Vision Zero for Youth Demonstration Project

Year One Report

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For:

Federal Highway Administration

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Introduction

Today, cities of all sizes are committing to eliminating traffic fatalities and serious injuries, often as part of Vision Zero initiatives. A growing number are focusing on improving safety for youth. Children and youth need and deserve special protection and starting with youth can be the catalyst that builds community support for a broader Vision Zero program or other specific actions that lead to improved road safety for everyone.

In October 2019 the Pedestrian and Bicycle Information Center (PBIC) with Toole Design Group partnered with the city of Philadelphia to implement a two-year Vision Zero for Youth Demonstration Project (subsequently referenced as "Demonstration Project" for brevity within this document). Demonstration Project goals included gaining an understanding of tangible strategies to ensure representation of youth within Vision Zero efforts and document potential benefits of a youth-focused approach in advancing safety for all road users. Broader project efforts included identifying replicable strategies and tools for other cities to use.

Philadelphia was selected because of a combination of assets and opportunities for improvement. The city prioritized children's well-being and road safety and multi-agency collaboration and had recognized the need to address safety among children and youth. They had also adopted a three-year Vision Zero Action Plan in 2017 that acknowledged pedestrians, bicyclists, and youth as vulnerable populations. The Action Plan noted that people walking and biking were involved in 23% of reported crashes but represented 40% of those killed in crashes on Philadelphia streets and, on average, four children each day were reported to be involved in traffic crashes.[1] Philadelphia's work on Vision Zero for Youth will serve as an example for other cities and be the first demonstration of the impact that a youth focus can have.

This report summarizes work, findings, and deliverables from the first year of the Vision Zero for Youth Demonstration Project work plan (October 2019-September 2020).

[1] City of Philadelphia Three Year Vision Zero Action Plan 2017.

Demonstration Project - Year 1 Work, Findings, and Deliverables

The following sections outline key actions taken in Year 1 of the Demonstration Project and summarize findings and deliverables to date.

Developing a Philadelphia Vision Zero for Youth Work Plan

The PBIC held a project kick off meeting with representatives from the city of Philadelphia and the Federal Highway Administration (FHWA) on October 1, 2019. Project team members reviewed the overall purpose of the Demonstration Project and discussed existing opportunities, work elements, and deliverables. Specifically, the team discussed opportunities related to a separate but complementary city project (led by an outside consultant) and the city's planned Vision Zero Action Plan update:

- The City of Philadelphia launched the **Vision Zero Pedestrian Safety Study and Action Plan** (VZPSSAP) in 2019 to study Philadelphia's pedestrian crashes, propose systemic recommendations to address crash risk factors and reduce injury severity, and share findings through public workshops. The team discussed opportunities to coordinate with that project and supplement their deliverables with youth-focused additions, including:
  - a youth pedestrian crash analysis,
  - discussion of countermeasure recommendations specific to youth issues and crashes,
  - participation in the project's community workshops to facilitate public input on youth pedestrian issues.
- The city released a **Three-Year Vision Zero Action Plan** in 2017 and scheduled an update for the fall of 2020. The VZPSSAP informed the update, and the youth-focused Demonstration Project also provided an opportunity to include more focus on youth and youth-specific strategies.

The team also discussed existing resources currently under development by PBIC that may play a role in the Demonstration Project, including a safety-based prioritization resource to support school travel planning.

Mayor Statement and Press Conference on Vision Zero for Youth

Figure 1. Mayor Kenney of Philadelphia signs "Vision Zero for Youth Mayors Statement on Safe Walking and Biking for Youth."

The city made a public, clear commitment to the Vision Zero for Youth Demonstration project. As part of Mayor Kenney's annual Vision Zero update press conference on Oct 1, 2019, he made remarks about his commitment to children's pedestrian and bicyclist safety, announced the Vision Zero for Youth Demonstration project, and signed the "Vision Zero for Youth Mayors Statement on Safe Walking and Biking for Youth," developed by the National Center for Safe Routes to School (Appendix A).

Walk to School Day Event

Figure 2. Students, parents, and caregivers on Walk to School Day in Philadelphia

The team held the national event for Walk to School Day in Philadelphia and walked to Gideon Elementary School. The event was organized by National Center for Safe Route to School/PBIC staff and included: Wesley Blount, Program Manager, FHWA; Carlton Williams, Streets Commissioner for City of Philadelphia Department of Streets; Michael Carroll, Deputy Managing Director for City of Philadelphia Office of Transportation, Infrastructure, & Sustainability; Marilena Amoni, FIA Foundation Trustee and retired NHTSA Administrator; school officials; Philadelphia Police Department officers; and other community partners.

Youth Pedestrian Crash Analysis

PBIC examined crashes among children and youth under 18 years of age (termed "youth" for the remainder of this section) that occurred during a five year period from 2014-2018, using the same Pennsylvania Department of Transportation crash data set that informed the VZPSSAP. Crash data methodology used cross-tabulations and spatial analyses (using buffer and density methods) to identify potential high-occurrence factors associated with youth pedestrian crashes and severity outcomes. Approximately 25 percent (n=2009) of all pedestrian crashes (n=8024) appeared to involve one or more pedestrians aged 17 or younger.

Findings were detailed in a memo (see Appendix B) and submitted to FHWA and the city.

Vision Zero Pedestrian Safety Study and Action Plan Contributions

In addition to the memo, the team summarized the findings from the youth pedestrian crash analysis and presented them to the VZPSSAP Steering Committee on February 6, 2020.

PBIC also developed content which the city integrated into the VZPSSAP report, including content to explain the city's focus on children and teens, summarize youth pedestrian crash analysis noting differences between youth pedestrian crashes and all-ages pedestrian crashes, and highlight considerations for youth for specific safety treatments that take into account age-appropriate abilities and special vulnerabilities. See Appendix C for report contributions.

Recommendations for the Vision Zero Action Plan Update

PBIC used findings from the youth pedestrian crash analysis and drew upon its decades of safe routes to school and transportation planning experience to draft broad recommendations for consideration in the city's Vision Zero Action Plan update. Based on discussions with the city and following the format of the city's existing Vision Zero Action Plan, the recommendations were organized into four categories: Education, Enforcement, Evaluation & Data, and Engineering.

PBIC's draft recommendations to the Vision Zero Action Plan included actions informed by the first phase of systemic safety analysis findings and was submitted to FHWA and reviewed with city staff in June 2020. In a follow-up meeting in late June, city staff indicated that they planned to discuss the recommendations with the appropriate Vision Zero plan subcommittees.

Systemic Safety Analysis

Concurrent with the Demonstration Project, PBIC developed the *Safety-Based Prioritization for Youth Pedestrian Travel Planning*. The Demonstration Project provided an opportunity to pilot test the prioritization process.

The systemic approach featured in the resource – and pilot tested as part of the Demonstration Project – followed steps outlined in the National Cooperative Highway Research Program (NCHRP) Research Report 893 -Systemic Pedestrian Safety Analysis[2], which describes a process for identifying and prioritizing high risk locations and applying countermeasures to prevent serious pedestrian crashes. The team modified variables to account for youth pedestrian abilities and applied the process to develop an understanding of high-risk locations for youth pedestrian travel throughout Philadelphia. Details on youth pedestrian systemic safety analysis methodology and findings are described in Appendix D.

The team analyzed pedestrian crashes for youth under age 18 that occurred within the city limits of Philadelphia from 2014 to 2018 and used available GIS roadway data and research to focus on a short list of key roadway characteristics and pedestrian exposure proxy variables for future risk determination. The team also incorporated an equity variable to represent traditionally underserved populations.

The team established risk thresholds for the roadway and pedestrian exposure data based on a review of prior research on pedestrian crashes. Some risk factor thresholds were adjusted to better reflect age-

[2] Thomas, L., Sandt, L., Zegeer, C., Kumfer, W., Lang, K., Lan, B., ... & Schneider, R. J. (2018). Systemic Pedestrian Safety Analysis (No. Project 17-73). Retrieved from https://doi.org/10.17226/25255.

appropriate abilities of youth. The team then created an Excel spreadsheet and performed cross tabulations to determine the degree of risk factor associated with prior crashes (see Appendix E).

The systemic analysis of youth pedestrian crashes in the city of Philadelphia resulted in four high-level takeaways:

- Youth pedestrian crash rates are two to three times higher on roads with any of the following risk variables: posted speed greater than 25 mph; AADT of 5,000 or greater; or more than one lane in each direction.
- More than one-half (56%) of youth pedestrian crashes that occurred near areas of concentrated poverty were on roads with one or more risk variables.
- 78% of youth pedestrian crashes occurred within ¼ mile of a school.
- Almost one-half (49% or 974 crashes) of youth pedestrian crashes occurred on roads with 25 mph or lower posted speeds; one or fewer lanes in each direction; AADT under 5000; and sidewalk coverage over 50% along both sides of the street.

PBIC presented these findings to city staff on June 5, 2020 (see Appendix F). They were also included in PBIC's draft recommendations for the City's Three-Year Vision Zero Action Plan update.

Safety-Based Prioritization for Youth Pedestrian Travel Planning

As mentioned above, the systemic analysis applied a draft approach described in PBIC's updated *Safety-Based Prioritization for Youth Pedestrian Travel Planning* resource. After receiving feedback on content from FHWA in December 2019, PBIC submitted a designed draft to FHWA on January 31, 2020 with the intention to then pilot the approach as part of the Demonstration Project. Through the pilot, PBIC gained an understanding of potential challenges and opportunities that other cities may face when pursuing the same approach, such as GIS data limitations. PBIC subsequently modified the prioritization resource to reflect changes in the approach and used Philadelphia data test the process. The final resource was submitted to FHWA on June 30, 2020.

Insights from the First Year of the Demonstration Project

The team gained several important insights during the first year of the Demonstration Project, including:

- **The value of high visibility commitment by leadership and staff**
  Mayor Kenney's kick off of the Demonstration Project both presented the importance of this project to the public and also signaled to Office of Transportation Infrastructure and Sustainability and other city departments the determination of the mayor. The celebration of Walk to School Day with multiple agencies provided an opportunity to establish relationships with several key stakeholders and give the project team a sense of the city.

  In addition to buy-in from the Mayor, there also appeared to be strong support from middle-level managers and technical support staff. This is important since it is this next level of officials within most cities where the real safety work is implemented. This level of support for pedestrian safety, and specifically youth safety, is also critical to the likelihood of the program's success.

- **Importance of multiple agencies at the table**
  Regular meetings, held once in-person, then subsequently on video conferencing platforms, included the director of Complete Streets, the manager of the Neighborhood Slow Zone program and Vision Zero team, the Safe Routes Philly Coordinator, and the City Transportation Analyst. The perspectives and experience at the table enhanced project work. The success of this program will ultimately depend not only on the City agencies currently participating in this project, but also on other agencies and groups Involvement of the city's transportation engineers will be critical during the next stages of the systemic analysis and discussion of findings to identify high-risk locations and countermeasures

- **The benefit of a flexible work plan and the ability to adjust to emerging priorities**
  At the start of the project, the team learned about an all-ages pedestrian safety study beginning at the same time as the Demonstration Project. Having a flexible work plan allowed inclusion of Vision Zero for Youth (VZY) in a citywide document and integration of a child pedestrian crash analysis and considerations for youth to countermeasure recommendations into the city's plan for all-ages of pedestrians. In addition to allowing for a Vision Zero for Youth emphasis, the flexibility of the original work plan also provided the opportunity to incorporate a systemic pedestrian safety approach, blending the identification of problem sites and countermeasures at both high-risk locations as well as sites with youth pedestrian crashes.

  Additionally, 2020 had been an extraordinary year in many ways. The pandemic forced cities to change and adapt. The tragic death of George Floyd in Minneapolis forced all communities to rethink the role of law enforcement and reexamine how cities address equity issues. A flexible work plan allowed the team to adjust the work to the immediate needs of the city. For example, the team proposed expanding the equity analysis in year two to give the city insights into how communities of color are impacted by youth crashes.

- **Need to understand local jurisdiction processes**
  Influencing how project prioritization to consider child safety can requires understanding a city's current process. Some cities are already committed to data approaches which can affect readiness for systemic safety analysis, even in communities that have committed to Vision Zero. Understanding these realities can help lead to solutions. The Demonstration Project would have benefited from spending more time at the start of the project to better understand the city's culture and dynamics relative to political and public support processes, the extent of coordination between departments, funding streams, and project prioritization processes.

- **Importance of understanding local capabilities and existing data systems**
  Cities have different institutional capacity and data systems; some have a small number of transportation staff handling many tasks and little information on pedestrian crashes and/or roadway characteristics. The data necessary for even high-level systemic analysis for Philadelphia proved challenging to obtain, and the team realized this would likely be the case for most jurisdictions, especially those of smaller size. The team adjusted the approach to focus on recommending an assessment using known crash and high-risk roadway variables which are

currently available for Philadelphia and likely to be available for most jurisdictions. The modified approach also made use of the best and latest knowledge from the safety literature on pedestrian safety for youth, including the known high-risk factors which should be more generally appropriate for all cities.

- **Need to find the right level and frequency of communication**
  City staff time and resources are precious, yet obviously they are critical to discussions about the analysis process. They provide a deeper understanding and build capacity for the approach and provide insight into how the analysis may impact current processes and decisions. Their important role became apparent during the COVID-19 pandemic when city staff time was more limited and attention had to be share among many priorities.

Next Steps

Despite competing city pressures due to a global pandemic and a nationwide focus on systemic racism, the city of Philadelphia remains committed to the project and receptive to adjusting and adapting the approach to fit the changing realities their community is facing. On August of 2020 the PBIC team facilitated a call with the city team to finalize plans for year two of the demonstration project.

Options included a combination of tasks to advance Philadelphia's work on Vision Zero for Youth and tasks to expand PBIC's experience with and understanding of how to help other cities advance Vision Zero for Youth (Appendix G).

During the first year, the project was able to inform widespread dissemination of a systemic analysis approach to youth pedestrian crashes for other cities to use. In the second year of the project, the PBIC team will work with the city to expand equity variables used in the systemic analysis and develop a crash tree to support countermeasure discussions, compare findings against the city's updated High Injury Network (HIN), obtain community input in partnership with Safe Routes Philly, and identify locations for targeted countermeasures, which will result in additional examples and tools for other cities to use.

Appendix

A. Mayor Kenney's Statement on Vision Zero for Youth
B. Youth pedestrian crash analysis memorandum
C. Vision Zero Pedestrian Safety Study and Action Plan contributions
D. Systemic analysis technical memorandum
E. Systemic analysis cross tabulation spreadsheet
F. June 2020 systemic analysis findings/recommendations presentation
G. Next steps proposal

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Since its inception in 1999, the Pedestrian and Bicycle Information Center's mission has been to improve the quality of life in communities through the increase of safe walking and bicycling as a viable means of transportation and physical activity. The Pedestrian and Bicycle Information Center is maintained by the University of North Carolina Highway Safety Research Center with funding from the U.S. Department of Transportation Federal Highway Administration.

Appendix A

"Vision Zero for Youth Mayors Statement on Safe Walking and Biking for Youth," developed by the National Center for Safe Routes to School

The ability of people to safely walk and bicycle is a vital part of what makes communities thrive. We recognize that by creating opportunities for children and youth to safely walk and bicycle, we can benefit people of all ages, abilities, and resources. My community is committed to work to promote safe walking and bicycling and to eliminate fatal and serious traffic crashes among all road users. Now is the time to act. We know the benefits this would bring to the health and well-being of our children, our communities, and the nation are immeasurable.

Appendix B

MEMO

To: Akshay Malik, Lily Reynolds, Kelley Yemen and Tara Woody, City of Philadelphia Office of Transportation, Infrastructure and Sustainability

From: Vision Zero for Youth Demonstration Project Crash Analysis Team – Libby Thomas, Mike Vann, Charlie Zegeer, Nancy Pullen-Seufert, Pedestrian and Bicycle Information Center at UNC Highway Safety Research Center

Subject: Pedestrians up to age 17 involved in reported collisions with motor vehicles in Philadelphia (2014-2018)

Date: Revised Jan 29, 2020

Introduction

This initial crash analysis was conducted to coordinate with the timing and data for the Vision Zero Pedestrian Safety Study conducted by WSP. This analysis represents the first component in the Vision Zero for Youth Demonstration Project, a partnership between the UNC Pedestrian and Bicycle Information Center (with subcontractor Toole Design Group) and the City of Philadelphia. 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 serve as an example for other cities and be the first demonstration of the impact that a youth focus can have.

The crash analysis seeks to describe the extent, nature and patterns of pedestrian crashes among children and youth under 18 years of age (termed "youth" for the remainder of this memo) in Philadelphia using crash data for the five year period of 2014-2018. A second phase will be a systemic safety analysis, using high crash roadway characteristics to proactively identify locations in need of safety improvements based on a high crash potential.

The data used in this analysis comes from WSP and the city's Open Maps data. WSP was generous in sharing their cleaned data based on crashes from publicly available PennDOT crash data. Please see WSP's Draft Technical Appendix document for information on their data cleaning and analysis process.

General Trends

Trends by year: Crashes involving one or more pedestrians were identified and included in the analysis. A total of 8,024 crashes involving pedestrians of all ages were identified. Of these, 2,009 crashes, an average of about 25 percent of the total, appeared to involve one or more youth pedestrians, with a peak of 451 crashes (31 percent) in 2014, and a low of 334 (also the lowest percentage of the total at 21

percent) in 2018 (Figure 1). Pedestrian crashes involving youth (as well as total pedestrian crashes) decreased between 2016 and 2018.

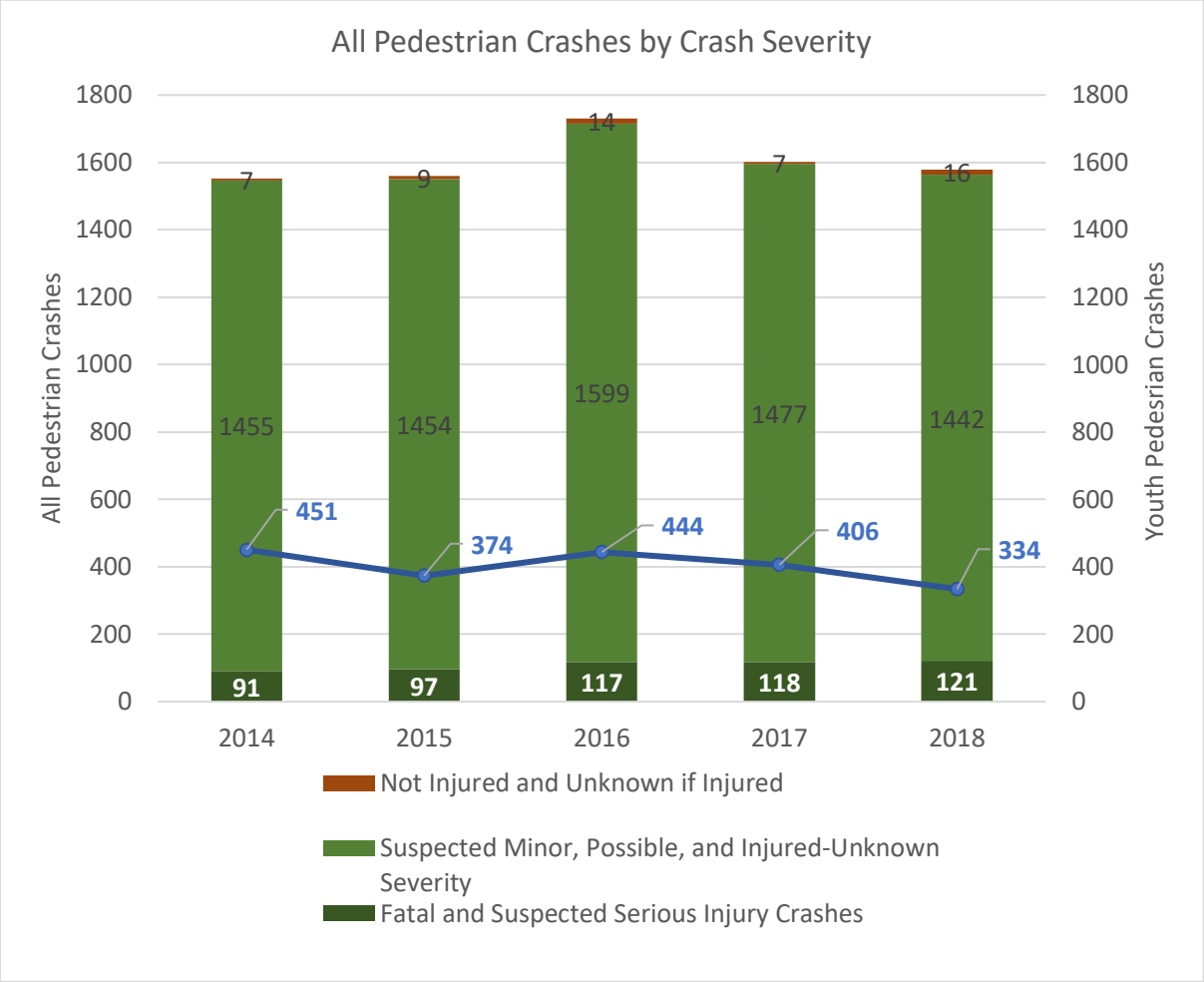

FIGURE 1. ALL AGES PEDESTRIAN CRASHES BY YEAR SHOWING YOUTH PEDESTRIAN CRASHES, 2014-2018.

Trends by severity: Figure 2 presents data on the numbers of youth pedestrians (count of persons) who were involved in collisions for 2014 through 2018. A total of 2,083 youth pedestrians were involved in the 2,009 collisions, since multiple pedestrians were struck in some crashes. Sixteen pedestrians in this age group were killed over this time period, with a total of 103 youth pedestrian received fatal or serious (A-type) injuries in total, for the five years. Stated a different way, five percent of pedestrians in this age range who were struck were killed or suspected seriously injured in the collisions. (One collision in 2014 involved three youth pedestrians being killed.) However, evidence from studies linking police-reported injury data with medical data sources suggest 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.

Certain conditions or crash factors were explored later in this memo and were found to be associated with more serious injury outcomes when collisions occur. These factors may be considered more strongly as candidates for potential interventions.

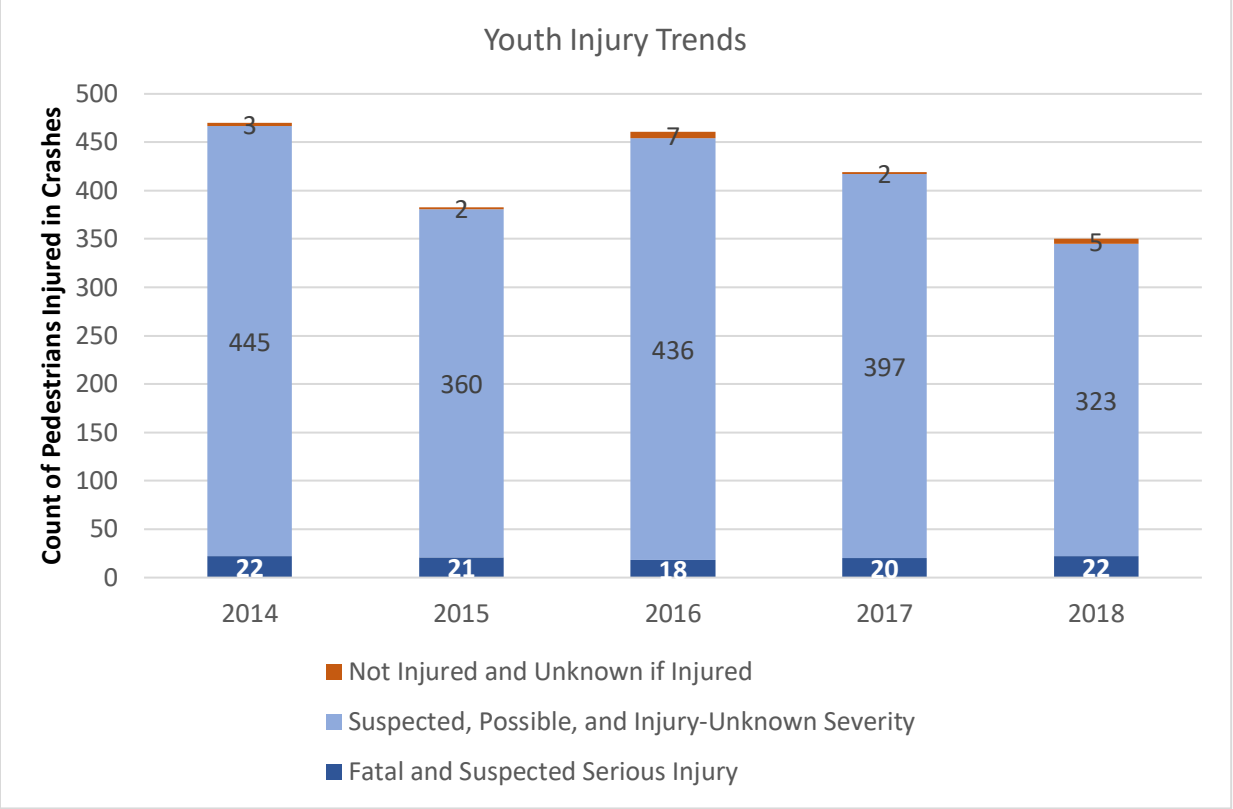

FIGURE 2. PEDESTRIANS UP TO AGE 17 AND REPORTED INJURY SEVERITY IN PHILADELPHIA, 2014-2018 (BASED ON COUNTS OF PEDESTRIANS REPORTED STRUCK, SO THESE FIGURES ARE HIGHER THAN THE CRASH FREQUENCIES).

Trends by time period: The next analyses are based on the 2,009 youth-aged pedestrian crashes. A few time-related trends suggest that youth are, in fact, more likely to be in collisions during certain times of year, weekdays, and times of day that may relate to school travel, or activities after school. However, it also could be that a portion of these are more "neighborhood" crashes, taking place during play or errands and are unrelated to the trip to school.

Youth pedestrian crashes are more likely to occur during fall and spring months, and on weekdays, consistent with most school calendars (Figure 3, Figure 4). Daylight hours are also shorter in spring and fall than during summer, so more hours of darkness each day may have contributed to this finding.

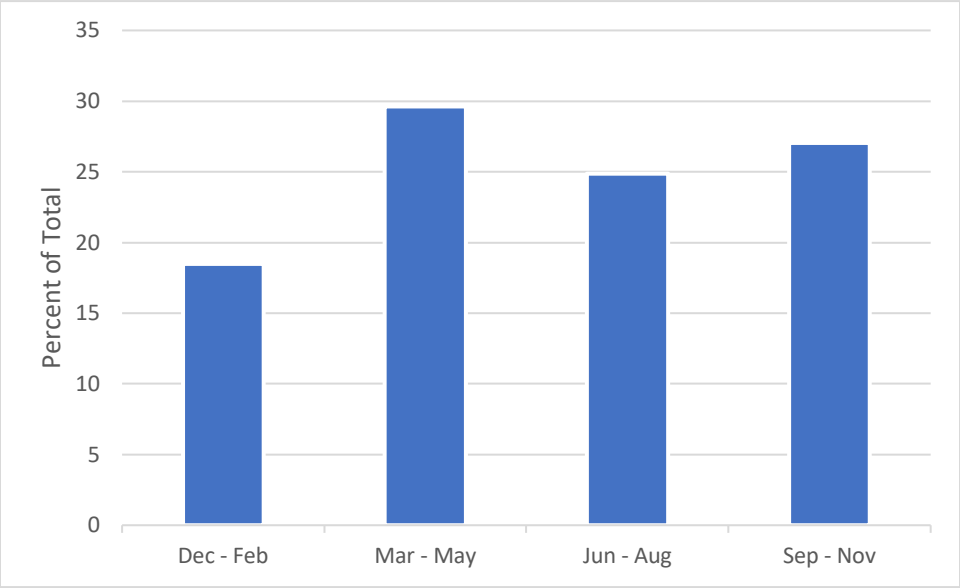

FIGURE 3. YOUTH PEDESTRIAN CRASHES BY SEASON, 2014-2018.

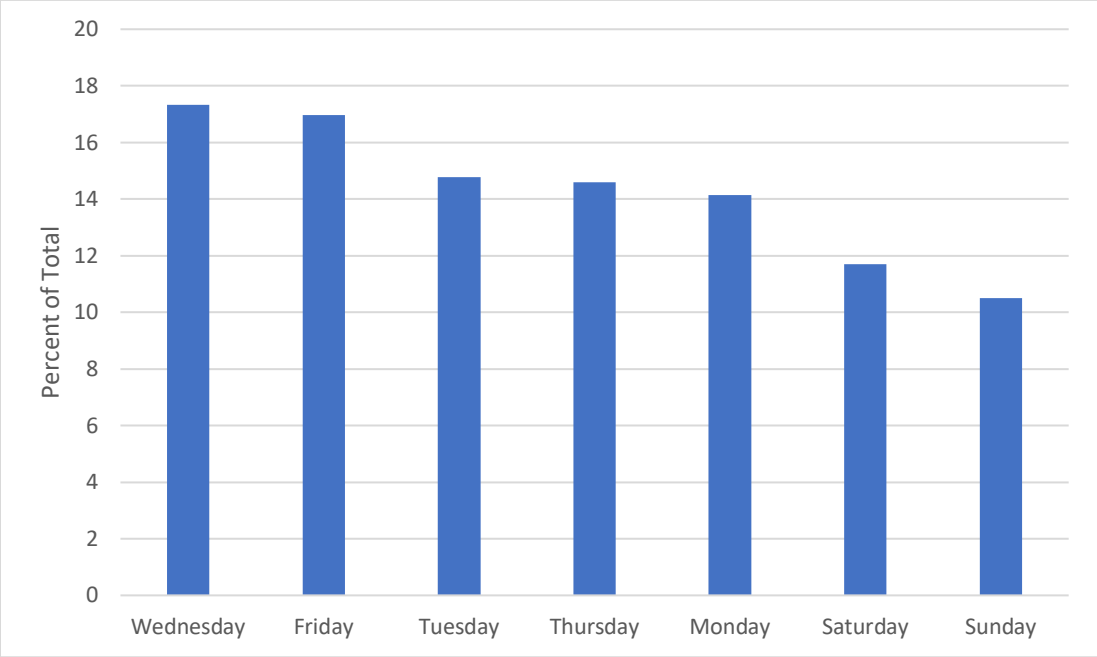

FIGURE 4. YOUTH CRASHES BY DAY OF THE WEEK, 2014-2018.

Nearly 60 percent of all youth crashes occur between 3 and 9 pm, on average. The two-hour afternoon peak period of 3 to 5 pm accounts for twice as many (25 percent) as the morning peak two-hour period between 7 and 9 am (12 percent).

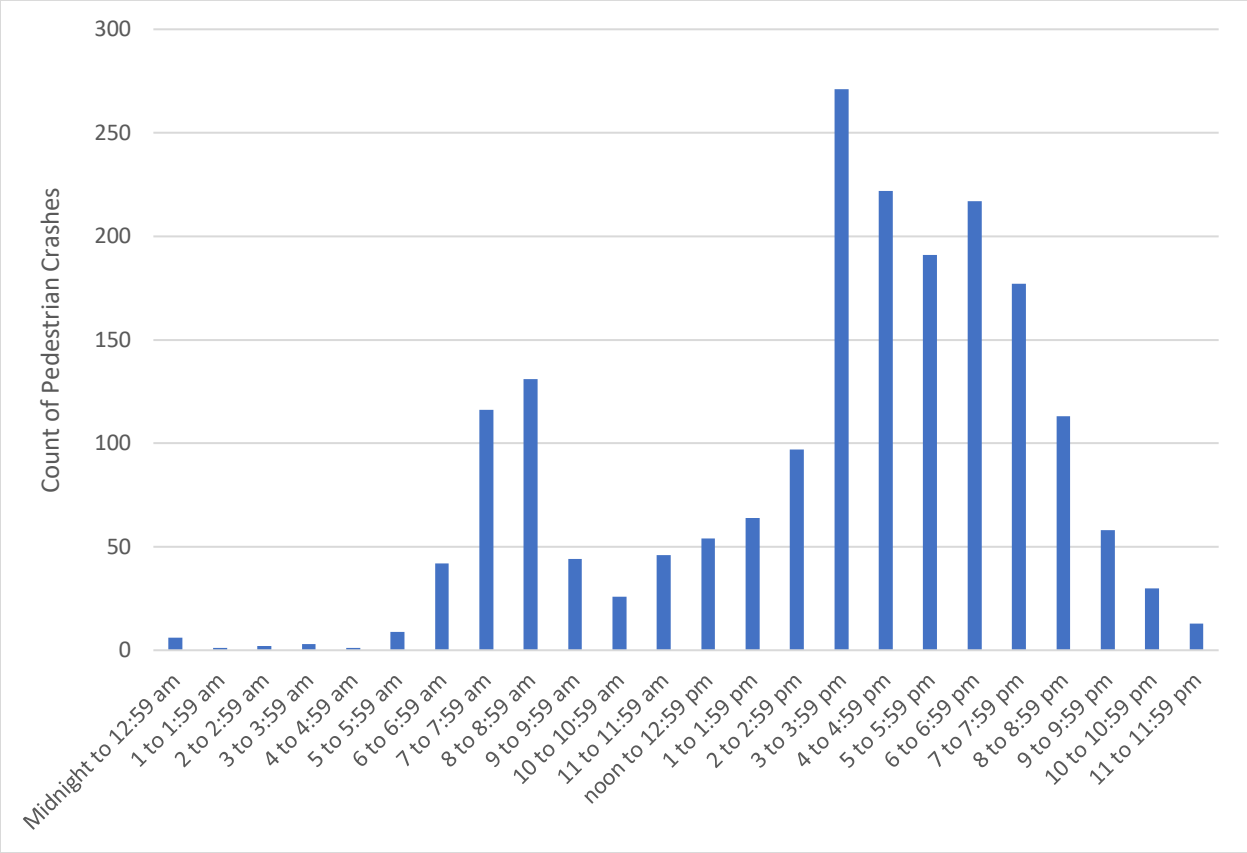

FIGURE 5. YOUTH PEDESTRIAN CRASHES BY HOUR OF THE DAY.

Table 1 shows youth pedestrian crashes by time of day for weekdays and weekend. The prevalence of weekday afternoons (3 to 6 pm), followed by 6 to 9 pm weekdays is very clear. These two periods combined account for 45 percent of youth crashes, which corresponds to periods when children are most likely to out walking.

TABLE 1. CRASHES BY TIME OF DAY AND WEEKDAY OR WEEKEND (SATURDAY/SUNDAY).

	WEEKDAY		Total
Time Period	Weekday	Weekend	
6 to 8:59 am	281	8	289
9 to 11:59 am	88	28	116
noon to 2:59 pm	146	69	215
3 to 5:59 pm	558	126	684
6 to 8:59 pm	355	152	507
9 to 11:59 pm	66	35	101
midnight to 5:59	14	8	22
Unknown	55	20	75
Total	1563	446	2009

Crash and severity-risk factors

Light condition: The next analyses look at both the frequency and severity of outcome of pedestrian youth collisions.

Daylight hours account for 74 percent of all youth pedestrian crashes, and 67 percent of all fatal and severe ones.

"Dark but lighted" conditions accounted for less than 20 percent of all crashes, but 27 percent of fatal and suspected serious injury crashes (Table 2). Pedestrian crashes under dark conditions are more than 1.5 times as likely to lead to fatal or suspected serious injuries (6.8 percent are fatal or suspected serious), compared with those struck during daylight (4.5 percent, Figure 6). This finding indicates higher average severity of injuries in crashes at night, compared to daytime events. Past research shows that pedestrian crashes during nighttime conditions often are associated with pedestrians crossing at uncontrolled locations, or walking along the road. Either of these situations are less expected by drivers who may be traveling at higher speeds before impact.

TABLE 2. LIGHT CONDITIONS AND CRASHES WITH PEDESTRIANS AGED 0 TO 17.

Illumination (all nighttime conditions combined)	Fatal and Suspected Serious Injury (FSSI)	Light cond. % of FSSI	Suspected Minor, Possible, Severity Unknown	Light cond. % of Minor, Pos. Injury	Not Injured and Unknown if Injured	Light cond. % of Uninjured/ Unknown if Injured	Row Total	Row % of Total
Dark - all	27	27.3%	366	19.3%	2	22.2%	395	19.7%
Dawn, Dusk, Other	6	6.1%	125	6.6%	0	0.0%	131	6.5%
Daylight	66	66.7%	1410	74.2%	7	77.8%	1483	73.8%
Total	99	100%	1901	100%	9	100%	2009	100%

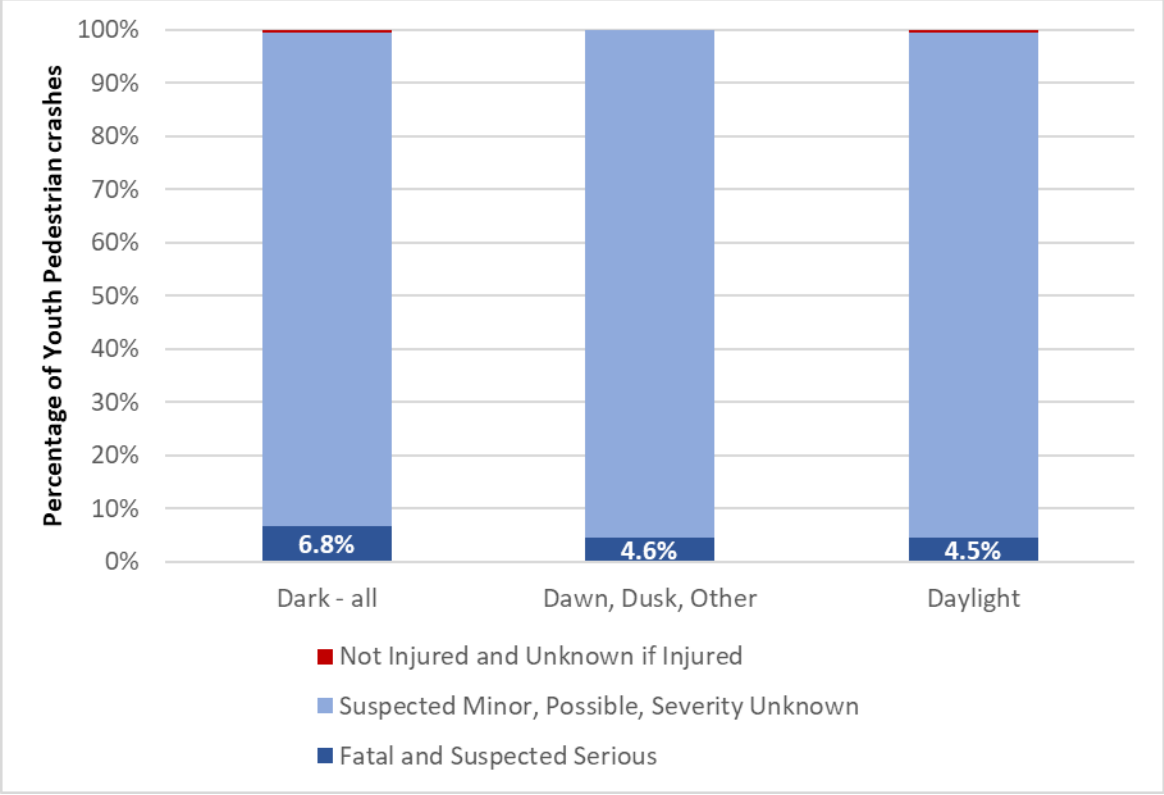

FIGURE 6. INJURY STATUS BY LIGHT CONDITIONS, N = 2,009 YOUTH PEDESTRIAN CRASHES.

Type of crossing location: As shown in Table 3, youth pedestrian crashes are more frequent (51 percent), and more injurious at midblock locations (61 percent of fatal and suspected seriously injured) compared to four-way intersections (38 percent of the total, and 29 percent of fatal and serious). 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. 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.

TABLE 3. LOCATION TYPE AND CRASHES WITH PEDESTRIANS AGED 0 TO 17.

INTERSECTION TYPE	Fatal and Suspected Serious (FSSI)	Intersection Type % of FSSI	Suspected Minor, Possible, Severity Unknown (SMPSU)	Intersection Type % of Susp. Minor, Possible, Severity Unkn.	Not Injured and Unknown if Injured	Intersection Type % of Not Injured and Unkn. if Injured	Total	Row % of Total
MULTI-LEG	2	2.0%	32	1.7%	0	0.0%	34	1.7%
FOUR-WAY INT	29	29.3%	721	37.9%	8	88.9%	758	37.7%
Y INT	0	0.0%	13	0.7%	0	0.0%	13	0.6%
T INT	8	8.1%	165	8.7%	0	0.0%	173	8.6%
MID-BLOCK	60	60.6%	968	50.9%	1	11.1%	1029	51.2%
OTHER	0	0.0%	2	0.1%	0	0.0%	2	0.1%
Total	99	100%	1901	100%	9	100.0%	2009	100%

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 those are associated with greater injury (fatal or suspected serious injury). Again, travel speed may be a factor in these findings. Motorists were traveling straight ahead in 86 percent of the 14 fatal crashes. Since the number of fatal crashes is fortunately relatively small, most of our analyses included combining fatal and suspected serious injury collisions. Thus, these collision types may be the basis of a more detailed future systemic safety analysis.

TABLE 4. MOTORIST MANEUVERS AND CRASHES WITH PEDESTRIANS AGED 0 TO 17

Vehicle Movement (Similar Movements combined)	Fatal and Suspected Serious Injury (FSSI)	Vehicle Movement % of FSSI	Suspected Minor, Possible, Severity Unknown	Vehicle Movement % of Susp. Minor, Possible, Severity Unkn.	Not Injured and Unkn. if Injured	Vehicle Movement % of Not Injured & Unkn. if Injured	Total	Row Total % of Total
Backing	1	1.0%	28	1.5%	2	22.2%	31	1.5%
Going Straight, Slowing in Lane	81	81.8%	1347	70.9%	1	11.1%	1429	71.1%
Passing, Merging, Neg. Curve, Avoiding Object	5	5.1%	59	3.1%	0	0.0%	64	3.2%
Entering/Leaving Parking	0	0.0%	6	0.3%	0	0.0%	6	0.3%
Turning Left (incl. U)	5	5.1%	268	14.1%	0	0.0%	279	13.9%
Turning Right	2	2.0%	92	4.8%	0	0.0%	94	4.7%
Other and Unknown	5	5.1%	101	5.3%	0	0.0%	106	5.3%
Total	99	100.0%	1901	100.0%	9	100.0%	2009	100.0%

Type of traffic control: Traffic control is also typically a factor in crash severity, with crashes at uncontrolled locations usually being more severe, whereas crashes at signalized locations may be more frequent (as these are usually high-volume locations of pedestrians and motorists). However, we have not found a variable in the PennDOT crash database that provides information on the type of traffic control at intersection locations. In addition, youth may have different crash patterns than adults with regard to traffic control type, due to the different crossing patterns of youth compared to older pedestrians.

Vehicle type: Larger vehicle types (including buses and large trucks, SUVs and small trucks) are associated with a higher percentage of serious injuries when a youth pedestrian collision occurs, as compared to other vehicle types, as expected (Table 5). In particular, SUVs accounted for 23 percent of all youth crashes, but 28 percent of fatal and suspected serious injury ones. Passenger autos account, however, 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. In short, the over-representation of crash severity of certain vehicle types can be seen by comparing the percentages in column 3 (p fatal and severe injury) with column 5 (% minor injury).

TABLE 5. VEHICLE TYPE AND CRASHES WITH PEDESTRIANS AGED 0 TO 17

1	2	3	4	5	6	7	8	9
Vehicle Type	Fatal and Suspected Serious (FSSI)	Vehicle Type % of FSSI	Suspected Minor, Possible, Severity Unknown	Vehicle Type % of Susp. Minor, Possible, Severity Unkn.	Not Injured and Unknown if Injured	Vehicle Type % of Not Injured & Unkn. If Injured	Total	Row Percent of Total
Auto	50	50.5%	1082	56.9%	8	88.9%	1140	56.7%
Bus & Lg Truck	4	4.0%	41	2.2%	0	0.0%	45	2.2%
Motorcycle and Other	4	4.0%	71	3.7%	0	0.0%	75	3.7%
Sm Truck	6	6.1%	97	5.1%	0	0.0%	103	5.1%
SUV	28	28.3%	431	22.7%	0	0.0%	459	22.8%
Van	3	3.0%	130	6.8%	1	11.1%	134	6.7%
Total	99	100.0%	1901	100.0%	9	100.0%	2009	100.0%

Further analyses, using data compiled by WSP that included some roadway elements (and not shown here), suggested that 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, however, more likely than adults to be in the road in a travel lane, not at an intersection or crossing (48% of those struck, compared to adults (31%), or at an intersection with no crosswalk (7% for youth, compared to 4% of adults), and less likely to be in a marked crosswalk at an intersection (38% for youth compared to 54% for adults). These relationships 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 centers, where adults may do more walking. These circumstances could also reflect youth pedestrian activities just prior to the crash - for example, children are 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 upshot is that there may be some divergence in countermeasures 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, we 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 be useful in knowing where to target various types of countermeasures.

The analysis first included examination of census blocks, but the numbers of crashes at a census block level were too small to interpret. To attempt to address the lack of counts or estimates of pedestrian activity, analysis included using several potential surrogates of activity, including youth population per census tract. Maps are provided in Appendix A.

The team also used spatial analysis to identify schools with frequent youth pedestrian crashes nearby. The schools with the highest counts of youth pedestrian crashes within 0.25 mile, and 0.10 mile radius of the schools (using nearest school for cases of overlapping buffers) are shown in maps and listed in tables by descending counts of crashes in Appendix B. In addition, tables listing schools are also included). The top-ranked schools could be considered for further investigation and potential early intervention.

The city of Philadelphia staff are best positioned to interpret these findings and may have further ideas about infrastructure or built environment conditions, development types, socioeconomic measures or populations within the different areas highlighted in the different maps that may be considered in future analyses. Future analysis could consider transit measures (i.e., bus stop locations), after-school or recreational programs, and other potential proxies for activity and travel exposure.

Conclusion and next steps

The previous analyses provide some evidence of factors associated with child pedestrian crashes. For example, most of these crashes occur at times in the afterschool, afternoon period and during weekdays and times of year when school is typically in session. Further analysis by weekday/weekend and time period confirms the importance of the afternoon and early evening periods.

Nighttime crashes and midblock crashes are likely to be more severe than at other times and locations. Also associated with increased crash severity are sport utility vehicles, buses and large trucks, and vehicle maneuvers such as going straight, or passing and merging. Non-intersection locations and motorist going straight maneuver types have greater severity, likely the result of with higher vehicle speeds.

It is important that intersections function safely for youth, providing opportunities to cross at controlled locations with a minimum of conflicts, to reduce their tendency to cross at non-intersections that may be even less safe. Thus, 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 walkers.

In the upcoming systemic analysis, we plan to further examine location characteristics to the extent the data allow. For example, multilane roads are typically associated with more frequent and severe

pedestrian collisions than one- or two-lane roads, but city roadway inventory data do not provide information on the number of lanes. It is possible that road size/number of lanes correlates with roadway classifications, which may be used as a surrogate measure for both size and traffic volume).

Other socioeconomic and built environment measures may also be important factors to consider in future systemic analyses, including household income, vehicle ownership, housing type and density, commercial land use and others. These measures have been found to be associated with safety outcomes in a number of other studies, likely because they are capturing unmeasured aspects of the built environment (for example, condition and type of pedestrian facilities) and social environment (for example, cultural norms around walking behaviors).

City staff can help interpret the findings and may have further ideas about infrastructure or built environment conditions, development types, and/or populations within the different areas highlighted in the different maps that may be considered for the systemic analysis. The analysis team will consider transit measures (e.g., bus stop location) and other potential proxies for activity and travel exposure, to the extent possible.

Appendix A. Spatial analysis

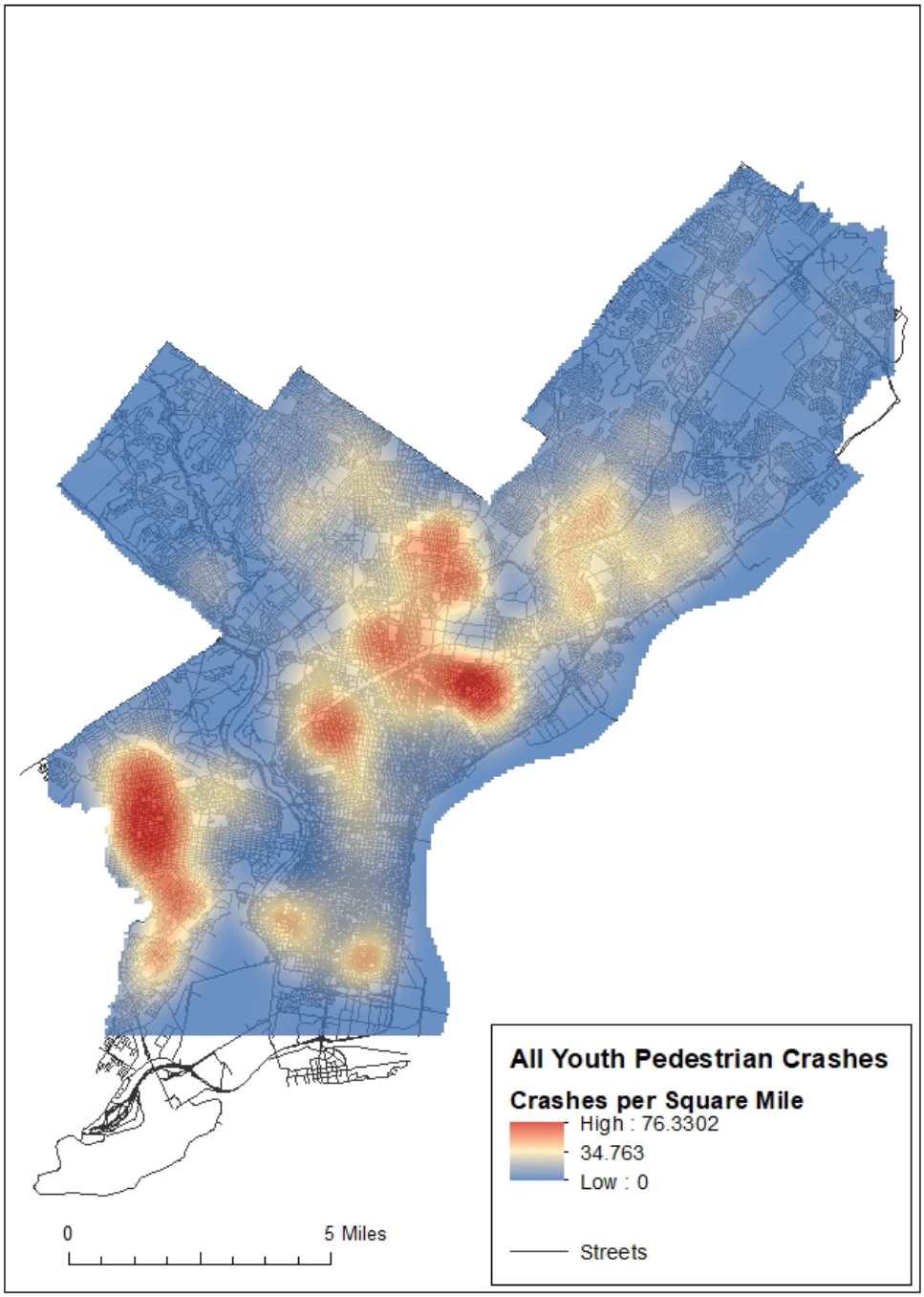

FIGURE 7. KERNEL DENSITY ANALYSIS OF YOUTH PEDESTRIAN CRASHES, DATA FOR 2014-2018 (N = 2009 CRASHES).

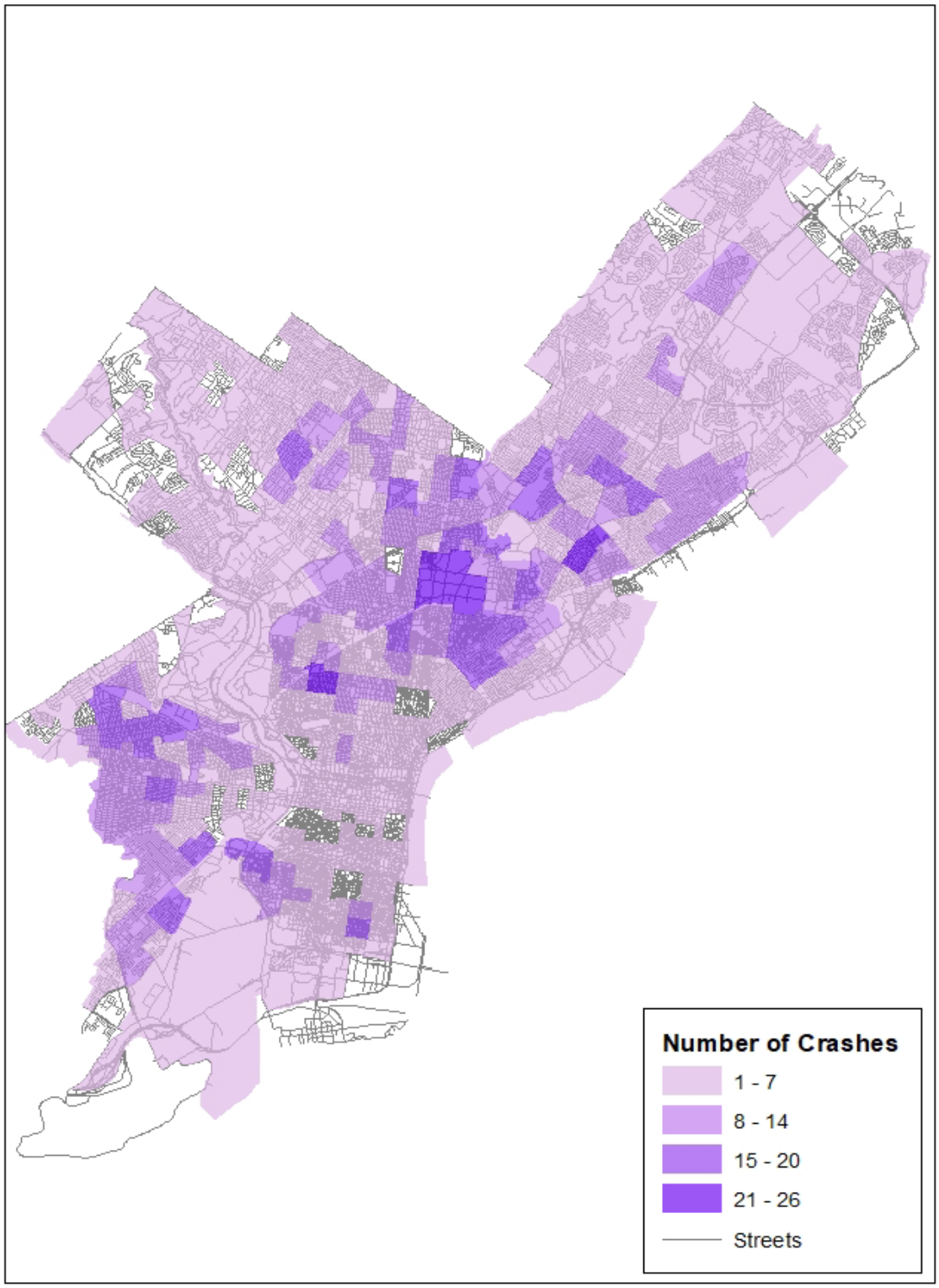

FIGURE 8. MAP OF YOUTH PEDESTRIAN CRASH COUNTS BY PHILADELPHIA'S CENSUS TRACTS BETWEEN 2014 AND 2018. 88 PERCENT (337) OF PHILADELPHIA'S 384 CENSUS TRACTS HAD ONE OR MORE CRASHES.

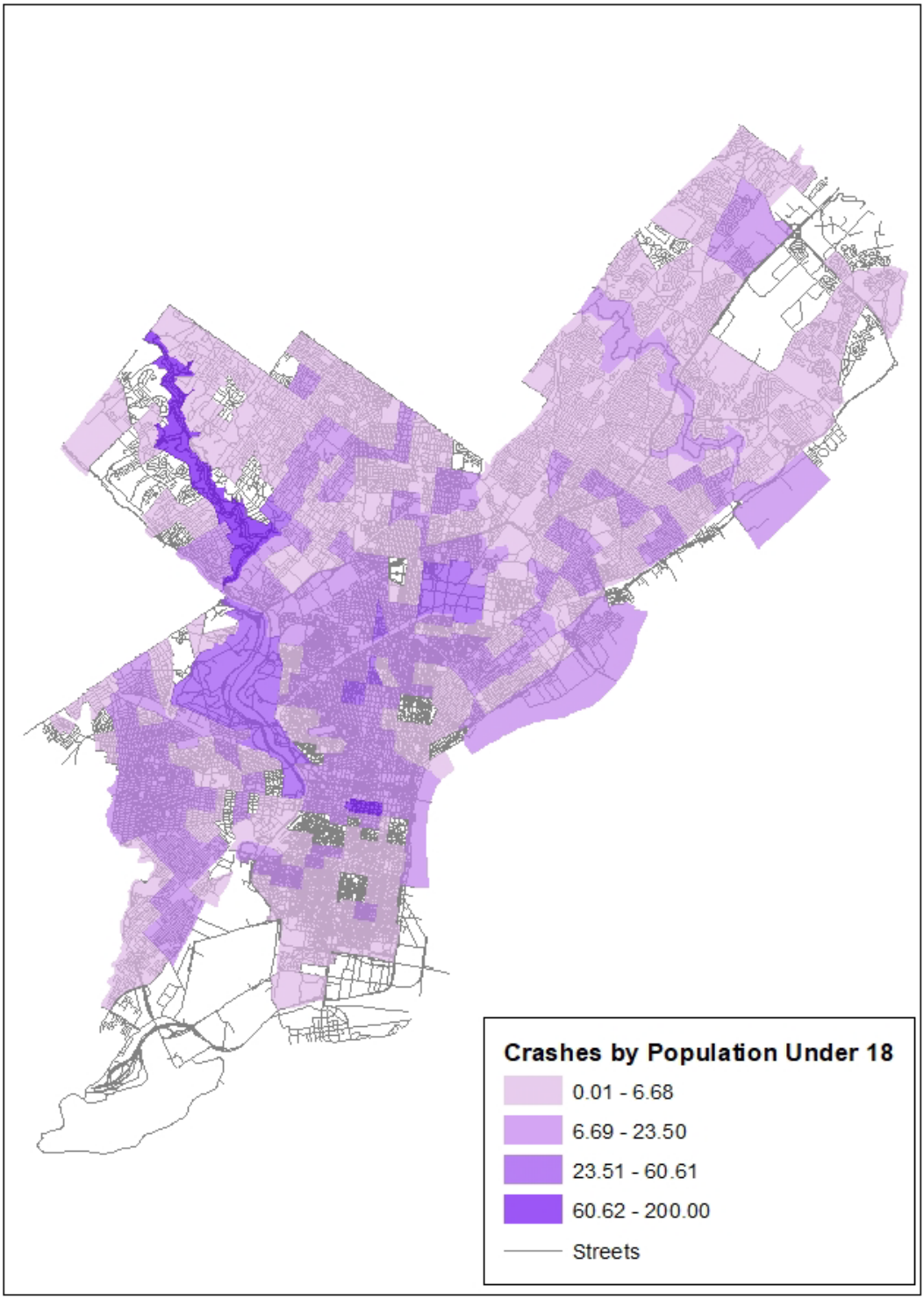

FIGURE 9. MAP OF YOUTH PEDESTRIAN CRASHES (< 18) PER YOUTH POPULATION (< 18).

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. City staff could investigation the census tracts with higher rates to validate concerns.

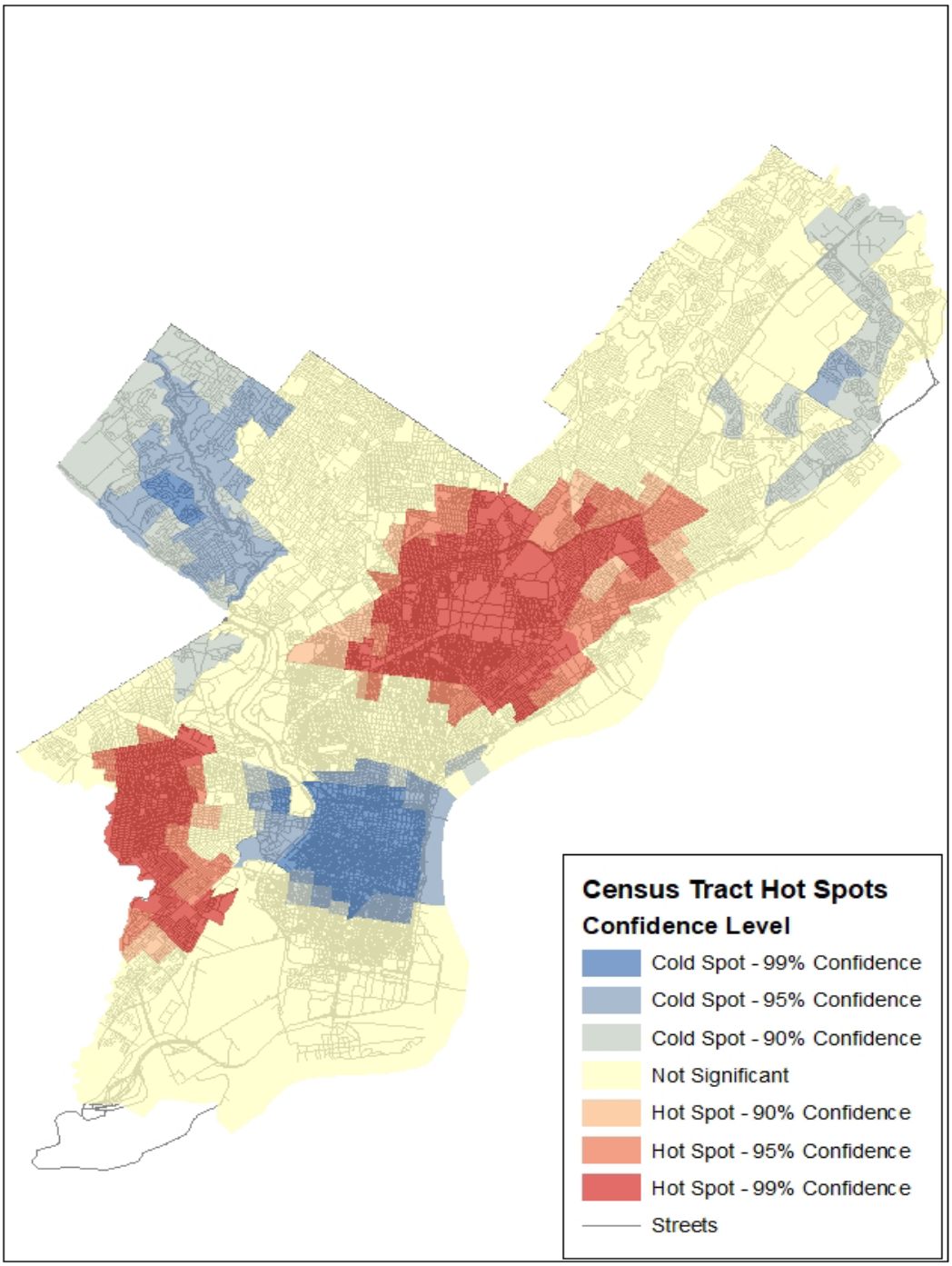

FIGURE 10. MAP OF PHILADELPHIA'S 384 CENSUS TRACTS BY HOT AND COLD SPOTS FOR YOUTH PEDESTRIAN CRASHES.

These census-tract-based hotspots were determined through the Hot Spot Analysis (Getis-Ord Gi*) tool in ArcGIS 10.5. The False Discovery Rate Correction parameter was applied to account for multiple testing and spatial dependence.

Appendix C

Introduction section

Sidebox

Focus on children and teens

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. Mayor Kenney and the city of Philadelphia are committed to creating a child-friendly city and road safety is a key priority.

Concurrent with the development of the Vision Zero Pedestrian Safety Action Plan, the city of Philadelphia 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.

Chapter 2 – Pedestrian Crash Findings

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.

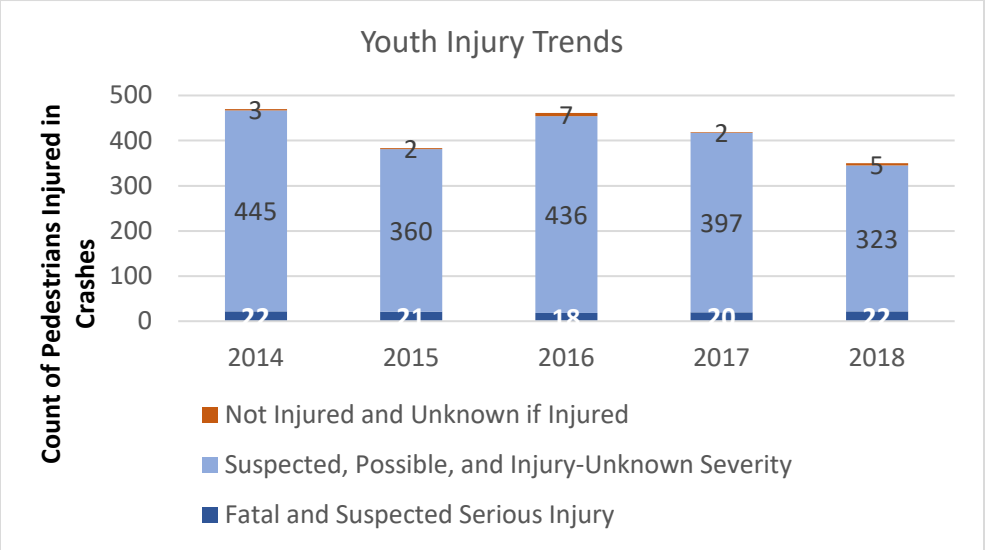

FIGURE 1. PEDESTRIANS UP TO AGE 17 AND REPORTED INJURY SEVERITY IN PHILADELPHIA, 2014-2018.

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.

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%

TABLE 1. DISTRIBUTION OF CHILD PEDESTRIAN CRASHES ACROSS AGE GROUPS, 2014-2018.

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 olds tend to be hit in the afternoon and evening (3 - 6 pm and 6 - 9 pm), older children (10 - 13 year olds and 14 - 17 year olds) 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

Location type

- 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.

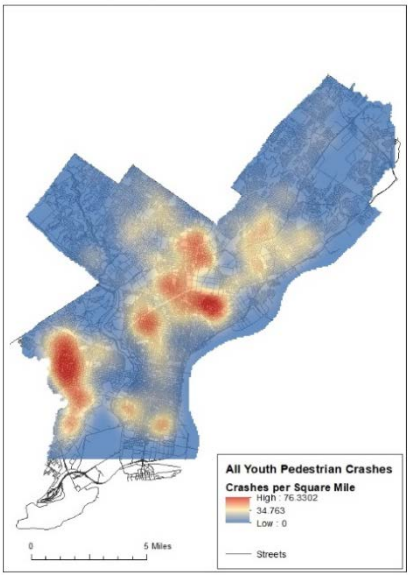

FIGURE 2. KERNEL DENSITY ANALYSIS OF YOUTH PEDESTRIAN CRASHES, DATA FOR 2014-2018 (N = 2009 CRASHES).

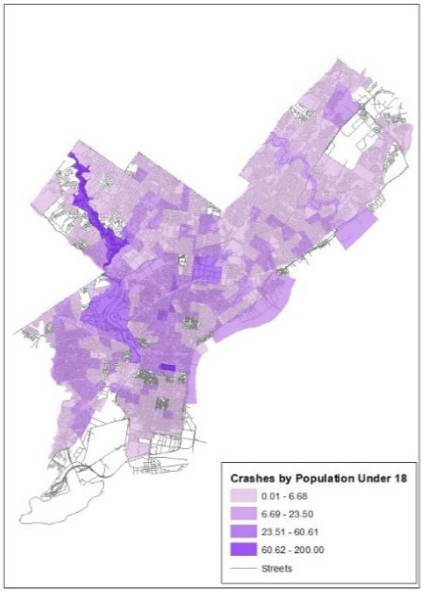

FIGURE 3. MAP OF YOUTH PEDESTRIAN CRASHES (< 18) PER YOUTH POPULATION (< 18).

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.

The team’s full analysis is available as Appendix X.

Chapter 2: Recommendations

Youth Considerations

A. Introduction

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* on Page 39 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 (see Chapter 1, Youth Crash Analysis). 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.

B. 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 in this chapter.

Table 1: 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	Cut Sheet Page Ref.
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 over turning vehicles. Such a separated interval has the potential to particularly benefit young pedestrians, who typically have added difficulty interacting with turning vehicles at intersections.[1]	
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.	

[1] 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.

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.	
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.[2]	
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.	

C. Recommendations for Consideration/Discussion

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.

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

[2] 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.

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.

- 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.
- 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.
- 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.

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.

D. Conclusion

This section describes key considerations for countermeasure selection as they relate to children and youth and areas where children are likely to walk. Children and youth have unique age-appropriate abilities and special vulnerabilities, and these should be factored in when planning, designing, and implementing Pedestrian Safety Crash Countermeasures. While countermeasure interventions targeted to children and youth may provide specific benefits, it's still important to emphasize that all of the Pedestrian Safety Countermeasures will improve safety for all roadway users, including children and youth, and that engineering countermeasures will not, in and of themselves, enable young children to walk safely without adult supervision. These physical improvements will need to be supplemented and reinforced by age-appropriate supervision by a responsible adult, educational programs and activities.

Appendix D

Philadelphia Vision Zero for Youth Pilot Demonstration

Systemic Safety Analysis Technical Memorandum

September 16, 2020

Introduction

This memorandum summarizes the systemic safety analysis that was conducted as part of the Vision Zero for Youth demonstration project in the city of Philadelphia. It includes details on data sources and limitations, GIS analysis processes used, how risk variables were constructed, and results of the analysis.

While the systemic approach is becoming more widely used in transportation planning, it has never been applied specifically to understanding youth travel risks. Concurrent to the Demonstration Project, the Pedestrian and Bicycle Information Center (PBIC) was developing the *Safety-Based Prioritization for Youth Pedestrian Travel Planning* and saw the demonstration project as an important opportunity to pilot test the prioritization process.

The systemic approach featured in the resource – and pilot tested as part of the Demonstration Project - followed steps outlined in the National Cooperative Highway Research Program (NCHRP) Research Report 893 -Systemic Pedestrian Safety Analysis[1], which describes a process for identifying and prioritizing high risk locations and applying countermeasures to prevent serious pedestrian crashes. The team modified variables to account for youth pedestrian abilities and applied the process to develop an understanding of high-risk locations throughout the City of Philadelphia for youth pedestrian travel. It also drew heavily on PBIC's participation in the development of the Systemic Pedestrian Safety Analysis report, and the work of the PBIC and National Center for Safe Routes to School to understand and prevent child pedestrian and bicyclist injuries and deaths.

Methodology

The pilot analyzed a single crash type—pedestrian crashes for youth under age 18 that occurred within the city limits of Philadelphia—and did not further stratify these crashes by roadway location and motor vehicle movements during the initial analysis. This simplified approach was taken to explore a process that may be more possible for jurisdictions that lack crash type information.

Data Sources and limitations

The project team explored the availability of GIS data on various roadway variables to use in the systemic analysis, considering what was available from the city of Philadelphia and the Delaware Valley Regional Planning Commission (DVRPC). The data necessary for even high-level systemic analysis for Philadelphia proved challenging to obtain - many salient features that could impact youth pedestrian crash risk, such as the location of crossing islands, marked crosswalks, signal phasing, and curb ramp locations and conditions, were not available in GIS, and we realized this would likely be the case for

[1] Thomas, L., Sandt, L., Zegeer, C., Kumfer, W., Lang, K., Lan, B., ... & Schneider, R. J. (2018). Systemic Pedestrian Safety Analysis (No. Project 17-73).. https://doi.org/10.17226/25255

most jurisdictions, especially those of smaller size. We adjusted our approach to focus on recommending an assessment using known crash and high-risk roadway variables which are currently available for Philadelphia and likely to be available for most jurisdictions. Our approach also made use of the best and latest knowledge from the safety literature on pedestrian safety for youth, including the known high-risk factors which should be more generally appropriate for all cities.

This approach is assumed to support a bigger picture of risk determination, with the intent that additional data collection and field work be conducted at higher risk sites to further inform countermeasure selection and project implementation decisions.

Specifically, the team assessed available data and used research to develop the following short list of key roadway, pedestrian exposure proxy and equity variables for analysis:

Roadway Risk Variables

Variable	Source
Posted Speed Limit	Pennsylvania Department of Transportation
Annual Average Daily Traffic Volume (AADT)	Pennsylvania Department of Transportation
Number of Lanes	Delaware Valley Regional Planning Commission
Presence of Sidewalks*	Calculated from an Impervious Surface dataset from the City of Philadelphia

*It should be noted that a sidewalk dataset was not available at the outset of the project, although sidewalk coverage was estimated for each roadway segment (city block) on both sides of the street to determine if continuous sidewalk facilities were available.

Exposure Proxy Variables

Pedestrian crash risk is influenced in part by the level of crash exposure, including the number of pedestrians as well as the frequency and location of their pedestrian trips. However, as in other jurisdictions, Annual Average Daily Pedestrian Volume data are not collected in Philadelphia (and even if they were, they likely would not be stratified by pedestrian age). To account for possible youth pedestrian crash exposure and neighborhood demographic factors, the following demographic and contextual proxy variables were collected.

Variable	Source
Density of Households in Poverty (per Census Block Group)	US Census American Community Survey 2014-2018 5-Year Estimates
Primary and Secondary School Locations	City of Philadelphia

Equity Variables

People of color, older adults, and residents of low-income communities are over-represented in pedestrian crashes. In the United States, communities with high concentrations of people of color are frequently underserved by transportation investments and are subjected to side effects associated with highway projects, such as pollution and displacement. Giving precedence to locations with higher concentrations of people of color or lower-income households can help to

address historical inequalities and the current discrepancies in crash risk that these historical inequalities have helped create.[2]

The analysis included low income household density, measured using US Census American Community Survey 5-Year Estimates, to initially identify these communities of concern.

Determining Risk Factors

Using the available data, the project team used a combination of two approaches to construct risk factors for systemic analysis, as described in the NHCRP Systemic Pedestrian Safety Analysis report: prior research and planning judgment, and the frequency-based method.

Roadway Risk, Pedestrian Exposure Proxy and Equity Variable Threshold Creation

First, the project team established risk thresholds for the roadway and pedestrian exposure data described above based on a review of prior research on pedestrian crashes; some risk factor thresholds were adjusted to better reflect age-appropriate abilities of youth. For example, while thresholds for traffic volume risk typically start at 10,000, AADT of greater than 5,000 vehicles were considered higher risk for youth. Similarly, multi-lane thresholds typically start at more than three lanes (sometimes five or more lanes) but more than two bi-directional lanes or more than one one-way lane were established as an appropriate risk threshold for youth. The risk factor thresholds established for the pilot are as follows:

- Posted speed limit > 25 mph.
- AADT greater than 5,000.
- Multi-lane roads (more than two lanes bi-directional, more than one lane on one-way roads).
- Lack of sidewalks (less than 50% coverage on either side of the road).
- Household density (top 20% densest weighted area of households within 200 ft of a road).
- Concentrated areas of poverty (top 20% densest weighted areas of households in poverty within 200 ft of a road).
- Proximity to one or more schools (within .25 miles of a crash).

Analysis of Youth Pedestrian Crashes for Risk Frequency

Once these above roadway risk and exposure proxy variables were created in a consolidated database, they were preliminarily mapped for qualitative analysis of youth pedestrian crash locations and their presence on segments that had roadway risk variables or proximity to exposure proxy variables.

The team also performed cross tabulations to quantify the degree of risk factor association with prior crashes. In total, 17 combinations of roadway risk factors were assessed, including “none” (no roadway risk factors present) and “any” (roads including one or more roadway risk factor):

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[2] Smart Growth America. (n.d.). *Complete Streets Means Equitable Streets*. Retrieved from http://old.smartgrowthamerica.org/documents/cs/factsheets/cs-equity.pdf.

1. The roadway network was analyzed based on how many miles of road, and the percentage of the overall road network where each roadway risk factor or combination of roadway risk factors is present. This included an assessment of roads with none of the identified risk factors and roads with any of the identified risk factors.
2. The number and percentage of youth pedestrian crashes that occurred on roads with these risk factors were calculated. This allowed for examination of any single roadway risk variable—or combination of variables— that represented an elevated number or percentage of crashes.
3. Crash rates (the number of youth pedestrian injury crashes per mile) were then calculated to see if a higher number of crashes occurred after accounting for differences in the number of miles of road with each risk variable present. Without comparing crash rates, it is possible that a higher number or percentage of crashes captured by a given risk variable could simply reflect a high percentage of the roadway network having that risk variable present. By comparing the crash rates, it is possible to see which risk variables were associated with more crashes once the number of miles of road are normalized.
4. Finally, pedestrian exposure proxy and equity variables were added to the spreadsheet, including the number and percentage of youth pedestrian injury crashes associated with each variable, as well as the percentage of all youth pedestrian injury crashes.

Findings

Four high-level takeaways resulted from the systemic analysis of youth pedestrian crashes in the city of Philadelphia. The takeaways were presented to city staff on June 5, 2020 and were included in PBIC's draft recommendations for the City's Three-Year Vision Zero Action Plan update:

1. Youth pedestrian crash rates are two to three times higher on roads with any of the following risk variables: posted speed greater than 25 mph; AADT of 5000 or greater; or more than one lane in each direction, than those roads without.
    - These roads accounted for 51% of crashes but represent 32.4% of the roadway network.
    - 66% of these crashes occurred at intersections.
    - Roads with AADT above 5,000 and posted speed limit above 25 mph represent 14% of Philadelphia's roadway network but are associated with 30% of youth pedestrian all injury crashes.
    - While the analysis did not find this same level of crash risk with sidewalks, there is strong evidence for the safety benefit of sidewalks and that they play a critical role in accessibility.
2. More than one-half (56%) of youth pedestrian crashes that occurred on roads with any risk variables (posted speed greater than 25 mph; AADT of 5000 or greater; or more than one lane in each direction; or lacking sidewalk coverage) were in areas of concentrated poverty. These areas were defined as the top 20% most dense areas of households in poverty in the city.
3. Almost one-half (49% or 974 crashes) of youth pedestrian crashes occurred on roads with 25 mph or lower posted speeds; one or fewer lanes in each direction; AADT under 5000; and sidewalk coverage over 50% along both sides of the street.
    - These roads are under-represented in youth pedestrian crashes; they make up 66% of Philadelphia's roadway network but are associated with 49% of youth pedestrian crashes.

- As such, these roads carry approximately half the crash rate of roads with posted speed greater than 25 mph; AADT of 5000 or greater; or more than one lane in each direction.
- Nearly all (92%) occurred on local or collector roads.
- Most crashes (70%) occurred mid-block.
- These crashes are dispersed throughout the city; not concentrated in any single neighborhood or planning district.

4. 78% of youth pedestrian crashes occurred within 1/4 mile of a school.

Appendix E

1/4 mi buffer for each exposure proxy variable

Risk Factor Group	Street Network Miles		Youth Ped All Injury Crashes			Youth Ped All Injury in Top Quintile of Household Density			Youth Ped All Injury in Top Quintile of Population Density			Youth Ped All Injury Road Risk Factor in Top Quintile of HH in Pov			Youth Ped All Injury Road Risk Factor Near 1+ Schools			Youth Ped All Injury in Top Quintile of HH in Pov and Near 1+ Schools		
	#	%	#	%	Crashes Per Mile	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes
None	1831	65.8%	974	48.7%	0.53	326	65.9%	16.3%	379	62.1%	18.9%	293	44.3%	14.6%	770	49.3%	38.5%	250	45.8%	12.5%
Any	953	34.2%	1028	51.3%	1.08	169	34.1%	8.4%	231	37.9%	11.5%	368	55.7%	18.4%	792	50.7%	39.6%	296	54.2%	14.8%
Total	**2784**	**100.0%**	**2002**	**100.0%**	**0.72**	**495**	**100.0%**	**24.7%**	**610**	**100.0%**	**30.5%**	**661**	**100.0%**	**33.0%**	**1562**	**100.0%**	**78.0%**	**546**	**100.0%**	**27.3%**
AADT	612	22.0%	967	48.3%	1.58	158	31.9%	7.9%	220	36.1%	11.0%	349	52.8%	17.4%	746	47.8%	37.3%	282	51.6%	14.1%
Multilane	344	12.4%	382	19.1%	1.11	61	12.3%	3.0%	69	11.3%	3.4%	129	19.5%	6.4%	258	16.5%	12.9%	87	15.9%	4.3%
Speed	460	16.5%	618	30.9%	1.34	84	17.0%	4.2%	118	19.3%	5.9%	196	29.7%	9.8%	457	29.3%	22.8%	148	27.1%	7.4%
Sidewalk Gaps	373	13.4%	161	8.0%	0.43	16	3.2%	0.8%	16	2.6%	0.8%	49	7.4%	2.4%	108	6.9%	5.4%	35	6.4%	1.7%
AADT and Multilane	295	10.6%	371	18.5%	1.26	60	12.1%	3.0%	69	11.3%	3.4%	127	19.2%	6.3%	251	16.1%	12.5%	86	15.8%	4.3%
AADT and Speed	381	13.7%	599	29.9%	1.57	78	15.8%	3.9%	113	18.5%	5.6%	190	28.7%	9.5%	439	28.1%	21.9%	142	26.0%	7.1%
AADT and Sidewalk Gaps	101	3.6%	127	6.3%	1.26	12	2.4%	0.6%	10	1.6%	0.5%	38	5.7%	1.9%	86	5.5%	4.3%	28	5.1%	1.4%
Multilane and Speed	258	9.3%	318	15.9%	1.23	40	8.1%	2.0%	52	8.5%	2.6%	102	15.4%	5.1%	212	13.6%	10.6%	67	12.3%	3.3%
Multilane and Sidewalk Gaps	69	2.5%	83	4.1%	1.20	11	2.2%	0.5%	9	1.5%	0.4%	27	4.1%	1.3%	51	3.3%	2.5%	17	3.1%	0.8%
Speed and Sidewalk Gaps	106	3.8%	95	4.7%	0.90	2	0.4%	0.1%	2	0.3%	0.1%	21	3.2%	1.0%	60	3.8%	3.0%	14	2.6%	0.7%
AADT, Speed, and Sidewalk Gaps	77	2.8%	93	4.6%	1.21	2	0.4%	0.1%	2	0.3%	0.1%	21	3.2%	1.0%	59	3.8%	2.9%	14	2.6%	0.7%
AADT, Multilane, and Speed	229	8.2%	317	15.8%	1.38	40	8.1%	2.0%	52	8.5%	2.6%	102	15.4%	5.1%	212	13.6%	10.6%	67	12.3%	3.3%
AADT, Multilane, and Sidewalk Gaps	59	2.1%	82	4.1%	1.39	11	2.2%	0.5%	9	1.5%	0.4%	27	4.1%	1.3%	51	3.3%	2.5%	17	3.1%	0.8%
Multilane, Speed, and Sidewalk Gaps	58	2.1%	65	3.2%	1.12	1	0.2%	0.0%	1	0.2%	0.0%	15	2.3%	0.7%	36	2.3%	1.8%	8	1.5%	0.4%
AADT, Multilane, Speed, and Sidewalk Gaps	51	1.8%	64	3.2%	1.25	1	0.2%	0.0%	1	0.2%	0.0%	15	2.3%	0.7%	36	2.3%	1.8%	15	2.7%	0.7%

Appendix F

Philadelphia Vision Zero for Youth Demonstration Project

Safety Based Prioritization for Student Pedestrian Travel Planning

TOOLE DESIGN

vision zero FOR youth

Overview of VZY Demonstration Project

1. Thank you
2. Project components in year 1:
   - Child pedestrian crash analysis
   - Youth considerations for countermeasure selection
   - Vision Zero Action Plan recommendations
   - Systemic analysis

Pilot – Youth Pedestrian Systemic Safety Analysis

A systemic approach:

- Aligns with Vision Zero
- Identifies high risk roadway features correlated with specific or severe crash types
- Proactive & reactive: Seeks to address both locations with prior crash occurrence AND locations with crash risk (regardless of crash history)
- Countermeasure application knowing resources are limited

Guided by NCHRP Report 893, *Systemic Pedestrian Safety Analysis*

Methodology – Pedestrian Systemic Safety Analysis (NCHRP 893)

1. Define the study scope
2. Compile data
3. Determine risk factors
4. Identify potential treatment sites
5. Select potential countermeasures
6. Refine and implement treatment plan
7. Evaluate program and project impacts

Methodology – Pedestrian Systemic Safety Analysis (NCHRP 893)

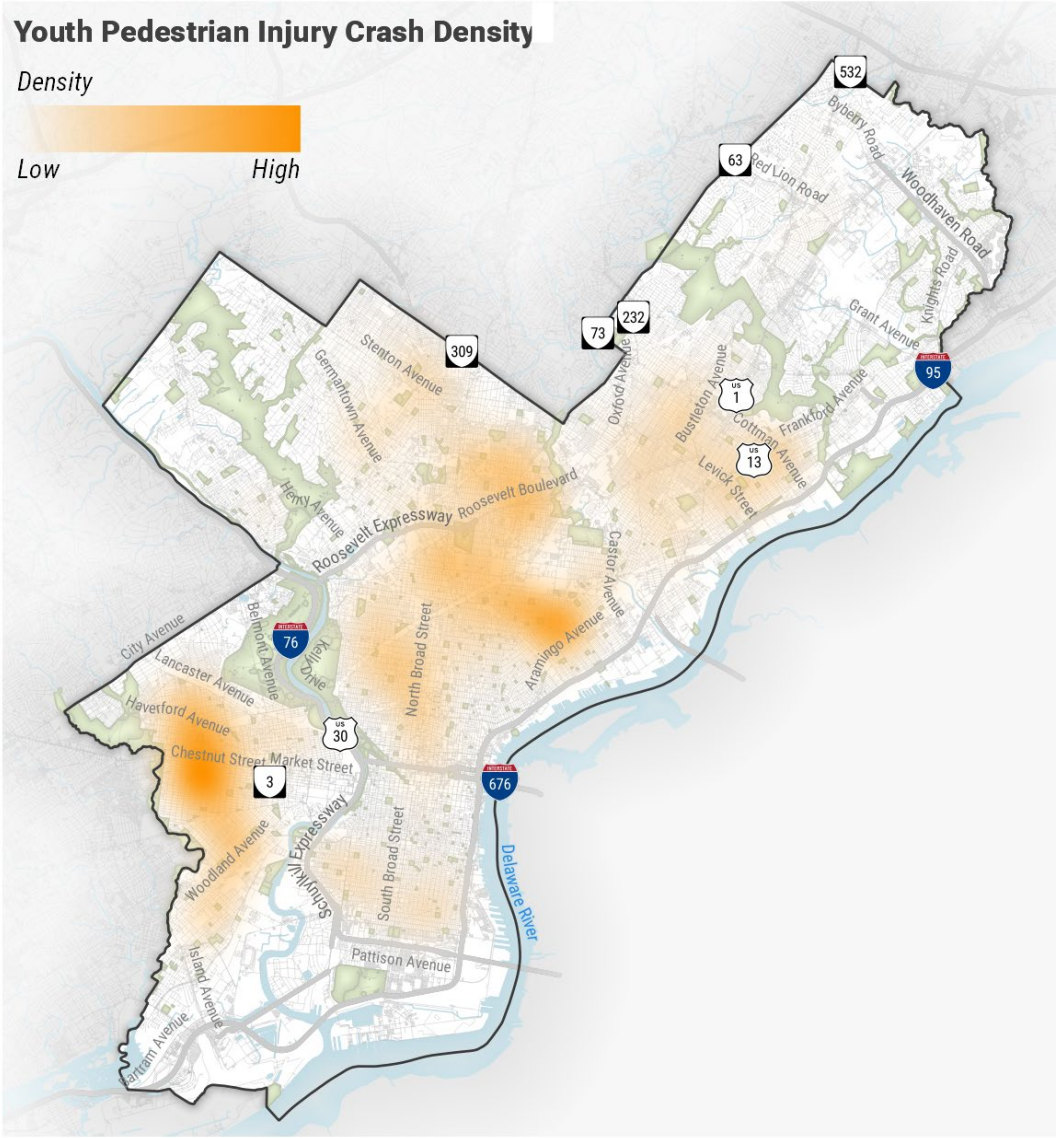
1. Define the study scope
2. Compile data
3. Determine risk factors
4. Identify potential treatment sites
5. Select potential countermeasures
6. Refine and implement treatment plan
7. Evaluate program and project impacts

Step 1: Define Study Scope

- City of Philadelphia
- Youth pedestrian all-injury crashes

Youth Pedestrian Crashes

- ¼ of Philadelphia's 2014-2018 pedestrian crashes involved one or more youth
- Most likely to be hit during the day (74% of all youth pedestrian crashes, 67% of all fatal and severe crashes)
- More likely to be in the road when struck - 48% youth, 31% adult
- Less likely to be struck at the intersection of two major arterials (3.5% for youth, compared to 7.5% for adults).



Step 2: Compile Data

Roadway Characteristics	Pedestrian Exposure Proxy Variables
Speed	Proximity to Schools
AADT	Low income household density
Multi-lane	Household density
Lack of Sidewalks	

Step 3: Determine Risk Factors

Roadway Characteristic	Threshold	Data Source	Network Coverage
Posted Speed	>25 mph	PennDOT	88.25%
AADT	>=5,000	PennDOT	26%
Multi-lane	>2 lanes bi-directional, >1 lane one-way	DVRPC	100%
Lack of sidewalks	<50% coverage either side	Toole Design Group	100%*

Pedestrian Exposure Proxy	Threshold	Data source
Proximity to school	Crashes within ¼ mile of one or more school	City of Philadelphia
Low income household density	Top 20% of dense areas of households in poverty	Census (federal poverty level)
Household density	Top 20% of dense areas of households	Census

*derived from citywide permeable surface layer

Frequency-based method

Fifteen Risk Factor Variable Combinations:

1. AADT
2. Multilane
3. Speed
4. Sidewalk Gaps
5. AADT and Multilane
6. AADT and Speed
7. AADT and Sidewalk Gaps
8. Multilane and Speed
9. Multilane and Sidewalk Gaps
10. Speed and Sidewalk Gaps
11. AADT, Speed, Sidewalk Gaps
12. AADT, Multilane, Speed
13. AADT, Multilane, Sidewalk Gaps
14. Multilane, Speed, Sidewalk Gaps
15. AADT, Multilane, Speed, Sidewalk Gaps

Cross-tab Analysis

1) Roadway risk factors by street network miles

	Philadelphia VZY Demonstration Project - Systemic Pedestrian Safety Analysis Pilot - May 27, 2020	Street Network Miles	
3	**Risk Factor Group**	**#**	**%**
4	None	1831	65.8%
5	Any	953	34.2%
6	**Total**	**2784**	**100.0%**
7			
8	AADT	612	22.0%
9	Multilane	344	12.4%
10	Speed	460	16.5%
11	Sidewalk Gaps	373	13.4%
12	AADT and Multilane	295	10.6%
13	AADT and Speed	381	13.7%
14	AADT and Sidewalk Gaps	101	3.6%
15	Multilane and Speed	258	9.3%
16	Multilane and Sidewalk Gaps	69	2.5%
17	Speed and Sidewalk Gaps	106	3.8%
18	AADT, Speed, and Sidewalk Gaps	77	2.8%
19	AADT, Multilane, and Speed	229	8.2%
20	AADT, Multilane, and Sidewalk Gaps	59	2.1%
21	Multilane, Speed, and Sidwealk Gaps	58	2.1%
22	AADT, Multilane, Speed, and Sidewalk Gaps	51	1.8%

Cross-tab Analysis

2) Added youth pedestrian injury crashes, detailing the number and percentage of crashes and crashes per mile

2	Philadelphia VZY Demonstration Project - Systemic Pedestrian Safety Analysis Pilot - May 27, 2020	Street Network Miles		Youth Ped All Injury Crashes		
3	Risk Factor Group	#	%	#	%	Crashes Per Mile
4	None	1831	65.8%	974	48.7%	0.53
5	Any	953	34.2%	1028	51.3%	1.08
6	**Total**	**2784**	**100.0%**	**2002**	**100.0%**	**0.72**
7						
8	AADT	612	22.0%	967	48.3%	1.58
9	Multilane	344	12.4%	382	19.1%	1.11
10	Speed	460	16.5%	618	30.9%	1.34
11	Sidewalk Gaps	373	13.4%	161	8.0%	0.43
12	AADT and Multilane	295	10.6%	371	18.5%	1.26
13	AADT and Speed	381	13.7%	599	29.9%	1.57
14	AADT and Sidewalk Gaps	101	3.6%	127	6.3%	1.26
15	Multilane and Speed	258	9.3%	318	15.9%	1.23
16	Multilane and Sidewalk Gaps	69	2.5%	83	4.1%	1.20
17	Speed and Sidewalk Gaps	106	3.8%	95	4.7%	0.90
18	AADT, Speed, and Sidewalk Gaps	77	2.8%	93	4.6%	1.21
19	AADT, Multilane, and Speed	229	8.2%	317	15.8%	1.38
20	AADT, Multilane, and Sidewalk Gaps	59	2.1%	82	4.1%	1.39
21	Multilane, Speed, and Sidwealk Gaps	58	2.1%	65	3.2%	1.12
22	AADT, Multilane, Speed, and Sidewalk Gaps	51	1.8%	64	3.2%	1.25

Cross-tab Analysis

3) Added pedestrian exposure proxy variables

	Philadelphia VZY Demonstration Project - Systemic Pedestrian Safety Analysis Pilot - May 27, 2020	Street Network Miles		Youth Ped All Injury Crashes			1/4 mi buffer for each exposure proxy variable															
							Youth Ped All Injury in Top Quintile of Household Density			Youth Ped All Injury in Top Quintile of Population Density			Youth Ped All Injury Road Risk Factor in Top Quintile of HH in Pov			Youth Ped All Injury Road Risk Factor Near 1+ Schools			Youth Ped All Injury in Top Quintile of HH in Pov and Near 1+ Schools		
	Risk Factor Group	#	%	#	%	Crashes Per Mile	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes
4	None	1831	65.8%	974	48.7%	0.53	326	65.9%	16.3%	379	62.1%	18.9%	293	44.3%	14.6%	770	49.3%	38.5%	250	45.8%	12.5%
5	Any	953	34.2%	1028	51.3%	1.08	169	34.1%	8.4%	231	37.9%	11.5%	368	55.7%	18.4%	792	50.7%	39.6%	296	54.2%	14.8%
6	**Total**	**2784**	**100.0%**	**2002**	**100.0%**	**0.72**	**495**	**100.0%**	**24.7%**	**610**	**100.0%**	**30.5%**	**661**	**100.0%**	**33.0%**	**1562**	**100.0%**	**78.0%**	**546**	**100.0%**	**27.3%**
7																					
8	AADT	612	22.0%	967	48.3%	1.58	158	31.9%	7.9%	220	36.1%	11.0%	349	52.8%	17.4%	746	47.8%	37.3%	282	51.6%	14.1%
9	Multilane	344	12.4%	382	19.1%	1.11	61	12.3%	3.0%	69	11.3%	3.4%	129	19.5%	6.4%	258	16.5%	12.9%	87	15.9%	4.3%
10	Speed	460	16.5%	618	30.9%	1.34	84	17.0%	4.2%	118	19.3%	5.9%	196	29.7%	9.8%	457	29.3%	22.8%	148	27.1%	7.4%
11	Sidewalk Gaps	373	13.4%	161	8.0%	0.43	16	3.2%	0.8%	16	2.6%	0.8%	49	7.4%	2.4%	108	6.9%	5.4%	35	6.4%	1.7%
12	AADT and Multilane	295	10.6%	371	18.5%	1.26	60	12.1%	3.0%	69	11.3%	3.4%	127	19.2%	6.3%	251	16.1%	12.5%	86	15.8%	4.3%
13	AADT and Speed	381	13.7%	599	29.9%	1.57	78	15.8%	3.9%	113	18.5%	5.6%	190	28.7%	9.5%	439	28.1%	21.9%	142	26.0%	7.1%
14	AADT and Sidewalk Gaps	101	3.6%	127	6.3%	1.26	12	2.4%	0.6%	10	1.6%	0.5%	38	5.7%	1.9%	86	5.5%	4.3%	28	5.1%	1.4%
15	Multilane and Speed	258	9.3%	318	15.9%	1.23	40	8.1%	2.0%	52	8.5%	2.6%	102	15.4%	5.1%	212	13.6%	10.6%	67	12.3%	3.3%
16	Multilane and Sidewalk Gaps	69	2.5%	83	4.1%	1.20	11	2.2%	0.5%	9	1.5%	0.4%	27	4.1%	1.3%	51	3.3%	2.5%	17	3.1%	0.8%
17	Speed and Sidewalk Gaps	106	3.8%	95	4.7%	0.90	2	0.4%	0.1%	2	0.3%	0.1%	21	3.2%	1.0%	60	3.8%	3.0%	14	2.6%	0.7%
18	AADT, Speed, and Sidewalk Gaps	77	2.8%	93	4.6%	1.21	2	0.4%	0.1%	2	0.3%	0.1%	21	3.2%	1.0%	59	3.8%	2.9%	14	2.6%	0.7%
19	AADT, Multilane, and Speed	229	8.2%	317	15.8%	1.38	40	8.1%	2.0%	52	8.5%	2.6%	102	15.4%	5.1%	212	13.6%	10.6%	67	12.3%	3.3%
20	AADT, Multilane, and Sidewalk Gaps	59	2.1%	82	4.1%	1.39	11	2.2%	0.5%	9	1.5%	0.4%	27	4.1%	1.3%	51	3.3%	2.5%	17	3.1%	0.8%
21	Multilane, Speed, and Sidwealk Gaps	58	2.1%	65	3.2%	1.12	1	0.2%	0.0%	1	0.2%	0.0%	15	2.3%	0.7%	36	2.3%	1.8%	8	1.5%	0.4%
22	AADT, Multilane, Speed, and Sidewalk Gaps	51	1.8%	64	3.2%	1.25	1	0.2%	0.0%	1	0.2%	0.0%	15	2.3%	0.7%	36	2.3%	1.8%	15	2.7%	0.7%

Cross-tab Analysis

3) Added pedestrian exposure proxy variables

	Philadelphia VZY Demonstration Project - Systemic Pedestrian Safety Analysis Pilot - May 27, 2020	Street Network Miles		Youth Ped All Injury Crashes			1/4 mi buffer for each exposure proxy variable															
							Youth Ped All Injury in Top Quintile of Household Density			Youth Ped All Injury in Top Quintile of Population Density			Youth Ped All Injury Road Risk Factor in Top Quintile of HH in Pov			Youth Ped All Injury Road Risk Factor Near 1+ Schools			Youth Ped All Injury in Top Quintile of HH in Pov and Near 1+ Schools		
	Risk Factor Group	#	%	#	%	Crashes Per Mile	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes	#	%	% all youth ped injury crashes
4	None	1831	65.8%	974	48.7%	0.53	326	65.9%	16.3%	379	62.1%	18.9%	293	44.3%	14.6%	770	49.3%	38.5%	250	45.8%	12.5%
5	Any	953	34.2%	1028	51.3%	1.08	169	34.1%	8.4%	231	37.9%	11.5%	368	55.7%	18.4%	792	50.7%	39.6%	296	54.2%	14.8%
6	**Total**	**2784**	**100.0%**	**2002**	**100.0%**	**0.72**	**495**	**100.0%**	**24.7%**	**610**	**100.0%**	**30.5%**	**661**	**100.0%**	**33.0%**	**1562**	**100.0%**	**78.0%**	**546**	**100.0%**	**27.3%**
7																					
8	AADT	612	22.0%	967	48.3%	1.58	158	31.9%	7.9%	220	36.1%	11.0%	349	52.8%	17.4%	746	47.8%	37.3%	282	51.6%	14.1%
9	Multilane	344	12.4%	382	19.1%	1.11	61	12.3%	3.0%	69	11.3%	3.4%	129	19.5%	6.4%	258	16.5%	12.9%	87	15.9%	4.3%
10	Speed	460	16.5%	618	30.9%	1.34	84	17.0%	4.2%	118	19.3%	5.9%	196	29.7%	9.8%	457	29.3%	22.8%	148	27.1%	7.4%
11	Sidewalk Gaps	373	13.4%	161	8.0%	0.43	16	3.2%	0.8%	16	2.6%	0.8%	49	7.4%	2.4%	108	6.9%	5.4%	35	6.4%	1.7%
12	AADT and Multilane	295	10.6%	371	18.5%	1.26	60	12.1%	3.0%	69	11.3%	3.4%	127	19.2%	6.3%	251	16.1%	12.5%	86	15.8%	4.3%
13	AADT and Speed	381	13.7%	599	29.9%	1.57	78	15.8%	3.9%	113	18.5%	5.6%	190	28.7%	9.5%	439	28.1%	21.9%	142	26.0%	7.1%
14	AADT and Sidewalk Gaps	101	3.6%	127	6.3%	1.26	12	2.4%	0.6%	10	1.6%	0.5%	38	5.7%	1.9%	86	5.5%	4.3%	28	5.1%	1.4%
15	Multilane and Speed	258	9.3%	318	15.9%	1.23	40	8.1%	2.0%	52	8.5%	2.6%	102	15.4%	5.1%	212	13.6%	10.6%	67	12.3%	3.3%
16	Multilane and Sidewalk Gaps	69	2.5%	83	4.1%	1.20	11	2.2%	0.5%	9	1.5%	0.4%	27	4.1%	1.3%	51	3.3%	2.5%	17	3.1%	0.8%
17	Speed and Sidewalk Gaps	106	3.8%	95	4.7%	0.90	2	0.4%	0.1%	2	0.3%	0.1%	21	3.2%	1.0%	60	3.8%	3.0%	14	2.6%	0.7%
18	AADT, Speed, and Sidewalk Gaps	77	2.8%	93	4.6%	1.21	2	0.4%	0.1%	2	0.3%	0.1%	21	3.2%	1.0%	59	3.8%	2.9%	14	2.6%	0.7%
19	AADT, Multilane, and Speed	229	8.2%	317	15.8%	1.38	40	8.1%	2.0%	52	8.5%	2.6%	102	15.4%	5.1%	212	13.6%	10.6%	67	12.3%	3.3%
20	AADT, Multilane, and Sidewalk Gaps	59	2.1%	82	4.1%	1.39	11	2.2%	0.5%	9	1.5%	0.4%	27	4.1%	1.3%	51	3.3%	2.5%	17	3.1%	0.8%
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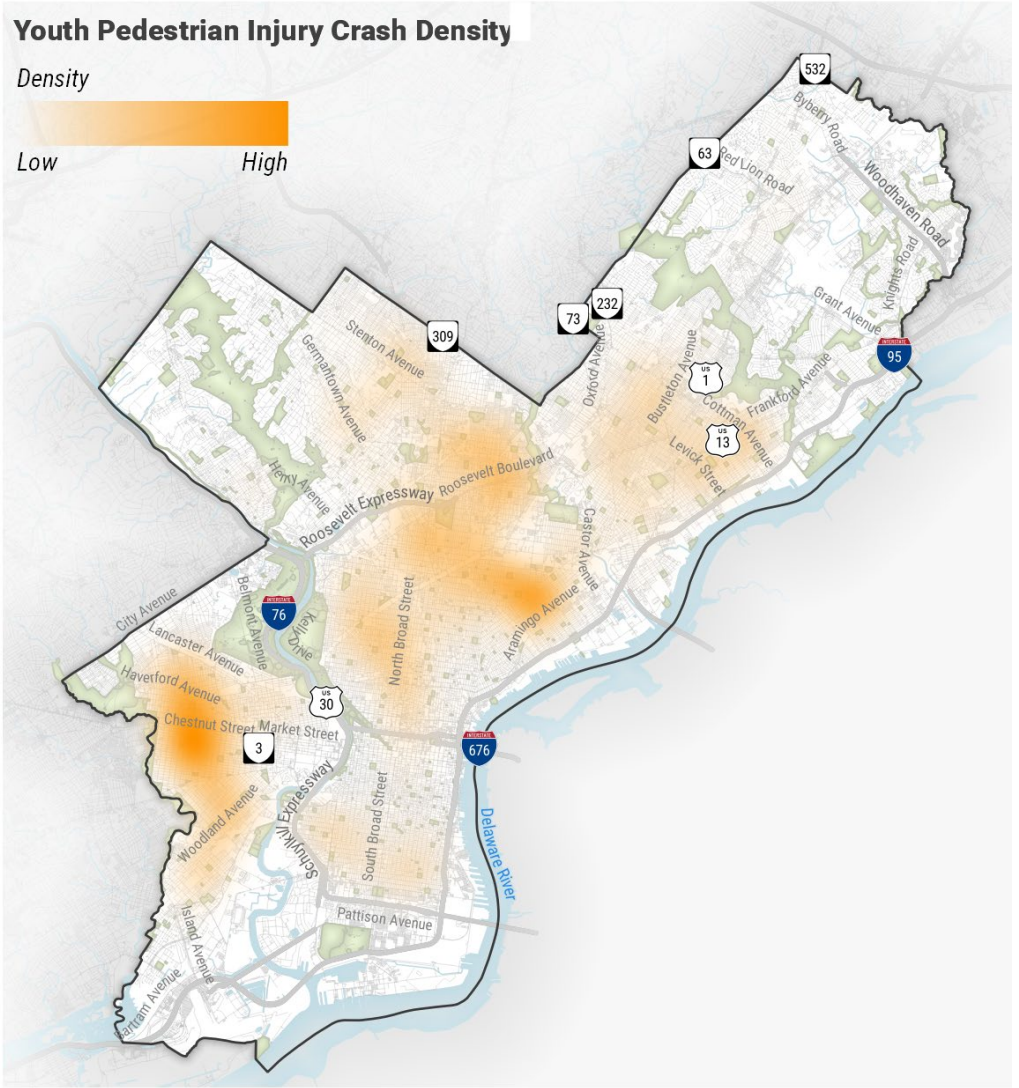
22	AADT, Multilane, Speed, and Sidewalk Gaps	51	1.8%	64	3.2%	1.25	1	0.2%	0.0%	1	0.2%	0.0%	15	2.3%	0.7%	36	2.3%	1.8%	15	2.7%	0.7%

Key takeaway

Youth pedestrian crashes need special attention

- ¼ of Philadelphia's 2014-2018 pedestrian crashes involved one or more youth
- Most likely to be hit during the day (74% of all youth pedestrian crashes, 67% of all fatal and severe crashes)
- More likely to be in the road when struck - 48% youth, 31% adult
- Less likely to be struck at the intersection of two major arterials (3.5% for youth, compared to 7.5% for adults).



Recommendation

Include in the Vision Zero Action Plan Update language to apply findings of the Vision Zero for Youth analysis to determine locations for youth pedestrian safety improvements.

Key Takeaway

Youth pedestrian crash rates are two to three times higher on roads with any of the following risk variables: posted speed greater than 25 mph; AADT of 5,000 or greater; or more than one lane in each direction, than those without.

- These roads accounted for 51% of crashes (n=1028) but represent 32.4% of the roadway network.
- 66% of these crashes occurred at intersections.
- Roads with AADT above 5,000 and posted speed limit above 25 mph represent 14% of Philadelphia's roadway network but are associated with 30% of youth pedestrian all injury crashes.

Key Takeaway

More than one-half (56%) of youth pedestrian crashes that occurred near areas of concentrated poverty were on roads with any risk variables.

Key Takeaway

78% of youth pedestrian crashes occurred within ¼ mile of a school.

Recommendation

Consider countermeasures that address the roadway risk variables present on riskier roads. For example:

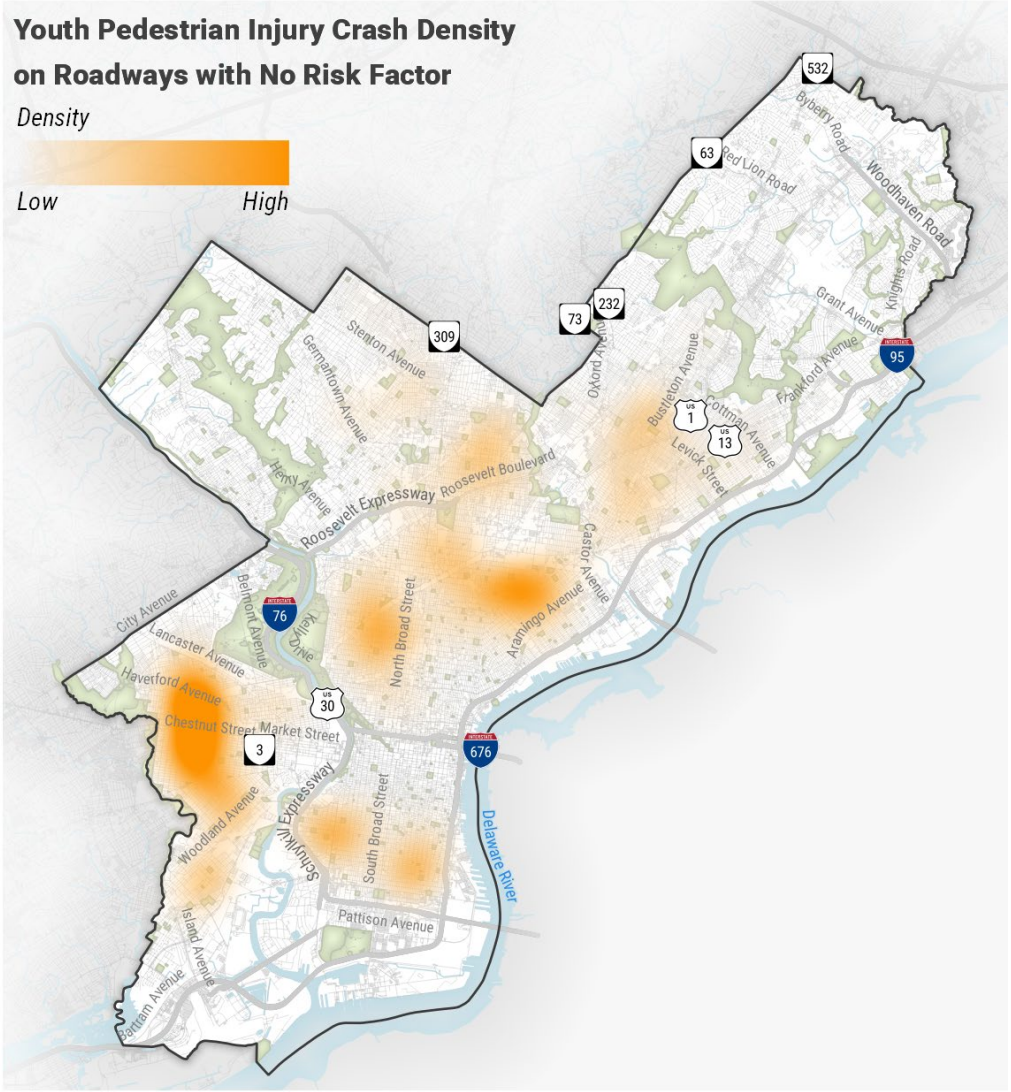
- road diets to reduce the number of lanes on multi-lane roads;
- through- or turning-speed-reducing countermeasures to achieve lower target speeds;
- reduced motor vehicle volumes through transportation demand management, enhanced public transit, and more complete and comfortable bicycle networks; and
- provision of accessible sidewalks where they are lacking

Further analysis is needed to narrow down locations for potential treatment and countermeasure selection

Key Takeaway

Almost one-half (49% or 974 crashes) of youth pedestrian crashes occurred on roads with 25 mph or lower posted speeds; one or fewer lanes in each direction; AADT under 5000; and sidewalk coverage over 50% along both sides of the street.

- These roads are under-represented in youth pedestrian crashes (66% of roadway network, 49% of youth pedestrian crashes).
- Nearly all (92%) occurred on local or collector roads.
- Most crashes (70%) occurred mid-block.
- Dispersed throughout the city; not concentrated in any single neighborhood or planning district



Appendix G

Philadelphia Vision Zero for Youth Demonstration Project

Next Steps Proposal

July 21, 2020

In June 2020, the Vision Zero for Youth Demonstration Project reached an important milestone when the Project Team (Pedestrian and Bicycle Information Center with subcontractor Toole Design Group) presented the city of Philadelphia with preliminary findings from systemic analysis of youth pedestrian crashes. Specifically, the Project Team presented key takeaways to provide a general understanding of roadway risk variable and pedestrian exposure variable associations with youth pedestrian crashes and submitted draft Vision Zero Action Plan Update recommendations to address youth pedestrian crashes (these recommendations are in addition to those submitted in late May).

The Project Team proposes to refine and use the systemic analysis of youth pedestrian crashes to proactively identify locations at risk for youth pedestrian crashes to guide systemic application of countermeasures. Proactive identification and treatment of crash risk is a key tenet of Vision Zero and necessary to identify many locations where a crash is likely to occur. Proactive, systemic planning is one of ten "core elements" of vision zero, to be implemented in tandem with responsive hot spot planning, according to the Vision Zero Network.[1] Proactive planning may help the City determine locations for traffic calming measures and programs, improved treatments at crossings near schools, or implementation of strategic safety education efforts.

Tasks 1 – 4 fit together to support an effort to reduce child pedestrian deaths and injuries with a focus on reducing speeds near schools. Speed is a major factor in child pedestrian deaths and injuries and 78 percent of child pedestrian crashes in Philadelphia occur within a quarter mile of school. This effort will have the larger goal to set the stage for implementing speed reduction strategies to benefit all pedestrians throughout the city. Places like New York City have demonstrated that focusing on youth can be an effective strategy to clarify efforts and build public support to implement countermeasures to reduce speed, with documented subsequent reductions in deaths and injuries.

Additionally, the High Injury Network data could be combined with systemic analysis to identify priority locations to address youth pedestrian crash risk near schools. Equity variables will better identify overlaps between traditionally underserved populations and areas of greatest need for transportation safety intervention, while community engagement will further illuminate the underlying dynamics driving youth pedestrian safety outcomes and preferred treatments to improve youth pedestrian safety.

[1] https://visionzeronetwork.org/wp-content/uploads/2018/11/VZN_CoreElements_FINAL.pdf

These steps could set the stage for a news conference where Mayor Kenney could restate the Vison Zero for Youth project he announced in October 2019, present key findings to date and announce that treatments (to be determined) will be installed at both the locations where crashes have happened and also at places likely to experience crashes, with an emphasis on neighborhoods with equity concerns.

The following tasks are proposed next steps for the Demonstration Project.

Task 1 – Expand equity variables used in systemic analysis and develop a crash tree to support countermeasure discussions and compare against the City's updated High Injury Network (HIN)

1a. Expand equity variables to include race, ethnicity, and historic redlining

In Philadelphia, the centerpiece of the City's diversity, equity, and inclusion (DEI) initiative is to "increase opportunities for all who have suffered from discriminatory practices." The City's DEI efforts are also explicitly focused on investments in "neighborhoods that have been harmed by unequal lending practices."[2]

The City of Philadelphia's Office of the Controller and others have documented the local history of federally-sponsored policies on racial segregation and unequal lending.[3] [4] In addition to these more well-known policies, the Federal Housing Administration also encouraged the use of physical barriers, including "artificially established barriers"—such as high-speed or elevated roadways without pedestrian accommodations—to maintain housing segregation based on income and race.[5]

Based on feedback from the oTIS Team, we will use Census data to add race and ethnicity to the systemic analysis. Addition of redlining variables will depend on the City's level of interest and ease of access to the data. Variables will be added to the crosstab spreadsheet and the team will reassess association of roadway risk factors, pedestrian exposure proxy variables and the expanded equity variables (race, ethnicity, income, and historic redlining) with youth crashes and present-day planning districts.

Task 1b. – Develop a crash tree by type of crashes (midblock vs intersection and vehicle pre-crash action) to refine the analysis and support identification of appropriate countermeasure options

To further understand youth pedestrian crashes and to support identification of appropriate countermeasure options (Task 3), the Demonstration Project Team will analyze youth pedestrian crash types—based on pedestrian location and vehicle movement—to better understand crash characteristics and inform countermeasure discussion.

Task 1c. – Review and compare the City's HIN with youth crash history and high-risk locations for youth pedestrian crashes (based on the completed systemic analysis)

To better understand opportunities to address youth pedestrian crash risk within the City's HIN, the Demonstration Project Team will compare it against identified high-risk youth pedestrian

[2] https://www.phila.gov/departments/office-of-diversity-equity-and-inclusion/
[3] https://controller.phila.gov/philadelphia-audits/mapping-the-legacy-of-structural-racism-in-philadelphia/
[4] https://nextcity.org/features/view/redlining-race-philadelphia-segregation
[5] http://wbhsi.net/~wendyplotkin/DeedsWeb/fha36.html

crash locations. Information on similarities and/or differences may inform approaches to Task 2 and Task 3 below.

Deliverable:

- Update to presentation summarizing findings from analysis of youth pedestrian crashes and roadway risk factors, to include expanded equity analysis, crash tree and comparison to the City's HIN.

Task 2 – Obtain community input in partnership with Safe Routes Philly

Stakeholder and community engagement will be essential to further understand the underlying dynamics causing youth pedestrian injuries and fatalities, which may be quite useful to Philadelphia officials for the selection of effective treatments to combat them. The type of information gathered, the timing and the setting would be set in close coordination with Safe Routes Philly.

Virtual roundtables or key stakeholder interviews could be used to understand the community's view of the youth pedestrian safety problems. The Demonstration Project Team and Safe Routes Philly will conduct a minimum of two invitational roundtables or six stakeholder interviews. We will work closely with Safe Routes Philly to finalize topics, identify potential participants, determine questions and set up the roundtables which will be conducted virtually via Zoom or Facebook Live, and may incorporate a pre-recorded or live presentation. Potential topics include:

- Perceptions of youth pedestrian safety issues and causes.
- Perceptions of role of law enforcement in safety for youth pedestrians.
- Meaningful engagement of underserved communities on future safe routes to school projects.
- Engagement of stakeholders in ongoing Safe Routes Philly initiatives and potential future youth pedestrian safety improvements.

Deliverables:

- Working with Safe Routes Philly to hold a minimum of two roundtables or six stakeholder interviews.
- Summary memorandum or presentation on the findings and recommendations.

Task 3 - Identify locations for targeted countermeasures

The Demonstration Project Team could use findings from the youth pedestrian systemic safety analysis and Task 2 (depending on timing) to identify potential priority locations* and potential countermeasures to support pedestrian safety engineering efforts that the City is already exploring, such as:

a. Speed cushions or speed humps near schools – Data analysis can identify riskier roads near schools in priority neighborhoods and located within communities of color and/or areas of concentrated poverty that may be suitable for speed humps or speed cushions.
b. Neighborhood slow zone program – In addition to community self-selection through the neighborhood slow zone application, the demonstration project safety and equity data can be analyzed and synthesized with community feedback to identify priority areas of the city where youth pedestrian injuries or deaths may be prevented through the neighborhood slow zone program.
c. Identify possible countermeasures for youth pedestrian high-risk locations The Demonstration Project Team could continue the analysis of identified higher risk roads and locations to explore

identification of low-cost countermeasure opportunities that could be systemically applied to address youth pedestrian crash risk. The result would be a list of suggested potential countermeasure options which have been found in the literature to be helpful in reducing pedestrian crash risk. However, the final selection of countermeasures will be the responsibility of Philadelphia city officials at each site.

d. Safe Routes Philly safety education – Schools located along or near higher risk roads could be identified to receive special outreach regarding safety education opportunities to supplement engineering improvement efforts and available resources to support safe student travel to and from school and improve safety conflicts during school arrival and dismissal. Note: Per previous discussions about the City's interest in an arrival/dismissal toolkit, our recommendation is to use findings from the Demonstration Project along with reported safety concerns to guide limited staff availability to observe school arrival and dismissal at priority schools. This technical assistance can supplement systemic countermeasure application by assessing additional procedural or infrastructure opportunities to reduce crash risk between pedestrians, bicyclists and motorists.

**Findings from Task 1c. (comparison of youth crash locations to the HIN) may be used to inform prioritization of locations.*

Deliverables:

- Brief memorandum or presentation with list of possible areas or locations of specific countermeasure as selected from above options.

Task 4 – Summary Report and GIS Data Transfer

The project team will summarize the methodology of the project in a consolidated report or presentation. The team will also consolidate datasets used in the analysis and deliver to the City.

Deliverables:

- Summary report detailing demonstration project methodology.
- GIS datasets created during the demonstration project.

Schedule

Task	Month											
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Task 1 – Expand Systemic Analysis (equity variables and crash tree)												
Task 2 - Community Engagement												
Task 3 – Identify Locations for Countermeasures												
Task 4 - Summary Report and GIS Data Transfer												