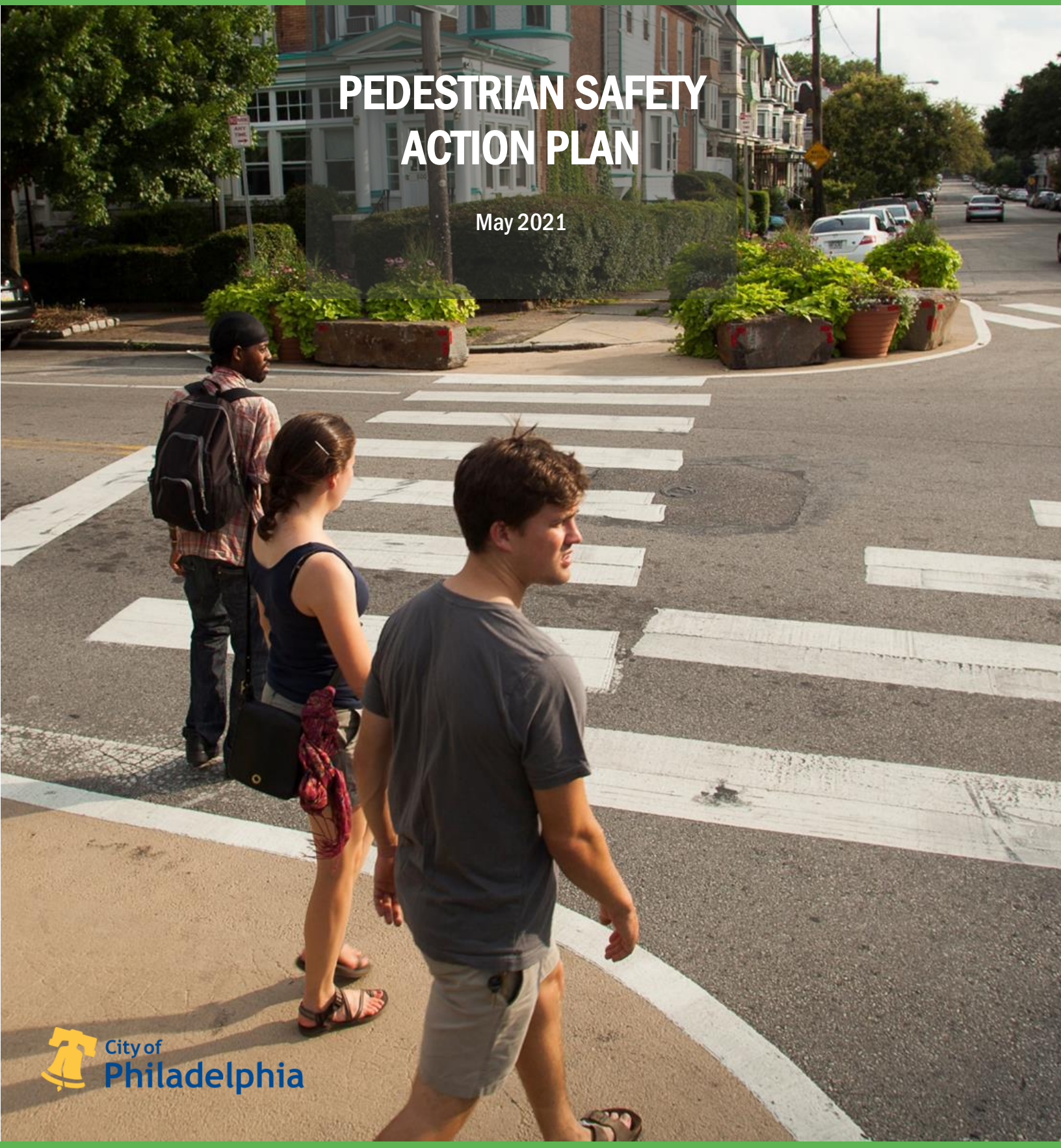
VISION ZERO

CITY OF PHILADELPHIA

PEDESTRIAN SAFETY ACTION PLAN

May 2021



City of Philadelphia

Information contained in this document is for planning purposes and should not be used for final design of any project. All results, recommendations, concept drawings, cost opinions, and commentary contained herein are based on limited data and information and on existing conditions that are subject to change. Further analysis and engineering design are necessary prior to implementing any of the recommendations contained herein.

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Philadelphia in Context

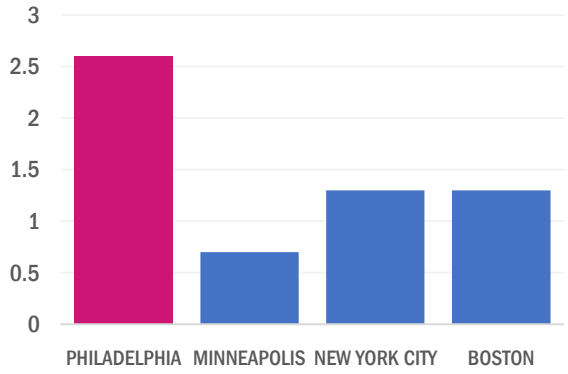
Walking in Philadelphia is often a wonderful experience, but it can also be challenging and sometimes even deadly. A pedestrian is injured or killed in the City every six hours. Compared to similar U.S cities, Philadelphia has a higher number of pedestrian fatalities per resident. Figure 1. compares Philadelphia's pedestrian fatalities per resident in 2018 to similar cities. In 2018, Philadelphia had 2.6 pedestrian fatalities per 100,000 residents, twice the number of New York City (1.3).[1]

In Philadelphia, injury crashes of all kinds peaked in 2016 (following national trends[2]). Though pedestrian injury crashes have steadily decreased each year since then, pedestrian fatalities have remained stubbornly high, averaging 35 people killed while walking every year, with large variability over the past five years. The nation experienced about a 5% increase in pedestrian fatalities in 2018[3], while Philadelphia saw a 20% increase.

With the City's commitment to reduce traffic fatalities to zero by 2030, the Key Findings, Key Actions, and Key Priorities outlined below will be critical to reaching that goal.

FIGURE 1.
PEDESTRIAN FATALITIES PER 100,000 RESIDENTS IN PHILADELPHIA AND SIMILAR CITIES IN 2018

Philadelphia has a higher pedestrian fatality rate per resident than peer cities.



Source: National Highway Traffic Safety Administration, 2018

Key Findings

Comparative analysis of all injury crashes, pedestrian injury crashes and pedestrian fatality crashes from 2014-2018, revealed key findings, grouped into **Where**, **When**, **How**, and **Who.** Pedestrian injury crashes and pedestrian fatality crashes exhibit overrepresentation of somewhat different set of crash factors as listed below.

WHERE

- **Urban Arterials & Auto-Oriented Commercial/Industrial Corridors:** Half of all pedestrian fatality crashes occurred on just 19% of street corridors (Urban Arterials &

[1] National Highway Traffic Safety Administration. (2018). *Traffic Safety Facts: A Compilation of Motor Vehicle Crash Data*, Table 124: Persons Killed, Population, and Fatality Rates by City.
[2] National Highway Traffic Safety Administration. (2017). *Traffic Safety Facts*. Retrieved from https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812681.
[3] National Highway Traffic Safety Administration. (2017). *Traffic Safety Facts*. Retrieved from https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812681.

Auto-Oriented Commercial/Industrial Corridors)

- **Near Transit:** Over 3/4 of all pedestrian fatality crashes occurred near transit stops and stations (within 300' feet)
- **Intersections:** About 2/3 of all pedestrian injury crashes occurred at intersection
- **Midblock:** Most crashes occurred at intersections, but pedestrian fatality crashes are overrepresented at the midblock (50.3%), compared to all injury (37%) and pedestrian injury crashes (35%).
- **Roosevelt Boulevard:** Almost a quarter of all pedestrians killed at intersections were crossing Roosevelt Boulevard or its cross-streets
- **High Pedestrian Activity:** Clusters of pedestrian fatalities occurred on North Broad Street, Lehigh Avenue, and Roosevelt Boulevard

WHEN

- **Nights and Evenings:** Over half of all pedestrian fatality crashes occur between 7 PM – 6 AM, with almost a quarter of those occurring after midnight. However, pedestrian injury crashes tended to happen earlier. Over half of all pedestrian injury crashes occurred between 3 PM – 12 AM.

HOW

- **Turning:** Almost half of all pedestrians in injury crashes were struck by a vehicle turning left or right whereas only 8% of all injury crashes involved turning movement by the vehicle
- **Hit & Runs:** Over a quarter of all pedestrian injury and fatality crashes were a result of a hit-and-run
- **Speeding:** 1 in 10 pedestrian fatality crashes were speeding-related and are overrepresented as compared to pedestrian injury crashes where only 2% of crashes were speeding related.

WHO

- **Over 50 Years Old:** Those over 50 represent 30% of Philadelphia's population, but almost 50% of pedestrians killed
- **Under 19 Years Old:** Those under 19 represent a quarter of Philadelphia's population, but 30% of pedestrians injured
- **Pedestrians Killed by a "Not Normal" Driver:** Ten times more pedestrians were killed by a "not normal" driver than passengers and other drivers combined. Crashes are considered "not normal" if they involve people who were under the influence of alcohol or drugs, having a medical emergency, or were fatigued.
- **"Not Normal" Pedestrians:** Pedestrians made up 40% of the "not normal" people killed in crashes

Key Action

Reduce Speeds: The reduction of vehicle speed represents the action expected to result in the greatest safety benefits for two primary reasons: first, reduced speeds should result in lowered injury severity if a crash occurs; and second, speed reductions should reduce the likelihood of crashes occurring at all. Actions that can lower speeds include:

- Automated Enforcement
- Narrowed Lanes/Roadway Reallocation
- Speed Limit Reductions
- Raised Intersections/Crossings

- Gateways/In-Street Pedestrian Crossing Signs

Increase Visibility: Greater visibility helps everyone see each other and increases the time needed to react and avoid crashes. Actions that can increase visibility include:

- Roadway Lighting
- Hardened Centerlines and Turn Wedges
- High Visibility Crosswalks
- Raised Intersections/Crossing
- Curb Extensions
- Daylighting Intersections/Parking Restrictions

Reduce Pedestrian Crossing Widths: Shorter crossing distances mean shorter crossing times, reducing the amount of time a pedestrian is in the street at risk of a crash. Actions that can reduce pedestrian crossing widths include:

- Median Islands/Pedestrian Refuge Islands
- Corner Radius Reductions
- Narrowed Lanes/Roadway Reallocation
- Curb Extensions

Reduce Conflicts Between Roadway Users: Reducing the number of potential conflicts between roadway users means reducing the number of eventual crashes. Actions that can reduce conflicts between users and provide separation between users include:

- Distinct Signal Phases (Protected Left Turns, Leading Pedestrian Intervals)
- Median Islands/Pedestrian Refuge Islands
- Sidewalk Buffers
- No Turn on Red Restrictions
- Hardened Centerlines and Turn Wedges

Ultimately, these actions should result in more drivers seeing and stopping for pedestrians and preventing a crash from occurring in the first place. See *Chapter 3: Systemic Solutions* for a toolkit that details each of the different types of improvements described above as well as policy recommendations.

Key Priority Locations

Priority locations will help guide the strategic investment of the City's resources, ensuring the maximum pedestrian safety benefits. Opportunities to improve pedestrian safety at locations not on this list, for example, as streets are identified for re-paving in the annual cycle, will still be reviewed for implementation of the key actions above. See Appendix B for lists and maps displaying the Top 50 Priority Corridors and Intersections.

Area Priorities

Figure 2. shows pedestrian injury and fatality hot spots in Philadelphia between 2014 and 2018.

Pedestrian Injury Crashes:

- Northern Philadelphia
- West Philadelphia
- Greater Center City

Pedestrian Fatality Crashes:

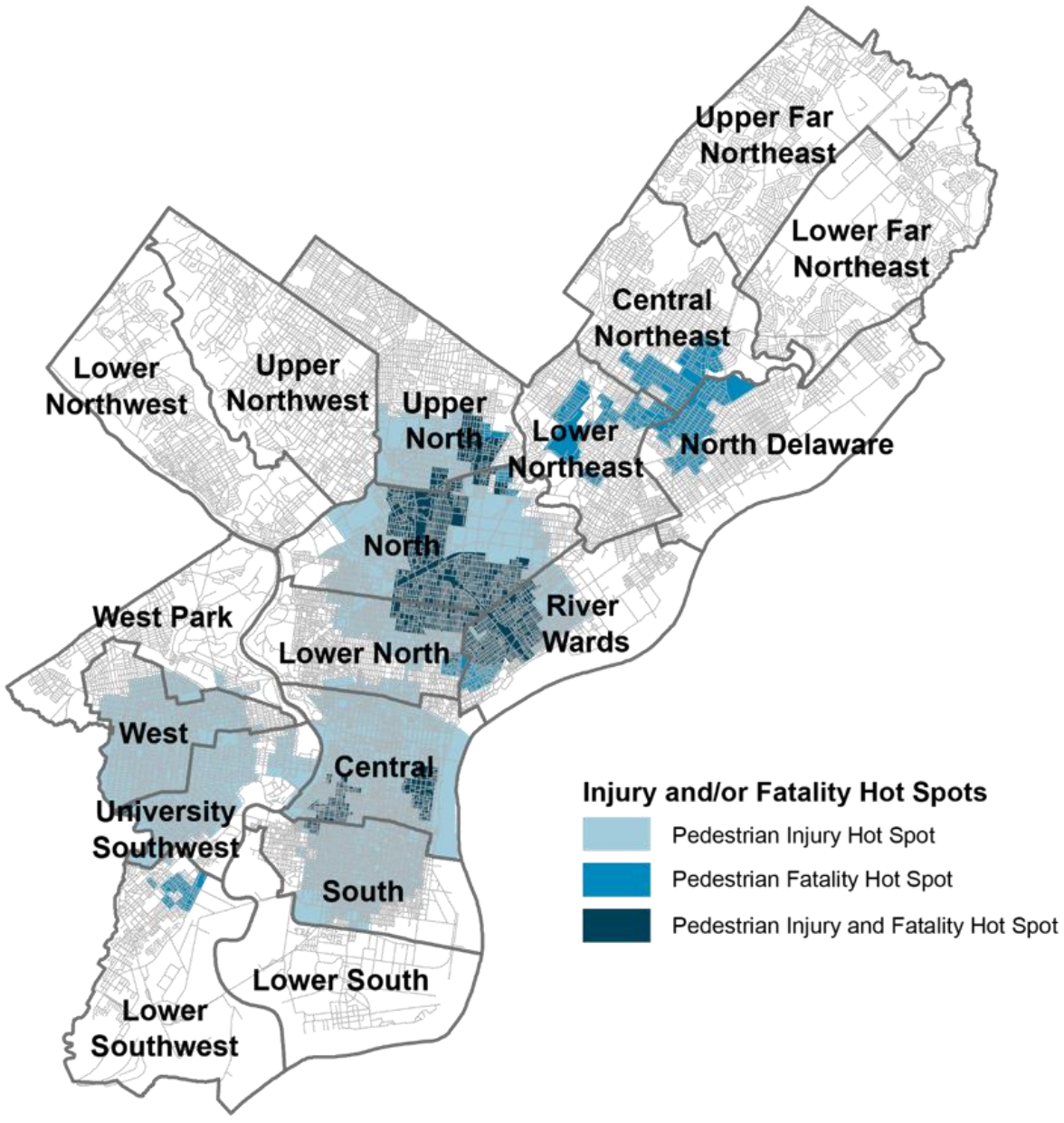
- Northeast Philadelphia (along Roosevelt Boulevard)
- Elmwood
- Kensington

Both Pedestrian Injury and Fatality Crashes:

- Northern Philadelphia
- Kensington
- Portions of Greater Center City

FIGURE 2.
PEDESTRIAN INJURY AND FATALITY CRASH HOT SPOT MAP OF PHILADELPHIA, 2014-2018

Pedestrian injury and fatality hot spots were concentrated in North Philadelphia, Kensington, and portions of Greater Center City between 2014 and 2018.



Source: PennDOT Crash Tables, 2014-2018; US Census Block Groups 2010

TABLE 1.
TOP TEN PRIORITY PEDESTRIAN CORRIDORS IN PHILADELPHIA

RANK	CORRIDOR	PEDESTRIAN FATALITIES (PEOPLE)	PEDESTRIAN INJURIES[4] (PEOPLE)	TOTAL PEDESTRIAN FATALITIES AND INJURIES (PEOPLE)	CORRIDOR LENGTH (MILES)
1	**Roosevelt Blvd** (Schuylkill River to Bucks County Line)	31	132	163	14.70
2	**N Broad St** (from City Hall to Glenwood)	5	177	182	3.04
3	**N Broad St** (from Glenwood to Windrim)	5	138	143	2.26
4	**S Broad St** (from City Hall to Oregon)	0	110	110	2.44
5	**Market St** (from City Hall to 2nd)	1	85	86	1.02
6	**Allegheny Ave** (from Sedgley to Ridge)	2	62	64	1.60
7	**N Broad St** (from Lindley to Montgomery County Line)	0	82	82	2.29
8	**Chestnut St** (from Independence Mall to 20th)	0	79	79	1.31
9	**Kensington Ave** (from Front to Pacific)	0	73	73	1.87
10	**Chestnut St** (from Cobbs Creek to 38th)	1	70	71	2.62

Source: PennDOT Crash Tables, 2014-2018; Street Centerlines

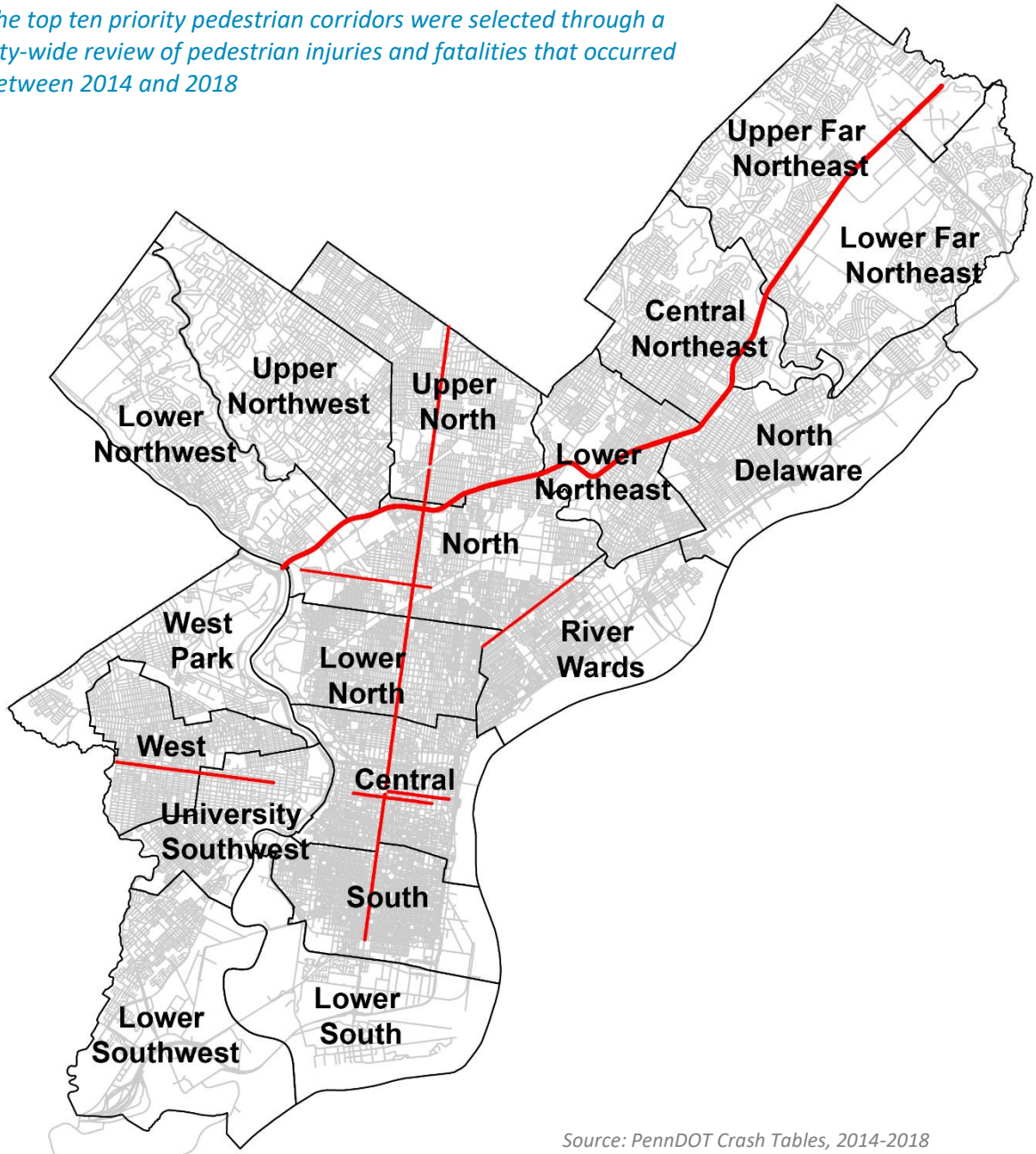
[4] Pedestrian injuries in this plan refer to all types of possible pedestrian injuries as defined by PennDOT, including possible injuries, injury of unknown severity, suspected serious injuries, and suspected minor injuries.

Corridor Priorities

Table 1. the top ten priority pedestrian corridors in Philadelphia. Figure 3. shows the top ten priority pedestrian corridors as a map.

FIGURE 3.
MAP OF TOP TEN PRIORITY PEDESTRIAN CORRIDORS IN PHILADELPHIA

The top ten priority pedestrian corridors were selected through a city-wide review of pedestrian injuries and fatalities that occurred between 2014 and 2018



Source: PennDOT Crash Tables, 2014-2018

Intersection Priorities

Table 2. lists the top ten priority pedestrian Intersections in Philadelphia. Figure 4. shows the top ten priority pedestrian intersections as a map.

TABLE 2.
TOP TEN PRIORITY PEDESTRIAN INTERSECTIONS IN PHILADELPHIA

RANK	INTERSECTION	PEDESTRIAN FATALITIES (PEOPLE)	PEDESTRIAN INJURIES[5] (PEOPLE)	TOTAL PEDESTRIAN FATALITIES & INJURIES (PEOPLE)
1	Bustleton Ave/Levick St & Roosevelt Blvd	4	3	7
2	W Allegheny Ave & Germantown Ave	4	2	6
2	Faunce St/Revere St & Roosevelt Blvd	4	2	6
4	Harbison Ave & Roosevelt Blvd	3	9	12
5	N 2nd St & W Lehigh Ave	3	7	10
6	Large St & Roosevelt Blvd	3	0	3
7	Whitaker Ave/Adams Ave & Roosevelt Blvd	2	7	9
8	N 9th St & Roosevelt Blvd	2	6	8
9	Arch St & N Broad St	2	5	7
10	E Allegheny Ave & Aramingo Ave	2	4	6

Source: PennDOT Crash Tables, 2014-2018

[5] Pedestrian injuries in this plan refer to all types of possible pedestrian injuries as defined by PennDOT, including possible injuries, injury of unknown severity, suspected serious injuries, and suspected minor injuries.

FIGURE 4.
MAP OF TOP TEN PRIORITY PEDESTRIAN INTERSECTIONS IN PHILADELPHIA

The top ten priority pedestrian intersections were selected through a city-wide review of pedestrian injuries and fatalities that occurred between 2014 and 2018.

Source: PennDOT Crash Tables, 2014-2018

CHAPTER 1: INTRODUCTION

Why Focus on Pedestrians

Who is a Pedestrian?

Everyone is a pedestrian at some point in their daily journey, whether walking to the bus, or the car, or wheeling to the grocery store. The Vision Zero Pedestrian Safety Action Plan focuses on the highest number of people using the City's transportation infrastructure to help improve safety for the most people. From a physical vulnerability perspective, pedestrians are much more likely to suffer more severe injuries or be killed in a crash than people in cars or buses because they do not have the protection of a vehicle around them. From a health and sustainability perspective, encouraging people to exercise outside, play on the street, or walk to work benefits the individual's health as well as the broader community in the form of improved air quality and decreased medical costs.

When considering equity and health, it is important to note people who are low-income, have a disability, or are older or younger are already much more likely to walk. Expanding equity is a fundamental City value, reflected in the hree-year Vision Zero Action Plan (2017), the and CONNECT: Philadelphia's Strategic Transportation Plan, and the Vision Zero Pedestrian Safety Plan intends to further enhance the focus on the social benefits of improved pedestrian safety. In short, Philadelphia must become a place where pedestrians both feel safer and are safer. This Plan identifies engineering recommendations targeted to help improve pedestrian safety to make walking safer and more appealing.

FIGURE 5.
PHILADELPHIA VISION ZERO THREE-YEAR ACTION PLAN

Source: City of Philadelphia, Office of Transportation, Infrastructure, and Sustainability (2017)

Safety Prioritized

What can the City do in the short term and long term to prevent pedestrian crashes? The City's **Vision Zero** program was created to focus attention on the policy changes and design solutions necessary to reduce severe injuries and ultimately eliminate fatalities on the City's transportation network. The City released the Vision Zero Three-Year Action Plan in 2017 and Vision Zero Five-Year Action Plan 2025 and Capital Plan in 2020, which propos several ways to reduce severe injuries and ultimately eliminate fatalities (the cover of the Three-Year Action Plan is shown in Figure 5.).

The Vision Zero Pedestrian Safety Action Plan represents a key step in identifying steps the City can take to reduce crashes that specifically involve pedestrians, often considered the roadway's most vulnerable users.6 While pedestrians were only 8% of all people involved in injury crashes in Philadelphia (2014-2018), they made up 41% of the people killed in those crashes. Reducing and preventing pedestrian injuries and fatalities requires a better understanding of what makes pedestrian fatality crashes different from other crashes, and what the available data reveals. Looking at these crashes more closely will enable the City to design streets that prioritize pedestrian safety.

FHWA Pedestrian Focus City

Since 2004, the Federal Highway Administration (FHWA) has been identifying and supporting states and cities with the highest pedestrian fatality rates with technical assistance, training courses, and guidance documents. Philadelphia is one of FHWA's Pedestrian Focus Cities, alongside other major metropolitan areas such as New York, Chicago, and Los Angeles. FHWA encourages the Pedestrian Focus Cities to develop Pedestrian Safety Action Plans to analyze and address the pedestrian crash problems in their communities. This Pedestrian Safety Action Plan helps fulfill that goal.

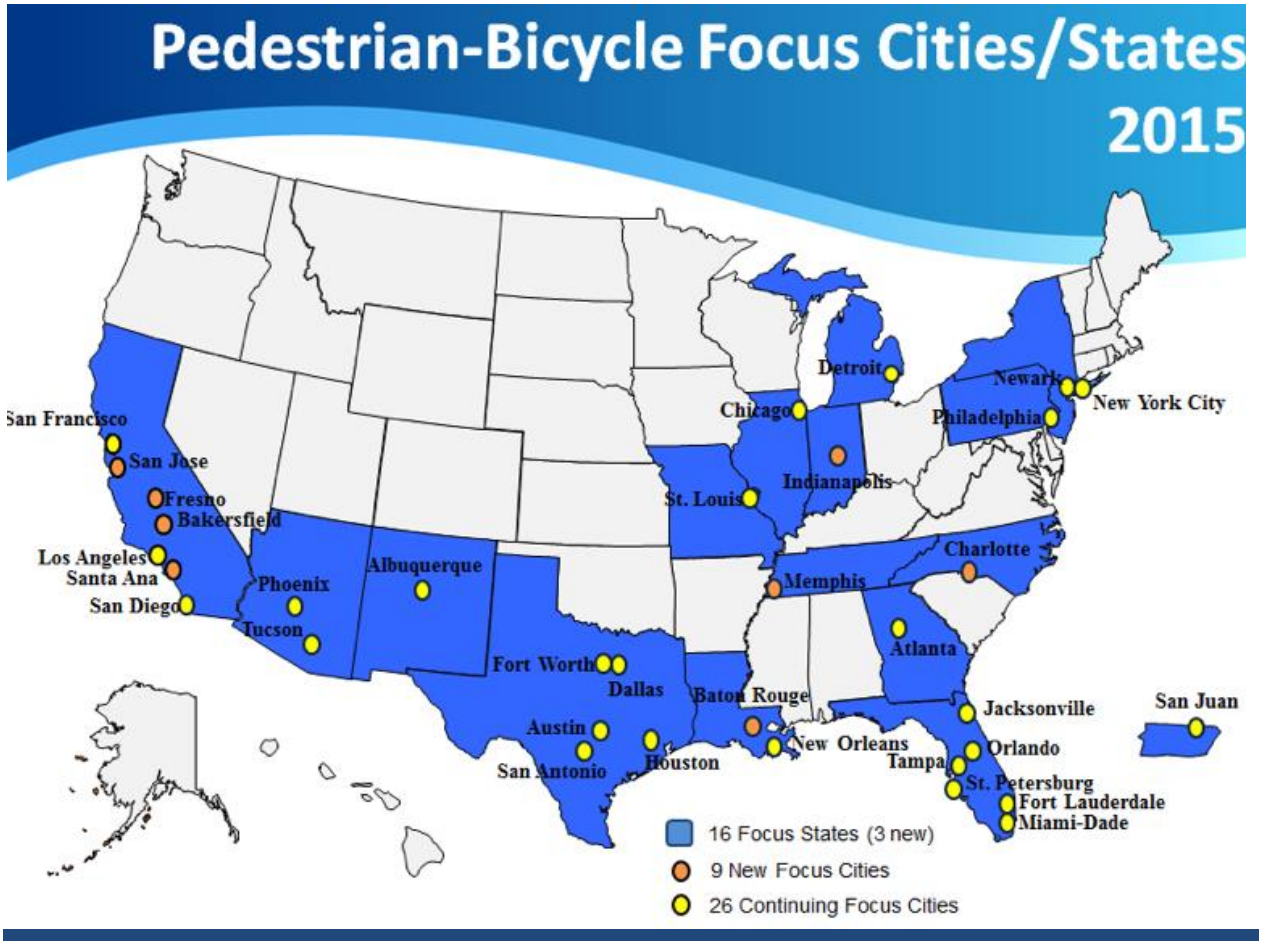


FIGURE 6.
MAP OF FHWA PEDESTRIAN-BICYCLE FOCUS CITIES/STATES, 2015

Source: Federal Highway Administration (2015)

Ongoing City Efforts

The City of Philadelphia, across multiple agencies, has developed multiple plans over the past ten years that seek to improve pedestrian facilities and safety. This Plan builds on this previous work, while adding an additional focus on data-driven recommendations that address pedestrian-specific crashes.

Bicycle & Pedestrian Plan (2012) and Plan Progress Report (2015)
The Bicycle & Pedestrian Plan and its companion Progress Report present a comprehensive examination of existing pedestrian facilities, identifying priority locations for pedestrian infrastructure improvements. The priority locations identified in the Bicycle & Pedestrian Plan frequently align with the priority areas, corridors, and intersections listed in this Vision Zero Pedestrian Safety Plan.

The Bicycle & Pedestrian Plan also included four key measures with targeted outcomes, one of which was reducing pedestrian fatalities and injuries by 50% by 2020. While some progress has been made, more work is needed to achieve this outcome. Implementing the recommendations in this Plan will help the City of Philadelphia reach this goal.

Complete Streets Design Handbook (2013)
The Complete Streets Design Handbook is a design-oriented document that offers guidance on the appropriate roadway characteristics, pedestrian infrastructure, and pedestrian-scale amenities for different types of streets, identified in the Handbook as the Complete Streets typologies. The Handbook defines 11 Complete Streets typologies, which were used in this Vision Zero Pedestrian Safety Action Plan to analyze pedestrian crashes on long stretches of streets with similar features identified as "corridors" (see sidebar on page 34).

Vision Zero Three Year Action Plan (2017)
The Vision Zero Three Year Action Plan includes four bold goals to save lives on Philadelphia's transportation network. These goals are not mode-specific but would result in improvements to the safety of pedestrians. Implementing the recommendations in this Plan would help the City:

- Save lives by reducing the number of severe traffic crashes on Philadelphia streets
- Improve the overall performance of the street system, and prioritize those using our streets who are most vulnerable
- Reduce Philadelphians' risk for developing chronic diseases by promoting active transportation
- Shift trips from motorized to active modes of transportation to reduce congestion, improve air quality, and improve health

The Vision Zero Three Year Action Plan also includes five Priorities focusing on Equity, Evaluation, Engineering, Education, and Enforcement. This Vision Zero Pedestrian Safety Plan specifically focuses on engineering recommendations with broader policy recommendations that address the other priorities.

CONNECT: Philadelphia's Strategic Transportation Plan (2018)
CONNECT identifies five goals to create a safer, stronger, and more equitable city through improvements and investments in the City's transportation system. CONNECT's first goal is implementing Vision Zero and working towards the aim of achieving zero traffic deaths by 2030. A core strategy is to seek opportunities to improve street safety through updated engineering and

design. This Vision Zero Pedestrian Safety Action Plan provides engineering recommendations that specifically will improve pedestrian safety.

Improve Safety for Youth Walking to School

In Philadelphia, one in four pedestrian crashes include someone under the age of 18. While there has been progress in reducing the number of pedestrian injuries among children and teens in the past five years, the number of deaths and serious injuries has not changed. City is committed to creating a child-friendly city by keeping road safety as a key priority.

Concurrent with the development of the Vision Zero Pedestrian Safety Action Plan, City partnered with the Pedestrian and Bicycle Information Center to serve as the first Vision Zero for Youth demonstration site. The purpose of the Demonstration Project is to support and evaluate a youth pedestrian-focused approach with the ultimate goal of improving road safety for all. Philadelphia's work will provide the first demonstration of the impact that a youth focus can have and what cities can accomplish. This plan captures initial findings from that project, including an overview of when and where pedestrians under 18 years of age are being hit by drivers and considerations for solutions that make children – and everyone – safer.

Vision Zero for Youth is built on the value communities place on keeping children safe, and the belief that children need and deserve special protection. Elementary-age children are at special risk because they may not be ready to navigate traffic situations including those that an adult might find relatively simple, like crossing a residential street. But the risks are not just to children. As youth gain more independence, they expand the places they travel, which often involves faster moving traffic and roads built to move motor vehicles. Starting with a priority for youth can create momentum for changing the culture of road safety and building the buy-in needed to reach the goal of zero deaths.

Support Inclusive and Resilient Neighborhoods

A transportation system that offers a variety of safe transportation options can equitably address the needs of all people, including those who are experiencing poverty or homelessness, older people, young people, and people with limited mobility.

Vulnerable Populations

Age: Children and young adults under 18 years old made up 22.0% of the Philadelphia population, while those over 65 are 13.2%.6 Both groups traditionally walk more than other age groups due to lack of access to a vehicle. Additionally, older people are physically more at risk in a crash and have more difficulty recovering from their crash injuries. Younger children, though generally more physically resilient, face different risks due to their shorter stature which can make them less visible to drivers.

[6] U.S. Census Bureau. (2018). Age and Sex [data table for 2018]. *2013-2018 American Community Survey 5-Year Estimates* (Table S0101). Retrieved from https://data.census.gov.

Income: In 2018, almost a quarter of all Philadelphians were living in poverty (24.3%)7 and almost a third of households earned less than $25,000 a year (31.5%).8 People with lower incomes are more likely to walk due to less access to vehicles and are often more financially burdened by healthcare costs related to crashes.

Vehicle ownership: Almost a third of households in Philadelphia do not have access to a vehicle (30.3%).9 Lack of vehicle access, whether by choice or financial reasons, is often a key reason why people walk.

Disabled persons: 16.3% of Philadelphia residents have a disability, whether physical or mental. The percentage rises to 42.6% for those over age 6510, meaning the design of the transportation network must consider the specialized needs of older, mobility-challenged City residents and assist those residents aging in place to the greatest degree possible.

Sustainability/Climate Change

A transportation system that is safe is also more likely to advance compliance with goals for improved environmental sustainability and enhanced public health. Safe and sustainable systems are synonymous and mutually reinforcing. Broader societal benefits that are reinforced by a safe transportation system include public health, accessibility, physical activity, air quality, climate change, and environmental sustainability. Greater access to walking, biking, and public transit has been shown to increase people's physical activity, enhance their quality of life, and increase their ability to access jobs and education.

Current Trends

Nationally, pedestrian fatalities crashes have steadily increased over the past ten years, reaching a ten-year high in 2018 (see Figure 7.). Pedestrian fatalities in Philadelphia, after falling substantially in 2015, have fluctuated from year to year, increasing in 2018 (see Figure 8.)

Traffic Deaths and Youth

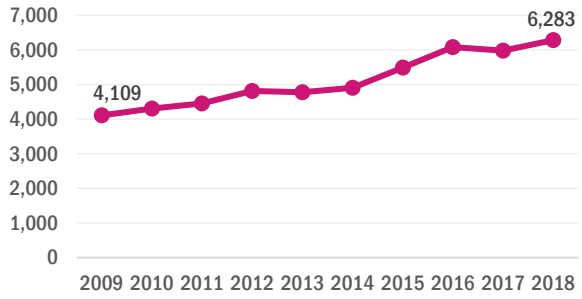
Globally, the World Health Organization reports that crashes are the number one cause of death for those ages 5-29 years.[11] Nationally, 20% of the children under the age of 15 killed in traffic crashes were pedestrians in 2017.[12] The overall number and rate of child pedestrians killed in crashes has declined steadily since 1975.[13]

FIGURE 7.
PEDESTRIAN FATALITIES IN THE UNITED STATES, 2009-2018

Nationwide, pedestrian fatalities were at their highest level in 2018 after increasing consistently over the past ten years.

[7] U.S. Census Bureau. (2018). Income and Poverty, Philadelphia County, Pennsylvania [data table]. *Quick Facts*. Retrieved from https://www.census.gov/quickfacts/philadelphiacountypennsylvania.
[8] U.S. Census Bureau. (2018). Income in the Past 12 Months [data table for 2018]. *2013-2018 American Community Survey 5-Year Estimates* (Table S1901). Retrieved from https://data.census.gov.
[9] U.S. Census Bureau. (2018). Physical Housing Characteristics for Occupied Housing Units [data table for 2018]. *2013-2018 American Community Survey 5-Year Estimates* (Table S2504). Retrieved from https://data.census.gov.
[10] U.S. Census Bureau. (2018). Selected Social Characteristics [data table for 2018]. *2013-2018 American Community Survey 5-Year Estimates* (Table DP02). Retrieved from https://data.census.gov.

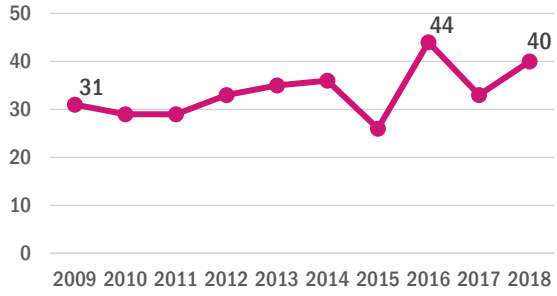
[11] World Health Organization. (2020). Road Traffic Injuries Fact Sheet. Retrieved from https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries
[12] National Highway Traffic Safety Administration. (2017). Traffic Safety Facts 2017 Data: Pedestrians. Retrieved from https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812681.
[13] Insurance Institute for Highway Safety. (2018). Fatality Facts 2018: Children. Retrieved from https://www.iihs.org/topics/fatality-statistics/detail/children



Source: National Highway Traffic Safety Administration, 2017

FIGURE 8.
PEDESTRIAN FATALITIES IN PHILADELPHIA, 2009-2018

In Philadelphia, pedestrian fatalities have varied substantially over the last ten years, increasing in 2018 after a drop in 2017



Source: PennDOT Crash Tables, 2009-2018

Economic and Social Impact of Crashes

The economic and social costs of pedestrian crashes are enormous and complex. In 2020 dollars, one study found that the cost of one pedestrian fatality was $5,104,485 including "medical care costs, household and wage work losses, and the value of pain, suffering, and lost quality of life."[14] The National Safety Council estimates that the average cost of a non-motor-vehicle fatality such as a pedestrian fatality would be $4,490,353 in 2020 dollars, including costs associated with decreased income/productivity, medical care, and administration.[15]

The impact on families and communities is much harder to measure, but there is evidence that pedestrian crashes have a serious toll on an individual and collective level, especially emotionally. One study pointed out that the "pain, suffering, disability and family cohesiveness are perhaps more important in determining the net cost of pedestrian injuries and mortality on society. These may include such chronic psychiatric conditions as post-traumatic stress disorder and major depressive episode[s]."[16]

Process

Crash Analysis

It is important to understand the problem of pedestrian crashes to plan and implement solutions. Where are pedestrian crashes occurring? What is happening in those crashes? Are there crash factors that a different engineering design could address? Pedestrian crash data was analyzed for all of Philadelphia for the years 2014-2018 to help answer these questions and important crash factors were identified.

The analysis and prioritization conducted in the Pedestrian Safety Action Plan built on the City's

[14] Miller, T., Zaloshnja, E., Lawrence, B., Crandall, J., Ivarrsson, J., & Finkelstein, A. (2004). Pedestrian and Pedalcyclist Injury Costs in the United States by Age and Injury Severity. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217422/

[15] National Safety Council. (2018). Average Economic Cost of Fatal and Nonfatal Injuries by Class of Injury, 2018. Retrieved from https://injuryfacts.nsc.org/all-injuries/costs/guide-to-calculating-costs/data-details/

[16] Chakravarthy, B., Lotfipour, S., & Vaca, F. (2007). Pedestrian Injuries: Emergency Care Considerations. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2859736/

previous work and best practices from the following resources:

- FHWA: How to Develop a Pedestrian Safety Action Plan
- Smart Growth America: Dangerous by Design
- New York State DOT: Pedestrian Safety Action Plan
- Virginia DOT: Pedestrian Safety Action Plan
- DVRPC: Crash Analysis Standards & Recommendations
- New York City DOT: Pedestrian Safety Action Plan (Bronx)
- City of Minneapolis: Pedestrian Crash Study
- Chicago DOT: Pedestrian Crash Analysis
- Alamo Area MPO: San Antonio-Bexar County Pedestrian Safety Action Plan
- City of Seattle: Bicycle & Pedestrian Safety Analysis

Recommendations

The engineering and policy recommendations in this Pedestrian Safety Action Plan are based on the results of the crash analysis and build on the recommendations in the Vision Zero Three Year Action Plan. The Year 1 and 2 Update reports show that the City is making progress in implementing engineering recommendations at select locations, but more widespread improvements are needed to reach zero pedestrian fatalities by 2030.

The recommendations in the Pedestrian Safety Action Plan build on the work to date and best practices from the following resources:

- Philadelphia: Vision Zero Action Plan (2017)
- Philadelphia: Vision Zero Year 1 Update (2018)
- Philadelphia: Vision Zero Year 2 Update (2019)
- Philadelphia: Complete Streets Design Handbook
- FHWA: Pedestrian Safety Guide and Countermeasure Selection System (2013)
- FHWA: Proven Safety Countermeasures (2017)
- FHWA: Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations (2018)
- Minnesota DOT: Best Practices for Pedestrian/Bicycle Safety (2013)
- Montgomery County, MD: Draft Vision Zero Crash Reduction Toolkit (2020)
- New York City DOT: Bronx Pedestrian Safety Action Plan (2015)

Collectively, these resources identified several safety objectives that are key to reducing the number of serious and fatal pedestrian crashes. Many of these objectives relate directly to the crash factors identified in the analysis and informed the selection of the engineering recommendations presented in the toolkit Chapter 3, Systemic Solutions.

Community Engagement

All public engagement was moved to an online format in response to the COVID-19 pandemic and the City's Stay at Home orders. Due to the technical, City-wide nature of this study, a survey was developed with questions relating to people's preferences for different design treatments that would improve pedestrian safety. For example, there are several different designs that can help make pedestrians more visible, so the survey presented different images of design treatments to participants and asked them to select the one that they would prefer to see in their neighborhood.

The survey was developed using SurveyMonkey and included information about Vision Zero policies and programs, pedestrian crash safety

trends in Philadelphia, recommended design options to improve traffic safety, a Vision Zero conceptual design toolkit, and optional demographic questions. Survey respondents gave feedback on the specific design improvements and traffic calming solutions they would prefer in their neighborhoods.

The survey was promoted through the Office of Transportation, Infrastructure, and Sustainability's (oTIS) Facebook and Twitter accounts, as well as sent out to stakeholder groups and shared among their networks. The survey was available in the first two weeks of June 2020. Approximately 150 survey responses were collected and analyzed.

The top walkability issues that respondents identified in their neighborhoods included drivers failing to yield, speeding, and failing to obey traffic control devices. Overall, respondents preferred reallocating roadway space to reduce speeding and provide shorter crossing distances, improving visibility at intersections with parking restrictions, and leading pedestrian intervals to increase drivers stopping for pedestrians.

The majority of respondents were residents of South Philadelphia, West Philadelphia, and Northwest Philadelphia, with 60% of respondents between the ages of 25 and 44. Survey participants primarily identified as White/Caucasian. See Appendix A for a summary of all survey results. City agencies will take these preferences into consideration when designing future neighborhood street projects, along with additional community input.

Purpose and Use of the Plan

This is a technical Plan that will guide City agencies and implementing partners in prioritizing resources at important locations to improve pedestrian safety. The Plan will help the City make data-driven design decisions to reduce pedestrian crashes, based on:

- Maps of Priority Areas, Intersections, and Corridors. These are locations with the highest concentration of pedestrian crashes, where design interventions will have the greatest impact.
- Pedestrian Toolkit. The Toolkit contains different engineering recommendations that target the crash factors identified in the crash analysis. These recommendations represent the most effective designs for improving pedestrian safety in Philadelphia.

The City and its partners will be able to select a combination of solutions that will have most impact within limited resources, as street projects are developed and implemented.

Lastly, the City's new Five-Year Vision Zero Action Plan will also incorporate relevant recommendations and actions from this Plan.

CHAPTER 2: PEDESTRIAN CRASH FINDINGS

Overview

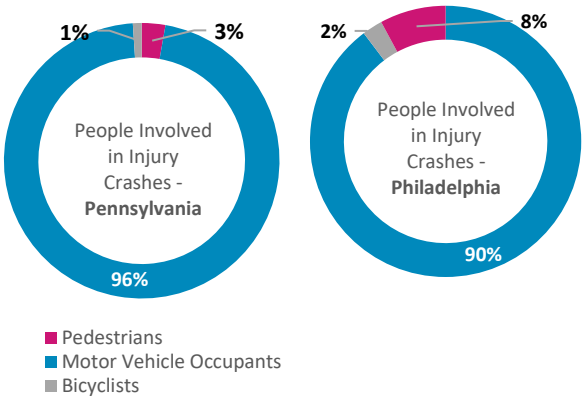
An average of 36 people per year were killed while walking in Philadelphia between 2014 and 2018. Out of all injury crashes in Philadelphia from 2014 to 2018, 21% resulted in a pedestrian injury.

Compared to the Commonwealth of Pennsylvania, Philadelphia had a higher share of pedestrians involved injury crashes between 2014 and 2018. Figure 9. shows the average percent of pedestrians involved in crashes in Pennsylvania and Philadelphia between 2014 to 2018.

While pedestrians represent an average of 8% of people involved in crashes in Philadelphia, pedestrians comprise 41% of crash-related deaths. Figure 10. (on page 23) shows pedestrians, bicyclists, and motor vehicle occupants (drivers and passengers) as a percent of the total crash-related fatalities in Philadelphia from 2014 to 2018.

FIGURE 9.
AVERAGE PERCENT OF PEDESTRIAN, BICYCLIST, AND MOTOR VEHICLE OCCUPANTS (DRIVERS AND PASSENGERS) INVOLVED IN INJURY CRASHES IN PENNSYLVANIA AND PHILADELPHIA, 2014-2018

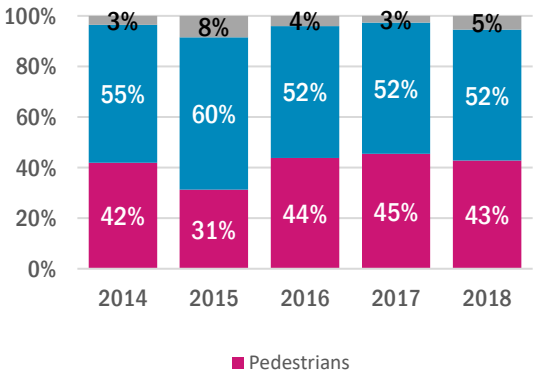
The percent of pedestrians involved in injury crashes in Philadelphia is more than double the percent of pedestrians involved in injury crashes in Pennsylvania.



Source: PennDOT Crash Tables, 2014-2018

FIGURE 10.
PEDESTRIAN, BICYCLIST, AND MOTOR VEHICLE OCCUPANT (DRIVERS AND PASSENGERS) FATALITIES AS A PERCENT OF TOTAL FATALITIES, 2014-2018

Pedestrians and bicyclists are overrepresented in crash fatalities in Philadelphia.



Source: PennDOT Crash Tables, 2014-2018

Methodology

This study analyzed publicly available PennDOT crash data from 2014-2018 in Philadelphia to identify pedestrian crash trends and patterns, detailed in the Findings section below. These system-wide crash patterns and characteristics were used to generate systemic solutions to address identified trends, discussed In Chapter 3, Systemic Solutions.

This study used statistical analysis to evaluate over 45 different variables at three different geographic scales: intersection, corridor, and area. First, all injury crashes (for all modes) were compared to pedestrian injuries and pedestrian fatality crashes to help us answer these key questions:

1. Why are pedestrian crashes more severe or fatal?
2. What makes pedestrian crashes more likely to occur?
3. What kinds of pedestrian crashes are overrepresented?

These findings were then grouped thematically into **Where**, **When**, **How**, **and Who**. Many of the findings echo trends documented in national and international research, but this study is the first comprehensive, city-wide analysis of pedestrian crashes which confirms with hard data that these trends are also occurring in Philadelphia.

Understanding Areas, Corridors, and Intersections

To understand the **Where**, **When**, **How**, **and Who** of pedestrian crashes in Philadelphia, crashes were evaluated at three geographic scales:

Areas: Areas are the largest geography of the three geographic scales. To understand where pedestrian crashes cluster in neighborhoods in Philadelphia, crashes were aggregated by Census Block Group. The US Census Bureau organizes cities and metropolitan areas into Census Block Groups, which contain between 600 and 3,000 residents.

Corridors: Corridor geographies examine the number of crashes along a continuous stretch of street or road. Analyzing crashes on a corridor level helps illustrate which types of streets are associated with higher pedestrian crashes and locations where pedestrian safety can be improved. Corridors were based on the roadway's functional classification (see the sidebar on page 34) and Complete Streets types.

Intersections: Intersections are the smallest of the three geographic scales. Evaluating crashes at an intersection level shows which types of intersections are dangerous or safe for pedestrians. Intersections were sorted into intersection types (see sidebar on page 34) based on functional classification.

Evaluating crashes at all three geographic scales helped strengthen the findings and to reveal specific patterns at different geographic scales. Understanding the three geographic scales, and how they relate to the findings, is the key to understanding the systemic solutions presented in Chapter 3 - Solutions.

Findings

Through the analysis, patterns began to emerge to explain what is happening in pedestrian crashes. The first step to understanding the problem of pedestrian crashes is the need to gain better insight into why pedestrian crashes occur and what circumstances makes them more severe or deadly. The second step is using those insights to develop targeted solutions. The third step is to implement those solutions where they make the most sense and will have the greatest safety benefit.

Below, these patterns are broadly grouped into **Where**, **When**, **How**, **and Who**. Throughout the Findings section, statistically significant findings with a *p*-value of less than 5% are indicated with *p** and a footnote.

These crash factors were combined into the list, to show the potential importance of that crash factor relative to the others. Note that crashes can have multiple factors and these factors are not directly comparable due to major differences in reporting different categories as well as the natural prevalence of that category. For example, almost all crashes are coded as occurring at "intersections" or "midblock" so with only two category options it is difficult to compare them directly against "Nights/Evenings" which have five category options.

TOP CRASH FACTORS FOR PEDESTRIAN INJURY CRASHES

- INTERSECTIONS
- NEAR TRANSIT
- MIDBLOCK
- TURNING
- URBAN ARTERIAL & AUTO-ORIENTED COMMERCIAL/INDUSTRIAL CORRIDOR
- UNDER 19 YEARS OLD
- NIGHTS/EVENINGS
- OVER 50 YEARS OLD
- HIT & RUNS
- NEAR SCHOOLS

*p**

This Plan examined crashes in many ways, including testing the strength of the relationship between crash factors. Each of the crash factors in the Where, When, How, and Who underwent statistical tests.

If a crash factor had a statistically strong relationship with pedestrian injury or fatality crashes, it was considered statistically significant. This Plan uses 'p*' to show when the relationship between crash factors was statistically significant.

For a relationship between crash factors to be considered statistically significant, the test had to prove 95% confidence (the p-value had to be under 5%).

Most significant factors for Pedestrian Fatality Crashes

- Nights/Evenings
- Urban Arterial & Auto-Oriented Commercial/Industrial Corridor
- Midblock
- Intersection
- Over 50 Years Old
- Hit & Runs

There is no one-size-fits-all solution to pedestrian crashes. Different types of crash factors need different design and policy solutions that can work in tandem to eliminate pedestrian deaths and serious injuries. The crash factors identified in the Findings section guided the selection of specific countermeasures that address those crash factors. To reduce the traffic fatality rate to zero for pedestrians, it is critical that these recommendations are implemented through specific projects, policies, and other activities, discussed in Chapter 3. Lists of intersections, corridors, and areas have been identified for prioritization to most effectively target resources. Addressing pedestrian crashes in those prioritized areas with the relevant design interventions is expected to result in a reduction in pedestrian deaths and injuries quickly and cost-effectively.

MAJOR CONTRIBUTING FACTORS

Major contributing factors are crash factors that are statistically significant, large in magnitude, and have been confirmed across several types of analysis.

WHERE

Pedestrians faced higher risks on Urban Arterial or Auto-Oriented Commercial/Industrial corridors, near transit stops and stations, near schools, and generally where there is high pedestrian activity. Intersections are where most pedestrian crashes happen, but midblock crashes were deadlier in Philadelphia between 2014-2018.

The **major contributing factors** of **where** pedestrian crashes occur include the following:

Urban Arterial and Auto - Oriented Commercial / Industrial Corridors

The study analyzed all of Philadelphia's street corridors using the Complete Streets roadway typologies (see sidebar on Complete Street Types34 and a description of the relationship between corridors and Complete Streets). Pedestrian crashes are more severe on urban arterials and auto-oriented commercial/industrial corridors *p**.[17] Pedestrian fatality crashes are more likely to occur on urban arterials *p**.[18] Both roadway types have higher

[17] The relationship between severity of pedestrian injuries and crashes occurring on Urban Arterials and Auto-Oriented Commercial/Industrial corridors was statistically significant (the *p* value was less than 5%).

[18] The relationship between incidence of pedestrian fatality crashes and crashes occurring on Urban Arterials was statistically significant (the *p* value was less than 5%).

speed limits, more travel lanes, and more vehicular traffic compared to some of the other roadway typologies (walkable commercial corridors, city neighborhood streets, low-density residential, shared narrow streets, and local streets).

Pedestrian fatalities from crashes are overrepresented on urban arterials and auto-oriented commercial/industrial streets. Urban arterials makeup only 16% of all roadways in Philadelphia, but they account for 44% of pedestrian fatality crashes. Similarly, auto-oriented commercial/industrial corridors include only 3% of all streets but account for 6% of pedestrian fatality crashes.

Where There's High Pedestrian Activity

Anywhere there are lots of people and vehicles interacting and sharing the same space, the likelihood increases that a crash will occur. To explore the relationship between activity and crashes, a composite activity index score (job and employment concentration) was used. Mean Average Annual Daily Traffic (AADT) and Mean Average Annual Daily Pedestrians (AADP) counts could not be used to account for activity levels due to limited data availability. For the high pedestrian activity and crash analysis, the total number of all injury, pedestrian injury, and pedestrian fatality crashes was aggregated for each Census Block Group and normalized by area size and the composite activity index score (refer to maps in **Accounting for Activity** sidebar).

The analysis demonstrated:

- **All injury crashes** were primarily concentrated in neighborhoods along major corridors such as Broad Street, Roosevelt Boulevard, and areas of West Philadelphia.
- **Pedestrian injury crash** clusters were in high activity areas such as Center City, North Broad, West Philadelphia neighborhoods near Market Street, and the Fairhill/Kensington neighborhoods near Allegheny Avenue.
- **Pedestrian fatality crashes** were mostly dispersed across the city, however, there are several clusters on North Broad Street, Lehigh Avenue, and Roosevelt Boulevard.

Near Transit Stops & Stations

Transit is associated with pedestrian activity, since people often walk to and from transit stops and stations. Pedestrian injury and pedestrian fatality crashes are more likely to occur at intersections near transit stops and stations of all types (within 300 feet) *p**.[19] Almost 80% of pedestrian fatality crashes happen at intersections with transit. In addition to examining intersections, the study also analyzed corridor segments across the city (see **Complete Streets Typologies & Corridor Analysis** sidebar on page 24). Among corridor crashes, pedestrian injury crashes are more likely to occur on corridors with subway stations *p**.[20]

Figure 13. shows that pedestrian injury crashes (crashes where one or more pedestrian was

[19] The relationship between incidence of pedestrian injury crashes and pedestrian fatality crashes and crashes occurring on near transit stops and stations (subway, trolley, bus, regional rail) was statistically significant (the *p* value was less than 5%).

[20] The relationship between incidence of pedestrian injury crashes and crashes occurring on corridors with subway service was statistically significant (the *p* value was less than 5%).

injured) and pedestrian fatality crashes (crashes where one or more pedestrian died) are overrepresented as compared to all injury crashes (a crash that resulted in one or more injuries).

Near Schools

Schools are typically associated with pedestrian activity since children often walk to school either alone or with parents or guardians. In Philadelphia, 38% of children in pre-school to 6th grade walk to or from school. Crashes at intersections near schools (within 500 feet) are more likely to be a pedestrian injury crash than an all injury crash *p**.[21] 20% of all intersections city-wide are near schools, but 26% of pedestrian injury crashes occur at intersections near schools.

Figure 17. and Figure 16. , show that pedestrian injury crashes (crashes where one or more pedestrian(s) were injured) are overrepresented at intersections near (within 500') of a school.

FIGURE 11.
URBAN ARTERIAL CORRIDORS AS A PERCENT OF ALL CORRIDORS IN PHILADELPHIA

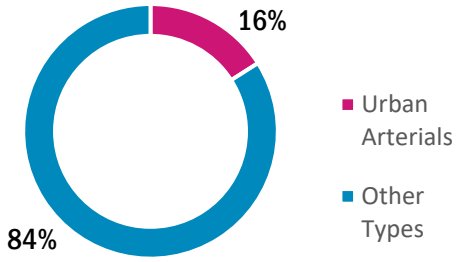
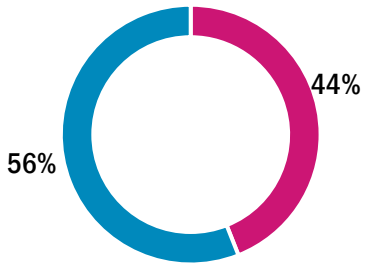


FIGURE 12.
PERCENT OF PEDESTRIAN FATALITY CRASHES ON URBAN ARTERIAL CORRIDORS, 2014-2018

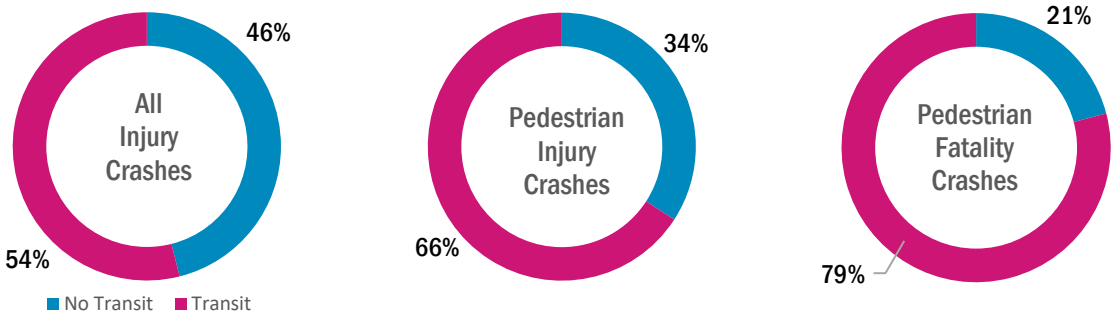


A disproportionately high number of pedestrian fatality crashes occurred on Urban Arterials in Philadelphia between 2014 and 2018.

[21] The relationship between incidence of pedestrian injury crashes and crashes occurring at intersections within 500' of a school was statistically significant (the *p* value was less than 5%).

FIGURE 13.
PERCENT OF CRASHES OCCURING NEAR* TRANSIT STOPS**, 2014-2018

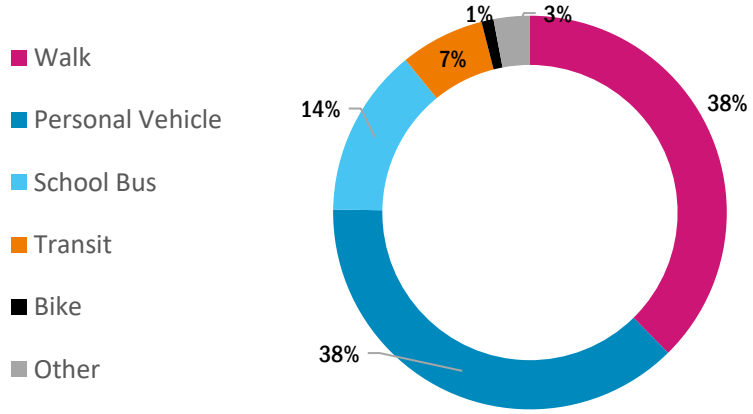
Pedestrian fatality and injury crashes occurred more often near transit stops.



** Near transit stops means transit stops in an intersection or within 300' of an intersection.*
*** Transit stops include bus stops, trolley stops, subway stations, regional rail stations, and Norris High Speed Line stations.*
Source: PennDOT Crash Tables, 2014-2018; SEPTA bus stops, trolley stops, and regional rail stations, SEPTA GIS Data Portal

FIGURE 14.
STUDENT TRANSPORTATION MODE TO/FROM SCHOOL, PRE-SCHOOL TO 6TH GRADE, 2018-2019

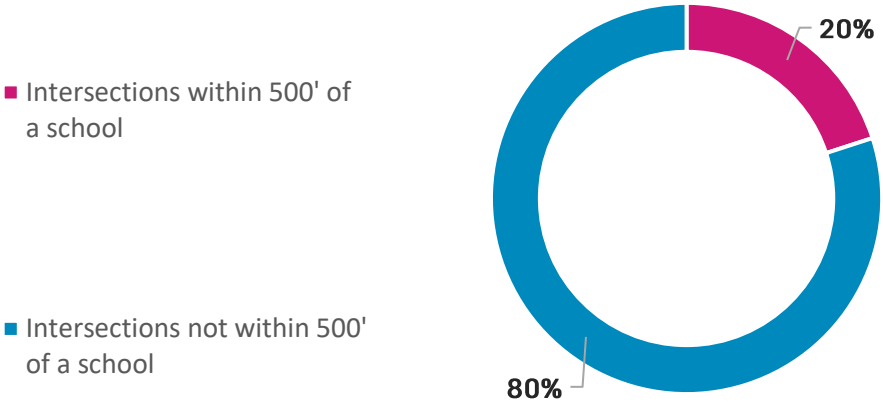
Four in ten students in Philadelphia – between pre-school and 6th grade – walk to school.



Source: The School District of Philadelphia Surveys

FIGURE 15.
INTERSECTIONS NEAR* A SCHOOL AS A PERCENT OF ALL INTERSECTIONS IN PHILADELPHIA

One in five intersections is within 500' of a school in Philadelphia.

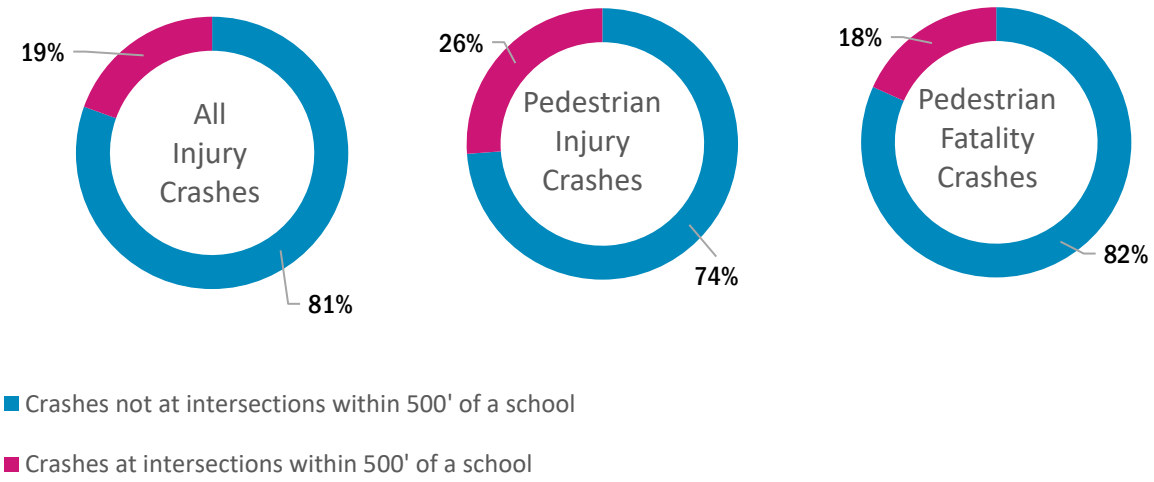


Source: The School District of Philadelphia Surveys

FIGURE 16.
PERCENT OF CRASHES AT INTERSECTIONS NEAR SCHOOLS*, 2014-2018

Pedestrian injury and fatality crashes occurred more often at intersections near schools.

** Intersections were considered near a school if it was within 500'*



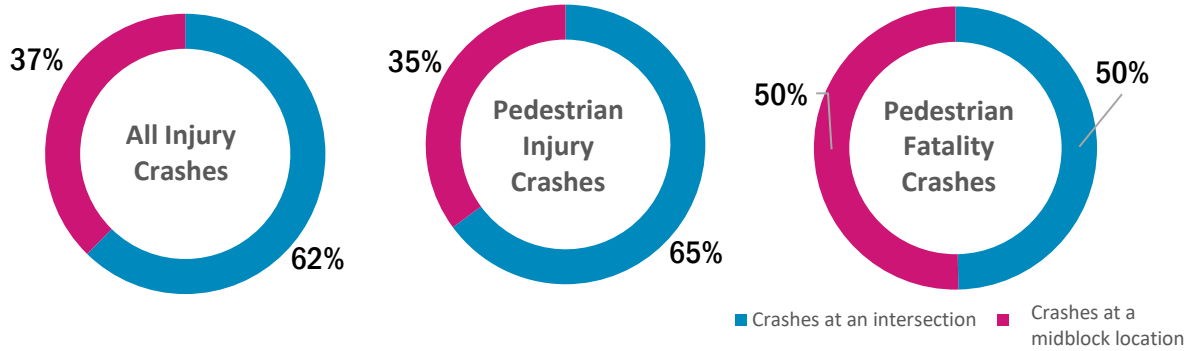
Source: PennDOT Crash Tables, 2014-2018

At Intersections & the Midblock

Overall, most crashes occurred at intersections, but pedestrian fatality crashes are overrepresented at the midblock (50.3%), compared to all injury (37%) and pedestrian injury crash groups (35%). This suggests a corridor-wide approach to address pedestrian fatalities may be needed, while design interventions at intersections may better target pedestrian injury crashes. Figure 17. shows that pedestrian fatality crashes occur much more often at midblock locations (not at intersections).

FIGURE 17.
PERCENT OF CRASHES AT INTERSECTION AND MIDBLOCK (NOT AT INTERSECTIONS) LOCATIONS, 2014-2018

Pedestrian fatality crashes occur more often at midblock locations than at intersections.



Note: approximately 0.2% of records are missing location information. Source: PennDOT Crash Tables, 2014-2018

The **minor contributing factors** of **where** pedestrian crashes occur include:

MINOR CONTRIBUTING FACTORS

Minor contributing factors are crash factors that may be statistically significant but are smaller in magnitude or were demonstrated in fewer types of analysis.

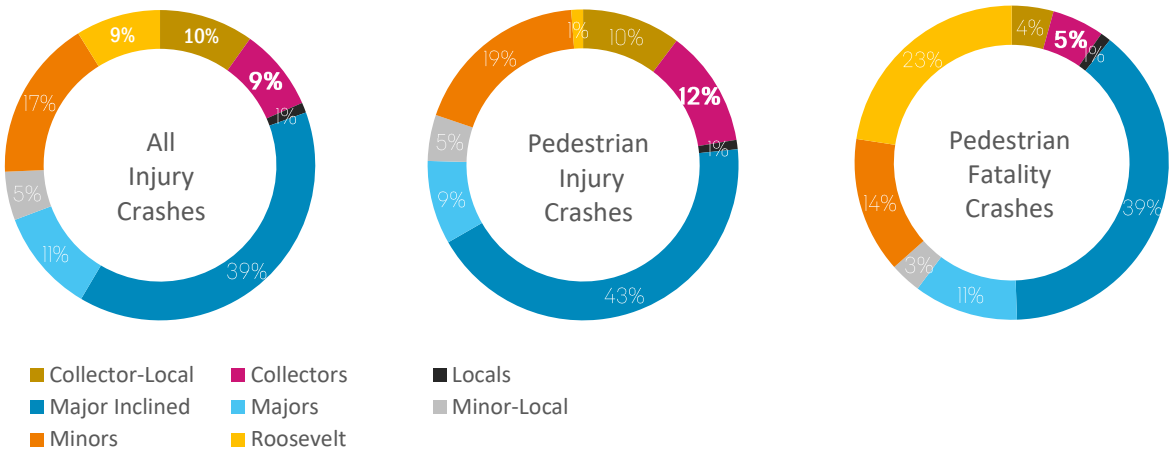
Types of Intersections

Pedestrian injury crashes are more likely to occur at intersections of collector streets, a type of street that features lower speed limits than an arterial but typically higher traffic volumes and speed limits than local streets *p**.[22] Collector street intersections make up about 13% of all intersections in Philadelphia. To learn more about collectors, intersection types, and functional classification, see the sidebar. Figure 18. shows the percent of crashes at different types of intersections.

[22] The relationship between incidence of pedestrian injury crashes and crashes occurring at Collector intersections was statistically significant (the *p* value was less than 5%).

FIGURE 18.
PERCENT OF CRASHES AT COLLECTOR INTERSECTIONS, 2014-2018

Pedestrian injuries are overrepresented at intersections where collectors meet.



Source: PennDOT Crash Tables, 2014-2018

Crosswalks

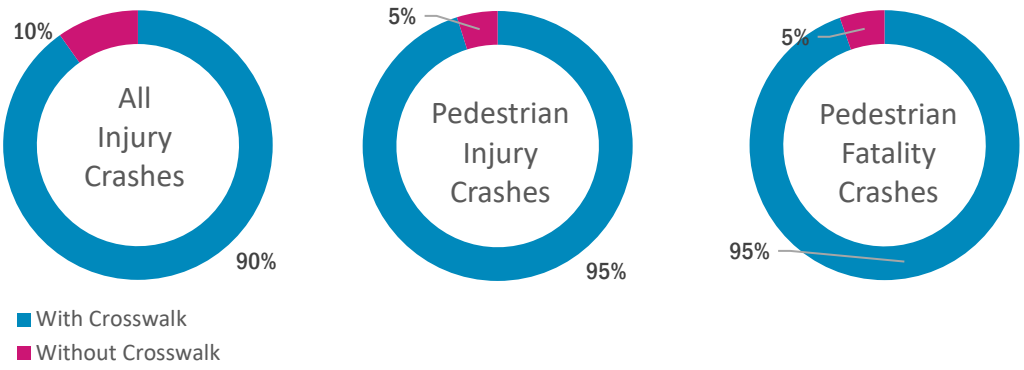
Pedestrian injury crashes are more likely to occur in intersections with marked crosswalks p*,[23] which is consistent with their installation in locations where there is higher pedestrian activity. Conversely, pedestrians struck in a marked crosswalk have less severe injuries p*.[24] Figure 19. shows the percent of crashes that occur at intersections with crosswalks. Pedestrian injury crashes (crashes that result one or more pedestrian injury) and pedestrian fatality crashes (crashes that result one or more pedestrian death) occur more often at intersections with crosswalks than all injury crashes.

Signal or Stop Sign

Intersection pedestrian fatality crashes are overrepresented at intersections with traffic signals (74.5% occur there, 25.5% occur at intersections with stop signs). By comparison, 63.9% of all injury crashes and 67.7% of pedestrian injury crashes occur at signalized intersections. Figure 20. shows the percent of crashes that occur at signalized versus stop sign intersections. Pedestrian injury crashes (crashes that result one or more pedestrian injury) and pedestrian fatality crashes (crashes that result one or more pedestrian death) occur more often at intersections with traffic signals.

[23] The relationship between incidence of pedestrian injury crashes and crashes occurring at intersections with marked crosswalks was statistically significant (the *p* value was less than 5%).
[24] The relationship between the severity of pedestrian injuries and crashes occurring at intersections with marked crosswalks was statistically significant (the *p* value was less than 5%).

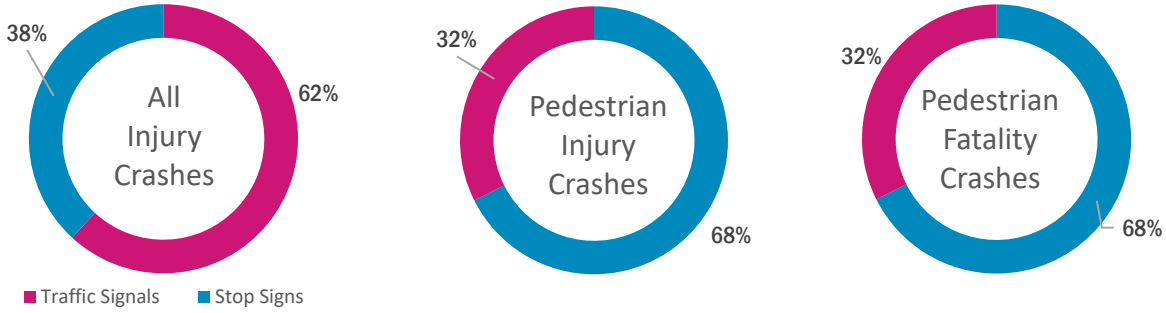
FIGURE 19.
PERCENT OF CRASHES AT INTERSECTIONS WITH CROSSWALKS, 2014-2018
Pedestrian injury and fatality crashes occur more often at intersections with crosswalks.



** Intersections classified as "intersections with crosswalks" either contain a crosswalk or are within 20' of a crosswalk*

Source: PennDOT Crash Tables, 2014-2018; City of Philadelphia, Crosswalk shapefile

FIGURE 20.
PERCENT OF CRASHES AT STOP SIGNS AND SIGNALIZED INTERSECTIONS, 2014-2018
Pedestrian injury and fatality crashes occurred more often at signalized intersections.



Source: PennDOT Crash Tables, 2014-2018; City of Philadelphia, Traffic Signals shapefile and Stop Signs shapefile

Functional Classifications, Intersection Types & Complete Streets Types

Functional Classification is the organization and hierarchy of the road network.(footnote) The City of Philadelphia's Streets Department defines five main street classifications:

- **Expressways:** expressways are separated and access-controlled roadways designed for mobility and long-distance travel. Expressways do not include or allow pedestrian access and are not included in this Plan. Interstate 676 and Roosevelt Boulevard are examples of expressways in Philadelphia.
- **Major Arterials:** major arterials serve the major centers of a metropolitan area. Unlike expressways, major arterials include pedestrian amenities (like sidewalks) and land uses directly abut the roadway. Broad Street or Market Street are examples of major arterials in Philadelphia.
- **Minor Arterials:** minor arterials serve smaller geographic areas within a metropolitan area and focus on connecting major arterials. South Street and Frankford Avenue are examples of minor arterials in Philadelphia.
- **Collectors:** collectors gather traffic from local roads and funnel them to the arterial network. Ridge Avenue and Locust Street are examples of collectors in Philadelphia.
- **Local**: local roads are not designed for long distance travel and are intended to serve final origins or destinations. Local roads are often designed to discourage through traffic. Small alley streets such as Camac Street or Bouvier Street make up much of Philadelphia's street network.

Intersection Types translate functional classification to each intersection in Philadelphia. Each intersection is classified into eight types:

- **Majors:** Major intersections are the intersection of mostly major arterials. Less than 600 intersections in Philadelphia (3%) are considered Major intersections. The intersection of N Broad Street and Spring Garden Street is considered a Major intersection.
- **Major Inclined:** Major Inclined intersections are the intersection of a major arterial and a minor arterial or a collector. Less than 3,500 intersections in Philadelphia (15%) are considered Major Inclined intersections. The intersection of Lehigh Avenue and Front Street is considered a Major Inclined Intersection.
- **Minors:** Minor intersections are the intersection of mostly minor arterials. More than 1,600 intersections in Philadelphia (7%) are considered Minor intersections. The intersection of Woodland Avenue and S 49th Street is considered a Minor intersection.
- **Minor-Local:** Minor-Local intersections are the intersection of minor arterials and local roads. Approximately 2,000 intersections in Philadelphia (9%) are considered Minor-Local intersections. Intersections of Poplar Street, which is a minor arterial, and the local roads along it – N 23rd Street or N Beechwood Street, for example – would be considered Minor-Local intersections.

Functional Classifications, Intersection Types & Complete Streets Types *(continued)*

- **Collectors:** Collector intersections are the intersection of collectors. About 3,000 intersections in Philadelphia (13%) are considered Collector intersections. The intersection of 40th Street and Powelton Avenue is considered a Collector intersection.
- **Collector-Local:** Collector-local intersections are the intersection of collectors and local roads. About 7,800 intersections in Philadelphia (34%) are considered Collector-Local intersections. Intersections of Wissahickon Avenue, which is a major collector, and local roads along it – W Price Street and W Stafford Street, for example – would be considered Collector-Local intersections.
- **Alleys:** Alley intersections are the intersection of two local roads. About 4,400 intersections in Philadelphia (19%) are considered Alley intersections.
- **Roosevelt Boulevard:** Intersections along Roosevelt Boulevard were considered their own intersection type due to the unique design of the roadway. Roosevelt Boulevard contains four roadways: two express roadways that run through the center of the Boulevard, and two local roadways that run on the outside of the Boulevard. The number of lanes within each roadway varies, and the roadway often includes separated turn lanes at larger intersections. At different points along the Boulevard, the grade changes for the express or local roadways. There are 132 intersections on Roosevelt Boulevard in Philadelphia (0.6%).

Complete Streets Types are a set of street "types" developed by the City of Philadelphia in the *Complete Streets Handbook*, released in 2013. The different Complete Streets Types describe the existing and future street design of all streets in Philadelphia. The street type considers the existing context, constraints, and significance to all modes. There are eleven Complete Street Types:

- High-Volume Pedestrian
- Civic/Ceremonial Street
- Walkable Commercial Corridor
- Urban Arterial
- Auto Oriented Commercial/Industrial
- Park Road
- Scenic Drive
- City Neighborhood
- Low-Density Residential
- Shared Narrow
- Local

What is the difference between Functional Classification, Intersection Types, and Complete Streets Typologies?

- **Functional Classification** describes the hierarchy of the road network. The categories – arterial, collector, local – are based on the Federal Highway Administration's national guidance and definitions. The Functional Classification of any roadway is related to the volume and speed of vehicles.
- **Intersection Types** describes the hierarchy of intersections in the road network. The categories – Major, Collector, Alleys – are based on the Functional Classification of the roads that intersect.
- **Complete Streets Types** are a set of street types – Urban Arterials, Walkable Commercial Corridors, City Neighborhood – developed by the City of Philadelphia that describe existing street context and preferred future street designs. All streets in Philadelphia have a Complete Streets Type. Unlike Functional Classification, Complete Streets Types include qualitative features such as the existing context, land use, and the significance of each street for different modes.

Crashes on Roosevelt Boulevard

Roosevelt Boulevard is a unique corridor in Philadelphia. It is a divided highway with two express lanes and two local lanes in each direction, creating large intersections with complex geometries. Between 2014 and 2018, 31 pedestrians were fatally injured, making Roosevelt Boulevard the city's most lethal corridor for pedestrians. The high number of pedestrian fatalities on the Boulevard make it a primary focus for this analysis.

ON ROOSEVELT BOULEVARD:

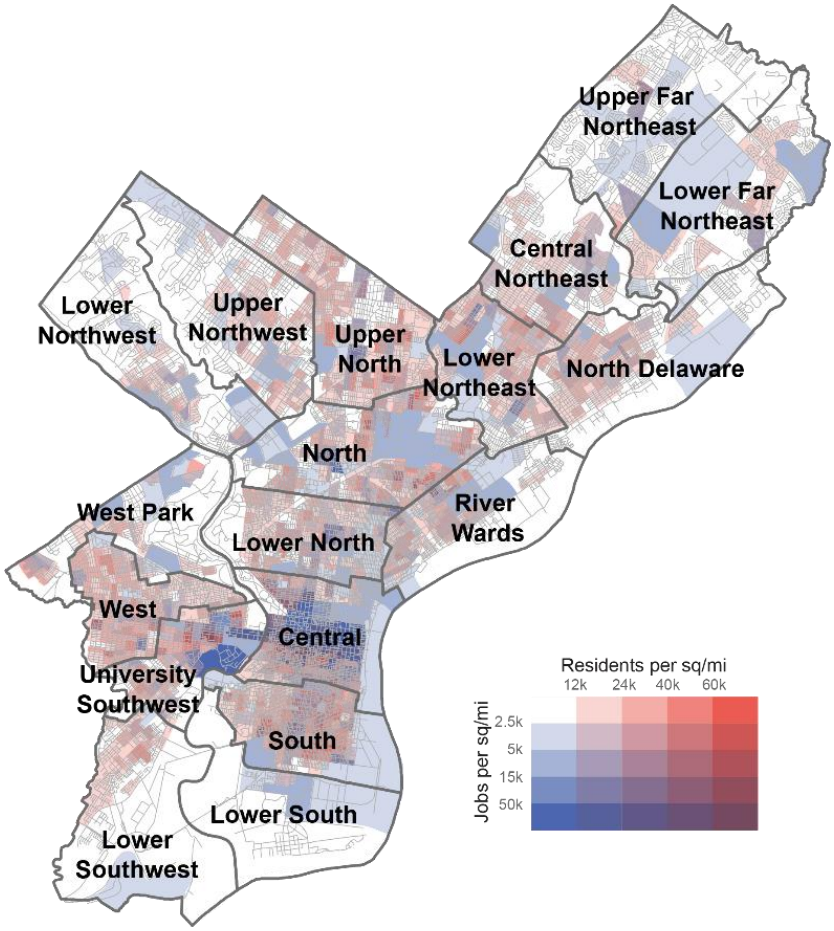
- Almost a quarter of all pedestrians killed at intersections in Philadelphia were crossing Roosevelt Boulevard or its cross-streets (22%). By comparison, Roosevelt Boulevard only contains 0.6% of the city's intersections.
- Pedestrian injury and fatality crashes are much more likely to occur on Roosevelt Boulevard compared to other city streets *p**.
- Pedestrian injury crashes are more likely to be severe *p**.
- Injury crashes and pedestrian fatality crashes are clustered along Roosevelt Boulevard.

Accounting for Activity

Safety research tries to distinguish between high numbers of crashes due to specific factors and high numbers of crashes simply because more crashes are occurring in an area due to high volumes of people and vehicles. Where there are high volumes of pedestrians, there are more pedestrian crashes. The greater the number of pedestrians is present in an area, the higher the likelihood of conflict with motor vehicles. Due to the lack of volume data at a city-wide level, this analysis focusing on accounting for levels of activity using residential and employment density. Figure 21. depicts the employment and residential activity by census block group, with the highest levels of activity shown the darkest shades of red, blue, and purple.

FIGURE 21.
RESIDENTIAL DENSITY AND EMPLOYMENT IN PHILADELPHIA

The highest density of activity (residential and/or employment) is located in Center City, West Philadelphia, North Philadelphia, and South Philadelphia



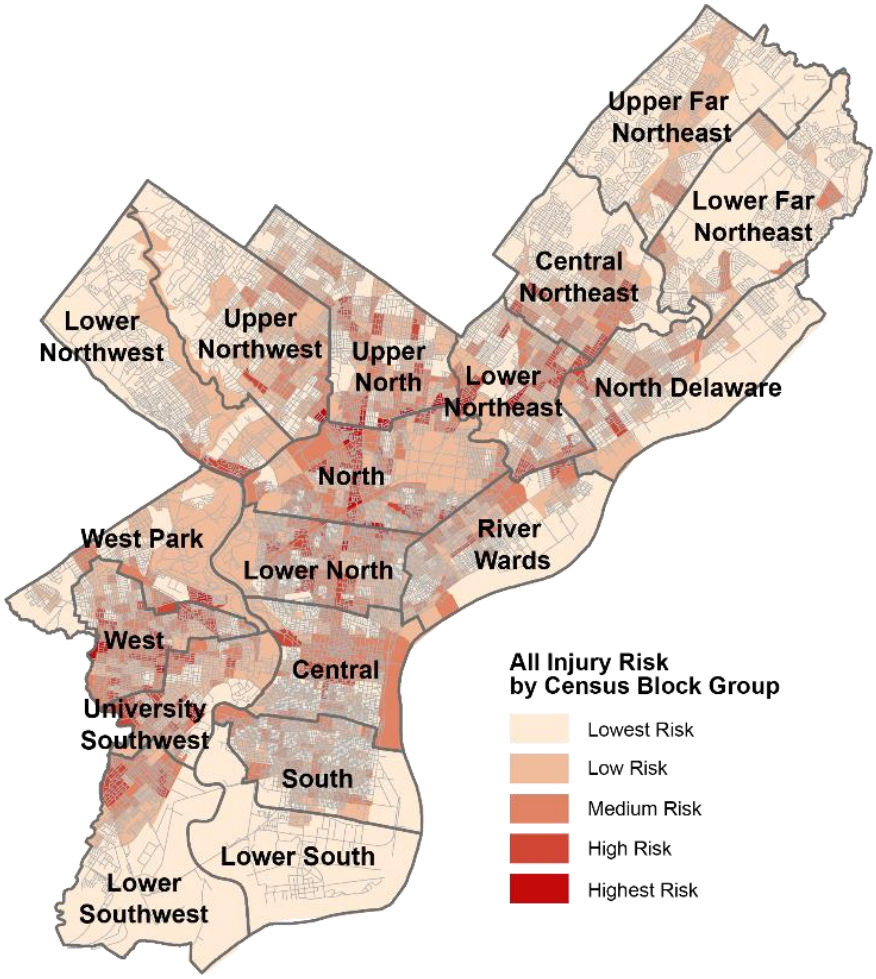
Source: U.S. Census Bureau block groups 2010; Philadelphia City Planning Commission districts; Philadelphia Activity Index (SEPTA)

In this analysis, a composite activity score (residential density + employment density at the Census block group level) serves as a proxy for pedestrian and vehicle volume data. The sum of all crashes in each block group is divided by the land area and composite activity score and then mapped, with darker red spots indicating a higher concentration of crashes. The resulting maps helps illustrate where crashes are truly concentrated or overrepresented, not just where lots of people are walking and driving.

Figure 22. shows the risk of all injury crashes by census block group. The analysis of all injury crashes demonstrates high concentrations of all injury crashes in neighborhoods along major corridors such as Broad Street, Roosevelt Boulevard, and areas of West Philadelphia.

FIGURE 22.
RISK OF INJURY CRASHES BY CENSUS BLOCK GROUP, 2014-2018

The highest risk of injury crashes is located on Broad Street, Roosevelt Boulevard, and areas of West Philadelphia

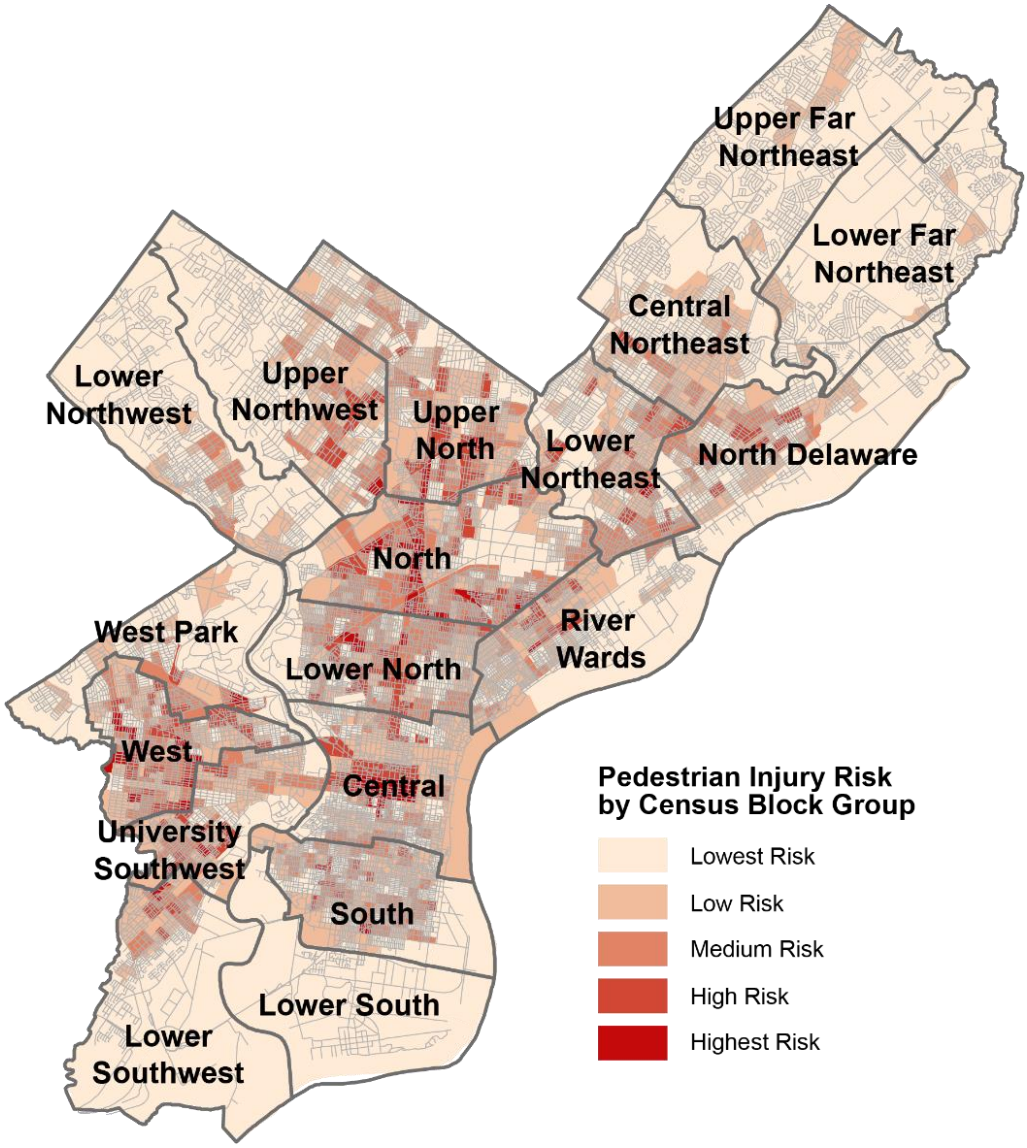


Source: PennDOT Crash Tables, 2014-2018; U.S. Census Bureau block groups; Philadelphia City Planning Commission districts; Philadelphia Activity Index (SEPTA)

Figure 23. below shows the risk of pedestrian injury crashes by census block group. Among pedestrian injury crashes, high crash concentrations are present in higher activity areas such as Center City, North Broad, West Philadelphia neighborhoods near Market Street, and the Fairhill/Kensington neighborhoods near Allegheny Avenue.

FIGURE 23.
RISK OF PEDESTRIAN INJURY CRASHES BY CENSUS BLOCK GROUP, 2014-2018

The highest risk of pedestrian injury crashes is located in Center City, North Broad, West Philadelphia neighborhoods near Market Street, and the Fairhill/Kensington neighborhoods near Allegheny Avenue

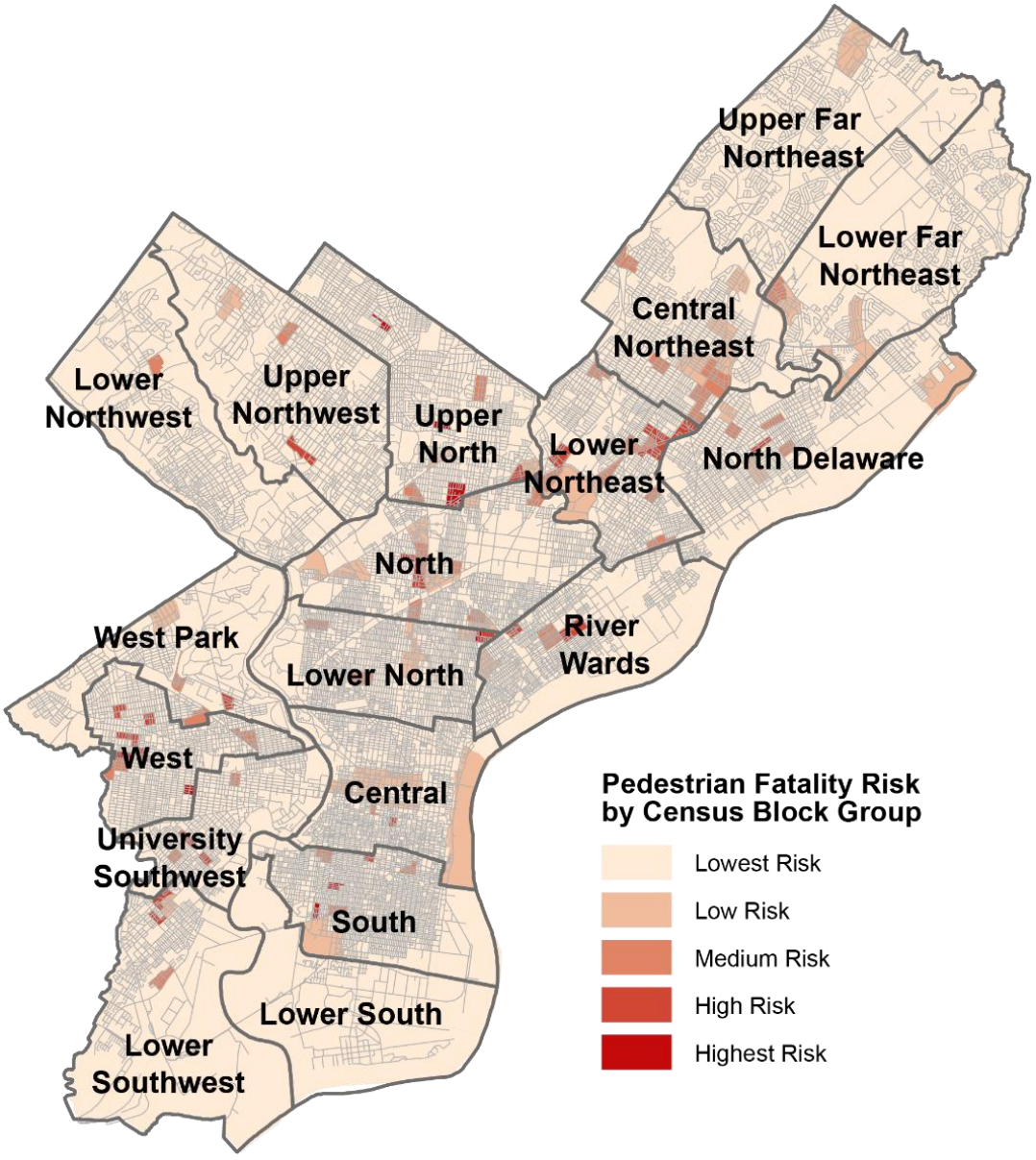


Source: PennDOT Crash Tables, 2014-2018; U.S. Census Bureau block groups; Philadelphia City Planning Commission districts; Philadelphia Activity Index (SEPTA)

Figure 24. shows the risk of pedestrian fatality crashes by census block group. Among pedestrian fatality crashes, high concentrations of crashes when normalized by area and combined activity index are somewhat dispersed across the city. However, there are several clusters on North Broad, Lehigh Avenue, and Roosevelt Boulevard.

FIGURE 24.
RISK OF PEDESTRIAN FATALITY CRASHES BY CENSUS BLOCK GROUP, 2014-2018

The highest risk of pedestrian fatality crashes is scattered through the city, but is present in clusters on North Broad, Lehigh Avenue, and Roosevelt Boulevard



Source: PennDOT Crash Tables, 2014-2018; U.S. Census Bureau block groups; Philadelphia City Planning Commission districts; Philadelphia Activity Index (SEPTA)

WHEN

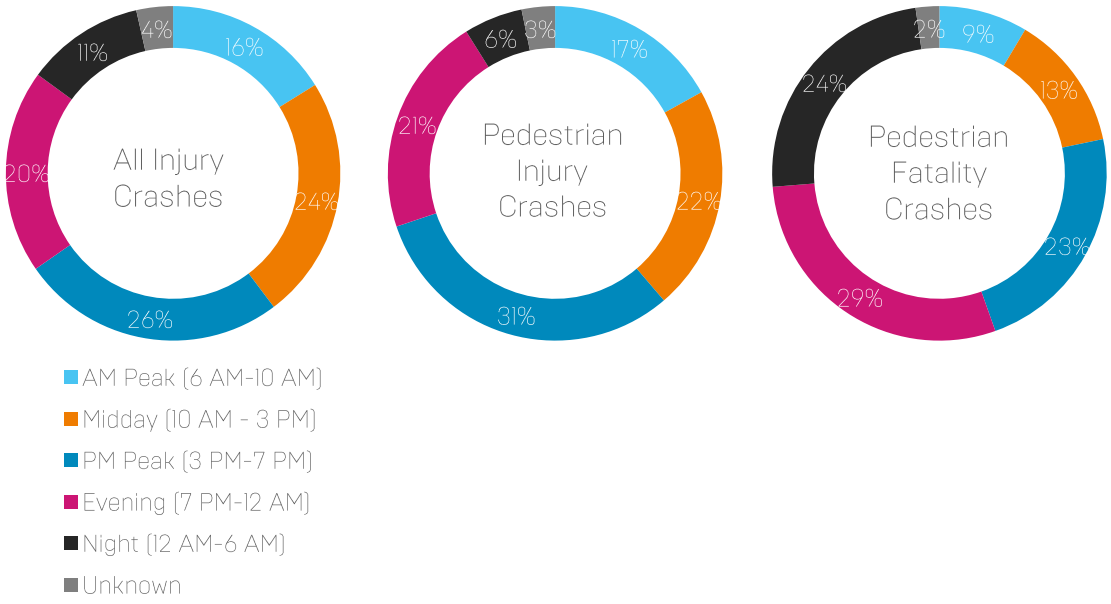
Pedestrians were more likely to be hit and injured or killed at night in Philadelphia. **Major contributing factors** to **when** pedestrian crashes occur include:

Nights and Evenings

Pedestrians were more likely to be hit and injured or killed at night p*.25 For all injury crashes in Philadelphia, most crashes occur during the midday and PM Peak (between 10 AM and 7 PM). Pedestrian injury and fatality crashes are different. Pedestrian injury crashes occur disproportionately in the PM Peak (3 PM and 7 PM) and pedestrian fatality crashes occur disproportionately in the evening and night periods (7 PM – 6 AM). Figure 25. shows the time period that crashes occurred for all injury crashes (crashes that resulted in an injury), pedestrian injury crashes (crashes that resulted in a pedestrian injury), and pedestrian fatality crashes (crashes that result in a pedestrian fatality).

FIGURE 25.
PERCENT OF CRASHES BY TIME PERIOD, 2014-2018

Pedestrian fatalities were overrepresented at evening and nighttime.



Source: PennDOT Crash Tables, 2014-2018

[25] The relationship between incidence of pedestrian injury crashes, incidence of pedestrian fatality crashes, the severity of pedestrian injury and crashes occurring at night (12 AM-6 AM) was statistically significant (the *p* value was less than 5%).

HOW

Pedestrians faced higher risks from speeding, turns, automobiles, and hit and run drivers in Philadelphia between 2014 and 2018. The **major contributing factors** of **how** crashes occurring include:

Speeding

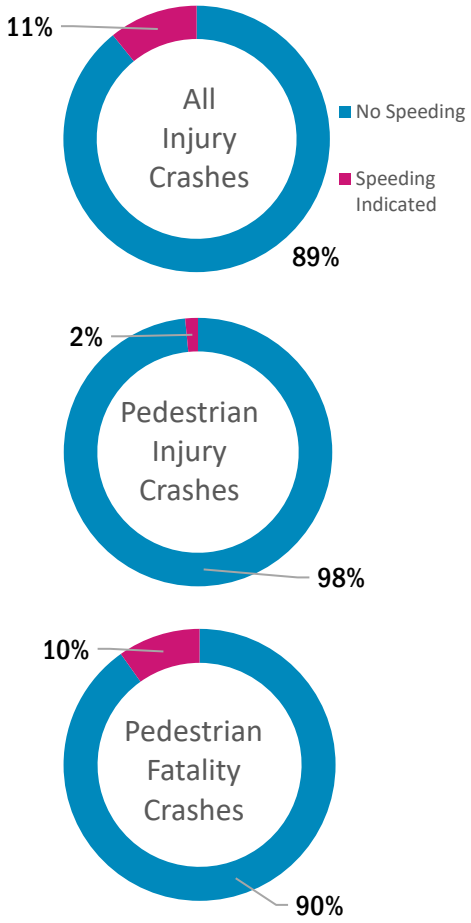
At intersections, speeding is overrepresented in pedestrian fatality crashes (9.8% of pedestrian fatality crashes but only 1.5% of pedestrian injury crashes). Figure 27. shows the percent of crashes where a speeding vehicle is involved.

FIGURE 26.
IMPACT OF SPEEDS ON PEDESTRIANS

Source: City of Philadelphia, Office of Transportation, Infrastructure, and Sustainability Vision Zero PHL Website

Speeding increases the likelihood of pedestrian fatality crashes occurring and the injury severity of a pedestrian crash *p**.[26] This finding is consistent with a large body of research that shows the chance of a pedestrian dying when hit by a car increases exponentially as speed increases, even when the speed of the car increases linearly. Figure 26. is from the City of Philadelphia's Vision Zero campaign that shows the relationship between speed and pedestrian injury.

FIGURE 27.
PERCENT OF CRASHES INVOLVING A SPEEDING VEHICLE, 2014-2018
One in ten pedestrian fatality crashes involves a speeding vehicle



Source: PennDOT Crash Tables, 2014-2018

[26] The relationship between incidence of pedestrian fatality crashes and crashes where speeding was a contributing factor was statistically significant (the *p* value was less than 5%). The relationship between severity of pedestrian injury and crashes where speeding was a contributing factor was also statistically significant.

Turning Movements

Left turns at intersections were involved in 35.2% of pedestrian injury crashes and 14.0% of pedestrian fatality crashes (compared to 3.2% for right turns and 78% for straight through movements). See Figure 28. below for comparison of vehicle movements among crash groups. Results included both one-way and two-way streets. Left turns at intersections with two-way streets, especially without protected left-turn signals, can create decreased ability for the driver to see a pedestrian crossing due to cross traffic and the size of the intersection, until they are already mid-turn and potentially increasing their speed to avoid being hit by oncoming vehicles.

Right turns at intersections were involved in 11.0% of pedestrian injury crashes and only 3.2% of pedestrian fatality crashes. Results included both one-way and two-way streets. Pedestrian injury severity decreased slightly with left and right turns *p**,[27] consistent with slowed speeds as drivers make turns.

Hit & Runs

Over a quarter of all pedestrian injury and fatality crashes were hit and run crashes (27.2% and 28.9% respectively), compared to just 9.8% of all injury crashes. Figure 29. shows the percent of hit and runs for all injury crashes (crashes that resulted in an injury), pedestrian injury crashes (crashes that resulted in a pedestrian injury), and pedestrian fatality crashes (crashes that result in a pedestrian fatality).

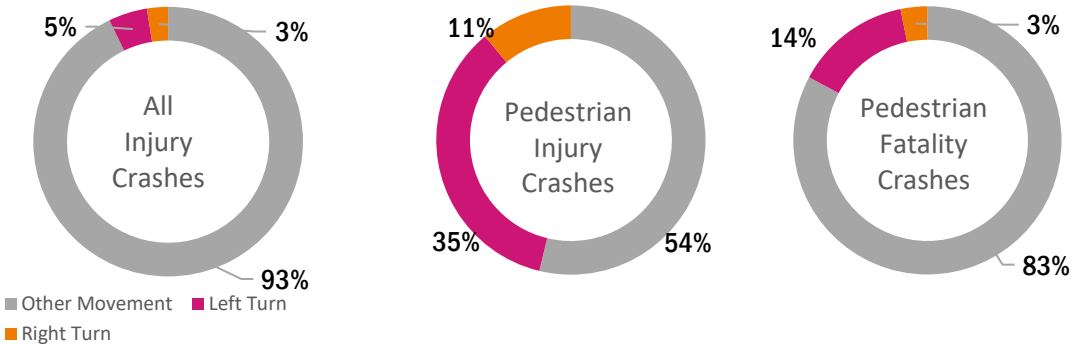
Striking Vehicle Type

Over half of all pedestrian fatality, pedestrian injury, and all injury crashes are caused by automobiles (51.1%, 57.1%, and 59.4%, respectively). The size and weight of a vehicle is related to the severity of the injury (larger/heavier vehicles can cause more severe injuries) and the large size of buses plays an important role in explaining why pedestrian fatalities involving a striking bus are overrepresented compared to pedestrian injury crashes (11.7% of pedestrian fatality crashes involved a striking bus compared to 2.0% of pedestrian injury crashes). Figure 30. shows the breakdown of striking vehicle type for all injury crashes (crashes that resulted in an injury), pedestrian injury crashes (crashes that resulted in a pedestrian injury), and pedestrian fatality crashes (crashes that result in a pedestrian fatality).

[27] The relationship between the severity of pedestrian injuries and crashes where the striking vehicle was turning left, or right was statistically significant (the *p* value was less than 5%).

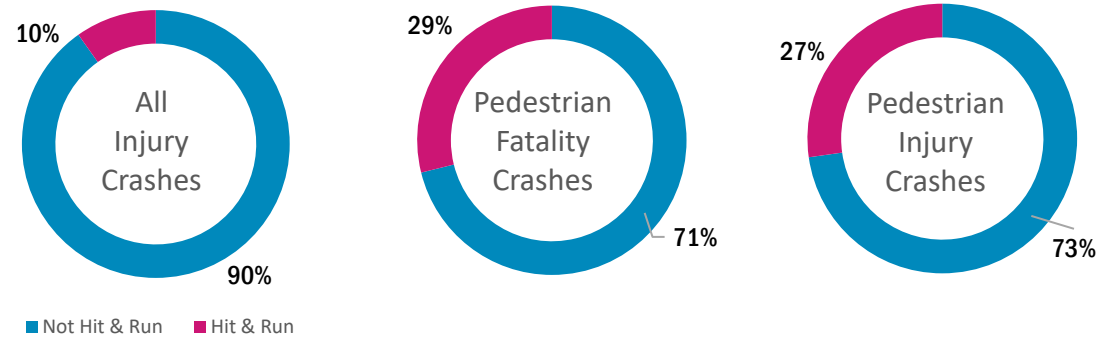
FIGURE 28.
PERCENT OF CRASHES BY VEHICLE MOVEMENT, 2014-2018

Left turns and right turns were overrepresented in pedestrian injury crashes



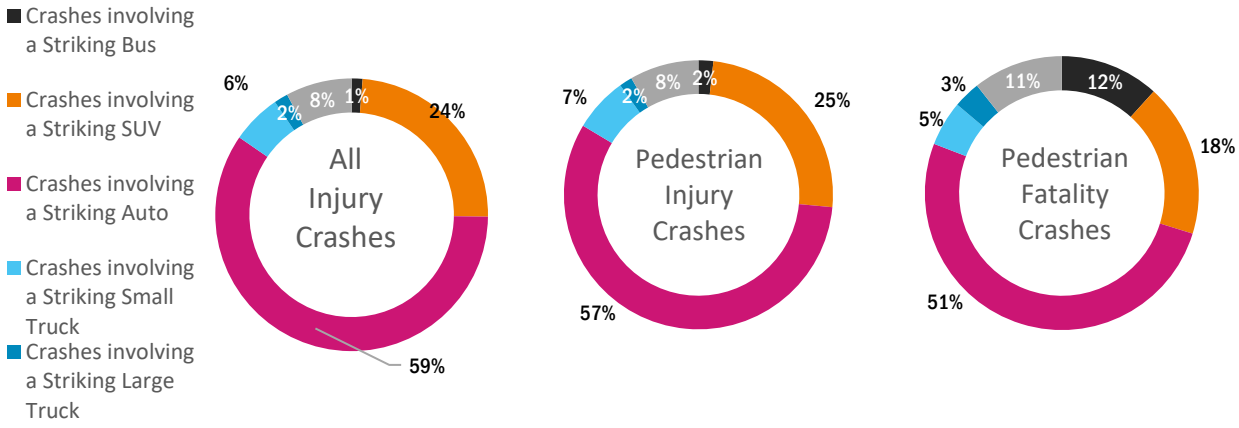
Source: PennDOT Crash Tables, 2014-2018

FIGURE 29.
PERCENT OF CRASHES INVOLVING A HIT AND RUN VEHICLE, 2014-2018
Hit and runs were almost three times more common in pedestrian injury and fatality crashes than in injury crashes (not just pedestrian crashes).



Source: PennDOT Crash Tables, 2014-2018

FIGURE 30.
PERCENT CRASHES BY STRIKING VEHICLE, 2014-2018
Over half of all pedestrian fatality, pedestrian injury, and all injury crashes are caused by automobiles



WHO

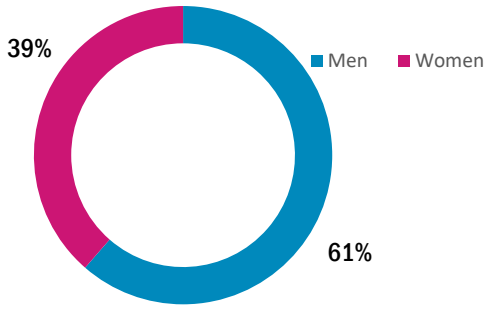
Male Drivers

Men are driving the striking vehicle more than 60% of the time in injury crashes. Male drivers ages 20-29 are the largest share of drivers of striking vehicles in injury crashes. Male drivers ages 20-29 are more also likely to cause more severe pedestrian crashes *p**.[28]

FIGURE 31.
PERCENT OF STRIKING VEHICLE DRIVERS IN INJURY CRASHES, BY SEX, 2014-2018

Male drivers are much more likely to be driving the striking vehicle in an injury crash

Source: PennDOT Crash Tables, 2014-2018



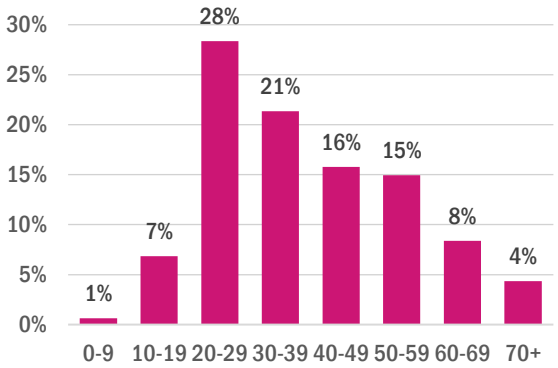
Over 50 years of Age

Individuals over 50 years old were overrepresented in pedestrian fatality crashes and children 10-19 were overrepresented in pedestrian injury crashes, compared to their city population share (see Figure 33. for city population and 0 on page 46 for the age ranges of people injured in crashes).

[28] The relationship between the severity of pedestrian injuries the driver of the striking vehicle being male and between the ages of 20-29 was statistically significant (the *p* value was less than 5%).

FIGURE 32.
PERCENT OF MEN DRIVING STRIKING VEHICLES IN INJURY CRASHES, BY AGE, 2014-2018

Male drivers ages 20-29 were behind the wheel of the striking vehicle in more injury crashes than any other age group

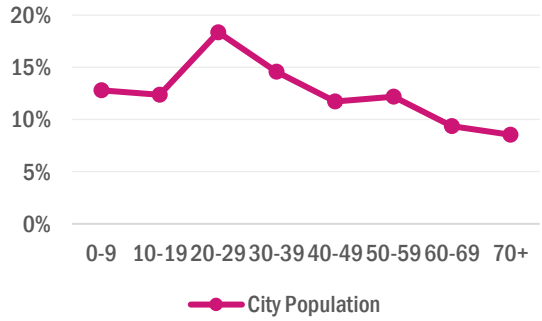


Disclaimer: Data may include incorrectly coded/reported age data and a small number of children gaining access to vehicles for fun.

Source: PennDOT Crash Tables, 2014-2018

FIGURE 33.
PHILADELPHIA POPULATION BY AGE, AVERAGED FROM 2014-2018

People ages 20-29 and 30-29 make up the largest share of Philadelphia's population



Source: PennDOT Crash Tables, 2014-2018

Not Normal Crashes

"Not normal" crashes are more fatal for pedestrians. Crashes are considered "not normal" if they involve people who were under the influence of alcohol or drugs, having a medical emergency, or were fatigued. Ten times more pedestrians were killed by "not normal" drivers than passengers (90.5% pedestrians, 9.5% passengers, and no drivers), see Figure 35. below. 40% of the "not normal" people killed in crashes were pedestrians, compared to 33.3% of drivers, and 26.7% of passengers, as shown in Figure 37 below. Approximately 8% or 2,694 of all injury crashes were flagged as "not normal."

FIGURE 34.
PERCENT OF PEOPLE INJURED IN CRASHES BY AGE, 2014-2018

Those over 50 and under 19 were overrepresented compared to their city population share

Source: PennDOT Crash Tables, 2014-2018

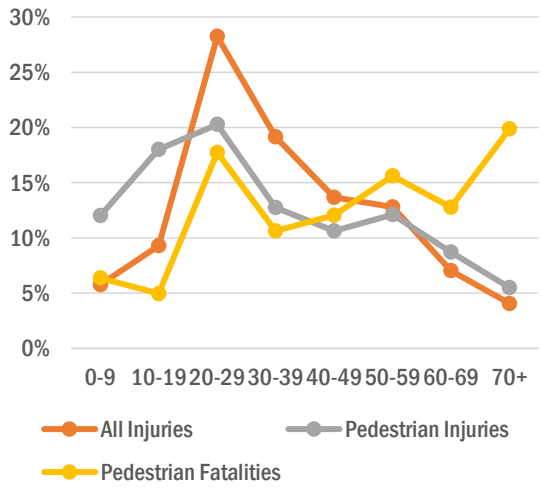
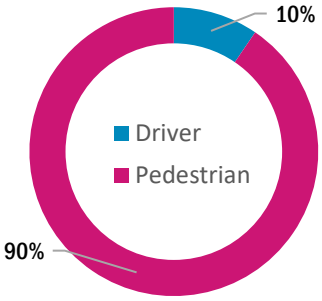


FIGURE 35.
PERCENT OF PEOPLE KILLED BY "NOT NORMAL" DRIVERS

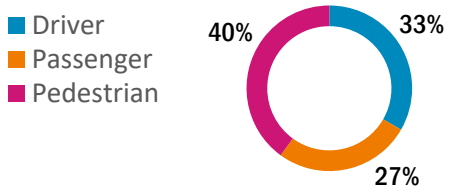
Ten times as many pedestrians are killed by "not normal" drivers



Source: PennDOT Crash Tables, 2014-2018

FIGURE 36.
PERCENT OF "NOT NORMAL" PEOPLE KILLED IN CRASHES

Pedestrians made up the highest percentage of "not normal" people killed in crashes



Source: PennDOT Crash Tables, 2014-2018

Other Factors

Many tested factors did not have a strong relationship to pedestrian injuries or fatalities. These factors included wet roads, bad weather, curved roadways, the presence of a driveway, the proximity of a park, and vehicle failure. See Appendix E for full details and charts for all factors analyzed.

Youth Pedestrian Crashes

Methods

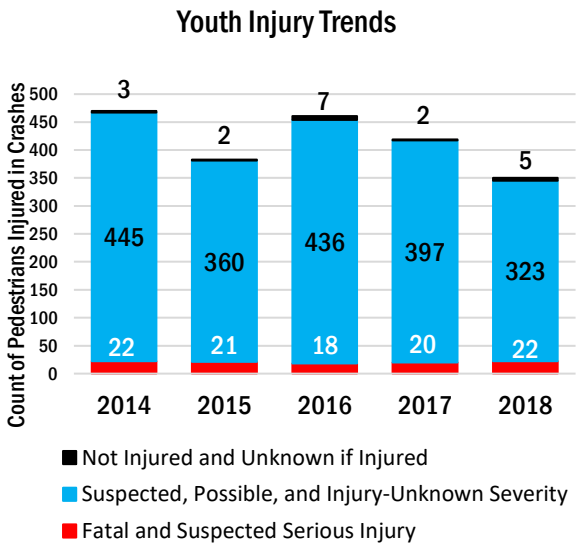
As part of the Vision Zero for Youth Demonstration Project (see Introduction for more details), the Pedestrian and Bicycle Information Center (PBIC) examined crashes among children and youth under 18 years of age (termed "youth" for the remainder of this section) occurring for the five year period of 2014-2018 using the same crash data set as was used for this report. The results presented here are descriptive and are based on cross-tabulations and spatial analyses (using buffer and density methods) to identify potential high-occurrence factors associated with youth pedestrian crashes and severity outcomes. Analyses examining both a crash-level factor (e.g. time or light conditions) and injury severity counted crashes and used the most severely injured youth pedestrian in the crash if there were differences in severity of injuries received.

Findings

Pedestrian crash trends among Philadelphia youth

- Of the 8,024 crashes involving pedestrians of all ages, 2,009 crashes, an average of about 25 percent of the total, appeared to involve one or more youth pedestrians. Both youth-involved pedestrian crashes and total youth pedestrian crashes decreased between 2016 and 2018 but youth serious and fatal injury crash numbers stayed relatively the same.
- A total of 2,083 young pedestrians were involved in the 2,009 collisions because multiple pedestrians were struck in some crashes.
- Five percent of young pedestrians who were struck were killed or suspected seriously injured. Evidence from studies linking police-reported injury data with medical data sources suggest, however, that pedestrians who are initially suspected of having minor, possible or unknown severity of injuries may later die or have serious injuries, even if not suspected to be serious at the time of the crash. Therefore, these fatal and serious injury rates may be underestimates.

FIGURE 37.
PEDESTRIANS UP TO AGE 17 AND REPORTED INJURY SEVERITY IN PHILADELPHIA, 2014-2018.



WHO

- Among youth, most crashes are occurring among 5 - 9-year olds
- Children in the age groups of 10 to 13 and 14 to 17 also are involved in a substantial number of pedestrian crashes.

TABLE 3.
DISTRIBUTION OF CHILD PEDESTRIAN CRASHES ACROSS AGE GROUPS, 2014-2018.

Age Group	Total	
1 to 4	303	14.5%
5 to 9	669	32.1%
10 to 13	554	26.6%
14 to 17	557	26.7%
Total	2083	100.0%

WHEN

- Youth are more likely to be in collisions on weekday afternoons (3 - 6 pm) during fall and spring months. Combined with the second-most common time, 6 – 9 pm weekdays, these time periods account for 45 percent of youth crashes. These patterns point to a potential link to injuries related to the school trip but could also be related to activities afterschool or neighborhood crashes.
- While 5 -9-year old children tend to be hit in the afternoon and evening (3 - 6 pm and 6 - 9 pm), older children (10 - 13-year old and 14 - 17-year old) are disproportionately represented in early morning crashes (6 - 9 am).

- In contrast to all-age pedestrian injury crashes, young pedestrians are most likely to be hit during the day, with daylight hours accounting for 74 percent of all youth pedestrian crashes, and 67 percent of all fatal and severe ones. Of course, this is likely the result of the fact that most child pedestrian activity occurs during these daylight hours. However, like all-age pedestrian injury crashes, nighttime crashes among youth have higher average severity than those occurring during the day, accounting for 27 percent of fatal and serious injury crashes but 20 percent of total youth pedestrian crashes.

WHERE

- While all-ages pedestrian crashes most commonly occur at intersections, youth pedestrian crashes are both more frequent (51 percent of all crashes), and more injurious at midblock locations (61 percent of fatal and suspected seriously injured) compared to four-way intersections (38 percent of the total).
- Multi-leg intersections, although accounting for low numbers (less than 2 percent of the total) also appear to be somewhat associated with more serious injuries when crashes occur.

Both of these results may be related to different impact speeds and/or different crash types associated with various location types. Midblock locations most often lack crossing facilities and traffic control, so drivers may not be expecting people to be crossing, and they may be especially difficult to detect at night. Also, crash-related speeds are likely lower at intersections than midblock locations, with lower-speed right-and-left turns, compared to through movements at midblock.

- Youth were less likely than adults to be struck at the intersection of two major arterials (3.5% for youth, compared to 7.5% for adults).
- Youth were less likely to be in a marked crosswalk at an intersection (38% for youth compared to 54% for adults).
- Youth were more likely than adults to be in the road in a travel lane when hit, not at an intersection or crossing (48% of those struck, compared to adults (31%), or at an

intersection with no crosswalk (7% for youth, 4% for adults). It is recognized, however, that an officer's designation of crosswalk may not always be accurate, additionally this does not provide insights into the presence of traffic signal in addition to the crosswalk.

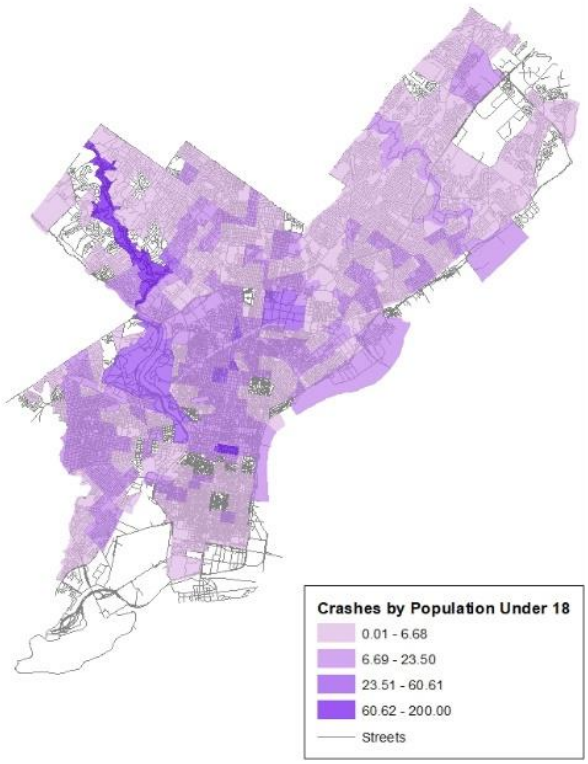
- Children ages 5 – 9 were most likely to be hit in the road compared to other age groups and older kids (age groups 10-13 and 14-17) were more likely to be hit at intersections.

These relationships, including the frequency of midblock collisions, may be a function of the types of streets where youth are most often walking, such as in neighborhoods near schools compared to more urban employment and commercial centers, where adults may do more walking. These circumstances could also reflect youth pedestrian activities just prior to the crash - for example, children may be more likely to be playing in or standing in the street socializing than adults prior to a crash. These are speculations only, as we have no data or observations on pedestrian activity by age. **The takeaway is that there may be some divergence in countermeasures or location types where treatments are most needed to prevent youth crashes compared to adult crashes.**

Spatial Analysis of Youth Pedestrian Crashes

In order to identify locations and areas where pedestrian crashes have been most prevalent, PBIC began exploring the spatial distribution of youth pedestrian crashes using simple spatial kernel density analysis in ARCGIS. This analysis has also included maps associated with census tracts and associated data, school locations, and street network. The results of these analyses can help inform where to target various types of countermeasures. This history can be useful if characteristics of these areas can be shown to be associated with crash and injury potential through further analysis.

FIGURE 38.
MAP OF YOUTH PEDESTRIAN CRASHES (< 18) PER YOUTH POPULATION (< 18).



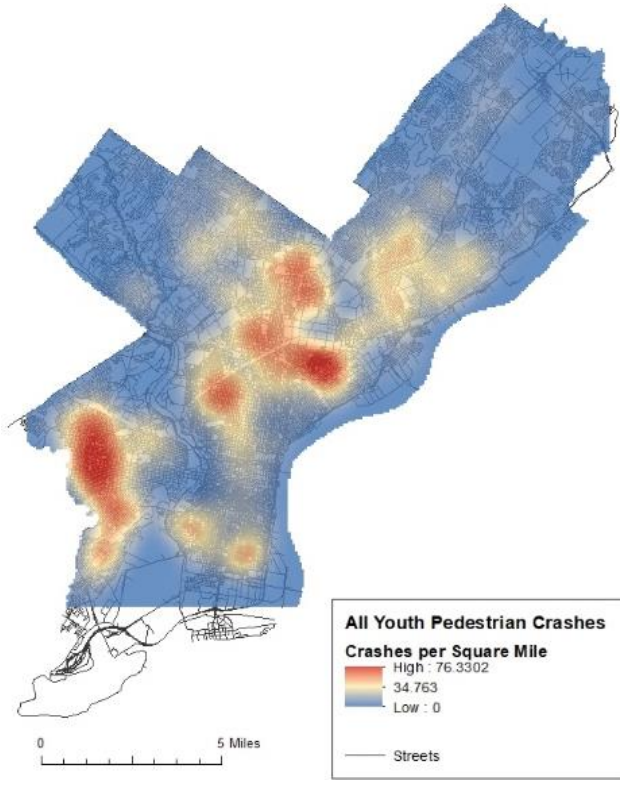


FIGURE 39.
KERNEL DENSITY ANALYSIS OF YOUTH PEDESTRIAN CRASHES, DATA FOR 2014-2018 (N = 2009 CRASHES).

A high rate of pedestrian youth crashes per youth population may signal concerns not identified in frequency-based methods. However, a combination of even relatively low crash frequencies divided by lower population counts in certain tracts could signal 'false' alarms therefore potential patterns require validation by city staff.

HOW

Vehicle movement pre-crash: Motorists traveling essentially straight ahead or slowing in a lane, and other 'straight ahead' maneuvers including actions such as passing, changing lanes/merging, or avoiding objects, were more severe on average than those involving turning maneuvers or backing (results in Table 4). Going straight or slowing in lane accounted for 71 percent of all severity youth crashes, but 82 percent of probable higher injury crashes (fatal or suspected serious injury).

Travel speed, interacting with crash locations (higher frequency at midblock locations) may be a factor in these findings.

Vehicle type: As with all-ages crashes, larger vehicle types (including buses and large trucks, SUVs and small trucks) are associated with a higher percentage of serious injuries, as compared to other vehicle types. Passenger autos account for the majority of all-severity crashes among youth (57%), which is likely the result of the predominance of passenger cars in the traffic stream.

Summary

Most youth pedestrian crashes occur during daytime hours, particularly weekday afternoons, which certainly aligns with when most children are likely outside walking or playing. Midblock crashes are slightly more frequent and, along with nighttime crashes, are likely to be more severe than at other locations and times for youth. Non-intersection locations and motorist going straight maneuver types have greater severity, likely the result of with higher vehicle speeds.

Speed is a crucial factor in safety for pedestrians of all ages and urban locations where youth and others walk, and play should have low speed limits, design and enforcement features in place to reduce the chances of serious and fatal injury in the event of a crash. Lower speeds also result in shorter stopping distances and may provide

better opportunities for drivers to detect and avoid hitting a pedestrian altogether.

It is important that intersections function safely for youth, providing opportunities to cross at controlled locations with a minimum of conflicts. There may be a need for midblock crossing improvements, especially if there are locations where youth often cross to access commercial destinations transit or other types of facilities. The distance between safe crossing should also be considered in these analyses as people of all ages tend not to walk far out of their way.

Further analyses of both intersection and non-intersection crashes are warranted. To address these crash factors, it is important to use the crash locations, crash types, and associated site characteristics to help uncover areas of greater risk, and to identify treatable risk factors. There may also be a need to review pedestrian and motorist actions and behaviors from field inspections, as well as caregiver knowledge to assess the need for the types of safety treatments that are most effective for young pedestrians. This crash analysis was conducted as the first of two phases, with the second phase taking a proactive approach to identifying locations with high crash potential due to a combination of crash history, roadway characteristics, exposure and neighborhood factors so these locations can be addressed without "waiting" for a child to be hit to make needed improvements. Identified locations require field investigation to give insight into problems and appropriate countermeasures.

Conclusion

Identifying the major crash factors behind pedestrian crashes in Philadelphia was the first step. Next, the study reviewed the findings to develop appropriate solutions to address those crash factors, focusing on design and policies. These recommendations are broad and applicable to many different streets across the city (see CHAPTER 3).

- **REDUCE SPEEDS** – If only one objective is pursued, it should be lowering speed, as it has the most potential to improve pedestrian safety. The benefits of reducing speed are two-fold: crash severity decreases at slower speeds, and drivers have a wider field of vision and can stop more quickly when traveling at slower speeds, reducing the likelihood of a crash occurring in the first place, as shown in 0
- **INCREASE VISIBILITY** – In addition to reducing speed to widen a driver's field of vision, additional roadway lighting and ensuring adequate sight distance at intersections with curb extensions and parking restrictions helps all road users see one another and react accordingly to prevent crashes.
- **REDUCE PEDESTRIAN CROSSING DISTANCES** – When pedestrian crossing distances are reduced, the time it takes for a pedestrian to cross the street is also reduced, limiting their exposure to collisions with motor vehicles. Common techniques to reduce crossing distance such as median refuge islands and curb extensions also narrow the street and encourage slower speeds.
- **REDUCE CONFLICTS BETWEEN ROADWAY USERS** – Reducing conflicts between roadway users means providing as much separation between modes as possible. Physical separation can come in the form of

sidewalk buffers and median refuge islands, but distinct signal phases can also create time-based separation.

FIGURE 39
RISK OF DEATH INCREASES AND FIELD OF VISION DECREASES WITH SPEED

Source: FHWA, Achieving Multimodal Networks

CHAPTER 3: SYSTEMIC SOLUTIONS

Overview

The previous chapter summarized key crash factors relating to pedestrian crashes in Philadelphia from 2014-2018. These crash factors help explain **Who** is involved in pedestrian crashes, and **When**, **Where**, and **How** pedestrian crashes are occurring. This information serves as the basis for the systemic approach recommended in this chapter.

As defined by the Federal Highway Administration (FHWA), the systemic approach to safety "involves widely implemented improvements based on high-risk roadway features correlated with specific severe crash types. The approach helps agencies broaden their traffic safety efforts at little extra cost." [29] While the FHWA definition deals primarily with engineering and the built environment, the systemic solutions presented here also include policy changes that affect the regulatory environment of the entire city.

Policies regarding transportation safety indicate the priorities of the city and lay the groundwork for directing resources and guiding decision-making by both city and partner agencies. By adopting the policy recommendations listed in this report, the City of Philadelphia would be closer to realizing its commitment to Vision Zero. Engineering solutions for pedestrian safety are the building blocks for changing the physical environment of the city of Philadelphia's streets. The engineering countermeasures recommended in this chapter have been identified because there are specific benefits for pedestrian safety. However, many of the recommendations have the added benefit of improving safety for all road users and reducing the total number of fatalities and serious injuries, regardless of travel mode.

Both policy and engineering are two of the six categories of action items in Philadelphia's Vision Zero Action Plan for 2016-2019. As the city nears the release of its next Vision Zero Action Plan for 2020-2025, these recommendations for pedestrian safety are needed to help Philadelphia reach its goal of eliminating all traffic deaths and serious injuries by 2030.

SYSTEMIC APPROACH TO SAFETY

The systemic approach to safety involves **widely implemented improvements** based on high-risk roadway features correlated with specific severe crash types.

[29] FHWA Office of Safety. (2019). "A Systemic Approach to Safety – Using Risk to Drive Action." Retrieved from: https://safety.fhwa.dot.gov/

Why a Systemic Approach

The systemic approach provides a more comprehensive method for safety planning and implementation that supplements and complements traditional site analysis. The systemic approach also helps agencies broaden their traffic safety efforts and consider risk as well as crash history when identifying where to make low-cost safety improvements.

To reach zero traffic fatalities or serious injuries—and effectively implement the Philadelphia Vison Zero Pedestrian Safety Action Plan—strong coordination and leadership is necessary, where system designers and government execute a proactive approach to create multiple layers of safety protection in the system, rather than primarily reacting to isolated traffic collisions after they occur.

To create these multiple layers of protection, multiple engineering countermeasures must often be applied at the same location, and coordinated policy and change is also required. A safe roadway environment depends on robust engineering changes, policy improvements, and broad cultural adoption of safer practices.

Policy Recommendations

A core tenant of Vision Zero holds that policy- and lawmakers, law enforcement officials, planners, administrators, designers, and engineers—among others—must collaborate to ensure their individual program areas contribute to a safe system. The policy recommendations below are intended to improve pedestrian safety across the city's roadway network and guide the City's efforts to prioritize pedestrian safety through better coordination among all agencies and personnel responsible for roadway safety. They build on action items in the Vision Zero Action Plan. Some of the recommended policies fall outside of the City of Philadelphia's purview. Therefore, this section is divided between city and state level policies and programs.

City Policies and Programs

1. **Align Pedestrian Safety Action Plan with other concurrent planning activities:** Recommendations in the Pedestrian Safety Action Plan should be coordinated with other concurrent planning activities led by oTIS, such as the Route for Change project along Roosevelt Boulevard (see Roosevelt Boulevard: Route for Change for more details) and Safe Routes to School program, as well as corridor studies and community plans led by the Philadelphia City Planning Commission. This coordination will help ensure pedestrian safety is addressed in projects across the city.
2. **Lower Target Speeds:** Speed is already a primary focus of Philadelphia's Vision Zero

Program[30]. To continue this area of focus, consider the following:

- Design residential streets for 20 mph target speeds using traffic-calming measures, as recommended by the North American Association of City Transportation Officials (NACTO)[31]
- Implement traffic calming on arterial and collector streets to achieve lower target speeds
- Focus first on the High Injury Network
- Implement slow zones

3. **Revise Intersection Traffic Control Operations:** Implement a comprehensive update to traffic signal operations and other intersection traffic control devices to support safety and other City goals. Make traffic signal operations changes to support City goals for safety, Complete Streets, and mobility.

    - Recommendations to consider include:
    - Retime progression of traffic signals to support safe speeds and lower speed limits;
    - Incorporate dedicated or restricted turn phases at intersections with a high number of conflicts;
    - Incorporate leading pedestrian intervals where there are a high number of conflicts between vehicles and pedestrians (Vision Zero Action Plan 1.3);
    - Develop guidance on where and what thresholds the city should use for LPIs.
    - Continue to implement pedestrian countdown-timers on all new signals and adjust the timing so that it is consistent and understandable (Vision Zero Action Plan 1.6);
    - Continue to implement coordinated signals with automatic pedestrian signals;
    - Consider converting traffic signals at intersections in predominantly residential areas to all-way stop control to reduce crashes and enhance the quality of life of residents.

4. **Expand Educational Campaigns:** Expand safe walking and bicycling education for youth. Recommendations to consider include:

    - Provide toolkits to fully integrate pedestrian and bicycle safety education to all Philadelphia schools, including public, private, and charter schools.
    - Provide technical support for pedestrian and bicycle safety education to schools in high-crash areas
    - Engage youth directly in street projects near schools (if keeping, what type?)
    - Create traffic gardens at schools throughout the city where children can learn safe walking and biking habits.

5. **Continue Enforcement Campaigns:** Equitably enforce traffic laws to reduce the most dangerous behaviors on Philadelphia streets.

[30] City of Philadelphia. (2017). Vision Zero Three-Year Action Plan. Retrieved from: http://visionzerophl.com/uploads/attachments/cj8a9vbdj074ojnd66ah3mxxi-2017-vz-action-plan-final.pdf

[31] NACTO. (2013). Design Speed. Urban Street Design Guide. Retrieved from: https://nacto.org/publication/urban-street-design-guide/design-controls/design-speed/

- Continue to focus traffic enforcement on the six leading behaviors in severe crashes on Philadelphia streets
- Create and implement a system to regularly evaluate the City's traffic enforcement efforts in coordination with Vision Zero efforts.
- Focus automated enforcement in coordination with expansion of the ARLE program and new speed cameras on Blvd with education campaign (which is currently ongoing from the city)
- Evaluate and implement a diversion program for traffic tickets.

6. **Expand Fleet Improvements:** Philadelphia's vehicle safety standards and government vehicle safety must be improved to reach Vision Zero. The crash study revealed that large trucks and buses are currently contributors to the deaths and serious injuries on Philadelphia's roads. The impact of trucks and SUVs with high front grills may need to be reviewed, as well as ubiquitous requirements for and installation of sideguards on heavy trucks operating in the city (on public as well as private vehicles). The City has an ongoing investment to equip city fleet and is well positioned to lead the conversation nationally on these kinds of standards. The City's fleet investments also include GPS, 360-degree cameras, sideguards.

Other recommendations to consider include

- Consider strategies for expanding fleet investments to private fleets, while recognizing that there are some limitations on expanding to private fleets, especially trash haulers given state law.
- Pilot and manage emerging vehicle technologies with the potential to improve safety while ensuring they support City goals and comply with state law.
- Evaluate the potential to use smaller vehicles in the public fleet to align with safer street designs. Acknowledge that Philadelphia already has some of the smallest vehicles due to the small streets.
- Use data to regulate and manage new mobility services to ensure pedestrian safety.
- Explore zoning policies and development practices for transportation demand management opportunities specifically benefiting pedestrians. This may include parking maximums and minimums, providing density bonuses or expedited review for projects with no parking and world-class pedestrian environments, developing better pedestrian design guidelines for certain planning areas, and earmarking a percentage of Transportation Impact Fees for pedestrian improvements.

State Policies and Programs

The following recommendations may require changes to state law or more substantial coordination with agencies outside the City of Philadelphia:

1. **Encourage state legislation to:**

    - Allow local control of speed limits below 25mph or 85th percentile,

including a citywide school zone speed limit of 15 mph.[32]

- Allow the use of radar guns/devices for speed enforcement.
- Allow the use of automated enforcement for speeding and other traffic violations throughout the City of Philadelphia.
- Change Pennsylvania law from "Yield" to "Stop" for pedestrians in crosswalk.
- Pass a curb bill to allow parking along painted ped plazas and parking protected bike lanes.
- Revise DM2 to allow greater traffic calming flexibility on state roads.

2. **Encourage expansion of automated speed enforcement beyond Roosevelt Boulevard**
3. **Lobby for PA Driver's Manual Update:** Update the Pennsylvania Driver's Manual to include information on safe driving rules and regulations, defensive driving, and laws regarding stopping for and yielding to pedestrians (Vision Zero Action Plan 1.16).[33]

[32] Pennsylvania Department of Transportation. (2020). PA Speed Limit Laws. Retrieved from: https://www.penndot.gov/RegionalOffices/district-3/ConstructionsProjectsAndRoadwork/Documents/SR%2054%20-%20Speed%20Limit%20Information.pdf

[33] For example, New Jersey recently updated its driver manual to include these and other pedestrian safety topics. New Jersey Motor Vehicle Commission (2019). The New Jersey Driver Manual. Retrieved from: https://www.state.nj.us/mvc/pdf/license/drivermanual.pdf

Roosevelt Boulevard:
Route for Change Recommendations

The Roosevelt Boulevard "Route for Change" Program is developing a series of continuous and increasingly transformative changes that will create a safer and more inviting corridor.

Key Components

1. Improved bus service and better connections
2. Improved pedestrian crossings and access to public transportation
3. Consistent and dependable travel times
4. Integrated bicycle facilities
5. Broader economic development opportunities, resulting in job creation

Pedestrian-specific recommendations include:

- Changing Traffic Signal Cycle Times
- Realigning Crosswalks and Curb Ramps
- Building Curb Extensions
- Closing Sidewalk Gaps

Other recommendations that will benefit pedestrians include:

- Automated enforcement (pilot began in early 2020)
- Local bus stop improvements
  - ADA accessibility
  - Shelters at stops with 75+ daily riders
  - Seating at stops with 40-75 daily riders
  - Eliminating stops with inadequate pedestrian infrastructure
- Walkable Transit Station Areas

Learn more at *http://rooseveltblvd.com/*

Pedestrian Safety Engineering Toolkit

What is included in this toolkit?

The pedestrian safety engineering toolkit consists of a matrix and cut sheets with information on each engineering countermeasure.

The **matrix** associates the countermeasures with the crash factors identified in the analysis that contribute to pedestrian crashes. As the matrix shows, all the countermeasures address multiple factors and each of the factors can be mitigated by multiple countermeasures. Multiple treatments at the same location often have complementary benefits. When considering which countermeasures to implement, some of them address certain crash factors more directly than others:

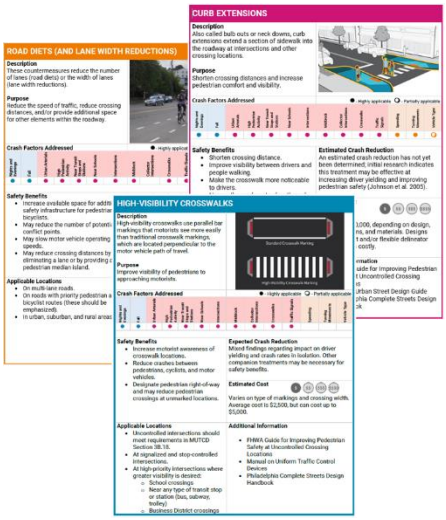
- ● Solid circles indicate that the countermeasure should be considered everywhere the crash factor applies.

- ❍ Hollow circles indicate that the countermeasure may be considered in certain locations or situations when the crash factor applies.

		WHEN		WHERE							
Countermeasure	Estimated Crash Reduction	Nights and Evenings	Fall	Urban Arterials and Auto-Oriented Streets	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	At Intersections	Midblock	Crosswalks	Traffic Signals
High-Visibility Crosswalks	Not available	●	●	●	●	●	●	●	●	●	●
Lighting	27%	●	●	●	●	●	●	●	●	●	●
Parking Restrictions at Crossing Locations / Daylighting	30%	●	●	❍	●	●	●	●	❍	●	●
Rectangular Rapid Flashing Beacons (RRFB)	53%	●	●	❍	●	●	●		●	●	
Accessible Sidewalks (Sidewalks and curb ramps)	65-89%	●	●	●	●	●	●	●	●	●	●
Signal Timing and Automatic Pedestrian Recall	50%	●	●	●	●	●	●	●		●	●
Corner Radius Reduction	Not available	❍	❍	●	●	●	●	●		●	●
Crossing Islands	56%	❍	❍	●	●	●	●	●	●	●	●
Curb Extensions	Not available	●	●	●	●	●	●	●	●	●	●
Hardened Centerlines / Turn Wedges	46%	❍	❍	●	●	❍	●	●		●	●
Gateways / In-Street Pedestrian Crossing Signs	Not available	●	●	❍	●	●	●	❍	●	●	❍
Leading Pedestrian Intervals (LPI)	60%	●	●	●	●	●	●	●		●	●
No Turn on Red	69%*	❍	❍	●	●	●	●	●		●	●

The **cut sheets** that follow the matrix explain each of the countermeasures in more detail. The cut sheets include photos or graphics depicting each countermeasure along with information on:

- Description and Purpose
- Crash Factors Addressed
- Safety Benefits
- Estimated Crash Reduction
- Estimated Cost
- Applicable Locations
- Design Guidance
- Considerations



Each cut sheet also includes a list of resources for additional information. The countermeasures have been grouped into categories based on their potential to address key issues related to the factors that describe **When**, **Where**, and **How** pedestrian crashes are occurring. The countermeasures in the **When** category focus on improving visibility of pedestrians in low-light conditions. The countermeasures in the **Where** category apply to locations with high pedestrian activity—especially on urban arterials and auto-oriented commercial/industrial corridors—and at

intersections where many pedestrian crashes are occurring. The countermeasures in the **How** category reduce the negative impacts of speeding, turning movements, and large trucks/buses.

Table 4. contains a list of the countermeasures included in this plan. The countermeasures in **bold font** are research-proven countermeasures recommended by FHWA. FHWA currently has 20 proven safety countermeasures that it strongly encourages transportation agencies to implement widely to achieve local, state, and national safety goals. Of the 20 proven safety countermeasures, there are five with significant pedestrian benefits.

What is an Estimated Crash Reduction? How is it determined?

Most of the countermeasures in this plan have been evaluated and assigned an Estimated Crash Reduction value. By studying the number of crashes across multiple locations before and after countermeasures are implemented, researchers can estimate the reduction in crashes associated with that countermeasure. Where these estimates are available based on a review of existing studies, they have been noted as percentages on the cut sheets. Estimates do not exist for all the countermeasures in this toolkit; however, ongoing research and prior use may indicate safety benefits.

It is important to note that the percentages given are estimates and should be regarded as a generic guide of safety effectiveness. Environmental, traffic volume, traffic mix, geometric, and operational conditions may affect the safety impact of a treatment and engineers must exercise judgement and consider these factors to ensure that a treatment applies to the conditions.

The following resources contain more information on crash reduction factors:

- FHWA: Desktop Reference for Crash Reduction Factors (2008)
- FHWA: Toolbox of Countermeasures and their Potential Effectiveness for Pedestrian Crashes (2008)
- US DOT & ITE: Toolbox of Countermeasures and Their Potential Effectiveness to Make Intersections Safer (2004)
- PennDOT: Pennsylvania CMF Guide (2014)

How much do these treatments cost?

Planning-level cost estimates for each countermeasure based on national guidance are included on the cut sheets. Actual construction costs will vary based on the ultimate project scope, site conditions and constraints, schedule, and economic conditions.

The dollar amounts listed are generally given for one treatment, while the shaded circles with the cost ranges consider the cost of an entire intersection or corridor project. The thresholds below can provide some general guidance:

$ = Less than $10,000

$$ = Typically, less than $50,000

$$$ = Between $50,000 - $100,000

$$$$ = More than $100,000

Which countermeasures can be implemented quickly?

Many countermeasures can be implemented relatively quickly using pavement markings, durable plastic curbs, and flexible delineator posts. Because these common materials have relatively low costs, the countermeasures can be applied at more locations than if the installation required more expensive materials. Paint and flexible delineator curb reductions or pedestrian median islands do not interfere with drainage or underground utilities the way the installation of a permanent curb might, so the installation can also be done more quickly. Paint and flexible delineator installations can always be upgraded to more permanent materials as time and budget allow, which is why some countermeasures have both short- and long- term designations in the matrix on the following page.

TABLE 4.
PHILADELPHIA PEDESTRIAN SAFETY ACTION PLAN ENGINEERING COUNTERMEASURES

WHEN	WHERE	HOW
• High-Visibility Crosswalks • Lighting + • Parking Restrictions at Crossing Locations / Daylighting ° • Rectangular Rapid Flashing Beacons (RRFB)	• Corner Radius Reduction • **Crossing Islands** ° • Curb Extensions ° • Hardened Centerlines and Turn Wedges ° • Gateways / In Street Pedestrian Crossing Signs • **Leading Pedestrian Intervals (LPI)** + • No Turn on Red • Raised Crossings and Raised Intersections + • **Roundabouts** • Signal Timing and Automatic Pedestrian Recall	• **Access Management** • Automated Enforcement° • Posted Speed Limit • Protected Turn Phases° • **Road Right Sizing with Lane Narrowing°** • Speed cushions

+ Philadelphia Vision Zero Action Plan Years 1 and 2 Recommendation

° Addresses a "Safety Six" issue

Bold font indicates countermeasure is an FHWA Proven Safety Countermeasure

TABLE 5.
PEDESTRIAN SAFETY COUNTERMEASURE MATRIX

Countermeasure	Estimated Crash Reduction	WHEN		WHERE								
		Nights and Evenings	Fall	Urban Arterials and Auto-Oriented Streets	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	At Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals
High-Visibility Crosswalks	Not available	●	●	●	●	●	●	●	●	●	●	●
Lighting	27%	●	●	●	●	●	●	●	●	●	●	●
Parking Restrictions at Crossing Locations / Daylighting	30%	●	●	○	●	●	●	●	○	○	●	●
Rectangular Rapid Flashing Beacons (RRFB)	47%	●	●	○	●	●	●		●		●	
Accessible Sidewalks (Sidewalks and curb ramps)	88%	●	●	●	●	●	●	●	●	●	●	●
Corner Radius Reduction	Not available	○	○	●	●	●	●	●		●	●	●
Crossing Islands	32%	○	○	●	●	●	●	●	●	●	●	●
Curb Extensions	Not available	●	●	●	●	●	●	●	●	○	●	●
Gateways / In-Street Pedestrian Crossing Signs	Not available	●	●	○	●	●	●	○	●		●	○
Hardened Centerlines and Turn Wedges (Left Turn Calming)	46%	○	○	●	●	○	●	●		●	●	●
Leading Pedestrian Intervals (LPI)	60%	●	●	●	●	●	●	●		●	●	●
No Turn on Red	3%	○	○	●	●	●	●	●		●	●	●
Raised Crossings and Raised Intersections	30, 36%	●	●		●	○	●	●	○		●	●
Roundabouts	27, 82, or 78%	○	○	●	○	○	●	●		●	○	●
Signal Timing and Automatic Pedestrian Recall	50%	●	●	●	●	●	●	●		●	●	●
Access Management	25-31%			●	●	○	●	○	●	○		
Automated Enforcement	16-25%	○	○	●	●		●	●	●	●		●
Posted Speed Limit	Not available	●	●	●	●	●	●	●	●		●	●
Protected Turn Phases	34%	●	●	●	●	●	●	●		●	●	●
Road Right Sizing with Lane Narrowing	29%	●	●	●	●	●	●	●	●		●	●

LEGEND ● Always consider ○ May want to cons

HOW			TIMEFRAME		
Speeding	Turning Movements	Vehicle Type	Short-Term (Quick Implementation)	Long-Term (Higher cost /	**Notes on estimated crash reduction**
			●		Varies based on context.
				●	For injury crashes (Harkey et al. 2008).
	●	○	●	●	For vehicle-pedestrian crashes (Gan et al. 2005)
					for vehicle-pedestrian crashes (Zeeger et al. 2017).
			●	●	for all crashes at locations with sidewalks (McMahon, P. et al. 2002).
●	●	○	●	●	A CMF has not yet been determined; initial research indicates curb radius reduction may reduce turning speeds which can increase motor vehicle yielding to crossing pedestrians and reduce the severity of crashes (Thomas et al. 2016).
○	●	○	●	●	For vehicle-pedestrian crashes at crossing islands (Zegeer et al. 2017).
●	●	○	●	●	A CMF has not yet been determined; initial research indicates this treatment may be effective at increasing driver yielding and improving pedestrian safety (Johnson et al. 2005).
●	○	○	●		A CMF has not yet been determined; initial research indicates gateway treatments may increase driver yielding and reduce vehicle speeds (Van Houten and Hochmuth 2017).
●	●	●	●		For all crashes at raised medians (Bahar et al. 2007). A crash reduction estimate has not been established for turn wedges.
	●	○	●		For vehicle-pedestrian crashes for LPIs (Fayish and Gross 2010).
	●	○	●	●	for all crashes. (Harkey et al. 2008).
●	●			●	for all crashes, or fatal or injury crashes, respectively (Bahar et al. 2007).
●	●			●	For pedestrian fatal or injury crashes from unsignalized intersection to roundabout conversion (De Brabander and Vereeck, 2006), or for severe crashes after converting from two-way stop-controlled or signalized intersections to roundabouts, respectively (Highway Safety Manual, 1st edition, 2010).
	●		●	●	For vehicle-pedestrian crashes, depending on specific signal phasing (Chen et al. 2012).
	●	○	●	●	Reduction in injury and fatal crashes along urban/suburban arterials (Highway Safety Manual, 1st edition, 2010).
●	●			●	For all injury crashes from red light (Persuad et al. 2005, Hu et al. 2011) and speed cameras (Li et al. 2013).
●	○	○	●		An estimate has not yet been determined for this treatment; however research indicates a significant reduction in fatal and injury crashes below the 85th percentile (Gayah et al. 2018).
	●		●	●	For exclusive pedestrian phase for vehicle-pedestrian crashes (ITE 2004).
●	●	○	○	●	For all crashes in urban areas (Pawlovich et al. 2006).

Pedestrian Safety Engineering Cut Sheets

The cut sheets include photos or graphics depicting each countermeasure along with information on:

- Description and Purpose
- Crash Factors Addressed
- Safety Benefits
- Estimated Crash Reduction
- Estimated Cost
- Applicable Locations
- Design Guidance
- Considerations

The countermeasures have been grouped into categories based on their potential to address key issues related to the factors that describe **When**, **Where**, and **How** pedestrian crashes are occurring. **Bold font** indicates the countermeasure is an FHWA Proven Safety Countermeasure.

TABLE 6.
COUNTERMEASURES AND ESTIMATED CRASH REDUCTION FACTORS

PEDESTRIAN SAFETY COUNTERMEASURE	EST. CRF	COSTS
High-Visibility Crosswalks	Not available	$
Lighting	27%	$$
Parking Restrictions at Crossing Locations / Daylighting	30%	$
Rectangular Rapid Flashing Beacons (RRFB)	47%	$$
Corner Radius Reduction	Not available	$$
Crossing Islands	32%	$$
Curb Extensions	Not available	$-$$
Gateways / In-Street Pedestrian Crossing Signs	Not available	$
Hardened Centerlines and Turn Wedges	46%	$$
Leading Pedestrian Intervals (LPI)	60%	$
No Turn on Red	3%	$
Raised Crossings and Raised Intersections	30, 36%	$$-$$$
Roundabouts	27, 82, or 78%	$$$$
Signal Timing and Automatic Pedestrian Recall	50%	$
Access Management	25-31%	$$
Automated Enforcement	16-25%	$$$
Posted Speed Limit	Not available	$
Protected Turn Phases	34%	$
Road Right Sizing with Lane Narrowing	29%	$$

HIGH-VISIBILITY CROSSWALKS

Description

High-visibility crosswalks use parallel bar markings that motorists see more easily than traditional crosswalk markings, which are located perpendicular to the motor vehicle path of travel.

Purpose

Improve visibility of pedestrians to approaching motorists.

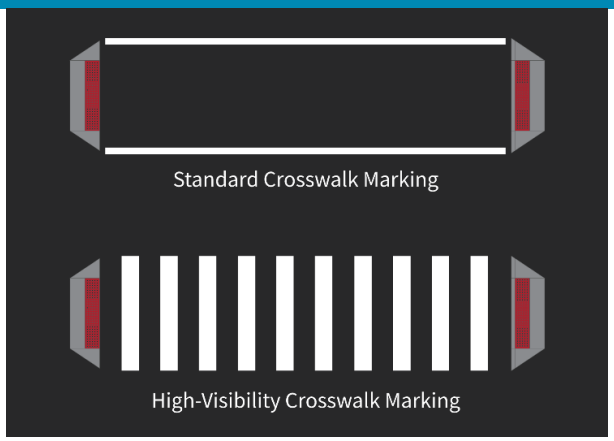


Image source: Toole Design

Crash Factors Addressed

● - Always consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	●	●	●	●	●	●	●	●	●			

Safety Benefits

- Increase motorist awareness of crosswalk locations.
- Reduce crashes between pedestrians, cyclists, and motor vehicles.
- Designate pedestrian right-of-way and may reduce pedestrian crossings at unmarked locations.

Expected Crash Reduction

Mixed findings regarding impact on driver yielding and crash rates in isolation. Other companion treatments may be necessary for safety benefits.

Estimated Cost

Varies on type of markings and crossing width. Average cost is $2,500, but can cost up to $5,000.

Applicable Locations

- Uncontrolled intersections should meet requirements in MUTCD Section 3B.18.
- At signalized and stop-controlled intersections.
- At high-priority intersections where greater visibility is desired:
  - School crossings
  - Near any type of transit stop or station (bus, subway, trolley)
  - Business District crossings

Additional Information

- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- Manual on Uniform Traffic Control Devices
- PennDOT Pub. 111 - TC 8600
- PennDOT TE-672, Pedestrian Accommodations at Intersections Checklist
- Philadelphia Complete Streets Design Handbook

HIGH-VISIBILITY CROSSWALKS

Design Guidance

- Marking pattern should be continental: a series of wide stripes parallel to the curb for the entire length of the crossing.
- Crosswalks should be at least as wide as the sidewalk or side path, with a minimum width of 10 feet.
- Install with curb ramps.
- At signalized intersections, install a stop bar in advance of the crosswalk at least 4 feet from the nearest edge of the crosswalk.
- Parking should be restricted in advance of a crosswalk to provide adequate sight distance.

Image source: Toole Design

Considerations

- Crosswalk location should be convenient for pedestrian access.
- Width may be wider than 10 feet at crossings with high pedestrian or bicycling demand.
- The Streets Department currently permits decorative sidewalks, provided a local partner signs a maintenance agreement. Standard MUTCD transverse pavement markings must also be used with non-retroreflective decorative crosswalks.

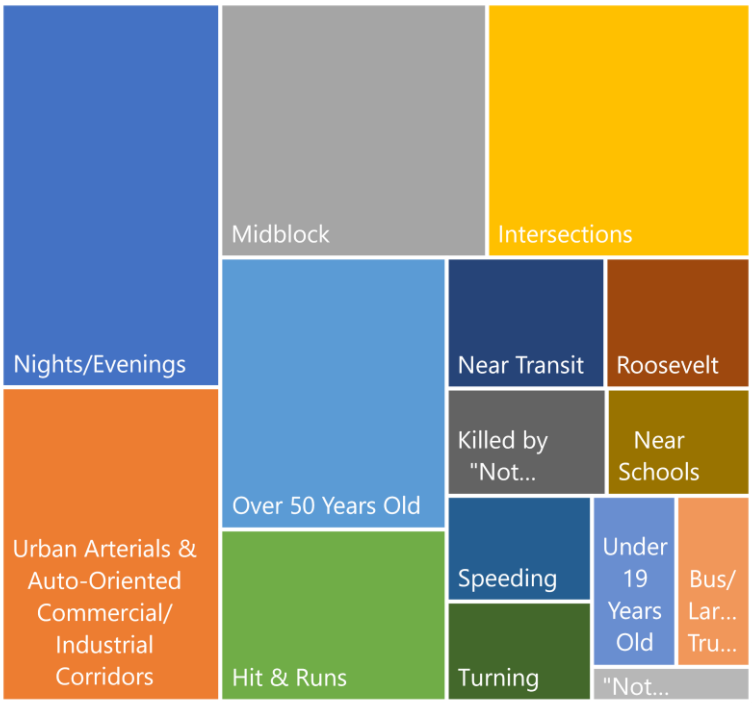


Image source: Toole Design

LIGHTING

Description

Well-placed lighting improves visibility for all road users. Pedestrian-scale lighting illuminates sidewalks and crossings and is not as tall as roadway-scale lighting.

Purpose

Increase visibility for all road users at dusk and darkness, especially at crossings.

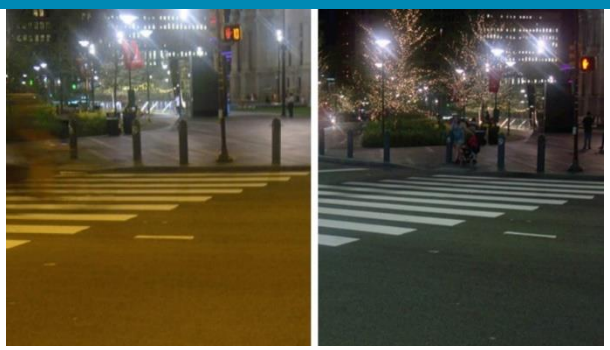


Image source: City of Philadelphia

Crash Factors Addressed

● - Always consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Inter-ections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	●	●	●	●	●	●	●	●	●			

Safety Benefits

- Improves visibility for all parties.
- May reduce crashes and injuries for all road users.
- May increase yielding and compliance with traffic control devices.
- Improves personal safety and comfort levels by deterring criminal activity.

Applicable Locations

- Controlled and uncontrolled intersections.
- On crossing approaches.
- Along sidewalks.
- At intersections in areas with high volumes of pedestrians, such as commercial or retail areas.
- Near schools, parks, and recreation centers.
- On both sides of arterial streets.

Philadelphia Locations

- Spruce Street & Market Street North City Hall Intersection (pictured)

Estimated Crash Reduction

27% for all injury crashes at intersections (Harkey et al., 2008).

42% reduction for nighttime pedestrian injury crashes (Pennsylvania CMF Guidebook).

Estimated Cost

$ **$$** $$$ $$$$

Varies based on type and amount of lighting. A streetlight costs approximately $5,000.

Additional Information

- FHWA Lighting Handbook
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- ANSI/IES RP-8 Standard Practice for Roadway Lighting
- International DarkSky Association Outdoor Lighting Guidelines*

LIGHTING

Design Guidance

- Use 3000K shielded LED lights wherever possible.
- Lighting should be consistent and uniform.
- To ensure light doesn't spill over into places where it isn't needed or wanted, factor in the placement of existing buildings and trees.
- Install lighting to Illuminating Engineering Society and DarkSky guidelines.

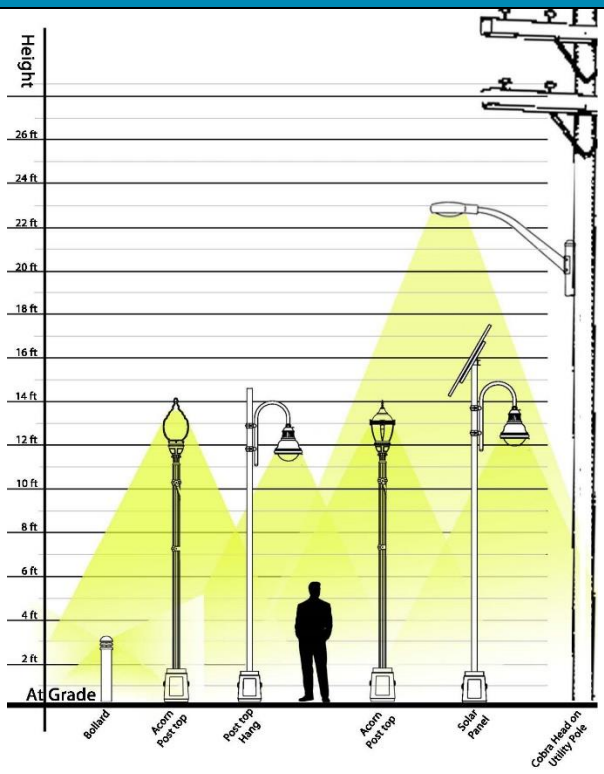


Image source: Toole Design

Considerations

- Uniform lighting can suggest pedestrian use and create a sense of enclosure.
- Lighting should be provided on crosswalk approaches. If a crossing has a crossing island, additional lighting may be provided.
- Consider energy usage and environmental impacts.
- Consider quality and color of light.

Image source: Toole Design

PARKING RESTRICTIONS AT CROSSINGS / DAYLIGHTING

Description

Daylighting and parking restrictions at crossings can be signs, pavement markings, curb extensions, or vertical delineators that restrict on-street parking near a crossing.

Purpose

Improve sightlines between motorists and pedestrians or bicyclists crossing the street.

Image source: Toole Design

Crash Factors Addressed

● - Always consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Inter-ections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	❍	●	●	●	●	❍	▪	●	●	▪	●	❍

Safety Benefits

- Increase sightlines for all road users.
- Encourage safer turning speeds when used on crosswalks at intersections.
- Provide physical barrier to restrict illegal parking too close to intersections and crosswalks.
    - Pennsylvania Vehicle Code Title 75 prohibits parking at corners.

Estimated Crash Reduction

30% for vehicle-pedestrian crashes (Gan et al. 2005)

Estimated Cost

$ $$ $$$ $$$$

Varies based on treatment type. Delineators cost vary from $30 to $100 per unit. Parking restriction signs cost approximately $200.

Applicable Locations

- Approaches to crossings where parked vehicles block sightlines.
- Approaches to crossings with high pedestrian volumes.

Philadelphia Locations

- 11th Street
- Woodland Avenue & South 49th Street

Additional Information

- Burlington, VT Quick Build Design + Materials Standards
- NACTO Urban Street Design Guide
- PennDOT Pub. 111 - TC 8600
- Philadelphia City Code, 12-913(1)(b)(iii)
- Unsignalized Intersection Improvement Guide

PARKING RESTRICTIONS AT CROSSINGS / DAYLIGHTING

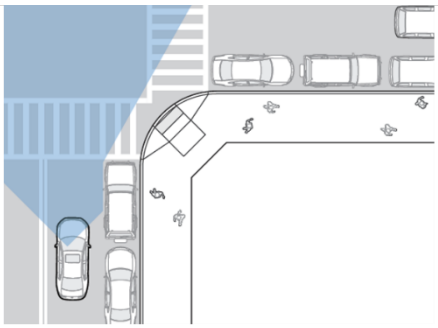
Design Guidance

- Parking should be restricted 20 to 40 feet from the back of the crosswalk on all sides.
    - Philadelphia City Code section 12-319 prohibits parking within 20' of a crosswalk.
- In locations with sight distance obstructions, the parking restriction should be extended as necessary.
- Area with parking restriction can be defined using curb extensions, planters, a painted curb, or flexible delineators.
- Install a "No Parking" sign (MUTCD R7 series).
- Install with a high-visibility crosswalk and curb ramps.

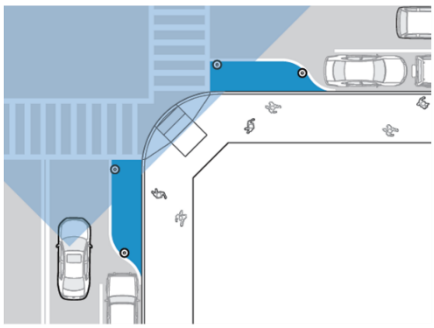
Image source: Toole Design

Considerations

- Parking removal should be discussed with community stakeholders, such as businesses and property owners.
- Areas with parking restriction can be used for green infrastructure, bicycle parking, or slow zone gateway features.
- Parking restrictions without physical barriers (i.e., painted curbs) are less effective and may require enforcement.
- Parking restrictions may be tailored to certain times of day.
- Requires removal of existing parking space markings and possibly meters.



Visibility obstructed



Visibility maintained by daylighting

*

Image source: Toole Design

RECTANGULAR RAPID FLASHING BEACONS (RRFB)

Description

A rectangular rapid flashing beacon has bright, irregularly flashing LEDs mounted with pedestrian crossing signs, which increase pedestrian visibility to drivers at uncontrolled crossings.

Purpose

Increase driver yielding to pedestrians at mid-block crossings.

Image source: Toole Design

Crash Factors Addressed

● - Always consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	❍	●	●	●		●		●				

Safety Benefits

- Consistently increases rates of drivers yielding to pedestrians.
- May increase effectiveness of other safety treatments, such as Advance Yield Markings with YIELD HERE FOR PEDESTRIAN signs.
- More effective than traditional overhead beacons (MUTCD 2009).

Estimated Crash Reduction

47% for vehicle-pedestrian crashes (Zegeer et al. 2017)

Estimated Cost

$ **$$** $$$ $$$$

Varies, but likely between $10,000 – 20,000.

Applicable Locations

- At many types of unsignalized pedestrian crossings, including at standard pedestrian, school or trail crossings.
- At multilane crossings with speed limits under 40 mph (PEDSAFE).

Philadelphia Locations

- 1700 block of Arch Street
- 34th Street & Smith Walk

Additional Information

- FHWA Achieving Multimodal Networks
- FWHA Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- MUTCD
- NCHRP Report 562
- Smart Transportation Guidebook

RECTANGULAR RAPID FLASHING BEACONS (RRFB)

Design Guidance

- Place on both sides of an uncontrolled crosswalk.
- If pole-mounted, place below a pedestrian, school, or trail crossing warning sign and above a diagonal downward arrow.
- May also be used with an overhead-mounted pedestrian, school, or trail crossing warning sign located at or immediately adjacent to an uncontrolled marked crosswalk.
- Most RRFB installations are activated with a pedestrian push button and should be accompanied by educational campaigns for pedestrians and drivers.
- If sight distance approaching the crosswalk is limited, an additional RRFB may be installed on the approach with an AHEAD or distance plaque. Consider other treatments in these locations.

Image source: Toole Design

Considerations

- RRFBs should not be used in conjunction with YIELD, STOP, or traffic signal control (except at roundabouts).
- If multiple RRFBs are needed in close proximity, consider redesigning the roadway to address systemic safety challenges.
- At multilane crossings, multiple threat crashes remain a concern. Use with caution at crossings with more than two lanes without a refuge.
- Other treatments may be more appropriate in locations with sight distance constraints.
- In Philadelphia, the Streets Department prefers hard wired installations of RRFB, which may increase costs if there is no existing power source nearby.

Image source: Toole Design

CORNER RADIUS REDUCTIONS

Description

Reducing a corner radius means changing the curb line, permanently or temporarily, using materials such as paint and bollards. Motorists generally reduce their speed to navigate a sharper turn.

Purpose

Reduce motor vehicle turning speeds, reduce pedestrian crossing distances, and expand waiting areas for pedestrians at intersections.

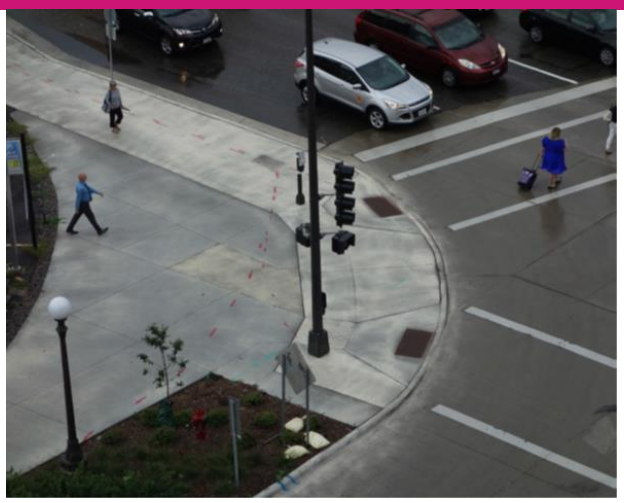


Image source: Toole Design

Crash Factors Addressed

● - Always consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
❍	❍	●	●	●	●	●		●	●	●	●	●	❍

Safety Benefits

- Reduce turning motor vehicle speeds.
- May reduce the risk of pedestrians in collisions with right-turn vehicles.
- Reduce crossing distance for pedestrians.
- Provide ample room for perpendicular curb ramps.
- May allow for shorter traffic signal cycle lengths, increasing compliance with walk signals (Chicago Metropolitan Agency for Planning 2015).

Estimated Crash Reduction

An estimated crash reduction has not yet been determined; initial research indicates curb radius reduction may reduce turning speeds which can increase motor vehicle yielding to crossing pedestrians and reduce the severity of crashes (Thomas et al. 2016).

Estimated Cost

$ $$ $$$ $$$$

Varies, but likely between $15,000 – $40,000.

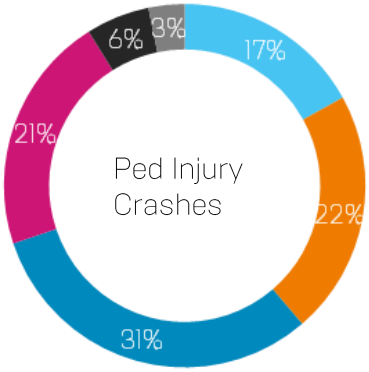
Applicable Locations

- Most intersections and street types, especially local streets and streets that are part of the HIN.
- Curb radii are contingent on the context and traffic characteristics of an intersection (e.g., land use, traffic volume, vehicle sizes).

Additional Information

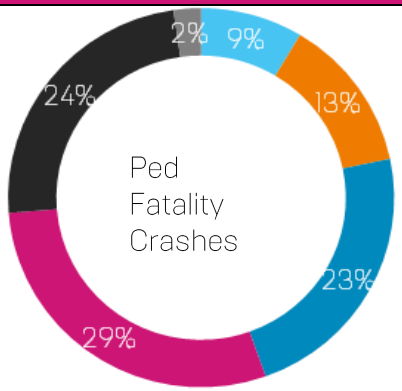
- PEDSAFE: Pedestrian Safety and Countermeasure Selection System
- Philadelphia Complete Streets Design Handbook

CORNER RADIUS REDUCTION



Curb radius reduction with mountable truck apron.

Image source: Toole Design



Curb radius reduction with full curb.

Image source: Toole Design

Design Guidance

- Implementation should be tailored to the largest design vehicle size that frequently uses the intersection. The effective turning radius should determine actual curb radius.
    - In Philadelphia, the prescribed radius for local streets is R-15.
    - Other cities, including Los Angeles, have established design vehicles based on their Complete Street types.
- Mountable truck aprons should be implemented to encourage a smaller effective radius for passenger cars or small trucks, while accommodating for a larger design vehicle.
- At intersections designed to accommodate passenger cars and small trucks, the corner radius should measure 5 to 10 feet, creating an effective corner radius of 15 to 20 feet.
    - On-street parking lanes and bike lanes widen the effective radius.
    - Where one-way streets intersect other one-way streets, the curb radii on the corners without turning movements should be made as small as possible.
- Install with curb ramps and high-visibility crosswalk markings.

Considerations

- The corner radius should make intersections as compact as possible while accommodating large vehicles that frequent the intersection.
    - Painted curb radii with rubber turn wedges or permanent curb radii with mountable truck aprons can accommodate larger vehicles while discouraging smaller vehicles from making wide turns.
- When designing the corner radius or a curb extension, consider the appropriate large vehicle turning path to prevent encroachment into the pedestrian space.
    - Corner radii that are too small may encourage motor vehicles to drive over the curb and onto sidewalks and bikeways.
- Large vehicles may need to encroach on the opposing travel lane when turning.
    - Set stop bars back from the intersection to allow large vehicles to complete the turn.
- Slope and the location of existing drainage inlets must be considered and will affect the total cost when designing permanent curb radius reductions.

CROSSING ISLANDS

FHWA PROVEN SAFETY COUNTERMEASURE

Description

Median crossing islands with a cut-out area for pedestrian refuge are used as a supplement to a crosswalk. These are also known as pedestrian refuge islands.

Purpose

Shorten crossing distance, enable two-stage crossings at mid-block locations, and increase pedestrian visibility.

Image source: Toole Design

Crash Factors Addressed

● - Alway consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
❍	❍	●	●	●	●	●	●	●	●	●	❍	●	❍

Safety Benefits

- Reduce maximum distance and time pedestrians exposed to crash risk.
- Allow pedestrians to cross the street one direction of travel/fewer lanes at a time.
- Ease crossing for slower pedestrians (e.g., youth, elderly and disabled).
- Provide space for additional lighting at the crossing.
- May slow motorist through speed.
- May slow motorists turning left.

Estimated Crash Reduction

32% for vehicle-pedestrian crashes at midblock crossing islands (Zegeer et al. 2017).

15-27% for all injury crashes at intersections (NYC DOT, 2013)

Estimated Cost

$ **$$** $$$ $$$$

Varies, but likely between $2,000 and $40,000.

Applicable Locations

- At mid-block crossings or at intersections.
- At uncontrolled crossings, wide signalized crossings, or complex intersections.
- On roads with operating speeds of 30 mph or more and roads with two or more lanes of through traffic.
- On roads with insufficient gaps in traffic and high pedestrian volumes.

Additional Information

- Philadelphia Complete Streets Design Handbook
- Chapter 8 of Designing Sidewalks and Trails for Access: Part II of II: Best Practices Design Guide
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations

CROSSING ISLANDS

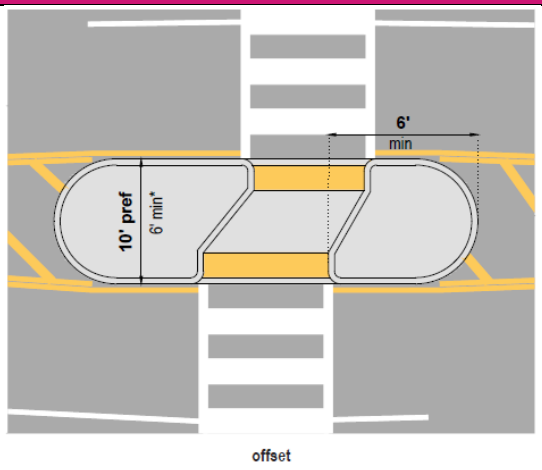


Image source: Toole Design

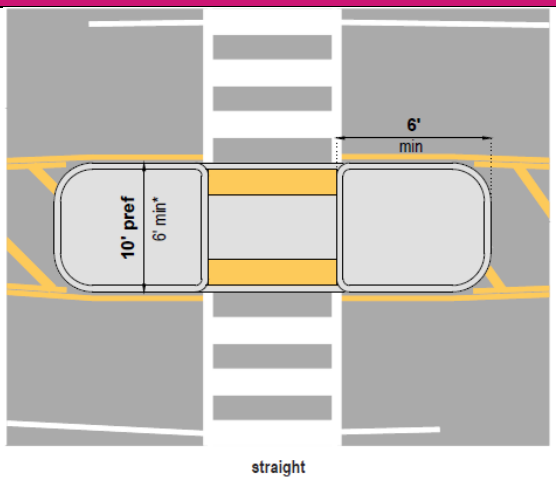


Image source: Toole Design

Design Guidance

- Median crossing islands should be a minimum of 6 feet wide.
- Ramps or island cut-throughs are required for accessibility. They should be the full width of the crosswalk, 5 feet minimum.
- All medians at intersections should have a "nose" that extends past the crosswalk. The nose protects people waiting on the median and slows turning drivers.
- At mid-block locations:
    - Install advance stop lines on multi-lane approaches.
    - Install with applicable warning sign (MUTCD W11-1, W11-2, W11-15, or S1-1).
    - On multi-lane approaches, place Stop Here for Pedestrians or Yield Here to Pedestrians signs (MUTCD R1-5 series).
    - Mark with a continental crosswalk.
- Retime pedestrian signals as necessary to enable safe, single-stage crossing. See Signal Timing and Automatic Pedestrian Recall for more information.

Considerations

- Pedestrians may get caught on the crossing island if motorists do not yield or signal timing is too short.
- Crossing islands at intersections may restrict left turning.
- Curb extensions can be built along with crossing islands to restrict on-street parking and reduce crossing distance.
- Temporary crossing islands can be constructed with temporary curbing or flex posts. Ensure temporary curbing is spaced appropriately to allow for drainage.
- Flexible delineators or vertical elements should be used to alert snow plow drivers of the presence of median islands.

CURB EXTENSIONS

Description

Also called bulb outs or neck downs, curb extensions extend a section of sidewalk into the roadway at intersections and other crossing locations.

Purpose

Shorten crossing distances and increase pedestrian comfort and visibility.

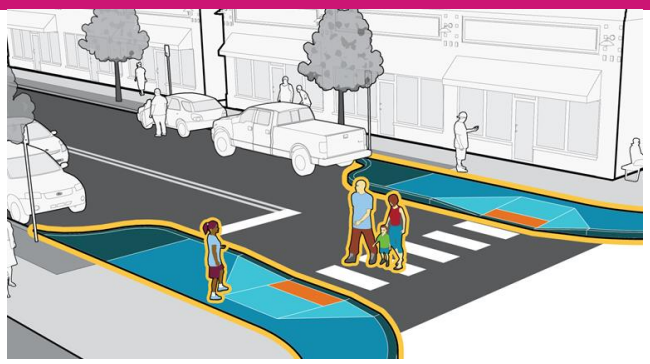


Image source: Minnesota Department of Transportation

Crash Factors Addressed

● - Always consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	●	●	●	●	●	●	❍	●	●	●	●	❍

Safety Benefits

- Shorten crossing distance.
- Improve visibility between drivers and people walking.
- Make the crosswalk more noticeable to drivers.
- Narrow the roadway to slow through speeds.
- Reduce vehicular turning speed.
- Provide additional space for ADA curb ramps aligned with the crosswalk.
- Create physical barrier that prevents parking encroachment on the crosswalk.

Estimated Crash Reduction

An estimated crash reduction has not yet been determined; initial research indicates this treatment may be effective at increasing driver yielding and improving pedestrian safety (Johnson, R. S. 2005).

Estimated Cost

$12,000 – $20,000, depending on design, sight conditions, and materials. Designs with only paint and/or flexible delineator posts are less costly.

Applicable Locations

- Everywhere from a mid-block crosswalk to a large signalized intersection.
- Curb extensions are a priority design treatment at local / local street and local / major street intersections in the Complete Streets Design handbook.
- In all-day parking lanes or wide shoulders.
- At transitions to lower speed areas.

Additional Information

- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- NACTO Urban Street Design Guide
- Philadelphia Complete Streets Design Handbook

CURB EXTENSIONS

Image source: Toole Design

Image source: Toole Design

Design Guidance

- Limit planting and street furniture height (to less than 3 feet) within curb extensions to preserve sight lines.
- Consider expanding curb extensions at bus stops to produce bus bulbs.
- If curb extension installation on one side is infeasible or inappropriate (i.e., no parking lane), this should not preclude installation on the opposite side.
- Maximum length can vary to accommodate sight lines, manage stormwater, facilitate transit loading, or restrict parking. Minimum length is the width of the crosswalk.
- Marked curb extensions must be supplemented with some physical barrier like delineator posts, flex curb with drainage, planters etc.
- Curb extensions should be supplemented with 'No Parking' signage to maintain sight distances between pedestrians and vehicles.
- Permanent curb extensions shall have returns of 45 degrees with R-5 radius to avoid trash accumulation and water puddles. These dimensions also make it easier for drivers to pull their vehicles out from the curb.

Considerations

- If funding for permanent curb extension construction is unavailable, curb extensions can be designed using lower cost alternatives such as bollards, temporary curbs, planters, or paint and striping.
- Curb extensions should not extend into travel lanes or bicycle lanes and should generally be designed with 1 foot of shy distance between the face of curb and the edge of travel lane.
- When designing the corner radius on a curb extension, consider the appropriate large vehicle turning path to prevent encroachment into the pedestrian space.
- Curb extensions can require modifications to or relocation of drainage structures. As an alternative consider drainage slots with solid surface plating at pedestrian crossings.

GATEWAYS / IN-STREET PEDESTRIAN CROSSING SIGNS

Description

Yield to Pedestrian signs (MUTCD R1-6) are placed in between opposing travel lanes to improve motorist awareness of pedestrians crossing.

Purpose

Reduce motor vehicle speeds and increase yielding at uncontrolled crosswalks.

Image source: City of Philadelphia

Crash Factors Addressed

● - Always consider ◔ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	◔	●	●	●	◔	●		●	◔	●	◔	◔

Safety Benefits

- Increase motorist yielding at uncontrolled crossings.
- May reduce delay for pedestrian crossings due to increased motorist yielding.
- Decrease vehicle speeds, even when pedestrians are not crossing.

Estimated Crash Reduction

An estimated crash reduction has not yet been determined; initial research indicates gateway treatments may increase driver yielding and reduce vehicle speeds (Van Houten and Hochmuth 2017).

Estimated Cost

$ $$ $$$ $$$$

Varies, but likely between $900 - $1,500.

Applicable Locations

- At crosswalks at uncontrolled vintersections.
- On roads with speed limits of 30 mph or less. v
- If speed limit is 35 mph, AADT should be below 12,000.

Philadelphia Locations

- 33rd Street
- 34th Street

Additional Information

- Philadelphia Complete Streets Design Handbook
- User Guide for R1-6 Gateway Treatment for Pedestrian Crossings
- Manual on Uniform Traffic Control Devices

GATEWAYS / IN-STREET PEDESTRIAN CROSSING SIGNS

Image source: Boston Complete Streets Design Guidelines

Design Guidance

- For gateways, all approaching travel lanes should have signs placed on both the left and right sides. Signs should be placed on center line, median, crossing island, or lane line, or near the curb.
- For treatment with in-street crossing signs only, place on the center line, median, crossing island, lane line, or near the curb.
- Install with curb ramps and high-visibility crosswalk markings.
- On multi-lane approaches, install with advance stop/yield markings.
- Signs and delineators should be installed between 1.5 feet and 50 feet in advance of the crosswalk. On multi-lane approaches, place Yield Here to Pedestrians signs (MUTCD R1-5 series).
- Double-sided signs are recommended because they increase the likelihood that drivers will see a sign in heavy traffic.

Considerations

- PennDOT encourages and provides in-roadway "Yield to Pedestrians" signs for use at uncontrolled intersections with significant pedestrian activity (local partners install and maintain).
- Signs should not be placed within the crosswalk.
- Use as a gateway treatment is more effective when the gaps between signs are smaller.
- Edge line and curb line placement require FHWA permission to experiment.
- Placing signs farther back from crosswalks at intersections (e.g., 30 feet) can reduce sign damage.
- A refuge island and advance yield lines are recommended where AADT is 12,000 or greater.

HARDENED CENTERLINES AND TURN WEDGES (LEFT TURN CALMING)

Description

Hardened centerlines are flexible delineators placed between opposing travel lanes. Turn wedges are raised curbs or flexible delineator posts and pavement markings on both sides of a crosswalk at an intersection.

Purpose

Reduce motor vehicle turning speed and increase motorist yielding to pedestrians.

Image Source: wamu.org

Crash Factors Addressed

● - Always consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
❍	❍	●	●	❍	●	●		●	●	●	●	●	●

Safety Benefits

- Slow left-turning motor vehicles without reducing traffic capacity.
- Guide motor vehicles to a wider turning angle for safer and more predictable turns.
- Make pedestrians in the crosswalk more visible to turning motorists.
- Mitigate visibility issues caused by metal reinforcement between vehicle windshields and windows.

Applicable Locations

- At intersections of midblock crossing locations where left turning vehicles do not yield sufficiently.
- At corners of an intersection.

Philadelphia Locations

- Broad Street – Allegheny Avenue to Erie Avenue

Estimated Crash Reduction

46% for all crashes at raised medians (Bahar et al. 2007). *A crash reduction estimate has not been established for turn wedges.*

20% decrease in pedestrian injuries at intersections in NYC with left turn calming (nyc.gov)

Estimated Cost

$ **$$** $$$ $$$$

Varies, but likely between $2,000 and $4,000 for a hardened centerline and turn wedge.

Additional Information

- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- FHWA Proven Safety Countermeasures
- NYC DOT Left Turn Traffic Calming

HARDENED CENTERLINES AND TURN WEDGES (LEFT TURN CALMING)

Image source: NACTO

Image source: NYCDOT

Design Guidance

- Hardened centerlines
  - Raise centerline with flexible delineator posts and durable plastic curbs (e.g., Leitboy Bollard with Guide Curb separator) before crosswalk.
  - Install a rubber speed bump, mountable curb, or flexible delineators and separators along the centerline, adjacent to the crosswalk, on the intersection side.
  - Paint lane extensions with yellow markings through the intersection.
  - Vertical elements should not be present in the crosswalk.
- Turn wedges
  - Have similar geometry and materials as a curb extension and are typically placed in line with a parking lane.
  - Reduce the effective turning radius for vehicles.

Considerations

- Can be constructed rapidly and inexpensively using paint, durable plastic curbs, and flexible dealineator posts.
- The turning radius of trucks and buses should be considered when installing turn wedges.

LEADING PEDESTRIAN INTERVALS (LPI)

FHWA PROVEN SAFETY COUNTERMEASURE

Description

Leading pedestrian intervals (LPIs) are adjustments to traffic signals that give pedestrians a 3 to 7 second head start before motorists enter the intersection. Bicyclists may also use LPIs where there are signs posted that instruct bicyclists to follow the pedestrian signal.

Purpose

Extend crossing time for pedestrians and bicyclists at signalized intersections.

Image source: Toole Design

Crash Factors Addressed

● - Alway consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	●	●	●	●	●		●	●	●		❍	❍

Safety Benefits

- Increase visibility of pedestrians.
- Increase motorist yielding.
- Provide more crossing time for pedestrians.

Applicable Locations

- At signalized intersections.
- At intersections with a significant number of turning vehicles and pedestrian volumes.

Philadelphia Locations

- Market Street & N 20th Street
- JFK Boulevard & N 15th Street

Estimated Crash Reduction

60% for vehicle-pedestrian crashes (Fayish and Gross 2010).

Estimated Cost

$ $$ $$$ $$$$

The cost to alter existing pedestrian signal is very little. Installing new signals can range from $40,000-$100,000.

Additional Information

- Pedestrian and Bicycle Information Center — Signals and Signs
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System

LEADING PEDESTRIAN INTERVALS (LPI)

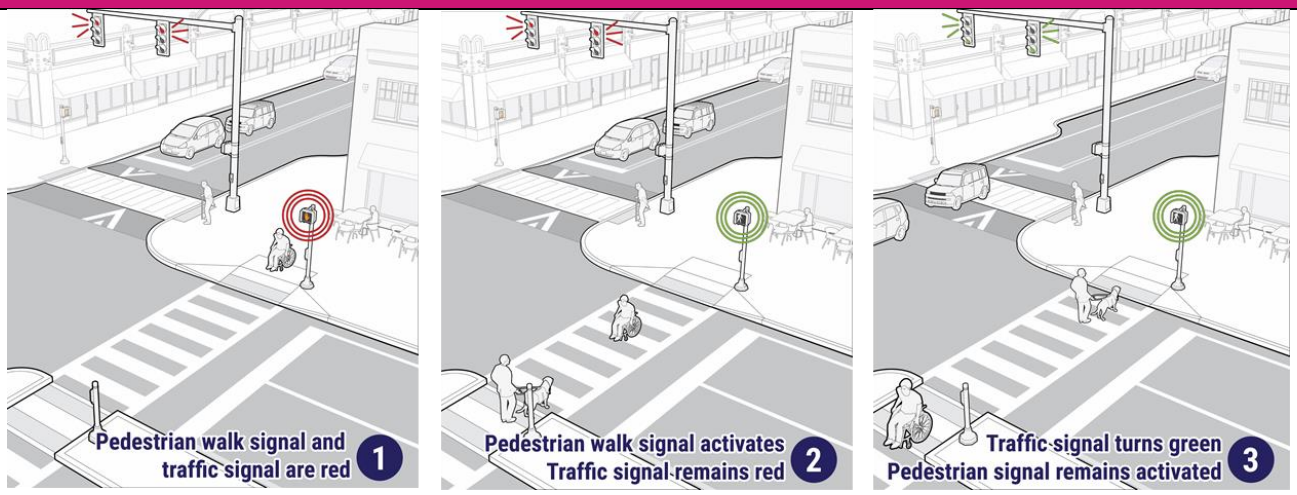


Image source: Massachusetts Pedestrian Transportation Plan

Design Guidance

- LPIs should be installed with:
  - high visibility crosswalk markings, curb ramps,
  - accessible pedestrian signals,
  - No Right Turn on Red sign (MUTCD R10-11).
- LPI installation should be standard for all signalized arterial streets carrying 12,000 or more ADT and crossing distances of 40 feet or wider.
- In Philadelphia, the City standard is a 3 sec head start or 5 seconds where there is demonstrated pedestrian crash problem, significant continuous right turn demand, or the street is excessively wide.

Considerations

- LPIs are an FHWA Proven Safety Countermeasure. The costs are very low and can be installed quickly where signal equipment is compatible.
- LPIs can be provided actively or only when actuated. Active detection requires an accessible pushbutton.
- The length of LPIs can be increased where pedestrian or bicyclist volumes are high.
- Right turn on red rules may limit the effectiveness of LBIs and LPIs.
- LPI may be accompanied with an audible noise for visually impaired pedestrians.

NO TURN ON RED

Description

No Turn on Red signs and signals prohibit motor vehicles turning right when the traffic light is red.

Purpose

Reduce conflicts between turning vehicles and pedestrians and bicyclists.

Image source: City of Philadelphia

Crash Factors Addressed

● - Alway consider ○ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
○	○	●	●	●	●	●		●	●	●		●	○

Safety Benefits

- Eliminate conflict between right turning vehicles and pedestrians traveling through.

Applicable Locations

- At signalized intersections, especially important at:
  - Intersections with crossing guards or at school crossings.
  - Intersections with high pedestrian volumes, such as those in Center City.
  - Intersections with inadequate sight distances.
- Right Turn on Red should be prohibited where bicyclists wait in front of motor vehicles, such as at bike boxes and two-stage turn queue boxes.

Philadelphia Locations

- 16th Street & Market Street
- Broad Street & Chestnut Street

Estimated Crash Reduction

3% for all crashes. (Harkey et al. 2008).

43% **increase** in vehicle – pedestrian crashes when **allowing** right turns on red (Gayah et al. 2014)

Estimated Cost

$ $$ $$$ $$$$

A sign costs approximately $200. Electric signs cost approximately $3,000.

Additional Information

- Highway Safety Manual
- MUTCD
- PEDSAFE and BIKESAFE
- Pennsylvania CMF Guide

NO TURN ON RED

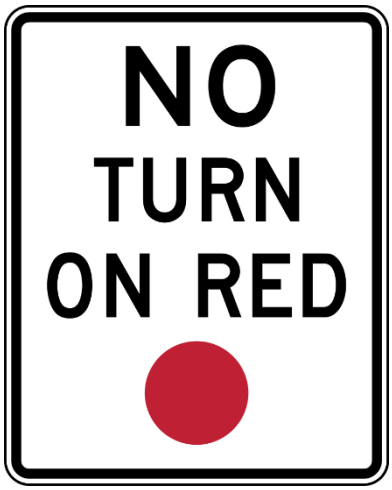


Image source: MUTCD

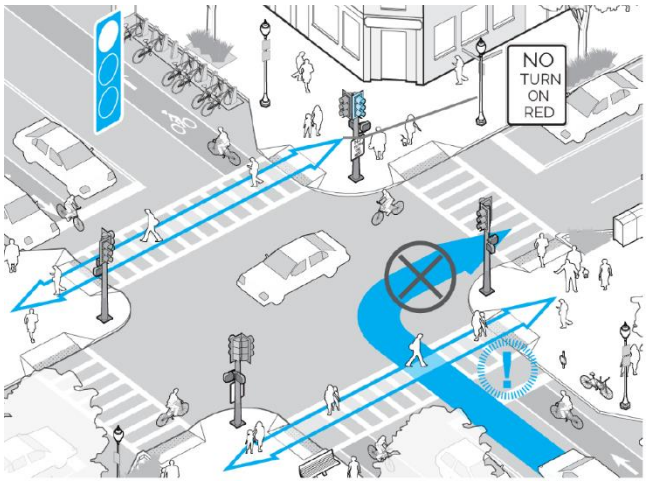


Image source: Boston Complete Streets Design Guidelines

Design Guidance

- Install No Turn on Red signs (MUTCD R10-11) on each applicable approach.
- Dynamic electronic signs can be used to restrict right turns to certain times of day or during certain signal phases.
- Signs restricting right turns on red should be visible to motorists stopped in the curb lane at the crosswalk.
- May increase the number of right turn on green conflicts. May be used with a leading pedestrian interval (LPI) to address the increased numbers of vehicles turning right on green.

Considerations

- Research indicates that dynamic signs may be more effective at reducing motorists turning right on red than static signs.
- Restricting right turns on red during times of high pedestrian volumes may be sufficient to reduce crashes.
- Two North American cities – New York City and Montreal – prohibit right turns on red unless otherwise specified.
    - A city-wide ban on right turns on red could have profound effects on pedestrian safety since studies have found that at locations with RTOR allowed, 56.9 percent of motorists do not come to a complete stop before turning right on red.

RAISED CROSSINGS AND RAISED INTERSECTIONS

Description

Raised crossings and intersections are elevated to the level of the sidewalk or placed on a ramped speed table.

Purpose

Reduce vehicle speeds, increase motorist yielding, and improve bicyclist and pedestrian crossing safety.

Image source: Toole Design

Crash Factors Addressed

● - Alway consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●		●	❍	●	●	❍		●	●	●	●	

Safety Benefits

- Increase pedestrian prominence in motorist field of vision.
- May reduce vehicle speeds and improve motorist yielding.
- Provide a flatter surface for pedestrians with disabilities.

Applicable Locations

- At uncontrolled marked crossings where additional speed reduction and visibility is desired.
- On streets with high pedestrian crossing demand and a maximum of two moving lanes and posted speeds below 35 mph.
- In the middle of a block (however, intersections can also have raised crosswalks, or the entire intersection can be raised).
- On school campuses and at shopping centers and pick up/drop off zones.

Philadelphia Locations

- At the Comcast Center on Arch Street
- 33rd Street – between Spruce Street and Walnut Street
- 54th Street – south of City Avenue

Estimated Crash Reduction

30% for all crashes (Bahar et al. 2007).

36% for all fatal or injury crashes (Bahar et al. 2007).

Estimated Cost

$ **$$** $$$ $$$$

Varies; $5,000 - $7,000 for raised crosswalks and $25,000 - $75,000 for raised intersections.

Additional Information

- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- Field Guide for Selecting Countermeasures at Uncontrolled Pedestrian Crossing Locations
- Philadelphia Complete Streets Design Handbook

RAISED CROSSINGS AND RAISED INTERSECTIONS

Image source: Toole Design

Image source: Toole Design

Design Guidance

- A raised crosswalk is typically a candidate treatment on 2-lane or 3-lane roads with speed limits of 30 mph or less and AADTs below 9,000.
- Place ramps on each vehicle approach.
- Raised crossings are often demarcated with different paving materials and additional paint markings.
- Mark the crossing with high-visibility crosswalk markings.
- Install with applicable warning sign (MUTCD W11-1, W11-2, W11-15, or S1-1).
- Raised crossings do not require curb ramps, though truncated domes should be included at each crossing entrance.

Considerations

- Further consideration is needed for roadways heavily used by trucks, buses, and emergency vehicles.
    - Minimize impacts to emergency vehicle response times through strategic placement and design details such as longer ramps, slots, or tire grooves.
- Raised crossings should not be used on steep curves or roadways with steep grades.
- May be used for bicyclists along crossings for shared use paths.
- Consider drainage needs.
- Raised crosswalks can be used in conjunction with other vertical treatments to maintain consistent speeds along the corridor.

ROUNDABOUTS

FHWA PROVEN SAFETY COUNTERMEASURE

Description

Roundabouts are circular intersections controlled by yield-control rather than a signal or stop sign.

Purpose

Reduce vehicle speeds, reduce high-speed collisions, and eliminate all left turns.

Image source: The Grand Rapids Press

Crash Factors Addressed

● - Alway consider ○ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
○	○	●	○	○	●	●		●	○	●	●	●	

Safety Benefits

- Reduce vehicle speeds.
- Eliminate angle collisions.
- Place emphasis on motorists yielding to all road users.

Estimated Cost

$ $$ $$$ $$$$

Varies based on planning, size, number of lanes, landscaping, and other site conditions. Lower cost of maintenance compared to signalized intersections.

Estimated Crash Reduction

27% in pedestrian fatal or injury crashes after unsignalized intersection to roundabout conversion (De Brabander and Vereeck, 2006).

82%, 78% in all severe crashes after converting two-way stop-controlled or signalized intersections to roundabouts, respectively (Highway Safety Manual, 1st edition, 2010).

Applicable Locations

- Can replace signalized intersections or be installed at intersections where signals are unwarranted.
- At intersections of local, collector, or arterial roadways.
- At intersections with high left-turning vehicle volumes.
- At intersections with more than four legs.
- At the entrance to an area with a change in land use.

Philadelphia Locations

- Walnut Lane & Park Line Drive
- 41st Drive & Landsdowne Drive

Additional Information

- FHWA Achieving Multimodal Networks
- NCHRP Report 672, Roundabouts: An Informational Guide, Second Edition
- NCHRP Report 834, Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities: A Guidebook
- Philadelphia Complete Streets Design Handbook

ROUNDABOUTS

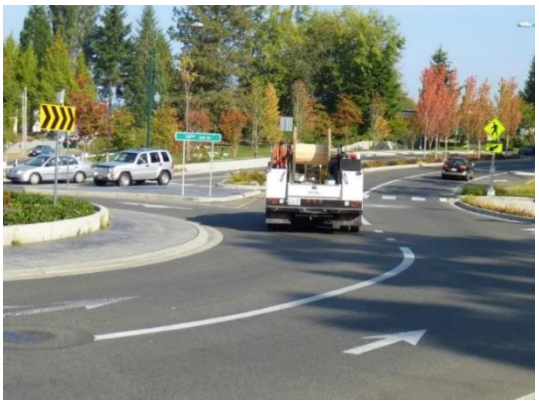


Image source: Toole Design

Image source: Toole Design

Design Guidance

- Construct a curbed island in the middle of the intersection
- Speeds and geometry should facilitate motor vehicle yielding. Entry speeds should be about 15 to 18 mph. Motorists can be slowed at exit and entry points using horizontal or vertical deflection.
- Channelization islands at all approaches can direct vehicles and slow traffic.
- Mark yield lines at all entries.
- Install crossing treatments for both pedestrian and bicyclists at least 20 feet from roundabout entry.
- Install with warning signs (MUTCD W11-1, W11-2, W11-15, or S1-1).
- May be installed with pedestrian-activated signals or beacons at crosswalks.

Considerations

- Add landscaping to the middle of the intersection for beautification and traffic calming.
- Account for pedestrian and bicycle volumes, the design vehicle, number of lanes, and available rights-of-way.
    - Roundabouts with high bicycle volumes should consider separated facilities for bicyclists
    - A truck apron should be provided around the center island if large vehicles are expected to use the intersection.
    - Mountable truck aprons can also be used on the approaches to achieve desired entry speeds for cars.
- Pedestrians may have to travel longer distances to cross the street due to location of crosswalks away from intersection but may experience less delay.
- Wayfinding should be provided for motorists, pedestrians, and bicyclists.
- Multi-lane or higher speed roundabouts may not be suitable for intersections with high pedestrian and bicyclist volumes without additional safety interventions.
- Acquiring right-of-way is the largest obstacle PennDOT has faced when trying to install roundabouts and is a major cost driver.
- Mini roundabouts may be more effective at intersections with low speeds and volumes.

SIGNAL TIMING AND AUTOMATIC PEDESTRIAN RECALL

Description

Coordinated signal timing can reduce speeding. Retimed pedestrian signals for children or older pedestrian crossing rates reduces crash risk and enhances equity.

With automatic pedestrian recall, the walk signal is illuminated at the same time as (or a few seconds before) the green signal without requiring pedestrians to push a button.

Purpose

Used together, these strategies can slow motor vehicle speeds, reduce pedestrian crossing delay, and create safer crossings.

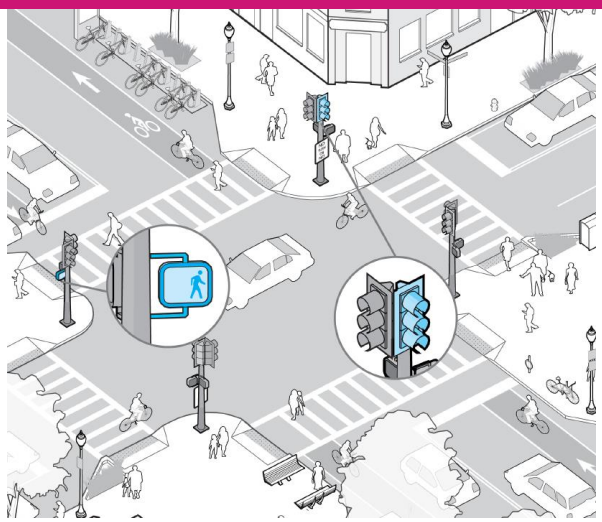


Image source: Toole Design

Crash Factors Addressed

● - Alway consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	●	●	●	●	●		●	●	●	●		

Safety Benefits

- Improve safety for all road users by managing vehicle speeds in certain circumstances.
- Reduce unsafe crossing behavior by improving the convenience of crossing at signalized intersections.
- Adequate pedestrian signal crossing time improves equity by allowing all people—including older pedestrians and those with disabilities—to cross safely.

Estimated Crash Reduction

50% for vehicle-pedestrian crashes, depending on specific signal phasing (Chen et al. 2012).

Estimated Cost

$ $$ $$$ $$$$

Signal phasing adjustment is low cost. New push buttons can range from $800 to $1,200; signals can range from $8,000 to $150,000.

Applicable Locations

- Coordinated signal timing should be considered across the network at all signalized intersections.
- Automatic pedestrian recall should be the default in locations with high pedestrian volumes.

Additional Information

- MUTCD
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System
- NACTO Urban Street Design Guide
- Traffic Signal Timing Manual
- US Access Board Public Right-of-Way Accessibility Guidelines (PROWAG)

SIGNAL TIMING AND AUTOMATIC PEDESTRIAN RECALL

Image source: Toole Design

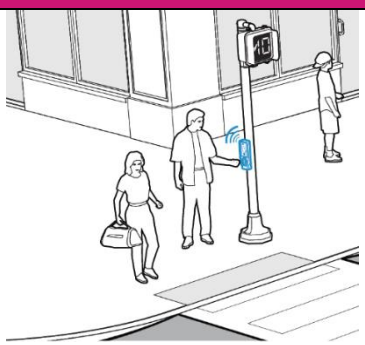


Image source: Toole Design

Design Guidance

- Time signals for the crossing speeds of older pedestrians, children, and people with disabilities, who cross more slowly.
- Time all pedestrian signals—including at intersections with crossing islands—to enable one-stage crossings by pedestrians in a single pedestrian signal cycle.
- Longer walk intervals and shorter cycle lengths (less than 90 seconds) better serve pedestrians and may increase safety.
    - The NACTO Urban Street Design Guide recommends cycle lengths between 60–90 seconds for urban areas.
- Where used, pedestrian push buttons:
    - Should be installed on either side of the crossing.
    - Must meet accessibility guidelines.
    - Can be made accessible by providing audible tones or vibrations.
- Passive detection devices may be used in place of pedestrian pushbuttons.
- Progression speeds should be set at or below the target speed, rather than existing 85th percentile speeds.

Considerations

- Concurrent signal phasing gives pedestrians more frequent crossing opportunities and less delay compared to exclusive signal phasing.
- Consider exclusive pedestrian signal phasing where significant or severe conflicts are expected, or where pedestrian volumes are lower and vehicle volumes are higher.
- Signal timing operations must account for motor vehicle volumes and turning movement volumes.
    - Off-peak signal timing plans that respond to lower traffic volumes may benefit from a shorter cycle length than the peak hour.
- Signal timing operations may impact delay to all travel modes. However, in congested areas, coordinating signals to reward slower speeds of 15-20 mph is unlikely to have much effect on existing peak hour delays.

PARKING & DRIVEWAY ACCESS MANAGEMENT

FHWA PROVEN SAFETY COUNTERMEASURE

Description

Access management refers to strategies that reduce or redesign driveways or intersections to limit the number and/or width of motor vehicle entry and exit points.

Purpose

Reduce or eliminate conflicts between road users.

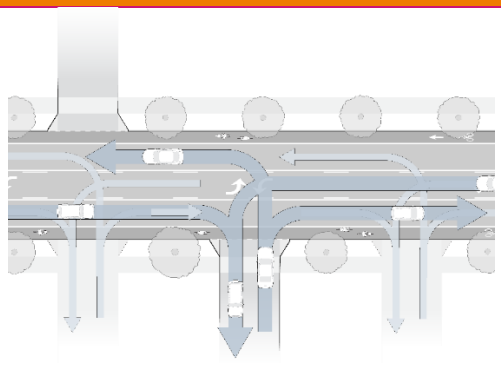


Image source: Toole Design

Crash Factors Addressed

● - Always consider ❍ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
		●	●	❍	●	❍	●	❍				●	❍

Safety Benefits

- Reduce or eliminate conflicts between pedestrians, bicyclists, and motor vehicle drivers.
- Increase amount of dedicated pedestrian space along a roadway.
- Improve accessibility of sidewalks with fewer driveway crossings.

Estimated Crash Reduction

25-31% Reduction in all injury and fatal crashes along urban/suburban arterials (FHWA Proven Safety Countermeasures: Access Management).

29% reduction in vehicle-pedestrian crashes when a raised median is provided (Pennsylvania CMF Guide).

Estimated Cost

$ **$$** $$$ $$$$

Raised medians cost between $2,100- and $40,000 per installation, depending on length.

Applicable Locations

- Highly applicable on higher-speed, auto-oriented streets with residential or commercial buildings.
- Close to intersections.
- Streets with high-volume driveways.

Additional Information

- FHWA Proven Safety Countermeasures
- NACTO Urban Street Design Guide
- Philadelphia Complete Streets Design Handbook

PARKING & DRIVEWAY ACCESS MANAGEMENT

Image source: Toole Design

Image source: Toole Design

Design Guidance

- Driveways must be level with the sidewalk and the material must change to demarcate the sidewalk crossing area (for example, to the same concrete as the rest of the sidewalk).
- Limit curb cuts in residential areas to make the parking supply more efficient and allow for safer bikeways.
- More than one driveway per 100 feet of frontage is strongly discouraged.
- Driveways should be at least 20 feet from unsignalized intersections or crosswalks and 40 feet from signalized intersections.
- Commercial properties may have only one driveway within 100 feet of an intersection, which must be as far as practicable from the intersection.

Considerations

- City policy states driveways should be located on service streets or minimized to the extent possible.
- Reduce or eliminate driveways to the maximum extent possible, especially on streets with higher pedestrian volumes.

AUTOMATED ENFORCEMENT

Description

Automated enforcement is a system for automatically issuing fines for running red lights or speeding. Mounted cameras record images of vehicles that speed or run red lights.

Purpose

Reduce serious injuries and fatalities caused by red light running and speeding.

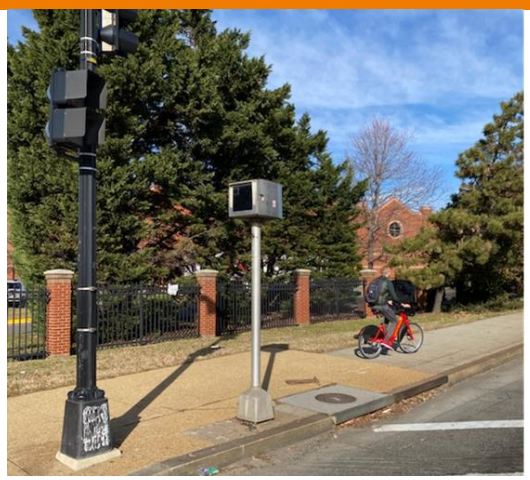


Image source: Toole Design

Crash Factors Addressed

● - Always consider ○ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
○	○	●	●		●	●	●	●		●	●	●	

Safety Benefits

- Reduces red light running.
- Reduces speeding.
- Reduces serious offset and right-angle crashes at intersections.
- Reduces speeding-related crashes outside of peak traffic flow times.

Estimated Crash Reduction

16% reduction for all injury crashes from red light cameras (Persuad et al. 2005, Hu et al. 2011)

25% reduction for all injury crashes from speed cameras (Li et al. 2013).

Estimated Cost

$ $$ **$$$** $$$$

Cameras typically cost $75,000 - $85,000 to install and $5,000/month in operating costs.

Applicable Locations

- Automated speed enforcement is currently allowed on:
  - Roosevelt Boulevard
  - Highway work zones
- Red light cameras are most applicable in:
  - Intersections with a history of red light running or crashes
  - School zones
  - Areas where it would be hazardous for police to stop vehicles

AUTOMATED ENFORCEMENT

Additional Information

- FHWA Red Light Camera Systems Operational Guidelines
- NHTSA Countermeasures that Work
- Pennsylvania CMF Guidebook
- Pennsylvania State TAC Report: Evaluating the ARLE Program

Image source: Toole Design

Implementation Guidance

- Red light automated enforcement is recommended for intersections with previously documented red light running.
- Install signage warning motorists in advance of the first red light or speed camera on a corridor.
- Place speed cameras in school zones away from traffic signals, stop signs, yield signs, freeway ramps, curves with advisory speeds, or established speed transition zones.
- Contract with a firm that specializes in these systems for installation and administration.
- A law enforcement officer must verify the violation and sign the citation.

Considerations

- Legal authority is necessary to use automated red light or speeding enforcement.
- Public education about the safety benefits of automated enforcement may increase support for the programs.
- Within the first 12 months of Philadelphia's ARLE program, red light running violations were reduced by 48 percent, and the total number of crashes at 10 ARLE intersections were down 24 percent.
- While red light cameras can reduce the total number of crashes overall, they can increase the number of rear-end crashes. However, rear end crashes tend to be less severe than angle crashes or other types of crashes that are typically reduced.

POSTED SPEED LIMIT

FHWA PROVEN SAFETY COUNTERMEASURE

Description

This countermeasure includes speed limit signs, pavement markings, and other speed reduction measures to achieve target speeds on roadways.

Purpose

Reduce motor vehicle speeds to prevent severe and fatal crashes.

Image source: Toole Design

Crash Factors Addressed

● - Always consider ○ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	●	●	●	●	●	●		●	●	●	○	○

Safety Benefits

- Increases motorist awareness of vulnerable road users.
- May reduce motor vehicle speeds.
- Lowers frequency and severity of pedestrian fatalities and serious injuries.

Estimated Crash Reduction

44% reduction in all fatal crashes when average speeds are lowered by 15% (Pennsylvania CMF Guidebook)

22% reduction in all injury crashes when average speeds are lowered by 15% (Pennsylvania CMF Guidebook)

Estimated Cost

$ $$ $$$ $$$$

Cost for signs and pavement markings typically ranges from $200 to $2,000.

Applicable Locations

- Posted and target speeds should be considered for all roadways.
- Lower posted and target speeds are especially effective at reducing pedestrian crash risk in areas of high expected activity, such as:
  - Near schools
  - Downtown commercial areas
  - Near senior living centers
  - Residential neighborhoods

Additional Information

- MUTCD 2009, Sec. 7B.08–7B.10.
- National Center for Safe Routes to School, The School Zone: School Zone Signs and Pavement Markings.
- PennDOT Pub. 111 - TC 8600

POSTED SPEED LIMIT

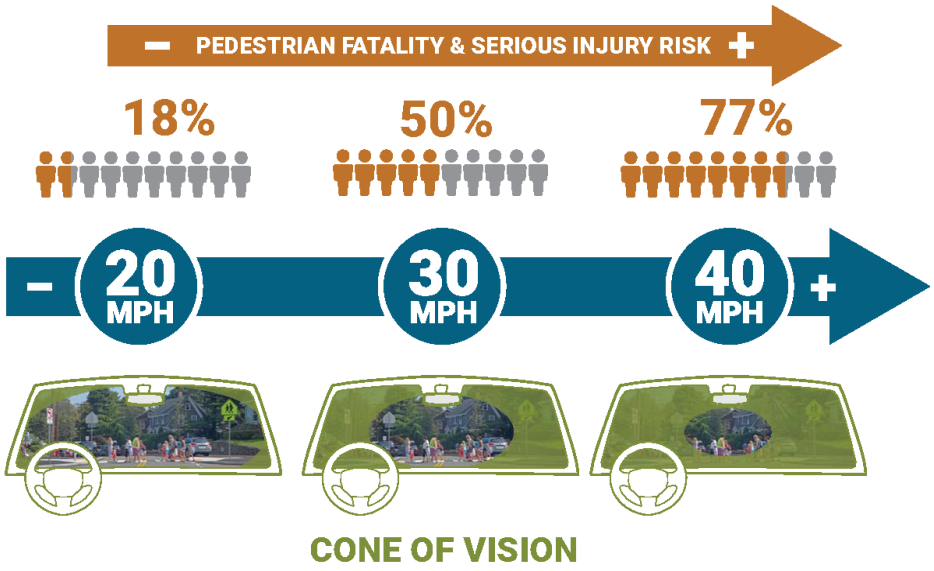


Image source: FWHA Achieving Multimodal Networks

Design Guidance

- Define the priority user when identifying appropriate speed limit. Within school zones, pedestrians and bicyclists should always be given priority.
- Indicate school speed zones with signs (including MUTCD S4-5 series, S5-1, S5-3, R2-1).
- Pavement markings indicating the speed limit can supplement signs.
- Most effective when used in conjunction with other traffic calming treatments.
- The City of Philadelphia has found dynamic speed feedback signs and trailers to be effective at lowering speeds around schools. Studies in other cities have found speed trailers to be effective at lowering speeds slightly, but the effectiveness disappears once trailers are removed.

Considerations

- School speed zones can be implemented for certain hours throughout the day, such as around arrival and dismissal times.
- Signs should be used carefully. Overuse can lead to drivers ignoring them.

PROTECTED TURN PHASES

Description

Protected turn phases are green or red arrow signals that restrict drivers from left or right turns, allowing through vehicles, pedestrians, and bicyclists to cross without interference from turning vehicles.

Purpose

Separate vehicular turns from other vehicle, pedestrian, and bicyclist movements to eliminate conflicts.

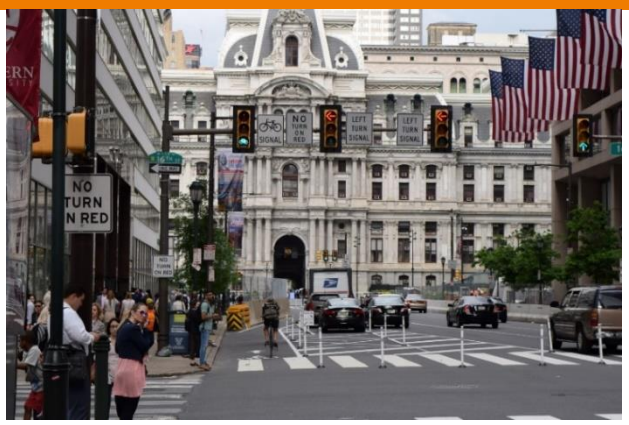


Image source: City of Philadelphia

Crash Factors Addressed

● - Always consider ○ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	●	●	●	●	●	●	●	●	●		●	

Safety Benefits

- Eliminate conflicts between turning vehicles and road users crossing parallel to traffic.
- Reduce instances of motorists turning at higher speeds and "sneaking" through intersections during yellow or red signal phases.

Applicable Locations

- At intersections with high turning volumes.
- At intersections in urban areas.
- At intersections with a high volume of pedestrians or bicyclists.

Expected Crash Reduction

34% for vehicle-pedestrian crashes with exclusive pedestrian phase (ITE 2004).

20% reduction in all left-turn crashes with flashing yellow arrow (PennDOT).

Estimated Cost

$ $$ $$$ $$$$

Adjusting phasing at existing signals has a low cost. Installing signals can vary in cost, ranging from $8,000 to $150,000.

Philadelphia Locations

- Arch Street & 15th Street
- John F Kennedy Blvd & 16th Street
- Market Street & 16th Street (pictured)

Additional Information

- FHWA Traffic Signal Timing Manual, Chapter 4
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System
- PennDOT Flashing Yellow Arrow Fact Sheet

PROTECTED TURN PHASES

Image source: Toole Design

Design Guidance

- Install green or red arrow capabilities in traffic signals.
- Can be used for both right turning and left turning vehicles.
- When restricting right turns, install a "No Right Turn on Red" sign (MUTCD R10-11 series).
- Exclusive left turn lanes support protected left turn phasing.
- PennDOT introduced flashing yellow left turn arrows in 2016. The flashing yellow arrow means drivers may turn left after yielding to oncoming traffic and pedestrians.

Considerations

- Needs of pedestrians, bicyclists, trucks, buses, and motor vehicles should be considered.
- Consider volume of motorists turning left and right.
- May reduce intersection vehicle capacity.
- When restricting left turns at intersections with manageable left turns but high volumes of through traffic, a protected/permissive phase can be used. This does not eliminate vehicle-pedestrian conflicts, and protected signal phases have higher safety benefits.
- Protected left turn and right turn protected phases directly impact intersection's vehicle capacity.

ROAD RIGHT SIZING AND LANE NARROWING

FHWA PROVEN SAFETY COUNTERMEASURE

Description

These countermeasures reduce the number of lanes (road right sizing) or the width of lanes (lane narrowing).

Purpose

Reduce the speed of traffic, reduce crossing distances, and/or provide additional space for other elements within the roadway.

Image source: Toole Design

Crash Factors Addressed

● - Always consider ○ - May want to consider

Nights and Evenings	Fall	Urban Arterials	High Pedestrian Activity	Near Transit Stops and Stations	Near Schools	Intersections	Midblock	Collector Intersections	Crosswalks	Traffic Signals	Speeding	Turning Movements	Vehicle Type
●	●	●	●	●	●	●	●		●	●	●	●	○

Safety Benefits

- Increase available space for additional safety infrastructure for pedestrians or bicyclists.
- May reduce the number of potential conflict points.
- May slow motor vehicle operating speeds.
- May reduce crossing distances by eliminating a lane or by providing a pedestrian median island.

Expected Crash Reduction

29% for all crashes on minor arterials in urban areas (Pawlovich et al. 2006).

Estimated Cost

$ **$$** $$$ $$$$

Lane restriping can cost $20,000 to $40,000 per mile. Additional infrastructure varies in cost.

Applicable Locations

- On multi-lane roads.
- On roads with priority pedestrian and bicyclist routes (these should be emphasized).
- In urban, suburban, and rural areas.

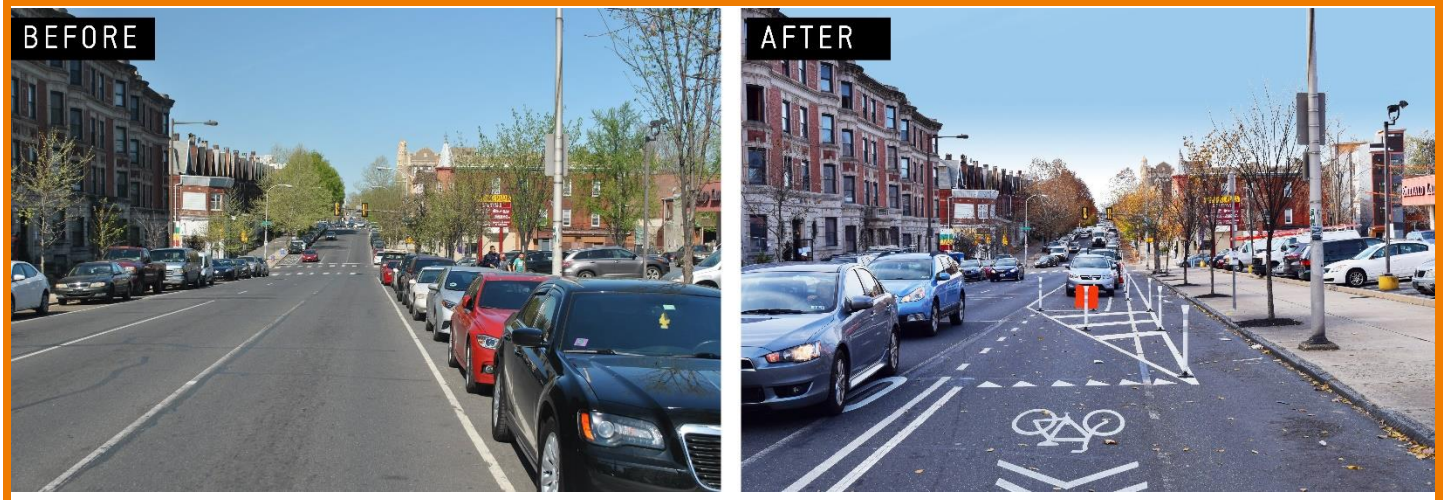
Philadelphia Locations

- Chestnut Street - 45th to 34th Street (pictured, next page)
- Monument Road – Ford Road to City Avenue

Additional Information

- Evaluation of Lane Reduction "Road Diet" Measures on Crashes
- FHWA Achieving Multimodal Networks
- FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
- PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System
- Road Diet Informational Guide

ROAD RIGHT SIZING AND LANE NARROWING



Chestnut Street - 45th to 34th Street

Image source: City of Philadelphia

Design Guidance

- Eliminating a travel through lane can make room for a bicycle lane, turn lanes, wider sidewalks, a median island, curb extensions, on-street parking, a transit lane, landscaping, or other uses.
- Road right sizing projects are often considered on four lane roadways with up to 24,000 AADT.
- A lane width of 10 feet can accommodate all vehicle types, but road sections with horizontal or vertical curves may need additional width.
- Lane width of outside travel lanes may be slightly wider to accommodate curbside uses.
    - 11' preferred for SEPTA bus routes
    - 10' preferred for other roadways

Considerations

- Evaluate the impact of a road right sizing on all road users, not just drivers.
- Consider implementing a road right sizing in conjunction with a pavement overlay.
- FHWA recommends considering the following factors:
    - Volume thresholds, such as average daily traffic (AADT)
    - Vehicle speed
    - Trip generation estimates
    - Level of Service
    - Pedestrian and bicyclist volumes
    - Transit and freight operations
    - Peak hour and peak direction traffic flow
- Eliminating a travel through lane may increase congestion during peak travel hours.

Automated Enforcement

Automated Red-Light Enforcement Program (ARLE)

The ARLE Program uses red light cameras at high-volume and high-risk intersections to reduce red-light running. The cameras have proved effective; a 2011 study found that they reduced red-light violations by an average of 48 percent in the first year after installation. Pennsylvania law requires that funding from the enforcement program is dedicated to transportation safety improvements. To date, the City's ARLE Transportation Safety Enhancements consists of 18 individual projects or programs; 7 are currently active.

Speed Cameras

In August 2020, the City started a five-year pilot program where automated speed cameras will be installed along Roosevelt Boulevard. There is a total of 8 cameras located near these intersections:

- Roosevelt Boulevard and Banks Way
- Roosevelt Boulevard and F Street
- Roosevelt Boulevard and Deveraux Street
- Roosevelt Boulevard and Harbison Avenue
- Roosevelt Boulevard and Strahler Street
- Roosevelt Boulevard and Grant Avenue
- Roosevelt Boulevard and Red Lion Road (near Whitten Street)
- Roosevelt Boulevard and Southampton Road (near Hornig Road)

The installation of the cameras was followed by a 60-day warning period to educate drivers about the program without being fined. After the 60-days, fines for drivers going 11 to 20 MPH above the posted speed limit will start at $100 and rise to $150 if drivers were exceeding the posted speed limit by 30 MPH or more. The starting fine is the same amount for the existing automated red-light enforcement camera fine.

Focus on Youth

Overview

This section describes key considerations for countermeasure selection as they relate to children and youth and areas where children are likely to walk. It references the *Pedestrian Safety Countermeasure Matrix* and highlights information provided on the *Pedestrian Safety Engineering Cut Sheets* specifically relating to children and youth. It ends with a set of recommendations for applying lessons learned in this study process moving forward. Children and youth have differing abilities and special vulnerabilities compared to adults, and youth crashes happen in different places and times of day than all ages crashes. These factors should be considered in the planning and design of specific infrastructure elements to improve youth pedestrian safety.

While this section focuses on children and youth, all of the Pedestrian Safety Countermeasures will improve safety for all roadway users, including younger people. It is also important to recognize that engineering countermeasures are not going to enable, for example, a 6-year-old to walk safely without adult supervision. Physical improvements will need to be supplemented and reinforced with age-appropriate supervision by a responsible adult, educational activities and programs such as walking school buses, and in some cases crossing guards.

Age-Appropriate Abilities and Special Vulnerabilities of Children and Youth

Regardless of location in the U.S., city streets are not generally designed with children's abilities in mind. Most elementary school-aged students don't have the cognitive ability to make safe, consistent decisions about when to cross streets, generally due to speed and distance calculations and impulsivity. This means that multi-lane roadways, high-speed streets, and complex crossings are going to be more difficult for children to navigate safely and they need a physical environment that is more forgiving of mistakes. This should impact decisions about pedestrian safety countermeasures needed on roadways where youth travel, for example near schools, parks, and on neighborhood streets.

In addition to age-appropriate abilities, children and youth also have special vulnerabilities that should be considered. They are not as visible to drivers because of their shorter height and school arrival hours and afterschool activities tend to occur at times when adequate lighting will be especially important. It is important to note that the importance of factors such as lighting and visibility extends beyond the immediate school site itself and to key crossings near schools, bus stops, and destinations.

Table 1 highlights considerations relating to age appropriate abilities and special vulnerabilities of youth, specifically as they relate to the Pedestrian Safety Countermeasure Matrix and Toolbox provided earlier in this chapter

TABLE 7.
EXAMPLES OF CONSIDERATIONS RELATING TO AGE-APPROPRIATE ABILITIES AND SPECIAL VULNERABILITIES OF CHILDREN AND YOUTH RELATING TO PEDESTRIAN SAFETY COUNTERMEASURES

PEDESTRIAN SAFETY COUNTERMEASURE	CONSIDERATIONS FOR CHILDREN AND YOUTH
Crossing Islands	Children can have challenges when crossing wide, multi-lane streets compared to older, more-experienced people. Providing a raised island can simplify the crossing maneuver.
Signal Timing and Automatic Pedestrian Recall	Shorter signal cycles can result in shorter pedestrian wait times for the WALK interval. Pedestrian recall means that pedestrians get the WALK interval every cycle, without having to activate a push-button. Both features have obvious advantages for young pedestrians.
Protected Turn Phases	Providing protected turn phases, such as a protected left-turn phase, allows for pedestrians to cross during a WALK interval, without having to worry about conflicting left-turn traffic. Such a measure reduces the decision burden for young, inexperienced pedestrians when crossing the street at a busy intersection.
Leading Pedestrian Intervals (LPIs)	LPIs provide an interval of a few seconds at the beginning of each signal phase which gives pedestrians priority overturning vehicles. Such a separated interval has the potential to particularly benefit young pedestrians, who typically have added difficulty interacting with turning vehicles at intersections.[34]
Gateways and In-Street Pedestrian Crossing Signs	These have been shown to increase motorist yielding at pedestrian crossings, which would benefit young pedestrians and their challenge with judging vehicle speed and acceptable gaps.
Motor Vehicle Speed Reduction	Children have difficulty perceiving speed of oncoming vehicles and take longer to decide and proceed with crossing, putting them at added risk the faster vehicles are traveling.
Lighting	Lighting can benefit children who cross streets to get to or from a bus stop or school especially during times of the year when they may be traveling to or from school or other destinations in darkness.
Parking Restrictions at Pedestrian Crossings	Since children are shorter than adults, this is a particular benefit for drivers and children to be able to see each other at intersections.

[34] Case Study: NYC showed crash reductions, for example on a two-way protected bike lane along a park, which offers cyclists a safer space, but also serves the dual purpose of reducing lane width, thereby slowing traffic. Leading pedestrian intervals were installed on a service road leading to an expressway, allowing pedestrians to get a head start crossing a street before traffic proceeds. Parking regulations along the corridor were overhauled, extending the 'no-standing' zone during school drop off and pick up hours, and removing several spaces to improve visibility. Slow zones were added, as well as stop controlled high visibility crosswalks. The merge of the two streets was also improved.

Corner Radius Reduction	This measure reduces the radius of a corner, creating a sharper turn for motor vehicle drivers, which reduces the speed of turning vehicles, while at the same time shortening pedestrian crossing distance at intersections. These are both beneficial features for children who cross such intersections.
Curb Extensions	This treatment shortens the crossing distance, reduces turning speeds, and improves sight distance between the driver and pedestrians, which can all benefit child pedestrians.
High-Visibility Crosswalks	These have been shown in a California study to be effective in reducing child pedestrian crashes in school zones, compared to parallel-line crosswalks.
Hardened Centerlines and Turn Wedges	Hardened centerlines can reduce the length of the conflict area between pedestrian crossings and left-turn vehicles at intersections. Turn wedges serve a similar purpose as curb extensions, including shorter crossing distances and slower speeds of right-turning vehicles. Both measures can potentially benefit young pedestrians at intersections, and both are relatively new and low-cost measures.
No Turn on Red (NTOR) Signs	NTOR signs help to reduce the conflict from right-turning vehicles at intersections during the WALK interval, which can benefit young pedestrians.
Raised Crossings and Raised Intersections	Raised crossings typically slow the speeds of motor vehicles where pedestrians cross at intersections. Shorter, younger pedestrians can benefit from such speed reductions and from the vertical elevation provided by the raised crossing surfaces.
Posted Speed Limits	Posting speed limits, in addition to selective speed enforcement and other measures (e.g., traffic calming) is a part of an overall effort to keep vehicle speeds at reasonably safe levels, which is essential for safer travel by child pedestrians.
Automated Enforcement	This measure can involve enforcing signal compliance and/or compliance of speed limits, both of which are obviously important to safe walking by children.
Access Management	This measure, among other things, implies the careful placement of driveways and a reduction of conflict points between motorists and pedestrians, which is certainly beneficial to children who are walking on the sidewalk.
Road Diets and Lane Narrowing	Road diets have a proven safety benefit to overall crashes, not just pedestrian crashes. This measure involves eliminating a travel lane which slows vehicle speeds and shortens crossing distance. Lane narrowing can reduce vehicle speeds and shorten the street crossing distance. Both of these measures can be beneficial to child pedestrians, in particular.[35]
Crossing Guards	Particularly at intersections heavily used by young pedestrians, crossing guards can play an important role in determining an appropriate time for crossing and controlling the crossing of young pedestrians. Their presence also serves as a deterrent to speeding drivers.
Neighborhood Slow Zones	Neighborhood Slow Zones reduce the speed limit and add safety measures within a select area, for example where children are walking, in order to change driver behavior.

[35] Case Study: New York City used traffic calming treatments in Bronx near schools that included a 4 lane to 3 lane right sizing, curb extensions, left turn traffic calming (such as a hardened center line, a treatment which tightens up and slows left turns), and pedestrian islands. In the first year after project implementation total crashes were reduced by 18 percent.

Recommendations

1. **IMPLEMENT TARGETED YOUTH PEDESTRIAN SAFETY ACTIVITIES**: These may include speed management measures such as installing speed cushions where kids are walking, for example in neighborhood slow zones and around Philadelphia schools, including public, private, parochial, and charter schools. The results of the forthcoming youth crash analysis, which includes identification of high-risk roads, should also inform locations for targeted youth pedestrian safety activities. Youth pedestrian safety activities can include staff technical assistance for skills-based pedestrian and bicycle safety education to schools in high-crash areas and the opportunities to engage youth directly in pedestrian safety-related activities near schools should also be explored. Another targeted pedestrian safety activity is the creation of traffic gardens at schools throughout the city where children can learn safe walking and biking habits.
2. **ENSURE THAT FUTURE CRASH ANALYSES INCORPORATE YOUTH-SPECIFIC LESSONS LEARNED FROM THIS STUDY PROCESS**. This study process uncovered many potentially important insights that should be considered and incorporated moving forward. Most notably, it appears that youth crashes happen in different places and times of day than all ages crashes. As a result, youth risks may be inadvertently lost if batched with all crashes in safety analyses. The initial observation highlighted below require additional study and should help improve decisions about locations and type of countermeasures.
    a. Most youth pedestrian crashes occur during daytime hours, particularly weekday afternoons, which certainly aligns with when most children are likely outside walking or playing. Midblock crashes are slightly more frequent and, along with nighttime crashes, are likely to be more severe than at other locations and times for youth. Non-intersection locations and motorist going straight maneuver types have greater severity, likely the result of with higher vehicle speeds.
    b. It is important that intersections function safely for youth, providing opportunities to cross at controlled locations with a minimum of conflicts. There may be a need for midblock crossing improvements, especially if there are locations where youth often cross to access commercial destinations transit or other types of facilities. The distance between safe crossing should also be considered in these analyses as people of all ages tend not to walk far out of their way.
    c. Speed is a crucial factor in safety for pedestrians of all ages and urban locations where youth and others walk, and play should have low speed limits, design and enforcement features in place to reduce the chances of serious and fatal injury in the event of a crash. Lower speeds also result in shorter stopping distances and may provide better opportunities for drivers to detect and avoid hitting a pedestrian altogether.
3. **IDENTIFY AND FURTHER EXPLORE POTENTIAL RESEARCH TO ANSWER KEY QUESTIONS RELATING TO CHILDREN AND YOUTH AND PEDESTRIAN SAFETY COUNTERMEASURES**. This study process highlighted research gaps concerning safety countermeasures, specifically as they relate

to efficacy for children and youth. Since the City of Philadelphia is a national leader in this space, it will be important to document these gaps, collect data where possible, and encourage local universities and national research bodies to conduct targeted research to fill gaps in practice and knowledge.

For example, although Rectangular Rapid Flashing Beacons (RRFBs), have been found to reduce crashes for pedestrians in general, their effect on youth at pedestrian crossings is not specifically known. When used at crossings on multi-lane arterial streets, young children may not be safe to cross alone, but older youth (e.g., high-school aged) may benefit from RRFBs, compared to having no traffic control at crossings. If a pushbutton is required, children will likely need guidance at first on how to use them. Similarly, while roundabouts have been shown to have an overall beneficial effect on pedestrian safety compared to traditional intersections, they have not been studied extensively regarding their safety effect on young pedestrians and children and youth may also initially require guidance on how to cross.

Conclusion

While achieving zero pedestrian fatalities or serious injuries requires a multi-faceted approach that includes education and enforcement, the importance of altering the built environment with engineering countermeasures that are proven to reduce speed, increase visibility, reduce pedestrian crossing distance, increase separation of modes and improve driver yielding should not be overlooked. Achieving these safety objectives can improve safety for all modes, resulting in an overall decrease in serious injury and fatal crashes in support of Philadelphia's goal of reaching zero by 2030.

To achieve this goal within the limited resources available, Chapter 4 - Priorities highlights the intersections, corridors, and areas that the City may want to consider focusing resources on first. These priorities will both guide the selection of corridors/intersections/areas for new, specifically pedestrian oriented safety improvements as well as offer pedestrian crash solutions for projects already in the development pipeline. When the City looks to do a repaving project, for example, the project development process would incorporate these pedestrian crash countermeasures into the design, considering the specific context around them.

CHAPTER 4: PRIORITIES

Overview

Identifying places to focus pedestrian improvements is the basis for an implementation program. Priority intersections, priority corridors, and priority areas were identified for the City of Philadelphia based on the findings. The top ten for each and a city-wide map are below, and the top fifty are detailed in Appendix B.

Intersection Priorities

To create a list of priority intersections, all pedestrians injured or killed in crashes at each intersection were added together. Pedestrian fatalities were weighted four times higher than injuries. Aligning with the City of Philadelphia's Vision Zero goal of bringing traffic deaths to zero by 2030, this prioritizes intersections with high numbers of pedestrian fatalities. Each intersection was then sorted by its score. For example, at Harbison Ave and Roosevelt Boulevard, there were three pedestrian fatalities (weighted by four, creating a score of 12) and nine pedestrian injuries between 2014-2018, totaling a score of 21 for that intersection. Below is a table of the intersections ranked by number of pedestrian fatalities and then pedestrian injuries. This list can be a foundation for plans to improve pedestrian safety.

TABLE 8.

TOP TEN PRIORITY PEDESTRIAN INTERSECTIONS IN PHILADELPHIA

RANK	INTERSECTION	PEDESTRIAN FATALITIES (PEOPLE)	PEDESTRIAN INJURIES[36] (PEOPLE)	TOTAL PEDESTRIAN FATALITIES & INJURIES (PEOPLE)
1	Bustleton Ave/Levick St & Roosevelt Blvd	4	3	7
2	W Allegheny Ave & Germantown Ave	4	2	6
2	Faunce St/Revere St & Roosevelt Blvd	4	2	6
4	Harbison Av & Roosevelt Blvd	3	9	12
5	N 2nd St & W Lehigh Ave	3	7	10

[36] Pedestrian injuries in this plan refer to all types of possible pedestrian injuries as defined by PennDOT, including possible injuries, injury of unknown severity, suspected serious injuries, and suspected minor injuries.

6	Large St & Roosevelt Blvd	3	0	3
7	Whitaker Ave/Adams Ave & Roosevelt Blvd	2	7	9
8	N 9th St & Roosevelt Blvd	2	6	8
9	Arch St & N Broad St	2	5	7
10	E Allegheny Ave & Aramingo Ave	2	4	6

FIGURE 40.
MAP OF TOP TEN PRIORITY PEDESTRIAN INTERSECTIONS IN PHILADELPHIA

The top ten priority pedestrian intersections were selected through a city-wide review of pedestrian injuries and fatalities that occurred between 2014 and 2018.

Source: PennDOT Crash Tables, 2014-2018

Corridor Priorities

To create priority corridors, crashes that occurred along each corridor were added together. Corridors are segments of streets that are contiguous, have the same street name, functional classification (e.g. major arterial, minor arterial, expressway), Complete Streets typology (from the City of Philadelphia's 2017 Complete Streets Handbook, which created street typologies such as Urban Arterial, Park Road, City Neighborhood Street), and are longer than 1,000 feet. To create a list of priority corridors, all pedestrians injured or killed in crashes in each corridor were added together. Pedestrian fatalities were given a weight four times larger than an injury. Corridors were then sorted by their "score": pedestrian injuries and pedestrian fatalities (weighted by four) added together. Below is a Top 10 list of priority corridors. This list can be a foundation for plans to improve pedestrian safety.

TABLE 6.
TOP TEN PRIORITY PEDESTRIAN CORRIDORS IN PHILADELPHIA

RANK	CORRIDOR	PEDESTRIAN INJURIES (PEOPLE)	PEDESTRIAN FATALITIES (PEOPLE)	TOTAL PEDESTRIAN FATALITIES AND INJURIES (PEOPLE)	CORRIDOR LENGTH (MILES)
1	**Roosevelt Blvd** from Schuylkill River to Bucks County Line	31	132	163	14.70
2	**N Broad St** from City Hall to Glenwood	5	177	182	3.04
3	**N Broad St** from Glenwood to Windrim	5	138	143	2.26
4	**S Broad St** from City Hall to Oregon	0	110	110	2.44
5	**Market St** from City Hall to 2nd	1	85	86	1.02
6	**Allegheny Ave** from Sedgley to Reach	2	62	64	1.60
7	**N Broad St** from Lindley to Montgomery County Line	0	82	82	2.29

RANK	CORRIDOR	PEDESTRIAN INJURIES (PEOPLE)	PEDESTRIAN FATALITIES (PEOPLE)	TOTAL PEDESTRIAN FATALITIES AND INJURIES (PEOPLE)	CORRIDOR LENGTH (MILES)
8	**Chestnut St** from Independence Mall to 20th	0	79	79	1.31
9	**Kensington Ave** from Front to Pacific	0	73	73	1.87
10	**Chestnut St** from Cobbs Creek to 38th	1	70	71	2.62

FIGURE 41.
MAP OF TOP TEN PRIORITY PEDESTRIAN CORRIDORS IN PHILADELPHIA

The top ten priority pedestrian corridors were selected through a city-wide review of pedestrian injuries and fatalities that occurred between 2014 and 2018.

Source: PennDOT Crash Tables, 2014-2018

Area Priorities

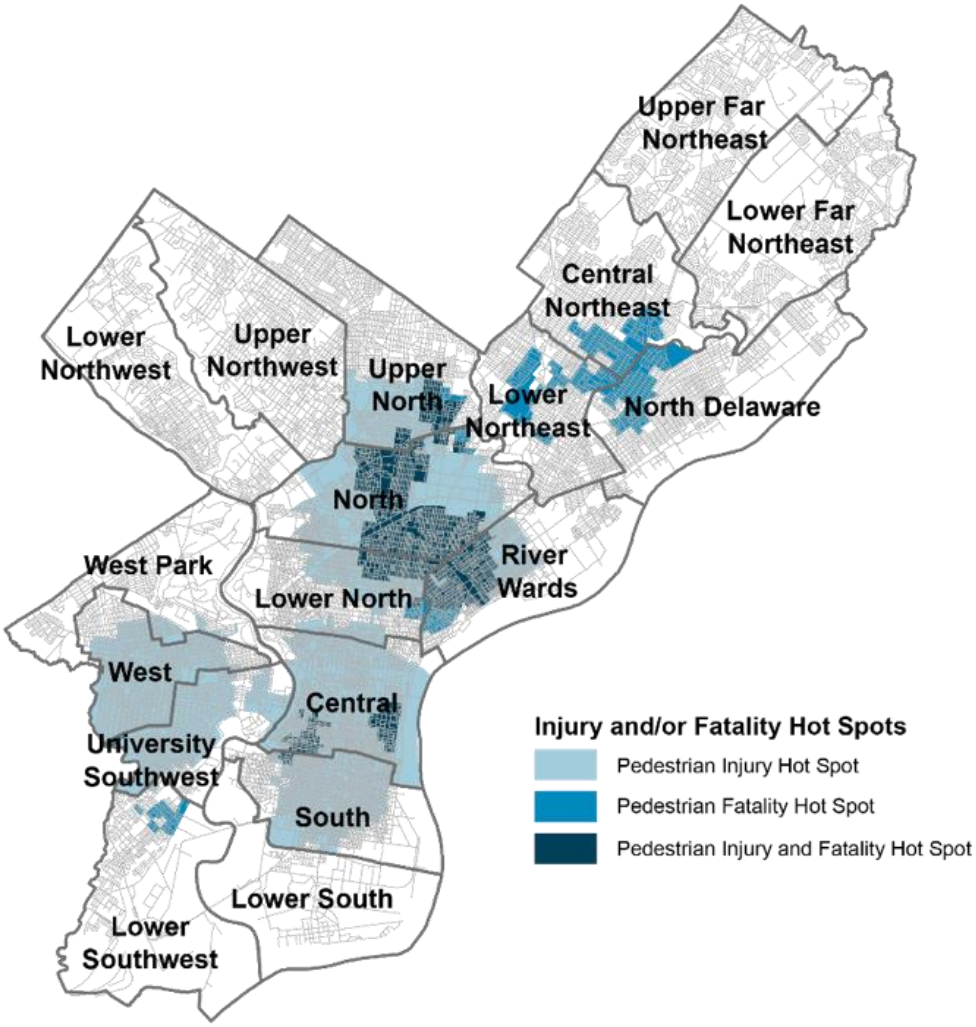
To identify priority areas in Philadelphia for focused safety improvements, a Hot Spot analysis was conducted using pedestrian injury and pedestrian fatality crashes (see map below). The Hot Spot analysis generated a score for each crash in the dataset. The scores, taken into consideration with nearby context, identify areas where high values cluster spatially within Census Block Groups at a statistically significant level. Significant hot spot clusters of pedestrian injury crashes occur in areas of Northern Philadelphia, West Philadelphia, and Greater Center City. Areas with significant hot spot

clusters of pedestrian fatality crashes occur in areas of Northeast Philadelphia along Roosevelt Boulevard, Elmwood, and Kensington. Areas with significant hot spot clusters of both pedestrian injury and fatality crashes occur in Northern Philadelphia, Kensington, and parts of Greater Center City.

FIGURE 42.
PEDESTRIAN INJURY AND FATALITY CRASH HOT SPOT MAP OF PHILADELPHIA, 2014-2018

Pedestrian injury and fatality hot spots were concentrated in North Philadelphia, Kensington, and portions of Greater Center City between 2014 and 2018.

Source: PennDOT Crash Tables, 2014-2018; US Census Block Groups 2010



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