

City of Salem

Pedestrian Safety Study

Final Report for

CITY OF *Salem*
AT YOUR SERVICE



Prepared by

DKS

September 2017

SALEM PEDESTRIAN SAFETY STUDY

FINAL REPORT

Prepared for:



City of Salem
Public Works Department

Prepared by:



Lacy Brown, Ph.D., P.E.
Scott Mansur, P.E., PTOE
Jenna Hills, EIT

September 2017



117 Commercial St NE
#310
Salem, OR 97301
503.391.8773
dksassociates.com

September 22, 2017

Anthony Gamallo
City of Salem
555 Liberty Street SE, Room 325
Salem, OR 97301

Subject: Salem Pedestrian Crash Investigation Final Report

Dear Anthony,

DKS Associates is pleased to submit the Final Report for the Salem Pedestrian Crash Investigation for the City of Salem. Please feel free to call if you have any questions or comments regarding this study.

Sincerely,
DKS Associates

Lacy Brown, Ph.D., P.E.
Transportation Engineer

Table of Contents

1.0 Project Introduction.....	1
2.0 Safety Data Investigation.....	2
Roadway Character	4
Weather Conditions	4
Time of Day and Lighting.....	5
Vehicle Movement	6
Driver and Pedestrian Behavior.....	7
Driver and Pedestrian Demographics.....	7
Fatal Crash Details	9
3.0 Field Observations.....	11
Field Data Collection	13
Citywide Observations.....	13
Intersection Observations.....	14
Corridor Observations	15
4.0 Recommendations.....	16
Citywide Strategies.....	13
Site-Specific Improvements.....	17
5.0 Summary	21

Appendix:

Example Data Collection Sheet
PBCAT Crash Type Definitions
Data Collection Summary

List of Figures

Figure 1: Map of All Pedestrian Crashes (2011-2016).....	3
Figure 2: Percentage of Crashes (2011-2016) by Roadway Character	4
Figure 3. Percentage of Crashes (2011-2016) by Weather Conditions	5
Figure 4: Number Crashes (2011-2016) by Time of Day.....	5
Figure 5: Percentage of Crashes (2011-2016) by Lighting Condition.....	6
Figure 7: Average Age of Crash Participants by Severity (2011-2016)	8
Figure 8: Gender Distribution of Crash Participants by Severity (2011-2016)	8
Figure 9: Map of Fatal Pedestrian Crashes (2011-2016).....	10
Figure 10: Map of Field Study Locations	12

List of Tables

Table 1: Salem Pedestrian Crashes by Year and Crash Severity	2
Table 2: Percentage of Crashes by Vehicle Movement and Location	7
Table 3: Field Study Locations and Observation Periods	11
Table 4. Recommended Safety Countermeasures for Study Intersections	17
Table 5. Recommended Safety Countermeasures for Corridors.....	19

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.

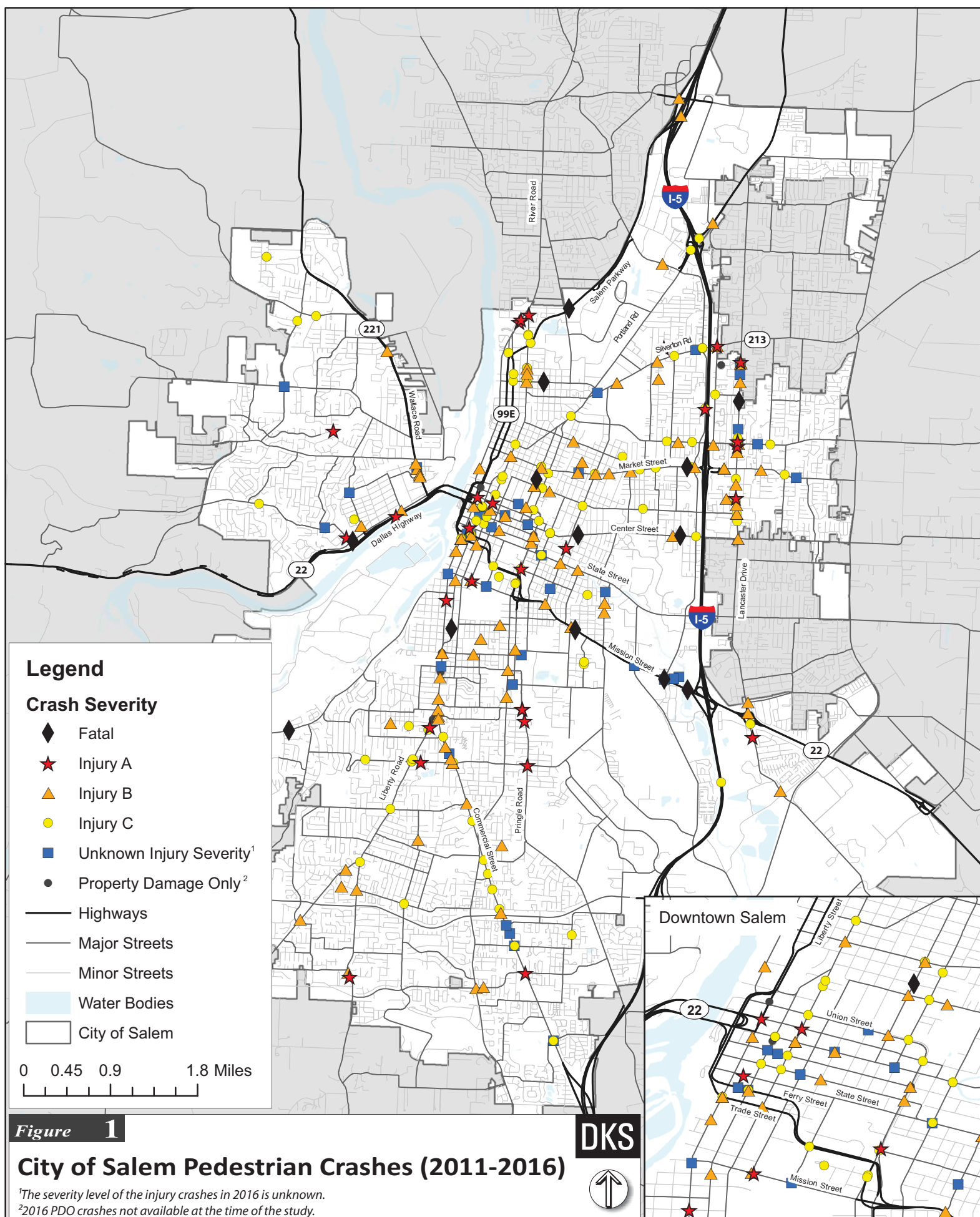
2.0 SAFETY DATA INVESTIGATION

DKS conducted a review of the available crash data for all 293 pedestrian crashes that occurred in the City of Salem between 2011 and 2016. These crashes are shown on Figure 1 on page 4 and are summarized by year and crash severity in Table 1. As shown, there was a slight increase in the number of fatal pedestrian crashes in 2015, although the combined number of serious injury crashes has remained fairly consistent since 2013.

Table 1: Salem Pedestrian Crashes by Year and Crash Severity

Year	Number of Crashes						Total
	Fatal	Serious Injury	Injury	Possible Injury	Unknown Injury ¹	Property Damage Only	
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	1	-	-	-	38	-	39

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.



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.

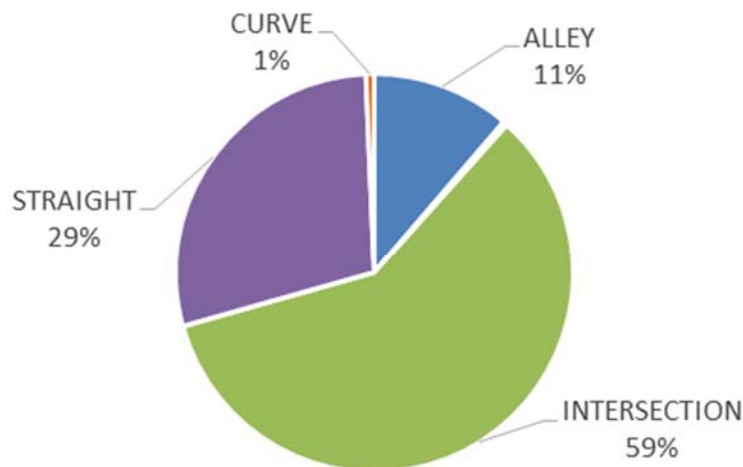


Figure 2: Percentage of Crashes (2011-2016) by Roadway Character

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).

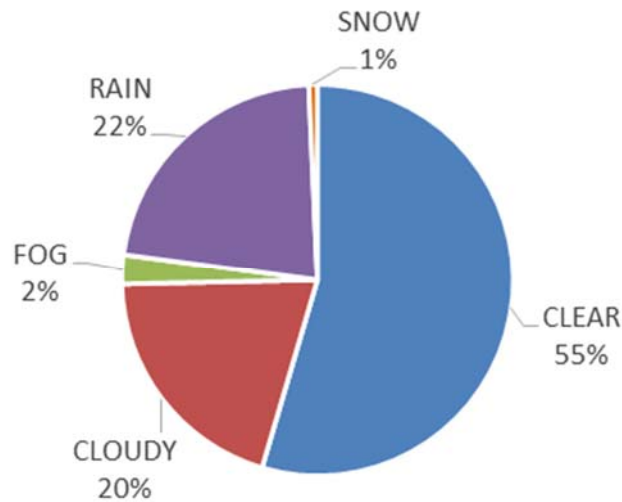


Figure 3. Percentage of Crashes (2011-2016) by Weather Conditions

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.).

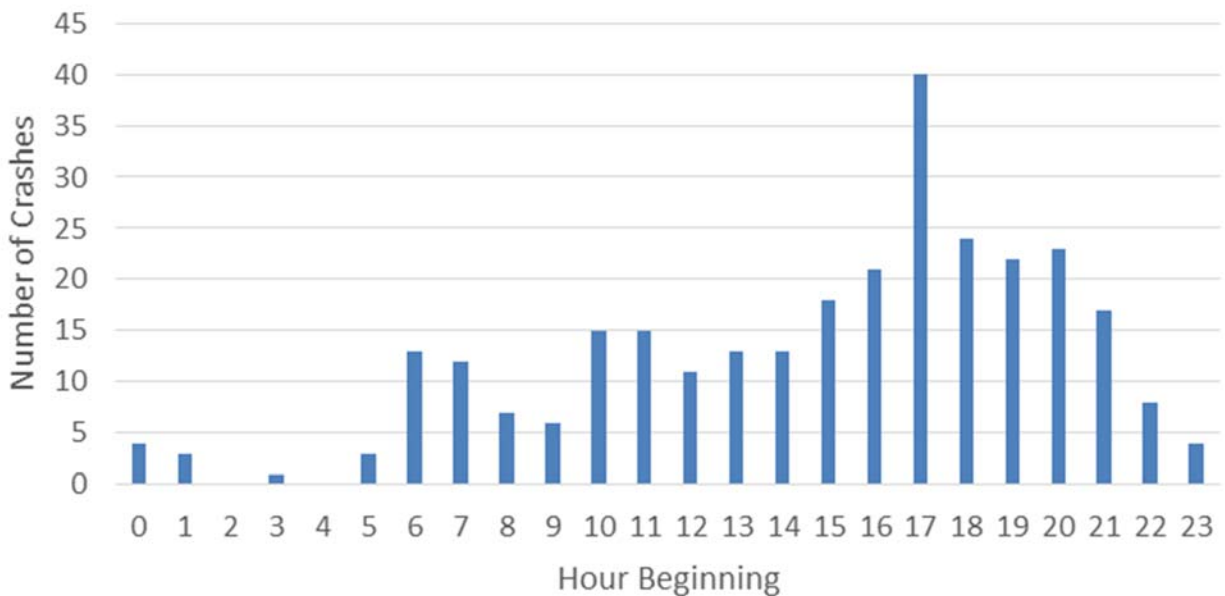


Figure 4: Number Crashes (2011-2016) by Time of Day

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).

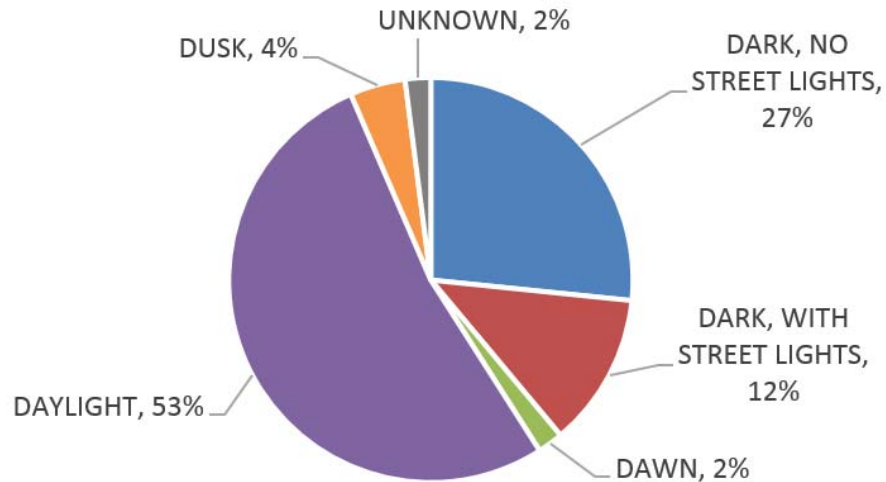


Figure 5: Percentage of Crashes (2011-2016) by Lighting Condition

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 (Sunnyview Road to Center Street), Center Street (Commercial Street to Winter Street), Commercial Street (Hilfiker Lane to Kuebler Boulevard), and Mission Street (21st Street to Ford Street).

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).

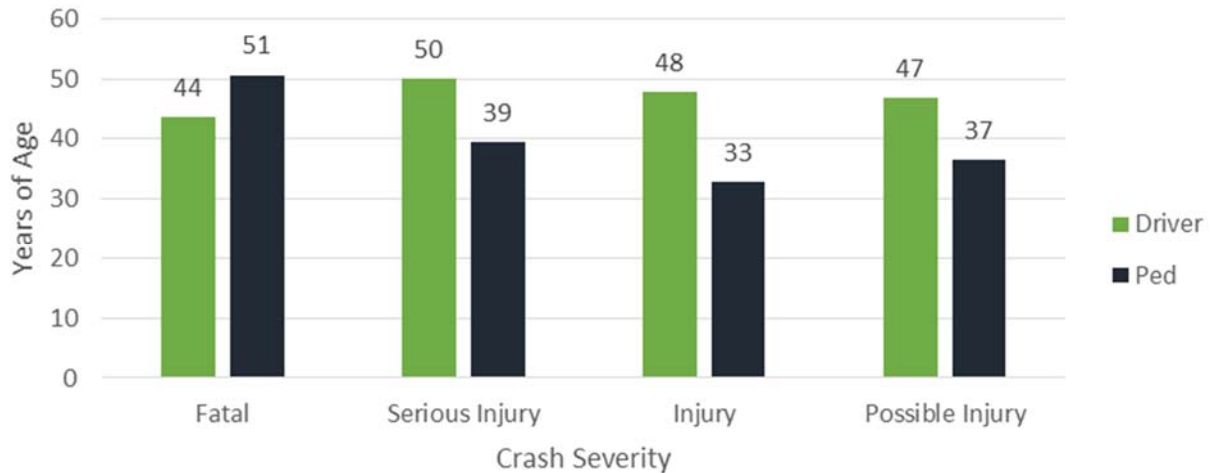


Figure 6: Average Age of Crash Participants by Severity (2011-2016)

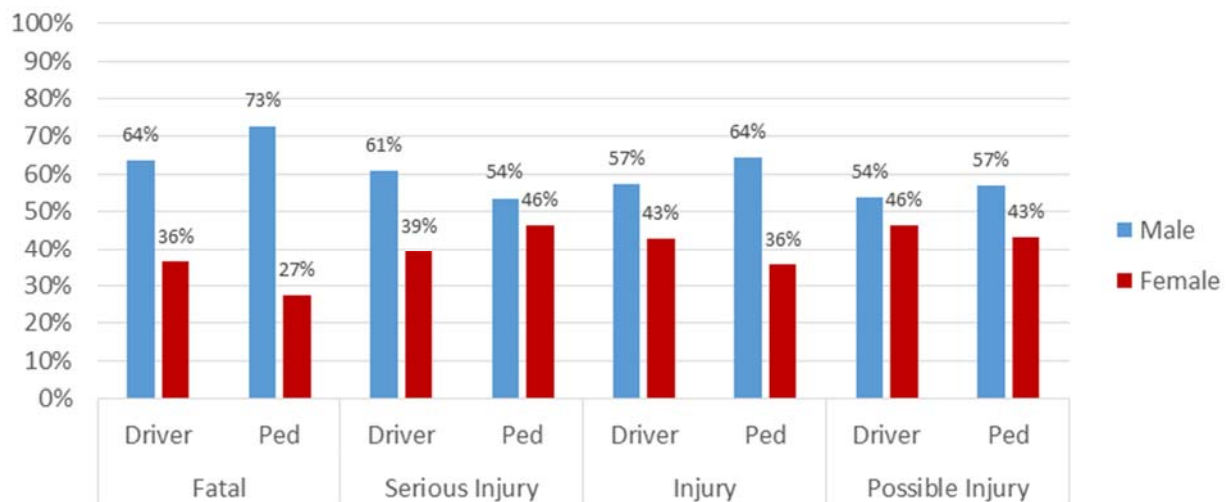


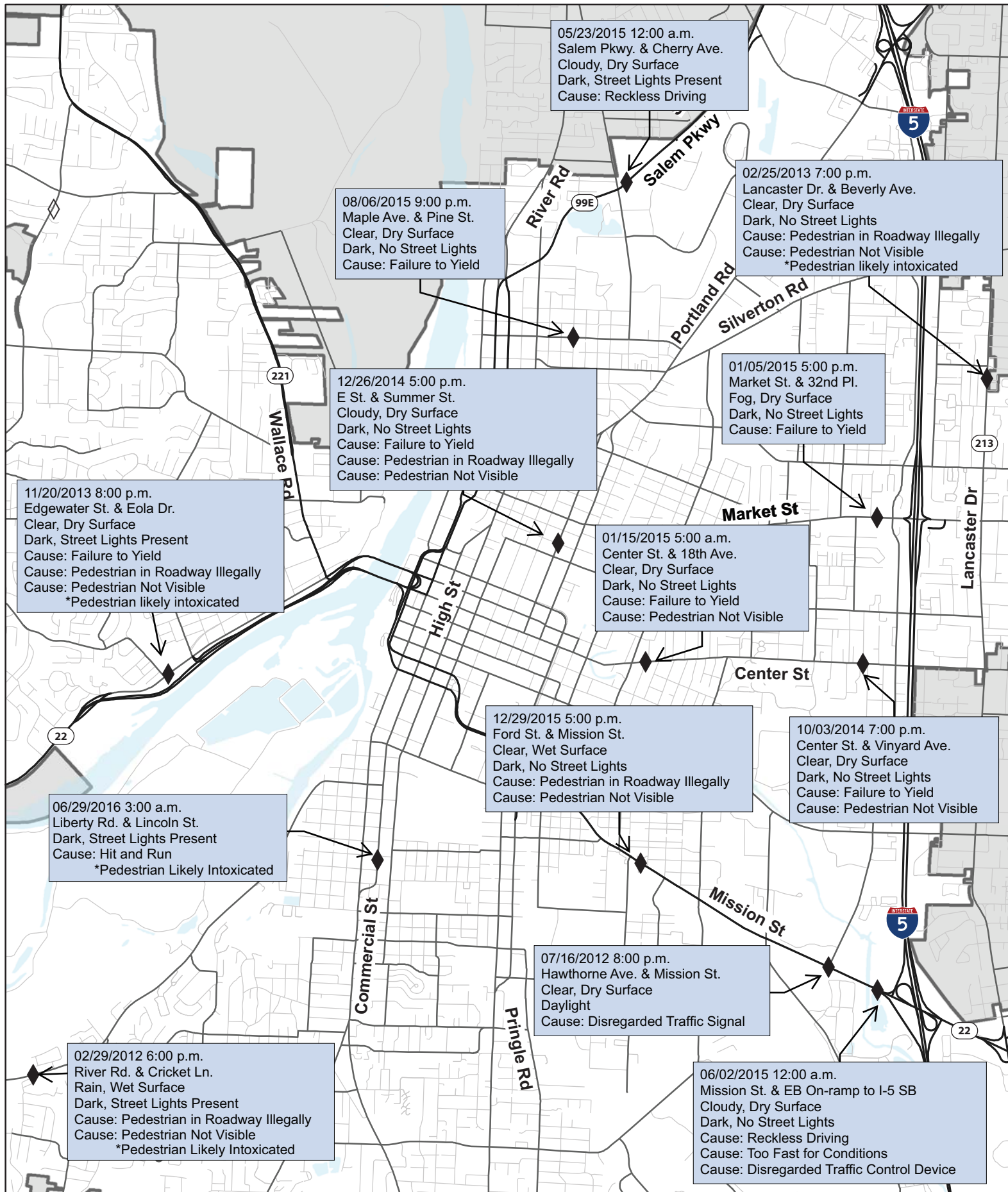
Figure 7: Gender Distribution of Crash Participants by Severity (2011-2016)

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 13 crashes, 12 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 they were 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.



LEGEND

- ◆ Fatal Crash
- Minor Streets
- Highways
- Water Bodies
- Major Streets
- City of Salem

0 0.2 0.4 0.8 miles



Figure 8

DKS

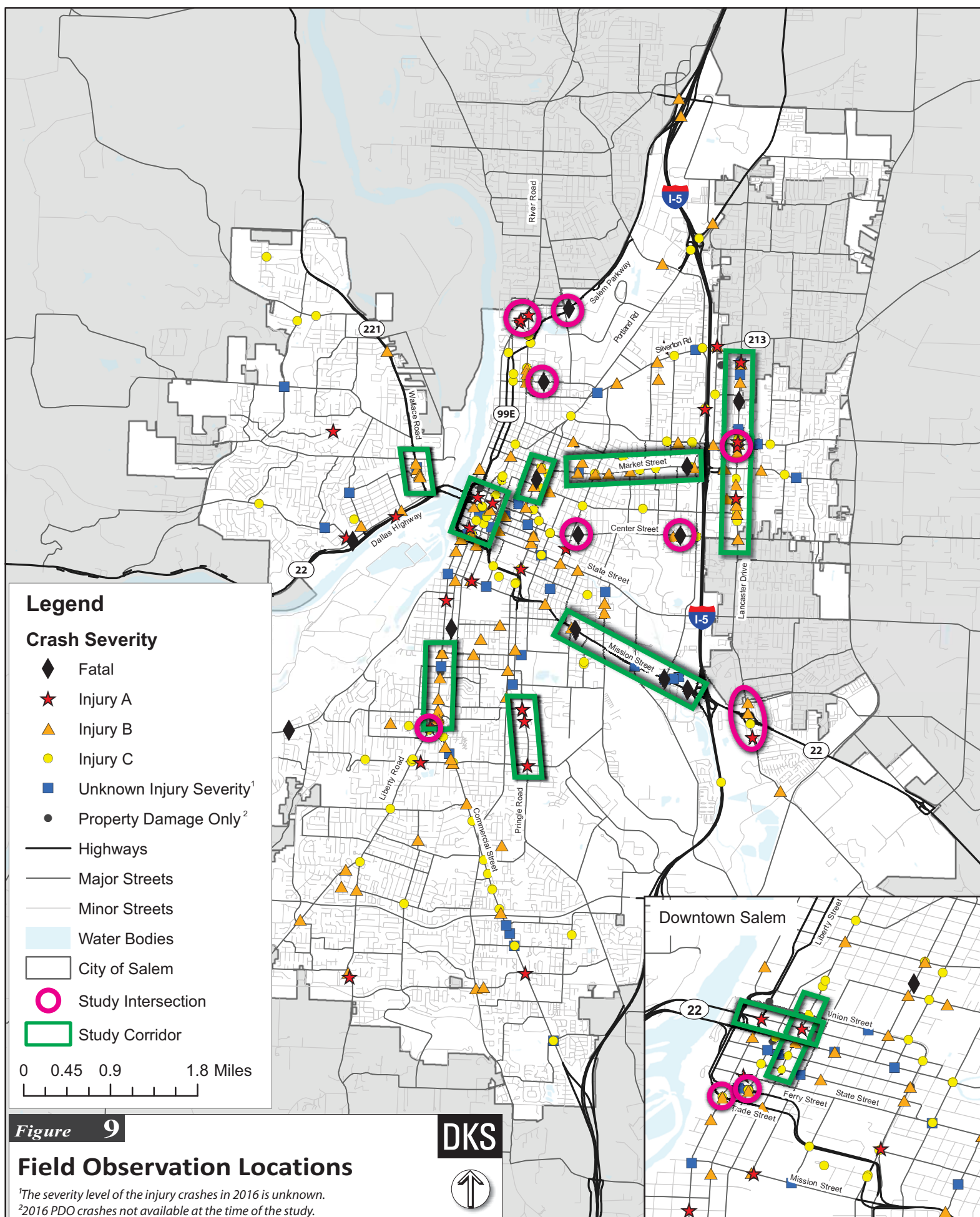
Fatal Pedestrian Crashes in the City of Salem (2011-2016)

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 18 th 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 22 nd 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 14 th 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			



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 PEDSAFE¹ 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, vehicles were often seen speeding, driving aggressively, and failing to yield to pedestrians.

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.

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.



Pedestrians crossing High Street NE



Pedestrian crossing mid-block on Lancaster Drive

¹ 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-functioning².
- **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.

² 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' *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 environment• 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 to ensure that 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 driving. Additionally, the City should reconsider the lack of jaywalking laws, which may be contributing to pedestrians crossing at undesired locations.

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 ³	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.

³ Conflict types correlate to PEDSAFE documentation. Definitions are included in the Appendix.

Table 4. (Continued)

Major Road	Minor Road	Conflict Types Observed ³	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 ⁴	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 ⁵ .
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.

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

⁵ City of Salem recently re-lighted some of the street lights along this corridor.

Table 5. (Continued)

Road	Extents	Conflict Types Observed ⁴	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 293 pedestrian-related crashes in the City of Salem. Of those, 13 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 13 fatal pedestrian crashes, 12 occurred at night (dark conditions) and four involved a pedestrian that was likely intoxicated. In 2017, there were two 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

Intersection

Salem Pedestrian Safety Study

Field Data Collection

Date: _____

Major road: _____ Time during observation: _____ to _____

Minor road: _____ Weather: _____
ex: 55°, cloudy, periodic drizzle

Site Sketch (show street layout, cardinal direction, sidewalks, signals, etc.)



General Information

Posted speeds _____ Major road: _____ Minor road: _____

Number of through lanes: _____ Channelized right turn lanes: Yes or No

Number of turn lanes: _____ Is the intersection skewed? Yes or No

Intersection traffic control type(s) (circle): signalized, unsignalized, stop controlled, yield, other

Is on-street parking present? Yes or No If yes, which approaches? _____

Distance from intersection: _____

Transit

Are transit stops present? Yes or No

If yes, describe access to transit stops: _____

Land use

Describe urban context : _____

(ex: urban residential, suburban shopping center, rural)

List nearby pedestrian traffic generator land uses: _____

Corridor

Salem Pedestrian Safety Study

Field Data Collection

Date: _____

Road: _____

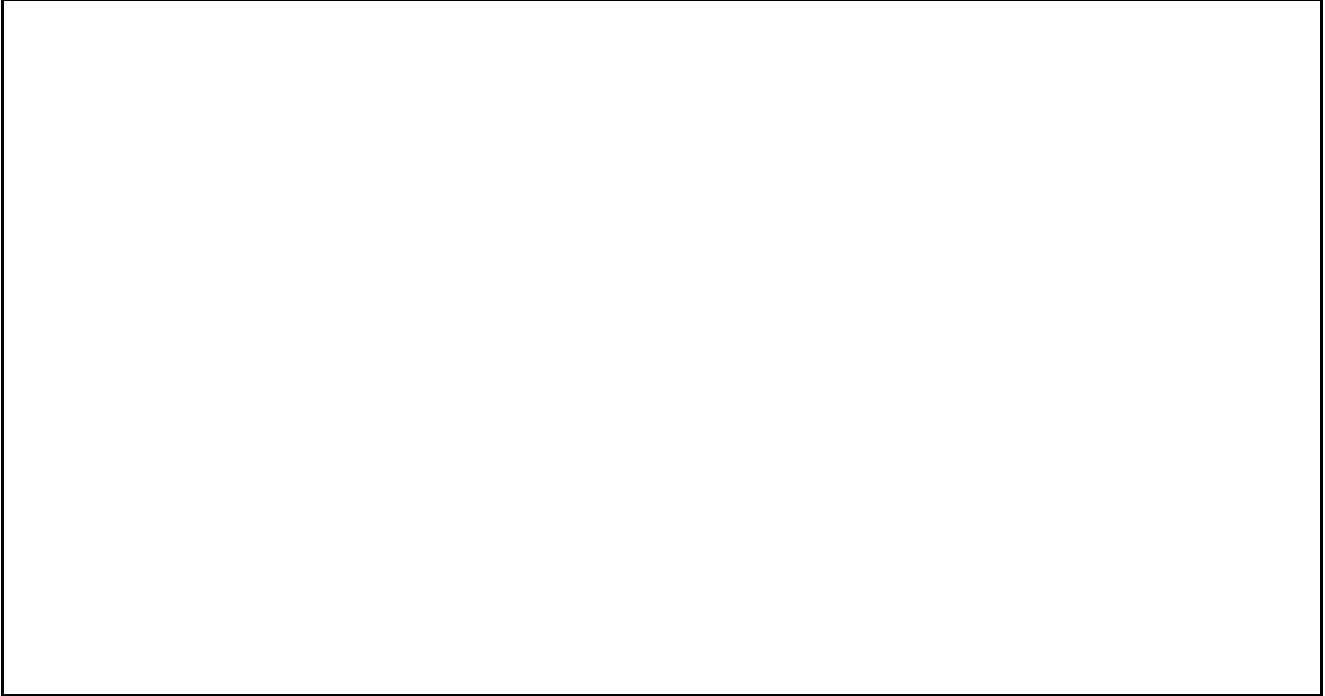
Time during observation: _____ to _____

Extents: _____ to _____

Weather: _____

ex: 55°, cloudy, periodic drizzle

Site Sketch (show cross section, intersections, cardinal direction, sidewalks, signals, etc.)



General Information

Posted speed: _____

Number of through lanes (typical section): _____

Number of turn lanes (typical section): _____

Intersection traffic control type(s) (circle): signalized, unsignalized, stop controlled, yield, other

Is on-street parking present? Yes or No

If yes, extents? _____

Type (circle): angle, parallel

Note general corridor geometry features and issues: _____

Transit

Are transit stops present? Yes or No

If yes, describe access to transit stops: _____

Land use

Describe urban context : _____

(ex: urban residential, suburban shopping center, rural)

List pedestrian traffic generator land uses: _____

Access management

Median Type: raised, painted, TWLTL, none

Are there turn restrictions? Yes or No

Extents: _____

Number of Driveways: _____

Corridor

Salem Pedestrian Safety Study

Field Data Collection

Date: _____

Behavioral Observations

List observed conflicts between turning vehicles and pedestrians: _____

Observed non-compliance issues (provide descriptions for each with lanes, approaches, and other details)

Drivers yielding to pedestrians: _____

Pedestrians yielding to drivers: _____

Red light running by drivers: _____

Pedestrians crossing against walk signal: _____

Observed speeding: _____

Other non-compliance behaviors: _____

Risks observed corresponding to PBCAT crash types (see reference page)

PBCAT crash type	Description	Observations
Dart/dash	Are pedestrians walking into street unexpectedly? Is visibility obstructed for motorists?	
Multiple threat/trapped	Is signal timing adequate to cross street? Does driver behavior pose issues at midblock crossings of 2+ lanes per direction?	
Unique midblock	Are there unique/temporary destinations (mailboxes, vendors, on street parking) that make pedestrians cross the street?	
Through vehicle at unsignalized location	Is failure to yield observed? Are there difficulties for pedestrians to cross?	
Bus-related	Is bus stop design and/or location posing crash risks?	
Turning vehicle	Are conflicts present? Is failure to yield observed? Are there large turning volumes or large pedestrian volumes? Is sight distance and visibility sufficient?	
Through vehicle at signal	Is traffic signal visible to pedestrians? Is there excessive delay to pedestrians? Noncompliance?	
Walking along roadway	Is the walking area adequate? Is there a gap in the pedestrian network? Can the sidewalk be reached easily?	
Working/playing in road	Are pedestrians working or playing in the street? Are vehicle speeds excessive for the	
Non-roadway	Are facilities adequate for pedestrians waiting to cross street? Are pedestrian facilities adequate outside the roadway? Are sight distance issues present at driveways or alleys?	
Backing vehicle	Are walkways delineated? Is lighting sufficient? Are there unneeded alleys and driveways?	
Crossing expressway	Are facilities sufficient for pedestrians to stand by and service disabled vehicles?	

Intersection

Salem Pedestrian Safety Study

Field Data Collection

Date: _____

Access management

Is access management present? Yes or No

If yes, type(s): _____

Extents: _____

Are there nearby driveways? Yes or No

If yes, approaches: _____

Sight distances

Site distances NB: _____

EB: _____

(by approach)

SB: _____

WB: _____

List possible sight distance issues: _____

Pedestrian facilities

Are sidewalks present on all sides of intersection? Yes or No. If partial, describe: _____

Describe condition of sidewalks: _____

Are crosswalks marked? Yes or No

If partial, describe: _____

Describe condition of marked crossings: _____

Describe separation from traffic at intersection approaches : _____

(ex: none, on-street parking, planter strip)

Describe connections to pedestrian network: _____

Describe barriers to walking (ex: closed crosswalks): _____

Lighting

Is lighting present? Yes or No

Are obstructions to lighting present? Yes or No. If yes, describe: _____

Traffic Signals

Are push buttons present at all corners? Yes or No. If partial, describe: _____

Are ped signal heads present at all crossings? Yes or No. If partial, describe: _____

Are ped countdown timers provided at all crossings? Yes or No. If partial, describe: _____

What is the approximate pedestrian delay? _____

(the wait time between arrival/push button request to service)

What is the approximate left turn phase duration? _____

Other notes

Intersection

Salem Pedestrian Safety Study

Field Data Collection

Date: _____

Behavioral Observations

List observed conflicts between turning vehicles and pedestrians:

Observed non-compliance issues (provide descriptions for each with lanes, approaches, and other details)

Drivers yielding to pedestrians: _____

Pedestrians yielding to drivers: _____

Red light running by drivers: _____

Pedestrians crossing against walk signal: _____

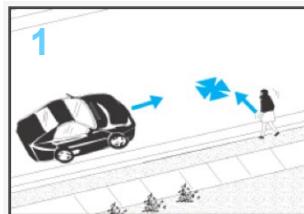
Observed speeding: _____

Other non-compliance behaviors: _____

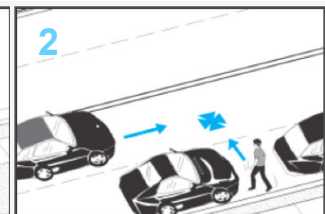
Risks observed corresponding to PBCAT crash types (see reference page)

PBCAT crash type	Description	Observations
Dart/dash	Are pedestrians walking into street unexpectedly? Is visibility obstructed for motorists?	
Multiple threat/trapped	Is signal timing adequate to cross street? Does driver behavior pose issues at midblock crossings of 2+ lanes per direction?	
Unique midblock	Are there unique/temporary destinations (mailboxes, vendors, on street parking) that make pedestrians cross the street?	
Through vehicle at unsignalized location	Is failure to yield observed? Are there difficulties for pedestrians to cross?	
Bus-related	Is bus stop design and/or location posing crash risks?	
Turning vehicle	Are conflicts present? Is failure to yield observed? Are there large turning volumes or large pedestrian volumes? Is sight distance and visibility sufficient?	
Through vehicle at signal	Is traffic signal visible to pedestrians? Is there excessive delay to pedestrians? Noncompliance?	
Walking along roadway	Is the walking area adequate? Is there a gap in the pedestrian network? Can the sidewalk be reached easily?	
Working/playing in road	Are pedestrians working or playing in the street? Are vehicle speeds excessive for the facility?	
Non-roadway	Are facilities adequate for pedestrians waiting to cross street? Are pedestrian facilities adequate outside the roadway? Are sight distance issues present at driveways or alleys?	
Backing vehicle	Are walkways delineated? Is lighting sufficient? Are there unneeded alleys and driveways?	
Crossing expressway	Are facilities sufficient for pedestrians to stand by and service disabled vehicles?	

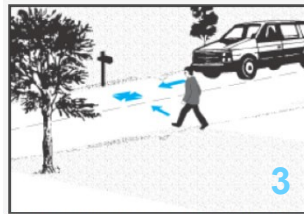
#	Crash Type	Definition
1	Dart/Dash	The pedestrian walked or ran into the roadway at an intersection or midblock location and was struck by a vehicle. The motorist's view of the pedestrian may have been blocked until an instant before the impact.
2	Multiple Threat/Trapped	The pedestrian entered the roadway 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



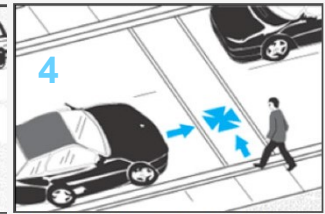
Pedestrian walking into the roadway at a midblock location and into the path of a vehicle.



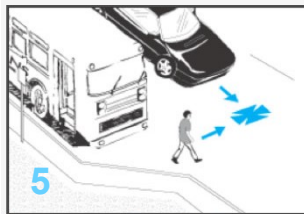
Pedestrian walking into the roadway, in front of stopped or slowed traffic, and into the path of a vehicle in the adjacent lane.



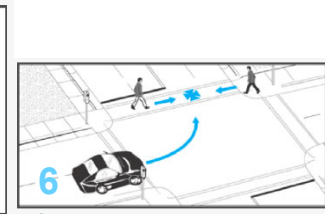
Pedestrian struck while going to/from a private residence mailbox/newspaper box.



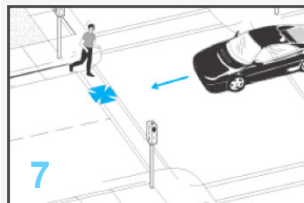
Motorist fails to yield to pedestrian at two-lane, low-speed road crosswalk.



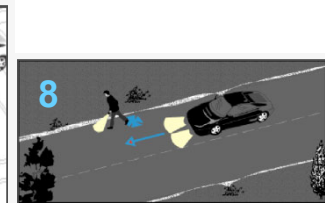
A pedestrian was struck by a vehicle while crossing in front of a public bus stopped at a bus stop.



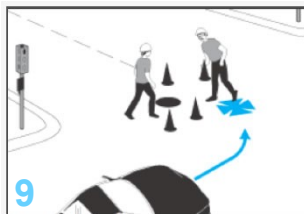
Conflict between pedestrians crossing in a marked crosswalk at an intersection and left-turning vehicle.



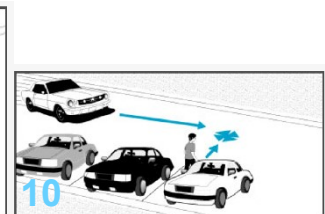
A pedestrian was struck at a signalized intersection or midblock location by a vehicle that was traveling straight ahead.



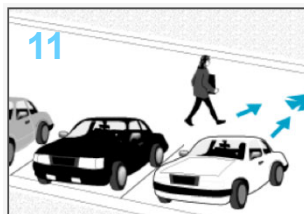
A pedestrian walking along the roadway during dark, unlit conditions, in the same direction as vehicular traffic, and was struck from behind by a vehicle.



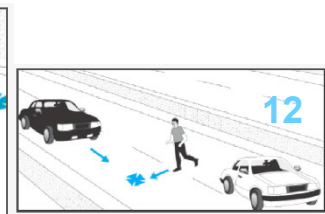
Worker struck in roadway.



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.