CAPE COD COMMISSION

Barnstable County High Crash Locations

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on behalf of the

CAPE COD METROPOLITAN PLANNING ORGANIZATION:

Massachusetts Department of Transportation
Cape Cod Regional Transit Authority • Cape Cod Commission
Barnstable County • Town of Barnstable
Towns of Bourne, Sandwich, Falmouth & Mashpee
Towns of Yarmouth, Dennis, Harwich, Brewster & Chatham
Towns of Orleans, Eastham, Wellfleet, Truro & Provincetown

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CAPE COD COMMISSION

Table of Contents

List of Figures

List of Tables

Introduction

CAPE COD COMMISSION

GOALS AND OBJECTIVES

This report is the result of the Cape Cod Commission's effort to identify the most dangerous intersections in Barnstable County. The data used for this endeavor, including crashes that occurred in 2006, 2007, or 2008, are the most recent available from the Massachusetts Department and Transportation (MassDOT) and local police departments from Barnstable County.

Through the analysis of our data, a series of top crash location lists have been generated. The lists will assist in directing federal, state, and local funds towards improving intersections that pose the highest safety risk to its users. It is anticipated that this information will be useful to local police departments who have the resources and ability to reduce speed and unsafe driving through enforcement. It is the Commission's hope that this document will highlight the need for accurate and comprehensive reporting between the fifteen Barnstable County towns and state agencies. Beyond serving as support for improvement funds, this report will also help focus future safety studies on the locations with most need.

TOP CRASH LISTS

There are several methodologies that can be used to generate a list of top crash locations for a given geographic area. Two common methods include sorting by total crashes that occurred during a specified time in history and sorting by crashes per one million entering vehicles (also known as a crash rate). Two other frequently used methods involve weighting each crash according to its severity (whether it included an injury or fatality). Each method has advantages and disadvantages. Using total crash numbers or a crash rate is simpler, and needs less information to use. Using crash severity can be helpful to highlight an intersection with few but severe crashes. Using a rate against a dataset further refines the number of crashes or severity of an area. Each methodology will be discussed in further detail later in this report.

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This report includes four high crash lists that identify the most dangerous intersections based on four different focuses.

DATA SOURCE

MASSDOT DATA

The initial data source, and the general foundation for this report, is the Crash Data Cluster Analysis provided by MassDOT for 2006-2008. This data are the end result of a series of data sharing procedures between citizens, local police departments, the Massachusetts Registry of Motor Vehicles (RMV), and MassDOT. If an individual is involved in a crash that results in $1,000 damage or injury, they are required to fill out a Motor Vehicle Crash Operator Report and mail copies to the local police department and the RMV. Also, local and state police officers will respond to many crashes located in their jurisdiction, and their subsequent reports will be sent to the RMV. The RMV will compile the data and input all available information from the reports into a large database. This database is then shared with MassDOT. MassDOT is then able to use geolocating tools in Geographic Information System (GIS) software to identify the locations of each crash. The resultant output of crash clusters in the basis for our analysis.

Unfortunately, this geolocating approach by MassDOT is only the minimum number of crashes at any given location. Of the 12,001 records sent to MassDOT from the RMV for 2006-2008, 9,220 locations were located (76.8%). Non-located crashes are typically the result of poor location identification in the written crash reports.

LOCAL DATA

In an effort to create a more robust dataset, the Commission solicited the police department of each Barnstable County town for crash statistics on their most dangerous intersections. There is a wide range between towns in terms of their ability to produce this data. In total, the Commission received top crash lists and the supporting data from ten of fifteen towns.

DATA ANALYZED

MASSDOT DATA

The data provided by MassDOT is far more comprehensive than the additional data provided by local sources. Each crash cluster is accompanied with information regarding the number of crashes – specifying number of fatal, injurious, and property damage only crashes. The inclusion of the information concerning severity allows for the calculation of an intersection's Equivalent Property Damage Only (EPDO). EPDO is a value created by weighting each crash based on its severity and then aggregating the totals. In this system, a crash that results in property damage only is assigned a value of one. A crash that includes an injury (while not including a fatality) is assigned a value of five. A fatal crash is assigned a value of ten.

Example: During a three year span, an intersection has twelve crashes with property damage only, four crashes including an injury, and two fatal crashes. For this three-year period, this intersection would have an EPDO of 52 ([12x1]+[4x5]+[2x10]).

From the 9,220 located crashes, 1,364 crash clusters were identified. A cluster is a grouping of at least two crashes at a specific location. For the purposes of the Commission's analysis, data from more than one cluster at a single intersection were sometimes aggregated. It is rare that a single approach to an intersection would be investigated without attention to the other aspects of the intersection, which is why some intersections have more than one cluster.

The following figure depicts the 9,220 located crashes in Barnstable County from 2006 to 2008. There are high densities of crashes in the Mid-Cape and Canal areas.

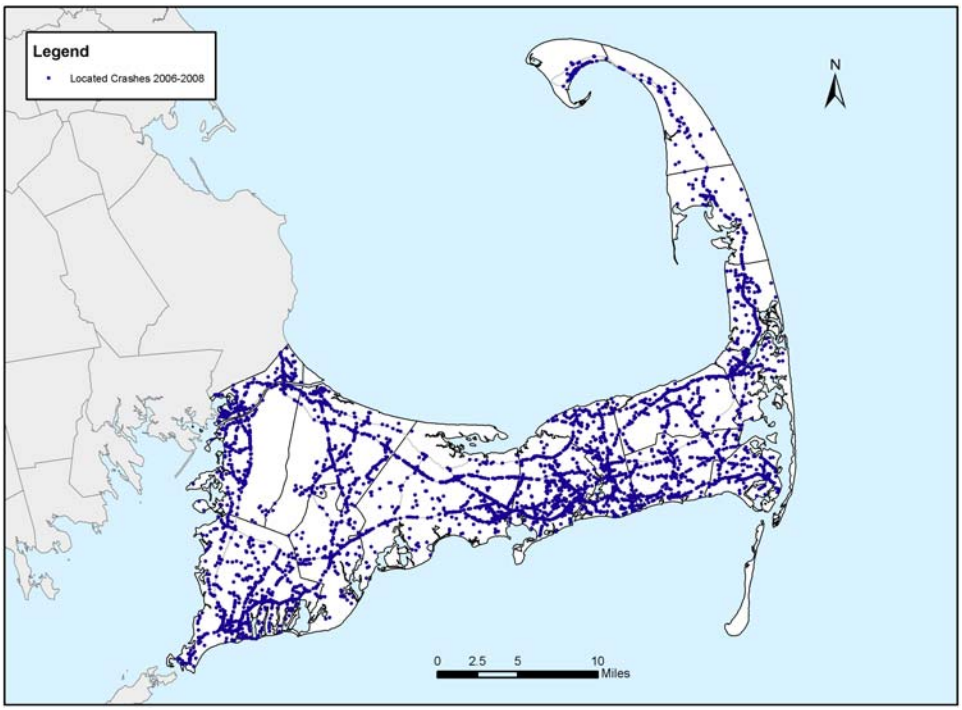

FIGURE 1: BARNSTABLE COUNTY LOCATED CRASHES, 2006-2008

LOCAL DATA

The Commission contacted each local police department in Barnstable County with a request for their town's high crash locations. Of the fifteen police departments, eleven use IMC Solutions crash data storage software, two use PAMET Software, one uses Microsystems, and one department does not have software to store crash data. Due to the differences in software, not all returns were equal in their comprehensiveness.

No department was able to provide the severities of crashes for their high crash lists. The information from local data is limited to the number of crashes per intersection. Without severity information, the local data could only bolster the data that were being used in creating the lists that use crash numbers and not EPDO. It should be noted, there are significant differences in the number of crashes at intersections as reported by MassDOT versus the local police departments.

Analysis

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TOP CRASH LISTS

TOP LOCATIONS BASED ON NUMBER OF CRASHES

The simplest method used in this report for establishing a high crash list is ranking intersections based on the largest number of crashes. The number of crashes for each intersection came from one of two sources (MassDOT and/or local police department). This report does not identify one source as being more reliable than the other. Therefore, in the case of an intersection having two different crash numbers, the larger number is used. The intersection with the greatest number of crashes receives the number one ranking.

TOP LOCATIONS BASED ON EQUIVALENT PROPERTY DAMAGE ONLY

The inclusion of severity information in the MassDOT data allows for the calculation of Equivalent Property Damage Only (EPDO). A list ranked by EPDO will bring more attention to locations where the accidents have produced injuries or fatalities. The formula for calculating EPDO is as follows:

EPDO = 10 x (# fatal crashes) + 5 x (# injury crashes) + property damage only crashes

While the EPDO method is useful in identifying intersections with the most severe crashes, it should be noted that not all crashes and their resultant injuries can be attributed to a road's conditions or geometry. For example, it could be a passenger's decision of whether or not to wear a seatbelt that determines whether an injury will be experienced. The intersection with the highest EPDO in this list is ranked number one.

TOP LOCATIONS BASED ON CRASH RATE

It is expected that a road with higher traffic volumes will experience more vehicles crashes. Using a crash rate helps to avoid highlighting

intersections whose problems may be magnified by a large traffic volume. With this methodology, the number of crashes is compared to the number of vehicles entering, and the resultant figure is in terms of crashes per million entering vehicles. To be certain to capture the top fifty crash locations based on crash rate, the top 100 intersections based on number of crashes were analyzed with the following formula:

$$R = ([C/Y] \times 1{,}000{,}000)/(V \times 365)$$

R = Crash Rate, C = Total Crashes, Y = # Years Analyzed, V = Daily Entering Volume

While this method is good for reducing the influence of high volume roads, it also has the capacity to rank a very low volume road with few crashes very highly. The intersection with the highest crash rate in this list is ranked number one. Note, the crash numbers in this list and the Crash Number Basis list come from both MassDOT and local police department sources.

TOP LOCATIONS BASED ON EPDO RATE

This method uses the same theory as the crash rate, where there is an assumption that heavily traveled roads are expected to have higher EPDO designations, and it is not necessarily indicative of poor road conditions or geometric flaws. To create this list, the intersections' EPDO is compared to the number of vehicles entering, and the resultant figure is in terms of crashes per million entering vehicles. To be certain to capture the top fifty crash locations based on EPDO rate, the top 100 locations with the highest EPDO were analyzed with the following formula:

$$\text{EPDO Rate} = ([\text{EPDO}/Y] \times 1{,}000{,}000)/(V \times 365)$$

Y = # Years Analyzed, V = Daily Entering Volume

The intersection with the highest EPDO rate in this list is ranked number one. Also note, the data analyzed in this list and the EPDO Basis list is strictly from MassDOT data.

TRAFFIC VOLUME DATA

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CAPE COD COMMISSION TRAFFIC COUNTING PROGRAM

To determine the crash rate and the EPDO rate, traffic volume data were needed to calculate a daily entering volume for each intersection. Base traffic data were taken from counts conducted by the Cape Cod Commission adjusted to the year 2009 (as found on www.gocapecod.org/counts). Using the Commission's Traffic Count Growth Management System (TCGMS) Excel macro, the Commission identified 2009 traffic volumes to be merely 0.4% less than 2006 traffic volumes and are therefore suitable for analysis with 2006-2008 crash data. The 2009 estimates are available for any traffic count that has been conducted in 2003 or later. Factors for adjustment are generated from year to year analysis of Commission counts.

CAPE COD REGIONAL MODEL

With all approaches to over 100 intersections included in the analysis, it was not possible to use solely actual traffic counts to estimate entering volumes. As a compliment to the Commission count data, volumes generated from the Cape Cod Regional Model were used. The model was last modified in 2006, using 2006 volumes as the base. Due to the minimal overall change in county-wide traffic volume between 2006 and 2009, the model's volumes were deemed comparable to the 2009 volume estimates.

TRIP GENERATION HANDBOOK

Several intersections in need of investigation included an approach from a commercial or institutional establishment where traffic data were not available from the Commission count database or the regional model. Using Trip Generation, 8th Edition from the Institute of Transportation Engineers, traffic volumes were estimated for those legs.

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ENTERING VOLUME CALCULATION

The daily entering volume is calculated as an average annual daily volume. Since the majority of Commission-conducted traffic counts take place in the summer months, an appropriate seasonal factor (dependent on the month and year) is applied to achieve the annual average. Likewise, the results from the regional model are annual averages. Annual averages were deemed appropriate for use since the crash data covers all twelve months.

The formula for calculating the daily entering volume for an intersection consist of aggregating the average annual daily traffic (AADT) for each leg of the intersection, then dividing that total by two.

Limitations

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STATE DATA COLLECTION

With an average of over 100,000 crashes per year statewide, it is difficult to report and locate all incidents accurately. To address the inefficiencies, in 2001, MassHighway (MassDOT's precursor) and the RMV made several significant changes to the crash reporting process. Their intent was to make the process more efficient and reduce the time it takes for information to reach the state offices. The changes that took place included new forms and new data input systems.

Cape-wide yearly crash averages had a significant change since the new reporting system was put in place. In the three years leading up to the change (1999, 2000, and 2001), Barnstable County averaged 5,174 crashes per year. In the following three years, the county averaged 3,928 crashes per year (a 24% reduction). Of the fifteen towns, only two towns averaged more crashes following the reporting changes. Three towns averaged less than 50% of their pre-change crash average.

One-year crash averages for the four years from 2005 to 2008 remained equally below the pre-change average (4,101, or 79%). Not enough evidence exists to determine if this is a direct result of the change in reporting. It is possible crashes have indeed been reduced since 2001. It should be noted that Cape-wide traffic has reduced by about 10% between 2001 and 2008.

In the latter part of this decade, some towns have shown sizable increases in crash numbers from one year to another. This is often the result of a local police department's change to an electronic crash reporting system (where crash reports are sent electronically to the RMV, rather than by physical paper copies). Electronic crash reporting has proved to be a more efficient method. Of the fifteen Barnstable County towns, six currently report records electronically.

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LOCAL CRASH DATA

In an effort to bolster the state-provided crash data, the Cape Cod Commission contacted the local police department from each town in Barnstable County, seeking a listing of their top crash locations (and supporting data). While the locations were often similar to the locations highlighted by MassDOT, the crash numbers were rarely similar. Unfortunately, there was not a pattern of all town data being less than the state's or vice versa. In some towns, the same top fifteen locations, as reported by the town, would be twice as high as the numbers reported by the state for those same locations. In other towns, the state data was reported twice as high.

There are several possible reasons for discrepancies in the data. First, many motorists involved in a crash will not notify the local police if injury or major damage are not involved (although they may submit a crash record to the state). Secondly, some police departments send the RMV all of their records, where some send only crashes involving at least $1,000 damage or injury. Third, many crashes on roads under State Highway jurisdiction will be handled by State Police personnel, and the reports will never arrive at the local departments. Lastly, some crash reports sent to the RMV are filled out inaccurately or lacking essential location data – making it impossible to be included in the geolocated database.

In light of these inconsistencies, the Commission assumed each data source represented at least the minimum number of accidents for each location. If a location had two crash numbers – meaning one from each source – the greater number was chosen for analysis in the crash number and crash rate lists.

High Crash Location Lists

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Top Locations based on Number of Crashes
Top Locations based on Equivalent Property Damage Only
Top Locations based on Crash Rate
Top Locations based on EPDO Rate

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TOP LOCATIONS BASED ON NUMBER OF CRASHES

Rank	Intersection	Town	Crash #
1	Route 6 (Mid-Cape Highway) @ Route 132 (Iyannough Road) - Exit 6_{1}	Barnstable	128
2	Route 6 (Mid-Cape Highway) @ Route 134 (East West Dennis Road) - Exit 9_{2}	Dennis	99
3	Otis Air Force Base Rotary @ Rt 28 / Sandwich Rd / Connery Ave_{3}	Bourne	88
4	Route 6 (Mid-Cape Highway) @ Willow Street - Exit 7_{4}	Yarmouth	86
5	Route 6 (Mid-Cape Highway) @ Route 149 (Prospect Street) - Exit 5_{5}	Barnstable	83
6	Route 6 (Mid-Cape Highway) @ Station Avenue - Exit 8_{32}	Yarmouth	78
7	Route 6 (Mid-Cape Highway) @ Route 130 (Forestdale Road) - Exit 2_{6}	Sandwich	73
8	Bourne Rotary @ Rt 28 / Sandwich Rd / Trowbridge Rd_{33}	Bourne	71
9	Route 25 @ Bourne Bridge	Bourne	68
10	Route 28 (Falmouth Road) @ Bearses Way_{7}	Barnstable	60
11	Route 28 (Falmouth Road) @ Route 149 (Prospect $Street)_{8}$	Barnstable	56
12	Route 6 (Mid-Cape Highway) @ Chase Rd - Exit 4	Sandwich	55
13	Belmont Rotary @ Rt 28 / Rt 6 / Rt 6 Bypass / Head of the Bay Rd_{34}	Bourne	54
14	Route 28 (Falmouth Road) @ South County $Road_{10}$	Barnstable	52
15	Route 28 (Iyannough Road) @ Yarmouth $Road_{11}$	Barnstable	48
16	Route 134 (East West Dennis Road) @ Upper County $Road_{12}$	Dennis	44
16	Route 6 (Mid-Cape Highway) @ Route 124 (Pleasant Lake Avenue) - Exit 10	Harwich	44
16	Route 6 (Mid-Cape Highway) @ Quaker Meeting House Rd - Exit 3	Sandwich	44
19	Route 28 (Falmouth Road) @ Osterville West Barnstable Road	Barnstable	43
19	Route 132 (Iyannough Road) @ Shoot Flying Hill $Road_{14}$	Barnstable	43
21	Airport Rotary @ Rt 132 / Rt 28 EB/WB / Barnstable Rd_{15}	Barnstable	42
22	Route 132 (Iyanough Road) @ Phinneys $Lane_{16}$	Barnstable	40
23	Route 132 (Iyannough Road) @ Independence Road / Enterprise $Road_{17}$	Barnstable	36
24	Eastham Rotary @ Rt 6A/28 / Rt 6, Smith Ln_{18}	Eastham	35
24	Route 28 @ Route 151 (Nathan Ellis Highway)	Falmouth	35
24	Route 28 (Falmouth Road) @ Old Stage $Road_{19}$	Barnstable	35
27	Route 28 (Chatham Road) @ Route 6A (Cranberry $Highway)_{20}$	Orleans	33
28	Mashpee Circle @ Rt 28 / Rt 151 / Great Neck Rd_{35}	Mashpee	32
29	Route 28 (Falmouth Road) @ Pitchers Way	Barnstable	31
29	Route 28 (Falmouth Road) @ Lincoln Road	Barnstable	31
31	Sandwich Road @ Adams Street	Bourne	30
32	Route 134 (East West Dennis Road) @ Market Place	Dennis	27
33	Theophilus F. Smith Road @ Cumberland Farm / Patriot Square SD	Dennis	25
33	Route 6A (Sandwich Road) @ Sagamore Bridge Connector	Bourne	25
33	Route 28 (Main St / Iyannough Rd) @ East Main $Street_{21}$	Yarmouth	25
36	Route 28 (Falmouth Road) @ Phinneys $Lane_{22}$	Barnstable	24
36	Route 151 (Nathan Ellis Highway) @ Sandwich Road	Falmouth	24
36	Route 28 (Main Street) @ Depot Street	Dennis	24
36	Route 28 (Main Street) @ Route 134 / Swan River $Road_{23}$	Dennis	24
40	Route 6 WB Off ramp @ Route 6 (Scenic Highway)	Bourne	22
40	Route 6 (GAR Hwy) @ Brackett Road / Old County $Road_{24}$	Eastham	22
40	Route 6 (Mid-Cape Highway) @ Route 6A (Cranberry Highway) - Exit 12	Orleans	22
40	Route 6 (Mid-Cape Highway) @ Route 137 (Long Pond Road) - Exit 11_{25}	Harwich	22
40	Station Avenue @ Whites $Path_{26}$	Yarmouth	22
45	Buck Island Road @ West Yarmouth Road	Yarmouth	20
45	Sandwich Road @ Brick Kiln Road	Falmouth	20
45	Station Avenue @ Old Town House Road	Yarmouth	20
45	Route 130 (Forestdale Road) @ Cotuit Road	Sandwich	20
49	Main Street @ Tonset Road	Orleans	19
49	Spring Bars Road @ Worcester Court	Falmouth	19
49	Route 28 (Teaticket Highway) @ Stop and Shop SD	Falmouth	19
49	Route 134 (East West Dennis Road) @ Bob Crowell Rd / Hemlock Ln / Agway SD	Dennis	19

Source: MassDOT 2006-2008 Crash Data and Towns of Barnstable County

TOP LOCATIONS BASED ON EQUIVALENT PROPERTY DAMAGE ONLY

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Rank	Intersection	Town	Crash #	EPDO
1	Route 6 (Mid-Cape Highway) @ Route 132 (Iyannough Road) - Exit 6_{1}	Barnstable	128	314
2	Route 6 (Mid-Cape Highway) @ Willow Street - Exit 7_{4}	Yarmouth	86	204
3	Route 6 (Mid-Cape Highway) @ Route 134 (East West Dennis Road) - Exit 9_{2}	Dennis	99	187
3	Route 6 (Mid-Cape Highway) @ Route 149 (Prospect Street) - Exit 5_{5}	Barnstable	83	187
5	Route 6 (Mid-Cape Highway) @ Station Avenue - Exit 8_{32}	Yarmouth	78	182
6	Otis Air Force Base Rotary @ Rt 28 / Sandwich Rd / Connery Ave_{3}	Bourne	88	172
7	Route 25 @ Bourne Bridge	Bourne	68	148
8	Route 6 (Mid-Cape Highway) @ Route 130 (Forestdale Road) - Exit 2_{6}	Sandwich	73	145
9	Route 6 (Mid-Cape Highway) @ Chase Rd - Exit 4	Sandwich	55	128
10	Bourne Rotary @ Rt 28 / Sandwich Rd / Trowbridge Rd_{33}	Bourne	71	115
11	Belmont Rotary @ Rt 28 / Rt 6 / Rt 6 Bypass / Head of the Bay Rd_{34}	Bourne	54	110
12	Route 6 (Mid-Cape Highway) @ Quaker Meeting House Rd - Exit 3	Sandwich	44	104
13	Route 134 (East West Dennis Road) @ Upper County $Road_{12}$	Dennis	44	100
14	Route 6 (Mid-Cape Highway) @ Route 124 (Pleasant Lake Avenue) - Exit 10	Harwich	44	96
15	Mashpee Circle @ Rt 28 / Rt 151 / Great Neck Rd_{35}	Mashpee	32	80
16	Eastham Rotary @ Rt 6A/28 / Rt 6, Smith Ln_{18}	Eastham	35	75
17	Route 151 (Nathan Ellis Highway) @ Sandwich Road	Falmouth	24	73
18	Route 28 @ Route 151 (Nathan Ellis Highway)	Falmouth	35	71
19	Route 6 (Mid-Cape Highway) @ Route 6A (Cranberry Highway) - Exit 12	Orleans	22	70
19	Airport Rotary @ Rt 132 / Rt 28 EB/WB / Barnstable Rd_{15}	Barnstable	42	70
21	Route 6 (GAR Hwy) @ Brackett Road / Old County $Road_{24}$	Eastham	22	62
22	Route 6A (Sandwich Road) @ Sagamore Bridge Connector	Bourne	25	58
23	Theophilus F. Smith Road @ Cumberland Farm / Patriot Square SD	Dennis	25	57
24	Route 6 (Mid-Cape Highway) @ Route 137 (Long Pond Road) - Exit 11_{25}	Harwich	22	54
25	Buck Island Road @ West Yarmouth Road	Yarmouth	20	52
25	Route 28 (Main Street) @ Depot Street	Dennis	24	52
25	Route 28 (Falmouth Road) @ Bearses Way_{7}	Barnstable	24	52
28	Sandwich Road @ Adams Street	Bourne	30	50
28	Route 28 (Teaticket Highway) @ Figuerido Way	Falmouth	18	50
30	Buck Island Road @ Higgins Crowell Road	Yarmouth	17	49
31	Great Neck Road North @ Old Barnstable $Road_{27}$	Mashpee	12	48
32	Route 28 (Teaticket Highway) @ Stop and Shop SD	Falmouth	19	47
33	Route 28 (Falmouth Road) @ Route 149 (Prospect $Street)_{8}$	Barnstable	22	46
34	Route 28 (Main St / Iyannough Rd) @ East Main $Street_{21}$	Yarmouth	25	45
35	Station Avenue @ Old Town House $Road_{31}$	Yarmouth	20	44
35	Route 151 (Nathan Ellis Highway) @ Old Barnstable Road	Mashpee	12	44
35	Route 6A (Cranberry Highway) @ Eldredge Park Way	Orleans	16	44
38	Main Street @ Tonset Road	Orleans	19	43
39	Station Avenue @ Wood Road	Yarmouth	18	42
39	Route 28 (Falmouth Road) @ Osterville West Barnstable Road	Barnstable	14	42
41	Route 132 (Iyannough Road) @ Independence Road / Enterprise $Road_{17}$	Barnstable	12	41
42	Rt 39 (Orleans Harwich Road) @ Pleasant Bay Road	Harwich	15	40
42	Forest Road @ Winslow Gray Road	Yarmouth	15	40
44	Route 6 WB Off ramp @ Route 6 (Scenic Highway)	Bourne	22	38
44	Sandwich Road @ Brick Kiln Road	Falmouth	10	38
44	Route 134 (East West Dennis Road) @ Airline Road	Dennis	14	38
44	Route 28 (Falmouth Road) @ Pitchers Way	Barnstable	10	38
48	Route 6A (Cranberry Highway) @ Union Street / Old Church Street	Yarmouth	13	37
48	Route 28 (Falmouth Road) @ South County $Road_{10}$	Barnstable	13	37
48	Route 132 (Iyanough Road) @ Phinneys $Lane_{16}$	Barnstable	17	37

Source: MassDOT 2006-2008 Crash Data

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TOP LOCATIONS BASED ON CRASH RATE

Rank	Intersection	Town	Crash #	Crash Rate
1	Otis Air Force Base Rotary @ Rt 28 / Sandwich Rd / Connery Ave$_{3}$	Bourne	88	2.73
2	Rt 39 (Orleans Harwich Road) @ Pleasant Bay Road	Harwich	17	2.32
3	Route 6 (Mid-Cape Highway) @ Route 134 (East West Dennis Road) - Exit 9$_{2}$	Dennis	99	2.16
4	Route 28 (Falmouth Road) @ Route 149 (Prospect Street)$_{8}$	Barnstable	56	2.14
5	Route 124 (Harwich Road) @ Tubman Road$_{36}$	Brewster	12	2.07
6	Theophilus F. Smith Road @ Cumberland Farm / Patriot Square SD	Dennis	25	2.04
7	Route 28 (Falmouth Road) @ South County Road$_{10}$	Barnstable	52	2.03
8	Station Avenue @ Wood Road	Yarmouth	18	1.95
9	Route 6 (Mid-Cape Highway) @ Route 132 (Iyannough Road) - Exit 6$_{1}$	Barnstable	128	1.78
10	Route 28 (Falmouth Road) @ Bearses Way$_{7}$	Barnstable	60	1.77
11	Spring Bars Road @ Worcester Court	Falmouth	19	1.73
11	Cotuit Road @ Harlow Road$_{28}$	Sandwich	17	1.73
13	Route 6A (Sandwich Road) @ Sagamore Bridge Connector	Bourne	25	1.71
14	Sandwich Road @ Adams Street	Bourne	30	1.64
15	Route 6 WB Off ramp @ Route 6 (Scenic Highway)	Bourne	22	1.61
16	Route 28 (Falmouth Road) @ Osterville West Barnstable Road	Barnstable	43	1.53
16	Route 28 (Chatham Road) @ Route 6A (Cranberry Highway)$_{20}$	Orleans	33	1.53
18	Route 132 (Iyannough Road) @ Shoot Flying Hill Road$_{14}$	Barnstable	43	1.52
19	Route 6 (Mid-Cape Highway) @ Station Avenue - Exit 8$_{32}$	Yarmouth	78	1.49
19	Route 134 (East West Dennis Road) @ Upper County Road$_{12}$	Dennis	44	1.49
21	Main Street @ Tonset Road	Orleans	19	1.43
22	Route 6 (Mid-Cape Highway) @ Willow Street - Exit 7$_{4}$	Yarmouth	86	1.42
23	Route 25 @ Bourne Bridge	Bourne	68	1.39
24	Route 6 (Mid-Cape Highway) @ Route 149 (Prospect Street) - Exit 5$_{5}$	Barnstable	83	1.38
24	Route 28 (Iyannough Road) @ Yarmouth Road	Barnstable	48	1.38
24	Belmont Rotary @ Rt 28 / Rt 6 / Rt 6 Bypass / Head of the Bay Rd$_{34}$	Bourne	54	1.38
27	Route 28 (Main Street) @ Depot Street	Dennis	24	1.33
28	Buck Island Road @ West Yarmouth Road	Yarmouth	20	1.30
28	Sandwich Road @ Brick Kiln Road	Falmouth	20	1.30
30	Route 28 (Falmouth Road) @ Pitchers Way	Barnstable	31	1.29
31	Route 6 (Mid-Cape Highway) @ Route 124 (Pleasant Lake Avenue) - Exit 10	Harwich	44	1.23
32	Route 6 (Mid-Cape Highway) @ Route 130 (Forestdale Road) - Exit 2$_{6}$	Sandwich	73	1.21
32	Bourne Rotary @ Rt 28 / Sandwich Rd / Trowbridge Rd$_{33}$	Bourne	71	1.21
34	Route 28A (Sandwich Road) @ County Road	Bourne	10	1.19
35	Depot Street @ Center Street	Harwich	9	1.17
36	Old Town House Road @ Forest Road$_{29}$	Yarmouth	15	1.12
37	Depot Street @ Center Street	Dennis	9	1.10
38	Great Neck Road North @ Old Barnstable Road$_{27}$	Mashpee	12	1.08
38	Route 132 (Iyanough Road) @ Phinneys Lane$_{16}$	Barnstable	40	1.08
40	Route 130 (Forestdale Road) @ Cotuit Road	Sandwich	20	1.07
41	Route 134 (East West Dennis Road) @ Bob Crowell Rd / Hemlock Ln / Agway SD	Dennis	19	1.06
42	Adams Street @ Sagamore Bridge Connector	Bourne	15	1.05
43	Route 151 (Nathan Ellis Highway) @ Sandwich Road	Falmouth	24	1.04
44	Route 28 (Main Street) @ Route 134 / Swan River Road	Dennis	24	1.02
44	Eastham Rotary @ Rt 6A/28 / Rt 6, Smith Ln$_{18}$	Eastham	35	1.02
46	Route 6 (Mid-Cape Highway) @ Chase Rd - Exit 4	Sandwich	55	1.00
47	Route 134 (East West Dennis Road) @ Market Place	Dennis	27	0.99
48	Buck Island Road @ Higgins Crowell Road	Yarmouth	17	0.98
48	Route 28 (Falmouth Road) @ Old Stage Road$_{19}$	Barnstable	35	0.98
50	Route 28 (Main St / Iyannough Rd) @ East Main Street$_{21}$	Yarmouth	25	0.97

Source: MassDOT 2006-2008 Crash Data and Towns of Barnstable County

TOP LOCATIONS BASED ON EPDO RATE

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Rank	Intersection	TOWN	Crash#	EPDO	EPDO Rate
1	Route 124 (Harwich Road) @ Tubman Road$_{36}$	Brewster	12	32	5.51
2	Rt 39 (Orleans Harwich Road) @ Pleasant Bay Road	Harwich	15	40	5.45
3	Otis Air Force Base Rotary @ Rt 28 / Sandwich Rd / Connery Ave$_{3}$	Bourne	88	172	5.33
4	Theophilus F. Smith Road @ Cumberland Farm / Patriot Square SD	Dennis	25	57	4.65
5	Station Avenue @ Wood Road	Yarmouth	18	42	4.54
6	Route 6 (Mid-Cape Highway) @ Route 132 (Iyannough Road) - Exit 6$_{1}$	Barnstable	128	314	4.36
7	Great Neck Road North @ Old Barnstable Road$_{27}$	Mashpee	12	48	4.32
8	Route 6 (Mid-Cape Highway) @ Route 134 (East West Dennis Road) - Exit 9$_{2}$	Dennis	99	187	4.08
9	Route 6A (Sandwich Road) @ Sagamore Bridge Connector	Bourne	25	58	3.97
10	Sandwich Road @ Carriage Shop Road$_{37}$	Falmouth	7	31	3.96
11	Route 6 (Mid-Cape Highway) @ Station Avenue - Exit 8$_{32}$	Yarmouth	78	182	3.48
12	Old Bass River Road @ Old Chatham Road	Dennis	6	26	3.44
13	Depot Street @ Center Street	Harwich	9	26	3.39
14	Route 134 (East West Dennis Road) @ Upper County Road$_{12}$	Dennis	44	100	3.38
14	Buck Island Road @ West Yarmouth Road	Yarmouth	20	52	3.38
16	Route 6 (Mid-Cape Highway) @ Willow Street - Exit 7$_{4}$	Yarmouth	86	204	3.36
17	Cotuit Road @ Harlow Road$_{28}$	Sandwich	17	33	3.35
18	Main Street @ Tonset Road	Orleans	19	43	3.23
19	Route 151 (Nathan Ellis Highway) @ Sandwich Road	Falmouth	24	73	3.17
19	Depot Street @ Center Street	Dennis	9	26	3.17
21	Route 6 (Mid-Cape Highway) @ Route 149 (Prospect Street) - Exit 5$_{5}$	Barnstable	83	187	3.12
22	Route 28A (Sandwich Road) @ County Road	Bourne	10	26	3.10
23	Route 25 @ Bourne Bridge	Bourne	68	148	3.02
24	Route 28 (Main Street) @ Depot Street	Dennis	24	52	2.88
25	Buck Island Road @ Higgins Crowell Road	Yarmouth	17	49	2.83
26	Belmont Rotary @ Rt 28 / Rt 6 / Rt 6 Bypass / Head of the Bay Rd$_{34}$	Bourne	54	110	2.81
27	Route 6 WB Off ramp @ Route 6 (Scenic Highway)	Bourne	22	38	2.78
28	Sandwich Road @ Adams Street	Bourne	30	50	2.73
29	Route 6 (Mid-Cape Highway) @ Route 124 (Pleasant Lake Avenue) - Exit 10	Harwich	44	96	2.68
30	Route 28 (Teaticket Highway) @ Figuerido Way	Falmouth	18	50	2.66
31	Forest Road @ Winslow Gray Road	Yarmouth	15	40	2.55
32	Route 28 (Chatham Road) @ Finlay Road$_{30}$	Orleans	8	32	2.55
33	Spring Bars Road @ Worcester Court	Falmouth	12	28	2.54
34	Sandwich Road @ Brick Kiln Road	Falmouth	10	38	2.46
35	Adams Street @ Sagamore Bridge Connector	Bourne	15	35	2.46
36	Route 6 (Mid-Cape Highway) @ Route 130 (Forestdale Road) - Exit 2$_{6}$	Sandwich	73	145	2.41
37	Route 6 (Mid-Cape Highway) @ Chase Rd - Exit 4	Sandwich	55	128	2.34
38	Route 6 (Mid-Cape Highway) @ EB approaching Exit 11	Harwich	10	30	2.31
38	Old Town House Road @ Forest Road$_{29}$	Yarmouth	15	31	2.31
40	Route 6 (GAR Hwy) @ Brackett Road / Old County Road$_{24}$	Eastham	22	62	2.29
41	Route 6A (Cranberry Highway) @ Main Street	Sandwich	11	27	2.26
42	Route 28 (Teaticket Highway) @ Stop and Shop SD	Falmouth	19	47	2.25
43	Mashpee Circle @ Rt 28 / Rt 151 / Great Neck Rd	Mashpee	32	80	2.23
43	Station Avenue @ Regional Avenue / Studley Road	Yarmouth	9	33	2.23
43	Route 134 (East West Dennis Road) @ Airline Road	Dennis	14	38	2.23
43	Sandwich Road @ Tanglewood Drive	Falmouth	7	27	2.23
47	Eastham Rotary @ Rt 6A/28 / Rt 6, Smith Ln$_{18}$	Eastham	35	75	2.19
48	Station Avenue @ Old Town House Road$_{31}$	Yarmouth	20	44	2.08
49	Route 6A (Cranberry Highway) @ Union Street / Old Church Street	Yarmouth	13	37	2.07
50	Route 130 (Forestdale Road) @ Quaker Meeting House Road	Sandwich	15	35	2.04

Source: MassDOT 2006-2008 Crash Data

CAPE COD COMMISSION

INDEX OF INTERSECTION NOTES

TABLE 1: INDEX OF INTERSECTION NOTES

Note	Intersection	Town	Notes
1	Route 6 (Mid-Cape Highway) @ Route 132 (Iyannough Road) - Exit 6	Barnstable	Signalization; TIP year 2005, 2006, 2007
2	Route 6 (Mid-Cape Highway) @ Route 134 (East West Dennis Road) - Exit 9	Dennis	RSA 2009
3	Otis Air Force Base Rotary @ Rt 28 / Sandwich Rd / Connery Ave	Bourne	CCC Safety Study 2006
4	Route 6 (Mid-Cape Highway) @ Willow Street - Exit 7	Yarmouth	Additional lanes; TIP year 2004
5	Route 6 (Mid-Cape Highway) @ Route 149 (Prospect Street) - Exit 5	Barnstable	RSA conducted 2010; under design, TIP year 2010
6	Route 6 (Mid-Cape Highway) @ Route 130 (Forestdale Road) - Exit 2	Sandwich	CCC Safety Study 2008; RSA 2009; under design; TIP year 2010
7	Route 28 (Falmouth Road) @ Bearses Way	Barnstable	RSA conducted 2009; under review by town
8	Route 28 (Falmouth Road) @ Route 149 (Prospect Street)	Barnstable	Signal design; construction 2010; TIP year 2009
10	Route 28 (Falmouth Road) @ South County Road	Barnstable	Signal design; construction 2010; TIP year 2009
11	Route 28 (Iyannough Road) @ Yarmouth Road	Barnstable	New design concepts recommended in Hyannis Access Study; part of Yarmouth Road Corridor Study
12	Route 134 (East West Dennis Road) @ Upper County Road	Dennis	RSA 2010; TIP year 2012
14	Route 132 (Iyannough Road) @ Shoot Flying Hill Road	Barnstable	Route 132 construction relocated intersection - TIP year 2005, 2006, 2007
15	Airport Rotary @ Rt 132 / Rt 28 EB/WB / Barnstable Rd	Barnstable	New design concepts recommended in Hyannis Access Study
16	Rt 132 (Iyanough Road) @ Phinneys Lane	Barnstable	Upgrade signals/additional lanes 2009; TIP year 2005, 2006, 2007
17	Route 132 (Iyannough Road) @ Independence Road / Enterprise Road	Barnstable	Left turn lane added to 132 southbound
18	Eastham Rotary @ Rt 6A/28 / Rt 6, Smith Ln	Eastham	CCC Safety Study 2009; recommendations included in Route 6 Outer Cape Safety and Traffic Flow Study 2004
19	Route 28 (Falmouth Road) @ Old Stage Road	Barnstable	RSA 2007
20	Route 28 (Chatham Road) @ Route 6A (Cranberry Highway)	Orleans	CCC Safety Study 2006; TIP year 2012
21	Route 28 (Main St / Iyannough Rd) @ East Main Street	Yarmouth	Recommendations included in Route 28 Safety and Traffic Flow Study 2006
22	Route 28 (Falmouth Road) @ Phinneys Lane	Barnstable	RSA 2007
23	Route 28 (Main Street) @ Route 134 / Swan River Road	Dennis	Added left turn lanes and new signal phasing, pedestrian improvements 2009/2010
24	Route 6 (GAR Hwy) @ Brackett Road / Old County Road	Eastham	CCC Safety Study 2008; recommendations included in Route 6 Outer Cape Safety and Traffic Flow Study 2004; Signal upgrade and westbound left-turn lane added 2009, 2010
25	Route 6 (Mid-Cape Highway) @ Route 137 (Long Pond Road) - Exit 11	Harwich	Under design; TIP year 2011
26	Station Avenue @ Whites Path	Yarmouth	Signal upgrade and northbound left-turn lane added 2003, 2004
27	Great Neck Road North @ Old Barnstable Road	Mashpee	RSA 2009
28	Cotuit Road @ Harlow Road	Sandwich	RSA 2009; TIP year 2011
29	Old Town House Road @ Forest Road	Yarmouth	RSA 2010; TIP year 2010
30	Route 28 (Chatham Road) @ Finlay Road	Orleans	TIP project, advertised 2006
31	Station Avenue @ Old Town House Road	Yarmouth	Signal upgrades 2003, 2004
32	Route 6 (Mid-Cape Highway) @ Station Avenue - Exit 8	Yarmouth	RSA 2011
33	Bourne Rotary @ Rt 28 / Sandwich Rd / Trowbridge Rd	Bourne	Signage & striping plan 2011
34	Belmont Rotary @ Rt 28 / Rt 6 / Rt 6 Bypass / Head of the Bay Rd	Bourne	Project Notification Form 2011
35	Mashpee Circle @ Rt 28 / Rt 151 / Great Neck Rd	Mashpee	VAI Study
36	Route 124 (Harwich Road) @ Tubman Road	Brewster	RSA 2011
37	Sandwich Road @ Carriage Shop Road	Falmouth	RSA 2011

RSA = Road Safety Audit
TIP = Transportation Improvement Program
CCC = Cape Cod Commission

In each of the four high crash location lists, select intersections are denoted with a subscripted number. Each number corresponds to a number in the “Note #” column in the preceding table. For those

intersections included, the table provides information relevant to studies that may have been performed, past or planned construction, or other changes that may influence an intersection's frequency of crashes.

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Bicycle and Pedestrian Crashes

MASSDOT DATA

From the overall crash dataset, MassDOT further narrows the data to highlight crashes involving bicycles or pedestrians. All of the crashes included in the bicycle/pedestrian data are also included in the data of all vehicular crashes. As opposed to the three-year analysis provided for all vehicular crashes, the most recent bicycle/pedestrian data include crashes from 2002-2008. The following figure depicts all located crashes on Barnstable County that occurred during these seven years. All bicycle/pedestrian crashes included at least one motor vehicle.

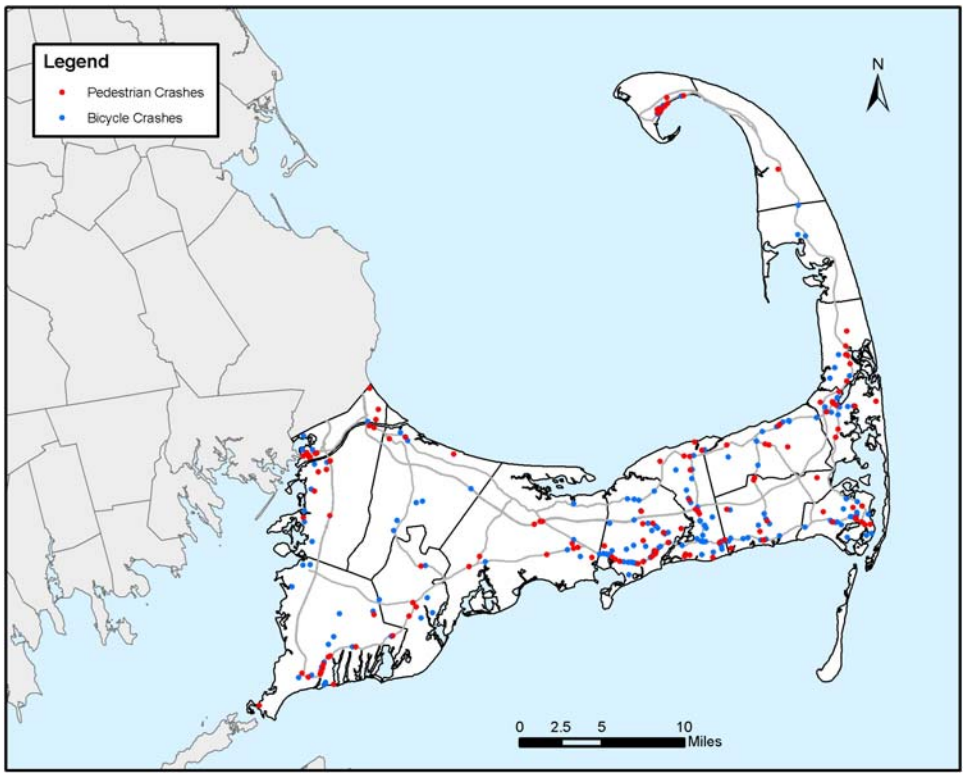

FIGURE 2: BICYCLE/PEDESTRIAN CRASHES, 2002-2008

The highest concentration of bicycle and pedestrian crashes occur along Barnstable County's major roads. The majority of crashes took place along Route 28 – particularly in downtown Falmouth, Yarmouth, Dennis, Chatham and Orleans. Other areas of high concentration are downtown Buzzard's Bay in Bourne, Station Avenue in Yarmouth, Route 134 in Dennis, downtown Orleans, and Commercial Street in Provincetown.

It should be noted, this data is representative of all reported bicycle/pedestrian crashes – not necessarily all crashes that have occurred. Furthermore, the reports must have had enough information to be located properly. Differences in number of crashes per town may be the result of a difference in reporting, although there is no evidence to suggest a difference.

Also, bicycle/pedestrian crashes are notoriously under-reported. It is not uncommon for bicyclists or pedestrians to decline reporting an incident with a vehicle if their injuries are too minor to warrant a hospital visit. Unfortunately, this lack of reporting diminishes the accuracy of a report like this, and does little to highlight problem areas in the county.

BICYCLE AND PEDESTRIAN CRASH CLUSTERS

As was done with the overall vehicular crash data, the individual bicycle/pedestrian crashes were grouped into clusters relevant to specific intersections. A cluster requires at least two incidents. The following table highlights the eight locations on Cape Cod that had at least two pedestrian related crashes (based on MassDOT data).

TABLE 2: BARNSTABLE COUNTY PEDESTRIAN CRASH CLUSTERS, 2002-2008

# Crashes	Fatal	Injury	No Injury	EPDO	Major	Minor	Town
2	1	1	0	15	Route 28 (Main St)	Seaview Avenue	Yarmouth
2	0	2	0	10	Route 6/28 (Main St)	St. Margarets Street	Bourne
2	0	2	0	10	Eldridge Avenue	Lincoln Avenue	Bourne
2	0	2	0	10	Main Street	Chatham Bars Avenue	Chatham
2	0	1	1	6	Route 6/28 (Main St)	Holt Road	Bourne
2	0	1	1	6	Route 6A (Bradford St)	Commercial Street	Provincetown
2	0	1	1	6	Route 28 (Main St)	Forest Road	Yarmouth
2	0	0	2	2	Bourne Rotary	Route 28 (Macarthur Blvd)	Bourne

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Of the 139 total pedestrian-related crashes that occurred within Barnstable County from 2002-2008, there are only eight locations with more than one incident (and no location with more than two recorded incidents). While this analysis does not highlight any particular intersection as a location of critical concern, the data does suggest issues with particular corridors – especially along the county's major roads.

The MassDOT data from 2002-2008 have located 224 bicycle-related crashes. There are twenty six bicycle crash clusters for that time period, meaning twenty six locations with at least two bicycle-related crashes. Those locations are highlighted in the following table.

TABLE 3: BARNSTABLE COUNTY BICYCLE CRASH CLUSTERS, 2002-2008

# Crash	Injury	No Injury	EPDO	Major	Minor	Town
5	4	1	21	Route 28 (Main St)	West Yarmouth/Winslow Gray Rd	Yarmouth
4	4	0	20	Route 28 (Main St)	Baxter Avenue	Yarmouth
3	3	0	15	West Yarmouth Road	Buck Island Road	Yarmouth
3	3	0	15	Route 6A (Cranberry Hwy)	Route 28 (Chatham Rd)/Canal Rd	Orleans
3	3	0	15	Route 28 (Main St)	Queen Ann Rd/Crowell Rd/Depot Rd	Chatham
4	2	2	12	Route 6A (Bradford St)	Standish Street	Provincetown
3	2	1	11	Route 28 (Main St)	Hudson Road	Yarmouth
2	2	0	10	Route 134 (East West Dennis Rd)	Route 6 (Mid Cape Hwy)	Dennis
2	2	0	10	Route 6 (GAR Hwy)	Cahoons Hollow Road	Wellfleet
2	2	0	10	Route 6 (GAR Hwy)	Hay Rd	Eastham
2	2	0	10	Route 28 (Main St)	Springer Lane	Yarmouth
2	2	0	10	Route 28 (Main St)	Pine Street	Dennis
2	2	0	10	Route 28 (Main St)	Marigold Rd/Rosemary Ln	Yarmouth
2	2	0	10	Route 28 (Main St)	East Main Street	Yarm/Barn
2	2	0	10	Route 6A (Cranberry Hwy)	Main Street	Orleans
2	2	0	10	Dry Hollow Lane	Weather Crescent	Mashpee
2	2	0	10	Route 28 (Chatham Rd)	Main Street	Orleans
2	2	0	10	Route 28 (Main St)	Seaview Avenue	Yarmouth
2	2	0	10	Route 6A (Cranberry Hwy)	Eldredge Park Way	Orleans
4	1	3	8	Route 6A (Bradford St)	Commercial Street	Provincetown
2	1	1	6	Route 134 (East West Dennis Rd)	Upper County Road	Dennis
2	1	1	6	Route 28 (Main St)	Depot Street	Dennis
2	1	1	6	Route 28 (Main St)	Shad Hole Road	Dennis
2	1	1	6	Route 28 (Main St)	Route 134 (East West Dennis Rd)	Dennis
2	0	2	2	Commercial Street	Court Street	Provincetown
2	0	2	2	Route 6A (Bradford St)	Shank Painter Road	Provincetown

Fatal Crash Database

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The Fatal Crash Database was started by the Cape Cod Commission in January of 2007 as a means of keeping track of all fatal crashes that take place in Barnstable County. Whenever a fatal crash occurs, the vital information is immediately added to the database, ensuring the records are always up to date. The vital information recorded includes location, time and date, direction of travel, type of crash, number of fatalities (and injuries), gender and age of those involved, and a brief description of the circumstances. The location is then mapped with GIS software and newspaper clippings of the event are digitally stored for future reference.

The following table identifies how many fatal incidents have occurred in each town from January 1, 2007 to July 1, 2010.

TABLE 4: FATAL CRASHES BY TOWN, 2007-2010

Town	2007	2008	2009	2010*	**Total**
Barnstable	7	3	3	2	**15**
Bourne	1	2	3	1	**7**
Brewster	2	0	1	0	**3**
Chatham	0	0	0	0	**0**
Dennis	2	2	2	1	**7**
Eastham	0	0	0	0	**0**
Falmouth	4	4	3	0	**11**
Harwich	1	0	2	0	**3**
Mashpee	0	1	0	0	**1**
Orleans	1	0	0	0	**1**
Provincetown	0	0	0	0	**0**
Sandwich	4	3	1	2	**10**
Truro	1	0	0	0	**1**
Wellfleet	2	1	0	1	**4**
Yarmouth	2	0	0	0	**2**
Total	**27**	**16**	**15**	**7**	**65**

Source: Cape Cod Commission

* As of July 1, 2010

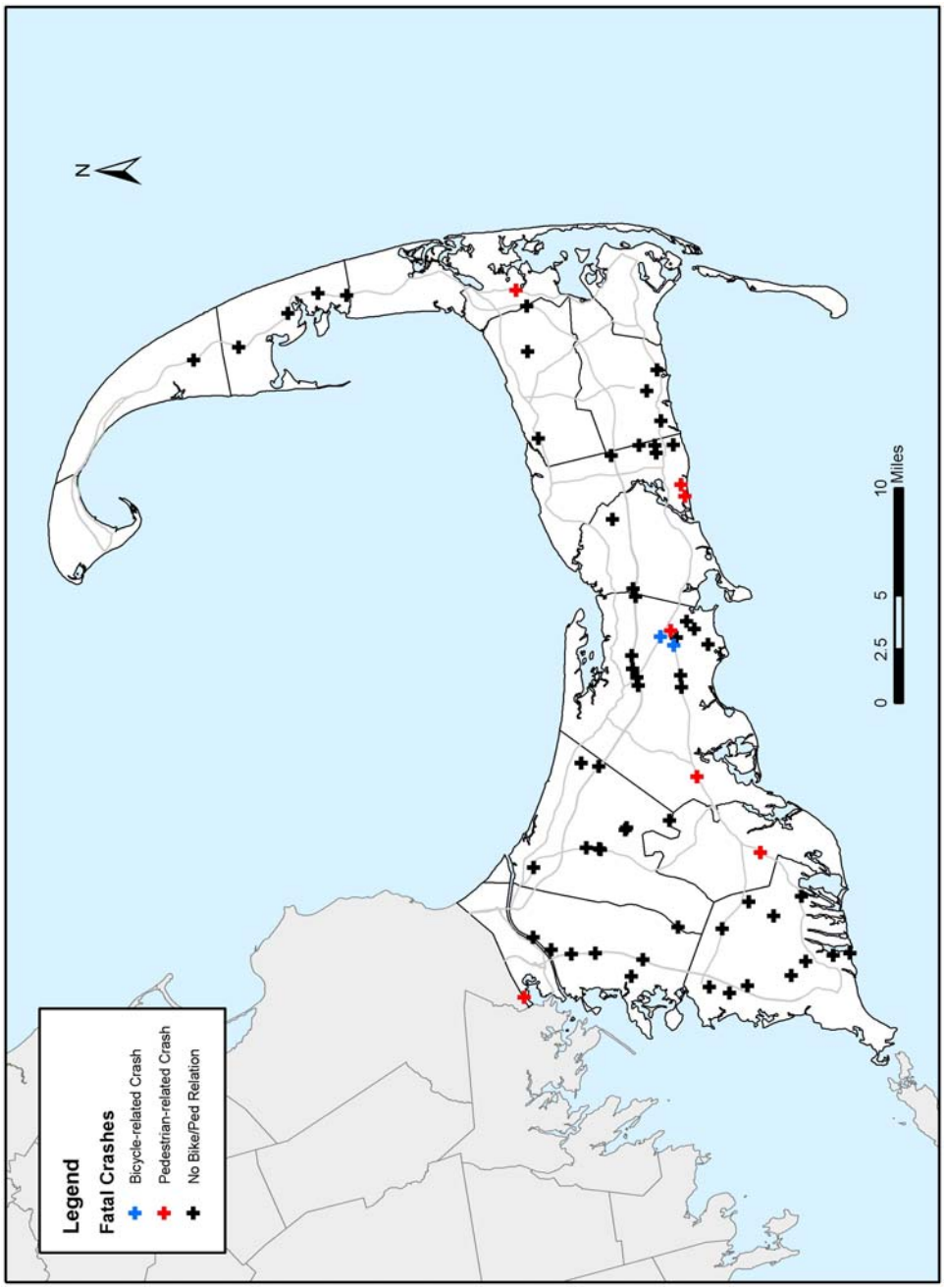

FIGURE 3: BARNSTABLE COUNTY FATAL CRASHES, 2007-2010*

* As of July 1, 2010

Of the sixty five fatal crashes that have occurred in Barnstable County since January of 2007, two have included bicycles and seven have included a pedestrian. The bulk of the fatal incidents have occurred on Cape Cod's major roads – notably Route 28 in Bourne and Route 6 in Barnstable. The towns of Barnstable, Falmouth, and Sandwich have experienced the most fatal crashes, with fifteen, eleven, and ten, respectively. On all of the Outer-Cape (Eastham and north), there are only five fatal crashes – all of which occurred on Route 6. Four of those incidents were in Wellfleet, and one happened in Truro.

Thirty three crashes were categorized as a lane departure. Additionally, there were three rear-end collisions, four side impact collisions, four at an angle, and ten head-on collisions. Forty one crashes included only one vehicle, while seventeen crashes involved two, six involved three, and one crash involved six vehicles.

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Summary

The information provided in this report has been presented with the intention of serving as a resource to make Cape Cod safer for motorists, pedestrians, and bicyclists. There are many ways to create a list of most dangerous intersections, and each methodology has its strengths and weaknesses. For this reason, the Commission has produced four high crash lists without identification of a preferred option. The user is responsible for selecting the list which is most appropriate based on the desired outcome's characteristics.

Geolocating crashes is an effective method used in identifying high crash areas. Better crash data will lead to better analysis, the most accurate identification of problem areas, and the deployment of appropriate safety improvements. Incomplete or inaccurate crash reporting may lead to a missed opportunity of funds for a project. These records are used to bolster an argument for funding.

At the end of November 2008, the Cape Cod Commission was sent 892 non-geolocated crash records to be individually investigated. The crash records spanned the period from January 1 to November 11, 2008. Of the 829 records sent, the Commission located 534 manually. The most common reasons for the initial problems with geolocating were spelling errors, vagueness in location description, and the use of abbreviations the GIS software could not compute. Although more than half of the non-geolocated crashes could be identified through manual inspection, still 40% of the crashes lacked enough information to be located. MassDOT does not estimate crash locations, so these un-located crashes will not be evidence for project funding without further information.

As of October 2008, sixty eight Massachusetts cities and towns have been submitting crash reports to the RMV electronically (six of the towns are located on Cape Cod). Taking advantage of this technology reduces the potential for erroneous information to be included in the RMV's computer database.

Accurate and comprehensive crash reporting will lead to better opportunities for safety improvements and focus further safety studies on the areas of most critical need.

CAPE COD COMMISSION

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