New York Metropolitan Transportation Council

Pedestrian Safety in the NYMTC Region

Prepared by

CUNY Institute for Transportation Systems

July, 2007

NYMTC
NEW YORK METROPOLITAN TRANSPORTATION COUNCIL

NYMTC Pedestrian Safety Study

Final Report

Prepared by

Claire E. McKnight
Kyriacos Mouskos
Camille Kamga
Institute for Transportation Systems
City University of New York

And

Chris Hardej
Aizaz Ahmed
Safety Advisory Work Group Advisors
New York Metropolitan Transportation Council

Prepared for
New York Metropolitan Transportation Council

July 2007

Disclaimer

Table of Contents

Table of Contents continued

Table of Tables

Table of Figures

Intentionally left blank.

I. INTRODUCTION

1.1 Study Origin and Objective

The New York Metropolitan Transportation Council (NYMTC) is an association of governments and transportation providers, which serves as the metropolitan planning organization designated for New York City, Long Island and the lower Hudson Valley. It provides a collaborative planning forum to address transportation-related issues from a regional perspective and plans and makes decisions on the use of federal transportation funds. The NYMTC region includes New York City, Long Island and three counties in the lower Hudson Valley. It encompasses an area of 2,346 square miles and a population of 12.3 million in 2004, approximately 64% of New York State's population (NYMTC, 2004).

The Voting Members are:
Counties of Nassau**,** Putnam**,** Rockland**,** Suffolk**,** Westchester
Metropolitan Transportation Authority
New York City Department of Planning
New York City Department of Transportation
New York State Department of Transportation

The Advisory Members are:
Federal Highway Administration
Federal Transit Administration
New Jersey Transit
New York State Department of Environmental Conservation
North Jersey Transportation Planning Authority
Port Authority of New York & New Jersey
U.S. Environmental Protection Agency

In April 2000, NYMTC established the Safety Advisory Working Group (SAWG) to provide a forum to facilitate interagency discussion, exchange information, address safety and advise its members on issues dealing with transportation safety. SAWG is also tasked with enhancing and expanding safety planning in all elements of NYMTC's metropolitan transportation planning process, including NYMTC's plans, programs, and activities.

Due to the events of September 11, 2001, SAWG was not able to hold its first meeting until January 2003. The first task of the SAWG was to identify the priority safety topics that the members would want to address. Pedestrian safety was by far the leading topic of concern among the agencies and therefore selected as the first topic to be studied.

The first step for the study was to determine the status of pedestrian safety and the related investment needs in the region. This report identifies the pedestrian safety issues and recommended countermeasures to improve pedestrian safety in the region. The method was to interview the agencies and organizations within the region about their existing activities and

perceptions of the issue. This project will develop the Pedestrian Safety Plan in collaboration with the NYMTC members and will be incorporated into the Regional Transportation Plan (RTP). The Pedestrian Safety Plan will periodically be updated along with the update of the RTP.

The second product of the study was to be a sourcebook on pedestrian safety strategies and technologies, based on the research findings reported by state and local agencies and the literature review of independent research organizations. Instead of creating a separate document, descriptions of countermeasures for addressing pedestrian safety issues and their effectiveness are included in Chapter 5. Additionally, Appendix D contains an annotated bibliography of the best on-line sources of information on pedestrian safety.

The organization of this report, which summarizes the result of the study, is outlined here. The rest of this chapter discusses the importance of pedestrian safety and describes how the study was conducted. The second chapter presents statistics on pedestrian safety in the region and contrasts regional characteristics with national characteristics. The third chapter describes the governmental and private non-profit organizations that are involved in pedestrian safety in the NYMTC region. It also includes sections on the state of pedestrian crash data. The fourth chapter describes the pedestrian safety issues that were identified during the interviews and public meetings. The fifth chapter describes countermeasures for improving pedestrian safety, and the sixth chapter is a brief summary of funding sources. The last chapter includes recommendations for improving pedestrian safety in the region.

1.2 Importance of Pedestrian Safety

The residents of the NYMTC region walk more than those in most other regions of the United States. According to the Regional Travel – Household Interview Survey, in 1997 about 22 percent of trips in the NYMTC region were made solely by walking. This ranges from a low of 6.4 percent in Long Island to 48.3 percent in Manhattan. (Parsons Brinckerhoff, 2000). To understand the magnitude of this number, the 2001 National Household Travel Survey indicated that 8.6 percent of trips nationally were made by walking (BTS, 2003).

Not only do the people in the region rely on walking extensively, but walking is important to the economy of New York City and many other communities in the region. All retail trips require walking as at least a part of the access trip. One analysis indicated that over 50 percent of retail sales are to customers that access the store primarily by walking, indicating the huge impact that walking has on the regional economy. In addition, tourism is also dependent on walking and is another important contributor to the regional economy. Additional reasons for attention to pedestrian safety include the number of people who cannot drive, the fact that other modes depend on access by walking, and that making roads safer for pedestrians makes them safer for all modes.

The high proportion of trips by walking means that the pedestrians in the region are exposed to potential crashes more than in most areas. (Ideally, the rates for pedestrian injuries and fatalities should be normalized based on the number of walking trips rather than population only.) New York and New Jersey pedestrian fatalities as a percentage of total traffic fatalities are the highest

in the United States; the 2004 data shows the two states share the highest rate of 21.2 percent (NCSA, 2006). Due to this statistic, the Federal Highway Administration has designated New York State as a focus state and New York City as a focus city for pedestrian safety.

In addition to it being a concern in the NYMTC region, pedestrian safety is receiving increased attention at the national and international level. United States Legislation that set policy for US Department of Transportation states: "The non-motorized modes are an integral part of the mission of FHWA and a critical element of the local, regional, and national transportation system." (Transportation Equity Act, 1999) US Department of Transportation Policy (1999 and 2000) FHWA Program Guidance on Bicycle and Pedestrian Provisions on Federal-Aid Program further states:

- "… bicycle and pedestrian improvements can be routinely included in federally funded transportation projects and program."
- "… bicycling and walking facilities will be incorporated into all transportation projects unless 'exceptional circumstances' exist."
- "… FHWA will encourage the development and implementation of bicycle and pedestrian plans as part of the overall transportation planning process."

The attention to the role of walking in maintaining good health has added to the interest. Internationally, pedestrian fatalities are a considerably higher percentage of traffic-related fatalities, at least partly due to the much greater reliance on walking as a mode of transportation in developing nations. The World Health Organization shows that road traffic accidents are a major cause of injury and death worldwide, and that a disproportionate number of the injuries and deaths occur to users of non-motorized transportation. They further point out "in many countries, the absence of a voice for the most vulnerable groups has meant that the safety of pedestrians and cyclists is often disregarded in favour of motorized travel. Equal protection of all road users should be a guiding rule, to avoid unfair burden of injury and death for poorer people and vulnerable road users." (WHO, 2004, p.10).

Walking is a basic human activity and the lifeblood of our urban areas. Pedestrians belong.

1.3 Study Method

The study was done primarily by interviewing key people in regional transportation and related agencies and organizations that have a role or interest in pedestrian safety. The list of agencies to be interviewed was initially developed by NYMTC staff assigned to the Safety Advisory Working Group. The list included member agencies of SAWG and others. A few additional agencies were added to the initial list during the interviews based on comments and recommendations from the people being interviewed. A very short survey was sent to one or several people within each agency. The objectives of this initial survey were to identify the person or people within the organization most involved in pedestrian safety; to determine their level of activity; and to identify data sources.

After the completion of the survey, a public meeting was held at NYMTC's offices in order to obtain public input to the project. Organizations to be contacted and issues to be discussed were

supplemented based on the survey responses. A few SAWG agencies did not participate in the project because the scope of work concentrated on pedestrian/vehicular conflict in the roadway environment and those agencies had limited exposure with regards to that scope; these agencies included the New York State Thruway Authority, Metropolitan Transportation Authority, and the Federal Transit Administration.

The second step was to develop the list of questions for the interviews. (The basic interview questions, as well as the initial survey questionnaire, are in Appendix A.) The interview questions were modified to fit each organization based on their response to the initial survey and the nature of the organization.

Most of the interviews were conducted in the office of the organization being interviewed, typically with several people from the organization. In a few cases, several different agencies had representatives present at one interview. The interviews were done by one or two members of the consultant team and usually one or both SAWG co-chairs. The persons interviewed were told that that they would not be cited by name; in those cases where it was relevant, the information would be attributed to the agency, not the person. After each interview, the information was typed in a question/answer format and emailed to the people who were at the interview for their corrections and additions.

One organization, Disabled in Action, was handled differently. Most of the questions from the interview form were not relevant to their activities; they were included in order to learn what the pedestrian safety issues are for a person with disabilities. The president of the organization gave a member of the study team time at one of their meetings; she explained the purpose of the study and asked for their input, specifically for their pedestrian safety problems and issues. Individuals from the audience volunteered their opinions from the floor; a few individuals spoke with the study team representative after the meeting or sent in postcards (provided to them for that purpose) with additional comments or issues.

The information from the interviews was used to develop the chapters in this report. Information from the literature on pedestrian safety was used to supplement the information from the interviews.

Table 1.1 is the list of organizations interviewed. Appendix B contains a list of the organizations and contact information.

Table 1.1 Organizations That Were Interviewed

- NYMTC Member Agencies and associated agencies
  - Nassau County
    - Nassau County Traffic Safety Board
    - Nassau County Planning Commission
    - Nassau County Police Department
  - Putnam County
    - Putnam County Planning Department
    - Putnam County Traffic Safety Board
    - Putnam County Highways and Facilities
  - Rockland County
    - Rockland County Department of Planning
    - Rockland County Department of Transportation
  - Suffolk County Department of Public Works
  - Westchester County
    - Westchester County Department of Public Works
    - Westchester County Department of Transportation
    - Westchester County Planning
    - White Plains Department of Traffic
    - City of Yonkers Traffic Engineering Division
  - New York City Department of Transportation
  - New York City Department of City Planning
  - New York City Department of Aging
- New York State Agencies
  - New York State Department of Transportation – Main Office
  - New York State Department of Transportation – Regions 8, 10, and 11
  - Governor's Traffic Safety Committee
  - New York State Department of Health and Mental Hygiene (by telephone)
- New York City Agencies
  - New York City Department of Parks and Recreation
  - New York Police Department
- Regional Agencies
  - Port Authority of New York and New Jersey
- Regional Offices of Federal Agencies
  - Federal Highway Administration – New York
  - Federal Highway Administration – New Jersey*
  - National Highway Traffic Safety Administration
- New Jersey Agencies
  - North Jersey Transportation Planning Authority
  - New Jersey Department of Transportation*
  - New Jersey Transit
  - Division of Highway Traffic Safety, Department of Law and Public Safety
- Non-government Organizations
  - Disabled in Action of Metropolitan New York
  - Transportation Alternatives
  - American Automobile Association
  - New York State SAFE KIDS Coalition (by telephone)

* The agency representative was unable to attend the interview, so they typed their responses to the interview questions previously emailed to them.

Intentionally left blank.

II. BACKGROUND ON PEDESTRIAN SAFETY

New York and New Jersey pedestrian fatalities as a percentage of total traffic fatalities are the highest in the Union (50 states plus the District of Columbia); the 2004 data shows the two states are tied, both with 21.2 percent of total fatalities being pedestrians (NCSA, 2006). The total number of pedestrian fatalities in New York State in 2004 was 317, which was the fourth highest after California, Florida, and Texas. The New York pedestrian fatality rate per 100,000 population was 1.65, which is the 15th highest rate among the 50 states plus District of Columbia. (NCSA, 2006)

New York State data shows that a disproportionate number of the pedestrian crashes occur in the NYMTC Region (GTSC, 2006A).[1] Table 2.1 shows 2004 crash data from the Governor's Traffic Safety Committee for pedestrian and total crashes for each of the NYMTC counties. While only 64 percent of the state residents live in the NMTC region, 86 percent of pedestrian injuries and 76 percent of pedestrian fatalities occurred in the region. The higher incidence of pedestrian injuries and fatalities is probably due to higher rates of walking in the more densely populated environment.

Table 2.2 shows the number of pedestrian crashes, injuries, and fatalities normalized by residential population for the NYMTC region in 2004. (Residential population is an imperfect measure of exposure, as discussed in the Section 3.2; however, it is easily available.) The ratios of crashes per residential population and of injuries per residential population tend to be higher in New York City than in the suburban counties, probably due to the greater extent of walking in the City. However, the ratio of fatalities per residential population is lower in the City.

Pedestrian fatalities have decreased by about 25 percent over the last decade. Figure 2.1 shows the trends in pedestrian fatalities in New York State and the NYMTC region, indicating an average decrease in both over ten years (NSCA, 2006B). During this same period, total traffic fatalities in New York State decreased about 11 percent. Table 2.3 shows the number of pedestrian fatalities in each county over a ten-year period along with the percentage change in each county for the ten years. Pedestrian fatalities in New York City decreased by 33 percent in the decade according to the FARS (Fatality Analysis Reporting System, maintained by NHTSA) data, while pedestrian fatalities in the total NYMTC region decreased by 24 percent. It is harder to draw conclusions from the trends in the suburban counties due to the small number of fatalities involved; the year-to-year changes can be greater than the ten-year change, and a particularly low or high number in the first or last year of the decade distorts the percentage change. Pedestrian fatalities in Suffolk County and Staten Island have increased over the decade, but they are two of the three counties with the fastest growing population in the region. Figure 2.2 graphically shows ten years of pedestrian fatalities for New York City and the five suburban counties.

[1] Both Federal data, i.e., FARS, which includes details on fatal pedestrian crashes, and State data, i.e., GTSC, which includes the numbers of pedestrian injuries, were used for this section. The two datasets are not in complete agreement, the FARS data showing 317 fatalities and the GTSC data showing 328 fatalities in 2004.

Table 2.1 Total Traffic and Pedestrian Crashes in 2004

Jurisdiction	Total Crashes	Pedestrian crashes	Total injuries	Pedestrian injuries	Total fatalities	Pedestrian fatalities
Nassau	23,675	1,001	22,462	996	121	34
Putnam	1,643	14	1,275	13	8	2
Rockland	4,517	154	4,020	157	33	3
Suffolk	22,044	600	21,420	881	171	41
Westchester	12,499	597	10,025	605	63	14
Suburban Counties	64,378	2,366	59,202	2,652	396	94
Bronx	11,623	1,587	13,511	1,556	56	30
Brooklyn	22,119	3,613	27,074	3,546	91	52
Manhattan	14,435	3,204	14,671	3,173	47	35
Queens	22,478	2,185	24,544	2,191	81	30
Staten Island	4,894	373	5,104	374	23	8
New York City	75,549	10,962	84,904	10,840	298	155
NYMTC Region	139,927	13,328	144,106	13,492	694	249
New York State	232,758	15,864	220,837	15,678	1,495	328

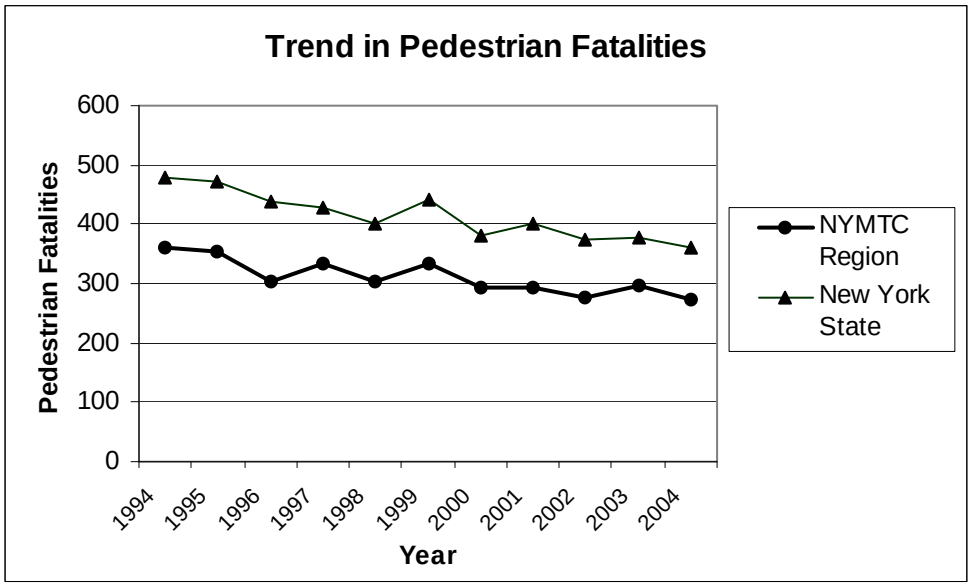
Source: GTSC, 2006A.

Table 2.2 Pedestrian Crashes per Residential Population in 2004

Jurisdiction	Pedestrian crashes per 100,000 population	Pedestrian injuries per 100,000 population	Pedestrian fatalities per 100,000 population
Nassau	75.09	74.71	2.55
Putnam	13.93	12.93	1.99
Rockland	52.57	53.60	1.02
Suffolk	40.68	59.73	2.78
Westchester	63.46	64.31	1.49
Suburban Counties	57.12	64.02	2.27
Bronx	116.90	114.61	2.21
Brooklyn	145.32	142.63	2.09
Manhattan	201.10	199.16	2.20
Queens	97.48	97.74	1.34
Staten Island	80.29	80.50	1.72
New York City	134.62	133.12	1.90
NYMTC Region	108.49	109.82	2.03
New York State	82.39	81.42	1.70

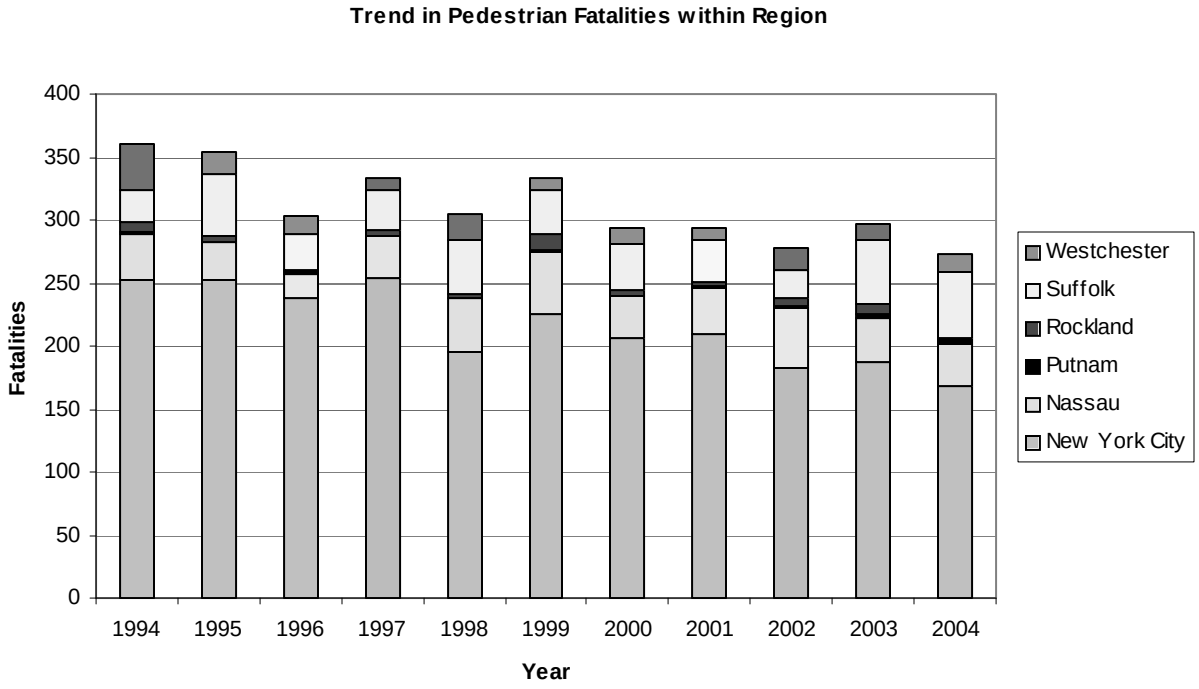
Source of data: GTSC.

Figure 2.1 Ten Year Trend in Pedestrian Fatalities in New York



Source of DATA: FARS.

Figure 2.2 Ten Year Trend in Fatalities in NYMTC Region



Source of data: FARS

Table 2.3 Pedestrian Fatalities in NYMTC Region from 1994 to 2004

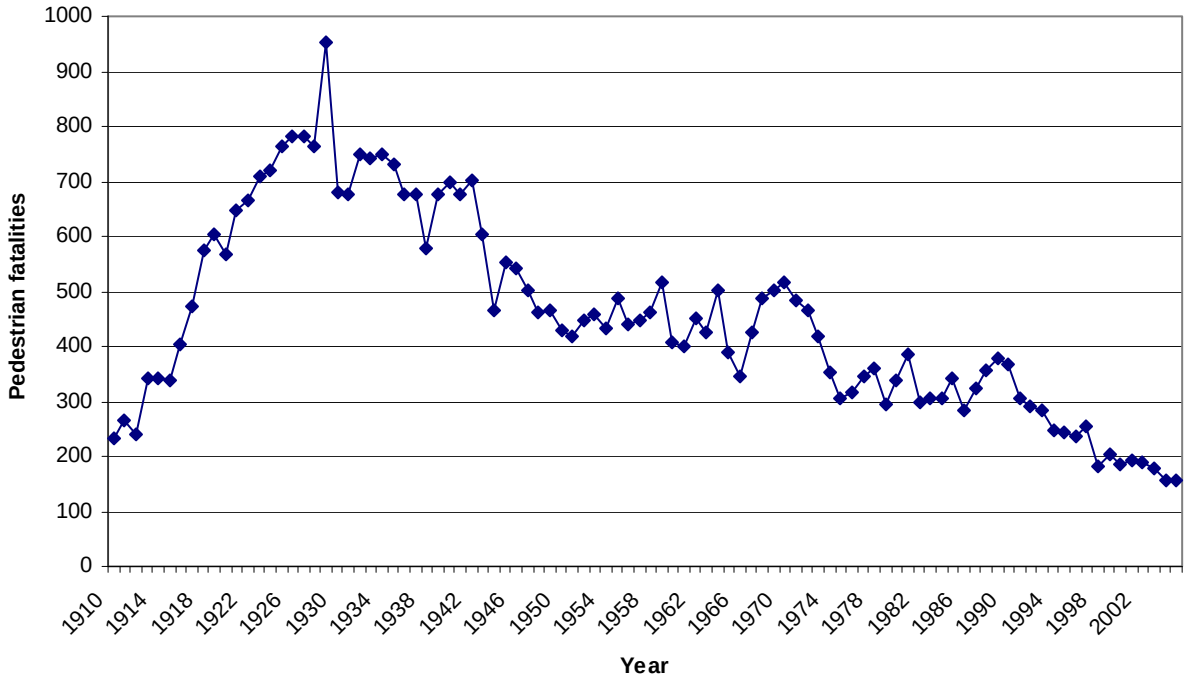
County or region	Pedestrian Fatalities per year											Ten year change
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Nassau	36	31	19	33	42	50	33	36	48	34	33	-8.3%
Putnam	2	0	2	0	0	1	0	2	2	3	2	0.0%
Rockland	8	4	1	5	3	13	4	3	6	8	3	-62.5%
Suffolk	25	50	29	32	43	35	37	33	22	51	51	104.0%
Westchester	37	17	14	10	21	9	13	10	18	13	15	-59.5%
Suburban counties	108	102	65	80	109	108	87	84	96	109	104	-3.7%
Bronx	46	36	38	29	19	32	28	33	29	23	31	-32.6%
Brooklyn	87	72	81	88	72	69	78	62	60	59	51	-41.4%
Manhattan	61	66	59	57	49	64	49	49	40	51	43	-29.5%
Queens	57	66	51	71	55	53	45	52	43	46	34	-40.4%
Staten Island	2	12	9	9	1	7	7	14	10	9	10	400.0%
New York City	253	252	238	254	196	225	207	210	182	188	169	-33.2%
NYMTC Region	361	354	303	334	305	333	294	294	278	297	273	-24.4%
New York State	480	472	439	429	402	441	381	401	375	378	360	-25.0%

Source of Data: FARS.

New York City Department of Transportation has kept data on pedestrian fatalities since 1910; see Figure 2.3. The number has been in decline since 1929, with an almost steady annual decrease from 1989 to 2005. There are small discrepancies between the NYCDOT and FARS data on pedestrian fatalities per year, which may be due to the date at which the data was recorded; seriously injured persons who die later are added to the number of fatalities up to a given time, which differs between agencies.

Table 2.4 shows the pedestrian actions preceding a fatal crash for the NYMTC region according to the 2004 FARS database. This information was compiled from police reports. While it may not be comprehensive nor totally accurate due to the pedestrian being unable to be interviewed, it provides potential insight into the pedestrian fatality. Given the small numbers of fatal crashes in the FARS database for the individual counties, the differences between New York City and the suburban counties are not significant.

Figure 2.3 Historic Trend in Annual Pedestrian Fatalities in New York City



Source of data: NYCDOT; see Appendix E for the data.

Table 2.4 Pedestrian Actions Contributing to Fatal Pedestrian Crashes in NMYTC Region–2004

Action contributing to fatal pedestrian crash	Suburban Counties		New York City		NYMTC Region	
	(Number)	(Percent)	(Number)	(Percent)	(Number)	(Percent)
None by pedestrian	62	59.6%	114	67.5%	176	64.5%
Darting, Running or Stumbling into Road	6	5.8%	15	8.9%	21	7.7%
Improper Crossing of Roadway or Intersection	20	19.2%	20	11.8%	40	14.7%
Walking, Playing, Working, etc. in Roadway	5	4.8%	7	4.1%	12	4.4%
Inattentive (Talking, Eating, etc.)	5	4.8%	0	0.0%	5	1.8%
Failure to Obey Traffic Control Devices, Traffic Officers, Traffic Laws, etc.	3	2.9%	6	3.6%	9	3.3%
Other	3	2.9%	7	4.1%	10	3.7%
Total	104	100.0%	169	100.0%	273	100.0%

Source: FARS Data

Table 2.5 Locations of Pedestrian Crashes in NYMTC Region in 2004

Location of crash	Suburban Counties		New York City		NYMTC Region	
	Number	Percent	Number	Percent	Number	Percent
Intersection - In Crosswalk	2	1.9%	56	33.1%	58	21.2%
Intersection - On Roadway, Not in Crosswalk	17	16.3%	23	13.6%	40	14.7%
Intersection - On Roadway, Crosswalk not Available	9	8.7%	10	5.9%	19	7.0%
Intersection - other	19	18.3%	5	3.0%	24	8.8%
Total at intersection	47	45.2%	94	55.6%	141	51.6%
Non-Intersection - On Roadway, Not in Crosswalk	29	27.9%	47	27.8%	76	27.8%
Non-Intersection - On Roadway, Crosswalk not Available	23	22.1%	11	6.5%	34	12.5%
Non-Intersection - On Road Shoulder	3	2.9%	2	1.2%	5	1.8%
Non- intersection - not in traffic way	2	1.9%	15	8.9%	17	6.2%
Total not at intersection	57	54.8%	75	44.4%	132	48.4%
Total	104	100.0%	169	100.0%	273	100.0%

Source: FARS Data

For the NYMTC region, a pedestrian injury or fatality is almost equally likely to occur at an intersection as at a non-intersection location. This is in contrast with the national data, which indicates that 79 percent of pedestrian fatalities occur at non-intersection locations. Crashes within New York City are a little more likely to occur at intersections while those in the suburban counties are more likely to occur at non-intersections (see Table 2.5). This may be due to significantly more intersections with designated crosswalks in the City compared to elsewhere. The greatest disparity between the locations of fatal pedestrian crashes within the region is shown in the first row of the table: almost a third of pedestrian fatalities in New York City happen to pedestrians in crosswalks, while only two percent of suburban pedestrian fatalities occur at an intersection in a crosswalk.

Further in suburban counties, 30.8 percent of fatalities occur at places where there is no crosswalk (this is the sum of no crosswalks available for intersections and non-intersections). A study done of pedestrian fatalities and injuries in Nassau County showed a similar high proportion, 36.2 percent, of pedestrian injuries in 1998 and 1999 occurred at crossings with no signal or crosswalk (Table 3, DiMaggio, 2005).

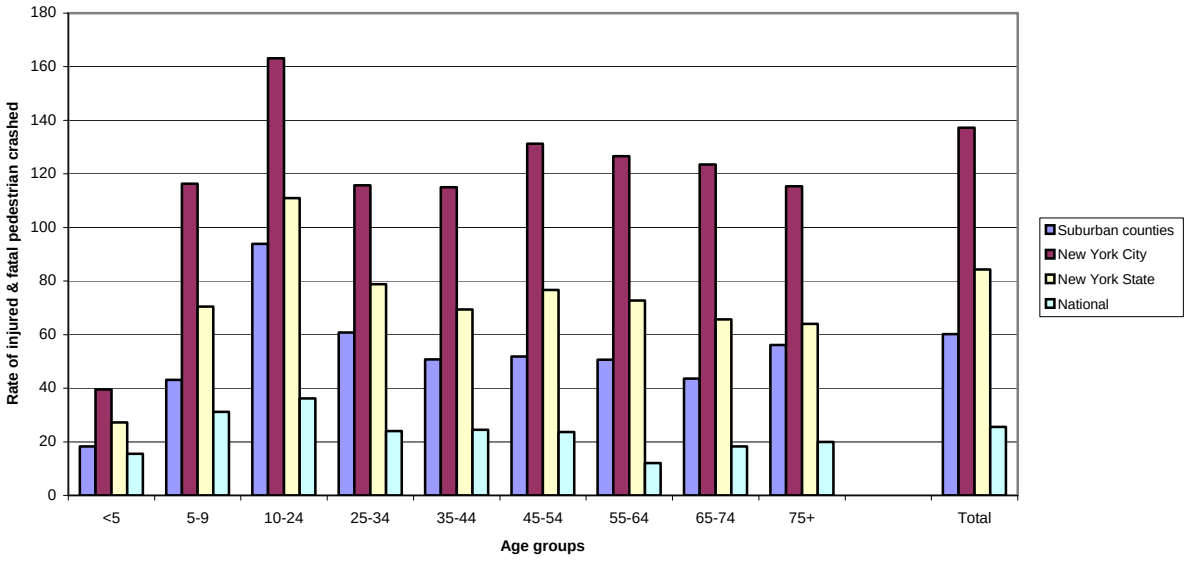
Figure 2.4 shows the combined pedestrian fatality and injury rate (normalized by population) for different ages for the suburban counties, New York City, New York State, and the country. (Since injuries outnumber fatalities by more than ten times, the rates are closer to injury rates

than fatality rates.) The most noticeable aspect of the graph is the much higher rates in New York City compared to the other three geographical areas. This is at least partially due to the greater number of people walking. If a better measure of exposure than residential population were available, the extreme differences between the rates might not appear. See Section 3.2 for further discussion of exposure measures.

The national data indicates that pedestrian injuries are highest for the adolescent and young adult years, gradually decline to the late 50s and then increase slightly for the oldest age groups. The fatality and injury rates in the suburban counties follow a similar pattern. The New York City fatality and injury rates are also highest in the teens and young adult ages but show a second, smaller peak for the 45 to 55 age group, and actually decrease slightly for the 75 years and older group.

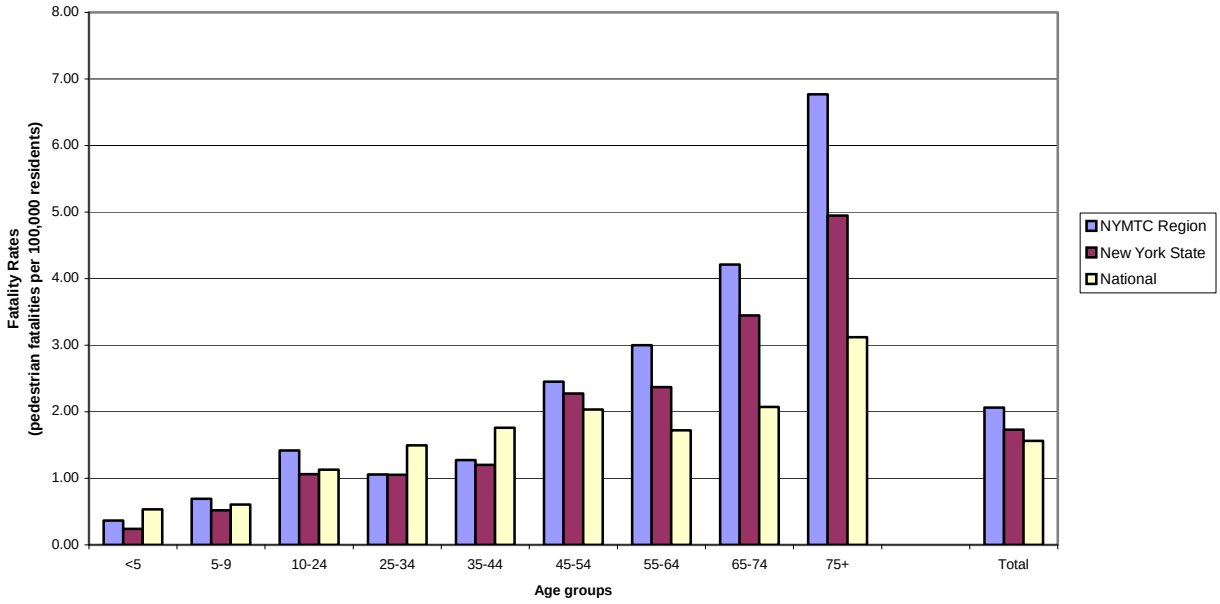
The pedestrian fatality rate for the NYMTC Region (see Figure 2.5) increases with age. The overall pedestrian fatality rate in the region (shown in the bars at the right of Figure 2.5) is higher than the rate for both New York State and the nation as a whole by a small amount, but the increase in the fatality rate with age is much more pronounced in the NYMTC region than it is in the nation as a whole.

Figure 2.4 Pedestrian Fatality and Injury Rates by Age of Pedestrian and Location in Region (Total pedestrian fatalities plus injuries per 100,000 residents in 2004)



Source of Data: GTSC, FARS, and U.S. Census

Figure 2.5 Pedestrian Fatality Rates by Age of Pedestrian
(Total pedestrian fatalities per 100,000 residents in 2004)



Sources: of Data: GTSC, FARS, and U.S. Census

III. ORGANIZATIONS FOR PEDESTRIAN SAFETY IN THE REGION

3.1 Agencies and Programs Concerned with Pedestrian Safety

Federal Level

Safety is part of the mission of the U.S. Department of Transportation; pedestrian safety is dealt with by two of the administrative branches of US DOT, the Federal Highway Administration (FHWA) and the National Highway Transportation Safety Administration (NHTSA). These agencies play a vital role in pedestrian safety within the region because: they help to set the agenda and policy in transportation; they support research and provide information from the research about effective countermeasures; and they provide funding that can be used for improving pedestrian safety. From the point of view of safety, FHWA concentrates on the roadway system, while NHTSA concentrates on the vehicle and the driver.

As noted earlier, the Federal Transit Administration (FTA) is not part of this project as this study's scope concentrated on pedestrian/vehicular conflicts in the roadway environment. Information on FTA's transit safety can be obtained through their homepage (http://transit-safety.volpe.dot.gov/).

FHWA has declared safety to be both a strategic goal and one of their "vital few priorities." The other two vital few priorities are congestion mitigation and environmental stewardship and streamlining. The vital few are those areas where FHWA believes it can make the greatest improvements, and these are the areas where they will concentrate resources. Under the safety priority, three areas have been identified: intersections, pedestrians, and run-off-the-road crashes. FHWA set a goal to reduce pedestrian accidents by 2003, which was not met. In 1998, realizing that it was not going to be met, they decided to reset the goal to a 10 percent reduction by 2008 and to focus on those states and cities with the highest crash statistics.

> The pedestrian safety goal of the Federal Highway Administration (FHWA) is to continually improve highway safety by reducing pedestrian crashes, fatalities and injuries by 10 percent by the year 2008, saving 465 lives. Doing so helps us achieve our overall goal of reducing roadway related fatalities from 1.5 per 100 million vehicle miles traveled (VMT) to 1 per 100 million VMT by the year 2008. Ensuring safe travel on roadways is the guiding principle throughout the FHWA. Pedestrian fatalities account for about 11 percent of all traffic fatalities and are one of the "Vital Few" focus areas of the FHWA's Safety Office. Walking is a legitimate mode of transportation. Pedestrian facilities need to be improved in every community in the United States. It is not acceptable that close to 5,000 pedestrians are killed in traffic every year, that people with disabilities cannot travel without encountering barriers, and that a desirable and efficient mode of travel is often made difficult and uncomfortable.
>
> [Source: FHWA Pedestrian Forum available at: http://safety.fhwa.dot.gov/ped_bike/ped/pedforum/pedforum_spring06.html]

At the national level, FHWA has sponsored research on pedestrian safety and has produced many resources on the topic, most available on their web site. Appendix D includes the links to several of the resources including PedSafe, a design manual for addressing pedestrian safety problems, "How to Create a Pedestrian Safety Action Plan," and a web page with links to "Exemplary Pedestrian Plans." They also have prepared a large amount of educational and promotional material, including the Pedestrian Safety Roadshow, which has been conducted at three sites in New York State.

FHWA has designated New York State as one of the focus states for pedestrian safety based on crash statistics. As a focus state, New York, both state and city, will receive additional attention and resources. One of the activities that FHWA sponsored in New York was the Domestic Pedestrian Safety Scanning Tour, in which seven representatives from transportation or related agencies in New York State toured six cities around the United States to identify innovative approaches to pedestrian safety.

The National Highway Transportation Safety Administration (NHTSA) has a number of activities related to pedestrian safety. At the national level, NHTSA houses the National Center for Statistics and Analysis (NCSA), which is the home of national crash data (Fatality Analysis Reporting System, FARS, and the General Estimates System, GES, which includes injury crashes). NHTSA also provides safety grants to states, including Section 402 formula grants to support state safety programs. They fund demonstration projects including three projects concerning older pedestrians in Madison, Wisconsin; San Francisco, California; and Henderson County, North Carolina. They maintain safety materials related to pedestrian safety on their web site, including educational brochures.

The regional NHTSA office, Eastern Region, (located in White Plains) is primarily involved in providing technical assistance and resources to agencies responsible for enforcing traffic laws, and as well as to agencies and organizations involved in educating the public on traffic safety issues, including pedestrian safety issues.

State Level

At the State level, two agencies responsible for pedestrian safety are the New York State Department of Transportation (NYSDOT) and the Governor's Traffic Safety Committee (GTSC).

NYSDOT has included pedestrian safety as part of their mission since the early 1990's. Their Pedestrian Program is based in the Office of Program Development and Management Community Assistance Delivery Bureau and has a Pedestrian Specialist. The State also has a Safe Routes to School Coordinator and a bicycle and pedestrian coordinator in each region.

Chapter 9 (Making Walking and Street Crossing Safer) of the New York State Comprehensive Highway Safety Plan (NYSDOT, 2005) describes the NYSDOT pedestrian strategies and efforts as well as those from those of other agencies around the state. The strategies (paraphrased from the plan) include:

- Updating and creating new standards that include pedestrian safety
    - Inclusion of pedestrian considerations in their engineering instructions (e.g., EI 04-011: Procedural Requirements for Pedestrian Accommodation) and providing the Pedestrian Generator Checklist to assist engineers in determining when accommodation is needed.
    - Issuing an EI for Sidewalk Construction and Maintenance for State Highways
    - Issuing an EI for Maintenance and Protection of Pedestrian and Bicycle Traffic in Work Zones
- Working with NYS Department of Health and partners such as Healthy Infrastructure to create physical environments that support healthy, active lifestyles.
- Addressing the issue of the impaired pedestrian as part of the impaired driving program
- Supporting and encouraging active public outreach and training in pedestrian safety
    - Partnership for Walk our Children to School
    - Pedestrian Road Shows
    - Safety City (a NYCDOT program)
    - Walkable Communities Conference
- Developing programs to improve pedestrian safety at intersections and interchanges
    - Installation of countdown signals at all new pedestrian signal installations and retrofits on State highways
    - Use of supplementary pedestrian crossing channelization devices (also called in-road signs – see Section 5.2.5 for description) at unsignalized and mid-block crossings
    - Replacing signalized intersections with roundabouts.
    - Providing training to engineers and local highway officials in pedestrian facility design and traffic calming design and engineering.
- Supporting new legislation
    - Yield to pedestrian law. Passed in 2003, the law requires motorists to yield to pedestrians anywhere in an unsignalized crosswalk.
    - Safe Routes to School. The program was incorporated into the Transportation Law in 2004.

The Comprehensive Highway Safety Plan also calls for updating the 1997 NYS Bicycle and Pedestrian Master Plan and re-activating the NYS Pedestrian and Bicycle Working Group.

In March 2006, the NYS Highway Design Manual Chapter 18 (Pedestrian Facility Design) was updated to include many recent engineering practices and countermeasures for pedestrian safety.

NYSDOT has 11 regional offices, including three in the NYMTC region: Region 8, which covers the lower Hudson Valley including Putnam, Rockland, and Westchester Counties as well as four other counties (Columbia, Dutchess, Orange, and Ulster) not within the NYMTC region; Region 10, which covers the Long Island counties of Nassau and Suffolk; and Region 11, which covers the five counties of New York City. While there are projects in all three regions that affect pedestrian safety, Region 10 has a program specific to pedestrian issues, a three million dollar per year grant program for traffic calming and bicycle/pedestrian safety projects on local roads. In Region 11, most pedestrian safety work is conducted by New York City Department of Transportation. Although all three regions have a bicycle and pedestrian coordinator,

transportation safety on state highways, including pedestrian safety, is ultimately the responsibility of the Regional Traffic Safety group.

The role of the bicycle and pedestrian coordinator is to be an advocate for pedestrians and bicyclists and a resource for the NYSDOT Region and local governments. The bicycle and pedestrian coordinator typically has other, additional job duties. The Regional Traffic Safety group does the Priority Investigation Location (PIL) and High Accident Location (HAL) investigations and analyses and investigates complaints from the public. The bicycle/pedestrian coordinator generally provides assistance to "Traffic" when a specific safety problem is identified that involves bicycle and/or pedestrian issues. The coordinator also provides input regarding the safety of designs under development and general programmatic safety issues such as crosswalk policy, traffic signal operations/equipment policy, sidewalk and shoulder policy, trailway design and policy, etc. The coordinator also reviews draft Initial Project Proposals for bicycle/pedestrian issues in project scopes.

A second state agency that deals with pedestrian safety is the Governor's Traffic Safety Committee, created in response to National Highway Safety Program, established in 1966.

> In New York, the Governor's Traffic Safety Committee (GTSC) coordinates traffic safety activities in the state. The Committee is comprised of the heads of thirteen state agencies with missions related to transportation and safety. The GTSC is chaired by the Commissioner of the Department of Motor Vehicles (DMV), and as a state department is also housed in the DMV. The Committee promotes and supports the state's highway safety program to provide for the safe transportation of people and goods on New York's roadways. The Committee acts as the state's official liaison with the National Highway Traffic Safety Administration. [Quoted from GTSC's web page: http://www.safeny.com/overview.htm]

The top priorities of the GTSC Highway Safety Strategic Plan (GTSC, 2006B) include "improving the safety of pedestrians." This is made more specific in three specific performance goals, that from 2004 to 2010, the state will:

- Reduce the number of pedestrians killed in traffic crashes statewide from 326 to 295
- Reduce the number of pedestrians killed in traffic crashes in New York City from 149 to 125.
- Reduce the number of pedestrians injured in traffic crashes from 16,665 to 15,000.

The GTSC works through 59 Traffic Safety Boards (TSBs), which are composed of transportation and safety professionals from the locality. Outside of New York City, each county has a TSB; New York City has several TSBs, one for the city as a whole and one for each borough. GTSC recognizes two of them, the TSB for all five boroughs and the TSB for Queens. The county executive or chair of the county legislative body appoints the TSB members and chair. The TSBs typically have from five to 20 members; the intent is that the members come from different organizations and have different points of view. Most of the funding from NHTSA for local projects is distributed by GTSC though the TSBs. (See Section 6.2: Funding Sources for details.)

GTSC, along with NYSDOT and the New York State Department of Health, is in the process of forming a statewide pedestrian advisory group.

The New York State Metropolitan Planning Organizations (NYSMPOs) is a coalition of all thirteen MPOs in New York State. The NYSMPOs advance initiatives through working groups and pool financial resources for training, planning and research. The NYSMPOs Safety Working Group (SWG) meets monthly to share information and advance safety initiatives.

In June 2005, the NYS MPO's annual forum focused on strategies for integrating safety into the traditional transportation planning processes. The top recommendation was that all MPOs consider establishing a systematic process for addressing safety. Several specifics having pedestrian implications are: adequate, timely, and geocoded crash data (TraCS); annual audits of high-crash locations and locations identified by the community; development of relationships with the county Traffic Safety Boards (TSBs), which will give MPOs access to TSB education and enforcement capabilities; provision of training for transportation planners on effective safety countermeasures; and development of tools that support the MPOs and encourage them to examine the data and establish safety priorities.

A Safety Roundtable at this year's NYS MPO's annual meeting continued the discussion with statewide stakeholders on those statewide issues: MPO/TSB relations, data, TraCS, Strategic Highway Safety Plan, safety audits, accident rates, information sharing, and public service announcements. NYSMPO will continue to advance goals on the items noted above to include a statewide campaign regarding pedestrian safety with local public service announcements the Spring of 2007. As an MPO, NYMTC participates in NYS MPO's monthly Safety Working Group meetings.

<u>New York Metropolitan Transportation Council (NYMTC)</u>

Besides undertaking this project, NYMTC has two working groups related to pedestrian safety, the Pedestrian/Bicycle Working Group and the Safety Advisory Working Group.

In September 1995 NYMTC established the Bicycle/Pedestrian Working Group to develop an improved update of the bicycle/pedestrian element of the MPO long range plan. In addition, its mission is to increase interagency and regional cooperation on bicycle and pedestrian issues.

The background and purpose of the SAWG was noted on the first page of this report. Although SAWG initiated this project to address its top concern, the issue of pedestrian safety overlaps the mission of both working groups and therefore requires coordination.

NYMTC annually produces its Regional Transportation Statistical Report, which contains tables of crash data including pedestrian numbers.

Additionally NYMTC sponsors pedestrian-related training workshops: Walkable Communities, Safe Routes to School, Designing Streets for Pedestrians Safety, and Road Safety Audits.

Walkable Community Workshops are four hours long and help groups of elected officials, local government staff, and citizens analyze pedestrian conditions of their community and identify needed improvements. There are three basic components of the workshop: a presentation, a

discussion of opportunities and obstacles, and identification of local issues and proposed solutions. Following each workshop, a "pedestrian audit" or walking field trip is conducted to show how the solutions can be applied. The participants make up a cross-section of their communities and typically include local government representatives, local businesses, nonprofit organizations with interests in the pedestrian and bicycling communities, and local residents.

Safe Routes to School workshops are typically half a day long and focus on improving children's commute to school. Safe Routes to School programs motivate children to walk or bike to school, encouraging an active and healthy lifestyle. At the same time, Safe Routes to School programs facilitate the planning, development, and implementation of measures to increase the safety of child walkers or bikers. The impact of these programs stretches far beyond the one-day kickoff as communities operate their own Safe Routes to School programs and develop their own initiatives for making their communities healthier and more pleasant places to live.

Designing Streets for Pedestrian Safety is one option of FHWA's Pedestrian Safety Action Plan Project which produced a "How-to-Guide" that explains the steps that an agency needs to take to reduce pedestrian crashes. This training can help the agency develop a safety action plan that will change the way the agency approaches pedestrian safety, or train their engineers and designers to provide pedestrian safety in their roadway design, or both. Instructors spend two days teaching attendees roadway designs that affect pedestrian safety, and cover effective countermeasures in great detail. The second day also includes a site visit to a problematic location where the participants suggest candidate countermeasures. Relevant crash data, traffic data and other relevant information on the pre-selected locations, as well as condition and collision diagrams, are utilized for the field exercise. A policy change exercise is also conducted as part of the workshop.

The Designing Streets for Pedestrian Safety workshop has led to changes in the way pedestrian facilities are designed and are included in projects already, as the following comment from a workshop participant indicates.

> The pedestrian safety workshop was very useful for our county road improvement projects. Pedestrian activity is increasing, and the need for sidewalks is being considered along several of our projects that are now in the design stage. On one project, we needed to evaluate whether occasional pedestrians could be accommodated with a shoulder or provide a sidewalk. The decision was made to provide a sidewalk instead of a 5' shoulder. The sidewalk will terminate at a proposed roundabout at the north end of the project, and the training material will be helpful in designing the sidewalk.

The Road Safety Audit workshop is similar to the two-day workshop described in the previous paragraph except it does not focus exclusively on pedestrians. The workshop starts with one-day in-house instruction followed by a second-day site visit that uses the relevant data and supplemental information to analyze a pre-selected problematic location. This course stresses the value of building a multi-disciplinary team to conduct the audit, including traffic engineers, planners, local community groups, and law enforcement officials. The inclusion of different disciplines ensures that solutions will be drawn from a wider range of approaches and will reflect community values and context sensitivity beyond traffic engineering. Also the audit emphasizes

getting input from people who have daily experience at the location, for example, police officers who direct traffic there. The end product is a report that identifies safety issues and may include suggested improvements.

County Level

Each of the five NYMTC counties outside New York City handles pedestrian safety a little differently. Although the agencies interviewed in several of the counties indicated that they do not have a formal pedestrian safety program, all of the counties have Traffic Safety Boards that actively deal with pedestrian safety issues.

Nassau County: The Traffic Safety Board acts as a safety forum, and pedestrian safety is one of their primary issues. The Nassau County Police also are particularly active in the area of pedestrian safety. Among other activities, they operate Safety Town, which is a model educational program. See Section 3.4 for a description of Safety Town.

Putnam County: The Traffic Safety Board deals with pedestrian safety; however, few people walk, and pedestrian crashes are very low (there were two pedestrian fatalities and 13 injuries in 2004, the lowest of any of the NYMTC counties), so pedestrian safety has a lower priority compared to other traffic safety issues.

Rockland County: The County Departments of Transportation and Planning do not have a formal pedestrian safety program, but they are working to improve pedestrian safety through activities of the Departments of Health, Highway, and Planning. The Highway Department's mission includes safety. Although Rockland County also has relatively few pedestrian crashes, they anticipate an increase in the future with new developments and the rapid increase in the older population (Rockland has the fastest growing older population in the state).

Suffolk County: The Department of Public Works does not have a pedestrian safety program, but their awareness of the issue is increasing.

Westchester County: There is no formal pedestrian safety program among the agencies interviewed, but several of the Westchester agencies have been actively implementing pedestrian safety projects. The Westchester County Department of Public Works Traffic Safety Office has identified pedestrian safety as a priority area and is providing safety outreach and educational programs to the community as a component of their GTSC grant entitled Promoting Roadway Safety. See Section 3.4 (Education) for more detail. Additionally, the City of White Plains recently won a commendation for pedestrian safety from the Automobile Club of New York.

New York City

New York City Department of Transportation (NYCDOT): NYCDOT has multiple units with responsibility for pedestrian safety. Because pedestrian safety is so important in New York City, it is included as an integral part of all NYCDOT programs. However, some programs have a

stronger pedestrian orientation; these include Safety Education and the newly created Safety and Street Management Division.

The first of NYCDOT's five goals is to:

> Provide *safe*, efficient, and environmentally responsible movement of *pedestrians*, goods, and vehicular traffic on the streets, highways, bridges, and waterways of the City's transportation network. [Source: NYCDOT Web page: http://www.nyc.gov/html/dot/html/about/dotdoes.html]

In 1991, NYCDOT had a goal of reducing traffic fatalities by 2000 fatalities per ten years by the year 2000. This goal was exceeded as fatalities over the decade were reduced by 2618 for the ten-year period (from the number of fatalities that would have occurred if the 701 fatalities that occurred in 1990 continued over that ten year period).

New York City Department of City Planning – Transportation Division: The staff of the Transportation Division of City Planning is organized into teams, one of which is a Bicycle and Pedestrian team. Additionally, when the traffic engineering team works on a project involving pedestrian issues, they include pedestrian safety in their planning.

New York City Department of Parks and Recreation: There is no formal pedestrian safety program; however, they are responsible for pedestrian planning and safety within park boundaries. They have done a study of impact of vendors on pedestrian congestion.

New York City Police Department (NYPD): The NYPD has instituted a Traffic Stat Program, which holds precinct commanders responsible for traffic crashes in their precinct. The program is discussed in more detail in Section 5.4.1 (Strategies and Technologies: Traffic Safety Teams).

Regional Agencies

Port Authority of New York and New Jersey: The Port Authority addresses pedestrian safety within their Traffic Safety Improvement Program. They are responsible for pedestrian safety at all Port Authority facilities including airports, terminals, bridges, and tunnels. They have also undertaken pedestrian safety projects near their facilities in conjunction with local agencies in New York State or New Jersey. The Port Authority has an exemplary Traffic Safety Improvement Program (TSIP), which has received an award from the Institute of Transportation Engineers (ITE). The TSIP consists of the following components:

1. Planning
    a. Analysis of crash data (using AAMS; see below)
    b. Safety audits of signalized intersections
    c. Identification of deficient or missing roadside safety hardware
2. Implementation
    a. Develop mitigation measures for priority crash locations from annual crash report
    b. Develop enhancements for traffic control devices
    c. Replace and refurbish roadside safety hardware
3. Evaluation
    a. Performance measures:

i. 20% of priority crash locations mitigate per year
ii. 60% reduction in crashers per location
iii. 20 signalized intersections audited per year

b. Accident Analysis and Mitigation System (AAMS)

The Accident Analysis and Mitigation System (AAMS), a crash analysis and database, also won awards, one from ITE and one from the Association of Transportation Safety Information Professionals (a committee of the National Safety Council). AAMS is described in more detail in Section 3.2 (Pedestrian Crash Data).

New Jersey Agencies

Northern Jersey Transportation Planning Authority (NJTPA): NJTPA has a unit dedicated to pedestrian issues and another dedicated to safety issues. One of their eight Capital Investment Principles is to support walking and safety is an emphasis area. They fund local community projects, many of which are pedestrian projects; all projects include safety components. The Bicycle/Pedestrian Technical Advisory Council (managed by the Voorhees Institute) addresses pedestrian safety issues. The Voorhees Transportation Center at Rutgers University is a clearinghouse of New Jersey and national bicycle and pedestrian information. Funded by NJDOT, they maintain a library of videos on safety, including pedestrian safety. http://www.njbikeped.org/

New Jersey Department of Transportation: NJDOT has a Pedestrian Task Force with the following mission:

> "To support walking as a safe, convenient, and sustainable form of transportation that increases our state's livability, enhances public life, and improves public and environmental health. We seek to improve New Jersey's pedestrian environment through education, collaboration, policy, activism, and advocacy." [Source: Questionnaire response by S, Davis, NJDOT, 4/5/06]

NJDOT has established a Safety Impact Team, a multi-agency group that investigates crashes. The Safety Impact Team will be discussed under best practices. All of the New Jersey agencies described in this section are members of the Safety Impact Team.

New Jersey Department of Law and Public Safety, Division of Highway Traffic Safety (DHTS): This is the New Jersey counterpart of the NYS Governor's Traffic Safety Committee. Pedestrian safety is a priority; pedestrian fatalities in New Jersey are 21.2 percent of total fatalities, the same proportion as in New York State. NJ DHTS is primarily involved in educational projects.

New Jersey Transit: NJT has a Bus Safety program that is also concerned about pedestrian safety. They inform passengers and educate bus drivers about pedestrian safety.

Non-Governmental Organizations

Transportation Alternatives: Transportation Alternatives is a bicycle and pedestrian advocacy group with the mission of improving walking and biking in New York City. They have many projects specifically about pedestrian safety or related to it, such as Safe Routes to School and

Safe Routes for Seniors. They also promote pedestrian safety through media campaigns and postcard campaigns. They maintain maps on their web site that plot the high pedestrian crash locations from 1995 to the last year data is available, using NYS Department of Motor Vehicle data (CrashStat, available at: http://www.transalt.org/crashmaps/index.html).

Automobile Club of New York: The AAA has several activities related to pedestrian safety, including educational programs for children, a Community Traffic Safety Awards program that frequently makes awards to communities for projects that reduce pedestrian crashes, and advocating for traffic calming. In 2005 New York City won a Platinum safety award for reducing pedestrian injuries by 23 percent and pedestrian fatalities by 16 percent as well as instituting Access Safety City (see more in Section 3.4: Educational Programs). Similarly, Yorktown, in Westchester County, won a Platinum award for reducing pedestrian injuries by 82 percent along with an impaired driver program. The AAA Foundation of Traffic Safety has also been involved with an evaluation study of countdown signals along with ITE; one of five case study sites is the City of White Plains.

Safe Kids Coalition: Safe Kids is an international organization that has local representatives in organizations with similar interests. In the NYMTC region the representatives are typically from a hospital or other health agency, although the Safe Kids representative for New York City is in NYCDOT. Safe Kids' mission is to reduce preventable injuries to children under 14 years old. Each locality determines what the high-risk activities for children are in their region, and they become the five major focuses for the local Safe Kids program. Pedestrian Safety is a high-risk activity and a focus area for Safe Kids programs in New York City and Nassau, but not, for instance, for Safe Kids Suffolk. The Safe Kids organizations activities are mostly educational. For example, Safe Kids New York City participates in the Walk to School program, attends health fairs, and talks to parents and pregnant women about being role models for their children.

3.2 Pedestrian Crash Data

The most common source of crash data for the agencies interviewed was the NYSDOT Safety Information Management System (SIMS). The NYS Department of Motor Vehicles (DMV) is the initial collector of the data. DMV is required by law to collect all reportable crash reports; the crash data is kept in the Accident Information Systems (AIS). The AIS data is the basis of the SIMS database.

The core of the data is from police reports. The police are required to report all fatal and injury crashes, using the MV-104 form issued by DMV.

They often report property damage only (PDO) crashes also; prior to May 31, 2002, these were also entered into the AIS database, but after that date, only reportable accidents were entered. Motorists are required to report crashes that result in over $1,000 of property damage. NYSDOT would like to include all crashes in the SIMS database.

The AIS data is more comprehensive; for example, they have more data on persons with injuries. However, SIMS has better information on crash location. For state highways, the crashes are

located by reference marker (the small green and white signs located every one tenth mile on divided highways and every two tenths mile on two lane roads. For local roads, the locations are indicated using a link-node system. The location data in SIMS is not in GIS format, but it could be.

NYSDOT personnel can access the SIMS data by a password. Municipalities and other agencies need to make a formal request for the data, which generally takes a few weeks.

The interviews identified several problems with the data. The most commonly cited problem was the timeliness of the data. In the recent past, the SIMS data has not been available for up to three to four years after the crashes occurred. This has been a severe problem for agencies trying to judge the safety impact of a recent improvement or trying to address problematic locations in a timely manner. It should be noted that NYSDOT and NYS DMV have made improving this a priority, and in December 2006 reported that the database is up to date, within the limits of the reporting procedures.

A second problem is its incompleteness, particularly for crashes on local roads. The crash reports do not have enough detail. Often the local transportation department has investigated the site, but this data is not included with the electronic file. Also, people who are severely injured or unconscious are typically taken to the hospital before the police collect information from them. Once the injured person is in the hospital system, information on them is confidential, unless the person dies. Since a pedestrian is more likely to seriously injured than a vehicle occupant, this affects pedestrian crash data more; one result of this is the probable underreporting of pedestrian crash participants who are impaired by alcohol or drugs.

A third problem is that there is no readily available data on exposure for pedestrian crashes. Vehicular crash rates are calculated based on crashes per vehicle miles traveled or sometimes on crashes per licensed drivers. For a particular roadway link or intersection, daily or peak hour traffic volumes could be used as a measure of exposure. For pedestrian crashes, pedestrian volumes are rarely available. The common measure of exposure is residential population, but it is a poor substitute for the number of pedestrians in an area and even worse for trying to compare accidents in different locations within a local pedestrian network. A better measure, although not as easy to find, would be daytime population. Other suggestions include the percent of population that walks to work or the sum of the percent who walk or use transit or a measure of land use or retail activity.

Another way to address pedestrian exposure is through a new modeling approach that estimates pedestrian flows for a large area of a city. The goals were to develop a pedestrian demand model that uses readily available data and to provide tools for enhancing the data to account for actual pedestrian and street network conditions. The model was applied for demonstration purposes in Baltimore and Langley Park, Maryland. In each case about 10 square miles of the city were modeled. The model is based on a traditional four-step process (trip generation, distribution, mode choice, assignment) and integrated with GIS mapping as well. The network assignment method replicates the multi-path patterns that pedestrians actually follow, and accumulates flow totals on sidewalks, crosswalks, corner areas, and jaywalk locations. It accounts for the barrier effects of streets and crosswalks, sidewalk quality and continuity, and other walkway factors that

influence pedestrian trip making and route choice. It estimates pedestrian volumes, and then computes pedestrian crash exposure rates for each link. The priority pedestrian crash locations that were identified in this way were considerably different from those that were identified as simply high crash-prone locations, which gave added insight into where actual problem locations occur.

The New York State Department of Health has data on persons with injuries from traffic crashes; however, the database is designed for the use of the health system. It lacks the location and engineering information that would make it useful to transportation agencies. NHTSA has a program that is attempting to link traffic injury data from health systems to crash data from state systems. The linkage is probabilistic, rather than a one-to-one link between injury and specific crash. The program is Crash Outcome Data Evaluation Systems or CODES.

NYSDOT and NYS DMV are introducing the TraCS (Traffic and Criminal Software), an electronic data collection and communication system developed by US DOT and the state of Iowa. Hardware in the police vehicles allows the traffic police to input the crash and violation records directly into an electronic form, which is transmitted via wireless technology to the database. The system also includes forms needed for other activities, GPS ability to establish the crash location, a GIS system, and bar code readers for driver and vehicle information. As its name implies, its applications go beyond crash data collection to criminal activity. The system is being introduced to the many police departments around the state. When its implementation is complete, the problems of crash data timeliness and crash location accuracy should be solved. The system has the following features:

- Ticket and accident form information can be scanned directly into the TraCS system from the 2D bar code on drivers' licenses and vehicle registrations.
- Driver license and vehicle registration data can be immediately searched for matches with files of suspended and revoked licenses and registrations and for stolen vehicle records.
- A diagram tool allows officers to create clear, accurate depictions of accident scenes. Templates of problematic intersections or roadways can be saved for repeated use.
- TraCS includes a location tool with DOT maps for pinpointing exact accident locations. These maps contain X-Y-Z coordinates and other location identifying features.

In July 2003, NYMTC adopted Resolution #172 recognizing and expressing the need for timely and accurate accident data. The resolution urges the NYS DMV to take immediate steps to improve the timeliness of accident data reporting and the resolution encourages it member jurisdictions to work with the NYS Police on taking steps to adopt and deploy the electronic accident reporting strategies that will ensure the long term realization of the most efficient, timely and accurate accident data system. As of July 2006, TraCS is licensed in 248 local police agencies in 54 counties. Additional information can be found on the NYS Police website at: http://www.tracs.troopers.state.ny.us/ .

Some agencies maintain their own crash database. For example, NYCDOT receives crash data within a few days of the crash directly from NYPD; however, it is not as detailed as the AIS data. The NYPD investigates all fatal or likely-fatal accidents, but their first interest is culpability. NYCDOT sends their own team out to investigate the fatal accident sites to ensure

that the proper signage and other traffic control devices are in place and functioning properly. NYCDOT also can get copies of the accident reports (the MV-104 reports); however, the forms are sometimes illegible or incomplete. The NYCDOT database provides comprehensive information on accident statistics, including information on accident factors, vehicle types, and demographics.

Nassau County also has their own crash data, based on MV-104 reports the County police have put into an electronic database. Some village police departments also have electronic crash data, which is combined with the County data. However, other villages collect data with little detail. Nassau County also uses data from the County Health Department; they find this data is much more complete. Their goal is to have all of the data in a GIS system.

The Port Authority of New York and New Jersey also has its own crash database, Accident Analysis and Management System (AAMS). The database includes crashes on Port Authority property. The data is collected by the Port Authority Police using their own motor vehicle accident report form. The crash locations are recorded at the site of the crash by the police marking the exact location on detailed facilities map on letter sized paper. The maps are reproduced from the AutoCAD drawings of the Port Authority facilities. The marked location is used to produce a GIS database of the crashes, which allows them to identify clusters of crashes. The data is entered into the Accident Analysis and Management System (AAMS), which is an SQL database that features AutoDesk MapGuide GIS technology.

New Jersey Department of Transportation maintains a crash database for the state of New Jersey. The data is based on police reports, which are compiled by NJDOT into an Access database and is available on the web. Crash data is available for state, county, and local roads, for about 330,000 crashes per year. Their timeliness is much better than in New York State; crash data from the previous year is available in May. The crash location is not geo-coded; however, location information is getting better as the base maps are improving. NJDOT has a good list of aliases to match locations. NJDOT also has a pilot program of electronic reporting of crash reports.

New Jersey Transit also has their own data on bus crashes. Their database has 22 categories of crashes. They use it for trend analysis.

Transportation Alternatives uses existing data from New York State to plot the locations of pedestrian and bicycle crashes in New York City on maps. In order to identify high crash locations, they use multi-year data, from 1995 to 2001. They have pointed out that maintaining the maps is a drain on their resources and suggested that it might better be done by a public agency.

3.3 Regional Pedestrian Safety Studies and Projects

Every NYMTC county is undertaking projects that either are primarily directed to or have elements for improving pedestrian safety. Some of the more significant projects will be briefly described here.

New York City

Subway/Sidewalk Interface Project (NYCDOT and NYC Department of City Planning, 2005): This project addresses the problem created by the combination of elevated structures with columns in the street and stairs from platform, bus stops where the bus cannot get to the curb, high pedestrian volumes, and poor vehicular sight lines. The solutions include refuge islands, raised medians with bollards, and neckdowns. (Available at: http://www.nyc.gov/html/dcp/html/transportation/td_projectspedestrian.shtml]

Citywide Pedestrian Bridge Safety Project (NYCDOT): The most common safety problem was at the landing (exit/entrance) to the bridges. NYCDOT developed a safety toolbox of remedial measures for addressing safety problems. Measures include staggered fencing design, signs, experimental pedestrian actuated signals, and markings. To date over 30 (out of 122) bridges have received remedial treatment.

Figure 3.1 Staggered Fencing at Foot of Pedestrian Bridge

Safe Routes to School Projects (NYCDOT, ongoing): A consultant is identifying traffic safety issues for children walking to school by looking at traffic accidents near 135 primary schools. This will be continued with the next 135 schools, and followed by a similar study for high schools. The schools selected for this in-depth analysis were those with a history of safety traffic issues. The schools not analyzed in this study are covered by a safety net of initiatives offered through other NYCDOT programs. Another project is assessing the impact of reducing the speed limit from 30 miles per hour to either 20 mph or 15 mph near 10 schools to determine the effectiveness of changing posted speed limits. Reports on the Safe Routes to Schools for individual schools are available at: http://www.nyc.gov/html/dot/html/safety/saferoutes.html

New York City Bicycle Master Plan (NYCDOT and NYCDCP, May 1997): The goal of the plan was to increase bicycle ridership with the objective of improving cycling safety. The safety or suitability of existing roads was ranked using stress level methodology. Although the focus is on bicycles, the off-street facilities accommodate multi-users such as pedestrians. It also includes an appendix on pedestrian safety legislation. (Available at: http://www.nyc.gov/html/dcp/html/bike/mp.shtml)

NYC Greenway Plan (NYCDOT/NYCDCP/NYCDPR, 1993): The Greenway Plan presents the city's vision for the nation's most ambitious urban greenway system of 350 miles of landscaped bicycle and pedestrian paths crisscrossing New York City. Priority routes have been identified

and funding has been secured to advance some of them. The Department of City Planning, the New York City Department of Transportation and the Department of Parks and Recreation have comprehensive programs to refine the preliminary plan, examine the feasibility of some of its components, create master plans to guide development, and implement portions of the greenway system. Although this plan is one of the older plans listed in this section, it identified the need for design standards and developed a public awareness program including safety information.

NYCDOT also publishes an annual report on safety improvements, which includes crash statistics and safety projects throughout the city. NYCDOT has accelerated its efforts to improve pedestrian and traffic safety at locations that have repeatedly been the site of traffic or pedestrian-related accidents. These efforts have sharply reduced the number of traffic-related accidents and fatalities. The most recent report, Safe Streets NYC, is available at: http://www.nyc.gov/html/dot/html/safety/safety.html.

Bronx

Grand Concourse Pedestrian Safety Demonstration Project (NYCDOT): The width of the service roads was decreased in order to slow down vehicle traffic, reduce pedestrian crossing distances, and increase refuge areas. Pedestrian accidents have decreased from 26 in 1998 to 14 in 2001.

Brooklyn

Pedestrian/Traffic Safety Mitigation Project (Urbitran for Borough of Brooklyn, 2002): Three of the top accident-prone intersections were analyzed. Recommendations included reconfiguration of lanes, changes to signal timing, high visibility crosswalks, curb extensions, new signage, and safety education.

Downtown Brooklyn Traffic Calming Study (Arup for NYCDOT, 2004): A comprehensive areawide Traffic Management Plan was developed, which included pedestrian safety improvements. The improvements including neckdowns (sidewalk extensions at corners), leading pedestrian intervals, and the reclamation of space for pedestrians have been implemented. Other improvement measures are being advanced through the City's Capital Program (http://www.nyc.gov/html/dot/html/motorist/dntnbklyntraf.html).

Manhattan

Lower Manhattan Pedestrianization Study (NYCDOT and NYC Department of City Planning, 1997): Although this project was completed in 1997, it is still referred to as a model project. The recommendations included neckdowns, signalization changes, removal of obstructions. These improvements to the pedestrian circulation system are complemented by the redesign of downtowns streets developed by the area's Business Improvement District.

Safe Routes for Seniors (Transportation Alternatives and NYS Department of Health): The goal of the project is to encourage seniors to walk. One of the results is recommendations for changes in design standards to make the streets safer for older pedestrians.

Queens

Queens Boulevard Pedestrian Safety Study (NYCDOT): Queens Boulevard is probably the most widely know pedestrian safety problem. The initial phase of the NYCDOT study of Queens Boulevard commenced in 1997 and was completed in 1999. A second phase began in 2002 and was completed in 2005. The Department has implemented improvements including installation of leading pedestrian intervals, increased signal cycle lengths to 150 seconds to increase pedestrian crossing time, closure of some cross streets, and installation of pedestrian fencing. Additional improvements are being advanced through the City's Capital Program. The number of pedestrian fatalities has decreased from 18 in 1997 to two in 2005.

Mid-Hudson South (Putnam, Rockland, and Westchester Counties)

Mid-Hudson South Region Bicycle and Pedestrian Master Plan (2001): Increasing pedestrian and bicycle safety was one of the objectives of the study. As well as an inventory of pedestrian and bicycle projects, the study has design strategies that address pedestrian safety, and it highlights the need for pedestrian safety strategies near downtowns and transit hubs.

A regional trailway system has been under development in MHSTCC for many years. The North County Trailway, South County Trailway, Putnam Trailway, Palisades Trailway and others are either complete or under construction. The Greenway Trail also extends through the Hudson Valley. NYSDOT Region 8 publishes the *Hudson Valley Bikeways and Trailways* map which shows all bikeways and trailways and provides safety education on rules for biking and walking.

Putnam County

Putnam County has an extensive trailway construction program underway as well as municipally generated sidewalk programs in village and hamlet areas. The Town of Carmel improved and extended sidewalks on Route 52 in the Hamlet of Carmel in cooperation with NYSDOT. NYSDOT, Putnam County, and the Town of Carmel are studying safety improvements on Routes 6 and 6N.

Rockland County

Rockland County and NYSDOT have several highway and bridge projects that include sidewalk or crosswalk improvements. The Rockland County Department of Planning routinely reviews capital projects in the TIP to ensure that sidewalks are included in major reconstruction projects.

Westchester County

Central Park Avenue Plan – Yonkers: Each pedestrian crossing was examined and recommendations for improvements were made. Countdown signals and dropped curbs included at each intersection. Some crossing locations are being moved to increase pedestrian way continuity.

Westchester County and NYSDOT have completed the North County Trailway and the County is in the process of completing the South County Trailway. The Westchester County Planning Department reviews capital projects on the TIP to ensure that sidewalks are included in major reconstruction projects. NYSDOT is completing a pedestrian bridge over the Taconic State Parkway in Yorktown as a link in the local trailway network.

NYSDOT and the Village of Ossining have been studying pedestrian safety problems on Route 9 in Ossining. Some improvements have been made. Other more extensive improvements are being discussed.

Long Island

Long Island Non Motorized Transportation Study (NYMTC and NYSDOT, On-going): The goal of the Long Island Non-Motorized Transportation Study (LINMTS) is a safe, efficient, and comprehensive regional network for pedestrian, bicycle, and other non-motorized modes of travel. The study represents the interests and ideas of pedestrians, bicyclists, advocates for the disabled, mass transit, urban planners, environmentalists, traffic engineers, health care professionals, community and citizen leaders, public safety, bicycle shop owners, and even automobile interests—from both Nassau and Suffolk counties. It used safety ratings and other criteria to select 10 priority corridors for more detailed analysis and conceptual design work from a larger group of 100 corridors. It also addresses Safe Route to Schools and developed a model local bicycle and pedestrian policy.

Nassau County

Pedestrian Injuries and Fatalities in Nassau County (Nassau Health, 2005): Crash data was used to map clusters of pedestrian injuries and fatalities.

3.4 Educational Programs

NHTSA, along with the corresponding non-federal agencies of GTSC and the Traffic Safety Boards, are primarily involved with educational programs. Most of the local agencies are involved with distributing flyers or visiting classrooms to talk about safety with young children. The more major programs or innovative programs will be discussed here.

Programs for School Children

Safety Town, Nassau County: Safety Town, located in Eisenhower Park, was started in 1972 by the Nassau County Police Department to teach children about bicycle and pedestrian safety. It is geared to third graders, the age when children typically begin to ride their bicycles in the street. The half-day sessions start with an hour classroom lecture about safety. The children then go outside for three modules: pedestrian (street crossing); bicycling; and driving cars (electric small size cars). The “street” and sidewalk network has 2000 feet of roadway and 3000 feet of sidewalks, with marked crosswalks, stop signs and two signalized intersections. After rotating through the three modules, the students return to the classroom for an interactive “quiz” session.

Children receive a certificate upon completing the session. Safety Town typically handles two classes at a time, for four classes per day; most Nassau County third graders receive training at Safety Town. In the summer Safety Town conducts other classes, and children who missed the regular sessions as well as older children and adults can sign up to attend a summer session. They have anecdotal evidence of its effectiveness from emergency room inquiries: when children are brought to local hospitals after pedestrian or bicycle crashes, they are asked if they have attended Safety Town; they seldom have.

Safety City, New York City: NYCDOT operates six Safety Cities, two in Manhattan and one in each of the other Boroughs. NYCDOT and Harlem Hospital started the first Safety City program in Harlem in 1989. The Safety Cities are located in schools, a hospital, and a park. The sessions are from 10 AM to 1 PM and two third grade classes participate in a session. The sessions are adapted to the location: For example, the Staten Island Safety City has more emphasis on bicycles than Manhattan, and also includes training getting on and off school buses. Recognizing that third graders often travel to school without adults, the curriculum lessons stress decision-making techniques and self esteem building. A session starts in the classroom for an hour interactive lecture on safety, and includes a video on safety. After that they go outside, and rotate through three modules: Crossing a street at a signalized intersection; bicycle riding; and use of seat belts in the back seat of a car. Upon returning, they eat a lunch, which they brought, with a safety video playing. This is followed by an interactive contest-quiz. By answering questions correctly, children win small prizes, most related to safety. Additionally, each child receives a small bag of safety materials and brochures. Safety City staff will visit them at their school a few days after the visit to reinforce the lessons and to distribute certificates. They used to have a truck at the Harlem site, which was used to show the children that a truck driver cannot necessarily see them when they are close to the front of the truck. Some classes are partially given in Spanish. In one year, 280 classes can visit one site; in a three-year period, all New York City schools will have visited a Safety City. The most recent Safety City is dedicated to people of all ages who have physical, cognitive, and sensory disabilities.

Figure 3.2 Safety City Class

Traffic Safety School Outreach Programs: Traffic safety programs are conducted by NYCDOT Safety Education in schools across the city for children in grades K-2, 4-5, 6-8 and 9-12 (grade 3 is served by Safety City – see above). Both classroom and assembly presentations are provided which cover pedestrian, bike and car passenger safety. Programs for grades K-2 include puppet shows, games and hands-on activities. Programs for students in grades 4-5 include interactive speaker's presentations and traffic safety musical theater shows. Students in middle and high schools participate in a two-day improvisational theater/workshop program. Geographic and demographic traffic accident/injury data for each age group is used to select schools to receive

programs in each borough. The NYCDOT Safe Routes Program database is used to identify grade schools in high priority precincts (with high numbers of pedestrian injuries and fatalities to children). Schools that participate in traffic safety education programs are encouraged to incorporate follow-up activities into the curricula to help reinforce what the children have learned. A variety of educational materials in English, Spanish and other languages including *Yes* and *Yes for Kids* traffic safety magazines, which address traffic safety issues specific to New York City children, are developed by NYCDOT to support school outreach programs. Students are also given materials to share with parents and other adults.

Programs for Older Adults

The NYC Department for the Aging (DFTA) assisted NYCDOT in making a video (and DVD) aimed at seniors, called "There's More to Taking a Walk Than Moving Your Feet: Pedestrian Safety for Older Americans." The video includes seniors from across New York City talking about walking in the City and demonstrating safe pedestrian behavior. The video has been shown at senior centers, health fairs, and other events targeted to older adults.

DFTA and NYCDOT also encourage members of senior centers to submit artwork to NCDOT's annual Traffic Safety Contest; winning art work will be included in NYCDOT's Traffic Safety Calendar.

Community Events

NYCDOT Safety Education hosts and participates in numerous special events, community fairs and health fairs through the year including Walk to School Week events at Safety Cities, and Safe Kids Coalition events. Events generally include activities such as neighborhood safety surveys and traffic safety quizzes in addition to the distribution of pedestrian safety information. The office also holds and annual Traffic Safety Calendar Contest which is open to New Yorkers of all ages, with cash prizes and a special winners ceremony at the American Museum of Natural History.

The transportation agencies in most of the counties participate in Health Fairs and similar events in order to provide information on pedestrian safety. For example, Westchester County Department of Public Works Traffic Safety Office participates in safety days, health fairs, and summer ethnic festivals. Yearly large events include Kids Fair with over 10,000 participants and Salute to Seniors with 6,000 participants. Partnerships with local police departments, schools, senior groups and organizations, such as Safe Kids and Older Driver Network assist with promoting pedestrian safety. Yearly pedestrian safety promotions include Walk to School Day, Safe Routes to School, and Safe Kids Walk this Way. Pedestrian safety issues are also addressed in safe driver programs. In addition, pedestrian safety issues concerning culturally diverse groups are coordinated with County Offices of Hispanic and African American Affairs. Other Westchester programs aimed at at-risk groups include providing safety materials and reflective giveaways at schools, senior centers, libraries, corporations and other community locations and events. Press releases promoting safety are regularly released from the Westchester County Executive's Office.

Private Organizations

Safe Routes for Seniors - Transportation Alternatives: The project includes an educational component, which includes subjects such as interpretation of pedestrian signals and the need to stand back from larger vehicles that are turning.
http://www.transalt.org/campaigns/safeseniors/index.html

Streets for People brochure (Transportation Alternatives): Transportation Alternatives has produced a brochure that explains traffic calming for communities, which is available in English and Spanish. http://www.transalt.org/info/streets4people/index.html

Automobile Club of New York has several educational programs. One is to provide assistance to schools in training safety patrols. The training curriculum includes bus loading and unloading, walking on school property, and safety at nearby intersections.

Education of parents and prospective mothers (Safe Kids): Material on safe walking habits is provided to teachers who give it to the children to take home to their parents. The material stresses being a role model for the children. Also, they work with pregnant women to encourage them to develop safe walking behavior as a lifelong habit for them and their children.

Walk this Way (Safe Kids, sponsored by Federal Express): Safe Kids and FedEx Express provide safety expertise and assist in the collection of research data to document the problems for child pedestrians. On International Walk to School Day, volunteers escort children to and from school.

New Jersey Pedestrian Safety Education Programs

New Jersey transportation agencies do many educational activities similar to those in New York State, as well as a few beyond what is done in New York. A few of the latter are listed below.

- NJDOT, through the Voorhees Transportation Center at Rutgers University, maintains an extensive library of videos and other resources on safety, including pedestrian safety. http://www.njbikeped.org/
- New Jersey Transit includes a pedestrian safety component in their bus driver training curriculum. They also distribute frequent “Safety Bulletins” to the drivers, many of which cover pedestrian safety. A third educational effort is to remind their passengers of safe pedestrian practices (e.g., don’t cross in front of buses) by leaving flyers on bus seats.
- The Division of Highway Traffic Safety sponsors radio spots on safety topics, including pedestrian safety.

IV. PEDESTRIAN SAFETY ISSUES IN THE NYMTC REGION

This chapter presents and describes the pedestrian safety issues in the NYMTC region based on the interviews and public meetings. It should be noted that in several cases people were stating opinions that they did not support with evidence; some of their opinions may be controversial or incorrect. This chapter attempts to fairly represent the input, and therefore included what people said with few qualifications.

In several cases, details from national studies have been included to give increased insight into the regional issues. Additionally, Chapter 2 uses regional and national statistics to describe the level and nature of pedestrian safety and to contrast pedestrian safety characteristics in this region with national characteristics.

The issues have been organized under the following categories: behavioral issues, issues of specific high-risk groups, issues that are specific to a particular situation or location, infrastructure and land use issues, and other issues not pertinent to these categories. As was frequently noted, the NYMTC region varies considerably, from the extreme density of buildings, traffic and pedestrians in Manhattan to rural areas in the further parts of the outer suburban counties; in places the issues are attributed to a specific area, frequently based on the location of the organization that brought the issue. However, many of the issues that one part of the region claimed as specific to their area were also brought up in contrasting areas. Also note that this chapter deals specifically with the problems and issues. Potential solutions are discussed in the next chapter.

4.1 Behavioral issues

One of the most frequently mentioned issues was the behavior of either pedestrians or drivers or both. Many of the behavioral problems are common to both groups; motorists and pedestrians do not respect each other's right of way, and motorists have not absorbed the concept of sharing the road with non-motorized users.

Common issues

Alcohol and drugs are problems for both drivers and pedestrians. There is better evidence for alcohol involvement than for drugs. Nationally alcohol use by either the pedestrian or the driver or both was reported in 47 percent of pedestrian fatalities. The pedestrian had been drinking in 38 percent of the cases, the driver in 16 percent. The overlap of crashes where both driver and pedestrian were drinking was nine percent. (NCSA, 2006) The problem is worse at night; 54 percent of pedestrians killed between 9 PM and 6 AM had a blood alcohol content (BAC) of 0.08 or more (IIHS, 2006). It is probable that limited nighttime visibility is compounding the effect of the alcohol.

Drivers and pedestrians suffer from inattention. Drivers and pedestrians do not always see each other, particularly in cases of cars turning. In suburban areas, making right turns on red makes it even worse because the drivers are concentrating on watching for gaps in the vehicular traffic, rather than on pedestrians. (Note that it is illegal to make a right turn on red in New York City unless otherwise posted.) Cell phone use adds to inattention. Much recent research has looked at the safety impact of drivers using cell phones; people at the public meetings and interviews have commented on the number of pedestrians crossing streets while on cell phones or using personal entertainment devices.

Many representatives of the organizations that were interviewed see lack of enforcement as contributing to the problem. Unsafe behavior continues because the police do not enforce what appear to be small infractions by pedestrians or motorists. Judges are reluctant to fine pedestrians. More specific comments were made about lack of enforcement when cars are turning left. Some comments indicate that traffic police are more concerned about mobility or keeping vehicles moving than they are in pedestrian safety; they point to cases when police will wave vehicles through red lights, in effect eliminating the pedestrian crossing opportunity. Another example given of lack of enforcement was at construction sites, where the contractors have closed sidewalks at mid block without providing a safe walkway. Lack of enforcement is seen as a sign of a lack of political will and the low priority the issue is given.

Resistance to change, a common human trait, affects everyone involved in safety, including drivers, walkers, police, engineers, planners, etc. This reluctance to change our behavior contributes to the many safety problems continuing despite efforts to improve the situation. How many of us jaywalk instead of walking to the crosswalk? Ride our bikes through traffic signals? Drive too fast? Plan and design the way we always have? A conscious focus on safety by all involved as the catalyst to change our own individual behavior seems to be another common thread.

Pedestrians:

Typical statements were: Pedestrians walk where they want. Everyone is in a hurry; many people are not willing to wait for walk signals; they jaywalk.[*] There is a lack of respect for the vehicles. Some pedestrians, particularly teenagers, challenge the rules. When pedestrian fences are added to enforce safe pedestrian behavior, some pedestrians will climb over them rather than modify their path. Pedestrians also cross the street against the "DON'T WALK" signal during left turn phases for cars.

A related issue is lack of knowledge, particularly not knowing what the flashing "DON'T WALK" (or flashing hand) means. Another area where further education is needed is informing the public about what the actuated pedestrian signals do. Pedestrians who press them expect to get a "WALK" signal immediately; when they don't, they assume the signals do not work (which is sometimes true), and therefore cross without the signal, often against the vehicle green or during a left turn phase.

[*] "Jaywalking" is not defined in NYS Law; Section 1152 of the NYS V&T Code states that when crossing at locations other than crosswalks, pedestrians must yield the right of way to all vehicles.

Drivers:

Typical statements about drivers were: Drivers do not respect pedestrians. Turning vehicles do not slow down or stop for pedestrians. They do not give pedestrians crossing with the walk signal the right of way, particularly when vehicles are making left turns

Some drivers' behaviors are specific to the outer suburban counties; for example, vehicles making right turns on red do not give the right of way to the pedestrian crossing with the signal. Research in the eighties correlated legal right turns on red with higher pedestrian fatality rates (cited in IIHS, 2005). Similarly, drivers often ignore signs that restrict right turns on red at a particular location and make the turn anyway. Drivers do not observe or do not obey the requirement to stop at mid-block crossings. Drivers do not stop at signals or stop signs. This was mentioned most frequently in low-density areas, but is not limited to them. In areas with few pedestrians, some of the behavior can be attributed to the drivers' not expecting pedestrians to be there.

Some drivers respond to intense congestion by becoming very aggressive or when there is an opening, driving too fast or recklessly. Aggressive driving such as "jumping" the signal (starting in anticipation of the signal turning green) or speeding is dangerous for pedestrians.

Unfamiliarity with local traffic rules and regulations also affects drivers, particularly concerning the new law that requires drivers to stop for pedestrians in any lane of an unsignalized crosswalk. Some of the drivers who do know there was a change in the law think that they are supposed to stop for pedestrians at any intersection.

In Manhattan, because of fully utilized curbside parking, taxis stop in the traffic lanes to pick up passengers, trucks stop in traffic lanes to make deliveries, and cars stop to pick up or drop off passengers. These stops create sight distance problems for pedestrians and drivers, as well as causing impatient drivers to swerve suddenly to pass the stopped vehicles.

* * *

It is challenging to alter human behavior that results in high-risk, unsafe consequences. It will require education at all levels, from children to older adults.

4.2 Special groups

Children

The highest pedestrian injury rate (injuries per population) from traffic crashes is for the ten to fifteen year olds, followed by the five to nine year olds (NCSA, 2006). The reasons for this, according to the Safe Kids organization (Safe Kids website), are that their cognitive, behavioral, physical, and sensory abilities are still developing. They are impulsive and have not developed judgment about how fast cars are approaching. Additionally, their parents think that they have better pedestrian skills and habits than they actually have (Campbell et al., 2004). The street

environment is a contributing factor; children are most often hit where volumes are high and there are many parked cars.

Comments from this region indicated that children have no sense that traffic is moving faster than they are. They are not taught how to be safe at intersections with atypical configurations. Safety City (operated by NYCDOT) and Safety Town (operated by Nassau County Police Department) do a good job at educating the children, but they cannot handle all of the children who need the training.

People who work with children listed the following behavior problems:

- Dart outs
- Children who are not mature enough to walk safely are on the streets without supervision
- Children do not look for turning cars at intersections

It was noted that in some neighborhoods, children are more afraid of gangs and pit bulls than of traffic. As a result, if they see a threatening situation at the corner (or between themselves and the corner) they may choose to cross the street mid-block rather than confront the gangs or dogs to get to the intersection.

The number of children who have been hit by large vehicles backing up has been increasing. The drivers cannot see the children; the children assume that they are seen. This is true for passenger vehicles (SUVs), buses, and large trucks. A study using data from death certificates indicates that the age group most often killed in backing crashes is the one to four year olds (NHTSA, 2004).

Seniors

The highest fatality rate for pedestrians killed in traffic crashes is for the 80 year and older group, followed by the 70 to 79 year olds. People over 65 represent 12 percent of the population, but 20 percent of pedestrian fatalities. However, the injury rate for the older age groups is not as high as younger adults and considerably lower than that of children. The difference is caused by the frailer bodies of the older pedestrian; in a traffic crash entailing a specific level of energy, the older person has a higher probability of being killed (NSCA, 2006). The older pedestrian in the NYMTC region has a worse safety record than the national record; the fatality rate of the oldest age group per 100,000 residents in the region is more than twice the national rate (6.8 versus 3.1; see Figure 2.4 in Chapter 2).

Research on the older pedestrian shows that functional capabilities among them vary considerably, with some seniors in excellent condition and others barely able to walk. However, there are certain problems that affect safe walking that tend to develop and get worse with age. These include cognitive, sensory (particularly vision), and physical problems, which affect walking in the following ways (Oxley et al., 2004):

- Walking speeds slow
- Balance and agility decrease

- Ability to lift foot high decreases (leading to more tripping)
- Reaction times slow down
- Visual scanning decreases, causing older person to not notice vehicles approaching
- Judging speeds of approaching vehicles becomes more difficult
- Tendency to become distracted or confused increases
- Hearing decreases making them less likely to hear approaching vehicles

As the baby boomers age, the number of older pedestrians will increase. Rockland County, which has the fastest growing senior population in the region, is already seeing this increase.

The problems of senior walkers are particularly concentrated near senior centers and naturally occurring retirement communities. The problem is even worse when a major attractor, such as a grocery store or medical center, is across a busy street from a senior center. These areas should be redesigned using design standards for senior pedestrians, and land use planning should discourage locating senior centers along high volume or high-speed roadways.

Specific problems mentioned for seniors in the NYMTC region were:

- Not having enough time to cross the street during the walk phase of the signals,
- Very wide streets, particularly those without medians,
- Sidewalks and streets that are in poor repair, and
- High traffic speeds.

<u>People with Disabilities</u>

Issues of pedestrian safety for the disabled vary by the type of disability, that is, physical, sensory, or cognitive. Several issues (for example, difficulties for wheelchairs on poorly maintained or obstructed sidewalks) have been mentioned above.

For the visually impaired, right turns on red, also mentioned above, are a particular problem. Another, potential problem for the visually impaired is the increased use of electric vehicles, which make no motor-noise and therefore do not produce the auditory cues that cars using an internal combustion engine make. The American Council of the Blind notes that the blind and visually impaired are disproportionately represented in the pedestrian population and list the following specific problems for the blind (2006):

- Traffic control systems are becoming more complex as traffic volumes increase,
- Exclusive left turn phases and uncontrolled right turn channels are increasingly used,
- Sound cues provided by traffic no longer provide enough information for the visually impaired.

The people attending a meeting of Disabled in Action in Manhattan, primarily people with mobility impairments, reported the following issues (note that their comments have not been verified):

- No one tells the people [car drivers] the law: it is illegal for a car to enter a crosswalk if someone is in the crosswalk.

- The signal time for crossing the street is too short.
- Speeds on the avenues (in Manhattan are too high)
- They need the leading pedestrian intervals at more intersections
- Wheelchairs cannot be seen – they are below the sight lines of large trucks and some buses.
- Existing audible signals need to be monitored and managed.
- There needs to be a City-wide policy to improve crossings around senior centers.
- The city population is aging.
- There are more cars and trucks than ever.
- Pedestrian laws are not enforced.
- Buses, including dialysis and school buses, are among the worst for running red lights.
- Many of the people who are hit are not reported to the police. They are taken to hospitals, and only the hospitals know about them.
- Wheelchair ramps are not being installed fast enough.
- When streets are repaved, many of the ramps are lost.
- Cars, including police cars, park in the bus stops, forcing pedestrians including those in wheelchairs to go into street to board the buses.
- Tour buses also block the bus stops.
- The police do not enforce the no-parking in bus stops.
- Community Boards are supposed to have a disability committee, but many don't.
- Pedestrians have no rights; it is even worse for the disabled pedestrian.
- Parks are inaccessible.
- Plows break off rubber projections of new mats with the rubber bumps at some ramps.

In addition, several individuals at the meeting of Disabled in Action mentioned problems at specific locations, including:

- Lack of ramps at
    - 24th street and 2nd Avenue is no longer there,
    - 65th Street at Columbus and Broadway
    - Shopping mall at Bronx Boulevard Plaza
- At park at Christopher Street and 7th Avenue, they recently renovated the Park and added a step to get into the park.
- At Metropolitan Oval, the bus stop for the Bx22 is under the traffic signal. Buses frequently leave during the red phase exposing pedestrians to traffic.
- At 1st Avenue and 23rd and 20th Streets, the lights are staggered making crossing difficult for the visually impaired.

<u>Recent immigrants</u>

Immigrants (particularly Hispanic) are overrepresented in pedestrian accidents. This was cited specifically for outlying counties, although it may be true throughout the region. Recent immigrants walk, bicycle, and use transit more than longer-term residents who often own cars. Immigrants are not familiar with traffic in the United States. A lot of the impaired pedestrians are immigrants (Hilton, 2006). The MV104 form does not record ethnicity, so it is hard to document the regional occurrence of pedestrian crashes among immigrants.

The national data indicates that the Hispanic pedestrian fatality rate was 2.88 per 100,000 population compared to 1.78 for non-Hispanic whites in 2001 (Knoblauch et al, 2004). Some of the contributing factors are they walk more, they are not used to the volume of traffic (they often come from rural areas), they are not familiar with U.S. traffic laws, they are confused by signs written in English as compared to those using the international symbols (Barreva Murphy and Knoblauch, 2004). The percent of fatally injured Hispanics who had been drinking (49 percent) is higher than for non-Hispanic whites who had been drinking (39 percent) or Asian immigrants, although not higher than Native Americans (Hilton, 2006).

Visitors

Visitors from a different part of the region are also at greater risk of being involved in a crash, out of unfamiliarity with the local laws, customs, or conditions. Specific cases reported by agencies included people from the more rural counties visiting Manhattan who are not used to the crowding on sidewalks or the custom of walking to the right. Drivers from the outlying counties visiting New York City may not be aware or may sometimes forget that right turn on red is not allowed in the City. Similarly, pedestrians from New York City visiting outlying areas may not know that vehicles can make right turns on red in many places. Drivers and pedestrians may not be aware of local driving laws thereby putting pedestrians at greater risk of being involved in a crash with an automobile.

4.3 Situations and Locations

The agencies that were interviewed were asked for specific locations where pedestrian safety was an issue. Many people answered with a particular type of location (e.g., bus stops or parking lots) or situation.

Parking lots

People walking in parking lots do not notice cars' reverse lights, walk directly behind cars, and appear to assume that the drivers are looking for and see them. The drivers in the cars backing out of parking places do not see the pedestrians either because of bad sight lines or because they do not look carefully. The result is the pedestrians are knocked down, frequently injured, and occasionally killed. Crashes on private property are not included in the national traffic crash data. However, NHTSA did a study using data from death certificates and estimated that approximately 120 deaths and 6000 injuries per year were caused by vehicles backing up; about a quarter of these occurred in parking lots (NHTSA, 2004).

Bus stops

There is high pedestrian activity in the vicinity of bus stops and hence there are more pedestrian crashes. People run across the street in order to catch the bus. People cross in front of the bus, and cars passing the bus do not see them. Also, in many areas, there are no sidewalks leading to the bus stops, and no pavement at the bus stop. Bus stops may be poorly located, for example not near the major pedestrian generators or not along the main pedestrian pathways. NYCDOT

has implemented improvements at bus stops under elevated train structures by providing raised medians and prohibiting traffic on the "service roads."

Buses blocking crosswalks was also cited as a problem. This occurs most often at far-side bus stops, when two or more buses arrive at the same time or in some cases for articulated buses. In some areas of New York City, tour buses park in or near the bus stops, blocking the view of waiting passengers who then go into the street to see if a bus is coming or to board the bus.

Children who are dropped off or waiting for a school bus often congregate and play at the bus stop, near the traffic lanes.

Intermodal terminals

Intermodal terminals attract pedestrians with the resulting potential for higher crash rates. For example, downtown Hempstead has higher crash rates near the bus terminal. Rail terminals also generate greater pedestrian traffic.

Airports

At airports, the majority of pedestrian accidents occur at the terminal frontage roads. Vehicle/pedestrian conflicts arise when heavy congestion causes vehicles to double or triple park. This leads to pedestrians walking behind, between, or around vehicles and increases the risk of a pedestrian being struck by a vehicle.

Suburban malls

Few malls have sidewalk access; to reach them pedestrians must walk through parking lots or along roadways. Malls attract children who often need to access them by foot or bicycle.

A recent strip mall in Suffolk County was cited as an example of lack of pedestrian consideration. It was built in an area with many pedestrians, where stores were typically built up to the sidewalk, and with plenty of space for parking in the back. Despite this, the new strip mall was built with the parking between the sidewalk and the store, blocking pedestrian direct access to the stores. The design standards or zoning for the community did not discourage this type of layout.

Schools

In some areas, parents routinely drive their children to school. Some school districts have cut back on providing bus transportation in order to save money, increasing the number of parents driving the children to school even more. Due to the high congestion near the school that this causes, they may drop them off a short way from the school leading them to walk through highly congested areas and exposing the children to potential pedestrian-vehicular conflicts. Few school grounds were designed to accommodate a mix of walking students, staff vehicles, school buses, and a high number of quickly circulating private vehicles leading to an often confusing (and potentially unsafe) situation for both children and adults.

Vendors

Vendors set up their carts at places with the maximum potential customers, often at street corners, adding to the congestion of an already crowded area and often forcing pedestrians off of the sidewalk and into the street. In New York City, this problem exists particularly in areas that attract visitors, such as Times Square, Herald Square, along Canal Street, and in major parks, such as Central Park and Battery Park. In the parks, this vendor practice might block emergency vehicles and jeopardize pedestrian safety. In suburban areas, coffee trucks and other vendor trucks set up along highway shoulders, at congested areas without regulation or driveway controls and attracting pedestrians and vehicles. They create a hazard for pedestrians, bicyclists, and motorists.

Bicycle-pedestrian conflicts

Conflicts can occur in several different ways. In some cases the pedestrians and bicycles are sharing common pathways; in others, one or both are acting against rules or are in the other's territory. Bicycles at times either run red lights or cross the stop line in order to get an early start, while pedestrians, not expecting moving vehicles (motorized or non-motorized), are crossing with the "walk" signal. Some bicyclists ride on the sidewalk, which is generally prohibited by law except for specific age groups. There are cases when bicyclists pass stopped buses on the right, endangering passengers that are getting off the bus. Pedestrians also can encroach on the bicyclists' space, for example, by stepping from the curb to the street or into a bicycle lane without looking for approaching bicycles.

Heavy congestion at intersections

When congestion is very heavy, vehicles may be stopped in the intersection when the traffic signal turns red. Pedestrians who were waiting to cross will often proceed when their signal says walk and weave through the cars. If the vehicular blockage clears, the vehicles may start to move, endangering the pedestrians amongst them. A common variation on this is turning vehicles blocked by a continuous flow of pedestrians; when the signal changes and the stream of pedestrian stops, pedestrians crossing in the other direction have already started weaving through the vehicles.

Table 4.1 lists locations based on statistical analysis of high pedestrian crash locations or taken from documents provided by the organizations that were interviewed. The crash data is typically from several years ago (2004 at the latest, with most of the data from 2002 or earlier). In many cases, the relevant agencies have installed safety improvement treatments already. Additionally, specific locations were reported in the interviews or during public meetings and gathered from other public outreach efforts. These locations, shown in Table 4.2, are based on people's experience or perceptions. The crash data does not necessarily indicate that the location is unsafe for pedestrians; this may be because pedestrian exposure is low (pedestrians may avoid it because they think it is unsafe) or because no crash has yet occurred due to the random nature of crashes or because the location is not unsafe. Even in the latter case, the input is valuable to understanding the communities' perceptions and the needs of the communities in the development of programs for safety improvements.

Table 4.1 High Pedestrian Crash Locations Based on Crash Data

Manhattan

- 33rd Street at Park Avenue*
- 7th Avenue at 34th Street* †
- Essex Street at Delancey Street*
- 14th Street at Sixth Avenue*
- 7th Avenue at 145th Street*†
- 8th Avenue at 42nd Street*
- 3rd Avenue at 42nd Street*
- 8th Avenue at 34th Street*
- 1st Avenue at 14th Street*†
- 6th Avenue at Broadway†
- 125th Street at Lexington Avenue†
- Amsterdam Avenue at 125th Street†
- 9th Avenue at 42nd Street†
- 6th Avenue at 42nd street†
- 5th Avenue at 135th Street†
- 2nd Avenue at 14th Street†
- 6th Avenue at 57th Street†

The Bronx

- Grand Concourse at 170th Street*
- Grand Concourse at 183rd Street*
- Grand Concourse at 167th Street*
- Grand Concourse at 161st Street*
- Webster Avenue at Fordham Road*†
- Bruckner Blvd. at Hunts Point Ave.*
- Gun Hill Road at White Plains Rd.*
- 3rd Ave. at Melrose Ave.*
- University Ave. at Burnside Ave.*
- University Ave. at Fordham Rd.* †
- Castle Hill Avenue at Westchester Ave. †
- Burnside Avenue at Jerome Avenue†
- 188th Street at Webster Avenue†
- 180th Street at Southern Boulevard†
- Concourse Village East at 161st Street†
- 188th Street at Fordham Road†
- Bainbridge Avenue at Fordham Road†
- 225th Street at White Plains Road†
- Tremont Avenue at Jerome Avenue†
- Bainbridge Avenue at Gun Hill Road†

Brooklyn

- Utica Avenue at Eastern Parkway*†
- Atlantic Ave. at Nostrand Ave.*
- Eastern Parkway at Franklin Ave.*
- Fulton St. at Flatbush Ave.*
- Eastern Parkway at Nostrand Ave.*
- Church Ave. at Flatbush Ave.* †
- Avenue U at Flatbush Ave.*
- Flatlands Ave. at Rockaway Pkwy*
- Utica Ave. at Church Ave.*
- Gold St. at Flatbush Ave.*
- 20th Avenue at 86th Street†
- Flatbush Ave. at Nostrand Ave. †
- Parkside Ave. at Ocean Ave. †
- Church Ave. at Nostrand Ave. †
- Hopkinson Ave. at Atlantic Ave. †
- Nostrand Ave. at Avenue X†
- 86th Street at Bay Parkway†
- Flatbush Ave. Ext. at DeKalb Ave. †
- Albemarle RD at Flatbush Ave. †
- Atlantic Avenue at Pennsylvania Avenue††
- Flatbush Ave at Empire Blvd & Ocean Ave ††
- Flatbush Avenue at Avenue U ††

Queens

- 63rd Dr. at Queens Blvd.*
- Hillside Ave. at Parsons Blvd.*
- Main St. at Roosevelt Ave.* †
- Jamaica Ave. at Parsons Blvd.*
- Archer Ave. at Sutphin Blvd.* †
- 46th St. at Queens Blvd.*
- 71st Ave. at Queens Blvd.*
- Union St. at Northern Blvd.*
- Archer Ave. at Parsons Blvd.*
- Northern Blvd. at Parson Blvd. †
- 40th Road at Main Street†
- Fresh Pond Rd. at Metropolitan Ave. †
- Kissena Blvd. at Main Street†
- 103 Rd. Ave. at 117th Street†
- Main Street Sanford Ave. †
- Jamaica Ave. at Woodhaven Blvd†

(Continued on next page)

Table 4.1 Continued

Staten Island
- Hylan Boulevard
- St. Marks Pl. at Victory Blvd.*
- Hylan Blvd. at New Dorp Lane*
- Morningstar Rd. at Forest Ave.*
- Tysens Lane at Hylan Blvd.*
- Hylan Blvd. at Jefferson Ave.*
- Hylan Blvd. at Midland Ave.*
- Victory Blvd. at Richmond Ave.*
- Cebra Ave. at Victory Blvd.*
- Manor Rd. at Victory Blvd.*
- Forest Ave. at Van Pelt Ave.*
- Bay Street at Street Marks Place†

Nassau County
- Hempstead, particularly near the bus terminal
- Near Hofstra University
- Nassau Road
- Babylon Turnpike
- Centennial Avenue near Roosevelt
- Zip Code Areas 11550, 11575, 11553, 11020, 11590, and 11501**

Putnam County
- Routes 9, 164, and 311

Rockland County
- Route 306
- Hasidic neighborhood
- Main Street in New City
- New Hempstead Road

Suffolk County
- Route 25
- Sunrise Highway
- Main St. (Rt 25A), Cold Spring Harbor***
- Routes 110/25A, Huntington***
- Route 110, Huntington Station***
- Route 110, North Amityville***
- Great Neck Road, North Amityville and Copiague***
- Wellwood Avenue, Lindenhurst***
- Straight Path/Wyandanch***
- Fifth/Suffolk Aves, Brentwood/Bay Shore***
- Suffolk Avenue, Central Islip***
- Carleton Avenue, Islip/Islip Terrace***
- Routes 27A/112, Patchogue***
- CR 80/46, Shirley***
- Route 112, Port Jefferson Station***
- Route 25/Eastwood Blvd., Centereach***
- Main Street/Maple Avenue, Smithtown***
- Indian Head Road/Rt. 25A, Kings Park***

Westchester County
- Central Avenue
- Route 119 from Tarrytown to White Plains

Notes and Sources for Table 4.1

* Based on Ten Highest Intersections based on 1995 to 2001 pedestrian injuries and fatalities (based on NYS DMV database); Source: Transportation Alternatives CrashStat web page, available at: http://www.transalt.org/crashmaps/index.html

** The Zip Code areas with the highest (over 3.0) Pedestrian Injury Hospitatliation Rates per 10,000 Population from 1992 to 2002, in *Pedestrian Injuries and Fatalities in Nassau County* [Available at: http://www.nassaucountyny.gov/agencies/Health/Docs/PDF/PedestrianWeb1203.pdf

*** Suffolk County Police Department, March 2004.

† Top ten locations for each Borough from List of High Pedestrian Crash Locations 2000, provided by New York City Department of Transportation.

†† Three locations reported in Pedestrian/Traffic Safety Mitigation Project, Urbitran for Borough of Brooklyn, 2002.

4.2 Specific Locations that were mentioned as unsafe for pedestrians

The following locations were mentioned during the interviews or public meetings or other outreach efforts. They were mentioned at least once and some of them many times.

Manhattan
- Times Square
- Herald Square
- Canal Street
- 125th Street
- 8th Avenue near the Port Authority Bus Terminal
- 33rd Street at Park Avenue

The Bronx
- Grand Concourse
  - At 170th Street
  - At 183rd Street
- Webster Avenue at East Fordham Road

Brooklyn
- Downtown Brooklyn
- Bay Parkway
- Ocean Parkway
- Utica Avenue at Eastern Parkway

Queens
- Queens Boulevard
- Northern Boulevard
- Hillside Avenue
- Archer Avenue

Staten Island
- Hylan Boulevard

Nassau County
- Hempstead, particularly near the bus terminal
- Near Hofstra University
- Nassau Road
- Babylon Turnpike
- Centennial Avenue near Roosevelt

Putnam County
- Routes 9, 164, and 311

Rockland County
- Route 306
- Hasidic neighborhood
- Main Street in New City
- New Hempstead Road

Suffolk County
- Route 25
- Sunrise Highway

Westchester County
- Central Avenue
- Route 119 from Tarrytown to White Plains
- Route 9 in Ossining

4.4 Existing Infrastructure and Land Use Patterns

During the interviews on which this chapter is based, several people spoke of the relationship between land use and transportation, and how it affects transportation safety. Much of this discussion emphasized the role that developers play in the construction of pedestrian facilities or in the lack of pedestrian facilities in growing areas.

Developers resist putting in pedestrian facilities. When they do put sidewalks in, they often do not line up with adjacent sidewalks. In some cases they have agreed to put in pedestrian facilities during the approval process, but at completion the developer had not complied.

Much of the regional infrastructure was built decades or even longer ago, with little consideration of vehicular-pedestrian conflicts. Given the vast extent of the existing infrastructure, it is difficult and very expensive to retrofit it for pedestrian safety.
At skewed intersections where streets are not aligned or one of the streets becomes narrower, crosswalks are often either diagonal or not on the shortest path; many pedestrians choose to cut straight across or jay walk.

Poor maintenance of sidewalks or other pedestrian facilities often discourages pedestrians, particularly people with disabilities, from using the facilities. Some sidewalks are in such poor shape that wheelchairs or strollers cannot use them. In winter, snow and ice is not removed, forcing pedestrians to use the streets. Pedestrian signals are often poorly timed. In small towns or low density areas, pedestrian signals may have stopped working or are lacking.

In many areas, vehicles exiting expressways need to slow down significantly in order to enter the new environment at an appropriate speed, but other than a sign, nothing about the ramp encourages the slower speed. Although there is typically a stop or yield sign, off-ramps need to be designed to slow vehicles down.

Urban areas

In New York City and some of the inner suburban cities and villages, there is a large existing infrastructure of streets and sidewalks. In Manhattan in particular, there is very high demand for both vehicular and pedestrian space and no room to expand either without sacrificing space from the other. The location of subway entrances, typically at corners, reduces the available space for pedestrians at the same time that they add to pedestrian volumes. Sidewalk cafes, movable shop signs, telephone booths, street furniture and sidewalk vendors also reduce pedestrian space. In some areas, where the pedestrian volume exceeds the available space, many pedestrians walk in the street or even the traffic lane; this is common along Canal Street in Manhattan. On Eighth Avenue approaching the Port Authority Bus Terminal, pedestrians will take over a whole lane.

Members of Transportation Alternatives point out that curbside parking in New York City is under priced, causing people to cruise looking for parking spots. The fact that the curbside parking is filled also leads to double parking, which causes vehicles to swerve to get around them and makes it more difficult for motorists to see pedestrians who cut between the parked

cars. Another result is that delivery trucks, the police, and occasionally other people park on the sidewalks.

Another issue specific to New York City is the elevated structure. Pedestrians sometimes walk underneath the structures rather than on the sidewalks or stand behind columns waiting for a gap in traffic; however the columns obstruct sight lines and the shadows make it difficult for drivers to see the pedestrians. (The New York City Departments of City Planning and of Transportation recently studied this issue; see Subway/Sidewalk Interface Study, discussed in Section 3.3.) NYCDOT has installed raised medians at subway stations under elevated structures to provide pedestrian refuges and to improve the safety of passengers transferring between subways and buses.

Continuously accessible paths, particularly from subways to parks, are often lacking due to lack of curb cuts, inadequate provision of pedestrian crossing of high-volume and high-speed arterials, or obstructions.

Low density areas

The auto-dominated society discourages people from walking. In some areas, pedestrians are rare enough to be considered out of the ordinary or eccentric. Children are driven everywhere, with the result that they do not develop good pedestrian habits. Pedestrian facilities are seen as unnecessary and therefore omitted.

There are many multi-lane arterials with high traffic volumes and speeds, and long distances between pedestrian cross walks. Often the cycle lengths of the signals are long (on Long Island, up to three minutes) making pedestrians and drivers impatient. The crossing distance is wide and seldom has refuges for the pedestrians. Often the arterials do not have sidewalks, causing the pedestrians to walk along the shoulder, with no separation between them and the traffic. If the shoulder is widened to provide additional space for pedestrians, the effect on traffic is to increase speed. When there are sidewalks, they are in the highway clear zone, again with little or no separation. An issue with differing opinions is the use of a barrier to separate motorized and non-motorized users of the highway on high-speed facilities; it was pointed out that the barrier may give the pedestrian a false sense of security and they can deflect when hit becoming a hazard to the pedestrian.

Many communities do not have sidewalks or the sidewalks are poorly placed or not continuous. Many destinations that attract pedestrians, such as parks, do not have sidewalk access. When there are sidewalks, lack of access management has resulted in closely spaced driveways and curb cuts, making it inconvenient and less safe to use the sidewalks, particularly for pedestrians with disabilities.

Lack of space to put sidewalks can be a problem in rural areas also, for example on old farm roads in areas with recent population growth. A related problem is where there is a sidewalk but the right of way is narrow or the road has been widened, with the result that the sidewalk is close to the moving traffic, making it less safe as well as unpleasant to use.

Some sidewalks are poorly designed or constructed. Sometimes utility poles or trees block the walks, forcing pedestrians into the street. This can be an even more severe problem for someone in a wheelchair or pushing a stroller. Often they are not wide enough, even when the space is available. The cross gradient may be too steep for comfort, particularly for the older or disabled pedestrian.

The design of the roadway or its environment may unintentionally encourage drivers to speed up on certain sections, for example where a curve makes a higher speed more enjoyable or a wider right of way suggests there are no conflicts. These sections are not consistent with use by non-motorized traffic.

4.5 Challenges to Improving Pedestrian Safety

One of the questions asked during the interviews was about the barriers that the agencies have encountered in improving pedestrian safety. Most of their answers fit into one of four categories: resources; conflicts between jurisdictions; conflicts of opinions and/or habits within agencies; and lack of land use control.

An issue that came up many times was people's perception that pedestrian safety is not a major problem. Because of this perception they do not make the changes in behavior needed to improve it. Different people made this comment about the public in general, about either or both pedestrians and drivers, about traffic engineers or the people at the top of the agencies, or about the mayor, zoning boards, city councils, or the police. There is a perception among many people involved in pedestrian safety that police do not place priority on enforcing laws affecting pedestrians, whether the infraction is by the pedestrian or a driver (see Section 5.4, Enforcement).

Resources

Lack of funding was mentioned many times, but then not having enough funding is a problem for most activities. The vast extent of the existing transportation infrastructure in the region increases the resource cost of improving it or maintaining it in good repair.

Another funding issue was getting funds for stand-alone sidewalk projects. Including sidewalks in a major reconstruction project is not a problem, but adding sidewalks to a roadway that does not otherwise need improvements can be difficult. Sometimes the issue is not lack of funding but not being aware of the appropriate grant programs. Smaller municipalities are not aware of the grant programs and don't have the resources to look for them.

Funding for safety projects is frequently targeted to locations with high incidences of fatal accidents as shown by crash data. Given that in most locations the majority of fatalities are vehicle occupants, not pedestrians, it can be difficult to get money for pedestrian safety improvements. This suggests that there is a need for funding targeted specifically to pedestrian (or non-motorized) safety.

Jurisdictional issues

Achieving substantial improvements to safety (pedestrian or other) is enhanced by the 3E process, that is the integration of engineering, education, and enforcement. In New Jersey, they found that many engineering improvements by themselves had insignificant impacts on reducing pedestrian crashes; when the projects include all three of the Es, they saw reductions in the range of 10 to 15 percent of crashes. However, the coordination of engineering, education, and enforcement is hampered by the organizational split between agencies responsible for these three activities at all levels of government, starting with the split of responsibilities between FHWA and NHTSA.

A common problem faced by the outlying counties is a difference of interest between NYSDOT or the counties on one hand and the municipalities on the other. For example, when a need for sidewalks exists on the state highway system, the state builds them, but the municipalities are required by law to maintain them. Some municipalities resist the sidewalks rather than take on the cost of maintaining them. Similar problems exist for sidewalks at and leading to bus stops as well as bus shelters and for establishing parking policies and speed limits along state or county roads within municipalities.

In Nassau County there are several places where streets form the boundary between adjacent municipalities; this creates a problem when the communities disagree on improvements to the street. They also have situations where school districts have roads on their property that the municipality maintains; again it can be difficult to get agreement on the design of improvements.

The data needed for identifying unsafe locations is initially in the hands of the police. Some agencies have worked out arrangements which allow the to have the data immediately, but several agencies had difficulty getting the data from the police and had to wait to obtain it from NYSDOT, but by then it is out of date.

A particular problem exists in Putnam and Westchester Counties, where large parts of the counties are within the New York City Watershed. Environmental regulations designed to protect water quality require minimizing the addition of new impervious surfaces (paved sidewalks and trailways, wider shoulders) and mitigating any added impervious surfaces. This lengthens the environmental approval, permitting and design processes, often discouraging communities from adding facilities.

Conflicts between modes can interfere with some countermeasures, for example, neckdowns were proposed to shorten the crossing width of Queens Boulevard, but they would have interfered with the turning radius required by buses operating in the area. In other cases, the neckdowns conflicted with the turning radius needed for emergency vehicles.

Conflicts within agencies

Several people mentioned that the engineers within their own agency either were ignorant of the need for designing for pedestrians or did not agree that it was needed. This is partly due to the lag in the education system; the traffic engineering curriculum is just beginning to include

pedestrian design. At least one person mentioned inconsistency within NYSDOT. The Department's policy says that pedestrian safety has to be considered and included in projects when appropriate, but project level decisions for a variety of reasons (limited project scope, high cost, impacts on adjacent properties, local input, or lack of awareness) may limit pedestrian safety features included in the plans. The Department has recognized this sometime inconsistency and regional bicycle/pedestrian coordinators have been tasked to actively seek out these inconsistencies and work to increase internal awareness.

There is also a perception among some pedestrian advocates that some people within the agencies do not place a high priority on pedestrian mobility and safety issues, undermining the effort. In these cases, the mindset that traffic engineering is about moving vehicles rather than people remains.

Lack of land use control

Land use is a local, home rule process in New York State. The state and counties have limited powers in controlling land use as well as access to state and county highways. Individual municipal planning and zoning boards working with their appointing town boards, village boards, or city councils control land use. Historically, local interest has been in increasing the amount of tax rateables to keep down local property tax rates while facilitating easy vehicular access and maintaining a good level of service for vehicles. Pedestrian and bicycle accommodation has not been a primary consideration. That said, within the last few years there has been a great increase in interest among local land use planning officials in better urban design and improved facilities for pedestrians and bicyclists. Local government staff attendance at NYMTC's pedestrian design education programs is evidence of this, yet much remains to be done.

Poughkeepsie, although outside the NYMTC region, provides a good example of how land use decisions can affect pedestrian safety. Marist College is located on west side of Route 9. In the nineties, they constructed student housing and parking lots on the east side. The result was a large number of students crossing Route 9, a major north south highway, creating the potential for increased pedestrian crashes and rear end vehicular crashes. Recognition of the potential consequences led to action by NYSDOT, Marist College, and the Town of Poughkeepsie to implement physical improvements combined with targeted education and enforcement programs.

Developers historically did not, on their own initiative, include pedestrian improvements or vehicular improvements unless asked. More recently a growing number of developers appear to be recognizing that good design including walkable (and bikeable) features help sell new residential and commercial properties and speed the approval process. However, despite this communities need to adopt pedestrian friendly master plans and zoning ordinances along with official maps and other controls to give them the tools they need to require development occur the way the community wants and not be something that just happens. Yet developers frequently do not put in agreed upon pedestrian improvements. Even where the planning agency has an agreement with them, when it is time for improvement to be constructed, the developer does not do it.

Other challenges

Some public advocacy groups are perceived to be obstructionists, demanding more or a different type of accommodation for bicycles and pedestrians with no room for compromise, and thus blocking a proposed improvement. The people who support projects seldom come to meetings. Also some segments of the public have misconceptions about pedestrian safety measures that cause them to try to block the implementation of the measures. Merchants in communities have blocked proposals to use traffic calming in the downtown areas, believing that it will reduce customers coming to their stores. Homeowners whose properties back up to a proposed trailway, objected to it, saying they did not want people walking behind their houses; after the trailway was built they were among the major users of it.

Some communities do not want sidewalks. They think that sidewalks would detract from a rural or "exclusive" character of the area or would lower property values or attract "undesirables."

Some authority figures (for example, police or transportation agency employees), who should act as role models and set an example of safe pedestrian behavior, instead follow poor walking habits, jaywalking or ignoring pedestrian signals. This is a similar situation to parents and other adults who set a poor example of safe behavior for children.

Evaluation of implemented safety measures is often left undone due to limited staff resources; as a result, we do not know how effective many of the measures are or in what situations they work best. It is also hard to measure long-term effectiveness.

Another challenge is the new MS4 regulation (from implementation of the Federal Clean Water Act) concerning drainage and the impacts of adding impervious surfaces. Sidewalks are impervious surfaces that can require mitigation in the form of special drainage facilities. This issue has come up on pedestrian facilities within the New York City watershed in Putnam and Westchester Counties and will come up in other areas as MS4 implementation continues.

4.6 Other Issues

This section reports the issues that were brought up that do not fit in the categories above.

The design of large trucks is a problem for pedestrians for two reasons. Trucks have wider and off-track turning radii, which many pedestrians, particularly children, do not realize (or perhaps think about); a pedestrian may, through ignorance or inattention, stand in an area that is the path of a turning truck. The second problem is that the driver's sight lines are frequently blocked directly in front of or near the sides and rear of the truck. Again, this problem is more severe for children, both from their lack of knowledge and their shorter height. Trucks may leave the designated truck routes, either because of street blockages causing them to seek a less congested route or due to getting lost. In these cases they end up on narrow residential streets where they are even more dangerous because of higher volumes of pedestrians or children on residential streets.

Crosswalks need to be more visible. This requires good striping and in some areas, highly visible patterns such as ladders. Striping is frequently lacking at ramps and jug handles. There also needs to be a clear delineation between parking and pedestrian space. Poor lighting was also mentioned as an issue. New York City is currently experimenting with different patterns to determine which are the most visible.

Poor lighting was also mentioned as an issue. People waiting to cross the street are hard for drivers to see at night because the waiting areas are not sufficiently illuminated. Bicyclists need to realize the need for reflective markings and/or lights on their bicycles if they ride at night. No one would drive a car at night without lights yet we ride our bikes, a much smaller and less visible vehicle, only with reflectors on the pedals. Pedestrians also need to realize they are less visible at night even in built up areas amid the jumble of headlights, tail lights, illuminated signs, etc. The wearing of lighter colored clothing or something reflective makes people more visible.

Intentionally left blank.

V COUNTERMEASURES AND STRATEGIES

This chapter describes various measures for improving pedestrian safety. The measures described here were identified through both the interviews and from a review of the literature on pedestrian safety. This chapter will not try to include comprehensive material; instead it will provide brief descriptions of methods and where available information of the effectiveness of the measure. It will also include references to documents with more complete information. Over the last several years, several excellent guides to improving pedestrian safety and many papers on specific methods have been published.

Four excellent comprehensive documents are:

- *PedSafe: Pedestrian Safety Guide and Countermeasure Selection System*, David Harkey and Charles Zegeer, September 2004, for FHWA. Available at: http://www.walkinginfo.org/pedsafe/pedsafe_downloads.cfm

- *Bicycle and Pedestrian Safety Resource Guide*, NHTSA, 2006. Available at: http://www.nhtsa.dot.gov/people/injury/pedbimot/bike/BikePedestrian/

- *Design and Safety of Pedestrian Facilities: Recommended Practices of the Institute of Transportation Engineers*, 1998. Available at: http://safety.fhwa.dot.gov/ped_bike/docs/designsafety.pdf

- *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan*; Volume 10*: A Guide for Reducing Collisions Involving Pedestrians*, NCHRP Report 500, volume 10, Zegeer, Charles, Stutts, Jean, et al. (2004). Available at: http://safety.transportation.org/guides.aspx

This chapter starts with a section on policy and planning for pedestrian safety. This is followed by specific methods organized by the three Es, engineering, education, and enforcement. Safety experts periodically suggest increasing the three Es to be four, five, or six Es in order to incorporate concerns about economics, evaluation, or emergency services. However, this study will concentrate on the original three.

Although the three Es are discussed in separate sections, a pedestrian safety project should include all three of them for maximum effectiveness. The New Jersey Division of Highway Safety found that many of the pedestrian safety engineering countermeasures that were implemented in isolation did not have the impact that was expected; when the engineering countermeasures were implemented in conjunction with education and enforcement programs, they found that the combined effort resulted in a 10 to 15 percent reduction in crashes. In September 2006, New Jersey announced a pedestrian safety program that includes initiatives under all three Es. (See program description at: http://www.state.nj.us/governor/news/news/approved/20060918.html .)

5.1 Policy and Planning for Pedestrian Safety

A first step, mentioned in several interviews, is to make pedestrian safety a priority, whether for a specific project or for a transportation planning or design agency. To be effective, the priority must be endorsed at the highest levels of the organization.

In terms of planning for pedestrian safety, two alternative, complementary approaches have been suggested. In the first approach, opportunities for improving pedestrian safety should be looked for in every project that is underway or planned. A specific instance of this is reviewing all projects in the Transportation Improvement Program (TIP) for capital improvements where pedestrian improvements could and should be included. In a similar vein, as part of the standard review of proposals from developers, the Westchester County Planning Department identifies ways to incorporate pedestrian improvements. For example, a recent Home Depot proposal was changed so that the developer would include a traffic signal and sidewalk to provide access between a bus stop and the store.

The other approach is to produce a pedestrian safety plan. FHWA has recently published a guide to assist in developing a plan, *How to Develop a Pedestrian Safety Action Plan* (Zegeer et al., 2006, http://www.walkinginfo.org/pp/howtoguide2006.pdf). Briefly, it incorporates the following eight steps (see the guide for a fuller description of the steps):

1. Define Objectives
2. Identify Locations
3. Select Countermeasures
4. Develop Implementation Strategies
5. Institutionalize Changes to Planning and Design Standards
6. Consider Land Use, Zoning and Site Issues
7. Reinforce Commitments
8. Evaluate Results

Most of these steps came up during the interviews. For example, setting goals and objectives, and in fact setting quantifiable targets is important if significant improvements are to be made. The need for better data in order to identify locations is discussed in Section 3.2. The need to coordinate land use planning, zoning decisions, and site design priorities in order to improve pedestrian safety was brought up in different ways in several of the interviews. Evaluating the effectiveness of safety improvements needs to be done rigorously whenever innovative measures are implemented in order to increase our understanding of which countermeasures work.

Another technique that is useful both for identifying locations and for identifying countermeasures for specific sites is the site visit or safety audit. Several workshops have been developed to promote this approach. For example, NYMTC recently held a Road Safety Audit, and NYMTC and other MPOs have been conducting a Walkable Community workshops; both of these programs entail visits to sites. Several agencies or collaborations of agencies currently do a similar safety inspection of either recent crash sites or sites identified as in need of improvement through analysis of crash data. NYCDOT has a safety unit that looks at every fatal or likely fatal crash scene to check existing conditions, including for example, traffic controls, markings, signal

timing and street lighting. New Jersey has a Safety Impact Team made up of representatives of several organizations representing the three Es of engineering, education, and enforcement, such as NJ DOT traffic engineers, NJ Transit, NJ Division of Traffic Safety, American Automobile Association, FHWA, and state and local police. The Safety Impact Team does a three day safety audit of locations identified by analyzing the crash data. The audit is multi-modal, looking at vehicular, pedestrian, bicycle, and bus movements.

A pedestrian Prompt List (checklist) may be used during these site visits. There are currently many pedestrian checklists, most of which are designed to facilitate walking (e.g., Walkability Checklist at http://www.walkinginfo.org/cps/checklist.htm) but also include some pedestrian safety items. Additionally there are more comprehensive safety checklists that include pedestrian items, such as those developed by NYSDOT as well as the Road Safety Audit (RSA) checklist. Although it is not pedestrian specific at this time, the RSA is an instrument to assess the safety of a facility. A pedestrian specialist should be part of an RSA team at locations that involve pedestrians. FHWA revised its Road Safety Audit Guideline and the Prompt List. Additional information at FHWA: http://safety.fhwa.dot.gov/rsa/index.htm. Noting that the revised prompt list does specifically address pedestrian issue, FHWA is currently working on a pedestrian oriented prompt list. Appendix F includes a prompt list compiled from several sources.

Another valuable resource for understanding the safety problems at a specific site is to ask people who are at the site on a daily basis, particularly people who live and work in the immediate neighborhood, including community groups, street maintenance crews, and traffic officers who direct traffic at the intersection.

Regional or local policy could also be developed considering local input. During the Designing Streets for Pedestrians Safety workshops hosted by NYMTC (NYMTC Workshop, 2006), the attendees participated in a policy change exercise. At the end of two days of pedestrian training and a site visit, the participants were asked to suggest policy changes, which were then ranked by polling the participants. The results from the brainstorming exercise of each workshop are noted below:

Long Island Workshop - 9/26/06

- Develop a Pedestrian/Bicycle Master Plan for each municipality with sidewalk and bicycle priorities
- Dedicate a percentage of all federal aid to pedestrians and traffic safety
- Pool the funding for sidewalks (re: Town of Islip)
- Enforce red lights and speed by cameras
- Increase police enforcement of existing traffic laws
- Connect sidewalks along streets to shopping centers
- Establish guidelines for placement of walkways (strong justification for not providing)
- Consider a roundabout for any intersection
- Place sidewalks further away from travel lanes

Westchester Workshop - 9/28/06

- Use pedestrian heads with countdown indications

- Adopt policy for high visibility crosswalks
- Establish an education program for pedestrian safety
- Redesign signals to meet MUTCD standards
- Prohibit sidewalk encroachments
- Adopt a law supporting "YIELD" sign on the back of buses
- Adopt policy for larger pedestrian indications

5.2 Engineering Methods

NCHRP Report 500 volume 10, which addresses pedestrian safety (Zegeer, Stutts, et al., 2004), identifies the following objectives for countermeasures:

Reduce the speed of motor vehicles
Improve sight distance and visibility for motor vehicles and pedestrians
Reduce pedestrian exposure to vehicular traffic
Improve pedestrian and motorist safety awareness and behavior

The first three of these objectives will be discussed in this section organized under five topics: Pedestrian Path, Speed Reduction, Signalization, Unsignalized Intersections, and Visibility. The Engineering Methods Section will conclude with a brief discussion of the effectiveness of some of the major countermeasures at reducing pedestrian crashes. The last of the NCHRP objectives is addressed in Sections 5.3 Education and 5.4 Enforcement.

5.2.1 The Pedestrian Path

The existence and location of crosswalks and pedestrian paths has a major impact on the likelihood of crashes. In 1988, Knoblauch, Tustin et al (cited by Ranck in ITE, 1998) found that 23 percent of pedestrian crashes in residential areas occurred in locations with no sidewalks although only 2.7 percent of the pedestrian traffic was in those locations. Further, "streets without sidewalks had 2.6 times more pedestrian collisions than expected (compared to the overall sample of streets) on the basis of exposure, while streets with sidewalks on only one side had 1.2 times more pedestrian collisions than expected."

Figure 5.1 Worn Path Suggests a Sidewalk is Needed

Thoughtful placement of crosswalks can reduce the exposure of pedestrians to vehicular traffic. Curb and sidewalks, indicating an urban setting, are more effective than signs at reducing traffic speeds. Various methodologies can be implemented to aid, encourage, and/or to restrict the pedestrians to crossing at certain locations along the roadway.

Providing Sidewalks: Walking-along-the-road crashes account for 10 to 15 percent of all pedestrian crashes. Providing sidewalks has been shown to reduce this type of crash by 88 percent (NYMTC workshop, 2006). Sidewalks also improve mobility for pedestrians, and allow travel by or with non-motorized wheeled conveyances, including wheelchairs, baby strollers, and shopping carts.

A study by McMahon et al. (2002) provides guidelines for recommended sidewalk widths under different circumstances. A sidewalk plan can be undertaken to document the continuity of the pedestrian path. Regular maintenance should be done to ensure that plants or snow do not block the sidewalk, and the surface condition is smooth enough to be safe for all pedestrians, including older or disabled people.

Walking in the street also happens in areas where sidewalks are in good condition but pedestrian volumes exceed the capacity of the sidewalk width. In some very dense areas this happens due simply to the very large number of pedestrians, but often it is due to a choke point created by some other use of the sidewalk, such as newsstands, sidewalk vendors, newspaper vending machines, subway entrances, street furniture or plantings, or other objects. If the sidewalk cannot be widened to accommodate both the pedestrian volume and the other use, the relocation of the other use should be considered.

Non-Sidewalk Pedestrian Paths: There are locations where low pedestrian numbers do not warrant a sidewalk. In cases such as rural roads, a shoulder helps pedestrians walk further away from traffic; it would be very expensive to install sidewalks on these types of roadways and probably not worth the cost given the low pedestrian use. Providing paved shoulders has been shown to reduce crashes up to 80 percent (NYMTC workshop, September 25, 2006). The McMahon study (2002) recommends a minimum four-foot shoulder or other walkable space. However, a six-foot width provides a more comfortable walking space. As the volumes of vehicles and pedestrians increase with the resulting increase in the potential for pedestrian-vehicle conflicts, the need for sidewalks increases and shoulders are no longer adequate.

Figure 5.2 Walking in the Street

Relocation of Crosswalks: A common complaint is that pedestrians ignore crosswalks and cross wherever they wish. In some cases this is because the crosswalks are poorly located to meet the pedestrians' natural desire to take the shortest path. Where possible, crosswalks should be located for direct access to major pedestrian attractions, particularly including bus stop and

transit terminals. Yonkers, in their Central Park Avenue Plan, examined each crosswalk along Central Park Avenue and relocated many of the crosswalks to improve pedestrian path continuity. The analysis of crosswalk locations should be included in both safety audits (discussed in Section 5.1) and in sidewalk plans (discussed in Chapter 6).

Figure 5.3 Non-Continuous Pedestrian Path

Controlled Midblock Crosswalks: Controlled midblock crosswalks are recommended for very long blocks where warrants for the installation of midblock signals are met. The elimination of turning vehicles reduces the number of potential vehicle pedestrian conflicts and reduces the number of places that the pedestrian must look for approaching vehicles. MUTCD recommends that midblock signals be 300 feet from the nearest signalized intersection (MUTCD 4C.05, 2003), indicating that they could be used for blocks that are 600 feet or longer. For two-way streets, a raised median improves the safety of midblock crossings. Bulbouts may also be used; they make the crossing more visible to the drivers and shorten the crossing distance for the pedestrian. Note that uncontrolled, but marked midblock crosswalks are not recommended because statistical evidence indicates that pedestrian crashes are much higher at uncontrolled marked crosswalks. This is discussed in more detail in section 5.2.4 (Uncontrolled Crosswalks).

Raised Median: Installing a raised median in wide streets breaks a long crossing distance into two shorter segments and provides a protected haven for pedestrians to wait for a WALK signal or a break in traffic. (Note that wheelchair ramps or a non-raised path must be included for ADA access.) It encourages the pedestrian to wait, rather than trying to finish crossing through moving vehicles. The height improves visibility for both the pedestrian and the drivers. It also has the effect of slowing traffic by narrowing the roadway. NYCDOT has installed several raised medians, sometimes with bollards added at the end toward the intersection. The NYCDOT studies of safety at schools (Section 3.3) recommend the installations of pedestrian islands at 80 of the 135 schools.

Figure 5.4 Raised Median with Non-raised Path for Wheelchairs

The average crash reduction factor for medians is 40 percent (NYMTC workshop, 2006). The Zegeer, Stewart, et al. (2005) states that the presence of a raised median was associated with a significantly lower pedestrian crash rate at multilane crossing locations, with both marked and unmarked crosswalks. In contrast, painted (not raised) medians and center two-way left-turn lanes did not offer significant safety benefits to pedestrians on multilane roads, compared to no median at all. Bowman and Vecellio (1994) compared undivided multilane roadways, two-way left turn lanes, and raised-curb medians. In both central business district and suburban locations,

the pedestrian crash rate was significantly higher on undivided arterials than on arterials with raised medians.

Raised Median with Slalom Path: Under this treatment, the pedestrian path has turns rather than proceeding straight across the median, further encouraging the pedestrian to wait for a second WALK signal rather than rushing across the second half of the roadway. This measure can be particularly effective at intersections where the street and/or pedestrian path either jogs or is diagonal to the cross street. When the path jogs, many pedestrians choose the shorter, diagonal path. When the pedestrian path is not at a right angle to the street being crossed, the pedestrian in one direction has to turn his/her head more than 90 degrees to see approaching traffic; many do not look carefully. A slalom path, with pedestrian fencing or planting to force pedestrians to follow it, can ensure that the pedestrian is crossing at right angle with the traffic.

Figure 5.5 Before and After Installation of Raised Median with Slalom Path (Computer enhanced)

Pedestrian Fencing: When no other measure has stopped pedestrians from crossing at dangerous locations, fencing could channel pedestrians to the crosswalk and discourage all but the most athletic and determined jaywalkers. NYCDOT has put pedestrian fencing at various locations in New York City. Pedestrian fencing is useful in places where vehicular traffic is forced to stop at a distance from the intersecting street, for example, to facilitate vehicle turns (e.g. trucks, buses). NYSDOT best practices recommend pedestrian fencing to channel pedestrians to safer crossing locations, to protect pedestrians in work zones, for crowd control and security purposes, and as temporary pedestrian safety measures in lieu of future safety improvements. They do not recommend fencing where walking is a primary mode (for example, in CBDs), where they might impede disaster-related evacuations, or in

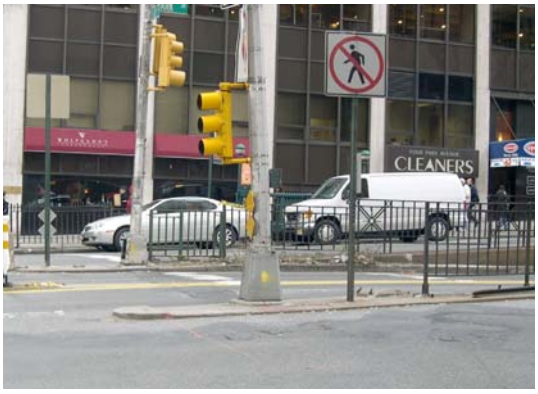


Figure 5.6 Pedestrian Fencing

place of a permanent design or operational safety improvement.

Pedestrian Bridges and Underpasses: Grade separation can be useful when pedestrian and/or vehicular traffic volumes or speeds make controlled at-grade crosswalks undesirable - if the pedestrian can be persuaded to use them. However, they are expensive and often the space needed for access to the bridge or underpass is not available. A 1965 study by Moore and Older (reported in Campbell et al., 2004) found that a slight increase in the time needed to cross the roadway by bridge discouraged the majority of pedestrians from using it, and that no

one used a bridge if the crossing time increased 50 percent over the at-grade alternative. Pedestrians were more willing to go out of their way to use an underpass or subway. The study indicated that up to 80 percent of the pedestrians would use an underpass if the time required was about 130 percent or less than that of the alternative route (perhaps because the less onerous down ramp or stair came first). In order to be effective, pedestrian bridges and tunnels must be a part of the natural walking path; ideally the walker should be unaware of the fact that he is diverting from the most direct route.

Other problems with bridges and underpasses occur when they are not well designed. These may include lack of ramps for access of wheelchairs and other wheeled vehicles and accoutrements (e.g., strollers, grocery cars, bicycles), gradients that are too steep, poorly designed railings, lack of sound screening from traffic (besides adding to discomfort, the sound can prevent the visually-impaired from hearing oncoming pedestrian or bicycle traffic), poor drainage in underpasses causing them to flood during severe weather conditions, and ramp terminals without level areas to allow wheelchairs and bicycles to stop before going into adjacent streets. NYCDOT has developed a toolbox of measures for correcting this last problem for bridges under their jurisdiction (see Section 3.3).

5.2.2 Speed Reduction

The faster a vehicle is traveling when it strikes a pedestrian, the greater the likelihood of a serious injury or fatality. The obvious approach to lowering speed is to reduce the speed limit. However, research has found that the observed speed reduction was only a quarter or less of the reduction in the speed limit. Police enforcement of speed limits is costly and has its limitations also; drivers lower their speed only when they are aware of the enforcement. (Leaf and Preusser, 1999) In contrast, if the roadway is designed for a lower design speed, motorists will generally drive slower without police enforcement for their own safety and control. Thus, lower design speed is usually self-enforcing, making it both less expensive and more effective.

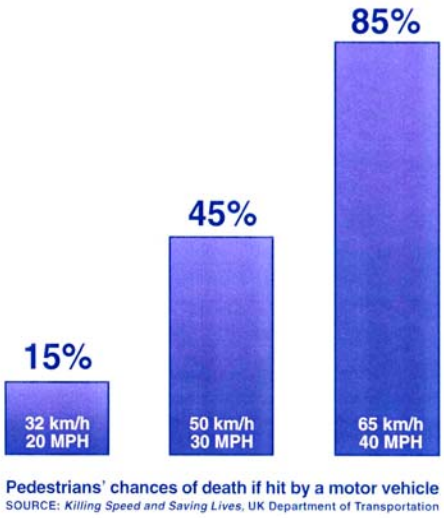


Figure 5.7 Impact of Speed on Pedestrian Fatalities

Speed management through engineering measures is probably the single most effective way to increase safety for all modes. Fatalities increase exponentially with speed. Speed-related factors that affect pedestrian safety include impact speed, stopping distance, and driver's narrowing field of vision. A policy change or a change in a design standard that leads to fewer pedestrian crashes may not cost anything. For example, almost all Seattle arterial streets are designed to a 48 km/h (30 mi/h) design speed, which is the legal speed limit unless otherwise posted. This is one of the reasons Seattle has one of the lowest pedestrian fatality rates in the nation; Seattle has made a commitment to safety as the number one priority.

In this section, three miscellaneous approaches to reducing speed will be discussed, followed by a longer section on traffic calming.

Approaches to Reducing Speed

Reduced Speed Zones: The use of reduced speed zones in areas with a large number of vulnerable pedestrians is an old practice for school zones. NYCDOT has a demonstration project involving 10 schools to test 20 mph and 15 mph zones near schools. A similar concept could be considered for senior zones, in areas where a large number of seniors walk. Such senior zones could involve other modifications, such as increased crossing times at signalized intersections. However, the walking patterns and locations of seniors are different from those of children; while children can be expected to walk in the vicinity of schools during school hours, seniors walking patterns are more diffuse and not confined to specific areas or times. NYCDOT policy is to examine conditions on a site-by-site basis and implement special treatments for seniors when found appropriate. Thus, if a higher proportion of seniors are found in a location, the signal timing will be adjusted to better meet their needs. However, NYCDOT's policy is to not demark senior zones.

If a reduced speed zone is implemented, the driver should be alerted through traffic calming methods and/or by flashing beacons. In cases where the reduced speed zone applies during specific times, such as school zones, the flashing beacons should be activated only during those times. As noted above, in order to be effective, the reduced speed zone should be reinforced by engineering measures, such as traffic calming.

Speed Monitoring Displays (SMD): An SMD is a speed monitoring radar combined with an LED sign that informs approaching drivers at what speed they are traveling. Typically the speed limit is also included. A Utah study (Saito, 2005) found that they reduced both average speeds and the percent of vehicles over the speed limit in school zones. A similar study of their use in work zones found that they reduced speeds by six percent (about four mph); they were most effective in the first week after implementation (Saito, 2003).

Curve Radius: One common pedestrian crash type involves the right turning vehicle at an intersection. The concept of a reduced radius is simple and basic - control speed through geometry. Instead of accommodating the vehicle with a large sweeping turn, a tighter radius will force the driver to negotiate the turn at a slower speed and with increased reaction time. There are also the added benefits of a shorter pedestrian crossing distance and more sidewalk area. The turn radius should be designed within the context of the turning area, whether it needs to

accommodate the turning movement of larger vehicles or an intersection with no pedestrian traffic (for example, in an industrial area) versus a densely populated area.

Traffic Calming

Traffic calming was mentioned in several of the interviews, with four traffic calming measures being specifically mentioned: *bulbouts (or neckdowns), roundabouts, speed tables, and on-street parking*. The objectives of traffic calming include reducing traffic speeds, reducing traffic volumes, and facilitating the shared use of the roadway by different types of users (including both motorized and non-motorized). All of these objectives contribute to pedestrian safety, but speed reductions in particular can increase pedestrian safety considerably. A good in-depth source of information on the design and impacts of different traffic calming measures is the ITE *"Traffic Calming: The State of the Practice"* (Ewing, 1999, available on line at the Institute of Transportation Engineers website: www.ite.org). This section describes first, traffic calming programs that combine multiple traffic calming measures in one neighborhood or area and second, individual traffic calming measures. There are tables that indicate the effectiveness of the traffic calming measures in reducing speed and volumes at the end of the traffic calming section..

Traffic Calming Programs

A set of programs aimed at calming the traffic have been adopted at various places around the world. Such programs include: Community Streets, "Woonerf," Play Streets, transit malls, and area wide traffic restrictions:

Community Streets: In Japan traffic calming strategies have been directed toward community streets, which rely on measures such as speed humps, bulbouts, chicanes, and other devices (see below for descriptions) to slow down motor vehicle traffic. Roadpia (short for Road Utopia) is neighborhood-wide installations of community streets that give priority to pedestrians and cyclists. The combination of traffic calming devices was effective in reducing traffic, vehicle speeds, and collisions (See Sriver and Kwon, 1999).

Woonerf: The Netherlands developed the concept of "woonerf" (a Dutch word meaning roughly street for living) based on the residential yard (Kraay, 1976). These are areas where the physical and visual treatments of the public right-of way create a pedestrian-oriented area. Only local traffic is allowed to use the roadway and all modes are "forced" to travel almost as slow as the slowest mode (the pedestrian) through design features, such as special paving materials, lack of curbs, trees planted in the street, and street parking. (See example at: http://www.walkinginfo.org/de/curb1_print.cfm?codename=32d&CM_maingroup=TrafficCalming)

Transit Malls with Shared Use of Pedestrian-Oriented Space: A study of crashes occurring before and after implementation of transit malls in Philadelphia and Minneapolis, showed non-pedestrian collisions decreasing sharply on transit malls with no evidence of an increase on

nearby streets. Whereas Bus-pedestrian conflicts are much higher on transit malls than on other streets, they have not resulted in a higher number of bus-pedestrian collisions.

Areawide Traffic Restrictions*:* Areawide traffic restriction plans have been employed in Upsala, Sweden, entailing closing streets to vehicular traffic, using one-way flow on bypasses, and bus-only streets. Risk for pedestrians within the restricted area declined by 29 percent. However, risk on the streets outside the restricted area increased although by only 12 percent. (Lovemark, 1974 and Brownfield, 1980, cited in Campbell et al., 2004).

Traffic Diversion: Traffic diversion can be made by street closures, diverters, and signs restricting access, either during the peak travel hours or on a 24-hour basis. These projects are designed to shift traffic off of a neighborhood street that is suffering from cut-through traffic onto other streets. If these " other streets" are major streets or arterial roads (that is, not other residential streets), the project generally can be considered successful. Traffic diversion projects often limit resident access, as well as for their guests and service vehicles.

Play Streets*:* Play streets entail closing, usually for a period of several hours, a neighborhood street to allow children to use it as a playground. Play streets have been employed in the United States in center city neighborhoods with few parks to provide safe play areas. A series of interview studies at 20 sites in Philadelphia and New York City found play streets to be effective in eliminating traffic and parking. (See example at: http://www.walkinginfo.org/pedsafe/popup4.cfm?codename=34e)

Traffic Calming measures

Gateways: Entrance and exit symbols such as "gates" into/out of a city are widely utilized in Europe to visually inform drivers of a change in driving environment such as speed limit, pedestrian and/or bicycling activity. Entrance gates also offer an aesthetic effect that welcomes visitors and drivers to the city or a neighborhood and acknowledges them as they leave. Such entrance and leaving gates would be most beneficial for major roadways that enter well-designated cities. In densely developed areas such as most of the NYMTC region, the boundaries of the cities and villages are often not clearly distinguishable. However, it is still possible to integrate similar "gates" on roadway sections that warrant speed and/or volume reduction or to indicate a transition from one type of street to another. Examples may include business districts, dense residential areas, and school areas. Additional gateway examples can be found in Brewer et. al. (2001).

Figure 5.8. Gate at City College of New York

Bulbouts (also called neckdowns, nubs, intersection narrowings, and corner bulges): A bulbout is a curb extension at an intersection that reduces the roadway width from curb to curb. They are primarily of use on streets with curb parking, and should not extend into the travel lane. They have multiple impacts on pedestrian safety, the most direct one being the reduction in the length of time that the pedestrian is in the roadway thus reducing the time the pedestrian is exposed to traffic. Other impacts are to reduce vehicle speed (due to the psychological impact of the narrower roadway) and to increase visibility for the driver by raising the height of the pedestrian waiting to cross and for the pedestrian by putting him or her at the outer edge of any parked vehicles. They also slow turning vehicles by reducing the available turning radius. Planning for bulbouts should take into consideration the types of vehicles that need to travel through them. Local municipalities that use bulbouts include Nyack (along Main Street), Huntingdon Village, and New York City.

A NYCDOT study (King, 1999) of bulbouts found that results varied by location but on average bulbouts reduced overall crash rates. (See Table 5.1.) To measure the impact on injury severity, the researcher weighted the crashes by the NYSDOT CASIUS severity mapping program. In two of the high pedestrian intersections, injury severity was reduced; at the third (along Queens Boulevard), severity increased substantially. The researcher attributed the difference to the greater complexity of intersection.

Table 5.1 Effect of Neckdowns on Crash Rates at Intersections in New York City

1983-1995		ALL CRASHES		VEH/PED CRASHES	
		relative change	factored for severity	relative change	factored for severity
LOCATION	NOTES				
Brooklyn: Nassau / Norman	(low pedestrian, trucks)	-12 %	-31 %	*	*
Staten Island: Port Richmond	(low pedestrian, low vehicle, some signals)	-45 %	-42 %	*	*
Queens: Jackson Heights	(high pedestrian, signals)	14 %	-41 %	*	*
Manhattan: Restaurant Row (W 46 St)	(high pedestrian, signals)	14 %	-2 %	**7 %**	**-7 %**
Brooklyn: Flatbush Avenue	(high pedestrian, low speed, some signals diagonal)	-4 %	30 %	**31 %**	**-24 %**
Queens: Sunnyside	(high pedestrian, high speed, some signals, diagonal)	-42 %	25 %	**4 %**	**97 %**

* Number of crashes statistically irrelevant (<30).
Source: King, 1999.

Other research has shown that motorists are more inclined to stop behind the crosswalk at a bulbout, and that pedestrians are more inclined to wait on the curb at the bulbout rather than the street.

Roundabouts and Neighborhood Traffic Circles: Roundabouts and neighborhood traffic circles are circular intersections that force the drivers to deflect their route. Roundabouts have yield control and channelized approaches at the entrances, require counter-clockwise circulation,

and have geometric curvature that ensures circulatory speeds that are typically less than 30 mph. Neighborhood traffic circles are generally at the intersections of local streets for traffic calming or aesthetic purposes. They usually are not channelized and do not have yield control.

Roundabouts have been used successfully in Europe in recent years but have not been popular in the United States because of bad experiences with the rotaries of the early 20th Century. With the older rotary, the entering vehicles had the right of way, with the result that rotaries tended to lock up under congested conditions and to have severe safety problems. The modern roundabout requires the entering vehicles to yield to traffic already in the circular pathway, relieving these problems. (See NYSDOT, http://www.dot.state.ny.us/roundabouts/back.html and FHWA, Robinson et al. 2000, http://www.tfhrc.gov/safety/00068.htm)

Roundabout: Modern roundabouts have small diameters, which require low speeds for entering and circulating. They usually have raised islands at the center of the intersections that require vehicles to travel in a counterclockwise direction. The islands are typically circular in shape and frequently landscaped. Entrances to roundabouts are controlled by YIELD signs and splitter islands to channelized traffic at the approaches. Roundabouts are particularly useful at non-standard intersections, for example, where more than two streets intersect or the streets are not at 90 degrees to each other.

Roundabouts prevent drivers from speeding through intersections by impeding the straight-through movement and forcing them to slow down to yield.

Another advantage of a roundabout for pedestrian safety is the reduction in the number of potential vehicle-pedestrian conflicts. For example, a conventional intersection with four single lane approaches has 16 points of potential pedestrian-vehicle conflict; a roundabout for the same situation, has only eight points of potential conflict.

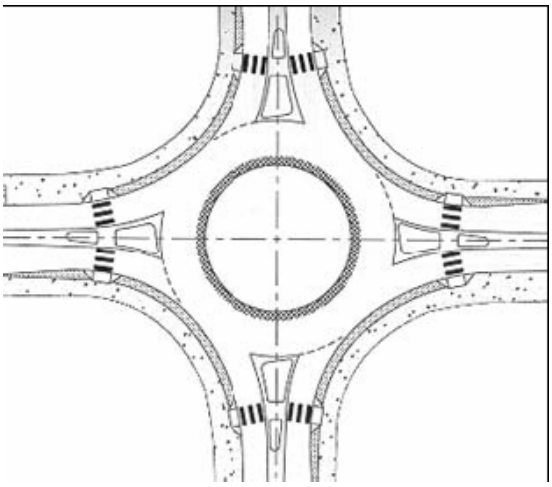


Figure 5.9 Splitter Islands and Traffic Sign for Roundabouts

The channelization by splitter islands (see Figure 5.8) improves pedestrian safety further by providing a pedestrian refuge between traffic traveling in different directions. With the splitter islands, pedestrians can cross the intersection in two stages and need to pay attention to vehicles approaching from only one direction at a time.

Pedestrian crossings are uncontrolled, and therefore might be a safety concern if not well designed. The design should include splitter islands, which deflect approaching vehicles and thereby slow them and which ensure that the pedestrian has to watch for traffic approaching from one direction only. The crosswalk should also be recessed so approaching vehicles watching for traffic that is in the circle are not in conflict with crossing pedestrians. A Dutch study of 181 intersections that were converted to roundabouts found a reduction in all types of crashes of 51 percent. The reduction in pedestrian crashes was 73 percent and in pedestrian injury crashes was 89 percent. (Robinson et al., 2000)

Figure 5.10 Roundabout in Suffolk County

The public's reaction to plans for implementing roundabouts has been negative, perhaps due to memories of the earlier rotaries. However, a survey by NYSDOT indicates that after drivers have experienced the roundabouts they are more accepting. See Table 5.2 below.

Table 5.2 NYSDOT Survey of Public Acceptance of Roundabouts

	Public Acceptance		
	Low	Moderate	High
Before Construction	29%	59%	12%
After Construction	3%	42%	55%

Source: A Citizen's Guide to Roundabouts, NYSDOT, 2004B.

Neighborhood Traffic Circles: Neighborhood traffic circles (sometimes called mini-circles) also require traffic generally to circulate counterclockwise around a center island, but in contrast to roundabouts, they do not have yield control at the entrance or splitter islands. They are typically used in very low volume, residential locations. The radius of the center island is frequently tight, making circulation by large vehicles difficult; one solution is to use mountable curbs on the center island. Additionally, large vehicles may be allowed to turn left in front of the center circle (that is, circulate clockwise). Seattle found a 90 percent reduction in crashes of all types with neighborhood traffic circles. (Harkey and Zegeer, 2004)

Narrowings: There are two types of narrowings, center island narrowings and roadway narrowings. Center island narrowings are used as gateways to residential and/or business areas.

Roadway narrowings are used to provide a visual effect to the drivers that they have to slow down. Often roadway narrowings are combined with pedestrian crossings. They can also be used to simplify traffic patterns.

Center Island Narrowings*:* The main functions of center island narrowings are speed reduction, alerting drivers to a change in driving environment, and sometimes as a warning of pedestrian activity. Usually the lane width is narrowed to less than 11 feet and sometimes it is combined with a pedestrian crossing. The narrowing may be combined with the start of a bike lane.

Usual locations for narrowings include:

Gateways to residential/business areas: Driver senses a change in driving environment and is forced to slow down due to a change in the lane alignment and lane width.

Midblock medians/ median slow points: Driver is forced to reduce speed due to a change in lane alignment and reduced lane width. Median narrowings may further reduce the traffic volume that passes by that roadway.

Pedestrian Crossings: Narrowings are also used in places where pedestrian crossing is needed but a signal is not warranted. They are less expensive and less intrusive than signals, requiring relatively less maintenance.

Road Diets: A road diet, like any other diet, slims down the travel lanes and reconfigures road space for other uses. The concept of a road diet is basically a more systematic application of narrowings. Some roads may be designed with multiple lanes to handle peak traffic that occurs for as little as 30 minutes a day. This space may better be used through a road diet with this space accommodating on-street parking, medians, center turn lanes, and/or bike lanes.

Figure 5.11 shows one example of a typical road diet. Which roadway carries the most traffic? It depends. Both are about equal up to 15,000 ADT or so; three lanes perform better if there are a lot of left turns. The four-lane option allows drivers to pass others at high speeds. The results of an implementation of five road diets in San Francisco's Mission District showed no real change in ADT with an increase in bicycle ridership (ADT between 10,000 – 25,000 including Valencia Street).

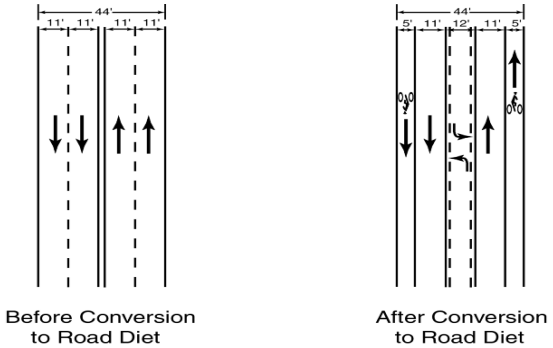


Figure 5.11 Example of a Road Diet

The three-lane option above has fewer crashes of all types. A road diet typically reduces conflict points and crashes, especially rear-enders and sideswipes. Left-turning drivers have a better view of oncoming traffic with just one lane versus the problem of shielded traffic in the outside lane while waiting to turn.

There are numerous benefits for pedestrians. Pedestrian crash risk increases with number of travel lanes and speed. Road diets reduce crossing distance. They allow for medians or crossing island to break a long crossing into 2 simpler crossings. Road diets reduce top end travel speeds. They eliminate or reduce "multiple threat" crash types. They increase sidewalk buffer from travel lanes (parking or bike lane). As mentioned in the first paragraph, they reclaim street space for "higher and better use" than moving peak hour traffic

Figure 5.12 Before and After an Implementation of a Road Diet

Textured or Colored Pavements (Cobblestone, Brick Pavement, Stamped Pavement): Various methods are used to create textured or visually distinct pavements such as cobblestones, bricks, stamped (or printed) patterns or color pigment. Their main objectives are to reduce speed, to create a pleasant aesthetic effect, or to indicate a change in the character of the area. They are used for pedestrian crossings, raised intersections or entire streets. However, the use of cobblestones or bricks can cause difficulty for pedestrians, particularly older or disabled pedestrians, and also for maintenance equipment. They also can generate noise from vehicles driving on them. Printed or painted patterns are less of a problem, but paint and textures can both be slippery when wet.

Figure 5.13 Colored Pavement in Pearl River, New York

NYCDOT used colored pavement treatments in Downtown Brooklyn to indicate a change in the driver environment (that is, from commercial to residential). For example red pavement designates the transition from commercial to residential at Hicks Street/Atlantic Avenue. They

have experienced a maintenance problem; when a street is dug up, for example for a utility repair, the contractors do not always replace the original treatment.

Speed Humps (Road Humps, Undulations, Speed Reducers): Speed humps are rounded raised areas placed across the roadway. They are generally 10 to 14 feet long in the direction of travel (making them distinct from the shorter "speed bumps," which are about 12 inches long and found in many parking lots) and are 3 to 4 inches high. The profile of a speed hump can be circular, parabolic, or sinusoidal. They are often tapered as they reach the curb on each end to allow unimpeded drainage.

Speed humps have been found effective in many cities in reducing vehicle speeds. A synthesis of eight studies found that 85th-percentile speeds decreased by 4 to 23 mi/h after speed humps were installed. Studies in Omaha, Nebraska, and Montgomery County, Maryland found that fewer crashes occurred after adding speed humps. Some studies have found that drivers speed up between speed humps to make up for lost time. While their main objective is to reduce speeds, speed bumps can also reduce traffic volumes. After installation of speed humps, traffic volumes fell by up to one half in three Australian cities and also fell in Bellevue, Washington. Traffic volumes remained constant in Agoura Hills, California, though. (See Campbell et al., 2002). Speed humps are not appropriate for use on arterials, bus routes, truck routes, of snow emergency routes.

Many cities install speed humps in response to neighborhood requests after an analysis of its appropriateness; for example, the NYCDOT website invites individuals and groups to write to the commissioner to request a speed hump.
(http://www.nyc.gov/html/dot/html/about/faqs_trafcalming.html)

Speed Table: A speed table is a raised section of pavement, similar to a speed hump, but longer, typically as long as a car, and having a flat top. They are often used at intersections or crosswalks. The flat surface is often made of bricks or other textured material to increase visibility and improve the appearance. The ITE book (Ewing, 1999) found an average decrease in speed from 58 studies of speed tables (22 foot long tables) of 18 percent.

Raised Intersections (Raised Junctions, Intersection Humps, Plateaus): Raised intersections are also Speed Tables that cover the entire intersection, which are usually implemented with some type of a textured pavement. Their main objectives are to alert drivers that heavy pedestrian activity is expected at this intersection, to raise the awareness of drivers that a pedestrian crossing is in place, and to make pedestrians more visible from a further distance to approaching motorists. Raised intersections have a small impact in the reduction of speed.

At one intersection in Cambridge, Massachusetts, about 10 percent of motorists yielded to pedestrians crossing before a raised intersection was installed. The yield rate increased to 55 percent after the raised intersection was installed (reported in Zegeer, Stutts, et al., 2004).

Raised Crosswalks: Raised crosswalks are speed tables or speed humps that are at crosswalk locations and extend the width of the crosswalk. They are usually implemented with some type of a textured pavement. Their main objectives are to alert the pedestrians that a pedestrian

crossing exists, to raise the awareness of drivers that a pedestrian crossing is in place, and to make pedestrians in the crosswalk more visible to drivers. Raised crosswalks also aid in the reduction of speeds. If the level of the entire intersection is raised it is referred to as a *raised intersection*. A study of effectiveness found that there were significant reductions in vehicle speed at two out of three locations. It also found that there was an increase from 31 percent to 79 percent of motorists stopping for pedestrians at a raised crosswalk with an overhead flasher, but an insignificant increase at a similar intersection without a flasher. (Huang and Cynecki, 2001)

Chicanes: Chicanes are roadway curb extensions that usually alternate from the one side of the street to the next. Their main objective is to force drivers to reduce speed by following an S-type curve vehicle path. One form of chicane is alternate parking (diagonal or parallel). Their main advantage over speed humps is a reduction of noise.

Chokers (Pinch Points, Midblock Narrowings, Midblock Yield Points, Constrictions): Chokers are also curb extensions that are created mid-block of a roadway. These curb extensions can take various forms such as: Curb extensions at both sides of the street – main effect is reduction of speed at both directions; Curb extensions at both sides of the street plus crosswalk – main effect is reduction of speed plus a "safe" pedestrian crossing; Curb extensions that effectively leave only one lane crossing such that vehicles proceed one at a time alternating for each direction – severe reduction in speed up to a complete halt.

Roadway Lane Width: Roadway lane width is listed separately as a traffic calming control measure as it could be used by itself or in combination with roadway narrowings. The theory is that lane narrowing "forces" the driver to become more attentive, which leads to reduced speeds and crashes. Lane widths of 12 feet and above tend to make the drivers less attentive since they worry less about the vehicles next to them, resulting in an increased probability of crashes. It is noted that for two-lane highways this implementation may not be effective since the narrowing usually is only visual rather than actual – the driver does not feel any danger from his/her right side so he may simply drive partially on the shoulder. A comprehensive study related to traffic fatalities and injuries by Noland (2002) notes that "as more arterial and collector lane widths are increased up to 12 ft or more, traffic fatalities and injuries increase" and concludes that roadways with lanes less than 11 feet wide are safer. The study was based on 14 years of data from FHWA covering all 50 states up to 1996.

Therefore, the lane width may be used as a traffic calming measure to reduce fatalities and injuries. Lane width narrowing should be properly designed such that it indeed forces the drivers to slow down and become more alert. A previous study by FHWA where only visual narrowing was attempted had shown there was no effect on traffic speeds. Under those conditions, the lane width was indeed narrowed, however wider shoulder widths negated any effect on traffic speeds.

Concluding Comments of Traffic Calming

The choice of specific traffic calming measures should take into consideration the requirements of the particular location, including the character of the area, the type and volume of traffic, and the needs of emergency vehicles. Several variations of traffic calming measures can be observed throughout the country, including comprehensive traffic calming strategies that combine several

measures with specific geographic areas and strategies that are part of a more general context sensitive design.

If not properly designed, some traffic calming measures may have an adverse effect on emergency services that need to respond in a timely manner. Atkins and Coleman (1997) in a study of several types of emergency vehicles negotiating traffic-calming devices including humps and roundabouts concluded that implementing traffic-calming projects on streets that provide primary access to fire stations, hospitals, and other emergency service should be carefully evaluated.

Figure 5.14 Use of Flexible Bollards and Paint for Cost Effective Changes

Finally, NYCDOT has found that implementing some of these measures (for example, narrowings) through the use of striped markings or cones is quick and cost effective compared to construction.

Traffic calming measures affect pedestrian safety in many ways but particularly by reducing vehicle speeds and volumes. Tables 5.3 and 5.4 (from ITE study; Ewing, 1999) summarize the impact of traffic calming measures on traffic speed and volume based on evidence from many studies.

Table 5.3 Speed Impacts Downstream of Traffic Calming Measures

		85th Percentile Speed (mph)*		
Sample Measure	Sample Size	Average After Calming	Average Change After Calming	Percentage Change*
Hump, 12-foot	179	27.4 (4.0)	-7.6 (3.5)	-22 (9)
Hump, 14-foot	15	25.6 (2.1)	-7.7 (2.1)	-23 (6)
Table, 22-foot	58	30.1 (2.7)	-6.6 (3.2)	-18 (8)
Longer Tables	10	31.6 (2.8)	-3.2 (2.4)	-9 (7)
Raised Intersections	3	34.3 (6.0)	-.3 (3.8)	-1 (10)
Circles	45	30.3 (4.4)	-3.9 (3.2)	-11 (10)
Narrowings	7	32.3 (2.8)	-2.6 (5.5)	-4 (22)
One-lane Slow Points	5	28.6 (3.1)	-4.8 (1.3)	-14 (4)
Half Closures	16	26.3 (5.2)	-6.0 (5.2)	-19 (11)
Diagonal Diverters	7	27.9 (5.2)	-1.4 (4.7)	-4 (17)

Table 5.4 Volume Impacts of Traffic Calming Measures

Measure	Sample Size	Average Change In Volume* (vpd)	Average Percentage Change in Volume* (vpd)
Hump, 12-foot	143	-355 (591)	-18 (24)
Hump, 14-foot	15	-529 (741)	-22 (26)
Table, 22-foot	46	-415 (649)	-12 (20)
Circles	49	-293 (584)	-5 (46)
Narrowings	11	-263 (2,178)	-10 (51)
One-lane slow points	5	-392 (384)	-20 (19)
Full closures	19	-671 (786)	-44 (36)
Half closures	53	-1,611 (2,444)	-42 (41)
Diagonal diverters	27	-501 (622)	-35 (46)
Other volume controls	10	-1,167 (1,781)	-31 (36)

*Measures in parentheses represent the standard deviation from the average.

5.2.3 Signalization

Signalization on arterials and at isolated intersections is used to move traffic efficiently and safely. The traffic engineer has to identify the best cycle length, phasing, and offsets for each intersection to accommodate pedestrian safety while maintaining traffic efficiency. The engineer may also prohibit some turns at specific intersections in order to improve safety.

Centralized traffic signal control offers the advantage that the traffic operators can identify signal malfunctions in real time and take appropriate actions to first log the problem, then try to fix it either remotely through the existing communication system or by sending a crew to fix it. This is particularly useful for intersections that employ pedestrian signals with push buttons. One of the main complaints that pedestrians make is that the pedestrian signals are not functioning, sometimes due to a misunderstanding of how the buttons work. However, when the push buttons actually are not working properly, it may not be brought to the attention of the traffic operators and thereby further contribute to the publics misunderstanding or lack of reliance on the signals. A centralized system may aid in a much more efficient response system. In addition, if the intersection is also equipped with automated pedestrian detection system then the system could optimize the signals to accommodate both the vehicular and pedestrian traffic.

The Port Authority of New York and New Jersey (PANYNJ) is progressing toward the implementation of a centralized traffic control system to monitor the status of its signalized systems in real time to provide proactive timely maintenance in cases of failures of actuated pedestrian signals.

Pedestrian Crossing Time: In the past, the minimum time provided for pedestrians to cross a roadway was based on a design walking speed of 4.0 feet per second, a speed that is about the average for a mixed age group of pedestrians. Using this design speed to determine the clearance interval will result in about half of the pedestrians still being in the street when the cross traffic is allowed to proceed. Research (e.g., Fitzgerald et al., 2006) suggests that 3.5 feet per second (that is, the 15^{th} percentile) is a more appropriate design speed for the general public

and 3.0 feet per second more appropriate when a significant number of older pedestrians or children are likely to cross at the intersection. For example, NYCDOT uses 3.0 feet per second near schools. The aging population and the increased use of cell phones and other electronic devices also suggest that a slower design speed is more appropriate. However, using slower design walking speeds may adversely affect traffic efficiency, and therefore the context of the intersection should be considered. The use of the 3.0 feet per second might be restricted to "senior zones."

Figure 5.15 Sign to Explain Signal Designation

Methods of signal phasing that may improve pedestrian safety include: Split phasing, exclusive pedestrian phasing, leading pedestrian interval (LPI), actuated pedestrian signals. The main designations for pedestrian crossing signals are: WALK/DON'T WALK signals (including the international symbols of a walking man for WALK and a upraised hand for DON'T WALK), countdown pedestrian signals, and audible signals.

WALK/DON'T WALK Signal designations: This is the most common signal designation that exists today. The signal has three designations: WALK; flashing DON'T WALK; and steady DON'T WALK. Many cities have switched to the international symbols (shown at right). A problem with these designations is that many pedestrians do not understand the flashing DON'T WALK (or flashing hand). Many municipalities are posting signs (see Figure 5.15) that explain the designations.

Countdown Pedestrian Signals: Instead of a flashing DON'T WALK or flashing symbol of a walking pedestrian, countdown pedestrian signals show the time that remains in the pedestrian crossing phase. (In some cities, the countdown starts with the WALK signal.) They provide actual information on when to cross and how much time is left to cross the intersection to the pedestrians. One objection to them is that drivers waiting for a green signal may use them to anticipate the signal (note that the authors could not find any data on this topic). A simple modification to the countdown signal keeps the driver from seeing the countdown signal for the perpendicular direction.

5.16 Countdown Pedestrian Signal

A study in San Francisco (an urbanized environment) found a 52 percent reduction in pedestrian injury crashes at 14 pilot locations where countdown pedestrian signals were installed. This was compared to a three percent (statistically insignificant) decrease at a control sample of intersections. Because the pilot locations were selected because they were intersections with a high number of pedestrian

crashes, the 52 percent is an overstatement of the impact that could be expected in other locations. (Markowitz, et al., 2006) A more realistic crash reduction factor for countdown pedestrian signals is 25 percent (NYMTC workshop, 2006). The study also found the meaning of the countdown was obvious to pedestrians; note that in San Francisco the countdown starts when the flashing hand would have started. Additional findings were that the number of pedestrians who were in the intersection when the signal turned red decreased, as did the number of pedestrians who started running. There was a small (insignificant) decrease in pedestrian/vehicle conflicts. The shifts in driver behavior that the study noted were not statistically significant. (Markowitz, et al., 2006)

Other studies were not as positive. In Lake Buena Vista, Florida, Huang and Zegeer (2000) found that countdown pedestrian signals reduced the number of pedestrians that start running due to the flashing DON'T WALK signal. However, the number of pedestrians who did not comply with the Walk phase actually increased. In Berkeley, California, the impact of countdown pedestrian signals was an increase in pedestrian speeds and a decrease in the number of "late finishers," but otherwise there were few changes in pedestrian behavior (PHA, 2005).

Leading Pedestrian Intervals (LPIs) (also known as Advanced Walk Signals): LPIs provide a head start to the pedestrian signal indicator (often 3 seconds) before the vehicular green phase starts. NYCDOT uses a six second LPI. By allowing pedestrians to take possession of the intersection first instead of being intimidated by the turning cars, they clear the intersection sooner, allowing more time for the cars. Thus, they can improve traffic operations also. NYCDOT has implemented LPIs at many intersections and has found them well received by the public. King (1999) found a 12 percent decrease in vehicular-pedestrian crashes after the implementation of LPI at some New York City intersections. When compared to control sites and factored for severity, he estimated a 64 percent decrease in crashes.

The LPIs combined with the audible signals are very successful; the audible signal alerts the pedestrians that the signal has changed, allowing them to take advantage of the early start; this is particularly valuable where the LPI is only three seconds.

Split Phasing: Split phasing is recommended where there is heavy pedestrian activity. The green phase is split into two parts. During the first part (which is long enough for pedestrians to cross the intersection), pedestrians receive protected walk time when vehicles can go straight but not turn. In the second part of the green phase, vehicles are allowed to turn. See Figure 5.17 below.

NYCDOT found an average reduction of 86 percent in pedestrian-vehicle conflicts after the implementation of split phasing at 12 midtown Manhattan intersections, as well as a ten percent decrease in pedestrian crashes, and a reduction of 52 percent in illegal pedestrian crossings. The reduction in conflicts also had the impact of increasing vehicular speed by 33 percent. (NYCDOT, 2004)

Figure 5.17 Split Phase Cycle

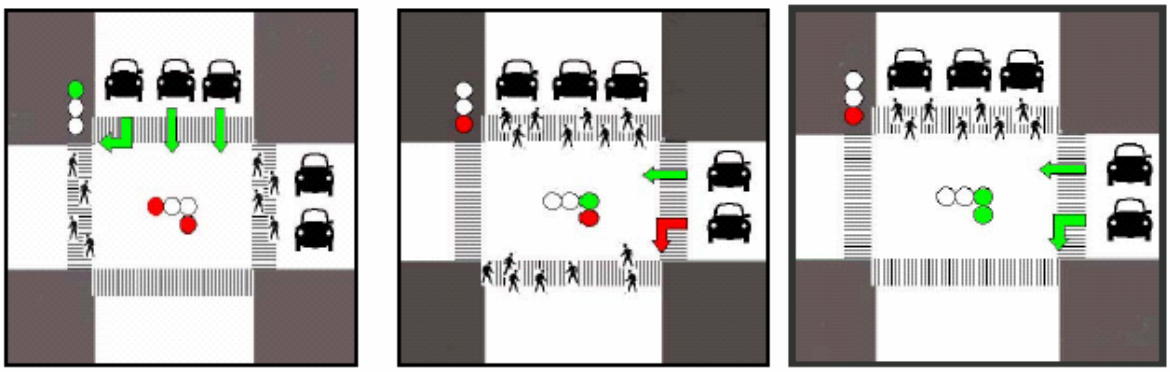


Figure 8. Split Phase Cycle. In the first image, traffic on the avenue moves and cross street traffic is stopped. In the second image, the avenue is stopped, and vehicles on the cross streets can travel straight and turning vehicles are stopped. Pedestrians can cross the avenue at both crosswalks. In the third image, both straight and turning movements are permitted from the cross street while pedestrians can continue to cross at the non-turning crosswalk only.

Source: NYCDOT, 2004.

Pedestrian Scramble (Barnes Dance or exclusive pedestrian phase): The pedestrian scramble is an exclusive pedestrian phase. It is usually accompanied with pedestrian crossing marking diagonally across the intersection. A consequence of this is a longer signal cycle length that potentially may increase vehicle delays. It also increases the wait for the pedestrian during the vehicle phases. This may lead to the pedestrian crossing when there is a gap in traffic, thus negating any potential safety benefit. Yet, exclusive pedestrian timing has been shown to reduce pedestrian crashes by 50 percent in some downtown locations with heavy pedestrian volumes and low vehicle speeds and volumes. (See Signals and Signs in Countermeasures, Harkey and Zegeer, 2004)

Protected Left Turns: A particularly dangerous situation for pedestrians at signalized intersections is the conflict between the pedestrian crossing with the signal and cars turning left from the parallel street; if the vehicles do not have protected left turn, they are under pressure to observe and use a gap in the on-coming traffic for their turn, while simultaneously watching the signal. When the gap occurs (sometimes not until the signal has turned to amber or even red), the driver has to quickly react and make the turn, often without noticing that a pedestrian is in the crosswalk.

Providing a protected left turn takes the pressure off the driver and prevents the conflict by holding the pedestrian out of the crosswalk during the left turn interval. The crash reduction factor for protected left turns is 50 percent (NYMTC workshop, 2006). One factor that probably reduces the effectiveness of the protected interval is pedestrians that, noticing that vehicles on the cross street have a red signal, assume that it is safe to cross despite the red DON'T WALK or hand.

A related measure is to provide a left turn bay. This further reduces the pressure on the driver by removing the threat of rear end collisions from behind. In addition, by converting a two through-

lane configuration into a one through-lane with left turn bay, left-turning vehicles only have to be aware of one lane of oncoming traffic rather than the possibility of cars that are hidden behind vehicles in the left oncoming lane. This allows more driver attention to be on pedestrians in the crosswalk.

Right-Turn-on-Red Restrictions: Vehicles that are taking advantage of right turn on red often are not alert to pedestrians trying to cross because the driver is watching for vehicles coming from the left. Additionally, the vehicles often pull across the crosswalk in order to have better a view. In areas with many pedestrians, prohibiting red turns on red increases pedestrian safety and convenience. New York City has a citywide prohibition of red turns on red.

Pedestrian-Actuated Signals: Actuated signals are recommended in areas where there is low, mostly random pedestrian activity. Their function is to initiate the WALK indicator; in some cases, they also lengthen the time available for the pedestrian to cross the intersection. The most common technology used for actuated pedestrian signals is a push button.

Pedestrians frequently complain that the push buttons do not work properly – usually because they are not aware of the buttons' function or how the buttons actually operate. Push buttons should provide feedback to assure the pedestrian that their input was received and the button is functional. Three types of feedback are vibratory, audible, and light up (or a combination of the two or three of them). NYSDOT has installed buttons that light up to provide such feedback on Route 9 at Marist College.

Vandal Proof push buttons: Push buttons are sometimes vandalized; for example, they attract kids, who stick gum and other things in the buttons. At least one manufacturer, Polara Engineering, has produced a push button called the Bull Dog, which they claim cannot be vandalized. The Port Authority of New York and New Jersey is considering testing them at an intersection.

On call Priority Pedestrian Phase: A rather new technology that is becoming popular in places where there is low pedestrian activity – where no pedestrian phase is in place within the signal cycle – is an on-call pedestrian phase. The push button activates the pedestrian phase within a few seconds of actuation. This technology is popular for pedestrians as it eliminates the uncertainty mentioned earlier on the operation of the push buttons. NYSDOT has installed them in several places; the feedback from pedestrians so far has been very positive due to their almost immediate activation. This technology should only be used where appropriate; in many high volume locations or for coordinated signal networks, it would be very disruptive to traffic flow.

Passive Pedestrian Detectors: Passive detectors detect if someone is at or near the curb at a crosswalk and actuates the crossing signal automatically. The Port Authority estimates that about 80 percent of pedestrians do not push buttons for crossing, and as a result cross the intersection in dangerous situations (e.g., when traffic on the parallel street have a left turn signal that the pedestrian may be unaware of). They may consider testing passive detectors. One disadvantage of passive detectors is that false signals (caused by pedestrians walking nearby, weather, or even vehicles) may be disruptive to traffic.

Combined Automatic and Actuated Signals: Automatic pedestrian phases are provided at times when pedestrian traffic volume is high, for example, during commute periods. At other, times when pedestrian traffic is expected to be low, the pedestrian phase is actuated by push button or pedestrian detectors.

Accessible Pedestrian Signals (APS): An APS is a non-visual device for communicating crossing information to a visually-impaired person, using either an audible or tactile signal. The WalkingInfo website is a good source for additional information about the different types (http://www.walkinginfo.org/aps/15-1.cfm).

Audible Pedestrian Crossing Signals: They make an audible signal, such as a chirping sound, drumbeat, or voice, to indicate when it is safe to cross an intersection. They are very popular in Japan and Europe and are becoming more common in the United States as well. Some residents complain due to the constant "noise" that they produce. Australia uses the drumbeat sound at a low level, which does not annoy the neighbors as much as the chirping signals. The tone can be adjusted to be only audible from the appropriate crossing area to avoid confusion as to which direction is safe for crossing; this has the added advantage of avoiding irritating other, nearby people. NYCDOT is testing signals with a voice, which alerts pedestrian as to the status of the signal, at intersections near facilities for the visually impaired.

The information conveyed by audible signals increases the attention of all pedestrians to traffic and may contribute to a reduction in pedestrian-vehicular conflicts and crashes at signalized intersections (Van Houten et al., 1997). It is widely believed in many European countries that the audible signals increase the speed at which most pedestrians initiate their crossings, thereby decreasing the necessary length of the pedestrian interval.

VibroTactile Crossing Signals: The pushbutton vibrates when the walk signal is on. Its advantages are there is no sound to annoy people in the area and the walk direction is less liable to be misunderstood. To use the device the visually-impaired pedestrian must stand with their hand on the button; this requires careful placement of the device so that the pedestrian can also be in position to start crossing the street when the vibration starts. The disadvantage is the visually impaired person must be aware of the presence and location of the button in order to take advantage of it.

Locator Tone: The locator tone is a quiet, repeating tone that alerts visually-impaired pedestrians that they need to push an actuation button and aids in locating the button.

Rest-on-Red, Rest-on-Green: One new adaptation to an existing technology is the use of speed detectors upstream of an intersection that continuously monitor the speed of oncoming vehicles. If a speeding vehicle is detected, the traffic controller changes the signal indication for the signal to yellow and then red. If the green is on and a vehicle approaches at or below the speed limit, the green is extended. Since this is at an experimental stage, its effectiveness is not yet known. (www.ite.org - Traffic Calming Practices).

Animated Eyes: This signal indication displays an animated eye where two elliptical shapes resembling eyes oscillate between looking left and right. It can be used for alerting either drivers

or pedestrians to conflicting traffic. The animated eyes display may be used to alert drivers exiting parking lots to the presence of pedestrians. (Hagen, 2006) Van Houton and Malefant found a small but significant decrease in pedestrian/vehicle conflicts in this type of location. The animated eye also can be part of the pedestrian signal (reminding pedestrians to look both ways). A passive (non-animated) set of eyes can also be used. (For examples of applications see http://www.cers-safety.com/products.htm.)

Electronic Pedestrian Crossing Indicators: LED pedestrian signs directed toward the motorist that light up when activated either by a pedestrian or a passive pedestrian detector can alert the driver to the presence of a pedestrian and also show the direction that the pedestrian is crossing. They are similar in concept to the in-pavement flashing lights, but mounted overhead or on roadside poles. A study found that the proportion of drivers that yield to pedestrians was always higher when the signs were activated (reported in Zegeer, Stutts, et al., 2004). They are often combined with animated eyes.

5.2.4 Unsignalized Intersections

Three main treatments used at unsignalized intersections are: marked crosswalk; enhanced high-visibility crosswalk (see 5.2.4 section) or "active when present" traffic control device; red signal or beacon device.

Marked crosswalks at uncontrolled intersections are not recommended. An NCHRP study (Fitzpatrick, Turner, et al., 2006) on unsignalized crossings, which looked at research from the 1970s to 2006, found that crosswalk markings at unsignalized intersections are correlated with higher pedestrian crash rates. For example, a study of 104 locations in Los Angeles where crosswalk marking were removed found a decrease in pedestrian crashes after removal.

The NCHRP study also found: "Those treatments that show a red signal indication to the motorist have a statistically significant different compliance rate from devices that do not show a red indication. These red signal or beacon devices had compliance rates greater than 95 percent and include midblock signals, half signals, and high-intensity activated crosswalk (HAWK) signal beacons. Nearly all the red signal or beacon treatments evaluated were used on busy, high-speed arterial streets. Pedestrian crossing flags and in-street crossing signs also were effective in prompting motorist yielding, achieving 65 and 87 percent compliance, respectively. However, most of these crossing treatments were installed on lower-speed and lower-volume, two-lane roadways. The measured motorist compliance for many crossing treatments varied considerably among sites. Number of lanes being crossed and posted speed limit were other factors in addition to type of treatment influencing the effectiveness of the crossing treatments."

The research team of the NCHRP study developed and presented recommendations to the National Committee on Uniform Traffic Control Devices to revise the MUTCD pedestrian warrant for traffic control signals. The study proposed two revisions to the MUTCD: 1) the use of median refuge islands or curb extensions as alternatives to traffic control signals; and 2) the inclusion of a new type of highway traffic signal, Pedestrian Traffic Control Signals.

5.2.5 Visibility

To insure safety, the pedestrian needs to be able to see approaching traffic and the motorist and bicyclists need to be able to see pedestrians and to be aware of crosswalks.

Lighting: The lighting conditions on pedestrian pathways and at pedestrian crossings are a factor in the overall safety of pedestrians. Improved lighting at crosswalks and along sidewalks and pedestrian pathways provides the following benefits: drivers become more alert of the presence of pedestrians and pedestrian crosswalks; pedestrians become aware where they are supposed to cross; security against theft, muggings, and other crimes increases; and pedestrians feel safer. Almost 50 percent of pedestrian crashes occur at night. The Swiss report a 60 percent drop in nighttime crashes when previously dark areas were illuminated. (NYMTC workshop, 2006).

Visible Crosswalks: Making drivers more aware of crosswalks alerts them to the possible presence of pedestrians. The first step is being sure that crosswalks are located where sight distance is adequate, that is, they are not too close to horizontal or vertical curves. A number of other measures that can improve the visibility of crosswalks follow.

Marked Crosswalks: Marking a crosswalk increases its visibility to the driver. Using a high visibility pattern is useful at controlled intersections and along roadways with low speeds (40 mph or lower). Figure 5.18 below shows the typical patterns used to mark crosswalks. (It should be noted that different pedestrian safety sources do not use the names of the patterns consistently; this document will refer to the patterns as shown in Figure 5.18.) The standard pattern of two six inch parallel lines is not highly visible to a driver. It is recommended that a municipality choose one of the patterns with thick bars (continental, zebra, or ladder) as a standard for use at controlled intersections, particularly intersections used by vulnerable pedestrians (e.g., along school routes).

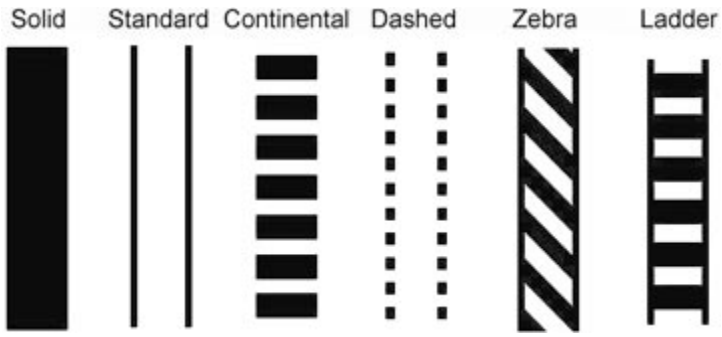


Figure 5.18 Crosswalk Marking Patterns

Inlay tape, which is highly reflective and slip resistant, has been found to be more effective and less expensive in the long run than paint for new and resurfaced pavement. Thermoplastic may be preferred for old or rough pavement. (Zegeer, Stutts, et al., 2004)

Marking crosswalks is not recommended for uncontrolled crossings on high speed or wide (four lanes or more) roadways. Marked crosswalks by themselves on multilane roadways with volumes above 12,000 vehicles per day have been correlated with higher pedestrian crash rates than unmarked sidewalks, presumably because the pedestrians have a false sense of security with the markings (Campbell et al., 2004).

Brick Textured Pavement: The actual use of bricks or paving stones at crosswalks is a pleasant architectural treatment that is sometimes used in downtown improvement areas. However, the treatment creates problems for maintenance and plowing and is more difficult to walk on, creating a potential tripping hazard for older or disabled pedestrians. A five-foot smooth area within the brick or paver texture area can solve this problem. (See Traffic Calming section.)

Concrete Printing: The concrete is stamped to make it look like bricks or some other texture, making the crosswalks more visible. Sometimes reflective tape is put in the indentations. The printing is less susceptible to snow plows than other treatments, but not as visible as painted or taped markings. Combining printing with a speed hump or table makes it more visible.

In-pavement Warning: These warning, such as LOOK LEFT (or right) are painted on or inlaid in pavement. The Port Authority uses them on one-directional roads such as an airport terminal frontage road or at a toll plaza lane. The Port Authority's general observation is that they point toward being an effective tool, but they have not conducted a formal study of their effectiveness.

In-pavement Flashing Lights: Lights are installed in the pavement in the crosswalk area. When the pedestrian phase is activated (automated or through a push button), they flash to warn motorists of the presence of pedestrians. Reports have been conflicting. An evaluation of their use in New Jersey (Boyce & Van Derlofske, 2002) recommended their use in cases where the crosswalk is in an unusual location (e.g., midblock), there are distractions competing for the drivers' attention, the sight distance from which the crosswalk can first be seen is short, or where the crash history indicates additional warning is needed. The New Jersey study also recommends the push-button version over the automated system, and recommends that the lens be cleaned on at regular intervals, e.g., at six months when traffic is heavy. A second study found that they were effective in increasing drivers yielding to pedestrians at low vehicular and pedestrian volumes (Karkee et al, 2006).

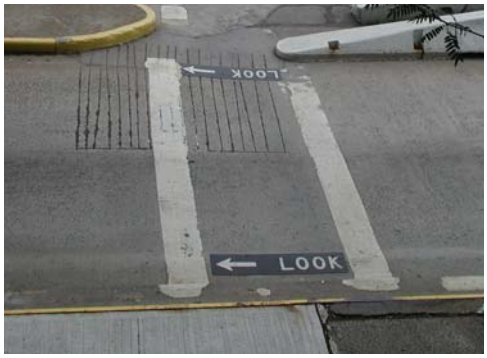


Figure 5.19 In-Pavement Warning

In-pavement flashing lights were used at a midblock crossing location along State Route 9 at Marist College. The lights flash when a pedestrian pushes a button. It was reported that they did not work well at Marist College because motorists and pedestrians did not know what to do when the light blinked. Some motorists would stop immediately increasing the probability of rear-end collisions, some would not stop, creating a situation on a four lane divided highway where pedestrians would start crossing because the nearest car stopped only to be surprised by the car in the next lane not stopping. An education program coordinated with the implementation of the lights was done for Marist students and local drivers. However, the mix of local and inter regional traffic on Route 9 made it impossible to reach all drivers. In response to this dangerous situation, a conventional midblock signalized pedestrian crossing was installed.

Pedestrian Crosswalk Signs: There are several different types of pedestrian crossing signs, including "Yield to Pedestrians" and the picture of a walking pedestrian. A study in Florida found that daytime drivers were 30 to 40 percent more likely to yield when an unsignalized crossing had a combination of high-visibility markings and overhead crosswalk signs; even though the signs were illuminated, nighttime drivers were only eight percent more likely to yield (Huang et al., 2000). The newest roadway pedestrian sign, the *fluorescent yellow-green school crossing marking,* is becoming a standard around the US. Cities and townships are replacing the older signs with this one that is more fluorescent and more visible.

"I never know where I'm going to cross, so I keep the sign with me."

In-roadway Pedestrian Crossing Signs (also referred to as a Supplemental Pedestrian Crossing Channelization Device or SPCCD): A "Yield to Pedestrian in Crosswalk" or similar sign is installed in the crosswalk at the lane demarcation at the middle of the road or on the side but very near the traffic lane (for one-lane, one way streets). They are installed in many locations throughout the NYMTC region at places where the speed limit is low (less than 30 mph). The traffic is "forced" to stay in lane and it slows down. A before/after study of their effectiveness in New York and Oregon (Huang et al., 2000) found that drivers yielded to pedestrians 81.2 percent of the time with the signs, compared to 69.8 percent of the time before they were installed. The sign should be made of plastic; metal is a safety hazard when they are struck by vehicles.

Figure 5.20 Sign to Increase Pedestrian Awareness

In Carmel, NY (in Putnam County), the high school has a movable sign instructing motorists to yield to pedestrians that is placed in the center of the street during school hours. It is effective in causing drivers to slow down, both because of its unexpected location and the narrowing of the roadway. A problem is created because it frequently is not removed at night with the result that cars frequently hit it under the lower visibility conditions.

Signs to Increase Awareness of Pedestrian Safety: "Share the Road" or "Pedestrian Killed Here" signs can be used to increase awareness of both drivers and pedestrians.

Pedestrian Crossing Assistance: A police officer or an authorized person assists pedestrians to cross. These programs are particularly popular in heavy pedestrian volume and near school crossing sites. AAA has a program that trains persons who Awareness want to assist in pedestrian crossing programs. Putnam County routinely

puts an extra flagman at a crossing location if road construction occurs near school.

Flags for Visibility: Pedestrian crossing flags are kept in a bucket next to the crosswalk. Pedestrians can pick them up to carry with them across the street, where they then return them to a bucket on that side. Having the flags in the bucket at the crosswalk also helps to alert the drivers to the presence of the crosswalk. Salt Lake City has been using the flags at some crosswalks since 2000. (Mean Streets 2004, available at: http://www.transact.org/library/reports_html/ms2004/files/Salt_Lake_City_Pedestrian_Safety_Activities_12_1_04.doc)

Figure 5.21 Sign to Increase Driver awareness

Pavement Treatments to Guide the Visually Impaired: Usually a groove is constructed at the sidewalk and the pedestrian crosswalks that aids visually impaired persons to walk along their desired path using their guidance cane. They are becoming a standard practice in Europe, Japan and other countries. They are supposed to last longer, be visible, and provide better traction.

Raised Median: Raised medians, which are discussed in more detail in an earlier section (5.2.1: The Pedestrian Path) also increase visibility.

Eliminate Screening: Obstacles that block the drivers' view of pedestrians at the edge of the road or the pedestrians' view of approaching traffic increase the likelihood of a crash. Thus light poles, street furniture, trees, bridge rails, guardrails, plantings, or signs should be placed away from crossing locations or in such away that they do not block sight lines. Parking also can block sight lines, particularly with the increasing proportion of SUVs and other large vehicles in the traffic mix. Parking should be held back 20 feet from crosswalk locations or alternatively, curb extensions used to bring the pedestrian to the edge of the traffic lane before stepping off the curb. Bushes, trees and other planting should be regularly pruned to keep vegetation from obscuring sight lines or signs. (Plants that block sidewalks or other pedestrian paths should also be trimmed back.)

Advanced Stop Lines: One of the most dangerous types of screening is that done by a vehicle that is stopped to allow a pedestrian to cross. It blocks the sight lines of an overtaking driver in the adjacent lane. The New York State law requiring drivers to yield for pedestrians in uncontrolled crosswalks may actually contribute to this type of crash; the pedestrian is given a sense of security by the stopped vehicle, while the driver of the second vehicle is unaware of the pedestrian's presence. (A similar problem exists at bus stops; passengers getting off the bus often cross the street in front of the still-stopped bus, unaware of vehicles approaching in the second lane.)

One measure that reduces the likelihood of this type of crash is placing the stop line well in advance of the crosswalk; this increases the sight distance of the second vehicle. To increase the effectiveness of the advanced stop line, a sign that instructs the drivers to stop at the line should

also be placed next to the stop line. The crash reduction factor for advanced stop lines is 90 percent when used with a "Stop Here for Pedestrians" sign (NYMTC workshop, 2006).

Improve Visibility of Pedestrians: Retroreflective materials are required for roadway markings such as crosswalks, stop lines, and lane markings. These materials reflect light from vehicle headlights and from roadway illumination using specially designed glass beads. Vests and other clothing for pedestrians have also been made with reflective materials. Studies have found that wearing retroreflective clothing can increase the visibility of a pedestrian by a factor of five. However, some retroreflective clothing can lose its reflective properties after repeated washings. Retroreflective material has been used on shoes, backpacks, jackets, and other clothing.

In a later 1994 study, Owens et al. (1994) conducted an experiment in which retroreflective materials were placed on different body locations. They found that pedestrians wearing reflective materials on knees, waist, elbows, and shoulders were seen more readily and the motion of pedestrians wearing reflective materials were more readily interpreted as human motion.

5.2.6 Other Measures

There are other measures that do not fit neatly into the above categories, which primarily address the street and sidewalk environment. Parking lots are the location of a substantial number of pedestrian-vehicle collisions, and transit access is a major generator of pedestrians and has its own pedestrian safety issues.

Parking Lots: One of the characteristics of parking lots that adds to their safety deficit is the tendency of drivers to take the shortest route to where they are going. Because of the lower speeds, many drivers do not follow the lanes and aisles, but proceed diagonally through the lot; as a result, they many approach a pedestrian from an unexpected direction. The use of raised islands in parking lots could help to channel the traffic into the intended lanes, rationalize the flow, and control speed.

Transit: Transit needs good pedestrian access to its facilities. An isolated bus stop sign on the side of the road does not promote transit. Sidewalks should be wide enough to provide space for pedestrian waiting, boarding and passing, as well as to accommodate bus wheelchair lifts. The pedestrian path, including crosswalks, should be continuous to the "trip generator" whether it is a nearby development or mall across four-lane arterial. For each round trip, the pedestrian needs to cross the street at least once.

A common issue is the location of the bus stop, nearside or farside. Farside is generally preferred because bus driver can pull across the intersection before the traffic signal turns red; nearside may require the bus to wait an extra signal cycle. But more importantly for pedestrian safety, a farside bus stop ensures that pedestrians cross behind the bus. By placing the crosswalk behind the bus stop, the bus can pull forward and pedestrians can cross the street. This avoids two types of crashes: One, multiple threat crashes, in which pedestrians crossing in front of the bus are hidden from or cannot see approaching traffic; and two, passenger-bus collisions, in which the passenger is hit by bus as it pulls forwards.

On the other hand, there are cases where the stop should be placed nearside. If passengers are better served by a nearside stop because that is where their ultimate destination is, then the stop should be placed nearside. Another reason for nearside stops is an intersection that is prone to being blocked by several buses queuing at a transfer point. Additionally, if a bus route takes a right turn at an intersection, a farside stop is not possible.

Transit stops where transfers between modes occur also need to consider the natural pedestrian path from the exit of one mode to the waiting point for the second mode.

Agencies should coordinate with transit providers to ensure stops are placed correctly for a variety of reasons; pedestrian safety is one of those concerns.

Figure 5.22 Bus Stops below Subway Tracks without and with Raised Median

5.2.7 Conclusions of Engineering Measures

The engineering measures described above will be effective to the extent that they fit the situations where they are implemented. The goal of the measures is to increase pedestrian safety, usually by achieving one or more of the objectives of reducing vehicular speed, increasing visibility of pedestrians (to drivers) and vehicles (to pedestrians), and reducing pedestrian exposure. If an engineering measure reduces crashes or serious injuries and fatalities by a few percent, the measure is usually considered to be successful. However, some measures have been shown to achieve much larger reductions and therefore should be given first consideration. The following crash reduction factors were noted at the recent FHWA workshops, "Designing Streets for Pedestrian Safety," hosted by NYMTC (September 25-26 and 27-28, 2006); they are listed in Table 5.5 in order of effectiveness. It should be noted that these measures may have an even greater impact in reducing the number of conflicts between vehicles and pedestrians.

Table 5.5 Crash Reduction Factors for Engineering Measures

Measure	Crash reduction factor
Advanced stop line	90% (with “Stop Here For Pedestrians” sign)
Sidewalks	88%
Paved shoulders	80%
Roundabouts	60% (90% reduction in fatalities and severe injuries)
Illumination	60%
Protected left turn	50%
Medians and islands	39 to 46%
Countdown signals	25%

The workshop also introduced the following general principles for planning and engineering for pedestrian safety:

- Recognize pedestrians want and need to cross the street safely
- Pedestrians will cross where it’s most convenient
- Drivers need to understand pedestrians’ intent
- Speed matters
- Good design makes use of these principles

In addition to the crash reduction factors cited in the NYMTC workshops, Table 5.6 below summarizes CRFs previously mentioned in this chapter.

Table 5.6 Additional Crash Reduction Factors

Measure	CRF	Site	Source
Traffic circles	90%	Seattle	Harkey & Zegeer,2004
Pedestrian scramble	50%	NA	Harkey & Zegeer, 2004
Leading pedestrian interval	12%	New York City	King, 1999
Split phase	10%	New York City	NYCDOT, 2004

The actual effectiveness of a countermeasure in a particular location will depend on characteristics of the site, for example, posted speeds, street widths, and visibility. Additionally, combinations of countermeasures are typically more effective than any single measure. While the following quote is from an NCHRP study of unsignalized crossings (Fitzgerald et al., 2006, p. 16), it is probably applicable to most situations: “Several evaluations have tested a combination of crossing treatments and found these treatments to be more effective when used together systematically. For example, a study in St. Petersburg, Florida, found that advanced yield lines, Yield Here to Pedestrian Signs, and pedestrian prompting signs were most effective when used together.” Note that the After image in Figure 5.5 shows at least seven pedestrian safety measures not included in the Before picture.

5.3 Education

Education can have multiple roles. However, the most challenging role is to change pedestrian and driver behavior. It is difficult to get the attention of adults to this issue, which they tend to take for granted. Education of children for pedestrian safety is more likely to produce results. Additional roles are to introduce and create acceptance of innovative measures, to inform local officials of the importance of pedestrian safety considerations in planning, zoning, and other decisions, and to add to the engineering and planning professionals' level of expertise in improving pedestrian safety. A good reference for education for pedestrian safety is the NCHRP document, *A Guide for Reducing Collisions Involving Pedestrians*, Volume 10 of *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan* (Zegeer, Stutts, et al., 2004).

5.3.1 Changing Behavior

Public Relations Campaigns: If the campaign is to be effective, the objective, the audience, and the message must be clear. The message will differ depending on the awareness of the target audience. Zegeer, Stutts, et al. (2004) suggest that a public awareness campaign to increase public concern about pedestrian safety should be the first step before trying to change pedestrian or driver behavior.

FHWA has initiated a pedestrian safety campaign, which includes a "toolkit" of materials (planning guide, public service announcements, brochures, and other materials) (http://safety.fhwa.dot.gov/local_program/pedcampaign/index.htm).

Press Releases: Getting the news media to do stories on pedestrian safety would be more effective than paid for spots; however, to interest the media in pedestrian safety, it needs a "hook" that makes it newsworthy. One possible hook is the release of new data; for example, an August 22, 2006, FHWA press release with the title "Rise in Motorcycle and Pedestrian Deaths Led to Increase in Overall Highway Fatality Rate in 2005" announced the most recent FARS result. Locally, a particularly serious or poignant pedestrian crash might be used effectively. The implementation of an innovative measure could be used with the dual purpose of increasing the public's awareness of pedestrian safety and developing their understanding and acceptance of the new measure.

Targeted Programs: Programs aimed at specific groups, such as children or seniors, can be effective and easier to implement. There are several national program aimed at children, including Safe Routes to School (which is supported by targeted funding in SAFETEA-LU), Walk This Way (sponsored by Safe Kids and Federal Express), and Walk You Child to School Program.

Educational programs for children may well be the most effective way of changing behavior; the children are more open to the message, and once the message has been learned, it may stay with them for life. The children can also help to develop awareness among adults; a particularly effective way of reaching parents is to

ask them to act as role models for their children. Pedestrian safety programs can be conducted at schools and health fairs.

Two particularly in-depth local programs targeted to developing safe pedestrian behavior in children are Safety City, a NYCDOT program, and Safety Town, run by the Nassau County Police Department. They are both described in Section 3.4 (Educational Programs). These programs are aimed at third graders; children at this age are beginning to become more independent while still be open the message.

To reach the older child, including teenagers, NYCDOT puts on an improvisational play. There are also videos designed for the older child. However, by the time they reach their mid-teens, mush of the safety educational materials concentrate on driving issues.

There are also educational programs and materials targeted to seniors. NYCDOT has produced a video (There's More to Taking a Walk than Moving Your Feet: Pedestrian Safety for Older Adults) that alerts seniors to the walking dangers and informs them about safe pedestrian behavior, particularly for crossing city intersections.

Changing Driver Behavior: The programs described above are aimed at pedestrians; changing driver behavior may be more difficult since the driver has less at stake than the pedestrian. One means of reaching drivers is to include brochures on pedestrian safety in driver license renewal. However, the NYS Department of Motor Vehicles rotates the brochures that are inserted; therefore, only a proportion of drivers would receive one specifically on pedestrian safety. Further, given the large number of brochures that people receive with bills and other mailings, many people routinely throw them out without reading them.

Another way that NYS DMV might assist in making drivers more aware of pedestrian safety is to include more questions on legal and recommended driving behavior around pedestrians on the written examination for becoming a licensed driver, as well as increase the material on sharing the road with pedestrians in the "Driver's Manual and Study Guide" (http://www.nysdmv.com/dmanual/chapter11-manual.htm#the-ped).

The American Automobile Association (AAA) publishes a magazine for their members, which has on occasion included articles on pedestrian safety.

Signs that remind drivers that there are other road users (e.g., "Share The Road" or "Pedestrian Killed Here") are one way of making drivers more aware. However, to the extent that they add to "sign clutter" they may have a negative impact in some locations. Enforcement is another means of education; as one person put it, "A ticket is the best education" (see next section).

Coordinated educational efforts on several fronts will be more effective than any single measures. New Jersey announced a new 3E pedestrian safety program (NJ Office of Governor, 2006), which states "Fundamental to reducing pedestrian safety accidents in New Jersey is a change in driver behavior . . ." (See press release, available at: http://www.state.nj.us/governor/news/news/approved/20060918.html) Under the Education section of the initiative, they include three driver education efforts:

- Changes to the driver education curriculum to include the responsibility of the driver toward pedestrians and the laws that protect pedestrians.
- An increase in pedestrian safety information in the New Jersey Driver Manual with a forceful emphasis on the responsibilities of both motorists and pedestrians.
- Incorporation of pedestrian safety laws into the New Jersey driver examination.

Educational materials: Several organizations produce educational materials for increase awareness of pedestrian safety and instilling safe walking habits. For example:

- NHTSA has a Traffic Safety Material Catalog of educational materials (Available at: http://www.nhtsa.dot.gov/people/outreach/SafeSobr/20qp/planner/publications/page7.html).
- NHTSA also has a Traffic Safety Digest web site that describes good examples of educational and promotional safety programs for many safety problems from around the United States. (http://www.nhtsa.dot.gov/people/outreach/safedige/).
- NYCDOT has developed many of their own materials in order to make them relevant to the urban environment of the city.
- The New Jersey Bicycle and Pedestrian Resource Center, operated by the Voorhees Transportation Center, has an On-Line Video Library of materials which includes videos on pedestrian safety (http://www.njbikeped.org/body.php?page=videolib).
- The Kids and Cars organization puts out educational material on some particular safety hazards, such as the hazard of children being backed over (http://www.kidsandcars.org/).
- San Francisco Department of Public Health has published a Pedestrian Safety Handbook, which is specific to that city, but has some excellent material in it. It could serve as a model for a local handbook. (Available at: http://www.dph.sf.ca.us/traffic_safety/PedSafety%20handbook.pdf)
- FHWA publishes a series of brochures on safety, including pedestrian safety. (http://safety.fhwa.dot.gov/media/brochures.htm).
- The PedSafe document includes four examples of education efforts with the results at http://www.walkinginfo.org/pedsafe/pedsafe_curb1.cfm?CM_NUM=48&GRP_NBR=8&CM_maingroup=Other%20Measures&lngFlag1=1&X=999.

5.3.2 Introducing Pedestrian Countermeasures

The effectiveness of countermeasures may be undermined by the public's lack of understanding of the purpose or use of the measure. For example, the installation of the flashing in-pavement lights at Marist College (in Poughkeepsie) led to confusion; however, in other locations they have been considered a successful measure. An educational program to inform drivers of their purpose and how they should respond when the lights flash could have corrected the problem. Similarly, there is widespread misunderstanding of the flashing DON'T WALK signals; the use of simple signs that explain the signals can help.

5.3.3 Educating Local Officials and Community Groups

Many pedestrian safety improvements require the cooperation and coordination with non-transportation agencies or organizations. For example, in order to get developers to provide pedestrian facilities, the local zoning board may need to agree to the desirability of the providing the facilities. They need to be aware and sensitive to the issue of pedestrian safety and the potential ways of improving it. Some educational efforts can be targeted to them. For example:

- Fact sheets on pedestrian crashes, the costs of crashes, or the reductions that can be achieved by proposed improvements can be distributed.
- Invitations to participate in Walkable Communities or similar events can be extended.
- Local task forces or ad hoc meetings on pedestrian safety can extend invitations to other officials or members of community groups to attend or join.

5.3.4 Increasing Professional Knowledge and Expertise

Education and training that targets the engineers, planners, enforcement agencies and other transportation professionals should be an integral part of the pedestrian safety program. Educational programs and materials that cover technical material in different media are provided by many different agencies, including FHWA, NHTSA, Volpe Center, and other groups.

5.4 Enforcement

The enforcement of the traffic laws related to traffic safety is considered to be one of the principal factors that contribute to traffic safety. However, a frequent comment during the interviews was that the police do not enforce laws concerning pedestrian safety, whether drivers or pedestrians are breaking them. Actually, the police make a strong effort in enforcing speed limits, DWI laws, and red light running, all of which are important to pedestrian safety. However, as the AASHTO Safety Plan volume concerning pedestrians (Zegeer, Stutts, et al., 2004, p. v-76) states:

> Enforcement of right-of-way legislation presents a more daunting challenge for most police forces. The nature of the offense (not yielding to pedestrians, for example) appears at first glance to be a more subjective infraction of a shared responsibility. Police departments may not assign priority to enforcement of pedestrian right-of-way laws and/or may not provide officers adequate training in the enforcement of these laws.

Enforcement is seen as a way of changing behavior. One NHTSA document (NHTSA, 2000) suggests that ticketing an offender has three purposes:

- To stop the specific violation
- To deter other potential violators
- To change future behavior

Zegeer, Stutts, et al. suggests similar purposes: To increase driver and pedestrian alertness and to introduce engineering interventions.

There has been relatively little research on the effectiveness of enforcement in changing behavior. Malenfant and Van Houten (1989; reported in Zegeer, Stutts, et al., 2004) measured large increases in yielding behavior in three Canadian cities employing enforcement complemented with educational outreach and several engineering interventions. Although safety may have been greatly influenced by the engineering interventions, the enforcement component increased yielding behavior. Another study in Seattle (Britt et al., 1995) found little change in motorist behavior as a result of an enforcement campaign in conjunction with a change in the law requiring stopping for pedestrians in a crosswalk; however the authors suggested that an enforcement campaign aimed at a small neighborhood might be more effective than a city-wide program.

5.4.1 Traffic Safety Teams

One of the best practices highlighted in the interview process was the NYPD Traffic Stat Program (similar programs are operated in Nassau County and other locations). The teams include the precinct commanders and representatives from the transportation and engineering community, including NYSDOT, NYCDOT, Port Authority police, MTA Bridge and Tunnel Police, and New York City Transit. At monthly meetings, a commander from a precinct with a poor crash record is called to report what he is doing to improve the situation. This encourages innovation and the sharing of ideas among the precincts. The multidiscipline nature of the teams educates the different groups about each other, both what they can do and what measures are infeasible. Other activities include reviewing the scene of crashes, reaching out to the community, visiting classrooms. Since Traffic Stat was started in 1997, traffic fatalities have been reduced from about 600 to 300 per year.

Traffic Stat and the traffic safety teams are not directed specifically toward pedestrian safety, but they are powerful tools for addressing all traffic safety issues, and can be directed to pedestrian safety issues.

5.4.2 Enforcement Campaigns

Enforcement campaigns may be used to make drivers and pedestrians more aware of existing laws. Some of the illegal behaviors that might benefit from an enforcement campaign include drivers stopping at the stop line at crosswalks, drivers making full stops before making legal right turns on red, jaywalking, trucks stating on the truck routes, and vehicles not parking on sidewalks among other issues.

Zegeer, Stutts et al. (2004) suggests the following measures for ensuring the success of an enforcement campaign.

- Good planning and organization. The characteristics and special needs of the neighborhood should be considered. It also should entail coordinating with the engineers and traffic safety educational groups.
- Training of police for right-of-way enforcement. Right-of-Way enforcement differs from other types (e.g., speed, right light).
- Support from senior police staff.
- Informing of prosecutors and judges.
- Media and public support.
- Precede citations with warnings. This is particularly important if there is no history of crosswalk right-of-way enforcement.
- Start strong and gradually reduce. Enforcement should be very frequent at beginning of the campaign and reduced gradually but sustained over a long period.
- Choose locations with higher frequency of poor pedestrian safety behavior.
- Provide good engineering measures first. This could include ensuring crosswalks are well marked and signs are up and clearly visible.

5.4.3 New Laws and Regulations

Several new laws or changes to existing laws have been suggested. One is the use of No Right Turn on Red in areas with high pedestrian volumes. New York City already has banned the RTOR throughout most of the city. Other jurisdictions should look at where the number of conflicts with pedestrians would be reduced by banning them

Another New York City practice that could be expanded to other jurisdictions in the region is Red Light Cameras. The city has recently received permission from the state legislature to expand the number of cameras from 50 to 100, but they are still banned from the rest of the state. A recent evaluation of their effectiveness (Council et al., 2005) indicates that the decrease in right angle crashes due to red light cameras is partly balanced by the increase in rear end crashes, but there is a small positive improvement in safety overall. Since a pedestrian is more likely to be endangered by a vehicle that runs a red light than one that stops too quickly, the impact for pedestrian safety may be greater.

New York State authorization to use speed cameras would be beneficial to pedestrian safety also; lowering speeds is often suggested as the one most beneficial change for reducing pedestrian deaths and injuries.

New York City has been seeking a law that would require all large commercial trucks to be equipped with cross-over mirrors. These mirrors are commonly used on school buses and increase ability of the drivers of large vehicles to see directly in front to the vehicle. This would be of particular benefit to the safety of children and people in wheelchairs, and again would be beneficial in all parts of the region.

Other suggestions for new laws made by Zegeer, Stutts et al. (2004) are:

- Model ice cream truck ordinance: Suggested provisions are restricting the types of locations were the trucks are allowed and requiring other vehicles to stop before passing them.
- Model bus stop ordinance: Requiring bus stops to be far-side, where possible (see Section 5.2.6 for some exceptions), would reduce the danger of pedestrians crossing in front of the bus after disembarking.
- Multiple vehicle overtaking ordinance: This would require vehicles to stop if another vehicle is stopped at a cross walk, reducing crashes caused by vehicles that have stopped for pedestrians and thereby block the view of overtaking vehicles. (The purpose is similar to that of the bus stop ordinance.)
- Parking near intersections or crosswalk ordinance: The ordinance would prohibit parking within 15 to 18 meters of a crosswalk, again with the objective of increasing visibility.

VI. FUNDING

Funding for pedestrian safety projects came up frequently during the interviews. This section provides a brief summary of funding strategies and sources.

6.1 Funding Strategies

The new manual, *How to Develop a Pedestrian Safety Action Plan* (Zegeer et al., 2006; available at http://www.walkinginfo.org/pp/howtoguide2006.pdf), suggests four strategies for funding pedestrian safety improvements:

- Routine accommodation in new projects
- Partnerships
- Dedicated funds and set asides
- Annual maintenance budget

Routine accommodation in new projects: Several agencies in the NYMTC region are already doing this as a routine planning measure, and in fact, all roadway and transit projects should be analyzed for associated pedestrian improvements. Project selection criteria for inclusion in the TIP could be modified to promote projects that have pedestrian safety components. NYSDOT has a "Pedestrian Generator Checklist" in Chapter 18 the NYSDOT Design Manual for determining if pedestrian improvements should be made as part of a project. [Available at: http://www.dot.state.ny.us/cmb/consult/hdmfiles/chapt_18.pdf]

Partnerships: The partnership might be with another public agency or with a private developer. Possible examples of projects to partner with are utility work along a roadway could or the construction of a new school. An important partnership that should be considered for many projects is using NHTSA funds (through the local Traffic Safety Board and GTSC) to add enforcement and education components to engineering projects. Another suggestion is grouping several small pedestrian improvement projects and including them with a nearby larger project.

Dedicated funds and set asides: NYSDOT, NYMTC, or a local government can set up a dedicated fund or set aside a percentage of a larger fund to be used specifically for pedestrian safety improvements. NYSDOT Regions typically block out funds for future pedestrian projects in their 12 year capital programs. A similar possibility is to establish a sidewalk fund with fees paid by developers in lieu of building sidewalks in their projects. The funds could then be used for pedestrian facilities where they are most needed. The manual cautions that the dedicated fund should not be used for routine accommodation in projects.

Annual maintenance budget: Small improvements, such as widening a sidewalk or providing high visibility crosswalks, can be included during maintenance.

An important strategy for obtaining funding is to develop a sidewalk plan (or sidewalk and bicycle plan) to identify and prioritize pedestrian infrastructure needs. The plan would provide

credibility for funding requests. It would also be the basis for asking developers to provide either sidewalks or funds toward a sidewalk fund. The plan would allow for specific sidewalk and other pedestrian projects including new sidewalks, repair and maintenance of existing sidewalks, widening of sidewalks, and closing gaps in the pedestrian network. The plan should be continually updated.

6.2 Funding Sources

While TEA-21 was in effect, a matrix of the federal funding sources in TEA-21 and their suitability for specific types of bicycle and pedestrian projects was developed and posted on the WalkingInfo web site (http://www.walkinginfo.org/pp/funding/gov/index.htm). Table 6.1 has been adapted from that table. Although the Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU) has replaced TEA-21, most if not all of the programs are still active and therefore the table is still relevant.

SAFETEA-LU states that pedestrian (and bicycle) improvements "shall be considered, where appropriate, in conjunction with all new construction and reconstruction of transportation facilities, except where bicycle and pedestrian use are not permitted." (quoted in Zegeer et al., 2006).

Federal Highway Administration

National Highway System: NHS funds can be used for pedestrian facilities along a national highway corridor.

Surface Transportation Program (STP): Funds can be used for projects relating to intersections that have disproportionately high accident rates, have high congestion, and the community has a sidewalk plan. The broad eligibility requirements make this a particularly good source for bicycle and pedestrian programs.

Congestion Mitigation Air Quality (CMAQ): Funds can be used for pedestrian projects that can demonstrate air quality benefits. CMAQ funds have been used regularly for pedestrian and bicycle projects in the NYMTC region.

Transportation Enhancement Program: The purpose of Transportation Enhancement (TE) activities is to benefit the traveling public and help communities to increase transportation choices and access, enhance the built and natural environment, and provide a sense of place. The first eligible activity for TE funds is the provision of facilities for pedestrians and bicycles and the second eligible activity is the provision of safety and educational activities for pedestrians and bicyclists.

Recreational Trails: A total of $370 million is authorized nationwide through 2009 to continue this program to develop and maintain trails for recreational purposes that include pedestrian, equestrian, bicycling and non-motorized snow activities as well as off-road motorized vehicle activities. New eligibilities include construction and maintenance equipment, real estate costs, educational program costs, State administration costs, and assessment of trail conditions. In New

York, Projects are chosen by the NYS Office of Parks and Recreation and Historic Preservation in cooperation with FHWA.

Highway Safety Improvement Program (HSIP): The program will fund projects to achieve a significant reduction in traffic fatalities and serious injuries on all public roads or publicly owned bicycle and pedestrian pathway or trail.

Metropolitan and Statewide Planning Funds: These funds can be used for pedestrian safety planning.

Safe Routes to School: SAFETEA-LU authorized $100 million nationally specifically for Safe Routes to School. Both infrastructure-related and behavioral projects will be geared toward providing a safe, appealing environment for walking and biking that will improve the quality of our children's lives and support national health objectives by reducing traffic, fuel consumption, and air pollution in the vicinity of schools.

Other FHWA funding programs for which some aspects of pedestrian projects are eligible include:

- Federal Lands Highway Program (Projects on federally owned sites)
- Scenic Byways Program (Projects on federally designated scenic byways)

Congestion Mitigation Air Quality (CMAQ), Surface Transportation Program (STP), and Transportation Enhancement Program traditionally funded pedestrian projects solicited through NYMTC. Other funding programs such as National Highway System (NHS) and Highway Bridge Replacement Program (HBRR) as listed on Table 6.1 offer more limited opportunities as NHS is normally used to fund limited access facilities such as freeways and parkways and HBRR is confined to rehabilitating or replacing bridges. However, opportunities exist to accommodate a pedestrian facility as part of a reconstruction project on a freeway or parkway such as a pedestrian facility over or under, a separate trailway within or parallel to a parkway's right-of-way, or adding sidewalks to a bridge being rehabilitated or replaced using HBRR funds.

Federal Transit Administration

Grants to improve transit systems can be used for pedestrian access.

National Highway Traffic Safety Administration

State and Community Highway Safety Grant Program (Section 402): The primary NHTSA source of funds for local safety-related projects is the State and Community Highway Safety Grants or Section 402. The funds are intended to support the State's Performance Plan and Highway Safety Plan and to address highway safety problems that are related to human factors and roadway environment; the funds cannot be used for hardware or construction.

Table 6.1 Appropriateness of TEA-21 Funding Programs for Typical Pedestrian Projects

	Federal Funding Programs														
Project Type	National Highway System	Surface Transportation Program	STP-Hazard Elimination Program	STP-Rail / Highway Crossings	STP-Transportation Enhancements	Congestion mitigation and air quality improvement program	Recreational trails program	Highway bridge replacement Program	402 / State & Community Highway Safety Program	State / Metropolitan Planning & Research Funds	Transportation, Community and System preservation Pilot Program	Public Lands Discretionary Funds	National Scenic Byways Program	Urbanized Area and Non-Urbanized Area Formula Transit Grants	Transit Enhancements
Pedestrian & Bicycle															
Spot improvement program		2	2		1	3									
Shared-use path (off-road trail)	2	2			3	3	3	2				3	3		
Trail / highway intersection	2	2	2		3	3	3					3	2		
Overpass, underpass, tunnels or bridges	2	3	2	2	3	3	1	2				2		2	2
Trailhead facilities		1			3		3								
Land acquisition for trails		1			2	1	3								
Trail maintenance							3								
Regional trail plan		1			2	2	2			2	3				
State / MPO bicycle and pedestrian plan		2				2				3					
Research or innovations in planning						2				3	3				
State b/p coordinator position		2				3				3					
Training						1	3		3	2	3				
Pedestrian															
Pedestrian access path or boardwalk		1			3	3	3					3	3	1	2
Sidewalks	1	2	2	1	3	3		2				2	2	1	2
Curb cuts and ramps	1	3	2	2	3	3							2		
Crosswalks	1	2	3	2	3	3						2	3	1	2
Signal improvements	1	3	3	2	3	3							2	1	2
Traffic calming		2	2		2	2					3				
Bus shelters and benches	1	2	2		2	3								3	3
Walking promotion program		1			2	3					3				
Back country hiking trail							3								
Safety															
Safety education position		1			2	2	3		3	1					
Safety campaigns and publications					2	2	3		3						
Police patrol						2			3						
Share the Road signs	1	2	2		3	3			3						

Code: 3 Best Bet 2 Rough Sledding 1 Slim to none

NHTSA distributes the Section 402 funds by formula to the State, in New York State specifically to the Governor's Traffic Safety Committee, with the requirement that at least 40 percent of the funds be expended by local jurisdiction; GTSC's policy is to distribute 50 percent to local jurisdictions. Applications for 402 grants for projects at the local level must be made to the appropriate Traffic Safety Board. The New York State allocation in 2006 is $11.6 million.

Section 403: The Highway Safety Research and Development funds are administered by NHTSA headquarters primarily for research. However, they also cover demonstration projects, and currently two demonstration projects supported by Section 403 funds on older pedestrian safety are underway in San Francisco, CA, and Madison, WI.

Section 408: SAFETEA-LU established a new program to encourage States to adopt programs to improve the timeliness, completeness, uniformity, integration and accessibility of State data.

Pedestrian and Bicycle Safety: SAFETEA-LU allocates $1.7 million in 2007 to support the implementation of high-visibility, community-based, pedestrian safety or innovative law enforcement initiatives or to develop countermeasures to reduce pedestrian and bicycle-related injuries among Latinos or demonstration projects of interventions to reduce impaired-riding.

Other Funding Sources

New York State periodically solicits proposals for several programs throughout the year. Those projects cover several areas such as: brownfields, watersheds, and waterfronts to name a few. The Quality Communities Clearinghouse Web Site has been created in response to requests by local governments, community organizations, businesses and citizens to consolidate and organize those state agency services which support the development of Quality Communities. The Clearinghouse is an easy to use directory or 'portal' to 25 State agencies with brief descriptions of services and links to the appropriate agency web site pages.

It is generally organized by the eight Quality Communities Principles (economic development, planning, agriculture and farmland protection, transportation & neighborhoods, partnerships, conservation & environment, revitalization, and technology) and sorted by four subcategories: Grant and Financial Information; Technical Assistance, which includes training, publications, events and other information**;** Data And Regional Inventories; and Success Stories. These subcategories are then organized by several topical areas such as transportation, business, energy, environment, planning and zoning. Pedestrian facilities often are eligible under many of the solicitations. (See http://qualitycommunities.org/index.asp.)

Community Development Block Grants (CDBG): A potential source of funds for pedestrian facilities is Community Development Block Grants. Seventy percent of the funds allocated to New York State go to "eligible cities;" the remaining 30 percent is reserved for small cities. The Governor's Office for Small Cities (GOSC) announces the availability of Small Cities funding by publishing a Notice of Funding Availability (NOFA) for each of the rounds of funding. The NOFA for the Annual Competitive Round and the Economic Open Round is typically published after the first of the year.

6.3 Highway Safety Improvement Program – Funding Criteria

The federal Highway Safety Improvement Program (HSIP) is based on funding projects through a systematic process that includes the analysis of crash data. Section 1401 of SAFETEA-LU, the current federal legislation, amended Section 148 of Title 23 USC to designate the HSIP as a "core" FHWA program with dedicated funding rather than a set-aside of STP funds. Under the Highway Safety Improvement Program (HSIP), states are required to develop and implement a Strategic Highway Safety Plan (SHSP). As part of its SHSP, a State must have a crash data system with the ability to perform safety problem identification and countermeasure analysis. The analysis must identify hazardous locations, sections and elements, and "using such criteria as the State determines to be appropriate, establish the relative severity of those locations in terms of accidents, injuries, deaths, traffic volume levels, and other relevant data." Guidance on development of SHSPs has been issued and is available at http://safety.fhwa.dot.gov/safetealu.

Highway Safety Investigation Program (HSIP) funds are intended to be spent on projects that are developed through a data driven, problem identification method to address safety needs at identified high crash locations. Projects proposing effective countermeasures to address safety needs at high crash locations as a result of crash data analysis are eligible for STP-Safety and HSIP funds.

Occasionally, specific locations needing safety improvement are not part of previously identified locations in need of a safety investigation. Projects developed for these locations that will address a safety deficiency must demonstrate a performance based result (i.e. fatal, injury, accident reduction, benefit/cost ratio) in order to be eligible for STP-Safety/HSIP funds.

HSIP funds may not be assigned to projects solely based on project scope. This includes preventive projects where safety type work and items are to be funded, but the scope does not address specifically identified safety needs. For example, requirement type contracts for items such as traffic signals, signs and pavement markings may only use safety funds if the requirement contracts are used as a result of a safety investigation where the items under a requirements contract are considered the appropriate countermeasure for a safety treatment. The applicability of STP-Safety/HSIP funding for a project is to be based on the project's ability to address safety needs identified through a Highway Safety Investigation Process or other appropriate level of accident-data analysis and effective countermeasure identification process.

VII. RECOMMENDATIONS

As noted in Chapter 2, pedestrian crashes and fatalities have been declining in the NYMTC Region over the past decade. However, there are still a significant number of crashes; in 2004, there were 13,328 pedestrian crashes in the region resulting in 249 pedestrian fatalities and 13,492 pedestrian injuries (see Table 2.1). Also, pedestrian crashes have been increasing in some of the counties, particularly those with growing populations. Thus, there is still room for additional efforts to improve pedestrian safety. This section makes some specific recommendations to that end. Note that specific countermeasures are not included here. Many countermeasures are described in Chapter 5; while some specific countermeasures (see Table 5.5) have been shown to be particularly effective in reducing pedestrian crashes, the countermeasures to be used at a specific site should be determined by an analysis of that site.

7.1 Make Pedestrian Safety a Priority

Each jurisdiction should establish a policy on how pedestrian safety will be integrated into the planning and design of transportation facilities. Because of the wide differences in the characteristics of the region, the approach to pedestrian safety should be individualized. Some general features should be considered, however.

- Establish a policy that pedestrian safety is part of every project.
- Develop a sidewalk plan. The plan would indicate where sidewalks are needed or will be needed given future growth in the area. Having such a plan as an integral component of the CEQR and SEQR process would make it easier to include pedestrian infrastructure in projects when roads are being built or rehabilitated. It would also facilitate better control the scope and scale of pedestrian facilities desired in new developments. Sidewalks/paths should be included on local government's official map.
- Recognize the link between land use and pedestrian safety.
- Creation of special pedestrian zones for children or seniors. In areas with high concentrations of more vulnerable pedestrians, for example, near schools or senior centers, the design standards should be adapted to the users. For example, slower walking times for traffic signals could be used in senior pedestrian zones if analysis indicates that they would be beneficial to a majority of the intersection users. Schools should accept responsibility for student access on their grounds and in adjoining area.
- Recognize the natural connection between pedestrians and transit. The sidewalk plan should include the location of transit stops and how pedestrians access them.
- Establish a Road Safety Audit program to address known high crash locations.

7.2 Promote Coordination and Collaboration

Pedestrian safety information and efforts should be coordinated. There are several aspects to coordination:

- Fostering the 3Es: Effective implementation of safety improvements requires coordination of engineering, education, and enforcement; however, the agencies responsible for the three efforts often operate in isolation. Within each jurisdiction, the lines of communication between the enforcement and engineering agencies should be opened and maintained. Engineering improvements should entail education and enforcement components where appropriate.

- Development of Safety Impact Teams, similar to New Jersey DOT's, to investigate the scenes of fatal and serious injury crashes. Information from the investigations should both be used to make corrections or improvements to the crash sites and be included in the crash database for analysis that will lead to a fuller understanding of conditions that contribute to crashes. The teams should include representatives of engineering, education, and enforcement agencies, and should seek input from the community where appropriate.

- Coordination between agencies and/or jurisdictions: Collaboration with/between engineers (state, county, town, municipal) is a key when designing intersections, bus stops, etc. There are pedestrian safety issues that cross-jurisdictional lines; for example, corridors that cross municipal or county lines, and the areas around the Port Authority Bus Terminal.

- Sharing of technical information: Many municipalities and agencies are not aware of effective techniques and strategies for pedestrian safety. This project should improve information among agencies, but there is an ongoing need for quickly assimilated information. The SAWG should periodically review new techniques for improving pedestrian safety and provide brief summaries with references to longer documents about the techniques. This is particularly important for the smaller agencies and municipalities, which do not have the resources to stay aware of recent research. The NYMTC website could be a source for information and links to other sites.

  Many of the agencies within the NYMTC region implement new technologies and innovative strategies; SAWG should act as a forum for sharing information about the technologies and strategies and their outcomes.

7.3 Provide Training in Pedestrian Safety

NYMTC should continue to host and promote training and workshops in pedestrian safety. Some specific suggestions are:

- NYMTC should continue to host workshops and other programs specific to pedestrian safety such as:
  - How to Develop a Pedestrian Safety Action Plan
  - Designing Streets for Pedestrian Safety
  - Walkable Communities
  - Road Safety Audits with an emphasis on pedestrian safety

    - Safe Routes to School
- NYMTC should conduct a forum on pedestrian safety and best practices
- NYMTC should hold workshop for municipalities and community groups on how to apply for pedestrian safety grants.
- NYMTC should host forums for decision makers on pedestrian safety

The nature of how the courses are delivered should also be adapted to the characteristics of the region and how design is done:

- Course workshops should be offered in multiple locations throughout the region. It is difficult for engineers from the smaller, more remote departments to get to the city.
- Consultants should be invited. In some jurisdictions, much of the design work is done by consultants; to ensure that pedestrian safety is considered early in the design stage, the consultants need to be knowledgeable about the latest techniques.
- Other media, such as handouts (particularly brief, quickly assimilated handouts), brochures, conferences, brown bag lunches for engineers, should also be used.

Other agencies should also provide education and training to their constituencies and their employees. For example:

- Transit agencies should consider providing their drivers with pedestrian awareness training, similar to that conducted by New Jersey Transit.

7.4 Educate the Public

A common thread throughout the interviews was that pedestrians and drivers need to change their behavior. This requires an effective education program. Effective means of getting existing educational material to the target groups should be developed. New materials should be developed by educators and translated into different languages recognizing cultural factors. Materials should also use a positive approach, and avoid the negative commandment; instead of "Don't . . .." explain what to "Do.." and how it will protect us. The negative consequences of unsafe behavior should also be made clear. An effective way of changing adult behavior is to emphasize their role as models for their children.

- Educate children in good walking habits:
    - There are several good programs in existence already, such as Safety City (NYCDOT) and Safety Town (Nassau County Police Department); other counties should consider developing similar programs.
    - All communities should develop Safe Routes to School Programs.
    - Develop or expand the use of brochures for parents that will be distributed through the schools. Keep in mind that one of the most effective ways to change adult behavior is through engaging the children, and they engage the rest of their family.
    - Develop a brochure for children from suburban communities for walking in New York City.

- Educate seniors in good walking habits:
  - Establish educational programs and pedestrian safety workshops for senior centers. NYCDOT has developed a DVD for seniors; develop similar material modified to fit the specific community.
  - Offer program at senior centers, local religious institutions, etc.
- Educate the general walking public. This is a more difficult group to reach. Explore different media (radio spots, TV spots, CDs, videos) and ways of getting their attention.
- Educate the driver. One way to do this is to use signs at local cross walks to alert motorists to the change in the state crosswalk law.
- Implement a targeted enforcement program to raise public (pedestrian and driver) awareness of the laws.
- Explore the inclusion of an educational component in grants for improvements to roads and pedestrian facilities where it would enhance the public acceptance and safe pedestrian behavior. The educational component would inform the public about what is being done and how it will improve safety.
- Provide education and outreach to public and to decision makers. For example, the local zoning and planning boards need to be made aware of pedestrian safety. These meetings should be scheduled at times and places that will ensure participation of decision-makers and stakeholders. Educate merchants and other local groups about the purpose and impact of various projects; they can effectively block projects if they think that they will adversely affect them.

7.5 Develop a Data Program

A concern indicated by many agencies was the lack of reliable, detailed, timely data. Several things need to be done to correct this situation.

- All police departments in the NYMTC region should be encouraged to implement TraCS (Traffic and Criminal Software) as quickly as possible. This would have three major advantages: it would eliminate repetitive data entry, in that the data would be entered into an electronic system at the crash site, it would it would make the information available sooner, and it would ensure that the crashes were consistently located using GIS.
- Improve the correctness and completeness of data.
- Explore how information beyond the crash report can be incorporated in the database. For many accidents, the local transportation departments have observed the site, but this data is not included with the record. To the extent that Safety Impact Teams are initiated, their findings should also be incorporated in the database.
- Find a means to coordinate the police reported data with data from the hospitals or departments of health.
- Develop an inventory of pedestrian facilities, including characteristics such as sidewalk width, street crossings, and pedestrian-related traffic operational characteristics such as signalization and phasing.
- Develop a measure (or measures) of exposure. Comparing crash statistics between areas is misleading unless a common measure of effectiveness is used. The most common and

easy to use is residential population, but it does not take into consideration how much people walk, particularly in daytime employment or shopping areas, or the environment in which they are walking. Explore using the new models that predict pedestrian flows.

- Institute a working group or ad hoc committee to develop a data policy and plan that would address the items above. At a minimum, the group should include representatives from GTSC, NYSDMV, NYSDOT, and NYSDOH at the state level, as well as from state, county and municipal police departments, and county and municipal planning and traffic engineering departments.

7.6 Develop a Plan for Funding Pedestrian Safety Projects

Many agencies expressed a problem in funding pedestrian safety projects, despite the fact that pedestrian safety is both a federal and state priority. Agencies report specific difficulty in funding stand-alone sidewalk projects and sidewalk maintenance including snow removal, educational programs, providing safety gear such as reflective materials to high-risk non-motorized road users.

- NYMTC should develop a plan or set of recommendations for funding different types of pedestrian safety projects.
- Sidewalk plans, as described in Section 7.1, should be developed and funded through development fees.

7.7 Identify a Pedestrian Advocate

Pedestrian advocates should be established within the various organizations, similar to the pedestrian/bicycle coordinators for the three NYSDOT regions in the NYMTC region. Some of the functions of the advocates would be:

- Maintain an awareness of pedestrian safety.
- Remind agencies that the planning process should include pedestrian safety.
- Remind agencies that they need to meet federal standards for including pedestrian safety when they are applying for federal money.
- Alert engineers of new techniques and opportunities for training in pedestrian safety.
- Advocate for consistent laws that promote pedestrian safety, such as no-right-turn-on-red laws in high pedestrian areas and the use of red light cameras.
- Act as a liaison for inter-agency coordination.

Intentionally left blank.

REFERENCES

American Council of the Blind (2006) "Pedestrian Safety Fact Sheet," [Available at: http://www.acb.org/pedestrian/factsheet-copy1.html]

Atkins, Crystal, and Michael Coleman: "*The Influence of Traffic Calming on Emergency Response Times*," ITE Journal, August 1997, pp. 42-46.
[Available at: http://www.findarticles.com/p/articles/mi_qa3734/is_199708/ai_n8758400]

Barreva Murphy, N., and R.L. Knoblauch (2004) Hispanic Pedestrian and Bicycle Safety: Report of Focus Group Discussion in Washington, Miami, New York, and Los Angeles, July 2004. [Available at: http://safety.fhwa.dot.gov/ped_bike/ped_bike_hsp.htm]

Bowman, B.L. and R.L Vecillio (1994) "Effects of Urban and Suburban Median Types on Both Vehicular and Pedestrian Safety," in *Transportation Research Record 1445*, pp. 169 - 179.

Boyce, Peter, and John Van Derlofske (2002) Pedestrian Crosswalk Safety: Evaluating In-Pavement, Flashing Warning Lights, Final Report Rensselaer Polytechnic Institute for NJ Department of Transportation, March 2002.

Brewer, J., J. German, R. Krammes, et al. (2001) "Geometric Design Practices for European Roads," FHWA- PL-01-026, Office of International Programs, Office of Policy, Federal Highway Administration, U.S. Department of Transportation [Available at: http://international.fhwa.dot.gov/pdfs/converted_to_html/geometric_design/geometric_design2.htm .]

Britt, John, Abraham Bergman, and John Moffat (1995) "Law Enforcement, Pedestrian Safety, and Driver Compliance with Crosswalk Laws: Evaluation of a Four-Year Campaign in Seattle," in *Transportation Research Record No. 1485*, Transportation Research Board.

BTS (2003) *NHTS 2001 Highlights Report*, BTS03-05, U.S. Department of Transportation, Bureau of Transportation Statistics, Washington, D.C.

Campbell, B.J., et al. (2004). *A Review of Pedestrian Safety Research in the United States and Abroad*, Washington, D.C: Federal Highway Administration Publication No. FHWA-RE-03-042, January 2004. [Available at: http://www.walkinginfo.org/pdf/PedSynth/Ped_Synthesis_Report.pdf]

Council, Forrest M., Bhagwant Persaud, et al. (2005) Safety Evaluation of Red-Light Cameras, Battelle Memorial Institute for FHWA, April. [Available at: http://safety.fhwa.dot.gov/intersections/rlc_guide/rlcguide05jan.pdf]

DiMaggio, Charles (2005) *Pedestrian Injuries and Fatalities in Nassau County*, prepared for Nassau County. [Available at: http://www.nassaucountyny.gov/agencies/Health/Docs/PDF/PedestrianWeb1203.pdf]

Ewing, Reid, (1999) *Traffic Calming: The State of the Practice*, Washington, D.C: Institute of Transportation Engineers. [Available at http://www.ite.org/traffic/tcstate.htm#cgntc]

Fitzpatrick, Day, et al. (2006) "Another Look at Pedestrian Walking Speed," presented at 85th Annual Meeting of the Transportation Research Board, Washington, D.C., January 22-26.

Fitzpatrick, Kay, Shawn Turner, et al. (2006) *Improving Pedestrian Safety at Unsignalized Intersections*, TCRP112/NCHRP562. Available at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf]

GTSC (2006A) Traffic Safety Data Reports for 2004 by County, Governor's Traffic Safety Committee. Available at: http://www.safeny.com/hsdata.htm

GTSC (2006B) *Highway Safety Strategic Plan 2006*, Governor's Traffic Safety Committee.

Hagen, Lawrence (2006) "Selecting the Most Effective ITS Application for Pedestrian Safety in Florida," Center for Urban Transportation Research, University of South Florida, Tampa, FL, Report No. BC353-50.

Harkey, David, and Charles Zegeer (2004) *PedSafe: Pedestrian Safety Guide and Countermeasure Selection System*, September 2004, for FHWA. Available at: http://www.walkinginfo.org/pedsafe/pedsafe_downloads.cfm

Hilton, Judith, (2006), "Race and Ethnicity Factors in Fatal Motor Vehicle Traffic Crashes 1999-2004," National Highway Traffic Safety Administration, May. [Available at: http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/Rpts/2006/809956.pdf]

Huang, Herman F., and Michael J. Cynecki, "The Effects of Traffic Calming Measures on Pedestrian and Motorist Behavior, FHWA-RD-00-104, August 2001.

Huang, Herman F., and Charles Zegeer (2000) *The Effect of Pedestrian Countdown Signals in Lake Buena Vista*, prepared by Highway Safety Research Center, University of North Carolina at Chapel Hill, for Florida Department of Transportation, November, 2000. [Available at: http://www.dot.state.fl.us/Safety/ped_bike/handbooks_and_research/research/CNT-REPT.pdf#search=%22herman%20huang%20charles%20zegeer%22 .]

Huang, Herman, C. Zegeer, R. Nassi, and B. Fairfax (2000) *The Effects of Innovative Pedestrian Signs at Unsignalized Locations: A Tale of Three Treatments*, prepared by Highway Safety Research Center, University of North Carolina at Chapel Hill, for FHWA, August, 2000. [Available at: http://www.tfhrc.gov/safety/pedbike/pubs/00-098.pdf]

IIHS (2005) "Q & A: Pedestrian: as of December 2005," Insurance Institute for Highway Safety. [Available at: http://www.iihs.org/research/qanda/peds.html]

IIHS (2006), "Fatality Facts 2004: PEDESTRIANS," Insurance Institute for Highway Safety. [Available at: http://www.iihs.org/research/fatality_facts/pedestrians.html#sec1]

ITE (1998) *Design and Safety of Pedestrian Facilities,* Institute of Transportation Engineers. [Available at: http://safety.fhwa.dot.gov/ped_bike/docs/designsafety.pdf]

Karkee, Ganesh, et al. (2006) "An Evaluation of the Effectiveness of an In-pavement Flashing Light System," presented at 85th Transportation Research Board Annual Meeting, Washington, DC, January 2006.

King, Michael R. (1999) "Calming New York City Intersections," presented at Urban Street Symposium, Dallas, Texas, June 1999. [Available at: http://onlinepubs.trb.org/onlinepubs/circulars/ec019/Ec019_i3.pdf .]

Knoblauch, R.L., et al. (2004), "The Pedestrian and Bicyclist Highway Safety Problem As It Relates to the Hispanic Population in the United States."
Available at: http://safety.fhwa.dot.gov/ped_bike/docs/03p00324/index.htm#toc

Leaf, W.A., and D.F. Preusser (1999) Literature Review on Vehicle Travel Speeds and Pedestrian Injuries, Preusser Research Group, for National Highway Transportation Safety Administration, October 1999. [Available at: http://www.nhtsa.dot.gov/people/injury/research/pub/HS809012.html]

Markowitz, Frank, S. Sciortino, J. L. Fleck, and B.M. Yee (2006) "Pedestrian Countdown Signals: Experience with an Extensive Pilot Installation," in ITE Journal, pp. 43-48, January.

McMahon, Patrick J., et al. (2002) *An Analysis of Factors Contributing to "Walking Along Roadway" Crashes*, University of North Carolina Highway Safety Research Center, prepared for FHWA, February 2002. [Available at: http://www.walkinginfo.org/pdf/rd/SidewalkReport.pdf]

NCSA (2006). "Traffic Safety Facts, 2004 Data: Pedestrians," National Center for Statistics and Analysis. [Available at: http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/TSF2004/809913.pdf]

NCSA (2006B). *Traffic Safety Facts 2004: A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System*, National Center for Statistics and Analysis, NHTSA, U.S. DOT. [Available at: http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/TSFAnn/TSF2004.pdf]

NHTSA (2000) *Strengthening The Citizen and Law Enforcement Partnership at The Traffic Stop: Professionalism is a Two-Way Street*. [Available at: http://www.nhtsa.dot.gov/people/injury/enforce/professionalism/index.html]

NHTSA (2004) "Date Collection Study: Deaths and Injuries Resulting from Certain Non-Traffic and Non-Crash Events," U.S. Department of Transportation National Highway Traffic Safety Administration, May. [Available at: http://www.nhtsa.dot.gov/cars/problems/studies/NonTraffic-NonCrash/]

New Jersey Office of Governor (2006) "Governor Corzine unveils $74 million Pedestrian Safety Initiative," Press Release, September 18, 2006. [Available at: http://www.state.nj.us/governor/news/news/approved/20060918.html]

Noland, Robert (2002) Traffic Fatalities and Injuries: The Effect of Changes in Infrastructure and Other Trends, Department of Civil and Environmental Engineering, Imperial College of Science, Technology, and Medicine, London, UK. Available at: http://www.cts.cv.ic.ac.uk/documents/publications/iccts00203.pdf

NYCDOT (2004) THRU Streets: An Innovative Approach to Managing Midtown Traffic, March, 2004. Available at: http://www.nyc.gov/html/dot/pdf/thrustreetsreport04.pdf

NYCDOT & NYCDCP (1997) *New York City Bicycle Master Plan*, [Available at: http://www.nyc.gov/html/dcp/html/bike/mp.shtml]

NYCDOT/NYCDCP/NYCDPR (1993) NYC Greenway Plan. [Available at: http://www.nyc.gov/html/dcp/html/bike/gp.shtml]

NYMTC (2004) 2004 Selected Regional Demographic Statistics. [Available at: http://www.nymtc.org/files/2004_Dem_at_a_Glance.pdf]

NYMTC Workshop (2006) Training Course on "Designing Streets for Pedestrian Safety." Option 2B: Instructors: Michael Ronkin and Fred Ranck, Hauppauge, NY, September 25-26, 2006. Mount Vernon, NY, September 27-28, 2006.

NYSDOT (2004) Highway Mileage Summary, [Available at: http://www.dot.state.ny.us/tech_serv/high/highwaym.html]

NYSDOT (2004B) A Citizen's Guide to Roundabouts, [Available at: https://www.nysdot.gov/portal/page/portal/main/roundabouts/files/roundabbrochure.pdf]

NYSDOT (2005) *New York State Comprehensive Highway Safety Plan*, New York State Department of Transportation and Governor's Traffic Safety Committee, July. [Available at: http://www.dot.state.ny.us/safety/chspa.html]

Robert B. Noland, (2002) *Traffic Fatalities And Injuries: The Effect Of Changes In Infrastructure And Other Trends*, Centre for Transport Studies, Department of Civil and Environmental Engineering Imperial College of Science, Technology and Medicine, January 25, 2002 [Available at: http://www.cts.cv.ic.ac.uk/documents/publications/iccts00203.pdf]

Owens, D. A., Antonoff, R. J., & Francis, E. L. (1994) Biological Motion and Nighttime Pedestrian Conspicuousness. *Human Factors, 36*(4), 718-732.

Oxley, J., B. N. Fildes, R.E. Dewars (2004). "Safety of Older Pedestrians," in *Transportation in an Aging Society*, TRB Conference Proceedings 27, Washington, D.C., pp. 167-191.

Parsons Brincherhoff Quade & Douglas (2000) Regional Travel-Household Interview Survey: General Final Report, for NYMTC and NJTPA, February. [Available at: http://www.nymtc.org/project/surveys/files/fr00321.pdf]

PHA Transportation Consultants (2005) Pedestrian Countdown Signal Evaluation, Final Report to City of Berkeley. [Available at: http://www.ci.berkeley.ca.us/transportation/Reports/PedestrianCountdownSignalReport2_July%202005.pdf]

Robinson, B.W., L. Rodegerdts, W. Scarsborough, et al. (2000) Roundabouts: An Informational Guide, FHWA-RD-00-067, June. [Available at: **http://www.tfhrc.gov/safety/00068.htm**]

Safe Kids (no date) "Child Pedestrian Safety: The Problem," [Available at: http://www.usa.safekids.org/tier3_cd.cfm?content_item_id=7570&folder_id=680]

Saito, M. (2003) *Efficacy of Speed Monitoring Displays in Increasing Speed Limit Compliance in Highway Work Zones*, Brigham Young University, Department of Civil and Environmental Engineering, for Utah Department of Transportation, July 2003

Saito, M. (2005) *Evaluation of Four Recent Traffic Initiative*s: Volume IV: Increasing Speed Limit Compliance in Reduced Speed School Zones, Brigham Young University, Department of Civil and Environmental Engineering, for Utah Department of Transportation, June 2005.

Sriver, Jeffrey J., and Young-In Kwon (1999) "Recent Pedestrian Planning Issues and Initiatives in Japan and South Korea," in *Transportation Research Record No. 1695*, Transportation Research Board. [Available at: http://ekoti.koti.re.kr/project/coop.nsf/21FABC3EF680437749256DF60010102F/$file/recent.pdf

Van Houten, R., Malenfant, J., Van Houten, J. & Retting, R. (1997) "Using auditory pedestrian signals to reduce pedestrian and vehicle conflicts," in *Transportation Research Record No. 1578*. Washington, DC. [Available at: http://www.enhancements.org/download/trb/1578-03.PDF#search=%22Using%20auditory%20pedestrian%20signals%20to%20reduce%20pedestrian%20and%20vehicle%20conflicts%22]

Van Houton, Ron, and J.E. Louis Malenfant ( ) "The Animated "Eyes" Symbol as Part of the Walk Signal: An Examination of the Generality of its Effectiveness Across a Variety of Intersection Geometries and Timing Parameters,"

WalkingInfo (no date) Funding Sources: Federal: Transportation. [Available at: http://www.walkinginfo.org/pp/funding/gov/index.htm]

WHO (2004) World Report on Road Traffic Injury Prevention, World Health Organization, Geneva, Switzerland. [Available at: http://www.who.int/world-health-day/2004/infomaterials/world_report/en/]

Zegeer, Charles, Richard Stewart, Herman Huang, et al. (2005) Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations, Highway Safety Research Center, University of North Carolina, for FHWA, February 2005. [Available at: http://www.walkinginfo.org/pdf/r&d/safetyeffects.pdf .]

Zegeer, Charles, Stutts, Jean, et al. (2004) Guidance for Implementation of the AASHTO Strategic Highway Safety Plan; Volume 10: A Guide for Reducing Collisions Involving Pedestrians, NCHRP Report 500 v10. [Available at: http://safety.transportation.org/guides.aspx]

Zegeer, Charles, et al. (2006) *How to Develop a Pedestrian Safety Action Plan*, prepared by Highway Safety Research Center, University of North Carolina, for Federal Highway Administration Safety Office. [Available at: http://www.walkinginfo.org/pp/howtoguide2006.pdf]

Intentionally left blank.

Appendix A:
Survey and Interview Instruments

The project involved first a survey of the agencies to determine who within the agency should be interviewed and preliminary information on the level of activity in pedestrian safety. The questionnaire on page A-2 was mailed and emailed to each agency.

The second step was to interview the person or persons that were identified in the responses to the survey. The basic list of questions for the interview (on pages A-3 to A-4) was modified for each agency to reflect the primary purpose or mission of the organization and their response to the first survey.

Intentionally left blank.

Survey Form - Pedestrian Safety Program

Name: _____ Title: _____
Agency: _____ Date: _____

1	Does you agency have a pedestrian safety program in place?	yes ☐ no ☐
2	Who heads the program? If you do not have a formal pedestrian safety program, please list the person within your organization handles pedestrian safety issues.	Name: Title: Telephone: Email:
3	Do you have any documentation (e.g., studies, needs evaluations, project documentation) of the pedestrian safety program that you could send us? (Please list titles on opposite side or separate sheet.)	yes ☐ no ☐
4	What type of data do you collect for your pedestrian program (e.g., accidents, accident location, number of pedestrians)? How do you collect them? Who collects/ inputs the pedestrian safety data into your pedestrian safety program?	Name: Title: Telephone: Email:
5	What tools (software) do you use for pedestrian safety analysis?	
6	How is the data stored? How long is the data stored?	
7	Does your organization have a formal policy concerning pedestrian safety? If yes, please enclose a copy with this questionnaire.	yes ☐ no ☐
8	Please list other agencies/organizations that are involved in pedestrian safety in your geographic area? (Please list on opposite side or separate sheet if needed.)	Agency: Contact person: Telephone: Email:

NYMTC Pedestrian Safety Interview form

Date: _____ Time: _____

Host agency: _____

Location: _____

Study team participants: _____

Agencies at interview

Introduction: The information gathered from this interview will be included in the NYMTC report on the status of pedestrian safety in the region and will be used for developing needs and determining future steps in promoting pedestrian safety. Where it is pertinent, information will be attributed to the agency providing it. The names of individuals will be kept confidential.

1. Attendees by sign in sheet.

2. Do you have an existing Pedestrian Safety Program / Forum?
   What is the structure and mission of that forum
   What is the structure of the Traffic Safety Board within your County (if applicable).

3. Please identify the persons responsible for pedestrian safety in your organization.

4. Do you have any pedestrian safety studies/projects, or other studies/projects that will affect pedestrian safety, under way or recently finished [including those you sent us]?

   Project title:
   Abstract:
   Funding source:
   Year awarded:
   Year completed:
   Total budget:
   Consultants involved (if any):
   Final report (if any):

5. Do you have a "Needs Study" for traffic safety in general? If so, is pedestrian safety addressed in the study?

6. Have you encountered any barriers to improving pedestrian safety or to undertaking any pedestrian safety projects?

7. [According to your survey response, you do not collect any pedestrian safety data. Why is that? Is funding an issue?]

8. Is lack of data a problem? For example, a problem in identifying locations with high or potential pedestrian accidents?

9. What are the major pedestrian safety issues in your county [or other appropriate jurisdiction]?

   [If prompting is needed: accidents at mid-block; accidents at intersections; seniors; children; children en-route to school; crossing wide or busy streets or highways; right-turn-on-red conflicts; road or intersection geometry]

   [For those who do not collect data: How have you become aware of these issues?]

10. Do you have any specific locations where pedestrian safety is an issue?

11. What procedures do you use to identify these locations?

12. Do you have any strategies or technologies that you currently use to improve pedestrian safety or to correct problems at specific locations?
    For example, better lighting, zebra crosswalks, traffic calming action, software.

    Why has this strategy been adopted?
    Do you have any cost or effectiveness studies for this strategy?
    Please discuss the success and challenges of that strategy.

13. Have you tried any innovative strategies to pedestrian safety?
    Please discuss the success and challenges of that strategy.
    [If yes: Have they been successful?] (Asking in above for both pluses and minuses)

14. In your opinion, how should pedestrian safety be addresses in the NYMTC region?

15. Are there any special needs for your jurisdiction?

16. What type of help with the issue of pedestrian safety can NYMTC, as your MPO, provide?

17. What kind of training is needed for your organization?

18. Is there anything they you would like to add to this discussion about pedestrian safety?

Intentionally left blank.

Appendix B:
PEDESTRIAN SAFETY CONTACTS

The following pages list the agencies and organizations that took part in this project. The contact name listed for the organization is the person best able to answer questions about pedestrian safety activities, projects, or polices at the organization.

The organizations are listed in alphabetical order.

Automobile Club of New York (AAA)
1415 Kellum Place
Garden City, NY 11530
Contact: Chris McBride
516-873-2299
cmcbride@aaany.com

Federal Highway Administration New York Division
Leo W. O'Brien Federal Building
Suite 719
Clinton Avenue and North Pearl Street
Albany, NY 12207

Contacts:	Jim Growney (Retired)	Emmett McDevitt
	518-431-4125 x254	518-431-4125
	jim.gowney@fhwa.dot.gov	emmett.mcdevitt@fhwa.dot.gov

Nassau County Traffic Safety Board
100 County Seat Drive
Mineola, NY 11501

Contacts:	Chris Mistron	Joanne McGarry
	516-571-5032	516-571-5032
	cmistron@nassaucountyny.gov	jmcgarry@nassaucountyny.gov

Nassau County Planning Department
400 County Seat Drive
Mineola, NY 11501
Contact: Lowell F. Wolf
516-571-0431
lwolf@nassaucountyny.gov

National Highway Traffic Safety Administration Eastern Region
222 Mamaroneck Avenue, Suite 204
White Plains, NY 10605
Contact: Richard Simon
914-682-6162
Richard.Simon@dot.gov

New Jersey Department of Law and Public Safety
Division of Highway Safety
140 East Front Street
Trenton, NJ 08625-0048
Contact: Robert Gaydosh
Regional Supervisor, Northern New Jersey
609-633-9022
Robert.gaydosh@lps.state.nj.us

New Jersey Transit
General Office Building
180 Boyden Avenue
Maplewood, New Jersey 07040
Contact: Dale Sulpy
Director of Bus Safety
DSulpy@njtransit.com

New York City Department of City Planning
2 Lafayette Street, Suite 1200
New York City, NY 10007
Contact: Jack Schmidt
212-442-4724
jschmid@planning.nyc.gov

Kevin Olinger
212-442-4653
kolinge@planning.nyc.gov

New York City Department of Parks and Recreation
830 Fifth Avenue, Room 403
New York, NY 10021
Contact: Jennifer Hoppa
212-360-3449
Jennifer.hoppa@parks.nyc.gov

New York City Department of Transportation
28-11 Queens Plaza North
Long Island City, New York 11101
Contact: Gerard Soffian
718-433-3372
gsoffian@dot.nyc.gov

New York State Governor's Traffic Safety Committee
6 Empire State Plaza
Swan Street Building, Room 414
Albany New York, 12228
Contact: Jennifer Hogan
518-473-7786
jhoga1@dmv.state.ny.us

New York State Department of Transportation
50 Wolf Road
Albany, New York 12232
Contact: James Ercolano
518-485-8291
jercolano@dot.state.ny.us

New York State Department of Transportation – Region 8
Eleanor Roosevelt State Office Building
4 Burnett Boulevard
Poughkeepsie, New York 12603
Contact: James Rapoli
845-431-5750
jrapoli@dot.sate.ny.us

New York State Department of Transportation – Region 10
State Office Building
250 Veterans Memorial Highway
Hauppauge, NY 11788

Contacts	Frank Pierson	David Glass
	631-952-6020	631-952-6058
	fpierson@dot.state.ny.us	dglass@dot.state.ny.us

New York State Department of Transportation – Region 11
Hunters Point Plaza
47-40 21st Street
Long Island City, NY 11101
Contact: Richard Egan (replaced Roger Weld)
718-482-4622
regan@dot.state.ny.us

North Jersey Transportation Planning Authority
One Newark Center, 17th Floor
Newark, NJ 07102
Contacts

Ron Tindall	Lois Goldman
Pedestrian Coordinator	Safety Coordinator
973-639-1953	973-639-8413
Tindall@njtpa.org	lgoldman@njtpa.org

Port Authority of New York and New Jersey
Engineering/Architectural Design Division
Two Gateway Center, 14th Floor
Newark, NJ 07102
Contact: M. Rizwan Baig
Senior Traffic Engineering
mbaig@panynj.gov

Putnam County Planning Department
841 Fair Street
Carmel, New York 10512
Contact: John Pilner
Transportation Planner
845-878-3480x108
john.pilner@putnamcountyny.com

Rockland County Department of Planning
50 Sanatorium Road, Building t
P.O. Box 350
Pomona, New York 10970
Contact:

Patrick Gerdin	Neil Trenk
845-364-3231	845-364-3231
gerdinp@co.rockland.ny.us	trenkn@co.rockland.ny.us

Suffolk County Department of Public Works
335 Yaphank Avenue
Yaphank, New York 11980

Contacts:	M. Paul Campagnola	Robert J. Bornholdt
	Director of Highway Planning	Director of Traffic Safety
	631-852-4004	631-852-4085
	Paul.campagnola@suffulkcountyny.gov	Robert.bornholdt@suffolkcountyny.gov

Transportation Alternatives
127 West 26th Street,
New York, New York 10001
Contact: Amy Pfeiffer
212-629-6023
amy@trasnalt.org

Westchester County Department of Public Works
148 Martine Avenue, Room 400B
White Plains, New York 10601

Contacts:	Kevin Roseman	Barbara Peters-DeMeo
	Traffic Engineer	Traffic Safety
	914-995-4084	914-995-2271
	Kmr5@westchestergov.com	bnp1@westchestergov.com

White Plains Department of Traffic
255 Main Street
White Plains, New York 10601
Contact: Tom Soyt
914-422-1316
tsoyt@ci.white-plains.ny.us

City of Yonkers Traffic Engineering Division
40 S. Broadway
Yonkers, New York 10701
Contact: Brian O'Rourke
914-377-6777
Brian.orourke@cityofyonkers.com

Intentionally left blank.

Appendix C:
TRAFFIC SAFETY BOARD CONTACTS

NASSAU
Ms. Joanne McGarry
Assistant Director, Nassau Traffic Safety Board
Coordinator, Nassau STOP-DWI Program
100 County Seat Drive
Mineola, NY 11501
Phone: 516 571-5034

SUFFOLK
Ms. Lynn Weyant
Chairman, Suffolk County Traffic Safety Board
Director Town of Brookhaven
Division of Traffic Safety
1 Independence Hill
Farmingdale, NY 11738
Phone: 631 451-6338

NEW YORK CITY
Dr. Ilona Lubman, Ph.D,
Coordinator
NYC STOP-DWI Program
NYC Department of Transportation
40 Worth Street, Room 1035
New York, NY 10013
Phone: 212 442-7653

QUEENS
Ms. Cindy Brown, Secretary
Secretary, Queens Traffic Safety Board
Queens Borough President's Office
120-55 Queens Boulevard, Room 219
Kew Gardens, NY 11424-1015
Phone: 516 571-5032

PUTNAM
Sheriff Donald B. Smith
Chairman, Putnam County Traffic Safety Board
Putnam County Sheriff's Office
Three County Center
Carmel, NY 10512
Phone: 845 225-4300

ROCKLAND
Ms. Rosie Jackson
Program Coordinator
Rockland County Traffic Safety Board
Sheriff's Department
55 New Hempstead Road
New City, NY 10956
Phone: 845 638-5187

WESCHESTER
Ms. Barbara Peters-DeMeo
Program Administrator
Westchester County Traffic Safety Board
148 Martine Avenue, Michaelin Building Room 400B
Phone: 914 995-2271

Intentionally left blank.

Appendix D:
ON LINE PEDESTRIAN SAFETY RESOURCES

The links for the documents and web sites listed in this section were tested shortly before the study was completed. However, organizations constantly change their web sites, moving and removing documents as well as adding them. The authors apologize for any out of date web addresses.

General Sources of Pedestrian Safety Information

WalkingInfo.org Extensive site on pedestrian transportation: It includes community problems and solutions; design and engineering; a digital library; data on pedestrian crashes, etc. It is an excellent resource for pedestrian design and safety.
http://www.walkinginfo.org

Some of the specific documents on the WalkingInfo web site are:

> **PedSafe: Pedestrian Safety Guide and Countermeasure Selection System**, David Harkey and Charles Zegeer, September 2004, for FHWA. Available on CD Rom and in paper also. Is a good guide to countermeasures, with a brief section on each counter measure.
> http://www.walkinginfo.org/pedsafe/pedsafe_downloads.cfm
>
> **Exemplary Pedestrian Plans**: Includes pedestrian plans and pedestrian safety plans from around the country.
> http://www.walkinginfo.org/pp/exem2005.htm

Bicycle and Pedestrian Safety Resource Guide, NHTSA, 2006. This is an extensive interactive guide, which allows users to choose countermeasures appropriate to specific safety problems (e.g., dart outs or excessive speed) and types of implementer (e.g., public highway agencies or law enforcement).
http://www.nhtsa.dot.gov/people/injury/pedbimot/bike/BikePedestrian/

Design and Safety of Pedestrian Facilities: *Recommended Practices of the Institute of Transportation Engineers*, 1998. Although this document is older than most of the others on this page, it is still a good comprehensive guide.
http://safety.fhwa.dot.gov/ped_bike/docs/designsafety.pdf

Guidance for Implementation of the AASHTO Strategic Highway Safety Plan; Volume 10*: A Guide for Reducing Collisions Involving Pedestrians*, NCHRP Report 500, volume 10, Zegeer, Charles, Stutts, Jean, et al. (2004). This is a succinct guide to countermeasures, including information on cost, effectiveness, potential difficulties, etc.
http://safety.transportation.org/guides.aspx

Pedestrian Safety Planning

How to Develop a Pedestrian Safety Action Plan, 2006:
http://www.walkinginfo.org/pp/howtoguide2006.pdf

Exemplary Pedestrian Plans:
http://www.walkinginfo.org/pp/exem2005.htm

Zone Guide for Pedestrian Safety, NHTSA:
http://www.nhtsa.dot.gov/people/injury/pedbimot/ped/ZoneGuideWeb/pages/index.htm

Improving the Pedestrian Environment through Innovative Transportation Design, ITE, 2005:
http://www.ite.org/activeliving/ImprovingPedestrian.pdf

Traffic Calming for Communities: Selected Reports:
http://www.ite.org/traffic/tcstate.htm

Examples of pedestrian plans from the NYMTC Region

New York State Comprehensive Highway Safety Plan:
http://www.dot.state.ny.us/safety/chspa.html
Chapter 9: Making Walking and Street Crossing Safer:
http://www.dot.state.ny.us/safety/files/ch09.pdf

Mid-Hudson South Region Bicycle and Pedestrian Master Plan, 2001.
http://www.co.rockland.ny.us/planning/documents/Bikeped/master%20plan.pdf

Downtown Brooklyn Traffic Calming Study:
http://www.nyc.gov/html/dot/html/motorist/dntnbklyntraf.html

NJ Statewide Bicycle & Pedestrian Master Plan: Phase 2:
http://www.bikemap.com/RBA/NJBikePed.pdf

Data Sources for Pedestrian Safety

National Center for Statistics and Analysis (NCSA), a subsidiary of NHTSA, has statistical reports on traffic safety in general and on many special topics. Their home page is at:
http://www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.f00599ac343cbdd24ec86e10dba046a0/

Resources available from the NCSA web page:

> *Traffic Safety Facts 2005* is the current issue of an annual report on traffic fatalities and injuries. It and fact sheets on specific safety issues are available at:
> http://www-nrd.nhtsa.dot.gov/Pubs/810624.PDF

FARS Query System is an interactive system for querying the Fatality Analysis Reporting System, a national database composed of all fatal crash reports provided by the states from 1994 to 2004. Detailed analyses can be done for national, state or county jurisdictions. It does not have injury crashes and does not allow cross year analysis. The entry point for the system is at: http://www-fars.nhtsa.dot.gov/main.cfm

Governors Traffic Safety Committee provides safety data for each county for the years 2001 through 2004 in PDF format. The data includes both injury and fatal crashes. The most recent report is: Traffic Safety Data Reports for 2005 by County available at:
http://www.safeny.com/05data/datapack05.htm

Transportation Safety Statistical Report 2003-2004, NYMTC, Latest annual report on traffic safety in the NYMTC region: http://www.nymtc.org/files/2003_04report.pdf

Transportation Alternatives has plotted crash data cumulative for 1995 through 2001 for New York City on Crash Stat maps. The maps show fatal crashes based on NYSDOT data. There also tables of ten worst intersections for fatalities and injuries for both pedestrians and bicycle crashes on their web page. The maps and tables are available at:
http://www.transalt.org/crashmaps/index.html

NYS troopers TRACS describes the TraCS (Traffic and Criminal System), a system that is currently being implemented to collect traffic crash data for New York State. The site does not include data:
http://www.tracs.troopers.state.ny.us/

Pedestrian and Bicycle Data Collection in United States Communities: Quantifying Use, Surveying Users, and Documenting Facility Extent, Highway Safety Research Center, UNC, for FHWA, 2005:
http://www.pedbikeinfo.org/pdf/casestudies/PBIC_Data_Collection_Case_Studies.pdf

Design of Pedestrian Facilities

See also the sites listed under General Sources of Pedestrian Safety Information.

Design and Safety of Pedestrian Facilities, Charles V. Zegeer, Institute of Transportation Engineers, March 1998:
http://safety.fhwa.dot.gov/ped_bike/docs/designsafety.pdf

Pedestrian Facilities for Individuals with Disabilities: A Brief Look at Guidelines and Practices Used, F. Wegmann, University of Tennessee, 2004:
http://stc.utk.edu/htm/pdf%20files/ped.pdf

Best Practices in Accessible Rights-of-Way Design and Construction, from Accessible Rights-of Way: a Design Guide; Access Board, November 1999:
http://www.access-board.gov/prowac/guide/PROWGuide.htm

Improving Conditions for Bicycling and Walking: A Best Practices Report, Rails to Trails Conservancy and Association of Pedestrian and Bicycle professionals, for FHWA, 1998:

http://safety.fhwa.dot.gov/ped_bike/docs/intro.pdf

Improving Pedestrian Safety at Unsignalized Crossings, NCHRP Report 562, 2006:
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf

NYS Highway Design Manual, Chapter 18: Pedestrian Facility Design:
https://www.nysdot.gov/portal/page/portal/divisions/engineering/design/dqab/hdm

Manual on Uniform Traffic Control Devices, 2003 edition, FHWA:
http://mutcd.fhwa.dot.gov/HTM/2003r1/html-index.htm

Resources from Study Participants

Pedestrian Injuries and Fatalities in Nassau County, 2005:
http://www.nassaucountyny.gov/agencies/Health/Docs/PDF/PedestrianWeb1203.pdf

New York City Department of Transportation
(http://www.nyc.gov/html/dot/html/safety/safety.html) has many on-line documents relevant to pedestrian safety, several of which have been cited in the text of this study. Some of them are listed below:

- Safe Streets New York: Traffic Safety Improvements in New York City, April 2006. Annual Report: http://www.nyc.gov/html/dot/pdf/safetyrpt06_part1.pdf

- Safe Routes to School Projects: http://www.nyc.gov/html/dot/html/safety/saferoutes.html

New York City Department of City Planning (http://www.nyc.gov/html/dcp/home.html) also has many relevant documents inlcuding

- Subway/Sidewalk Interface Project (with NYC Department of City Planning):
http://www.nyc.gov/html/dcp/html/transportation/td_projectspedestrian.shtml

AAA – examples of traffic calming in the region
http://www.aaany.com/safety/traffic/bicycles_and_pedestrians/local_calming_efforts/index.asp

The New Jersey Bicycle Pedestrian Resource Project:
http://www.njbikeped.org/

The New Jersey Bicycle Pedestrian On-Line Resources, including sections on Pedestrian and Safety:
http://www.njbikeped.org/body.php?page=onlinelib

Education and Enforcement

Countermeasures That Work, National Highway Transportation Safety Administration, January 2007. It is aimed at assisting state highway safety offices in identifying effective countermeasures, with an emphasis on educational and enforcement programs. Chapter eight focuses on pedestrian safety:
http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/CountermeasuresThatWork_2007.pdf

"Promoting Pedestrian and Bicyclist Safety to Hispanic Audiences," FHWA and NHTSA, November 2005:
http://safety.fhwa.dot.gov/ped_bike/toc.htm

Safety City, Description of the NYCDOT program:
http://www.nyc.gov/html/dot/html/safety/safecity.html

Educational materials aimed at the public

On-Line Video Library maintained by The New Jersey Bicycle Pedestrian Resource Project, Voorhees Transportation Center, Rutgers University:
http://www.njbikeped.org/body.php?page=videolib

A Citizen's Guide to Roundabouts is a 12 page booklet explaining roundabouts to laymen published by NYSDOT. It includes on how to navigate a roundabout for motorists, trucks, pedestrians, and bicyclists. An on-line version is available at:
https://www.nysdot.gov/portal/page/portal/main/roundabouts

Traffic Safety is a 2 Way Street, An educational site sponsored by NYCDOT:
http://www.trafficsafetyfornyc.org/

NYCDOT Catalog of Safety Materials:
http://www.nyc.gov/html/dot/html/safety/safety_form.html

Pedestrian Safety Campaign, materials for a campaign, FHWA:
http://safety.fhwa.dot.gov/local_program/pedcampaign/index.htm

Traffic Safety Material Catalog of educational materials, NHTSA:
http://www.nhtsa.dot.gov/people/outreach/media/catalog/Index.cfm?CFID=388&CFTOKEN=71984627

Intentionally left blank.

Appendix E:

NEW YORK CITY FATATLIES BY MODE 1910 TO 2006

YEAR	PEDESTRIAN	TOTAL
1910	232	332
1911	265	378
1912	241	344
1913	341	486
1914	340	486
1915	337	481
1916	403	575
1917	471	674
1918	573	818
1919	605	864
1920	568	811
1921	646	923
1922	664	952
1923	708	1012
1924	720	1029
1925	764	1092
1926	783	1117
1927	782	1117
1928	763	1090
1929	952	1360
1930	679	1145
1931	676	1116
1932	749	1037
1933	743	1113
1934	750	1126
1935	730	954
1936	677	838
1937	677	888
1938	577	839
1939	675	814
1940	699	880
1941	677	NA
1942	700	825
1943	603	685
1944	467	570
1945	554	671

YEAR	PEDESTRIAN	TOTAL
1946	542	680
1947	502	612
1948	463	568
1949	467	590
1950	429	554
1951	417	574
1952	447	596
1953	457	641
1954	432	605
1955	487	668
1956	441	617
1957	448	644
1958	462	655
1959	515	737
1960	406	616
1961	400	608
1962	452	677
1963	424	676
1964	501	736
1965	390	695
1966	347	652
1967	427	726
1968	486	900
1969	503	911
1970	517	944
1971	485	989
1972	467	922
1973	418	824
1974	351	712
1975	306	641
1976	317	596
1977	347	656
1978	360	629
1979	294	541
1980	337	617

Data is continued on next page

NEW YORK CITY FATATLIES BY MODE 1910 TO 2006
Continued

YEAR	PEDESTRIAN	BICYCLE	DRIVER	PASSENGER	MOTORCYCLE	TOTAL
1981	386					694
1982	298					552
1983	304	14	114	70	25	527
1984	304	15	126	82	31	558
1985	343	24	97	71	40	575
1986	285	24	126	91	36	562
1987	323	15	152	81	52	623
1988	357	16	149	25	85	632
1989	377	21	150	29	65	642
1990	366	20	160	121	34	701
1991	304	21	169	101	31	626
1992	291	19	152	93	37	592
1993	284	17	130	76	29	536
1994	246	15	120	86	21	488
1995	242	18	120	79	25	484
1996	235	17	101	63	10	426
1997	254	22	130	74	13	493
1998	183	20	94	57	14	368
1999	202	35	114	46	23	420
2000	187	18	95	59	21	380
2001	192	13	105	58	24	392
2002	189	22	103	53	19	386
2003	177	17	93	55	19	361
2004	156	16	68	36	22	298
2005	156	22	77	45	20	320
2006*	96	9	46	23	18	192

* 2006 data is for a partial year.

Sources: 1910-1929 NYC Department of Health
1930-1939 NYPD
1940-1982 NYSDMV
1996-2006 NYCDOT & NYPD

Appendix F:

Prompt Lists for Pedestrian Safety

Separate lists for general roadway segments and for intersections follow.

Intentionally left blank.

Pedestrian Safety Prompt List
General

Project location (roadway): _____
Between _____ and _____
For (East, south, west, or north – list one or both) _____ side of roadway
Date(s): _____ Time(s): _____
Conducted by: _____ Weather: _____

Item	Yes/No	Comments
General Environment		
Is the area Densely built up/urban		
Suburban or low density		
Very low density/rural		
Is there a major pedestrian attractor nearby (e.g., school, park, transit stop)?		
Are there many children in the area?		
Are there many seniors in the area?		
Is there a facility for or a concentration of persons with disabilities in the area?		
Are there bus stops on or near the road?		
Is there a sidewalk plan for this area?		
Characteristics of Roadway		
Is roadway two way?		
Is the road hilly?		
Are there many curves that affect sight lines?		
Is there a median?		
If there is a median, what is its width?		
If there is a median, is it raised?		
Number of lanes		
Speed limit		
Is the speed limit consistent with the presence of pedestrians?		
Design speed		
Is the design speed consistent with the speed limit?		
Is traffic moving at or below speed limit?		
Does the roadway design discourage speeds higher than the design speed?		
Traffic volume		
Is there parking along side of roadway?		
The edge of the roadway is A curb?		
Shoulder?		
No curb or shoulder?		

Are there frequent driveways?		
Is there a bicycle lane along the roadway?		
Pathway		
Is there a pathway?		
If there is not pathway or sidewalk, is the ROW width adequate to providing one?		
If there is a pathway, is the pathway continuous within the roadway segment being reviewed?		
If there is a pathway, is it Paved		
Unpaved		
If pathway is not paved, Is it separated from the roadway?		
If there is no separate pathway, Is there a shoulder?		
Is the ROW wide enough to accommodate a pathway or wider shoulder?		
Do bicycles share the pedestrian pathway?		
Indicate the distance between pathway and first traffic lane.		
Is there a guard rail or other barrier between the roadway and pathway?		
Is the surface rough or difficult to walk on?		
Are there obstructions in the pathway or shoulder (e.g., signs)?		
If the pathway in not paved, Does vehicular/pedestrian traffic warrant paving?		
Is the pathway liable to flooding or large puddles during rain or snow melt?		
If pathway is paved (a sidewalk), How wide is the sidewalk?		
Is sidewalk width enough for the pedestrian volume?		
Indicate the separation between the sidewalk and the first traffic lane.		
Is the sidewalk surface even?		
Are there obstructions within the width needed for the pedestrian volume (e.g., signs, vending machines)?		
Bus stops (if pertinent)		
Are bus stop locations clearly marked?		
Is there waiting space off the roadway?		
Is space adequate to probable number of waiting passengers?		
Is the waiting spaced paved?		
List any amenities (e.g., shelters, benches).		
If there is a pathway in the area, does the		

pathway provide direct access to waiting area?		
Crossings at Intersections		
What is the (average) distance between intersections?		
What is the (average) distance between signalized intersections?		
Mid-Block Crossings		
Is there a mid-block crossing spot?		
Is the mid-block crossing signalized?		
Is the mid-block crossing marked?		
If marked, is there an advanced stop line?		
Is there a ped-X sign for drivers?		
Are there any other crossing signs or devices?		
Visibility		
Are light lines adequate for speed limit?		
Are there visual obstructions (e.g., bushes, signs) that block pedestrians' view of approaching traffic?		
Are there visual obstructions (e.g., bushes, signs) that block drivers' view of pedestrians?		
Is there street lighting?		
General observations		
Is there any thing along the roadway that makes conditions less safe for pedestrians?		

Pedestrian Safety Prompt List
Intersection

Intersection location: _____
Major roadway: _____
Crossing roadway(s): _____
Date(s): _____ Time(s): _____
Conducted by: _____ Weather: _____

Item	Yes/No	Comments
Characteristics of Roadways		
Major roadway		
Oneway or twoway		
Number of lanes at intersection		
Roadway width at pedestrian crossing point		
Traffic volume		
Speed limit		
Is there a median?		
Crossing roadway		
Oneway or twoway		
Number of lanes at intersection		
Roadway width at pedestrian crossing point		
Traffic volume		
Speed limit		
Is there a median?		
Characteristics of Intersection		
How many roadway legs intersect?		
Are any of the legs at non-right angles to main roadway?		
Are any of the legs at an offset?		
Are curve radii long enough for vehicle mix (large trucks or buses, if present)?		
Are curve radii longer than needed given speed limits and presence of pedestrians?		
Is right turn on red allowed at this intersection?		
Signalized Intersections		
Is there a protected left turn?		
Is there a pedestrian signal?		
If so, indicate the type (e.g., words, symbols, countdown)		
Does the phasing include pedestrian-related features (e.g., LPI, split phase, etc.)?		
Is the signal pedestrian-actuated?		

If so, is there a sign that explains what the button does?		
Is there an accessibility feature? If so, indicate type.		
Pedestrian walk phase duration		
Are there any other features that affect pedestrians?		
Characteristics of Crosswalk		
Is there a crosswalk for each leg of the intersection?		
Is the crosswalk at a right angle to the roadway that it is crossing?		
Is crosswalk marked? If so, list type of marking?		
Is there a median in the roadway at the crosswalk?		
If there is a median, does the end of the median toward the traffic have protection (e.g., bollards or other)?		
If there is a median, is it raised? If it is raised, is provision made for WCs?		
Is the crosswalk clear of obstructions (e.g., light poles, vending machines)?		
Visibility		
Is sight distance from an approaching vehicle adequate?		
Are marked crosswalks clearly visible to an approaching vehicle?		
Is there street lighting at the crosswalk?		
General Observations		
Is there any aspect of the crossing area that makes it less safe for pedestrians?		

Intentionally left blank.