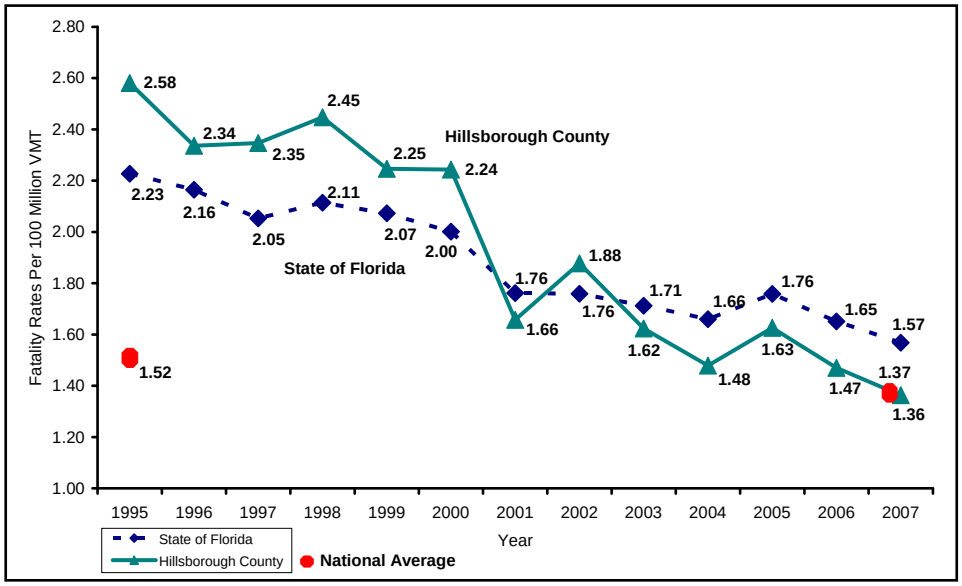
Source: Florida Department of Highway Safety and Motor Vehicles
* Includes Motor Vehicle, Bicycle and Pedestrian Crashes.

Figure 1.2: State of Florida vs. Hillsborough County
Injury Rates Per 100 Million VMT, 1995 to 2007*



Source: Florida Department of Highway Safety and Motor Vehicle
* Includes Motor Vehicle, Bicycle and Pedestrian Crashes.

Figure 1.3: State of Florida vs. Hillsborough County
Fatality Rates Per 100 Million VMT, 1995 to 2007*



Source: Florida Department of Highway Safety and Motor Vehicle
* Includes Motor Vehicle, Bicycle and Pedestrian Crashes.

Overall, the Federal Highway Administration (FHWA) and American Association of State Highway and Transportation Official's (AASHTO) joint goal is to reduce fatalities nation-wide to a rate of 1.0 per 100 million-vehicle-miles-traveled, which would reduce the total number of fatalities in the nation to approximately 30,000 per year.

1.2 COSTS OF CRASHES

The costs of motor vehicle crashes are a significant personal and fiscal burden to the residents of Hillsborough County. The National Safety Council[1] (NSC) estimates the average costs of motor-vehicle crashes to society. Specifically, the NSC reports that the calculable costs of motor-vehicle crashes involve wage and productivity losses, medical expenses, administrative expenses, motor vehicle damage, and employers' uninsured costs. According to the NSC, in 2006 the average costs for each traffic death, traffic injury, or property damage crash were:

- **Death:** $1,210,000
- **Nonfatal Disabling Injury:** $55,000
- **Property Damage Crash** (including non-disabling injuries)**:** $8,200

Additionally, for 2006, the NSC further defines average economic costs by injury severity as:

- **Incapacitating Injury:** $62,500
- **Non-incapacitating Evident Injury:** $20,300
- **Possible Injury:** $11,500

1.3 TRANSPORTATION SAFETY PLANNING

1.3.1 Planning Overview

Transportation Safety Planning (TSP), formerly Safety Conscious Planning, is defined as a comprehensive, system-wide, multimodal, proactive process that integrates safety into surface transportation decision-making. TSP provides an overall framework for integrating safety issues and concerns into the transportation planning process at all levels of government. Overall, effective safety programs involve a wide range of stakeholders. The MPO transportation planning process serves as an important forum for fostering safety program collaboration at the state and metropolitan level.

Safety has been traditionally viewed as an issue to be addressed during the design phase of transportation projects, or reserved for enforcement agencies, and is typically not integrated in the MPO transportation planning process. However, according to a recent report by the National Highway Cooperative Research Program[2] (NCHRP), *Incorporating Safety into Long-Range Transportation Planning (Report 546)*, the integration of safety into the transportation planning process is paramount to the Long-Range Transportation Plan. According to the Report:

- *Travel safety is affected by how the transportation system is designed, constructed, operated, and maintained.*
- *The economic impact of motor vehicle crashes is staggering. According to a study of 85 urban areas in the U.S., the cost has reached $164.2 billion per year in just those communities, or an average of $1,051 per person in 2005. According to NHTSA the economic impact of crashes, in 2000 dollars, is $230.6 billion per year, or an average of $820 for every person living in the U.S.*

- *Crashes represent a major source of nonrecurring congestion, which is estimated in some locations to account for half of all congestion.*
- *Evidence from around the world and throughout the United States suggests many crashes are preventable. More than 31 percent of U.S. fatalities involve alcohol. One third of fatal collisions are run-off-road collisions.*

1.3.2 SAFTEA-LU Requirements

The passage of SAFETEA-LU in 2005 established a greater emphasis on safety for MPO's to incorporate in the transportation planning process. Specifically, safety must now be addressed as a stand-alone factor at both the MPO and state level. In addition MPO's must integrate safety into the LRTP process, and identify specific safety strategies that will improve the overall performance of the transportation system, while maximizing the safety and mobility of both citizens and goods.

1.3.3 Florida Strategic Highway Safety Plan

In compliance with requirements from SAFETEA-LU, all states must develop a Strategic Highway Safety Plan (SHSP) to provide a comprehensive framework for reducing highway fatalities and serious injuries on all public roadways. To meet federal requirements and ensure an organized statewide approach to safety planning, the Florida Department of Transportation (FDOT) developed the Florida SHSP in 2006.

As part of the SHSP process, a coalition of federal, state and local government agencies, law enforcement, and transportation safety advocates developed four emphasis areas to allocate resources and efforts over the next five years. They include:

- **Aggressive Driving**: Reduce the rate of fatalities and serious injuries involving aggressive driving;
- **Intersection Crashes**: Reduce the rate of fatalities and serious injuries occurring at intersections;
- **Vulnerable Road Users**: Pedestrians, Bicyclists, and Motorcyclists – Reduce the rate of fatalities and serious injuries involving vulnerable road users; and
- **Lane Departure Crashes**: Reduce the rate of fatalities and serious injuries involving lane departures.

2.0 MPO CRASH PROFILE AND ANALYSIS

This section provides a summary and analysis of the overall crash statistics for intersections and segments of the MPO Major Road Network. Data reported in this report was prepared using Florida Long Form Crash Report data extracted from the Hillsborough County Traffic Crash Data Management System. The Long Form must be used for crashes involving an injury or non-traffic violations (i.e., DUI, suspended license), but may be used at the discretion of the law enforcement agency on any crash. It should be noted that the crashes along the MPO Major Road Network should be scrutinized to determine the proper location of the at-fault party to their respective intersection (or segment) approach.

2.1 TOTAL CRASH SUMMARY

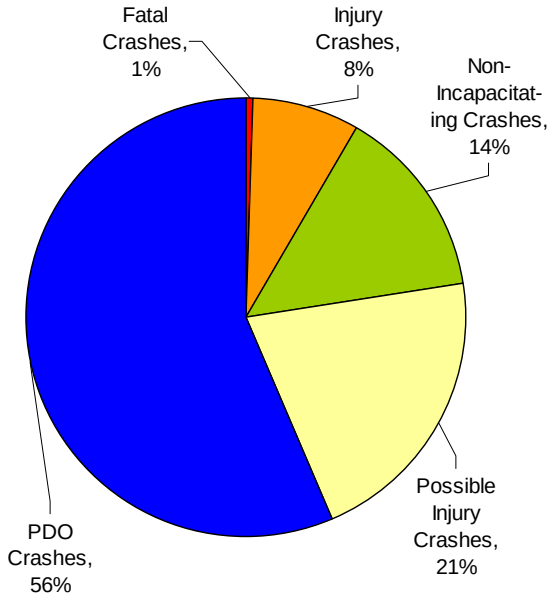
The following provides a summary of the crash statistics for the entire MPO Major Road Network from 2005 to 2007. As displayed in Table 2.1 a total of **67,540** crashes were recorded on the Major Road Network. This represents **96.6 percent** of all crashes recorded in Hillsborough County during the three-year period. There were 431 fatal crashes resulting in 462 fatalities; 28,796 injury crashes (injury, non-disabling, possible) resulting in 45,765 total injuries; and 37,744 property damage only (PDO) crashes. There were also a total of 534 bicycle crashes and 941 pedestrian crashes, and 1,939 truck crashes. Figure 2.1 provides a breakdown of the total crashes by severity. Based on the National Safety Council's average costs of motor vehicle crashes by deaths, injuries and property damage, the total crash three-year costs exceeded $1.5 Billion.

Table 2.1: Crash Summary Data, 2005-2007

Crash Statistic	Totals 2005-07
Total Crashes (Motor Vehicle, Bicycle & Ped.)	**67,540**
Fatal Crashes	431
Injury Crashes	5,143
Non-Incapacitating (Non-Disabling) Crashes	9,500
Possible Injury Crashes	14,153
Property Damage Only Crashes	37,744
Non-Classified Crashes	569
Total Fatalities	462
Total Injuries	45,765
Crashes per 100 Million VMT*	202.8
Bicycle Crashes	534
Pedestrian Crashes	941
Truck Crashes	1,939
Crash Costs to Hillsborough County#	$1,545,600,000

*VMT of MPO Major Road Network
#NSC Estimating Costs of Unintentional Injuries 2006 (standard formulas include death, injuries, PDO)

Figure 2.1: Total Crashes by Severity Type



2.2 METHODOLOGY – CRASH RATE APPROACH

The Hillsborough County Traffic Crash Data Management System contains data for the years 2005, 2006 and 2007. Also, a Geographic Information System (GIS) point database was obtained in a shapefile format. The spreadsheet and shapefile data were obtained from FDOT District Seven for Hillsborough County. An LRTP Network was defined by utilizing the latest MPO's Geodatabase segments, which constitute the MPO Major Road Network used in this analysis.

The point shapefile information was then imposed over the MPO Major Road Network to identify which crash nodes belong to an intersection or to a segment on the MPO network. Intersections were defined as being on the MPO Major Road Network, and include nodes having from three to six approaches. Segments were defined as being on the MPO Major Road Network, and contain at least one node not within a major MPO Road Network intersection. For each intersection, the total number of crashes was identified by the database as "at the intersection" or "influenced by the intersection". For each segment, the total number of crashes was identified as not being at the intersection. To be included in the crash rate analysis, intersection nodes and segments must have at least one crash and have Average Annual Daily Traffic (AADT) data. AADT data was obtained from the MPO Major Road Network database and generally covers the 2005 through 2007 timeframe. Crash rates were then calculated for all applicable nodes on intersections and segments, with the exception of ramps, overpasses or underpasses.

The Appendix contains a series of flowcharts depicting the methodology used for the crash rate analysis.

2.3 HIGH CRASH LOCATION SUMMARY AND ANALYSIS

This section provides a summary and analysis of the Top 50 High Crash locations by crash rate and total crashes for **Intersection** and **Segment** nodes on the MPO Major Road Network. These locations include all crashes (PDO, injury, fatality) recorded during the three-year period. This information is used to determine the appropriate programmatic approaches to apply strategies and countermeasures to address the identified prevailing safety challenges.

2.3.1 Intersection Crash Analysis

Figure 2.2 displays the **Top 50 High Crash Intersections** identified through the analysis of intersection crash rates on the MPO Major Road Network. The locations are ranked according to their respective crash rates. The formula used to determine crash rates was as follows:

The Intersection "Rate" (R_i) is calculated per Million Entering Vehicles (MEV), which is standard in the traffic engineering profession.

$$R_i = \frac{2 * C * 1{,}000{,}000}{V * Y * T}$$

C = Number of crashes at the intersection node location, during the three-year time period
V = Two way AADT (of all approaches)
Y = Years (3-year period)
T = Time, expressed in the number of days in the study period (365)

As displayed in Table 2.2, the Top 50 high crash intersections based on rates reveal a significant number of roadways, some of which include multiple intersections. Eight intersections are located along US 41; five intersections are located along US 301; five intersections are located along US 92; and four intersections are located along State Road 585 (North 22nd Street). As shown, a total of 11 intersection node locations have 100 or more crashes. The intersections with the highest crash rates in this group include SR 582 (Fowler Avenue)/Morris Bridge Road (2.39), US 301/Gibsonton Drive (2.31) and SR 60/Brandon Town Center Drive (1.82). There are also a significant number of intersections with more than 50 crashes and relatively high crash rates, including US 301/Big Bend Road (4.23) and SR 45/Columbus Drive (2.01.) Overall, a total of 2,878 crashes were recorded at or influenced by the Top 50 intersections.

Analysis of the 50 high crash intersections revealed that there were a total of 19 fatal crashes and 1,786 injury crashes. The general types of crashes at the intersection nodes included: Rear End (46%), Angle (25%), Left-turn (10%), Head-on (3%), Pedestrian (3%), Truck (4%), Right-turn (2%), and Bicycle (less than 1%) (Figure 2.3). 'Other' includes crash types not reported in the crash database. The most common crash causes involved aggressive driving (50%), driving at night (35%), followed by red

Figure 2.2: Top 50 High Crash Intersections, 2005-2007

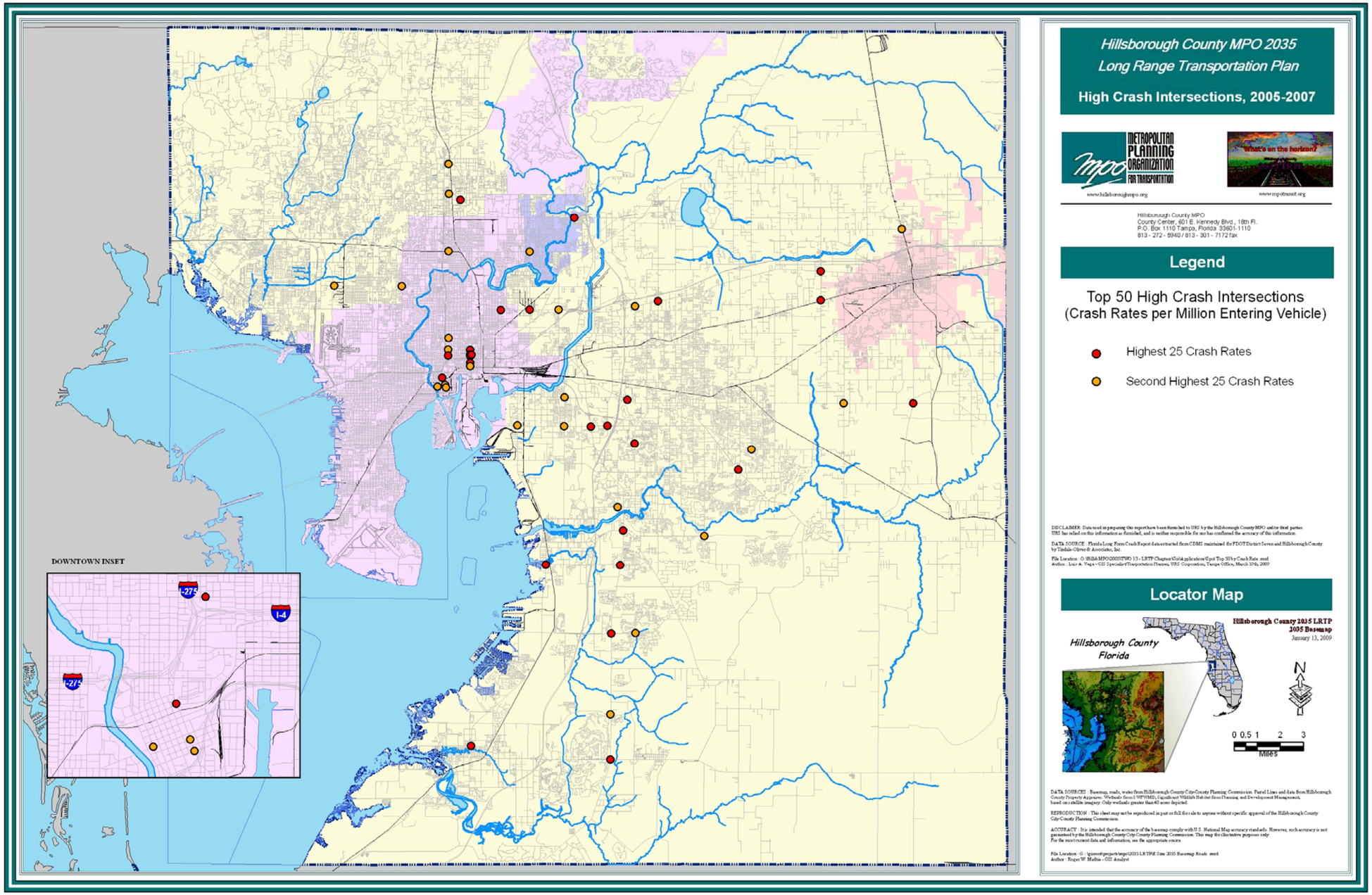
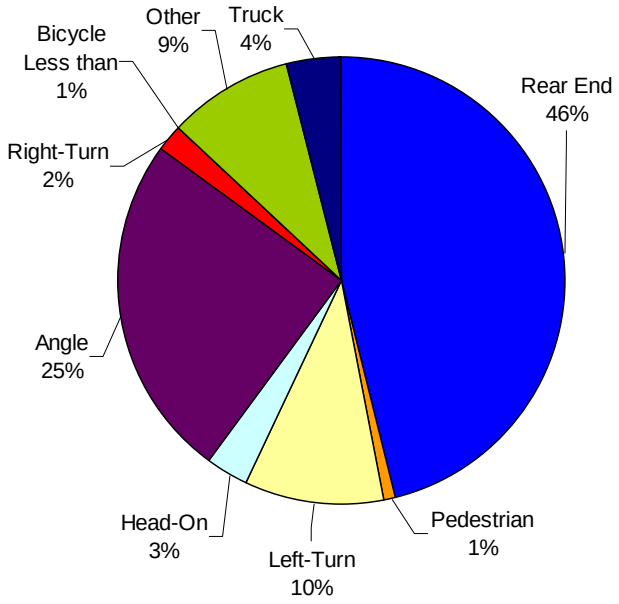


Table 2.2: Top 50 Intersection Crash Locations (identified by crash rate per million entering vehicles & sorted by number of crashes)

Street Name	Intersecting Street	Crash Rate	No. of Crashes
SR 60	BRANDON TOWN CENTER DR	1.82	195
US 301	CAUSEWAY BLVD	1.61	143
US 92	56TH ST	1.60	139
US 41	40TH ST	1.68	137
US 301	GIBSONTON DR	2.31	135
SR 582 (FOWLER)	MORRIS BRIDGE RD	2.39	123
US 41	FLETCHER AVE	1.54	119
CR 676	FALKENBURG RD	1.65	112
SR 580	56TH ST	1.37	109
US 41	BUSCH BLVD	1.33	107
US 41	BEARSS AVE	1.35	100
US 92	ORIENT RD	1.48	84
US 301	BIG BEND RD	4.23	82
SR 39	JAMES L REDMAN PKWY	1.91	72
US 41	CAUSEWAY BLVD	1.57	72
SR 45	COLUMBUS DR	2.01	64
US 301	SUN CITY CENTER BLVD	2.17	53
ARMENIA AVE	SLIGH AVE	1.42	53
US 41	SYMMES RD	2.32	51
US 301	SYMMES RD	2.17	51
US 41 BUSINESS	KENNEDY BLVD	1.50	50
SR 676	78TH ST	1.31	47
US 92	COUNTY ROAD 579	1.76	46
SR 60	TURKEY CREEK RD	1.42	45
SR 585 (N 22nd)	PALM AVE	3.83	43
SR 585 (N 22nd)	7TH AVE	1.33	43
US 92	BRANCH FORBES RD	1.83	41
SR 45	21ST AVE	1.48	41
SR 45	LAKE AVE	1.49	37
SR 574	FORBES RD	1.80	34
SLIGH AVE	ANDERSON RD	1.37	34
US 41	SHELL POINT RD	1.73	33
CR 579A	BELL SHOALS RD	1.38	33
SR 39	SAM ALLEN RD	1.56	32
US 41 BUSINESS	17TH AVE	2.58	30
CR 573	PALM RIVER RD	1.50	30
US 41 BUSINESS	JEFFERSON ST	1.56	29
BIG BEND RD	SUMMERFIELD BLVD	1.36	26
JEFFERSON ST	WHITING ST	1.57	25
PROVIDENCE RD	PROVIDENCE LAKES BLVD	2.77	24
CR 640	MILLER RD	1.66	24
15TH ST	131ST AVE	2.09	23
SR 585 (N 22nd)	COLUMBUS DR	2.04	23
SR 585 (N 22nd)	21ST ST	1.97	18
US 92	WILLIAMS RD	1.60	15
SR 585 (N 22nd)	17TH AVE	1.43	15
US 301	19TH AVE NE	1.38	14
JEFFERSON ST	CASS ST	1.90	8
DURANT RD	SAINT CLOUD AVE	1.38	8
RIVERVIEW DR	KRYCUL AVE	1.47	6

light running (9%), DUI (4%) and speeding (1%). A total of 3,159 crashes occurred during the day, and 1,465 occurred at night.

Figure 2.3: Intersection Crashes by Type, Top 50 Intersections



2.3.2 Segment Crash Analysis

Figure 2.4 displays the **Top 50 High Crash Segments** identified through the analysis of the segment crash rates on the MPO Major Road Network. The locations are ranked according to their respective crash rate, and include all non-intersection crashes occurring along the specified segment of the defined roadway. In many cases, more than one node is located along a specific segment.

The Segment "Rate" (R_s) is calculated per Million Vehicle Miles Traveled (VMT), which is standard in the traffic engineering profession.

$$R_s = \frac{C * 1{,}000{,}000}{V * Y * T * L}$$

C = Number of crashes at the location, during the three-year time period
V = Segment AADT
Y = Years (3-year period)
T = Time, expressed in the number of days in the study period (365)
L = Length of segment (in miles)

Figure 2.4: Top 50 High Crash Segments, 2005-2007

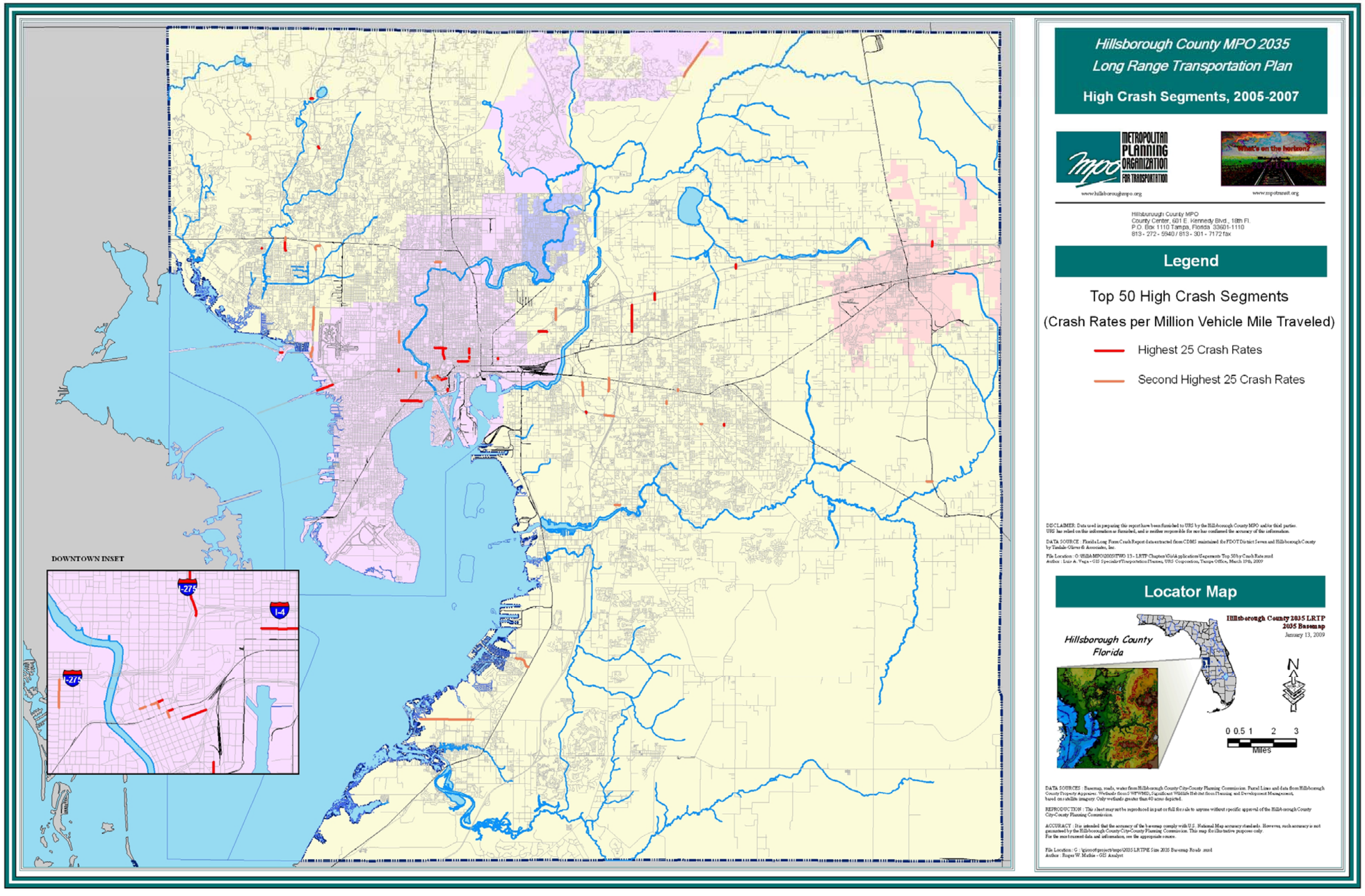


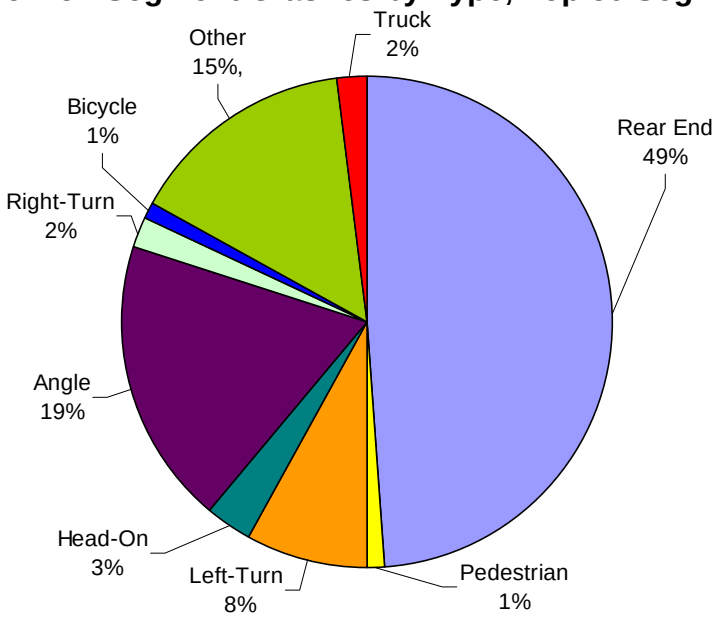
Table 2.3: Top 50 Segment Crash Locations (identified by crash rate per million VMT & sorted by number of crashes)

Street Name	From	To	Crash Rate	No. of Crashes
I-275	I-4 INTERCHANGE	FLORIBRASKA AVE	11.84	616
I-275	KENNEDY BLVD	MEMORIAL HWY	6.96	571
VETERANS EXPWY	MEMORIAL HWY	HILLSBOROUGH AVE	5.74	146
22ND ST	I-4 RAMP NORTH	14TH AVE	19.23	132
PARK RD	I-4 FRONTAGE RD S	I-4	24.51	131
US HWY 301	PALM RIVER RD	ADAMO DR	4.29	103
FALKENBURG RD	ADAMO DR	WOODBERRY RD	5.52	84
COURTNEY CAMPBELL CS	BAY HARBOR DR	ROCKY POINT DR	10.28	80
FLORIBRASKA AVE	FLORIDA AVE	NEBRASKA AVE	14.81	80
US HWY 301	CROSSTOWN E RAMP	CROSSTOWN W RAMP	25.82	69
LEE ROY SELMON EXPWY	FALKENBURG RD	I-75	5.03	64
39TH ST	12TH AVE	I-4 E RAMP	31.19	42
ORIENT RD	I-4	HILLSBOROUGH AVE	5.94	41
MORRIS BRIDGE RD	CROSS CREEK BLVD	COUNTY LINE RD	4.84	39
HUTCHINSON RD	VETERANS EXPY S RAMP	VETERANS EXPY N RAMP	34.68	38
VETERANS FRONTAGE S	COURTNEY CAMPBELL RAMP	MEMORIAL HWY	5.38	35
APOLLO BEACH BLVD	DICKMAN DR	US HWY 41	5.48	29
VAN DYKE RD	SUNCOAST S RAMP	SUNCOAST N RAMP	9.39	26
ARMENIA AVE	TAMPA BAY BLVD	M L KING BLVD	6.83	21
WILLIAMS RD	M L KING BLVD	US 92	14.32	20
22ND ST	PALM AVE	I-4 RAMP NORTH	4.71	12
22ND ST	17TH AVE	21ST AVE	9.62	12
KINGS AVE	ROBERTSON ST	SR 60/BRANDON BLVD	4.50	11
WATERS AVE	FLORIDA AVE	LAMAR AVE	4.23	10
ANDERSON RAMP	VETERAN'S EXPWY	ANDERSON RD	4.76	10
TWIGGS ST	JEFFERSON ST	NEBRASKA AVE	7.60	9
BOY SCOUT RD	RACE TRACK RD	CRAWLEY RD	4.54	9
ARMENIA AVE	LAUREL ST	I-275	68.85	8
SHELDON RD	COUNTRYSIDE VILLAGE BLVD	MEADOW PKWY	12.49	8
ARMENIA AVE	GREEN ST	MAIN ST	20.68	6
WILSKY BLVD	HANLEY RD	MARBELLA CREEK AVE	24.86	6
SWANN AVE	SNOW AVE	S BOULEVARD	14.95	6
LUMSDEN RD	LITHIA PINECREST	DURANT RD	5.54	6
PARSONS AVE	VICTORIA ST	CLAY AVE	5.89	5
SWANN AVE	HOWARD AVE	ROME AVE	9.87	4
RIVERVIEW DR	KRYCUL AVE	US HWY 301	4.58	4
KEYSVILLE RD	CEDAR GROVE RD	HENRY GEORGE RD	5.45	4
WILLOW AVE	CYPRESS ST	LAUREL ST	5.48	3
PALM AVE	15TH ST	21ST ST	10.21	2
POLK ST	MORGAN ST	PIERCE ST	68.73	2
TYLER ST	MARION ST	MORGAN ST	10.52	2
TYLER ST	FLORIDA AVE	MARION ST	6.88	2
MARION ST	CASS ST	TYLER ST	6.60	2
19TH AVE NW	EG SYMMONS PARK	US HWY 41	4.74	2
WILSKY BLVD	MARBELLA CREEK AVE	LINEBAUGH AVE	6.75	1
VALRICO RD	DIANE AVE	LUMSDEN RD	8.27	1
SWANN AVE	ROME AVE	SNOW AVE	7.47	1
CAESAR ST	CHANNELSIDE DR	CUMBERLAND ST	29.35	1
MORGAN ST	ZACK ST	POLK ST	5.65	1
TYLER ST	TAMPA ST	FRANKLIN ST	4.44	1

As displayed in Table 2.3, the Top 50 segments reveal diverse locations. As shown, a total of 11 segments have more than 50 crashes. The segments with the highest crash rates in this group with a high number of crashes include Park Road (I-4 Frontage Rd to I-4), Courtney Campbell Causeway (Bay Harbor Dr. to Rocky Point Dr.), Floribraska Avenue (Florida Ave. to Nebraska Ave.), US 301 (Crosstown E ramp to W ramp), and 39th Street (12th Ave to I-4 E ramp). Overall, a total of 2,518 crashes were recorded in this group of Top 50 segments.

Based on the total number of crashes at the Top 50 segments, there were a total of 15 fatal crashes and 1,156 injury crashes. The major types of crashes at all of the segment nodes were: Rear End (49%), Angle (19%), Left-turn (8%), Head-on (3%), Truck (2%), Right-turn (2%), Pedestrian (1%) and Bicycle (1%) (Figure 2.5). 'Other' includes crash types not reported in the crash database. The most common crash causes involved aggressive driving (47%), driving at night (30%), followed by red light running (5%), DUI (4%) and speeding (3%). A total of 2,033 crashes occurred during the day, and 510 occurred at night.

Figure 2.5: Segment Crashes by Type, Top 50 Segments



2.3.3 Hot Spot Cluster Analysis

The **TOP 50 Intersection** and **Segment** locations were further analyzed to assess the potential for clustering of high crash locations based on crash ratios. A crash Hot Spot or cluster is a small area where crashes with similar rates are concentrated. As opposed to a single stretch of road, a Hot Spot frequently involves an interaction of several roads[3]. The following provides a summary of the Hot Spot analysis and results.

2.3.4 Hot Spot Methodology

Using ArcGIS Version 9.3, a Hot Spot analysis was plotted based on the crash rates calculated in the intersection and segment analysis (see Appendix for more detail). The Hot Spot analysis involved a clustering process, which is a specific method to search for intersections or segments which have a high crash rates, and are also surrounded by other intersections or segments with high crash rates. To be considered a Hot Spot, intersection or segment crash rates are then compared spatially to the sum of all intersections or segments in the MPO Major Road Network; when the local sum is much different than the expected local sum, and that difference is too large to be the result of random chance, a statistically significant Standard Deviation Z-score results. In essence, Hot Spots reflect a clustering of intersections or segments with high crash rates in close geographical proximity to each other, resulting in a Hot Spot Cluster area or zone.

2.3.5 Hot Spot Summary

The Hot Spot analysis shows areas such as East Tampa, the University Area, Brandon, Valrico and South Shore, where more in-depth engineering analysis of safety conditions should concentrate. Figure 2.6 provides a depiction of the Hot Spot analysis for intersections. A similar analysis of segments was performed, revealing that there is presently no significant clustering of high crash rate corridors.

2.3.6 Injury Crashes

Figure 2.7 displays the total number of **Injury Crashes** by intersections and segments on the MPO's Major Road Network. This breaks down injury crash locations into three tiers. Total injuries include injury crashes, non-incapacitating injury crashes and possible injury crashes. As indicated in Table 2.4, the largest number of injury crashes occurred along I-4 from CR 579 to McIntosh Road. Eight of the top ten locations were on the I-75 and I-275 corridors. The largest total number of injuries occurred on the segment of I-4. Overall, the total injuries per 100 Million VMT over the three-year period were 137.4 (Table 2.5).

Table 2.4: Top Ten Injury Crash Locations, 2005-2007

Facility		Location	Total Injury Crashes	Number of Injuries
I-4	From CR 579 to McIntosh Rd	Segment	299	538
I-75	From Brandon Blvd to M.L. King Blvd	Segment	268	453
I-75	@ I-4	Intersection	268	433
I-275/SR 93	From Kennedy Blvd to Memorial Hwy	Segment	245	453
I-275	From I-4 to Floribraska Ave	Segment	198	312
I-75	Fowler Ave to Fletcher Ave	Segment	184	261
I-275	From M.L. King Blvd to Hills Ave	Segment	180	286
I-275	@ Ashley Dr	Intersection	162	240
I-75	@ Bruce B. Downs Blvd	Intersection	150	230
I-275/SR 93	From Armenia Ave to Ashley St	Segment	136	228

Figure 2.6: Hot Spots Clusters, 2005-2007

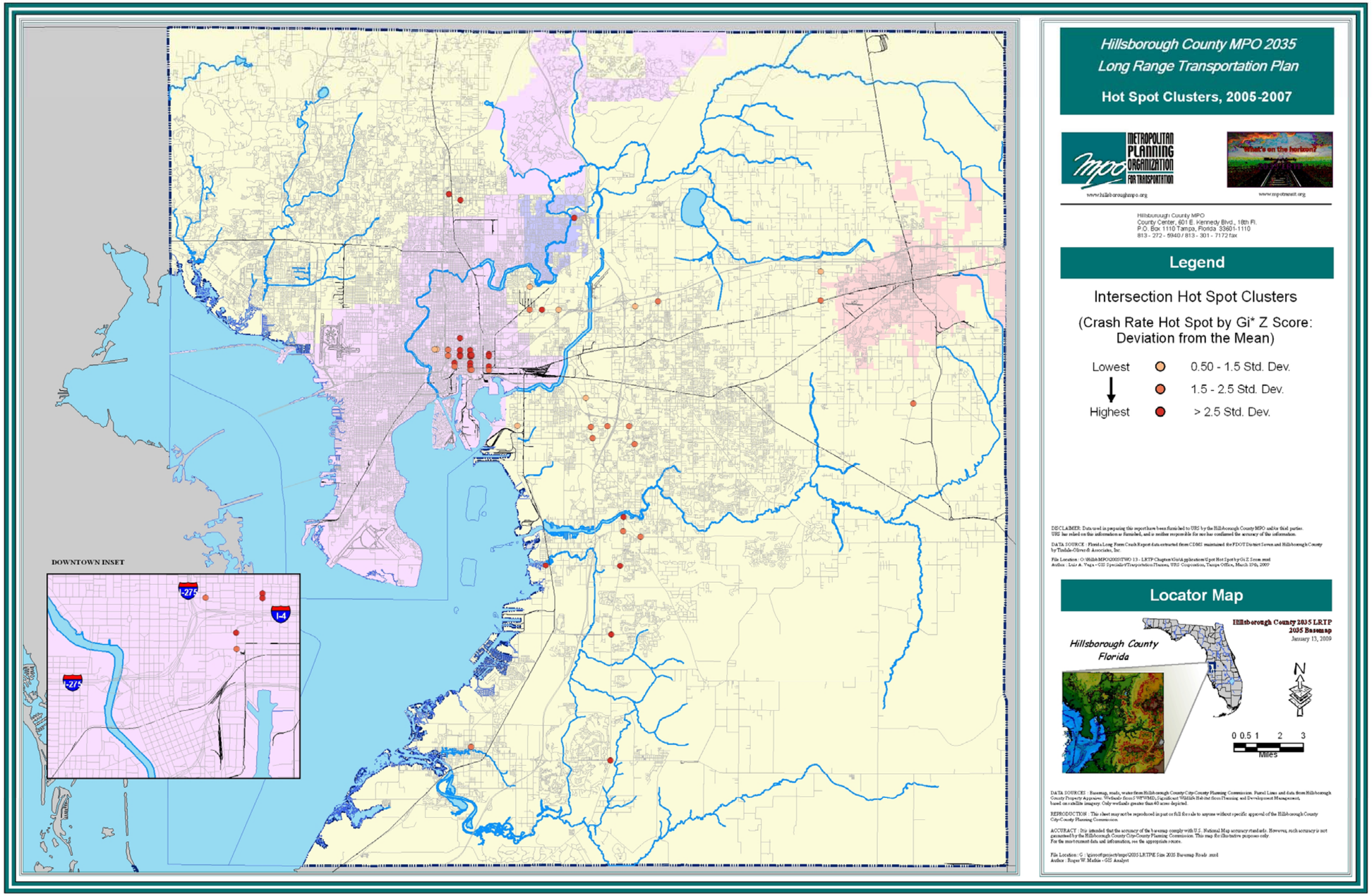


Figure 2.7: Injury Crash Locations (Motor Vehicle, Bicycle & Pedestrian Combined), 2005-2007

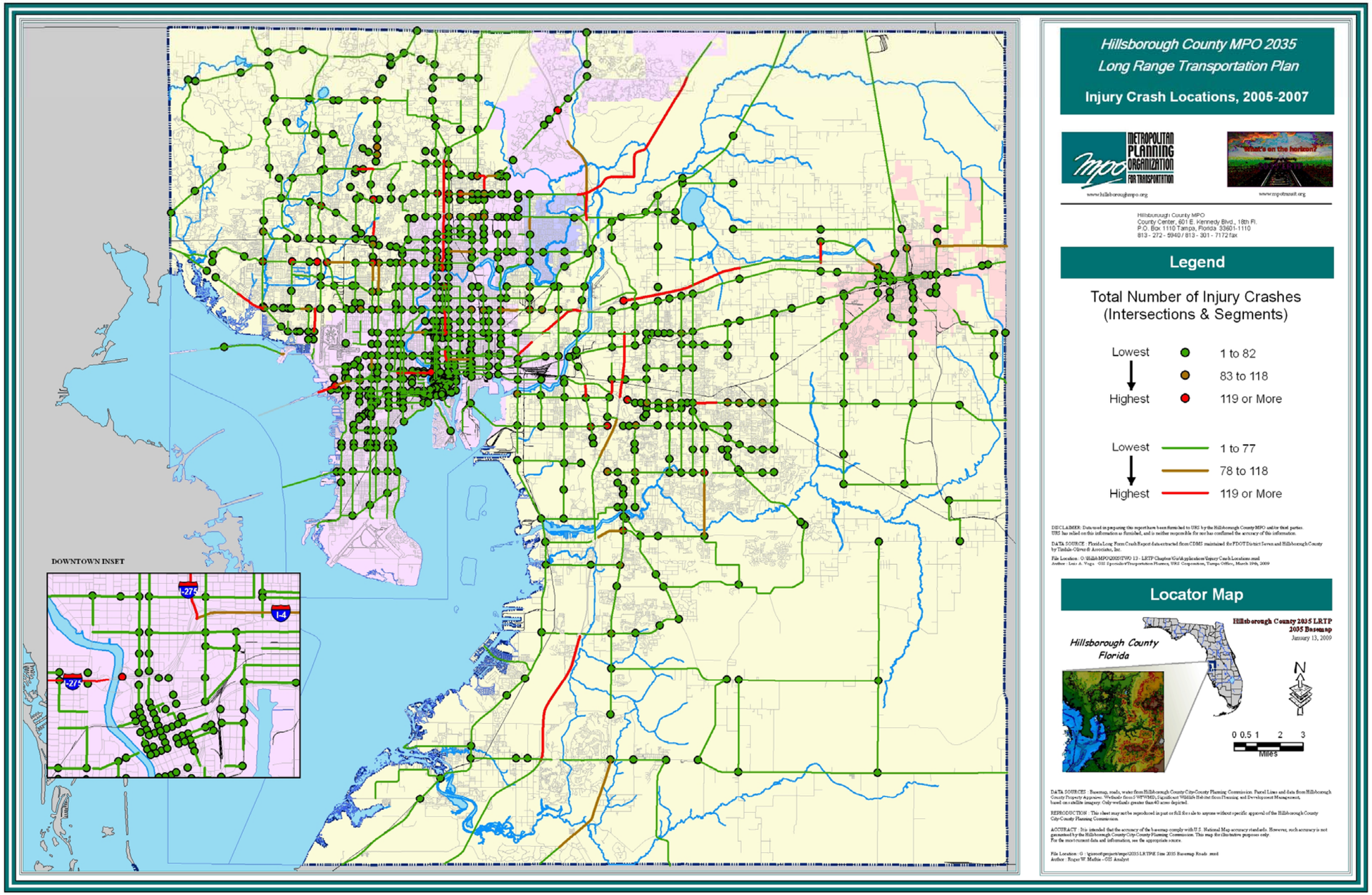


Table 2.5: Total Injury Crash Statistics, 2005-2007

Crash Type	Total
Total Injury Crashes	**28,796**
Total Injuries	45,765
Injuries per 100 Million VMT	137.4
Injuries per 100,000 Population	3,737

2.3.7 Fatal Crashes

Figure 2.8 displays the total number of **Fatal Crashes** by intersection and segment node within the MPO's Major Road Network. This includes a summary of all fatal crash locations within the Network, broken down into three tiers. As indicated in Table 2.6, the largest number of fatality crashes occurred on I-275 from Kennedy Boulevard Memorial Highway. Four of the top ten fatality locations were on I-75. The largest number of fatalities occurred on the segment of I-75 from SR 674 to Big Bend Road. Overall, the total fatalities per Million VMT over the three-year period were 1.4 (Table 2.7).

Table 2.6: Top Ten Fatality Crash Locations, 2005-2007

Facility		Location	Total Fatal Crashes	Number of Fatalities
I-275/SR 93	From Kenndy Blvd to Memorial Hwy	Segment	8	8
I-75	From SR 674 to Big Bend Rd	Segment	7	9
I-4	From CR 579 to McIntosh Rd	Segment	6	6
US 301	@ Sun City Center Blvd	Intersection	6	6
I-75	@ Bruce B Downs Blvd	Intersection	5	5
I-4	From Orient Rd to US 301	Segment	4	5
I-4	From Branch Forbes Rd to Thonotosassa	Segment	4	5
I-75	From Brandon Blvd to M.L. King Blvd	Segment	4	4
I-75	@ I-4	Intersection	4	4
I-275	From Fletcher Ave to Bearss Ave	Segment	4	4

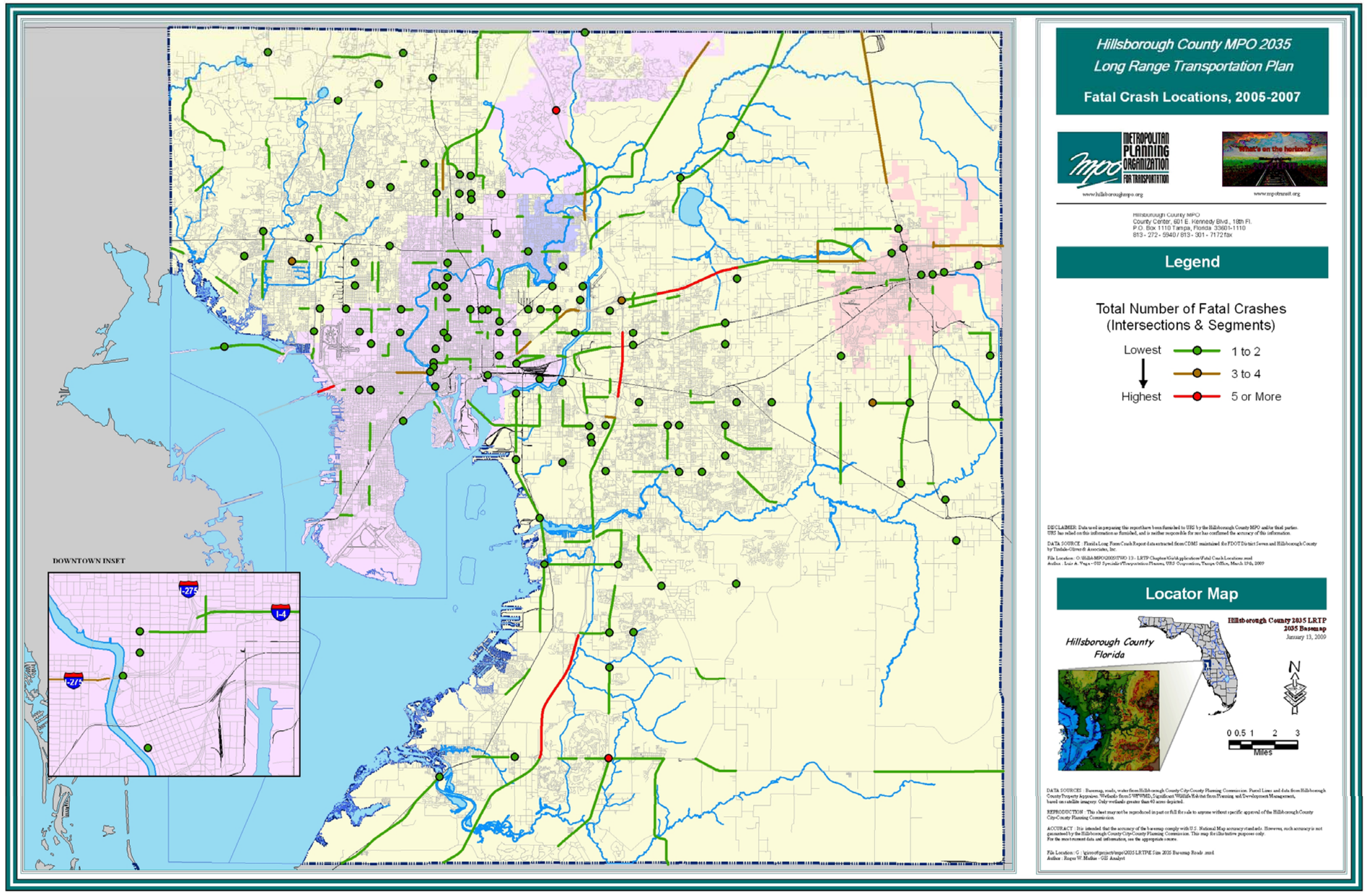
Table 2.7: Total Fatality Crash Statistics, 2005-2007

Crash Type	Total
Total Fatality Crashes	**431**
Total Fatalities	462
Fatalities per 100 Million VMT	1.4
Fatalities per 100,000 Population	37.7

2.3.8 Crashes Involving Bicycles

Figure 2.9 displays the total number of **Bicycle Crashes** by intersection and segment on the MPO's Major Road Network, broken down into three tiers. As indicated on the bicycle crash map, a total of 13 fatality crashes involving bicyclists occurred on the MPO Major Road Network during the three-year time period. Four other fatal crashes occurred off the MPO network and are therefore not shown. The largest number of

Figure 2.8: Fatal Crash Locations (Motor Vehicle, Bicycle & Pedestrian Combined), 2005-2007



bicycle crashes occurred at the CR 584 (Waters Avenue)/Sheldon Road intersection (Table 2.8). Overall, the total number of bicycle crashes over the three-year period was 534 (Table 2.9).

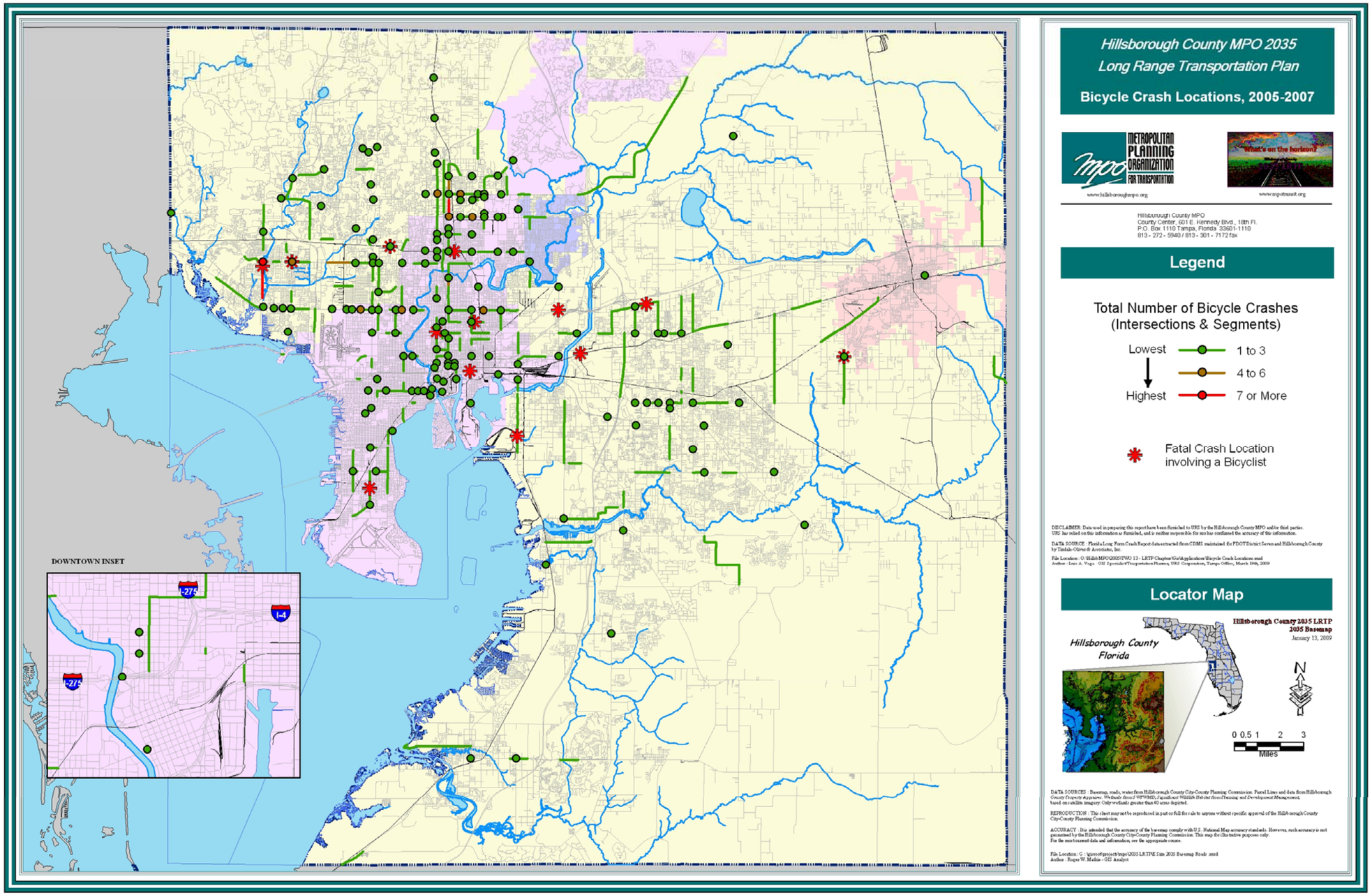
Table 2.8: Top Ten Bicycle Crash Locations, 2005-2007

Facility		Location	Total Bicycle Crashes
CR 584(Waters Ave)	@ Sheldon Rd	Intersection	7
SR 582 (Fowler Ave)	@ 22ND St/University Square Mall	Intersection	6
CR 584 (Waters Ave)	@ Hanley Rd	Intersection	5
US 41 Business	@ Fletcher Ave	Intersection	5
SR 580 (Hills Ave)	@ Lois Ave	Intersection	5
US 92 (Hills Ave)	@ Armenia Ave	Intersection	4
US 92 (Hills Ave)	@ 30TH St	Intersection	4
CR 582A (Fletcher Ave)	@ 15TH St	Intersection	4
CR 589 (Sheldon Rd)	From Mohr Rd to Waters Ave	Segment	4
US 41	@ Fowler Ave	Intersection	4

Table 2.9: Total Bicycle Crash Statistics, 2005-2007

Crash Type	Total
Total Bicycle Crashes	534
Fatality Crashes Involving Bicyclists	13
Bicycle Crashes per 100,000 Population	43.6

Figure 2.9: Bicycle Crash Locations, 2005-2007



2.3.9 Crashes Involving Pedestrians

Figure 2.10 displays the total number of **Pedestrian Crashes** by intersection and segment on the MPO's Major Road Network, broken down into three tiers. It also shows the fatal crash locations that were automatically geolocated using ArcGIS to the MPO network (59 locations). A total of 100 fatal crashes involving pedestrians occurred during the three-year time period. The largest number of pedestrian crashes occurred at the CR 582A (Fletcher Avenue)/22nd Street intersection (Table 2.11). Three of the top ten pedestrian crash locations occurred at intersections on Fletcher Avenue. Overall, the total number of pedestrian crashes over the three-year period was 941 (Table 2.12).

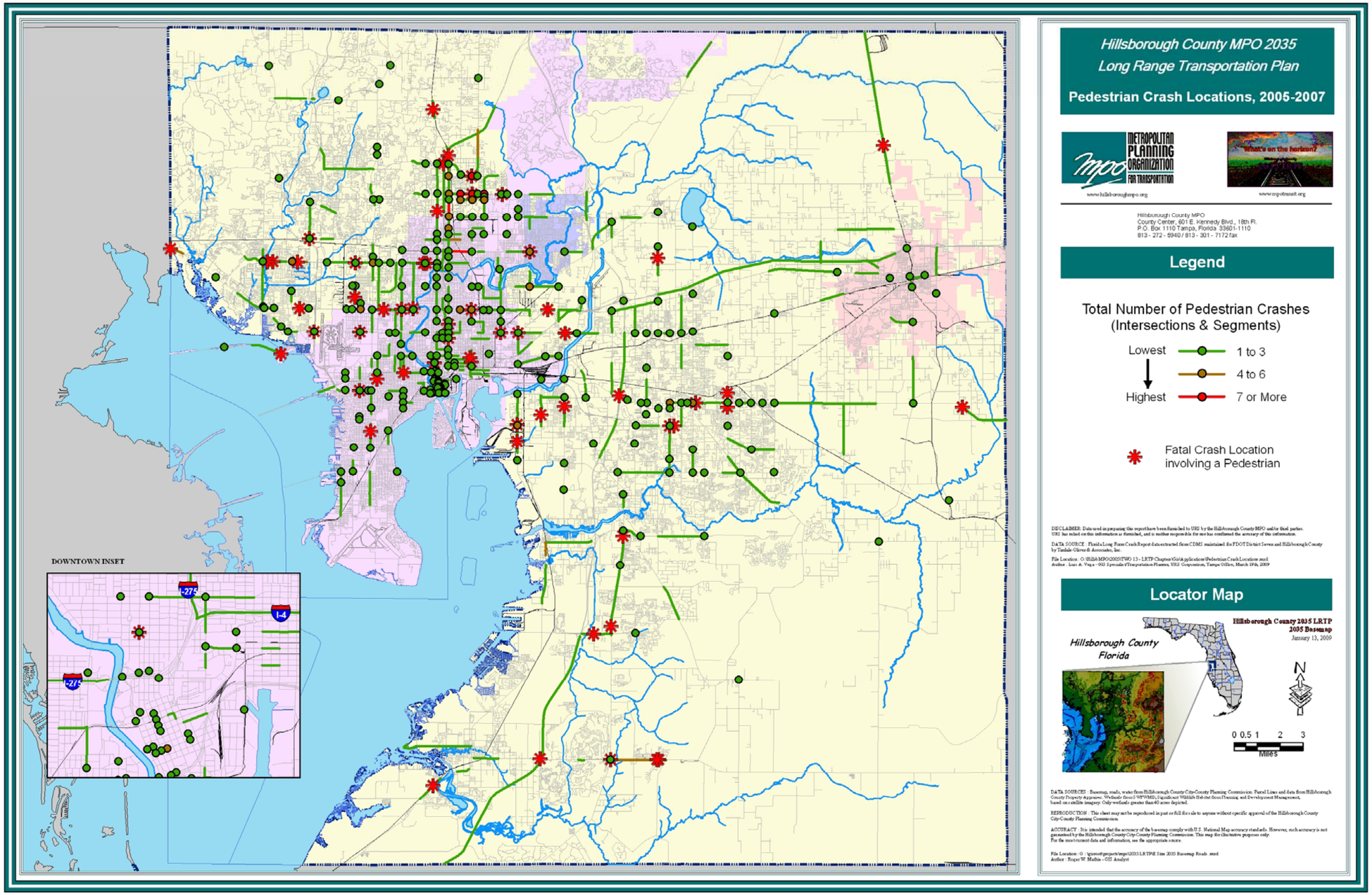
Table 2.10: Top Ten Pedestrian Crash Locations, 2005-2007

Facility		Location	Total Pedestrian Crashes
CR 582A (Fletcher Ave)	@ 22ND St	Intersection	11
SR 580 (Hills Ave)	From Sawyer Rd to George Rd	Segment	7
CR 582A (Fletcher Ave)	@ 15TH St	Intersection	7
22ND ST	@ Bearss Ave	Intersection	7
CR 581/Bruce B Downs	@ Fletcher Ave	Intersection	7
22ND ST	@ 131St Ave	Intersection	6
SR 583 (56th St)	@ Sligh Ave	Intersection	6
CR 584 (Waters Ave)	@ Hanley Rd	Intersection	5
SR 580 (Busch Blvd)	@ 56TH St	Intersection	5
SR 580 (Hills Ave)	@ Lois Ave	Intersection	5

Table 2.11: Total Pedestrian Crash Statistics, 2005-2007

Crash Type	Total
Total Pedestrian Crashes	941
Fatality Crashes Involving Pedestrians	100
Pedestrian Crashes per 100,000 Population	76.8

Figure 2.10: Pedestrian Crash Locations, 2005-2007



3.0 SAFETY IMPROVEMENT METHODS

A comprehensive transportation safety improvement program includes a range of strategies and countermeasures, and often involves multiple jurisdictions and agencies. To be most effective, safety programs typically require the collective coordination of all affected stakeholders. Section 4.0 provides an overview of improvement methods that may be implemented to address safety issues at both the **Top 50 Intersection** and **Segment** locations within the Hillsborough County MPO's Major Road Network.

3.1 SAFETY EMPHASIS AREAS

The *Transportation Planner's Safety Desk Reference (2007)*[4], referenced from *AASHTO's Strategic Highway Safety Plan: A Comprehensive Plan to Substantially Reduce Vehicle-Related Fatalities and Injuries on the Nation's Highways (2005)*, identified 17 Emphasis Areas for state and regional agencies to apply safety on the transportation system. The development of these Emphasis Areas reflects an innovative approach to roadway and intersection safety by including populations groups, types of crashes, infrastructure/hazards, driver behavior, geometry, and modes. The list of Emphasis Areas includes:

- Older Persons' Safe Mobility
- Pedestrian Collisions
- Aggressive Driving
- Unlicensed Drivers
- Signalized Intersections
- Unsignalized Intersections
- Run-Off Road Collisions
- Head-on Collisions
- Horizontal Curves
- Tree Collisions
- Utility Pole Collisions
- Occupant Protection
- Heavy Truck Collisions
- Work Zone Collisions
- Drowsy or Distracted Driving
- Rural Emergency Medical Services
- Alcohol-Involved Collisions

3.2 TOOLBOX OF SAFETY STRATEGIES AND COUNTERMEASURES

The implementation of strategies to improve the safety of the MPO's Major Road Network is an essential component of the transportation safety planning process. The main purpose of safety-related strategies is to reduce crashes, fatalities and injuries while improving the accessibility and operation of the transportation system through a variety of cost-effective improvements and programs. Carrying out these strategies generally depends on state and local implementing agencies. General Safety improvement strategies should focus on:

- Δ **Access Management**
- Δ **Education and Awareness**
- Δ **Increased Enforcement**
- Δ **Incident Management**
- Δ **Geometric Improvements**
- Δ **Mobility Management**
- Δ **Bicycle/Pedestrian and Transit Safety**
- Δ **Traffic Control Improvements**

These eight major groups of strategies serve as a means to improve safety on the MPO's Major Road Network. The following section provides a summary of candidate strategies, and specific countermeasures to improve safety, followed by their respective applicability to the 17 Safety Emphasis Areas as well as to the Florida Strategic Highway Safety Plan (SHSP) Four Emphasis Areas - Aggressive Driving, Intersection Crashes, Vulnerable Road Users, Lane Departures.

1. Access Management

Access management is the process for managing how major roadways impact through-traffic and provide access to property and land development. Policies and design criteria may be implemented to minimize the number of driveways and intersecting roads accessing a major roadway, including parallel service roads, shared driveways, median barriers, and curb cut limitations. This strategy can result in reduced crashes, and improved traffic flow.

Access Management Safety Countermeasures
Construct raised median barriers near major intersections
Construct parallel access roads
Implement driveway turn restrictions (right-in, right-out channelization)
Restrict access using driveway closures, consolidations
Restrict cross-median access near intersections

Safety Emphasis Areas Addressed:

- Older Person's Safe Mobility
- Pedestrian Collisions
- Signalized Intersections
- Unsignalized Intersections
- Run-Off Road Collisions
- Head-On Collisions
- Heavy Truck Collisions

Florida SHSP Emphasis Areas Addressed:

- Intersection Crashes
- Vulnerable Road Users
- Lane Departure Crashes

2. Education and Awareness

The promotion of safety policies, educational outreach programs and publications, and safety solutions to the public is an essential strategy to enable users of the transportation system to become more aware of the importance of safe travel.

Education and Awareness Safety Countermeasures
Conduct education and public information campaigns for safe driving
Educate and impose sanctions against aggressive and careless drivers
Educate schools, teachers and parents on County safety programs (Safe Routes to School, Safe Kids Tampa)
Promote bicycle and pedestrian safety education
Promote buckle-up programs
Promote motorcycle safety awareness
Raise awareness and publicity of safety programs in County (videos, brochures, publications)
Strengthen driver-licensing standards for teenage and older drivers

Safety Emphasis Areas Addressed:

- Older Persons' Safe Mobility
- Pedestrian Collisions
- Aggressive Driving
- Unlicensed Drivers
- Tree Collisions
- Utility Pole Collisions
- Occupant Protection
- Heavy Truck Collisions
- Work Zone Collisions
- Drowsy or Distracted Driving
- Rural Emergency Medical Services
- Alcohol-Involved Collisions

Florida SHSP Emphasis Areas Addressed:

- Aggressive Driving
- Vulnerable Road Users
- Lane Departure Crashes

3. Increased Enforcement

Large scale enforcement of safety for users of the transportation system is a strategy that requires a strong partnership between state, regional and local governments, and law enforcement agencies. Increased enforcement of speed, safety and driving behavior are effective methods to significantly improving safety on the transportation system.

Increased Enforcement Safety Countermeasures
Apply increased law enforcement practices
Enforce seat belt and occupant restraint usage
Increase enforcement at targeted locations (DUI/sobriety checkpoints, work zones)
Install red light enforcement white lights and surveillance cameras
Post appropriate/lower speeds on intersection approaches of major activity centers (universities, senior zones)
Reduce operating speed limits on major roadways

Safety Emphasis Areas Addressed:

- Older Persons' Safe Mobility
- Aggressive Driving
- Unlicensed Drivers
- Signalized Intersections
- Unsignalized Intersections
- Tree Collisions
- Utility Pole Collisions
- Occupant Protection
- Heavy Truck Collisions
- Work Zone Collisions
- Drowsy or Distracted Driving
- Alcohol-Involved Collisions

Florida SHSP Emphasis Areas Addressed:

- Aggressive Driving
- Intersection Crashes
- Vulnerable Road Users
- Lane Departure Crashes

4. Incident Management

Incident management includes programs to detect and respond to incidents, such as crashes and non-recurring events potentially impeding the flow of traffic on the transportation system. The use of Intelligent Transportation Systems (ITS) and other communications technology can play an important role in the alleviation of safety issues through the minimization of delays and congestion.

Incident Management Safety Countermeasures
Improve the coordination of emergency response
Coordinate the integration and expansion of Traffic Management Centers
Promote the expansion and coordination of multi-jurisdictional Arterial Traffic Management Systems (ATMS)
Promote the coordination and expansion of multi-jurisdictional ITS programs

Safety Emphasis Areas Addressed:

- Signalized Intersections
- Heavy Truck Collisions
- Work Zone Collisions
- Rural Emergency Medical Services

Florida SHSP Emphasis Areas Addressed:

- Aggressive Driving

5. Geometric Improvements

Geometric improvement strategies focus on improving the existing design characteristics and features of both intersections and corridors. Geometrical improvements generally result in improved safety and traffic flow.

Geometric Improvement Safety Countermeasures
Construct grade separations (rail-roadway crossing safety, overpasses)
Construct roundabouts at intersections as appropriate
Eliminate or reduce roadside hazards (utility poles, light poles, trees, slopes, sign posts)
Improved channelization and weaving
Implement Traffic calming techniques (traffic barriers, speed bumps/humps, raised crosswalks, street alignment, traffic circles, on-street parking)
Improve sight distance and visibility near and at intersections (clear trees, brush, move unnecessary signs, utility poles)
Install raised medians
Install rumble strips (centerline, shoulder) and guardrails
Provide wide shoulders or widen shoulders/bicycle lanes
Realign intersecting streets
Provide or improve right- and left-turn lanes
Improve turning radii of intersection

Safety Emphasis Areas Addressed:

- Older Persons' Safe Mobility
- Pedestrian Collisions
- Signalized Intersections
- Unsignalized Intersections
- Run-Off Road Collisions
- Head-On Collisions
- Horizontal Curves
- Tree Collisions
- Utility Pole Collisions
- Heavy Truck Collisions
- Work Zone Collisions

Florida SHSP Emphasis Areas Addressed:

- Intersection Crashes
- Vulnerable Road Users
- Lane Departure Crashes

6. Traffic Control Improvements:

Improved traffic controls and more efficient signal timing can significantly reduce delay and improve safety and travel times through major intersections within the transportation network.

Traffic Control Safety Countermeasures
Improve advanced notification of stop sign or signal (stop, yield, signal ahead, variable message sign)
Improve size and visibility of roadway signage (retroflective, fluorescent signs) and pavement markings/reflectors
Increase the use of protected left-turn signal phases
Increase vehicle preemption for emergency services
Guide motorists more effectively through intersection (pavement signage, lane markings)
Optimize signal timing of intersection
Restrict or eliminate turn maneuvers (left turns, right-turn on red)
Synchronize signal timings and coordination of multiple intersections
Improve visibility of traffic signals/larger signal heads

Safety Emphasis Areas Addressed:

- Older Persons' Safe Mobility
- Pedestrian Collisions
- Signalized Intersections
- Unsignalized Intersections
- Head-On Collisions
- Heavy Truck Collisions
- Work Zone Collisions

Florida SHSP Emphasis Areas Addressed:

- Intersection Crashes
- Vulnerable Road Users
- Lane Departure Crashes

7. Mobility Management:

Promoting a shift from driving a single-occupant vehicle to transit or other alternative modes of transportation, or participation in TDM programs, can improve safety along a major corridor by reducing total vehicle traffic, congestion and trip lengths.

Mobility Management Safety Countermeasures
Bicycle/Pedestrian and Transit integration (connections, improved access)
Construct HOV/HOT lanes
Expand Park n Ride facilities
Expand Telecommuting options
Expand Ridesharing programs
Implement transit service improvements
Improve and expand shuttle services

Safety Emphasis Areas Addressed:

- Older Persons' Safe Mobility
- Pedestrian Collisions
- Aggressive Driving
- Work Zone Collisions

8. Pedestrian/Bicycle/Transit Safety:

Bicycle/pedestrian and transit safety can be improved through the removal of perceived access barriers or deterrents by creating more safe connections and crossings, and eliminating gaps on sidewalks or bicycle facilities. Special attention should be focused on children, seniors, and persons with disabilities.

Pedestrian/Bicycle/Transit Safety Countermeasures
Complete sidewalk gaps
Construct pedestrian refuge islands and mid-block crossings
Construct pedestrian/bicycle over/underpasses
Ensure ADA-compliant access to transit stops and stations
Improve crosswalk signage and markings
Implement grade crossing improvements (railroad crossings)
Improve crosswalks and curb ramps to be ADA compliant
Implement Advanced Technology Systems (motion activated sensors, activated lighting and signage) and emerging safety-related technologies
Increase lighting conditions at intersections
Install countdown pedestrian signals
Install bicycle lanes/shoulders
Increase use of "No Turn on Red" at active pedestrian intersections
Promote adoption of standard walkability checklist for pedestrians

Safety Emphasis Areas Addressed:

- Older Persons' Safe Mobility
- Pedestrian Collisions
- Signalized Intersections
- Unsignalized Intersections

Florida SHSP Emphasis Areas Addressed:

- Intersection Crashes
- Vulnerable Road Users
- Lane Departure Crashes

Typically, design-oriented aspects of transportation safety are developed during early phases of a project. Interagency coordination and cooperation are vital to address safety issues pertaining to projects at the initial stage prior to going through the MPO process. A proactive approach is necessary to ensure that safety is integrated and considered in all MPO projects. Therefore, a selection of applicable safety countermeasures should be incorporated into the development of projects being prioritized for safety improvements.

4.0 SAFETY IMPROVEMENT RECOMMENDATIONS

The following section provides a set of recommendations utilizing the Toolbox of Safety Strategies and Countermeasures to address the predominant safety issues typically associated with the **Top 50 Priority Intersection** and **Segment** crash locations analyzed within the MPO's Major Road Network. The strategies and countermeasures are ordered by the most frequent types of crashes which occur at intersections and segments in Hillsborough County. However all intersections, segments or hot spot clusters need to undergo a more detailed engineering analysis to pinpoint specific safety issues, and develop solutions specific to these circumstances. The following offers general guidelines.

The relative costs of each potential countermeasure are provided in High, Medium and Low cost categories (Table 4.1). Since detailed cost estimates of any potential action are project-specific, a general range is provided for each type of safety countermeasure. In several cases, relative cost ranges are not provided, such as for some educational and enforcement programs. These programs reflect a broad range of strategies and actions, and can vary significantly in complexity and cost. Cost estimate ranges have been developed in part from National Highway Safety Transportation Administration (NHTSA) *Countermeasures That Work: A Highway Safety Countermeasure Guide For State Highway Safety Offices*[5] and U.S. Department of Transportation/ITE *Toolbox of Countermeasures and Their Potential Effectiveness to Make Intersections Safer*[6].

4.1 INTERSECTION LOCATIONS

Crashes occurring at intersections are frequently indicators of congestion, stop-and-go traffic, driver confusion and geometric or operational deficiencies. The primary safety issues identified from the analysis of the major types and causes of crashes at the **Top 50 Intersection** locations is reflected in seven major safety challenge areas.

Each major cause can be addressed and mitigated through a variety of safety countermeasures as displayed in Table 4.1.

Table 4.1: Intersection Safety Improvements

Safety Challenge	Safety Countermeasures	Relative Costs
Angle Crashes, Rear Ends	• Consider multi-way stop at unsignalized intersections	Low
	• Restrict median access near intersections	Medium
	• Install raised median barriers near major intersections	Medium/High
	• Restrict or eliminate turn maneuvers	Low
	• Construct roundabouts as appropriate	High
	• Optimize traffic signals, synchronize signals	Medium

Red Light Running	• Improve advanced notification of stop sign or signal • Increase enforcement at targeted locations • Install red light enforcement white lights and surveillance cameras	Low/Medium Medium Low/Medium
Crashes Involving Left-turns and Right-turns	• Increase the use of protected turn signal phases • Restrict or eliminate turn maneuvers (left-turns, right-turn on red) • Install additional exclusive right or left turn lanes • Provide continuous right- and left-turn lanes	Medium Low Medium High
Speeding/Aggressive Driving	• Increase enforcement at targeted locations • Post appropriate/lower speeds on intersection approaches • Install video cameras • Conduct education and public information campaigns for safe driving • Educate and impose sanctions against aggressive and careless driving • Raise awareness and publicity of safety programs in County	Medium Low Medium Varies Varies Varies
Driver Confusion/ Navigation Issues	• Improve advanced notification of stop sign or signal (stop, yield, signal ahead, variable message signs) • Improve size and visibility of roadway signage (retroflective, fluorescent) • Guide motorists more effectively through complex intersections with sign and pavement markings	Low/Medium Low Low
Sight-Distance Issues	• Improve sight distance and visibility at and near intersections (clear trees, vegetation, move unnecessary signs, utility poles) • Improve advanced notification of stop sign or signal • Improve visibility of signals • Improve lighting at intersection • Install larger signal heads	Low Low/Medium Low Medium Low
Bicycle/Pedestrian Safety	• Construct pedestrian refuge islands • Improve crosswalk signage and markings	Medium Low

	• Improve crosswalks and curb ramps to be ADA compliant • Implement Advanced Technology Systems (motion activated sensors, lighting) • Increase lighting at intersections • Install countdown pedestrian signals • Increase "No Turn on Red" at active pedestrian intersections • Implement Designated Bicycle Lanes • Construct bicycle/pedestrian over/underpasses • Bicycle/Pedestrian and Transit integration (connections, improved access) • Education and Awareness	Low Medium Medium Low Low Low/Medium High Low/Medium Varies

4.2 SEGMENT LOCATIONS

Crashes occurring along roadway segments are frequently indicators of congestion, driveway/access management, aggressive/speeding drivers, stop-and-go traffic, driver confusion and geometric deficiencies. The primary safety issues identified from the analysis of the major types and causes of crashes at the **Top 50 Segment** locations is reflected in six major safety challenge areas.

Each major cause can be addressed and mitigated through a variety of safety countermeasures displayed in Table 4.2.

Table 4.2: Segment Safety Improvements

Safety Challenge	Safety Countermeasures	Relative Costs
Access Safety	• Construct median barriers • Construct parallel access roads • Implement driveway turn restrictions (right-in, right-out) • Restrict access using driveway closures, consolidations • Restrict cross-median access	Medium/High High Low Low Low
Roadway Geometry/Horizontal Curves	• Eliminate or reduce roadside hazards (utility poles, light poles, trees, slopes, sign posts) • Improve channelization and weaving • Install raised medians • Provide wide shoulders or widen shoulders • Realign intersecting streets • Implement grade crossing	Low Medium Medium Low/Medium High

	improvements (railroad crossings)	Medium
Sight-Distance Issues	• Improve sight distance and visibility at and (clear trees, vegetation, move unnecessary signs, utility poles) • Improve advanced notification of stop sign or signal • Improve visibility of signs and signals	Low Low/Medium Low
Aggressive Driving/ Careless Driving/ Speeding	• Conduct education and public information campaigns for safe driving • Strengthen driver-licensing standards for teenage and older drivers • Apply increased law enforcement practices • Increase enforcement at targeted locations • Reduce operating speed limits on major roadways • Implement traffic calming techniques (traffic barriers, speed bumps/humps, raised crosswalks, street alignment, traffic circles, on-street parking)	Varies Low/Medium Medium Medium Low Low/Medium/ High
Pedestrian Crossings	• Educate schools, teachers and parents on County safety programs (Safe Routes to School, Safe Kids Tampa) • Promote bicycle and pedestrian safety education • Grade separations (over/underpasses) at high volume, high speed roads • Complete sidewalk gaps • Construct pedestrian refuge islands and mid-block crossings • Promote adoption of standard walkability checklist for pedestrians	Low Low High Low/Medium Medium Low
Incident/Congestion Management	• Improve the coordination of emergency response • Coordinate the integration and expansion of Traffic Management Centers • Promote the expansion and coordination of multi-jurisdictional Arterial Traffic Management Systems (ATMS) • Promote the coordination and expansion of multi-jurisdictional ITS programs	Low Medium/High Medium/High Medium/High

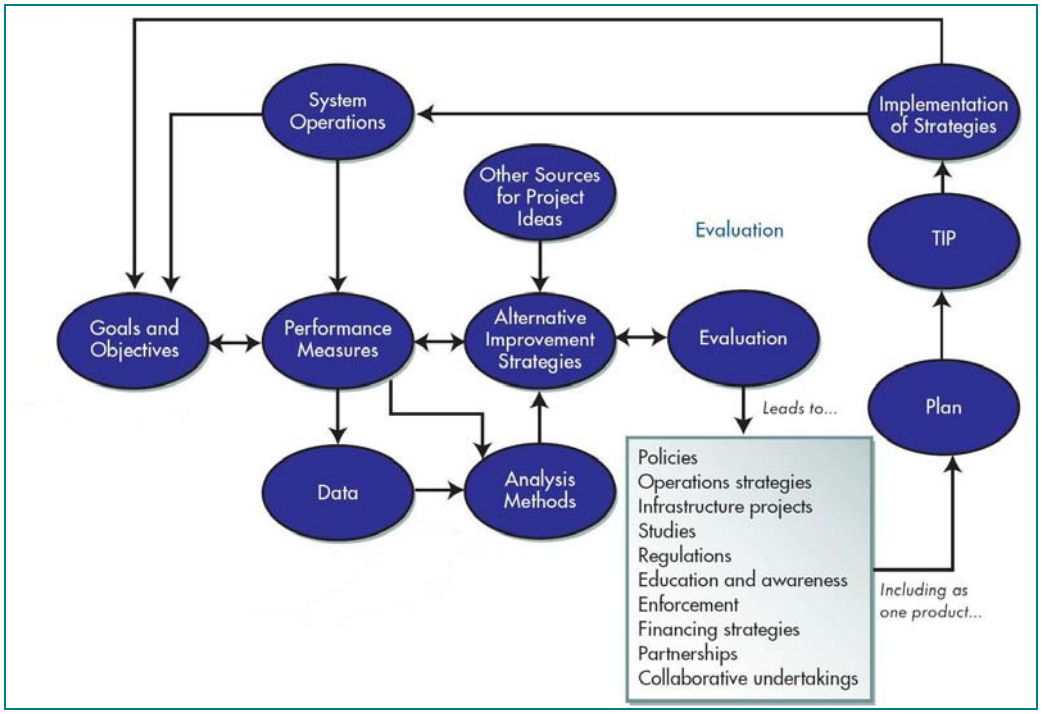
4.3 RECOMMENDED NEXT STEPS

The following section provides a summary for developing the process of setting priorities, and determining appropriate candidate safety projects. Two examples are provided – **Benefit to Cost Analysis** and **Road Safety Audits**, as a means to take the next step in further assessing priorities and projects.

4.3.1 MPO Planning Process and Project Implementation

Figure 4.1 displays a summary of the relationship of safety to the MPO's transportation planning process. As shown, the overall safety vision of the MPO provides the framework for the goals and objectives of the program, which are in turn monitored with performance measures. *Potential improvement projects and strategies should be developed along with alternative strategies in collaboration with the MPO's implementing partners.* Projects should then be evaluated according to how well they address system needs and deficiencies, cost, and safety. Additionally, new policies, regulations, strategies and partnerships, may be developed. Projects that meet the MPO's defined criteria including safety are then included in the LRTP. The MPO prioritizes projects in the LRTP and moves them into Transportation Improvement Program (TIP). Projects in the TIP are implemented, and system operations resulting from the improvements are evaluated. Throughout the process, the MPO monitors system performance and makes refinements as needed.

Figure 4.1: Relationship of Safety to MPO Planning Process



Source: Adapted from *Making the Case for Transportation Safety – Ideas for Decision Makers*[7]

The linkage between transportation safety planning and the Congestion Management Process (CMP) is also an important component to the MPO planning process. The most effective strategies and projects implemented for reducing crashes have a significant impact on the congestion levels of both the MPO Major Road Network and the CMP network. Furthermore, the integrated management and operation of the CMP network provides for a more safe transportation system. Since the CMP is an important part of identifying facilities to reduce congestion, the integration of transportation safety planning with the CMP is an important part of developing and prioritizing the MPO's TIP and LRTP projects.

4.3.2 Road Safety Audit Programs

Road Safety Audit (RSA) programs frequently result in the identification of countermeasures that are low cost, can be implemented in a short timeframe, and improve safety. RSA's are conducted on a continuous basis by FDOT District Seven and Hillsborough County's Public Works-Traffic Services Division. RSA's involve a comprehensive multimodal safety performance examination of specific roadways identified for review. RSA's are evaluated by an independent multidisciplinary team assessing road safety issues and recommending low-cost safety improvements to reduce crashes and improve the overall safety performance of the facility. The location of each RSA is assigned by the jurisdiction, and is based on key factors such as high crash locations, fatalities, specific traffic zoning requirements or traffic service requests. Overall, RSA's can serve as an important part of developing safety improvement strategies and countermeasures for high priority intersections and segments considered as potential MPO-funded projects.

4.3.3 Benefit to Cost Analysis

As part of the safety planning process, the decisions to implement specific projects for intersections and/or segments will in large part depend on funding. Some agencies fund their own safety programs and determine funding priorities. However, if desired, for prioritization purposes, the MPO and/or implementing agencies could also assess the benefits realized from a safety-related improvement (i.e., reduced crashes) to the overall cost, reflecting a true benefit to cost ratio.

FHWA has recommended the utilization of Benefit-Cost Analysis[8] as a means to consider when planning and programming safety improvement measures. According to FHWA, a useful application of Benefit-Cost Analysis includes:

Benefit-cost analysis (BCA) *considers the changes in benefits and costs that would be caused by a potential improvement to the status quo facility. In highway decision-making, BCA may be used to help determine the following:*

- *Whether or not a project should be undertaken at all (i.e., whether the project's life-cycle benefits will exceed its costs).*
- *When a project should be undertaken. BCA may reveal that the project does not pass economic muster now, but would be worth pursuing 10 years*

from now due to projected regional traffic growth. If so, it would be prudent to take steps now to preserve the future project's right-of-way.

- *Which among many competing alternatives and projects should be funded given a limited budget. BCA can be used to select from among design alternatives that yield different benefits and unrelated transportation projects in different transportation modes.*

In general, deciding what safety countermeasures to consider will often depend on the level of benefits potentially realized through standardized estimated crash reductions, including bicycle, pedestrian, injuries, and fatalities in relationship to the project costs. A comparison and ranking of BCA ratios amongst all proposed projects and corresponding countermeasures would be appropriate. Ideally, any selected improvements should have benefits that outweigh the associated costs. A process for evaluating the effects of transportation improvements on safety before and after implementation, and a comparison of the pre- and post-project crash frequency, rates, and severity, should also be conducted by the MPO and partnering agencies.

Overall, the Benefit-Cost analysis should include[9]:

- Three years of crash data;
- Projected traffic volumes;
- Service life of project;
- Reduction in crashes and associated benefit; and
- Expected countermeasure cost.

The NCHRP Report 617, *Accident Modification Factors for Traffic Engineering and ITS Improvements*, compiled a comprehensive listing of Accident modification factors (AMF), which are also known as crash reduction factors. According to NCHRP, AMF's "*provide a computationally simple and quick way of estimating crash reductions. Many states and local agencies have a set of crash reduction factors that are used for estimating the safety impacts of various types of engineering improvements, encompassing the areas of signing, alignment, channelization, and other traffic engineering solutions. Typically, these factors are computed using before-and-after comparisons, although recent research also has suggested the use of cross-sectional comparisons. Currently, AMF's are often used in program planning to make decisions concerning whether to implement a specific treatment and/or to quickly determine the costs and benefits of selected alternatives. AMF's are also used in project development for non-safety as well as safety-specific projects and could be used by agencies in deciding on policies affecting general project design (e.g., context-sensitive design solutions and traffic calming)*[10]".

The NCHRP Report provides a detailed description of AMF summaries, including before and after assessments and the level of reduction expected from implementing a specific safety countermeasure. For example, the addition of an exclusive left-turn lane at a four-leg signalized intersection in an urbanized area is estimated have the following crash reduction benefits:

- Total Intersection Crashes
  - 10% (.90 AMF) reduction for one approach
  - 19% (.81 AMF) reduction for both approaches
- Fatal and Injury Crashes
  - 9% (.91 AMF) reduction for one approach
  - 17% (.83 AMF) reduction for both approaches

4.4 TRANSPORTATION SAFETY IN HILLSBOROUGH COUNTY

There are numerous programs and organizations devoted to improving safety in Hillsborough County. Many transportation providers, agencies, professionals, businesses and citizens have worked cooperatively to engineer, design, plan and implement safety programs throughout the County.

4.4.1 Community Traffic Safety Team

Florida's Community Traffic Safety Teams (CTST) are locally based groups within each FDOT District, and consist of transportation safety professionals and advocates devoted to improving traffic safety problems in their respective jurisdictions. Members come from all levels of government - federal, state, county and local, as well as the private sector and local citizens. The common goal of all CTST's in Florida is to reduce the number and severity of traffic crashes within their respective jurisdictions.

The Hillsborough CTST was established in January of 1991 and covers the entire MPO area including Hillsborough County, the cities of Tampa, Temple Terrace, and Plant City. The major activities and programs that the CTST participates in or supports include child and occupant safety programs, bike and pedestrian safety, work zone safety, school bus safety, school zone safety, grade crossing safety, and motorcycle safety. The Hillsborough CTST also conducts education and enforcement campaigns involving red light running, driving under the influence of alcohol and drugs, and traffic safety. In addition, the CTST participates in Buckle Up Florida and You Drink, You Drive, You Lose sustained enforcement efforts. CTST consists of over 30 professionals from all levels of government, private sector interests, and non-profit organizations.

4.4.2 Road Safety Audit Programs (see 4.3.2)

4.4.3 Emergency Services

Emergency services are important component to safety planning, and to prevent the loss of additional lives and further debilitating injuries to users of the transportation system after an incident. Emergency services which serve transportation safety in Hillsborough County include emergency and incident responses, ambulance transportation, ladder companies, heavy rescue, paramedic response, hazardous materials (HAZMAT) and hazardous incident teams (HIT). The main emergency agencies include the Hillsborough County Fire and Rescue Department and Tampa Fire Rescue Office of Emergency Management. Ambulance Services for emergency & non-emergency medical transportation includes Emergency Medical Services (EMS) and paramedics that respond to an incident.

4.4.4 Law Enforcement

Law Enforcement officers and agencies serve an important role in maintaining transportation safety in Hillsborough County. Officers focus primarily on improving roadway safety through the enforcement of safe driving, maintaining proper travel speed, and deterring careless driving caused criminal behavior (i.e., DUI, aggressive driving). The main law enforcement agencies in Hillsborough County include:

- City of Plant City Police Department
- City of Tampa Police Department
- Florida Highway Patrol
- Hillsborough County Sheriff Office
- Temple Terrace Police Department

4.4.5 Florida Department of Transportation

Tampa Bay SunGuide Center

FDOT District Seven operates and maintains a Regional Traffic Management Center (TMC) to improve safety, mobility, and efficiency of the state highway system within the Tampa Bay Region, including Hillsborough County. The TMC includes the following key partners/programs within the TMC which impact safety in Hillsborough County:

- **Traffic Incident Management Team:** The program serves to lessen the effects of nonrecurring congestion, caused mainly by crashes and disabled vehicles. The use of ITS and surveillance monitoring enables the District to facilitate and dispatch a faster and more efficient response to crashes by emergency service providers (police, fire, ambulance). Current state facilities covered in Hillsborough County include I-4, I-75 and I-275.

- **Road Rangers:** The District operates a Road Rangers Program by providing a fleet of service trucks which patrol the interstate system within District Seven.

- **511 Tampa Bay System:** A service provided by FDOT District Seven providing real-time traffic information for the Tampa Bay Area to users via phone or website. Traffic information includes current traffic information for select area roadways and roadway segments; mass transit information including buses, trains, airports and seaports; event information including schedules for major concerts or sports events; public safety alerts; and live-camera images for select area roadways.

- **Emergency Operations Center:** A state emergency response team is on call to improve preparedness and response during emergencies with direct dispatch to State Law Enforcement agencies.

Advanced Traffic Management System (ATMS)
FDOT District Seven operates and maintains an ATMS process that employs a variety of detectors, cameras, and communication systems to monitor traffic, optimize signal timings, and control the flow of traffic on state-maintained major arterials.

Safe and Mobile Seniors
The FDOT State Traffic Engineering and Operations Office oversees a Safe Mobility for Life Program to promote safety and disseminate information via the internet to seniors on all aspects of transportation, in an effort to improve safety and mobility (http://www.safeandmobileseniors.org/). The program serves as a reference to available national, state, and local programs, and a resource for mature drivers, families and caregivers, senior resource centers, area agencies on aging, Community Traffic Safety Coordinators and Teams, safety councils, emergency road service agencies, and all others interested in mobility and safety issues concerning mature drivers.

4.4.6 Hillsborough County

The Traffic Division of Public Works manages and operates numerous programs and projects devoted to transportation safety. The following provides a summary of key programs, the vast majority of which are applying emerging technologies and addressing federal requirements to optimize safety.

- **Intersection Improvement Program:** Strategic goal of reducing crashes at existing high crash locations, including bicyclists and pedestrians.

- **Residential Traffic Calming (RTC) Program:** Program focused on calming excessive traffic and speeding in residential areas**.**

- **Crash Management System:** The crash management system applies crash analysis tools to help law enforcement agencies and traffic engineers combine multiple existing local and state crash databases; establish countywide geographic information systems (GIS) crash mapping in order to analyze high crash locations.

- **Traffic Management Center (TMC):** A new TMC will be in operation in 2010 and include ITS, ATMS, and a signal timing program.

- **Railroad Crossing Program:** All railroad crossings designated as “Passive” are being retrofitted for enhanced railroad crossing markings, signage and gate improvements.

- **Bicycle/Pedestrian Safety:** Programs devoted to improving bicycle and pedestrian safety include Safe Routes to School, ADA-compliant intersection studies, pedestrian safety audits, countdown pedestrians signal and lightning installation, and safe crossings (mid-block crossings, crosswalks).

- **Motorcycle Safety:** Program devoted to addressing motorcycle safety, and addressing high crash locations.

- **Engineering Investigations:** Continuous effort to serve citizen requests for safety concerns, by including access management studies, signage replacement (retroflective), median closures, etc.

- **Hillsborough County Senior Zone Program:** Safety zones devoted specifically to add an additional level of protection for seniors, regarded as the most vulnerable residents.

4.4.7 Plant City

The City of Plant City, in partnership with FDOT District Seven, has implemented an Automated Traffic Management System (ATMS) to help improve traffic flow at all intersections within the City. The ATMS deploys a traffic operations center equipped with video surveillance and communications equipment. The City also continuously implements signage (LED Signs) installation and pedestrian improvements (sidewalks) to improve safety.

4.4.8 Transit Safety

Transit safety is an important component to a more accessible and efficient transportation system. The Hillsborough Area Regional Transit Agency (HART) serves as the mass transit provider for residents and visitors of Hillsborough County.

HART Bus System Safety Program

The primary role of HART's Bus safety program is to ensure safe and reliable transportation for its employees, customers and the general public. Safety is recognized by HART as one of three fundamental elements to the success of its program and services. HART plans, implements, supports, and monitors safe work practices for its employees and all users of the system. Specifically, HART maintains an on-going System Safety Program, which contains procedures and guidelines to provide its employees and passengers with optimum safety based on current national standards and procedures. A System Safety and Security Officer oversees all responsibilities and programs related to safety. Some primary activities conducted by HART regarding safety include:

- Investigation of all crashes and incidents
- Annual and random safety audits of facilities and vehicles
- Hazard assessments and investigations
- Safety training
- Planning and conducting emergency drills

These activities are outlined in detail in the *Hillsborough Area Regional Transit System Safety Program Plan*. As part of its safety program, HART also operates a Safety Committee. This committee is chaired by the System Safety and Security Officer and

includes maintenance workers, supervisors and managers. The committee discusses safety and security issues facing the system, and reviews various incidents and key problems to be addressed.

HART Bus Stop and Facility Accessibility Study (2008)
The purpose of this study was to inventory bus stops and facilities throughout the fixed route system, and identify and prioritize improvements to address ADA accessibility, security, operational and passenger issues. The goal of the study is to bring all bus stops throughout the system into compliance with federal accessibility requirements. Approximately, 4,000 bus stops, 11 park-and-ride lots and 20 transfer centers are affected by the study.

4.4.9 Bicycle and Pedestrian Safety Planning

Jurisdictions in Hillsborough County promote walking and bicycling by improving the environment for safe, comfortable, and convenient trips as well as improving the performance and interaction among motorists, bicyclists, and pedestrians. Specifically, the following plans have been implemented which address bicycle and pedestrian safety.

- Comprehensive Bicycle Plan Update (Hillsborough County MPO 2008)
- 2025 Hillsborough County Comprehensive Pedestrian Plan (Hillsborough County MPO 2004)
- Pedestrian Safety Action Plan (FDOT/FHWA, Hillsborough County, To be completed in 2009)

The FDOT Safety Office promotes safety for pedestrians and bicyclists through District Seven's Pedestrian-Bicycle Program. The program oversees the Florida School Guard Crossing Training Program, the Florida Traffic Safety Education Program, and the Safe Routes to School Program, which all serve a role in supporting pedestrian and bicycle aspects of FDOT projects. The FDOT Central Office also maintains a Plans Preparation Manual which gives consideration for pedestrian, bicycle and transit facilities on all proposed projects including resurfacing, restoration and rehabilitation, safety, and traffic operation projects.

REFERENCES

[1] National Safety Council, *Estimating the Costs of Unintentional Injuries*, 2006.

[2] National Highway Cooperative Research Program (NCHRP), I*ncorporating Safety into Long-Range Transportation Planning (Report 546)* TRB, 2005.

[3] Houston Metropolitan Traffic Safety Planning Program, Houston-Galveston Area Council, 2006.

[4] Cambridge Systematics, *Transportation Planner's Safety Desk Reference*, 2007.

[5] National Highway Safety Transportation Administration (NHTSA) *Countermeasures That Work: A Highway Safety Countermeasure Guide For State Highway Safety Offices*, 2006.

[6] U.S. Department of Transportation/ITE *Toolbox of Countermeasures and Their Potential Effectiveness to Make Intersections Safer*, 2004.

[7] Cambridge Systematics, *Making the Case for Transportation Safety – Ideas for Decision Makers*, 2008.

[8] Federal Highway Administration, Economic Analysis Primer – Benefit-Cost Analysis, 2007.

[9] Federal Highway Administration*, University Course on Pedestrian and Bicyclist Transportation Safety*.

[10] National Highway Cooperative Research Program (NCHRP), Accident Modification Factors for Traffic Engineering and ITS Improvements (Report 617) TRB 2008.

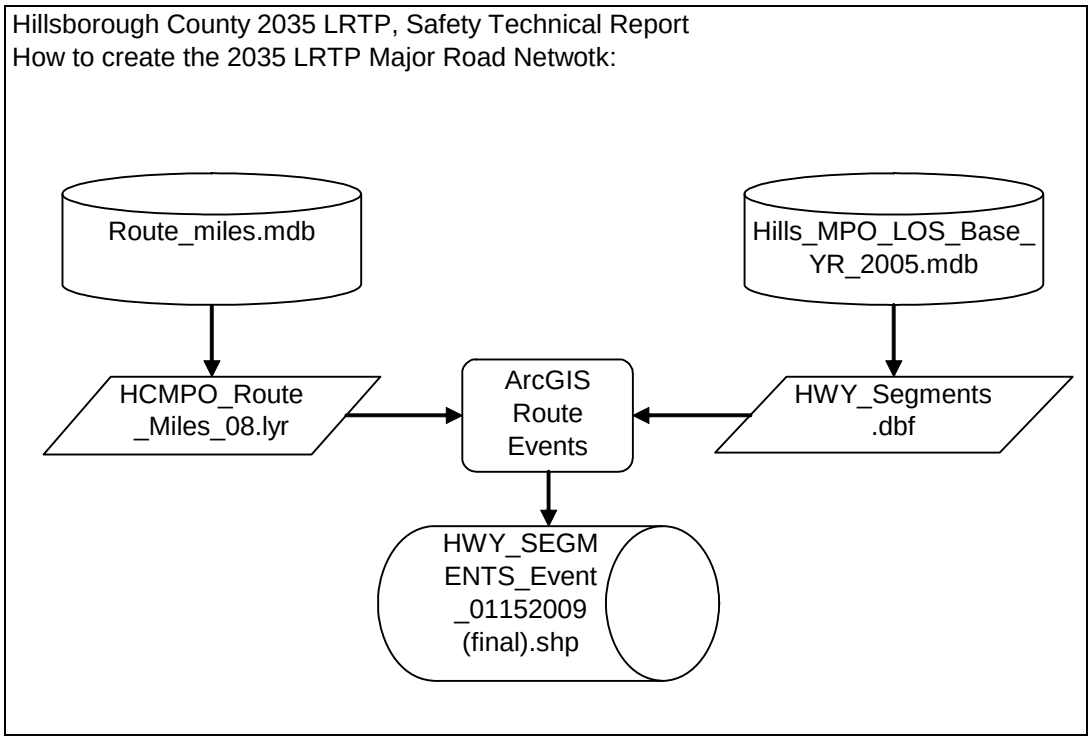
SAFETY TECHNICAL REPORT

APPENDIX

CRASH RATE METHODOLOGY

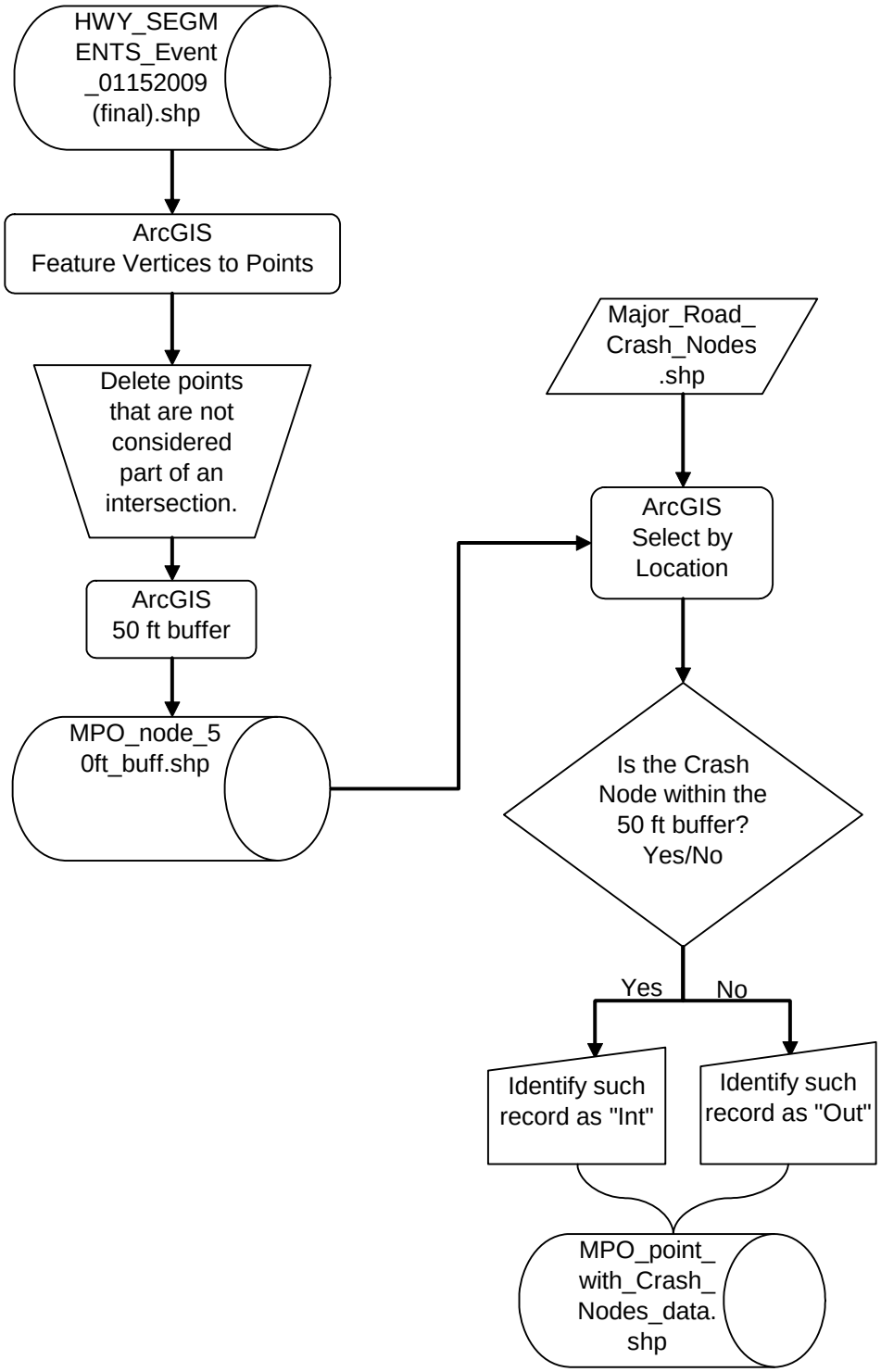
The following charts (5) depict the methodology used to conduct the crash rate analysis.

2035 LRTP Major Road Network

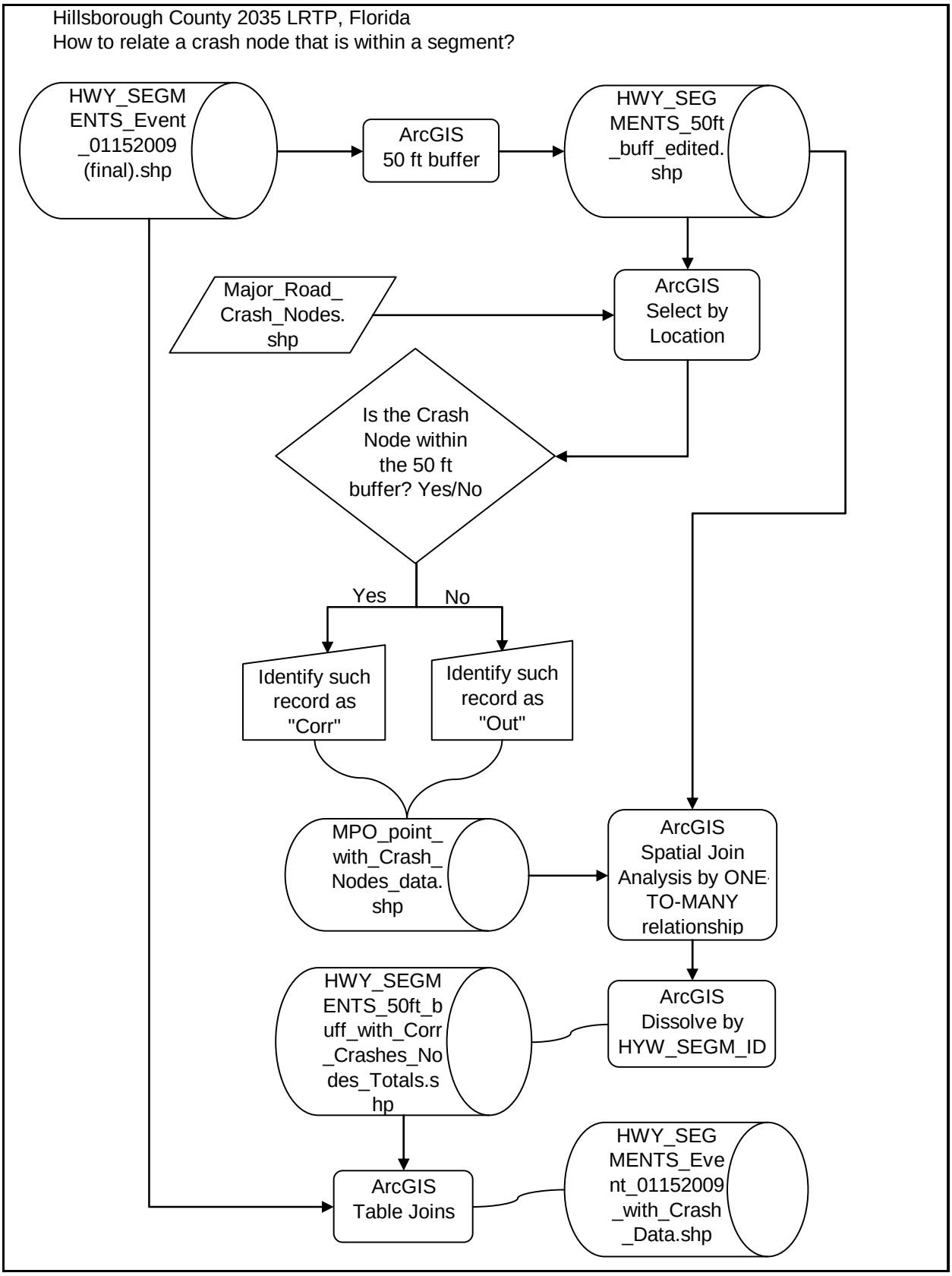


Intersection Crash Node Process

Hillsborough County 2035 LRTP, Safety Technical Report
How to determine if a crash node is within an intersesection:

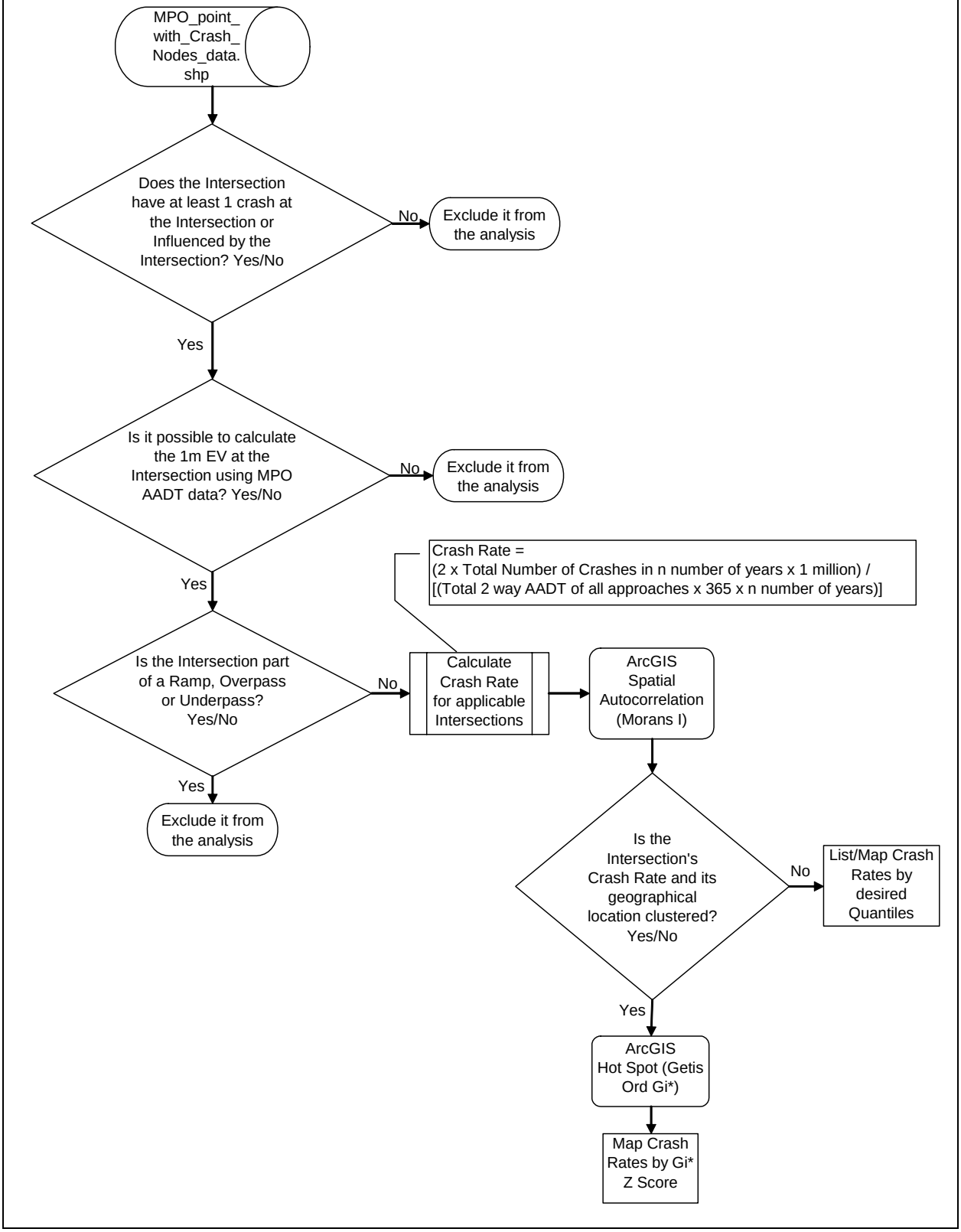


Segment Crash Node Process

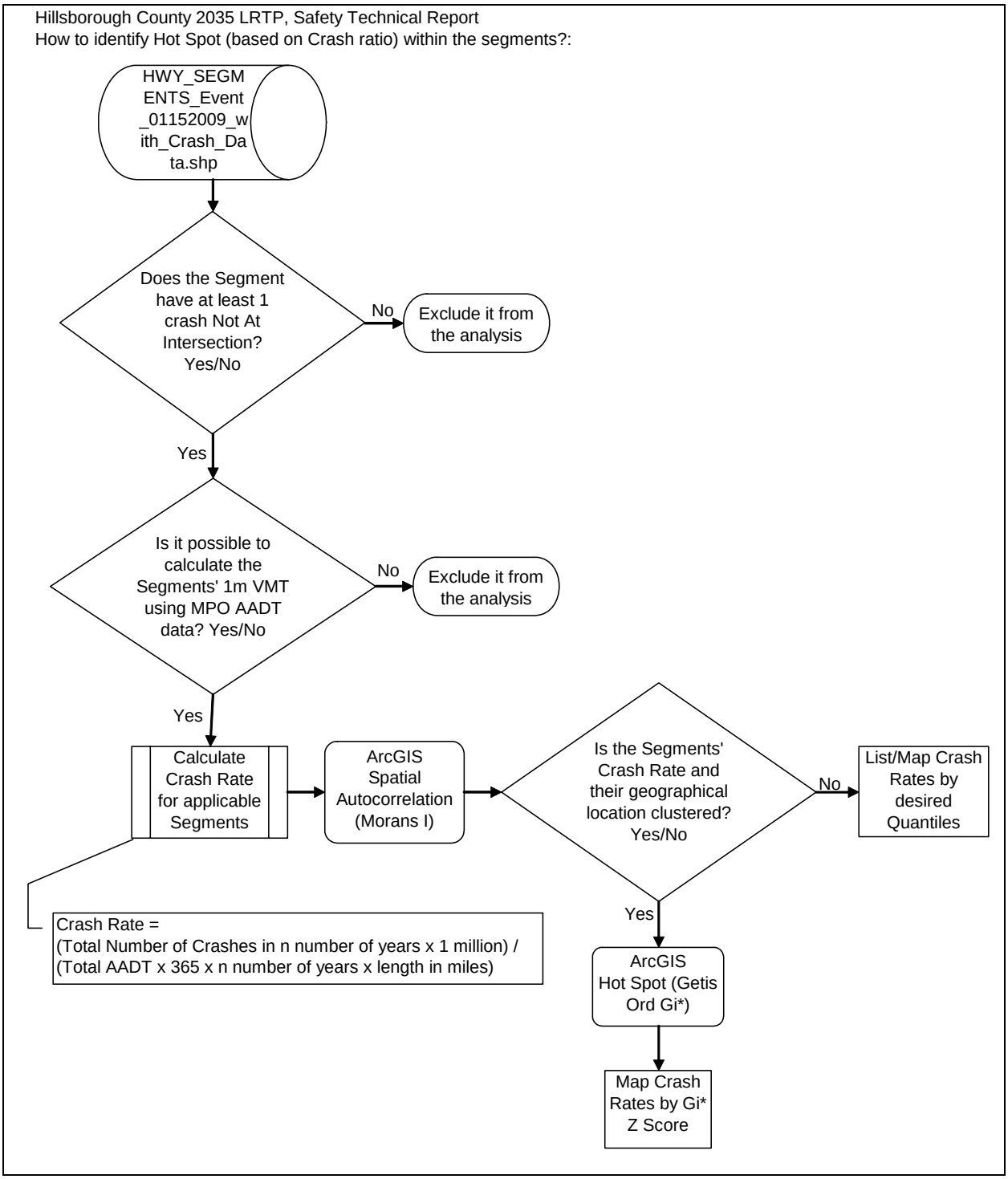


Hot Spot Identification Process, Intersections

Hillsborough County 2035 LRTP, Safety Technical Report
How to identify Hot Spot (based on Crash Ratio) within the intersesections:



Hot Spot Identification Process, Segments



Excerpted from ARCToolbox (ESRI)

How Hot Spot Analysis: Getis-Ord Gi* (Spatial Statistics) works

The Hot Spot Analysis tool calculates the Getis-Ord Gi* statistic for each feature in a weighted set of features. The G-statistic tells you whether features with high values or features with low values tend to cluster in a study area. This tool works by looking at each feature within the context of neighboring features. If a feature's value is high, and the values for all of it's neighboring features is also high, it is a part of a hot spot. The local sum for a feature and its neighbors is compared proportionally to the sum of all features; when the local sum is much different than the expected local sum, and that difference is too large to be the result of random chance, a statistically significant Z score is the result

Interpretation

The Gi* statistic is actually a Z score. For statistically significant positive Z Scores, the larger the Z score is, the more intense the clustering of high values. For statistically significant negative Z scores, the smaller the Z Score is, the more intense the clustering of low values.

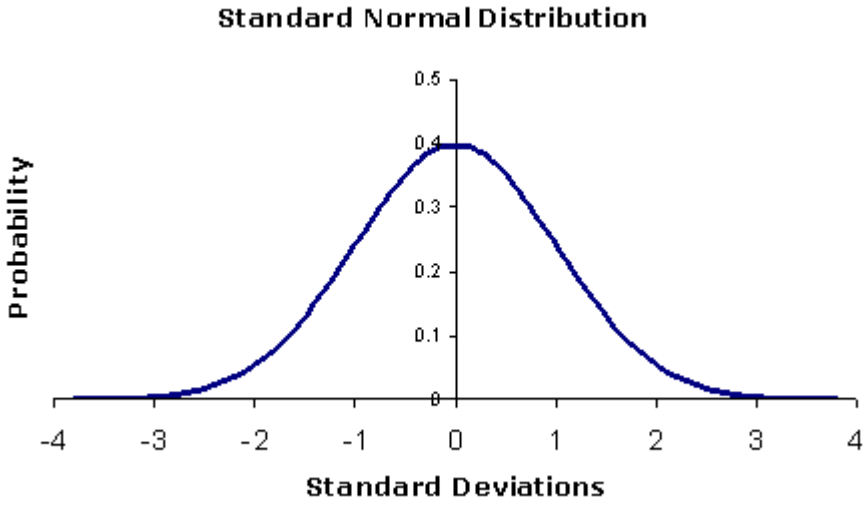
Potential Applications

Applications can be found in crime analysis, epidemiology, voting patterns, economic geography and demographics.

What is a Z Score?

Most statistical tests begin by identifying a null hypothesis. The null hypothesis for pattern analysis tools essentially states that there is no pattern; the expected pattern is one of hypothetical random chance. The Z Score is a test of statistical significance that helps you decide whether or not to reject the null hypothesis.

Z scores are measures of standard deviation. For example, if a tool returns a Z score of +2.5 it is interpreted as "+2.5 standard deviations away from the mean". Z score values are associated with a standard normal distribution. This distribution relates standard deviations with probabilities and allows significance and confidence to be attached to Z scores.



Very high or a very low Z scores are found in the tails of the normal distribution. From the graph above, it is evident that the probabilities in the tails of the distribution are very low. When you perform a feature pattern analysis and it yields either a very high or a very low Z Score, this

indicates it is very UNLIKELY that the observed pattern is some version of the theoretical spatial pattern represented by your null hypothesis.

In order to reject or accept the null hypothesis, you must make a subjective judgment regarding the degree of risk you are willing to accept for being wrong. This degree of risk is often given in terms of critical values and/or confidence level.

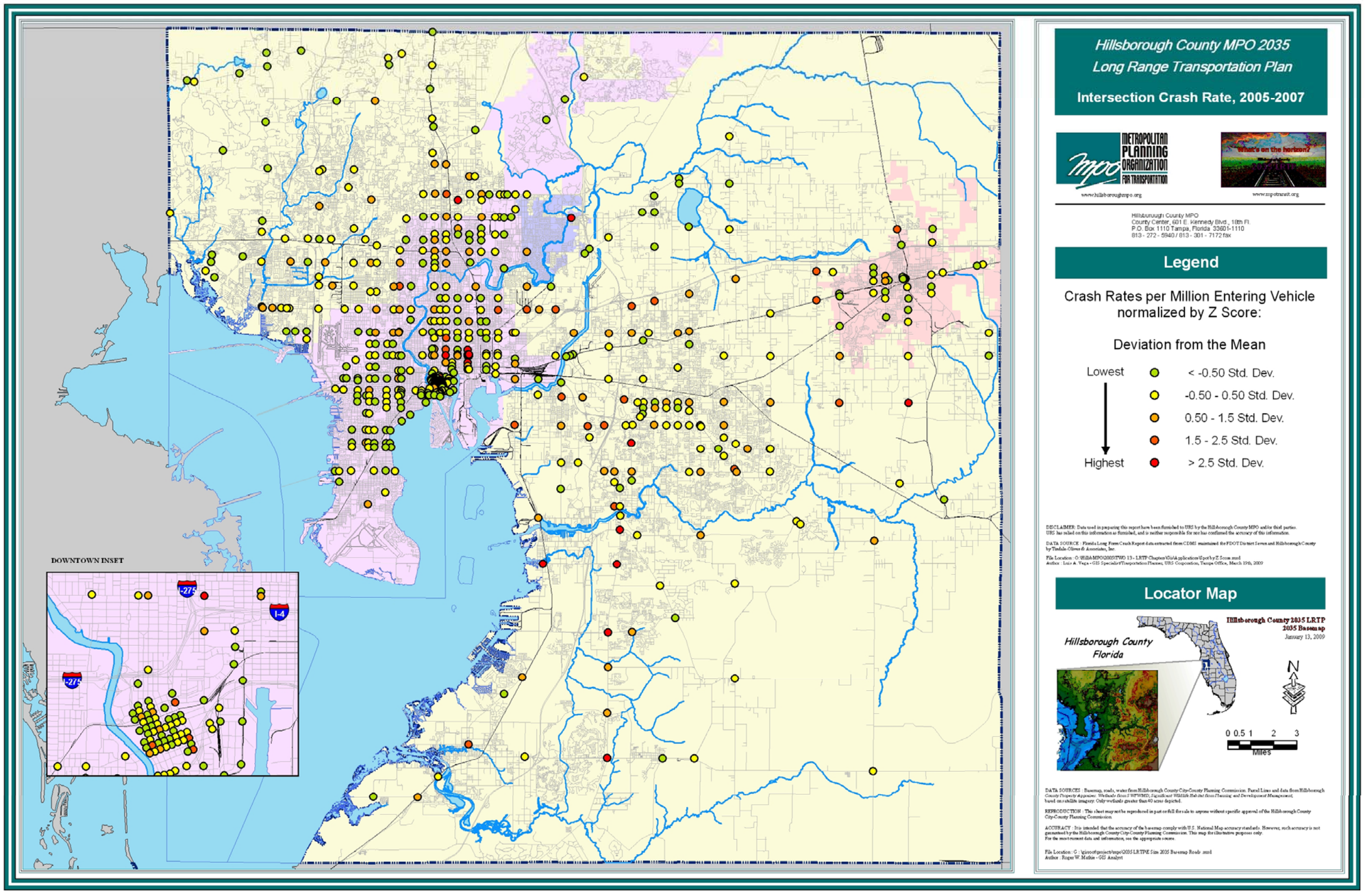
To give an example: the critical Z score values when using a 95% confidence level are -1.96 and +1.96 standard deviations. If your Z score is between -1.96 and +1.96 you cannot reject your null hypothsis; the pattern exhibited is a pattern that could very likely be one version of a random pattern. If the Z score falls outside that range(for example -2.5 or +5.4), the pattern exhibited is probably too unusual to be just another version of random chance. If this is the case, it is possible to reject the null hypothesis and proceed with figuring out what might be causing either the statistically significant clustered or statistically significant dispersed pattern.

Additional Resources:

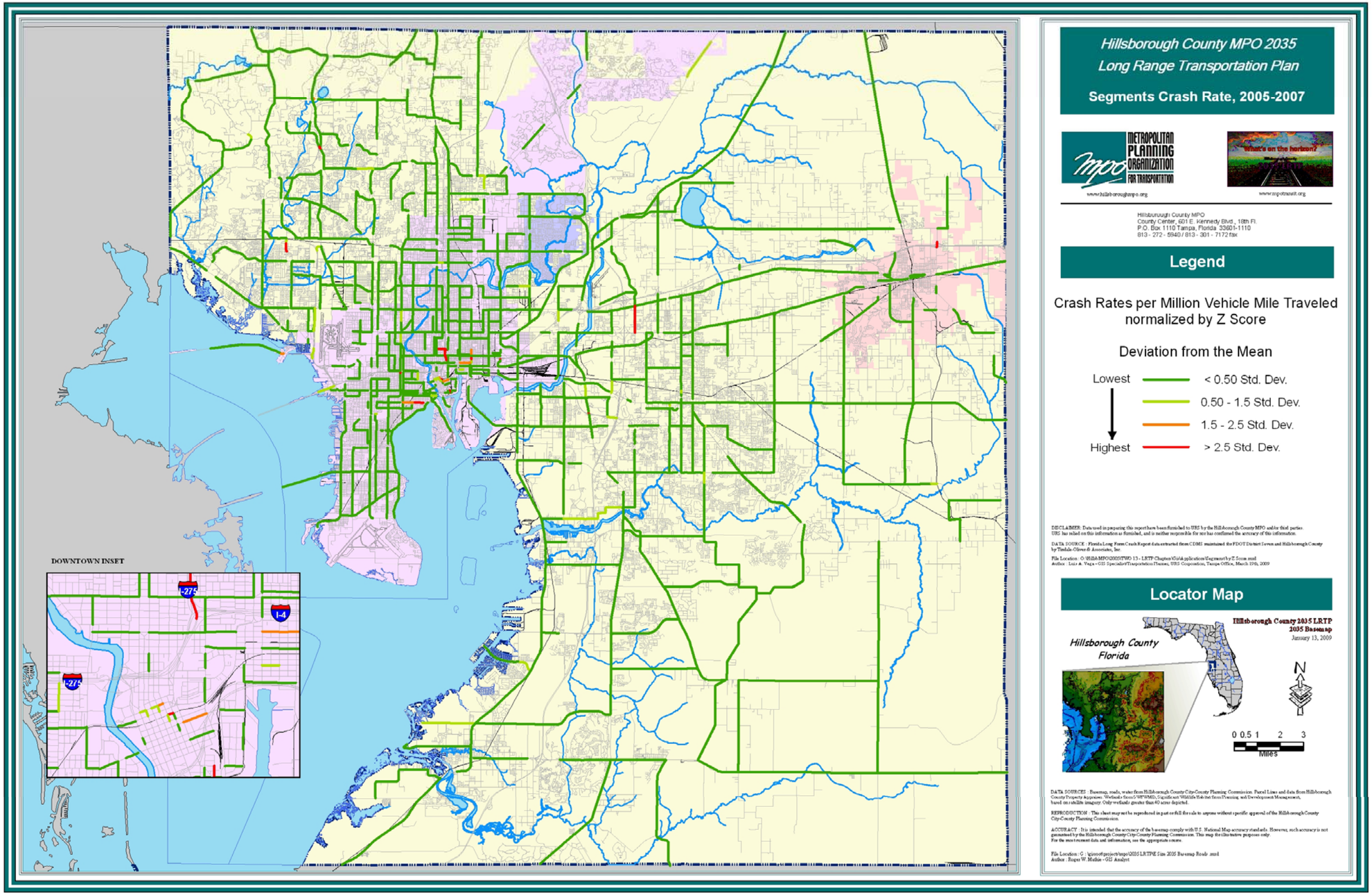
The following books and journal articles have further information about this tool.

Ebdon, David. Statistics in Geography. Blackwell, 1985.

Intersection Crash Rate Locations by Z-Score



Segment Crash Rate Locations by Z-Score



Hillsborough County MPO 2035
Long Range Transportation Plan

Segments Crash Rate, 2005-2007

Hillsborough County MPO
County Center, 601 E. Kennedy Blvd., 18th Fl.
P.O. Box 1110 Tampa, Florida 33601-1110
813 - 272 - 5940 / 813 - 301 - 7172 fax

Legend

Crash Rates per Million Vehicle Mile Traveled normalized by Z Score

Deviation from the Mean

Lowest	< 0.50 Std. Dev.
	0.50 - 1.5 Std. Dev.
	1.5 - 2.5 Std. Dev.
Highest	> 2.5 Std. Dev.

DATA SOURCE : Florida Long Form Crash Report data extracted from CDMS maintained the FDOT District Seven and Hillsborough County by Tindale-Oliver & Associates, Inc.

File Location : G:\HSB-MPO\2035STWD 13 - LRTP-Chapter3\Gis\Applications\Segments\by Z Score.mxd
Author : Luis A. Vega - GIS Specialist/Transportation Planner, URS Corporation, Tampa Office, March 19th, 2009

Locator Map

DATA SOURCES : Basemap, roads, water from Hillsborough County City-County Planning Commission. Parcel Lines and data from Hillsborough County Property Appraiser. Wetlands from SWFWMD. Significant Wildlife Habitat from Planning and Development Management, based on infrared imagery. Only wetlands greater than 40 acres depicted.

ACCURACY : It is intended that the accuracy of the basemap comply with U.S. National Map accuracy standards. However, such accuracy is not guaranteed by the Hillsborough County City-County Planning Commission. This map for illustrative purposes only. For the most current data and information, see the appropriate source.

File Location : G:\gisroot\project\mpo\2035 LRTP\E Sim 2035 Basemap Ready .mxd
Author : Roger W. Mellon - GIS Analyst

VMT Calculations for Major Road Network

3 Year Total Crash Summary Chart (within 6,986 locations in Hillsborough County MPO Network, FL)*	
Statistic	Total
Total Crashes	67,540
Fatal Crashes	431
Injury Crashes	5,143
Non-Incapacitating (Non-disable) Crashes	9,500
Possible Injury Crashes	14,153
PDO Crashes	37,744
Non-Classified Crashes	569
Total Fatalities	462
Total Injured Persons	45,765
Crashes Per 1 Million VMT	2.0284
Crashes Per 100 Million VMT	202.8365
Fatal Per 1 Million VMT	0.0139
Fatal Per 100 Million VMT	1.3875
Injury Per 1 Million VMT	1.3744
Injury Per 100 Million VMT	137.4417
Pedestrian Crashes	941
Pedestrian Per 1 Million VMT	0.0283
Pedestrian Per 100 Million VMT	2.8260
Bicycle Crashes	534
Bicycle Per 1 Million VMT	0.0160
Bicycle Per 100 Million VMT	1.6037
Commercial Vehicles Crashes	1,939

Sources: Hillsborough County Traffic Crash Data Management System (December, 2008), URS Corporation, Tampa Office and Hillsborough County MPO.

* MPO Network as of 2008.

MPO length =	1,438.21
MPO AADT =	48,673,479
SUM MPO AADT*Length (in ArcGIS) =	30,408,909.41
Average MPO AADT Weighted by the Segment's Length =	21,143.52
MPO VMT in 3 years =	33,297,755,809.16

Formula Used:
Average AADT Weighted by the Length of the Segment = Sum (MPO AADT * Length) / Sum (MPO Length).
MPO VMT in 3 years = AADT(length) * (MPO Length) * 3 * 365