City of Salem

Pedestrian Safety Study

Final Report for

CITY OF Salem AT YOUR SERVICE

Prepared by

DKS

March 2018

SALEM PEDESTRIAN SAFETY STUDY

FINAL REPORT

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EXECUTIVE SUMMARY

Since 2011, there have been over 300 pedestrian-involved crashes in the City of Salem, resulting in 15 people unnecessarily losing their lives. The average pedestrian fatality rate in Salem over the last six years is approximately 1.24 fatalities per 100,000 residents. While this is slightly lower than the national average fatality rate over the same time period (approximately 1.53), the City of Salem has remained focused on improving pedestrian safety and accessibility.

In 2015, there was a noticeable spike in pedestrian fatalities in Salem when six pedestrians were killed, which was triple the number of fatalities of the previous three years and also represented a fatality rate more than double the national rate (3.65 vs. 1.67). Interestingly, this unfortunate trend was also observed in other cities across the US, including Austin, Texas whose fatality rate jumped to 3.43 in 2015. Although crashes are random events and naturally fluctuate over time, every death on our roadways is tragic and the recent increase in pedestrian deaths has raised community concerns not just in Salem, but other similar cities as well.

In response to the spike in fatal pedestrian crashes in 2015, the City of Salem embarked on an effort to improve pedestrian safety throughout the city. As part of that effort, the City hired DKS & Associates (DKS) to study the intricacies of pedestrian crashes, identify trends and patterns, and develop a set of recommendations aimed at reducing the frequency and severity of pedestrian crashes. In addition to analyzing crash reports, DKS conducted over 100 hours of field observations at 19 locations with a high frequency or severity of pedestrian crashes. Key findings of DKS' investigation include the following.

- There is no single "silver bullet". Crash patterns, driver and pedestrian behaviors, and other contributing factors remain variable and unpredictable.
- At several of the field study locations, increased conflicts were observed where major traffic flows and popular pedestrian travel paths intersected. In addition, drivers were often seen speeding, driving aggressively, and failing to yield to pedestrians.
- Midblock conflicts between vehicles and pedestrians were often observed on roadways with wide cross sections (four or more lanes), long distances between signalized crossings (up to 3,000 feet), and unique midblock attractions such as transit stops, convenience stores, and restaurants.
- Many pedestrians were seen crossing mid-block at undesired locations or crossing against the pedestrian signal. This trend is supported by the crash data that indicates 65% of non-intersection pedestrian crashes involved pedestrians illegally[1] in the roadway.

After the 2015 spike in pedestrian fatalities, the City of Austin engaged in a comparable research investigation that yielded findings similar to those in Salem. Because Austin is a larger city with more pedestrian crashes, their larger dataset yielded concrete relationships DKS inferred, but could not verify, using the available data in Salem. Of particular note, City of Austin staff discovered a direct correlation with the distance between protected roadway crossings and the potential for a fatal pedestrian crash occurring: the greater the distance, the higher the potential. This affirms the

[1] The term "illegally" is based on statewide laws and does not reflect the lack of jaywalking laws in Salem which significantly narrows the definition of "illegal" behaviors.

importance of creating walkable communities by designing to pedestrian scale and providing more protected or higher visibility crossings at closer spaced intervals.

The transportation engineering profession can help create walkable communities by planning and implementing context-sensitive, people-centric solutions which consider the needs of all roadway users – pedestrians, cyclists, transit riders, and motorists – regardless of age or ability. There are many opportunities to accomplish this through the Five E's: Engineering, Education, Enforcement, Evaluation, and Encouragement. DKS developed approximately 50 recommendations to improve pedestrian safety citywide, including the following.

- Citywide strategies to provide more protected pedestrian crossings, to limit conflicts between pedestrians and turning vehicles, to improve lighting, to address concerning driver and pedestrian behaviors, and to consider the desired travel paths of pedestrians in the planning and design processes.
- Location-specific recommendations include enhanced crossings with median refuge islands and high visibility crosswalks, traffic signal modifications, improved signing and lighting, sidewalk infill, access management, traffic calming measures, and maintenance of trees and vegetation.

An aspect that is critical to success is policy level direction that clearly defines the intent and desired outcomes of a focused effort to improve pedestrian safety. Many cities have successfully implemented Vision Zero safety strategies that would be applicable in Salem, such as policies that emphasize a reduction in fatal and severe crashes, redefining roadway design and operations standards to be more safety oriented and people-centric, prioritizing funding of infrastructure improvements to support pedestrian travel both along and across roadways, encouraging land use and development to create safer pedestrian connections, and seeking collaborative partnerships with other entities to advocate, fund, design, and implement safety improvements. In Salem, this could involve strategies such as partnering with Cherriots to provide enhanced pedestrian crossings to access major transit stops while sharing the responsibility for funding and/or maintenance, and working with the police department to discourage unsafe driver and pedestrian behaviors.

In summary, there are several factors contributing to the 16 pedestrian deaths that have occurred on Salem's roadways since 2011, including unsafe driver and pedestrian behaviors, infrastructure design characteristics, and pedestrian facilities that do not align with appropriate land uses. These concerns are not unique to Salem, and are observed in cities across the US. Fortunately, there are numerous feasible improvements, including both short-term and long-term solutions, which can be implemented across the city to significantly improve the safety of pedestrian travel. The accompanying Pedestrian Safety Study describes many of these treatments as well as the locations that would likely see the greatest benefit from their implementation.

1.0 PROJECT INTRODUCTION

The goal of this study was to better understand the recent increase in severe and fatal pedestrian-related crashes in the City of Salem. A combination of crash data, police reports, and field observations provided insight into the infrastructure characteristics and human behaviors that have contributed to these crashes. The study focused on the most recent five years of comprehensively available data (2011-2015) but also includes information on fatal pedestrian crashes in 2016 and 2017, when available.

A thorough investigation of the crash data revealed trends related to the location, type, and severity of the crashes as well as environmental and human behavior characteristics such as time of day, lighting, weather, driver demographics, and contributing factors (speeding, distraction, intoxication, etc.). The project team identified 19 locations with high frequency or severity of crashes that warranted further investigation through field observations. The field observations focused on identifying conflicts between vehicles and pedestrians, infrastructure deficiencies, and behaviors (both driver and pedestrian) that may contribute to the occurrence of a vehicle-pedestrian crash.

The final chapter of this report outlines the recommendations for improving pedestrian safety in the City of Salem based on the notable patterns identified in the crash data investigation and field observations.

It should be noted that while this study examined only streets within the City of Salem, other urban locations just outside of the city limits are likely prone to similar patterns and may benefit from the recommendations outlined herein.

2.0 SAFETY DATA INVESTIGATION

DKS conducted a review of the available crash data for all 294 pedestrian crashes that were reported in the City of Salem between 2011 and 2016. These crashes are shown on Figure 1 on the following page and are summarized by year and crash severity in Table 1. As shown, there was a noticeable spike in the number of fatal pedestrian crashes in 2015, although the combined number of fatal and serious injury crashes has remained fairly consistent since 2013.

Table 1: Salem Pedestrian Crashes by Year and Crash Severity

Year	Number of Crashes						
	Fatal	*Serious Injury*	*Injury*	*Possible Injury*	*Unknown Injury*[1]	*Property Damage Only*	*Total*
2011	0	5	19	22	0	3	49
2012	2	3	19	15	0	1	40
2013	2	7	21	21	0	2	53
2014	2	10	22	24	0	1	59
2015	6	4	21	22	0	0	53
2016	2	-	-	-	38	-	40

[1] 2016 crash information is not yet available in the statewide crash database – all information was gleaned from City police reports which do not specify injury level.

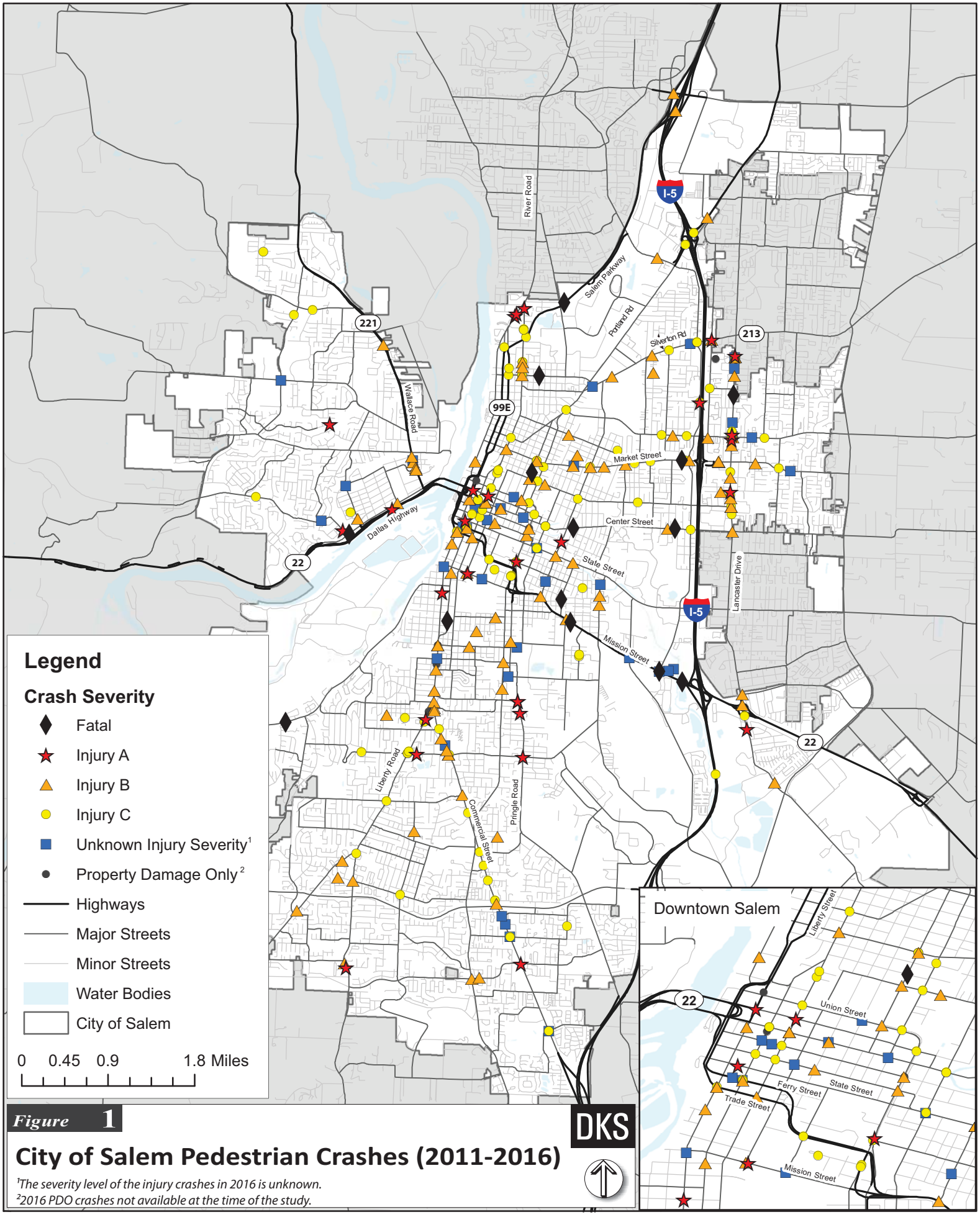


Figure **1**

City of Salem Pedestrian Crashes (2011-2016)

[1]*The severity level of the injury crashes in 2016 is unknown.*
[2]*2016 PDO crashes not available at the time of the study.*

The following graphs and tables summarize the notable trends related to location, roadway characteristics, environmental characteristics, and driver/pedestrian behavior that is associated with pedestrian-involved crashes in Salem.

ROADWAY CHARACTER

As shown in Figure 2, nearly 60% of the reported crashes occurred at intersections, with another 29% occurring on straight roadway segments and 11% occurring at alleys or driveways. Of the crashes that occurred at intersections, nearly 67% occurred at a signalized intersection.

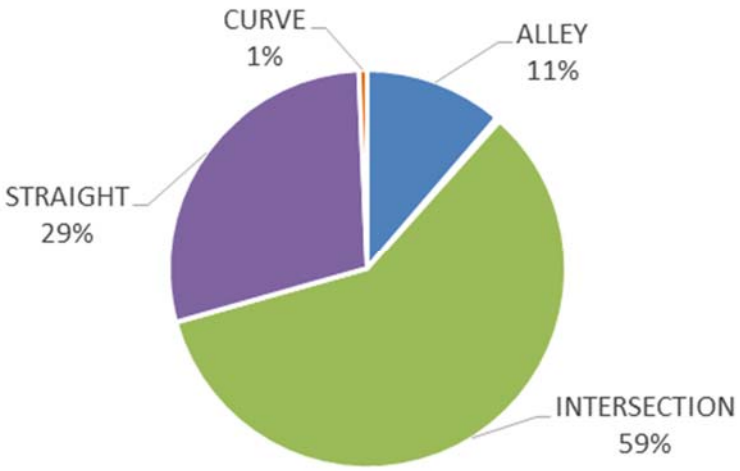


Figure 2: Percentage of Crashes (2011-2016) by Roadway Character

WEATHER CONDITIONS

The proportion of crashes occurring during different weather conditions is shown on Figure 3 on the following page. As shown, 75% of the reported crashes occurred during clear or cloudy conditions, and 22% occurred during rain events. Although more rain-related events might be expected due to the climate in Salem, the percentages are representative of typical pedestrian activity levels for weather conditions (fewer people travel by foot during inclement weather).

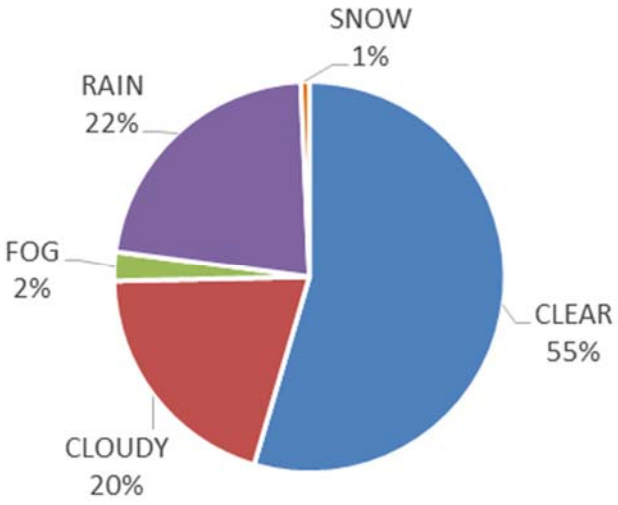


Figure 3. Percentage of Crashes (2011-2016) by Weather Conditions

TIME OF DAY AND LIGHTING

Figure 4 shows the distribution of crashes by time of day. As shown, the highest number of crashes occurred during the evening rush hour (5:00 to 6:00 p.m.). Aside from the rush hour peak, the number of crashes is relatively consistent during the afternoon and evening hours (3:00 to 9:00 p.m.).

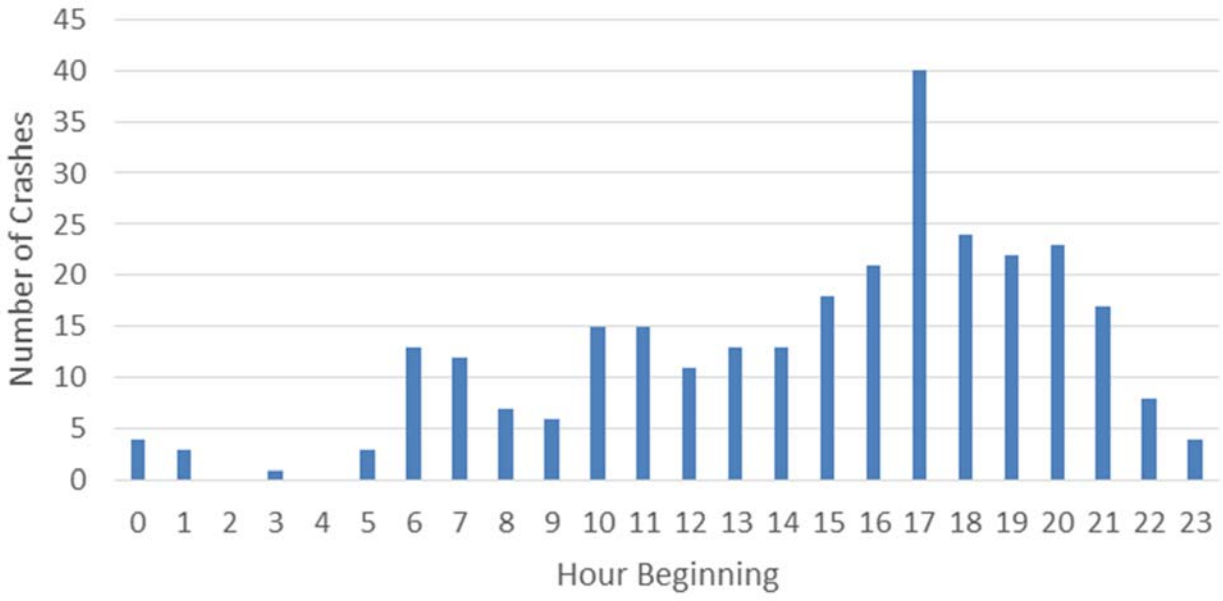


Figure 4: Number Crashes (2011-2016) by Time of Day

While time of day is an important consideration, the reported lighting conditions can provide further insight since daylight hours shift throughout the year. As shown on Figure 5, 53% of crashes occurred during daylight hours, while 39% occurred in the dark (both with and without street lighting).

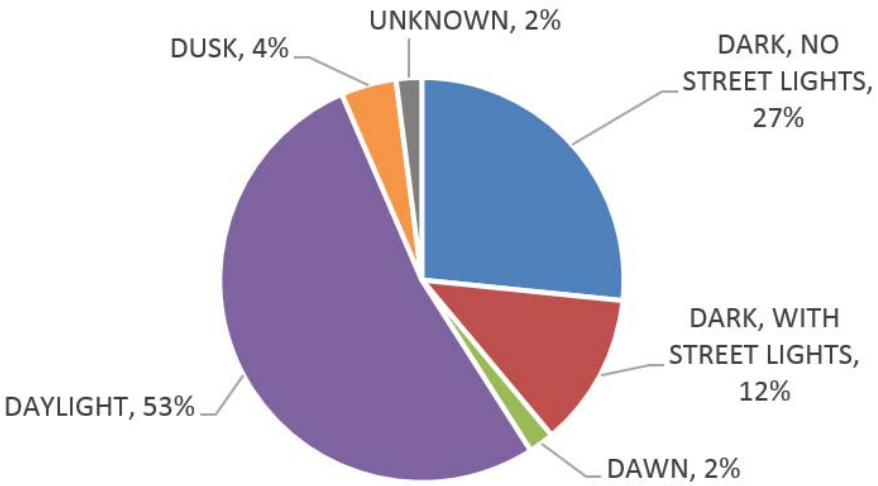


Figure 5: Percentage of Crashes (2011-2016) by Lighting Condition

Although only 39% of all crashes occurred in the dark (Figure 5), this proportion jumps to over 80% when looking only at fatal crashes. In fact, the percentage of crashes occurring at night (particularly when no street lights are present) increases steadily as crash severity increases. In other words, fatal and severe pedestrian crashes are more likely to occur in the dark than during daylight hours.

Notable clusters of crashes that occurred during dark conditions (with or without street lights) were observed at the following locations: Lancaster Drive NE (Silverton Road to Center Street NE, Rickey Street NE to Carson Drive NE), Commercial Street SE (Fairview Avenue SE to Madrona Avenue SE), Pringle Road SE (Fairview Avenue SE to Madrona Avenue SE), and River Road N (near Delmar Drive N). It should be noted that after reviewing police crash report narratives, the presence of street lighting appears to be very under-recorded in the ODOT crash database. Therefore, it is likely not meaningful to investigate trends based on the crash database descriptions of lighting condition.

VEHICLE MOVEMENT

Table 2 on the following page presents a summary of the reported vehicle movement for all crashes, categorized by crash location (intersection or non-intersection). As shown, non-intersection crashes predominantly involve vehicles travelling straight (73%), and of the vehicles that are turning at alleys or driveways there is equal representation of left and right turns. However, the trends are significantly different at intersections, where 65% of pedestrian crashes involve a turning vehicle, and the percentage of crashes involving a left-turning vehicle is nearly twice that for right-turning vehicles.

Table 2: Percentage of Crashes by Vehicle Movement and Location

Vehicle Movement	All Crashes	Intersection Crashes	Non-Intersection Crashes
Straight	48%	32%	73%
Left-Turn	29%	41%	9%
Right-Turn	19%	24%	10%
Backing	2%	1%	5%
Parking	1%	-	3%
Stopping	1%	2%	-

Clusters of pedestrian crashes involving turning vehicles were observed at several locations in Salem, including: Lancaster Drive NE (Sunnyview Road NE to Center Street NE), Center Street (Commercial Street NE to Winter Street NE), Commercial Street SE (Hilfiker Lane SE to Kuebler Boulevard), and Mission Street SE (21st Street SE to Ford Street SE).

DRIVER AND PEDESTRIAN BEHAVIOR

The most commonly reported contributing factor to pedestrian crashes during the study period was the driver's failure to yield (53%). Other reported factors include: pedestrian illegally in the roadway (30%), pedestrian not visible (14%), driver disregarding a traffic signal (11%), and inattention (3%). Although intoxication was not listed as a contributing factor in the ODOT crash database, a review of the police report narratives indicated that four of the 13 fatal crashes and three of the 29 serious injury crashes involved a pedestrian that was likely impaired (alcohol, drugs, or both).

It should be noted that all Oregon crash data is maintained by the State of Oregon, and thus references to "illegal" behavior (such as "pedestrian illegally in roadway" or "pedestrian violation") are categorized based on State laws. Such "illegal" behaviors include pedestrians crossing at unmarked mid-block locations, pedestrians crossing against signals or signs, pedestrians laying or standing in the roadway, and pedestrians entering the roadway unexpectedly. In the City of Salem, however, there are no jaywalking laws and it is legal for pedestrians to cross a roadway at any location. Because it is difficult or even impossible to isolate the exact behavior that warranted the "illegal" categorization, there is no way to re-categorize the crashes based on City of Salem laws. Therefore, the terms "pedestrian illegally in roadway" and "pedestrian violation" are still referenced in this report, even though a subset of the behaviors may not actually be illegal in the City of Salem.

DRIVER AND PEDESTRIAN DEMOGRAPHICS

Figure 6 and Figure 7 on the following page depict the demographic trends for both drivers and pedestrians. The drivers involved in the reported pedestrian-related crashes ranged in age from 16 to 95 years old, with an average age of 47. The pedestrians involved ranged in age from 1 to 90 years old, with an average age of 36. A higher proportion of drivers were male than female (59% to 41%, respectively). Similar to the driver demographics, more pedestrians were male than female (62% to 38%, respectively).

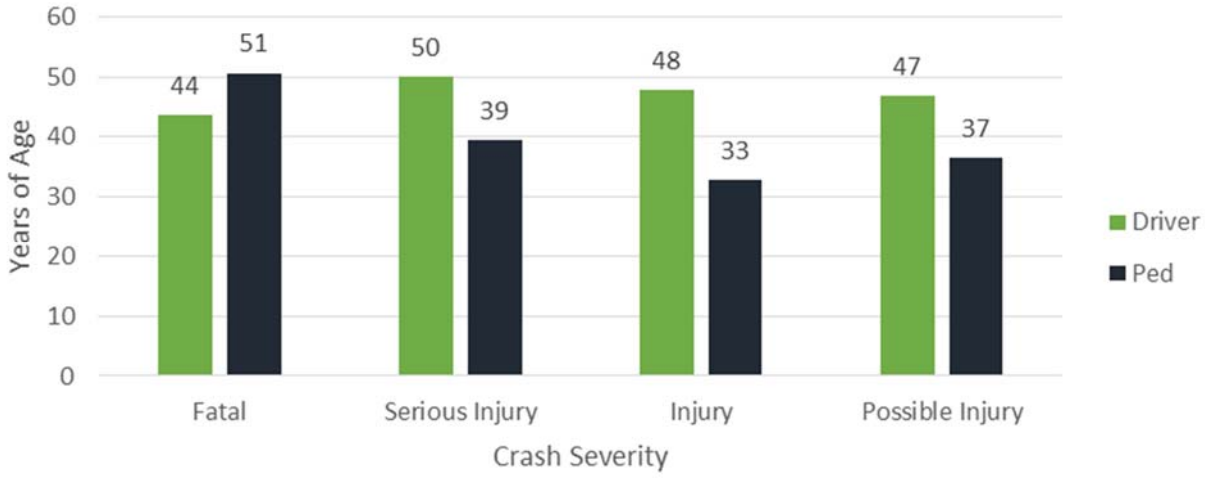


Figure 6: Average Age of Crash Participants by Severity (2011-2016)

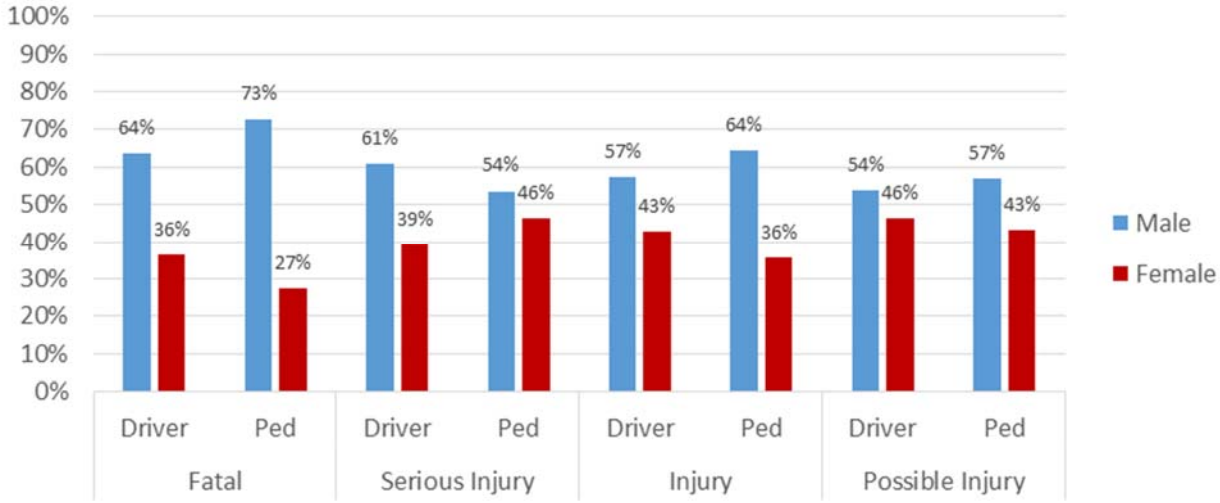


Figure 7: Gender Distribution of Crash Participants by Severity (2011-2016)

As shown on Figure 6 and Figure 7, the ages and gender of drivers remained relatively consistent across all crash severity levels. However, the average age of pedestrians involved in fatal crashes was significantly higher than other severity levels (51 years old compared to 36 years old). There was also a noticeable increase in the proportion of male pedestrians involved in fatal crashes as compared to other severity levels (73% male/27% female compared to 57% male/42% female).

FATAL CRASH DETAILS

Figure 8 on the following page shows the location and summary crash details for all the fatal pedestrian crashes reported from 2011 to 2016. Of the 14 crashes, 13 occurred at night (dark conditions) and four involved a pedestrian that was likely intoxicated.

Although formal crash reports are only available through 2016, two fatal pedestrian crashes have occurred thus far in 2017. The following details have been gleaned from newspaper articles. The first fatal crash occurred in March 2017 on Fisher Street NE. The pedestrian was checking her mailbox when the driver left the roadway and struck the woman. The driver was allegedly impaired at the time of the crash. The second fatal crash occurred on Commercial Street SE near Royvonne Avenue SE in July 2017. The pedestrian was crossing midblock when she was struck by a vehicle. Both crashes occurred during daylight hours. The details of these two crashes have not been fully processed by the Salem Police Department, and therefore, were not used as data in this safety analysis nor shown on Figure 8.

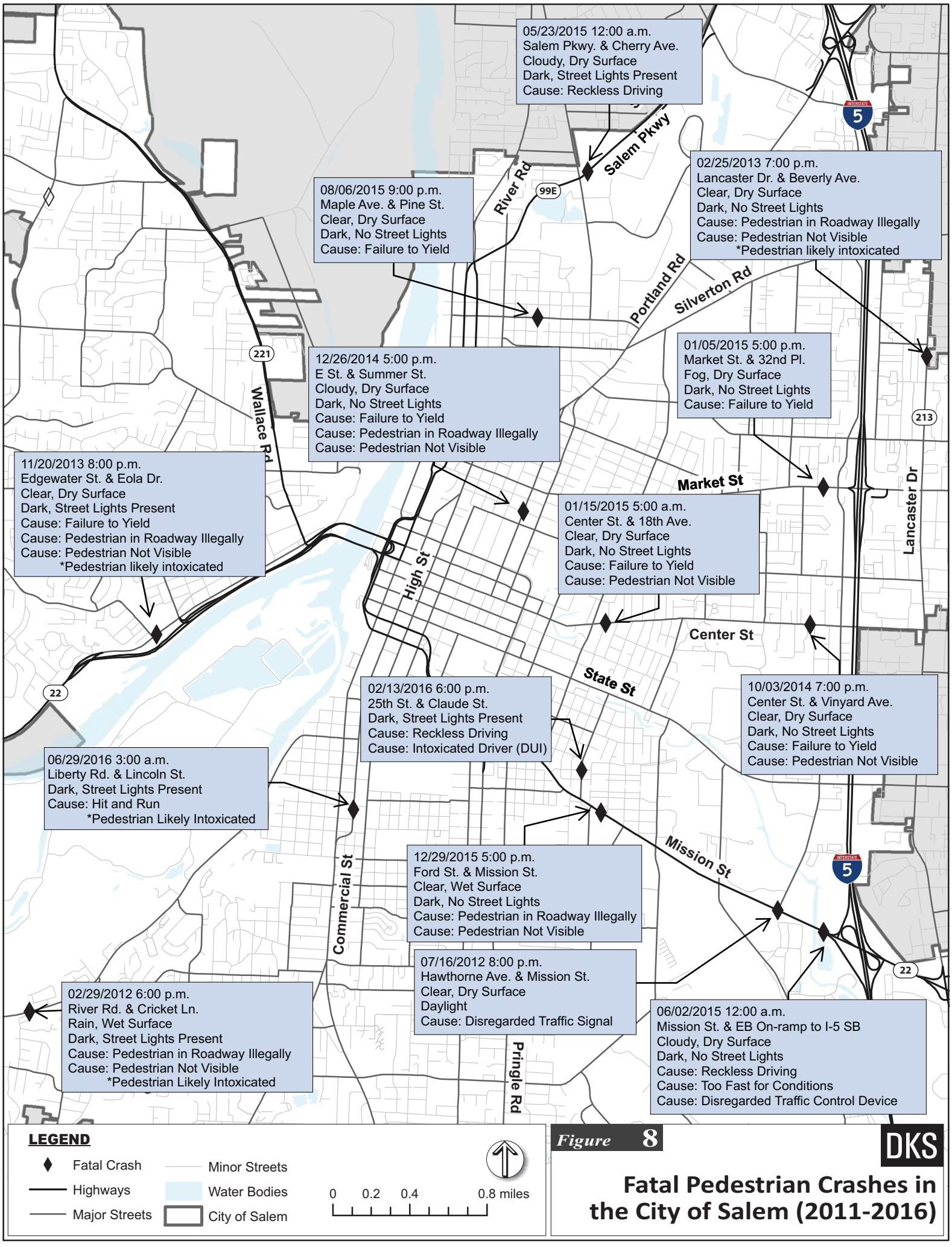


Figure **8**

DKS

Fatal Pedestrian Crashes in the City of Salem (2011-2016)

3.0 FIELD OBSERVATIONS

Based on the crash trends presented in this memorandum (including general crash characteristics, clusters of crashes, and locations of severe and fatal crashes), DKS investigated the following 19 locations through field observations. The time period for field observations was based on the time of day and lighting crash patterns at each location. As shown in Table 3, field observations were conducted during multiple time periods for most locations. In total, DKS conducted over 100 hours of field observations. The field study locations are also mapped on the following page on Figure 9.

Table 3: Field Study Locations and Observation Periods

Location	Total Pedestrian Crashes (2011-2016)	Observation Periods				
		AM Peak	*Midday*	*School Release*	*PM Peak*	*Night*
Intersections						
Salem Parkway at Cherry Avenue NE	1		x			x
Maple Avenue NE at Pine Street NE	1			x		x
Center Street NE at 18th Street NE	1		x	x		x
Center Street NE at Vinyard Avenue NE	1			x		x
River Road N near Delmar Avenue N	2				x	x
Lancaster Drive NE at Sunnyview Road NE	6		x			x
Liberty Road S at Triangle Drive SE	3		x			x
Lancaster Drive SE at OR 22 Interchange	4	x				x
Commercial Street SE at Trade Street SE	2		x			
Liberty Street SE at Ferry Street SE	12		x		x	x
Corridors						
Mission Street SE from 22nd Street SE to I-5 Southbound	7		x	x		x
Summer Street NE from Market NE Street to D Street NE	4			x		x
Market Street NE from 14th Street NE to I-5 Southbound	11		x		x	x
Lancaster Drive NE from Devonshire Avenue NE to Center Street NE	20		x			x
Pringle Road SE from Fairview Avenue SE to Madrona Avenue SE	3		x			x
Wallace Road NW from Glen Creek Road NW to Taggart Drive NW	5		x			x
Commercial Street SE from Rural Avenue SE to Fairview Avenue SE	5			x		
Marion Street NE from Commercial Street NE to High Street NE	2		x			x
High Street NE from Union Street NE to Court Street NE	6		x			

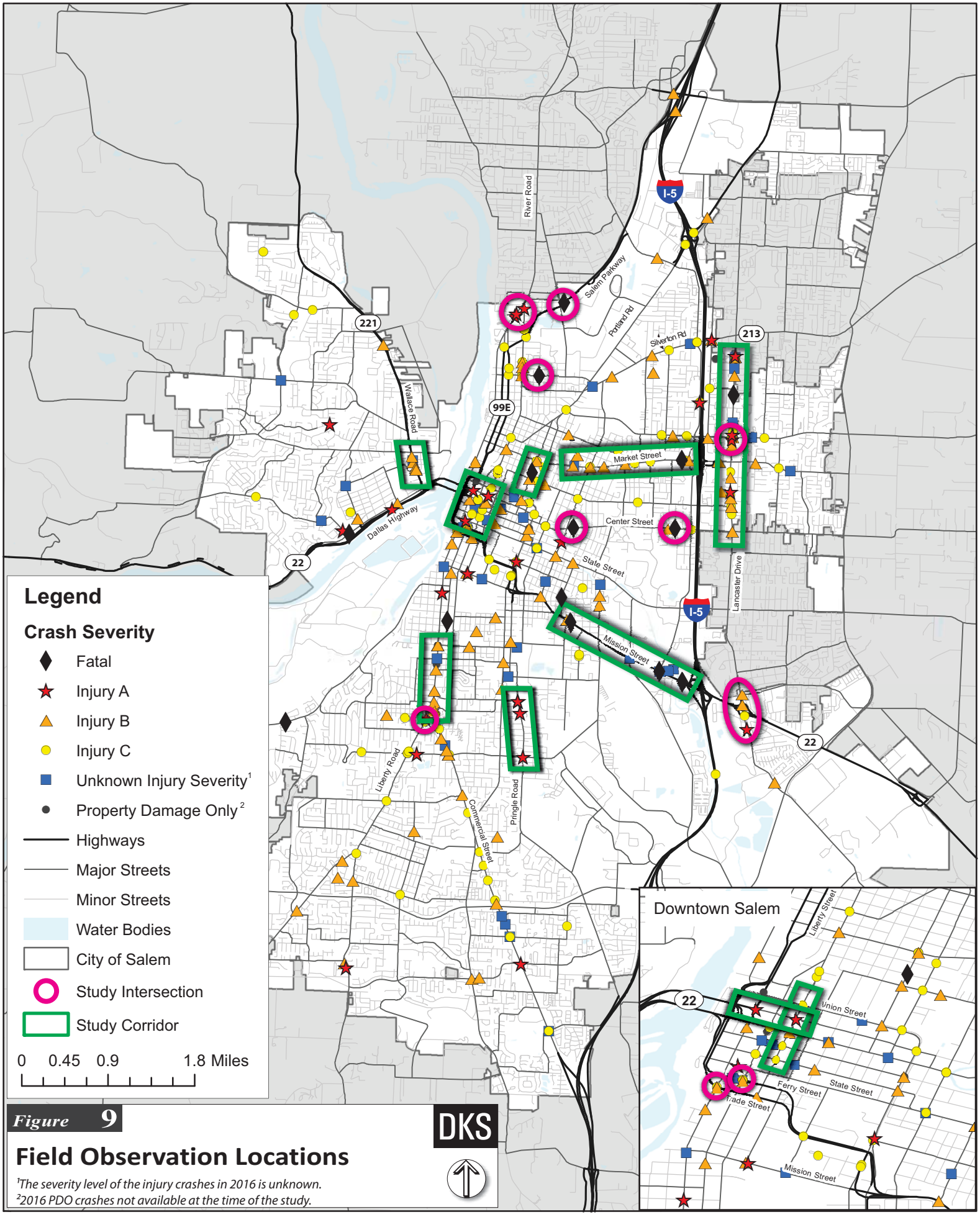


Figure **9**

Field Observation Locations

[1]*The severity level of the injury crashes in 2016 is unknown.*
[2]*2016 PDO crashes not available at the time of the study.*

DKS

FIELD DATA COLLECTION

DKS conducted field observations between May 4, 2017 and June 1, 2017. The following list summarizes the data collected during each field visit. An example data collection sheet for intersections and corridors is included in the appendix.

- A sketch of the site, including typical cross section, and locations of intersections, pedestrian facilities, crossing facilities, transit stops, and adjacent land uses
- Details pertaining to:
    - Traffic control
    - Parking
    - Land use
    - Access management
    - Sight distance
    - Pedestrian facilities (sidewalks, crosswalks, barriers to walking, etc.)
    - Lighting
    - Pedestrian signals and signage
- Driver and pedestrian behavior and non-compliance issues
- Vehicle-pedestrian conflicts and risks

Vehicle-pedestrian conflicts and risks were observed in accordance with the PEDSAFE[2] guidelines for conducting pedestrian crash type analysis. The most common risks observed in the field were dart/dash, unique midblock, and turning vehicle. Detailed descriptions of these crash types can be found in the appendix.

CITYWIDE OBSERVATIONS

At several of the field study locations, increased conflicts were observed where major traffic flows and popular pedestrian travel paths intersected. In addition, drivers were often seen speeding, driving aggressively, and failing to yield to pedestrians.

Pedestrians crossing High Street NE

Increased levels of midblock conflicts were observed on roadways with wide cross sections (four or more lanes), long distances between signalized crossings (up to 3,000 feet) and unique midblock attractions such as transit stops, convenience stores, and restaurants.

Pedestrian crossing mid-block on Lancaster Drive

Many pedestrians were seen crossing mid-block or crossing against the pedestrian signal. This trend is supported by the crash data that indicates 65% of non-intersection pedestrian crashes involved pedestrians illegally in the roadway.

[2] PEDSAFE 2013. Pedestrian Safety Guide and Countermeasure Selection System. Federal Highway Administration. 2013.

Another common trend was the high number of conflicts that occurred between pedestrians and turning vehicles. Long delays and impatient drivers resulted in aggressive turning movements through crosswalks and created several near-miss situations.

The final citywide observation was the limited, obstructed, or non-functioning street lighting along several corridors throughout the City which may be limiting drivers' ability to see pedestrians at night.

Left-turning vehicle yielding to pedestrians in crosswalk on Market Street

INTERSECTION OBSERVATIONS

- **Salem Parkway at Cherry Avenue NE:** Wide pedestrian crossing distance, short (possibly insufficient) pedestrian crossing time, and long pedestrian delays. Vehicles stop in crosswalks to gain better sight distance as a result of the skewed geometry.
- **High Street NE at Chemeketa Street NE:** Frequent pedestrian crossings, pedestrians disregard the crossing signal, aggressive driving behavior (particularly turning vehicles).
- **Maple Avenue NE at Pine Street NE:** High through traffic volume results in few gaps in traffic for pedestrians, bikes, or vehicles to cross or enter Pine Street. Speeding and aggressive driving and turning movements were also observed.
- **Center Street NE at 18th Street NE:** Westbound vehicle queues often extended through the intersection.
- **Center Street NE at Vinyard Avenue NE:** The midblock crossing is located between two closely spaced T-intersections, which creates unique vehicle-pedestrian conflicts, particularly with turning vehicles. Drivers use pedestrian crossings and resulting gaps in traffic to enter Center Street.
- **River Road N near Delmar Avenue N:** There is a lack of marked crossings between the neighborhoods/parks on the west side of River Road and the commercial development (including Fred Meyer) on the east side. Increased traffic volumes during the peak periods provide few gaps in traffic. The unique roadway geometry (including a lane drop, horizontal curve, and directional split) create a complex driving environment.
- **Lancaster Drive NE at Sunnyview Road NE:** Very busy intersection with high volumes of vehicle and pedestrian traffic. Vehicle-pedestrian conflicts during right turn overlap phasing were observed at this intersection. Aggressive driving was also observed because of long vehicle delays. Night observations revealed very dark conditions at the intersection.
- **Liberty Road S at Triangle Drive SE:** Because of increased traffic volumes, there are few gaps in traffic during peak periods. The skewed road geometry allows for fast turning movements and drivers failed to yield to pedestrians wanting to cross the road. Sidewalk facilities in poor condition.
- **Lancaster Drive SE at OR 22 Interchange:** The bridge is an uncomfortable pedestrian facility due to the lack of buffer between the roadway and narrow sidewalk. There are no marked crossings at the westbound OR 22 terminal intersection. At both interchange terminals, high turning volumes conflict with pedestrian movements.

- **Commercial Street SE at Trade Street SE:** Eastbound vehicles frequently stop in the crosswalk to gain better sight distance. Numerous conflicts between southbound left turning vehicles and pedestrians in the east crosswalk. Dual right turn also poses risk for eastbound bicyclists.
- **Liberty Street SE at Ferry Street SE:** Numerous conflicts between dual northbound left turning vehicles and pedestrians in west crosswalk. The buildings near the intersection limit sight distance for vehicles.

CORRIDOR OBSERVATIONS

- **Mission Street SE from 22nd Street to I-5 Southbound:** High vehicle volumes along entire corridor, pedestrian usage is highest west of Airport Road. High density of driveways west of 25th Street which creates more conflict points for pedestrians and vehicles. Night observation revealed that several lights along corridor were non-functioning[3].
- **Summer Street NE from Market Street NE to D Street NE:** Limited and obscured street and intersection lighting.
- **Market Street NE from 14th Street NE to I-5 Southbound**: High vehicles speeds, aggressive driving, and frequent pedestrian activity. Long distances between signalized crossings and few gaps in traffic resulted in limited pedestrian crossing opportunities.
- **Lancaster Drive NE from Devonshire Avenue NE to Center Street NE:** Frequent pedestrian activity, high vehicle volumes, high vehicle speeds, aggressive driving, and a wide roadway cross section. Long distances between pedestrian crossings and the lighting on west side of roadway appeared to be in poor condition.
- **Pringle Road S from Fairview Avenue SE to Madrona Avenue SE:** High vehicle speeds and limited sidewalk facilities create an uncomfortable environment for pedestrians. Several transit stops along the corridor, no midblock crossing locations. Very dark at night with intermittent lighting.
- **Wallace Road NW from Glen Creek Road NW to Taggart Drive NW**: High vehicle volume and speeds, wide roadway cross section can be a barrier to pedestrian crossings. Pedestrians observed darting across Wallace Road NW midblock.
- **Commercial Street SE from Rural Street SE to Fairview Avenue SE:** Permissive left turn phasing with long side street delays causes aggressive vehicle turning movements through crosswalks along Commercial Street. Frequent pedestrian activity and high vehicle volumes in this area. Long pedestrian crossing distances. High driveway density along corridor creates more conflict points for pedestrians and vehicles.
- **Marion Street NE from Commercial Street NE to High Street NE:** Pedestrian visibility is reduced due to on-street parking and adjacent trees along Marion Street. High vehicle speeds and turning volumes.
- **High Street NE from Union Street NE to Court Street NE:** Unique midblock attractions (mall, transit center, parking, Wednesday market) generate increased pedestrian demand.

[3] City of Salem has re-lamped several of these street lights since the time of this observation.

4.0 RECOMMENDATIONS

DKS has developed a set of recommendations that can be applied to improve pedestrian safety across the City of Salem and at specific study locations. These recommendations are based on the crash patterns and behaviors identified through the crash data analysis and field observations and include recommendations outlined in the PEDSAFE document to address the observed risk types.

CITYWIDE STRATEGIES

Limit Spacing between Protected Crossings

The Institute of Transportation Engineers' (ITE) *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach* suggests that pedestrians should not be expected to travel more than 400 feet out of direction to utilize a controlled intersection, with a recommended maximum spacing of 660 feet. This is of particular importance in locations where unique attractions and pedestrian generators exist midblock and encourage pedestrians to cross between intersections. Consider installing enhanced midblock crossings with median islands, Z-shaped crossings, and rectangular rapid flashing beacons (RRFB) or pedestrian hybrid beacons (PHB), where appropriate based on City guidelines.

Limit Conflicts between Pedestrians and Turning Vehicles

At signalized intersections, consider restricting permissive and overlap turns (left or right) when pedestrians are present at locations, where appropriate based on City guidelines. Alternatively, delayed overlap phasing and leading pedestrian intervals can provide additional protection for pedestrian crossings during these phases. Where appropriate for vehicle and pedestrian volumes, protected left-turn phasing can also be implemented to limit these types of conflicts. These types of signal timing adjustments can be permanent or can be limited to specific times of day.

Improve Roadway and Intersection Lighting

Many of the field study observations indicated that lighting at intersections and along corridors did not meet standards. Consider upgrading existing lights and installing additional lights to improve visibility of pedestrians and crossing locations at night.

Consider Pedestrian Paths at the Planning Level

Incorporate the concept of pedestrian "desire lines" into land use, zoning, and development decisions to avoid creating environments where the surrounding land use encourages pedestrians to cross at locations where no crossing facilities are present. This includes creating guidelines for the site plan review process that aim to align enhanced crossings with pedestrian access to developments.

Address Concerning Driver and Pedestrian Behavior

The crash data and field observations confirmed a prevalence of illegal and aggressive behavior by both drivers and pedestrians. Consider implementing education campaigns and targeted enforcement to reduce the incidence of unsafe pedestrian crossings, aggressive driving (including speeding), and impaired travel. Additionally, the City should reconsider the lack of jaywalking laws, which may be contributing to pedestrians crossing at undesired locations.

PROGRAMMATIC AND POLICY STRATEGIES

Safer Crossings Program

By developing an objective, request-driven process for implementing new pedestrian crossings, the City can improve the efficiency and transparency of the decision making process for where new crossings should be installed. This type of program has proven very successful in cities across the nation. The program would define a set of criteria (based on factors like crash history, pedestrian volume, roadway type, etc.) to evaluate a proposed crossing location. These criteria would be used to rank potential projects for initial consideration, design, and eventually construction. At any point in the process, the City can inform citizens of the current ranking of a crossing that has been requested. The program can also identify potential funding sources outside of City funds, such as private developers or entities, other public agencies, and public-private partnerships.

Committee for Vulnerable Roadway Users

It is likely that one or more of the City's existing committees can be revised, expanded, or combined to act as an advisory committee that considers the needs of all pedestrians, bicyclists, and transit riders, regardless of age or ability. The committee would seek collaborative partnerships with community stakeholders and provide guidance on policy level recommendations. The committee could also play a vital role in the Safer Crossings Program described previously, providing input and informing the community of the program's criteria, procedures, metrics, and status updates.

Policy Strategies

There are several policy changes that the City could implement to improve safety for not just pedestrians, but all modes of travel. These strategies include the following.

- Identify and establish dedicated funding streams for specific types of safety improvements, such as enhanced pedestrian crossings.
- Encourage "people-centric" transportation planning and land use development strategies.
- Adopt "best practice" documents as design guidelines, such as the National Association of City Transportation Official's (NACTO) *Urban Street Design Guide* and ITE's *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach.*

SITE-SPECIFIC IMPROVEMENTS

In addition to the strategies described in the previous section that are intended for broad application, DKS has also developed site-specific recommendations to improve the safety performance of the 19 study locations included in the field observation effort. The key findings of the field observations and potential countermeasures are shown for study intersections and corridors in Table 4 and Table 5, respectively.

Table 4. Recommended Safety Countermeasures for Study Intersections

Major Road	Minor Road	Conflict Types Observed[4]	Safety Issues Identified	Suggested Countermeasures
Salem Pkwy	Cherry Ave NE	Turning vehicle, walking along roadway, non-roadway	Very long crossing distance with insufficient crossing times; Long pedestrian delays; Vehicles stop in x-walks to gain better sight distance	Install a "porkchop" island on the SE and SW corners to shorten pedestrian crossing distances and provide refuge area for two-stage crossings; Ensure that field signal timings are sufficient for pedestrians.
Pine St NE	Maple Ave NE	Dart/dash	Speeding; aggressive driving and turning; few gaps in traffic for peds/bikes/vehicles to cross or enter Pine St	Install marked crossing and median refuge island to restrict vehicle turning movements and allow for two-stage crossings; Install speed feedback signs on Pine Street to reduce vehicle speeds.
Center St NE	18th St NE	Dart/dash, unique midblock	Vehicle queues extend through intersection	Consider installation of "Do Not Block Intersection" signs for WB traffic; Install enhanced crossing with median on west leg in front of convenience store.
Center St NE	Vinyard Ave NE	Through vehicle at unsignalized location, turning vehicle	Closely spaced T-intersections with crossing in the middle; turning vehicles use ped crossings as chance to enter Center St	Supplement existing crossing with "Stop Here for Pedestrians" signs; improve lighting.

[4] Conflict types correlate to PEDSAFE documentation. Definitions are included in the Appendix.

Table 4. (Continued)

Major Road	Minor Road	Conflict Types Observed[4]	Safety Issues Identified	Suggested Countermeasures
River Rd N	Delmar Dr N	Dart/dash, unique midblock, walking along roadway, walking/playing in roadway	No marked crossings between east side of River (Fred Meyer) and neighborhood/park to the west; no gaps in traffic during peak periods; speeding; lane drops and horizontal curves where peds want to cross (complex driving environment)	Install two enhanced midblock crossings with median refuge islands. Suggested locations: Between Delmar Dr and Stark St; near south end of River Rd City Park.
Lancaster Dr NE	Sunnyview Rd NE	Dart/dash, unique midblock, turning vehicle	Ped conflicts with RT overlap; aggressive driving (accelerating through intersection) as a result of long delays; very dark at night	Consider permissive left-turn restriction and delay right-turn overlap when ped call; improve lighting.
Liberty Rd S	Triangle Dr SE	Through vehicle at unsignalized location	Speeding; no driver yielding observed; few gaps in traffic during peak periods; intersection skew allows for very fast turning movements; poor/missing sidewalks	Improve and infill sidewalks; Consolidate driveways to reduce vehicle-ped (and vehicle-vehicle) conflict points; install enhanced crossing near Missouri St.
Lancaster Dr NE	OR 22 WB Ramp	Dart/dash	Crossing bridge feels unsafe; high turning volumes; no protected ped crossings	Install crosswalk closed signing; Consider installation of traffic signal (if/when warranted).
Lancaster Dr NE	OR 22 EB Ramp	Dart/dash	Crossing bridge feels unsafe; high turning volumes; lots of turns on red	Consider right turn restrictions when ped call present or provide leading pedestrian interval.
Trade St SE	Commercial St SE	Turning vehicle, multiple threat	EB vehicles enter crosswalk to gain better sight distance; conflicts between SB left turning vehicles and pedestrians; conflicts between EB thru bikes and right turning vehicles	Consider no-turn on red for EB right and leading pedestrian interval for east crosswalk; install advanced stop bar on EB approach.
Liberty St SE	Ferry St SE	Turning vehicle, dart/dash	Significant conflicts between dual NB LT movement and peds; buildings limit sight distance	Consider closing crosswalk on west leg; consider a pedestrian-only phase; Install curb extension on SW corner; restrict left turns on red (either during peak periods or at all times)

Table 5. Recommended Safety Countermeasures for Corridors

Road	Extents	Conflict Types Observed[5]	Safety Issues Identified	Suggested Countermeasures
Mission St SE	22nd St SE to I-5	Turning, working/playing in road	High pedestrian and vehicle volume; high density of driveways west of 25th St; conflicts between driveway traffic and pedestrians; very dark at night (several non-functioning lights)	Install enhanced midblock crossing and RRFB near 23rd Street; improve segment and intersection lighting[6].
Summer St NE	Market St NE to D St NE	Through vehicle at unsignalized location	Lighting obscured by trees	Improve segment and intersection lighting; maintain vegetation and tree canopy; install curb extensions at intersections.
Market St NE	14th St NE to I-5	Through vehicle at unsignalized location, turning vehicle, dart/dash, multiple threat	High vehicle speeds; high vehicle and pedestrian volumes; long distances between crossings; aggressive driving	Install enhanced midblock crossings with pedestrian refuge islands near 25th St and Childs Ave; improve signing and striping at existing crossings.
Lancaster Dr NE	Devonshire St NE to Center St NE	Turning vehicle, dart/dash, unique midblock, through vehicle at unsignalized and signalized locations	Wide cross section; high vehicle speeds; high vehicle and pedestrian volumes; long distances between crossings; aggressive driving; poor segment lighting on west side	Install enhanced midblock crossings with refuge islands near Watson Ave, between Wolverine and Sunnyview, and near Weathers St; improve lighting; consider restricting permissive left turns when a pedestrian call is present.
Pringle Rd SE	Fairview Dr SE to Madrona Ave SE	Dart/dash, unique midblock	Very dark at night; limited sidewalk facilities; no midblock crossing locations; several transit stops; high vehicle speeds	Infill sidewalks, improve lighting, provide midblock crossings near Hillendale Dr and Marilyn St; install traffic calming to reduce vehicle speeds.
Wallace Rd NW	Taggart Rd NW to Glen Creek Rd NW	Through vehicle at unsignalized location	High vehicle volumes and speeds; wide cross section	Widen median and install midblock crossing near 7th Street.

[5] Conflict types correlate to PEDSAFE documentation. Definitions are included in the Appendix.
[6] City of Salem recently re-lamped some of the street lights along this corridor.

Table 5. (Continued)

Road	Extents	Conflict Types Observed[5]	Safety Issues Identified	Suggested Countermeasures
Commercial St SE	Rural St SE to Fairview Ave SE	Turning vehicle, dart/dash	Permissive left turn phasing with long side street delays = aggressive turns; wide cross section; high vehicle and ped volumes (especially school kids); long crossing distances; high driveway density	Consider changing to protected left-turn phasing; provide midblock crossing with median refuge island near McGilchrist St; reduce access density (and/or restrict turning movements).
Marion St NE	Commercial St NE to High St NE	None	Reduced pedestrian visibility due to on-street parking and adjacent trees; high vehicle speeds; high turning volumes	Provide leading pedestrian interval at Marion St/Commercial St intersection.
High St NE	Union St NE to Court St NE	Dart/dash, through vehicle at unsignalized location	Frequent pedestrian crossings; unique midblock attractions (mall, transit center, parking, Wednesday market)	Targeted enforcement and education campaigns for pedestrian and driver behavior (via transit depot, Salem Center Mall, and Wednesday market).

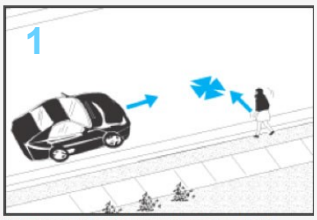
5.0 SUMMARY

- Between 2011 and 2016 there were 294 pedestrian-related crashes in the City of Salem. Of those, 14 were fatal and 29 resulted in severe injuries.
- Approximately 60% of the pedestrian-related crashes occurred at intersections, 67% of which were signalized. Nearly half of all pedestrian-related crashes involved a turning vehicle.
- The most commonly reported contributing factor to pedestrian crashes during the study period was the driver's failure to yield (53%).
- Of the 14 fatal pedestrian crashes, 13 occurred at night (dark conditions) and four involved a pedestrian that was likely intoxicated. As of November 2017, there had been two additional fatal pedestrian crashes. Both occurred during the daytime and one involved an intoxicated driver.
- Based on the crash trends, DKS conducted field observations at 10 intersections and nine corridors. Each of the identified locations were observed at various times of day during the months of May and June of 2017. Key observations included aggressive driving behaviors, unsafe pedestrian behaviors, long distances between crossing locations, limited or non-functioning street lighting, and conflicts between pedestrians and turning vehicles.
- DKS developed a set of recommended improvements and strategies that can be applied citywide and at specific study locations. Notable recommendations include the installation of enhanced midblock crossings, adjusting signal phasing to limit conflicts with turning vehicles, improving street and intersection lighting, implementing education and enforcement campaigns to encourage safe behaviors for drivers and pedestrians, and amending policies and laws to encourage safe pedestrian behavior.

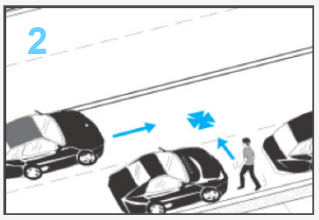
APPENDIX

Example Field Observation Sheets
PBCAT Crash Type Definitions
Field Observation Summary

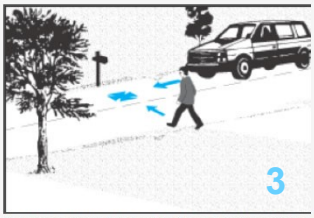
#	Crash Type	Definition
1	**Dart/Dash**	The pedestrian walked or ran into the roadway at an intersection or midblock location and was struck by a vehicle. The motorist's view of the pedestrian may have been blocked until an instant before the impact.
2	**Multiple Threat/ Trapped**	The pedestrian entered the roadway in front of stopped or slowed traffic and was struck by a multiple-threat vehicle in an adjacent lane after becoming trapped in the middle of the roadway.
3	**Unique Midblock**	The pedestrian was struck while crossing the road to/from a mailbox, newspaper box, ice-cream truck, similar unique/temporary destinations, or while getting into or out of a stopped vehicle.
4	**Through Vehicle at Unsignalized Location**	The pedestrian was struck at an unsignalized intersection or midblock location. Either the motorist or the pedestrian may have failed to yield.
5	**Bus-Related**	The pedestrian was struck by a vehicle while: (1) crossing in front of a public bus stopped at a bus stop; (2) going to or from a school bus stop; or (3) going to or from, or waiting near a public bus stop.
6	**Turning Vehicle**	The pedestrian was attempting to cross at an intersection, driveway, or alley and was struck by a vehicle that was turning right or left.
7	**Through Vehicle at Signalized Location**	The pedestrian was struck at a signalized intersection or midblock location by a vehicle that was traveling straight ahead.
8	**Walking Along Roadway**	The pedestrian was walking or running along the roadway and was struck from the front or from behind by a vehicle.
9	**Working/ Playing in Road**	A vehicle struck a pedestrian who was: (1) standing or walking near a disabled vehicle, (2) riding a play vehicle that was not a bicycle (e.g., wagon, sled, tricycle, skates), (3) playing in the road, or (4) working in the road.
10	**Non-Roadway**	The pedestrian was standing or walking near the roadway edge, on the sidewalk, in a driveway or alley, or in a parking lot, when struck by a vehicle.
11	**Backing Vehicle**	The pedestrian was struck by a backing vehicle on a street, in a driveway, on a sidewalk, in a parking lot, or at another location.
12	**Crossing Expressway**	The pedestrian was struck while crossing a limited-access expressway or expressway ramp.
13	**Misc.**	Other pedestrian crash types, such as: Intentional crashes, driverless vehicle incidents, pedestrian struck after a vehicle/ vehicle collision, pedestrian struck by falling cargo, emergency vehicle striking a pedestrian, pedestrian standing or lying in the road



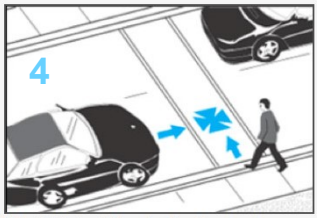
Pedestrian walking into the roadway at a midblock location and into the path of a vehicle.



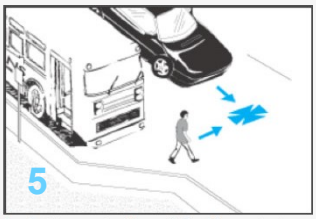
Pedestrian walking into the roadway, in front of stopped or slowed traffic, and into the path of a vehicle in the adjacent lane.



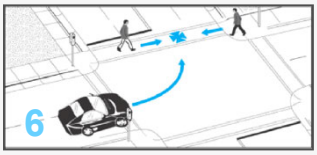
Pedestrian struck while going to/from a private residence mailbox/newspaper box.



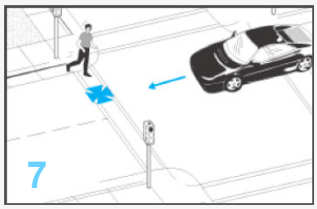
Motorist fails to yield to pedestrian at two-lane, low-speed road crosswalk.



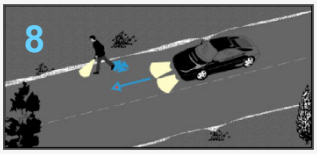
A pedestrian was struck by a vehicle while crossing in front of a public bus stopped at a bus stop..



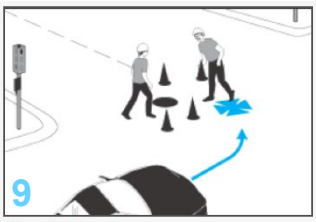
Conflict between pedestrians crossing in a marked crosswalk at an intersection and left-turning vehicle.



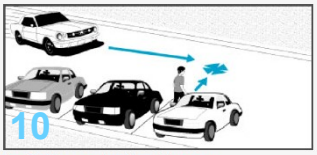
A pedestrian was struck at a signalized intersection or midblock location by a vehicle that was traveling straight ahead.



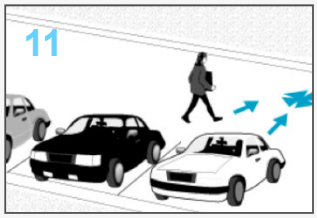
A pedestrian walking along the roadway during dark, unlit conditions, in the same direction as vehicular traffic, and was struck from behind by a vehicle.



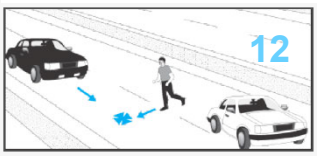
Worker struck in roadway.



A pedestrian was struck in parking area.



A pedestrian was struck by a backing vehicle in a parking lot.



A pedestrian was struck while crossing a limited-access expressway.

Major Road	Minor Road	PBCAT Observations - Intersections											
		Dart/Dash	Multiple Threat/ Trapped	Unique Midblock	Through vehicle at Unsignalized Location	Bus-Related	Turning Vehicle	Through Vehicle at Signal	Walking Along Roadway	Working/ Playing in Road	Non-roadway	Backing Vehicle	Crossing Expressway
Salem Parkway	Cherry Ave	0	few	0	few	0	few	few	few	0	few	0	0
High St NE	Chemeketa St NE	0	0	0	0	0	many	0	0	0	0	0	0
Pine St NE	Maple Ave	many	0	0	0	0	0	0	0	0	0	0	0
Center St	18th St NE	0	0	few	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0
		many	0	0	0	0	0	0	0	0	0	0	0
Vinyard Ave NE	Center St NE	0	0	0	many	0	many	0	0	0	0	0	0
River Rd	Delmar Dr N	few	0	many	many	0	0	0	0	0	0	0	0
		few	0	0	many	0	0	0	few	few	0	0	0
Lancaster Dr NE	Sunnyview Rd NE	few	0	few	0	0	some	0	0	0	0	0	0
		0	0	few	0	0	many	0	0	0	0	0	0
Liberty Rd S	Triangle Dr SE	0	0	0	many	0	0	0	0	0	0	0	0
Lancaster Dr NE	OR 22 WB Ramp	few	0	0	0	0	some	0	0	0	0	0	0
Lancaster Dr NE	OR 22 EB Ramp	0	few	0	0	0	0	0	0	0	0	0	0
Trade St SE	Commercial St SE	0	0	few	0	0	0	0	0	0	0	0	0
		few	some	0	0	0	many	0	0	0	0	0	0
Liberty St SE	Ferry St SE	few	0	few	0	0	many	0	0	0	0	0	0
		0	0	0	0	0	0	few	0	0	0	0	0

Note: Multiple rows for a single location indicate data collected by multiple staff and/or during multiple time periods.

Corridor	PBCAT Observations - Corridors											
	Dart/Dash	Multiple Threat/ Trapped	Unique Midblock	Through vehicle at Unsignalized Location	Bus-Related	Turning Vehicle	Through Vehicle at Signal	Walking Along Roadway	Working/ Playing in Road	Non-roadway	Backing Vehicle	Crossing Expressway
Mission St SE - 22nd to I-5	0	0	0	few	few	many	0	0	0	0	0	0
	0	0	0	0	0	many	0	few	some	0	0	0
	few	0	0	0	0	0	0	0	0	0	0	0
	0	0	few	0	0	0	0	0	0	0	0	0
Summer St NE - Market to D	0	0	0	some	0	0	0	0	0	0	0	0
Market St NE 14th to I-5	some	few	0	few	0	some	0	0	few	0	0	0
	0	0	0	many	few	few	0	0	0	0	0	0
	few	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	few	few	few	0	0	0	0
Lancaster Dr NE - Devonshire to Center	few	0	0	0	0	many	few	0	0	0	0	0
	few	0	few	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	some	few	0	0	0	0	few
	few	0	few	0	0	0	0	0	0	0	0	0
Pringle Rd SE - Fairview to Madrona	some	0	0	0	few	0	0	0	0	0	0	0
	few	0	few	0	0	0	0	0	0	0	0	0
	some	0	few	0	0	0	0	0	0	0	0	0
Wallace Rd NW - Taggart to Glen Creek	0	0	few	0	0	0	0	0	0	0	0	0
	0	0	0	few	0	0	0	0	0	0	0	0
Commercial St SE - Rural to Fairview	few	0	0	0	0	some	0	0	0	0	0	0
	some	0	0	0	0	few	0	0	0	0	0	0
Marion St SE - Commercial to High	0	0	0	0	0	few	0	0	0	0	0	0
High St SE - Union to Court	few	0	few	0	0	0	0	0	0	0	0	0

Note: Multiple rows for a single location indicate data collected by multiple staff and/or during multiple time periods.