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MEMORANDUM

To: Michelle Marx, City of Portland

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Date: February 19, 2018

Subject: PedPDX Pedestrian Safety Existing Conditions Memo - DRAFT

INTRODUCTION

This memo summarizes analyses of crashes involving people walking that was conducted for the Portland Citywide Pedestrian Plan (PedPDX) existing conditions chapter. General trends and patterns of pedestrian involved crashes citywide between 2006 and 2015 are complemented with a detailed analysis of the Vision Zero High Crash Network (HCN)[1]. PedPDX is guided in part by the City of Portland's Vision Zero goal of eliminating fatal and serious injury crashes by the year 2025. Towards that end, the findings of this memo will help shape the infrastructure related safety criteria for identifying needs and establishing investment priorities.

Key Findings

Figure 1 Summary of Key Findings

Finding	Potential Implications for Pedestrian Plan
Overall Trends	
Per capita, crashes involving people walking have been on the rise since 2006, with an average of over 220 injury crashes per year.	Safety is an important focus of PedPDX, consistent with the City's recent Vision Zero efforts, and may be a factor in project prioritization.
Crashes are most concentrated on larger roads, where more than 52% of pedestrian crashes occur on the 7% of roadway miles that have three or more travel lanes.	Focusing safety investments on larger streets, including the High Crash Network identified in the Vision Zero Action Plan, is the most efficient way to reduce crashes.
Crashes involving people walking are more frequent in the fall and winter months when days are shorter (most of the additional crashes occur in dark conditions with streetlights present).	Visibility is an important issue for pedestrian safety in Portland, where there is a big swing in the number of daylight hours depending on the time of year.

[1] The City of Portland provided the crash data for this analysis, which it received from the Oregon Department of Transportation (ODOT) Crash Analysis and Reporting Unit.

Finding	Potential Implications for Pedestrian Plan
What are the major crash types?	
Signalized intersections are not preventing crashes. ▪ Over 40% of crashes and 30% of serious/fatal crashes citywide occur at signals. ▪ Over a quarter of all crashes involve a turning driver failing to yield when the person walking has the right of way at the signal (nearly 20% left-turning drivers and 8% right turning drivers).	PedPDX can put an emphasis on additional pedestrian enhancements at signalized intersections.
Midblock crashes are common and more severe. ▪ Nearly 30% of crashes and over 40% of serious/fatal crashes occur midblock. ▪ Midblock crashes are more likely to result in a serious or fatal injury. ▪ Over 20% of all crashes involve people walking across the road between intersections. ▪ Many of the remaining midblock crashes involve people being in the road for a variety of reasons, but not attempting to cross it.	Increase the frequency of enhanced pedestrian crossings to reduce the number of street segments that do not meet the city's crossing spacing standards.
What is happening on the high crash network (HCN)? ▪ Nearly half of crashes (46%) on the HCN occur at signalized intersections. The most common action involves drivers turning left into a person walking across the high crash network street (17% of all crashes). ▪ Nearly a third of all crashes on the HCN involve people walking across the road midblock (19% of crashes) or at unsignalized intersections (12%).	Provide additional pedestrian enhancements at signalized intersections (including those that reduce conflicts with left turning vehicles) and reduce the number of street segments that do not meet the city's crossing spacing standards.
What makes crashes more severe?	
People walking are ten times more likely than people driving to sustain a serious or fatal injury.	Speed at the time of impact is the critical factor in injury severity.
Approximately 17% of all pedestrian crashes result in a killed or seriously injured (KSI) pedestrian. The following crash types are even more likely to result in a KSI: ▪ People walking across the street between intersections (20% of all crashes; 25% are KSI) ▪ People walking across the street against the signal (8% of crashes; 23% are KSI) ▪ Driver going straight at unsignalized intersection fails to yield (7% of crashes; 22% are KSI) ▪ People walking across the street at unsignalized intersection and did not provide sufficient time for person driving to stop (6% of crashes; 22% are KSI)	Crashes that involve crossing the road away from a signalized intersection are the most likely to result in a serious or fatal injury.
Crashes are less common in the late evening/early morning hours, but are more likely to result in a serious or fatal injury.	Measures that increase lighting and prevent speeding can reduce the risk associated with crashes that occur during these hours.

CRASH TRENDS

Overall Trends

Pedestrian crashes are on the rise in Portland, with injury crashes increasing by 25% between 2006 and 2015 (see Figure 2). Even considering the 17% population growth over this time-period, the number of pedestrian crashes per 100,000 residents (a common way of comparing safety across cities) has been trending up (see Figure 3). On average in this time-period, there were 223 reported crashes per year, 38 (17%) of which were fatal or serious injury crashes. Pedestrian crashes are ten times more likely to result in a serious injury or fatality – only 1.7% of vehicle crashes in Portland result in a serious injury or fatality.

Figure 2 Annual Pedestrian Crashes and Crash Severity

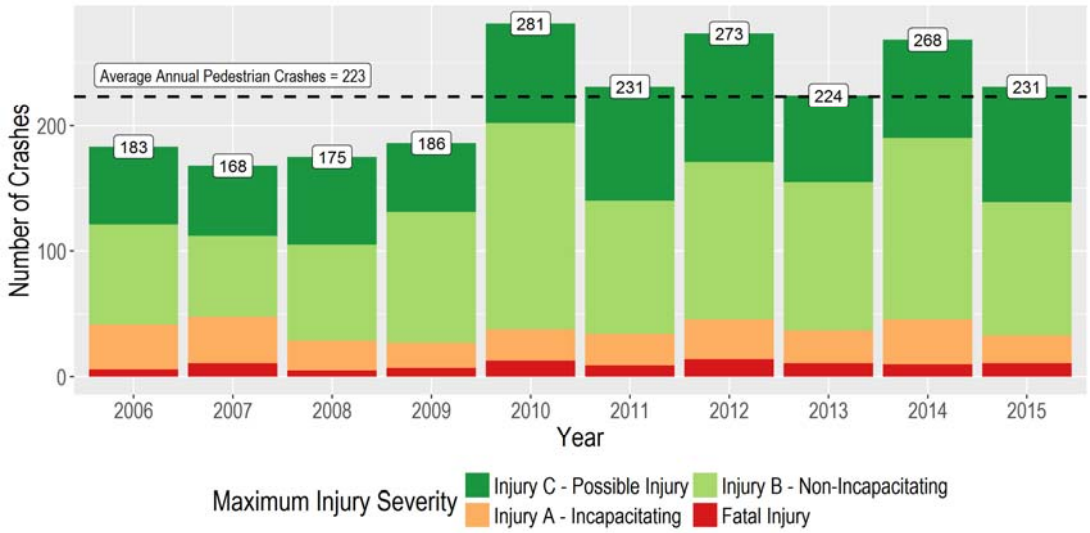


Figure 3 Annual Pedestrian Crashes vs. Population

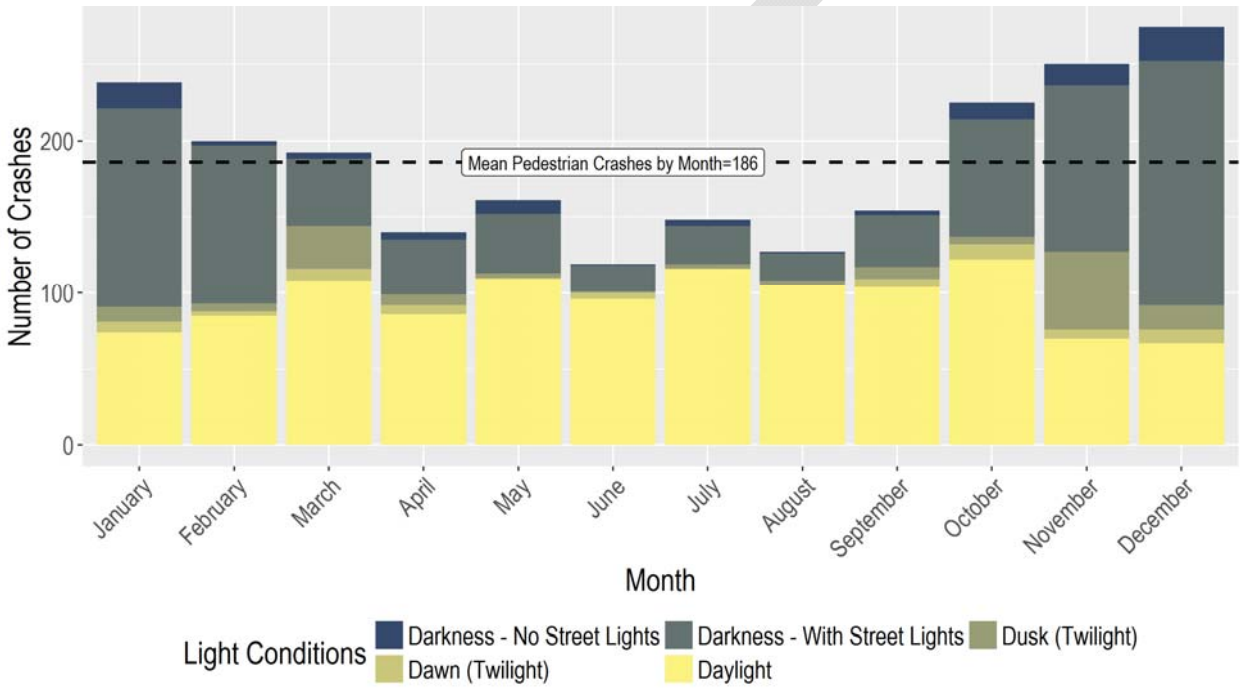
Year	Pedestrian Crashes	Population[1]	Pedestrian Crashes per 100,000 Residents
2006	184	538,091	34.2
2007	171	546,747	31.3
2008	175	556,442	31.4
2009	188	566,143	33.2
2010	281	585,478	48.0
2011	232	594,081	39.1
2012	273	603,124	45.3
2013	226	609,132	37.1
2014	269	619,334	43.4
2015	231	630,621	36.6
Average	223	584,919	38.0

(1) Source: US Census American Community Survey

Time of Year and Darkness

The fall and winter months see an uptick in pedestrian crashes as compared to the spring and summer. This despite the probability that there are likely more people walking in the warmer months. The number of crashes occurring in daylight is relatively constant throughout the year (Figure 4), while crashes in dark conditions increase dramatically in fall and winter, when there are fewer daylight hours. Pedestrian crashes after dark commonly have streetlights present, suggesting that streetlights alone are not sufficient to ensure motorists and pedestrians see each other. There is a noteworthy spike in crashes occurring at dusk in March and November, the months when daylight savings time begins and ends.

Figure 4 Pedestrian Crashes by Month of Year and Lighting Conditions



Time of Day

Pedestrian crash patterns are similar to overall travel patterns, with a larger and longer afternoon/evening peak period as compared to the morning. More pedestrian crashes occur in the late afternoon and early evening than any other time of day, particularly between 5 pm and 7 pm (Figure 5).

While there are fewer pedestrian crashes during the nighttime and early morning hours, crashes during these periods are more likely to result in a serious or fatal injury (Figure 6). Possible factors for the increased severity could include higher vehicle speeds when roads are less congested, reduced visibility causing drivers to fail slow down to avoid a pedestrian, and/or intoxication affecting decision-making regarding appropriate driving speeds and the ability to judge when it is safe to cross the street.

Figure 5 Pedestrian Crashes by Hour and Severity

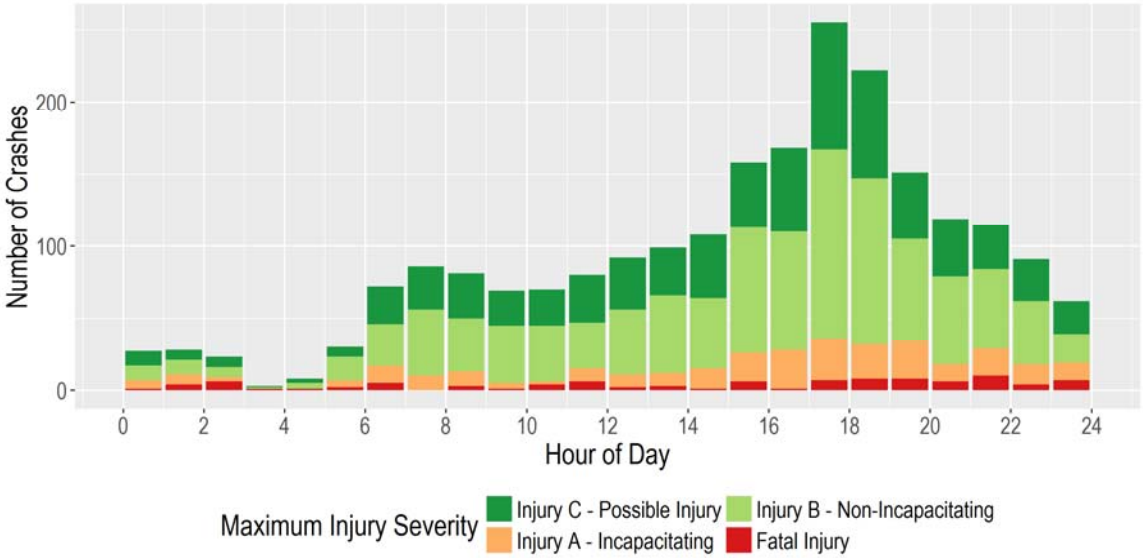
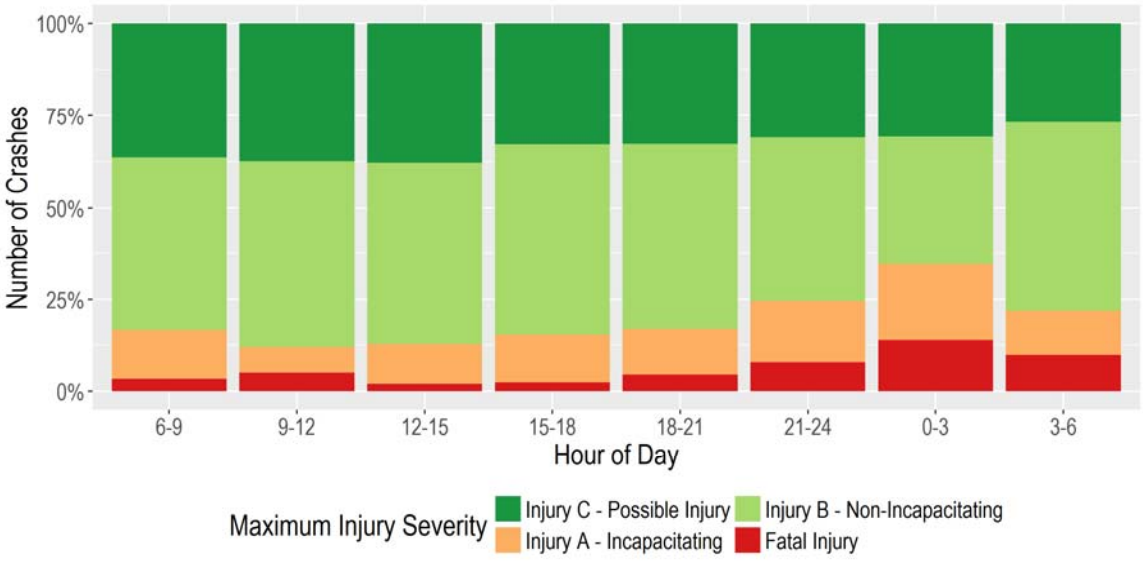


Figure 6 Proportion of Pedestrian Crashes Resulting in Serious or Fatal Injury by Time of Day



Age of Pedestrians and Drivers

Younger adult pedestrians (ages 20 to 24) were more frequently involved in crashes than other age groups, at over 10% of the total. Teenagers and younger adults ages 15 to 24 are disproportionately represented when compared to the population of Portland as a whole (Figure 7). The age distribution of drivers involved in pedestrian crashes roughly matches that of the driving age population.

Figure 7 Age Distribution of Pedestrians Involved in Crashes Compared to Portland Population

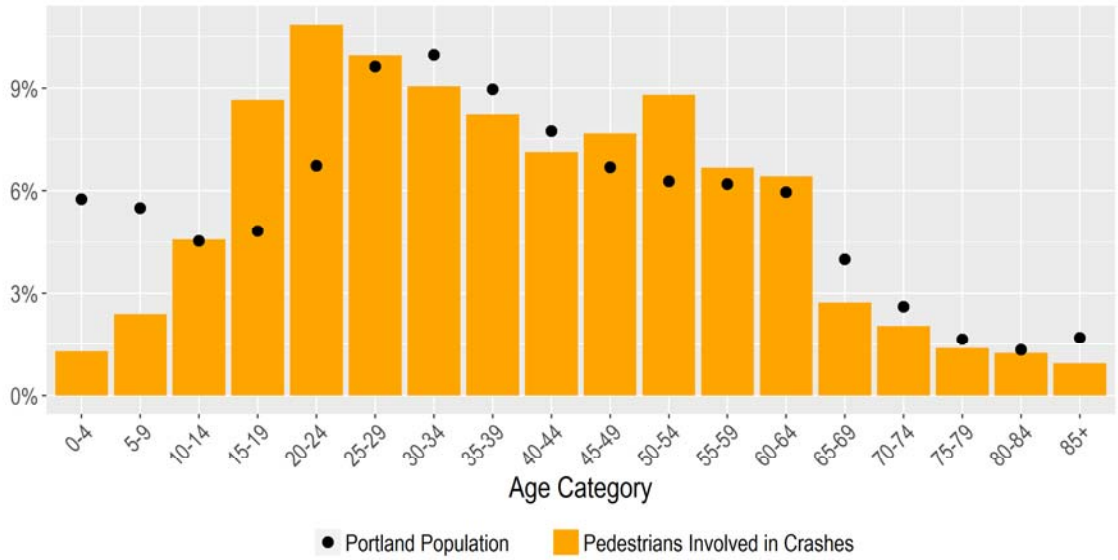
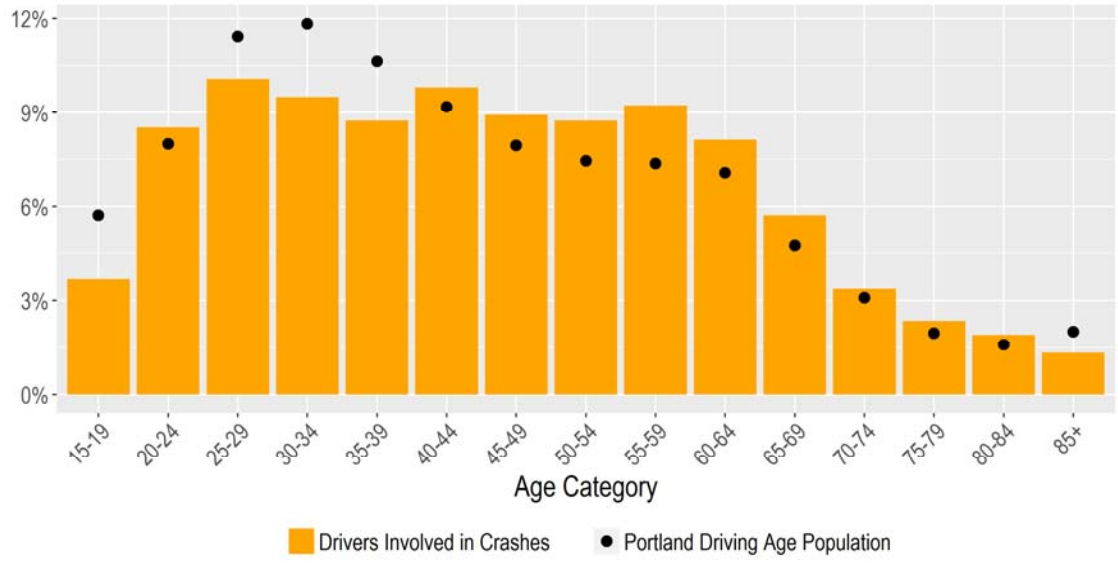


Figure 8 Age Distribution of Drivers Involved in Pedestrian Crashes Compared to Driving Age Population

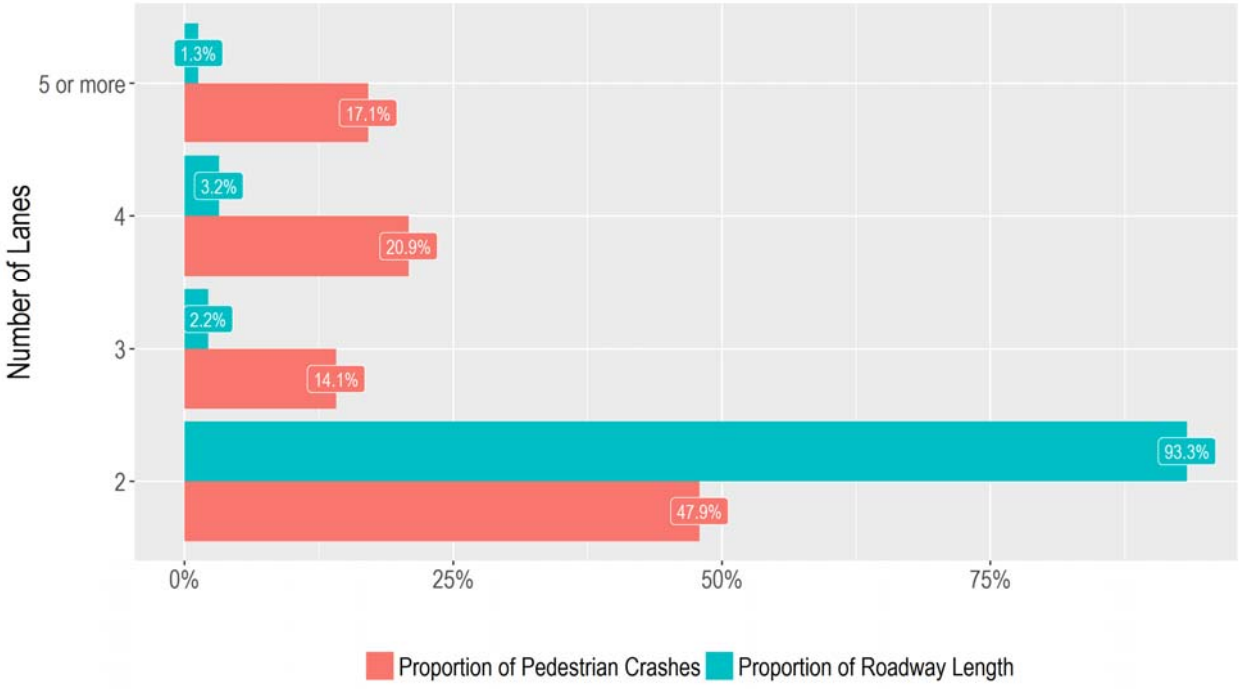


Source: US Census 2012-2016 American Community Survey 5-year estimates

Roadway Size

More than 52% of pedestrian crashes occur on the 7% of roads with three or more lanes. Nearly 20% of crashes occur on the 1.3% of roads with five or more lanes. This finding is consistent with the Vision Zero Action Plan finding related to the prevalence of crashes on arterials.

Figure 9 Distribution of Crashes by Number of Lanes as Compared to Miles of Roadway



Pedestrian Crash Types

The data were evaluated to identify crash types, which illustrate the kinds of locations and pedestrian or driver movements that occur most commonly prior to a pedestrian crash. The results of the crash type analysis are provided in Figure 10.

Key findings include:

- **Crashes at signalized intersections are prevalent.** They account for over 40% of pedestrian crashes and 30% of serious or fatal crashes.
- **Turning vehicles are failing to yield to pedestrians at signalized intersections.** Over a quarter of pedestrian crashes involve a turning driver failing to yield when the pedestrian has the right of way when crossing at the signal (nearly 20% left-turning and 8% right-turning drivers).
- **Midblock crashes are also prevalent.** Over 20% of crashes involve pedestrians crossing between intersections. These crashes tend to be more severe (see below).
- **Certain crash types tend be to more severe.** Approximately 17% of pedestrian crashes result in a serious or fatal injury. The following crash types are more likely to result in a killed or seriously injured (KSI) pedestrian:
  - Pedestrian crossing between intersections (20% of all crashes; 25% are KSI)
  - Pedestrian crossing against signal (8% of crashes; 23% are KSI)
  - Driver going straight at unsignalized intersection fails to yield (7% of crashes; 22% are KSI)
  - Pedestrian crossing at unsignalized intersection did not provide sufficient time for vehicle to stop (6% of crashes; 22% are KSI)

Figure 10 Pedestrian Crash Type Definitions, Counts, and Percentages

Pedestrian Crash Type	Criteria Description	Count	% of Crashes	% of KSI Crashes		% of Type Resulting in a KSI
Signalized Intersections	Crash at signalized intersection location (per reported Intersection field and geographic proximity to traffic signal)	907	42.2%	31.1%		12.8%
Left turning driver fails to yield to pedestrian	▪ Vehicle turning left preceding crash ▪ Driver assigned error code	418	19.5%	9.1%		8.1%
Right turning driver fails to yield to pedestrian	▪ Vehicle turning right preceding crash ▪ Driver assigned error code	168	7.8%	3.5%		7.7%
Pedestrian crossing against signal	▪ Pedestrian assigned error code ▪ Non-motorist action – crossing at intersection, traffic signal present	177	8.2%	11.0%		23.2%
Other	▪ All other crashes at signalized intersections	144	6.7%	7.5%		19.4%
Mid-block	▪ Crash at mid-block location (per reported Intersection field)	598	27.9%	42.4%		26.4%
Pedestrian crossing between intersections	▪ Non-motorist action – crossing between intersections	438	20.4%	29.0%		24.7%
Other	▪ All other crashes at midblock locations. Typically involve people being in the road for a variety of reasons but not attempting to cross it.	160	7.5%	13.4%		31.3%
Unsignalized Intersections	Crash at non-signalized intersection location (per reported Intersection field and no geographic proximity to traffic signal)	562	26.2%	24.1%		16.0%
Left turning driver fails to yield	▪ Vehicle turning left preceding crash ▪ Driver assigned error code	183	8.5%	3.8%		7.7%
Driver going straight fails to yield	▪ Vehicle traveling straight preceding crash ▪ Driver assigned error code	159	7.4%	9.4%		22.0%
Pedestrian crossing did not provide sufficient time for vehicle to stop	▪ Pedestrian assigned error code ▪ Non-motorist action indicated pedestrian crossing	136	6.3%	8.0%		22.1%
Other	▪ All other crashes at unsignalized intersection	84	3.9%	2.9%		13.1%
Driveway	Crash located at driveway (per Road Character field)	80	3.7%	2.4%		11.3%
Driveway	▪ All crashes located at driveway	80	3.7%	2.4%		11.3%
Total		2,147	100.0%	100.0%		NA

HIGH CRASH NETWORK

The City of Portland identified a High Crash Network (HCN) comprised of the 30 streets with the highest number of fatal and injury crashes for people driving, bicycling, or walking. This network was derived by combining the top 20 crash streets of each mode. The city's Vision Zero work is focused on these streets, many of which were in the top 20 for multiple modes. Portland's High Crash Network is illustrated in Figure 11. The total number of crashes on each of these corridors and the number of crashes per mile are displayed in Figure 12.

Figure 11 Portland's High Crash Network

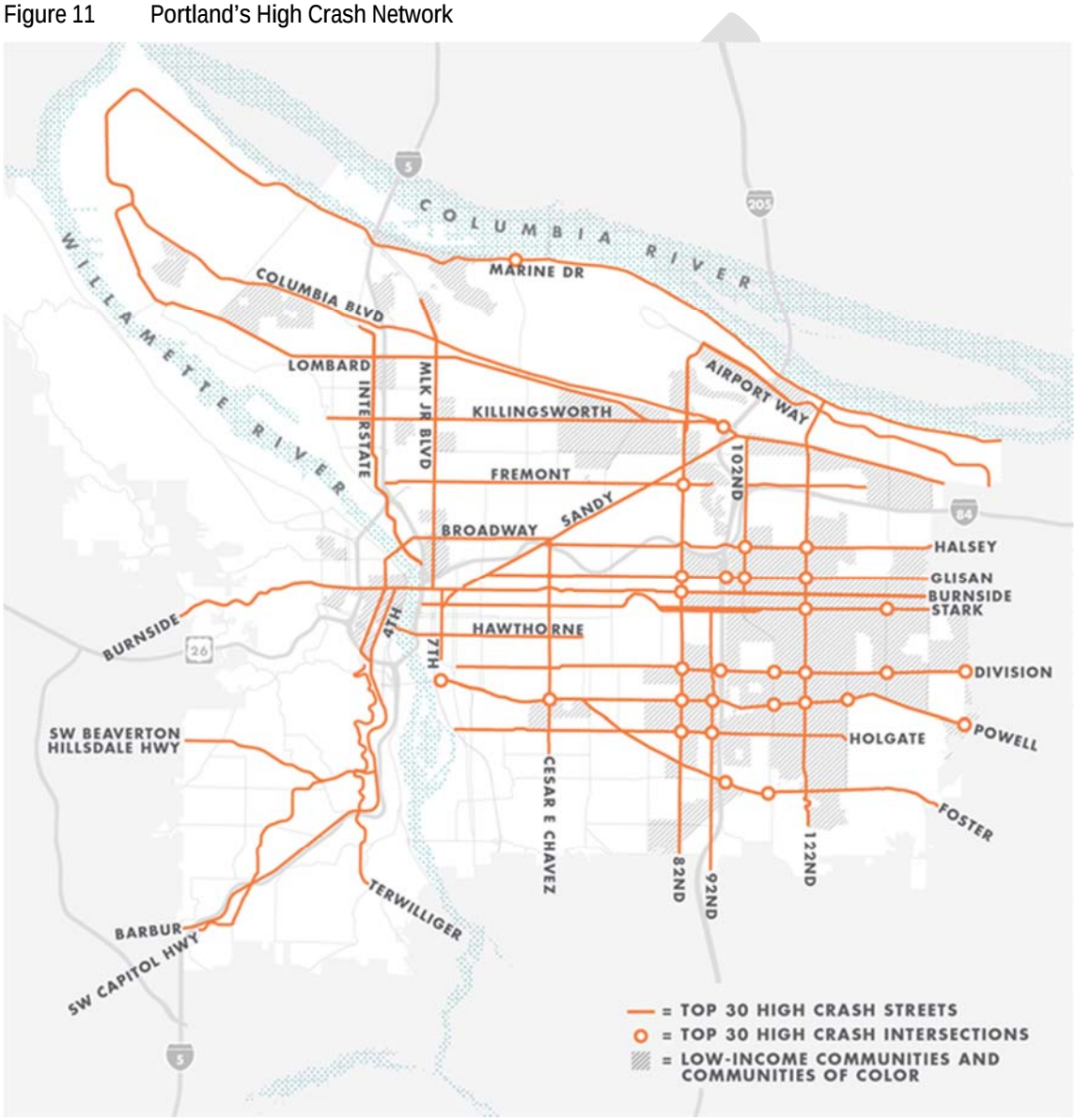


Figure 12 High Crash Corridor Summary

PBOT Corridor ID	Corridor Name	Length (mi)	Pedestrian Crashes[2]	Pedestrian Crashes per Mile
HCN1	E/W Burnside St	12.4	159	12.8
HCN2	N Interstate Ave	4.3	23	5.3
HCN3	N/NE Fremont St	7.3	22	3.0
HCN4	N/NE Killingsworth St	6.7	39	5.8
HCN5	N/NE Lombard St	12.6	78	6.2
HCN6	NE 102nd Ave	2.5	28	11.1
HCN7	NE Airport Way	5.5	2	0.4
HCN8	NE Columbia Blvd	10.3	6	0.6
HCN9	NE Glisan St	7.1	79	11.1
HCN10	NE Halsey St	6.3	36	5.7
HCN11	NE Marine Dr	15.7	3	0.2
HCN12	NE Martin Luther King Jr Blvd	4.7	60	12.6
HCN22	NE/SE 122nd Ave	7.1	88	12.4
HCN23	NE/SE 82nd Ave	8.4	155	18.5
HCN24	NE/SE Sandy Blvd	8.9	88	9.8
HCN13	SE 7th Ave	1.1	9	7.9
HCN14	SE 92nd Ave	4.3	18	4.2
HCN15	SE Cesar E Chavez Blvd	3.5	51	14.6
HCN16	SE Division St	8.3	135	16.2
HCN17	SE Foster Rd	6.2	46	7.4
HCN18	SE Hawthorne Blvd	2.6	41	15.5
HCN19	SE Holgate Blvd	6.4	41	6.4
HCN20	SE Powell Blvd	8.7	140	16.2
HCN21	SE Stark St	8.4	95	11.3
HCN25	SW 4th Ave	1.3	38	29.1
HCN26	SW Barbur Blvd	6.3	22	3.5
HCN27	SW Beaverton-Hillsdale Hwy	2.4	15	6.2
HCN28	SW Capitol Hwy	4.7	20	4.3
HCN29	SW Terwilliger Blvd	4.9	7	1.4
HCN30	SW/N/NE Broadway	4.6	100	21.6

[2] Includes crashes within 100 feet of each high crash network street

High Crash Network

This section describes collisions occurring on the High Crash Network (HCN) specifically. At the corridor level, it can be difficult to know, for example, if a turning movement crash involved the vehicle turning onto a particular street or off it. Establishing the high crash network as a point of reference allows for a much more nuanced understanding of crash patterns. Crashes on the HCN were classified according to whether the involved parties were walking or driving along a HCN street, crossing it, or, in the case of drivers, turning onto or off it (see Figure 14).

Approximately 2/3 of pedestrian crashes on the HCN involve people attempting to cross (rather than walk along) the HCN. Almost a third of all crashes involve people crossing midblock (19% of crashes) or at unsignalized intersections (12%). Nearly half of crashes (46%) occur at signalized intersections. Left turning crashes are twice as likely as right turning crashes, and this difference is especially pronounced at signalized intersections. A summary of the key trends is provided in Figure 13 below.

Figure 13 Pedestrian Crash Trends on the High Crash Network

Trend	Potential Implication
Signalized Intersections (46% of crashes)	
Driver turning onto the HCN corridor hits person walking across it ▪ 17% of crashes (> 1/3 of crashes at signals) ▪ 85% involve left turning motorists	Additional crossing enhancements or protected left turns on the minor legs may be needed at signalized intersections on the HCN.
Driver turning off the corridor hits person crossing the road while walking along it ▪ 9% of crashes ▪ 68% are left turns	
Unsignalized Intersections (25% of crashes)	
Driver traveling along the corridor hits person crossing it ▪ 12% of crashes; nearly ½ of crashes at unsignalized intersections	Additional pedestrian crossings so more streets meet the city's crossing spacing standards.
Driver turning on or off the corridor hits person crossing the road while walking along it ▪ 6% of crashes ▪ 97% are left turns	Consider the need for enhancements to raise driver awareness of pedestrians walking along the road.
Mid-block (26% of crashes)	
Driver traveling along the corridor hits person walking across it ▪ 19% of crashes; nearly ¾ of midblock crashes	Additional pedestrian crossings so more streets meet the city's crossing spacing standards.
Driveways (3% of crashes)	
Driver turning on to the corridor hits person walking along it ▪ 1% of crashes	This largest driveway category is only 1% of crashes citywide.

Figure 14 Pedestrian Crashes in Relation to the High Crash Network Streets, Location Type, and Vehicle Movement

Relation to High Crash Network (HCN)	Signalized Intersection				Unsignalized Intersection				Mid-Block				Driveway				Totals
	Straight	Turning Left	Turning Right	Other	Straight	Turning Left	Turning Right	Other	Straight	Turning Left	Turning Right	Other	Straight	Turning Left	Turning Right	Other	
Driver Along HCN Segment | Pedestrian Across HCN Segment	92	0	0	0	154	0	0	0	241	0	0	0	0	0	0	0	487
Driver Turning On To HCN Segment | Pedestrian Across HCN Segment	0	188	34	0	0	38	8	0	0	4	0	1	0	8	0	0	281
Driver Turning Off Of HCN Segment | Pedestrian Along HCN Segment	0	77	37	0	0	40	14	0	0	0	1	2	0	2	0	0	173
Driver Across HCN Segment | Pedestrian Along HCN Segment	54	0	0	0	14	0	0	0	29	0	0	0	2	0	0	0	99
Driver Turning On To HCN Segment | Pedestrian Along HCN Segment	0	11	33	0	0	4	22	0	0	0	1	0	0	6	10	1	88
Driver Along HCN Segment | Pedestrian Along HCN Segment	17	0	0	0	13	0	0	0	21	0	0	0	0	0	0	0	51
Driver Turning Off Of HCN Segment | Pedestrian Across HCN Segment	0	7	21	1	0	4	9	0	0	0	0	4	0	4	0	0	50
Other	14	1	3	3	3	0	1	0	25	0	0	3	0	2	1	0	56
Totals	177	284	128	4	184	86	54	0	316	4	2	10	2	22	11	1	1,285